



Full Duplex

84C30A

4-Port Ethernet Controller

96339

Features

- Low Power CMOS Technology
- 4-Port Ethernet Controller Optimized for Switching Hub, Multiport Bridge/Router, Server Applications
- Meets ANSI/IEEE 802.3 and ISO 8802-3 Standards for Thicknet (10Base-5), Thin Net (10Base-2) and Twisted Pair (10Base-T)
- Standard 10MBit/sec Serial Ethernet
- Selectable Little Endian/Big Endian Transmit Byte Ordering for FIFO Interface for Intel/Motorola Compatibility
- Open Bus Interface
- Programmability of Double Word Threshold Count for Space Available/Data Available Ready Condition for Transmit/Receive FIFO's
- Auto Retransmit Upon Collision Sense
- Preamble Generation and Removal
- Automatic 32-Bit FCS (CRC) Generation and Checking
- Collision Handling, Transmission Deferral and Retransmission with Automatic Jam and Backoff Functions
- Error Interrupt and Status Generation
- Single 5 V \pm 5% Power Supply
- Standard CPU and Peripheral Interface Control Signals
- Independent 128 Byte Transmit/Receive FIFOs on each Port
 - 1 G Bits/sec (133 M Bytes/sec) Peak Data Rate in 32 Bit Mode.
- Loopback Capability for Diagnostics
- 32 Bit FIFO Data Path
- Inputs and Outputs TTL Compatible
- The Following Additional Features can be Programmed for the 84C30A
 - 64 bit Multicast Filter
 - Reports Status of "SQE" During Transmits
 - Transmit No CRC Mode

Note: Check for latest Data Sheet revision before starting any designs.

SEEQ Data Sheets are now on the Web, at www.lsillogic.com.

This document is an LSI Logic document. Any reference to SEEQ Technology should be considered LSI Logic.

- Transmit No Preamble Mode
 - Transmit Packet Autopadding Mode
 - Receive CRC Mode
 - Disable Self-Receive on Transmits Mode
 - Disable Further Transmissions when Both Transmit Status Registers are Full
 - Disable Loading the Transmit Status for Successfully Transmitted Packets
 - Disable the Receive Interrupts Independent of the Receive Command Register Setting
- Transmit Status on a Per Packet Basis Reports the Following
 - Occurrence of a Transmit FIFO Underflow
 - Transmit Collision Occurrence
 - 16 Collision Occurrence
 - Carrier Sense Error During Transmission
 - 10 Mbit/sec Transmit Clock Detect
 - Late Collision Occurrence
 - Transmission Successful
 - Transmission Deferred
 - Each Port Includes the Following Counters or Status Bits for Network Management Statistics
 - 16 Bit Short Receive Frame Counter
 - 16 Bit Alignment Error Counter
 - 16 Bit CRC Error Counter
 - 8 Bit Oversize Receive Frame Counter
 - 16 Bit Transmit Collision Counter
 - 16 Bit Total Collision Counter
 - Transmit Status Bits for "Carrier" and "SQE" During Transmits
 - Full Duplex Operation
 - Provides 20 Mbps Bandwidth for Switched Networks
 - Supports AutoDUPLEX Mode for Automatic Full Duplex Operation
 - 208 Pin PQFP package



Table of Contents

1.0 Pin Description

2.0 Introduction

3.0 Functional Description

3.1 Frame Format

3.2 Packet Transmission per Port

3.2.1 Controlling Transmit Packet Encapsulation

3.2.2 Transmission Initiation/Deferral

3.2.3 Collision on Transmit

3.2.4 Transmit Termination Conditions

3.2.5 Conditions That Will Cause a Port TXRET Pin to go HIGH

3.2.6 Detecting and Clearing of a Transmit Retry Condition

3.3. Packet Reception Per Port

3.3.1 Preamble Processing

3.3.2 Address Matching

3.3.3 Terminating Reception

3.3.4 Using the Rxabort Pins to Terminate Reception of a Packet

3.3.5 Receive Discard Conditions

3.4 System Interface

3.5 FIFO Interface

3.5.1 Little and Big Endian Format

3.5.2 Transmit FIFO Interface

3.5.3 Receive FIFO Interface

3.5.4 Special Conditions on RXRD_TXWR Clock Input

3.6 Register Interface

3.6.1 Internal Channel Register Addressing Table

3.6.2 Station Address Register

3.6.3 Transmit Command Register

3.6.4 Transmit Status Register

3.6.5 Receive Command Register

3.6.6 Receive Status Register

3.6.7 Configuration Registers

3.6.8 FIFO Threshold Register

3.6.8.1 FIFO Threshold Register Address Settings Table

3.6.9 Defer Register Calculations for the 84C30A

3.6.10 Transmit Control/Product I.D. Register

3.7 Counters

4.0 DC Characteristics

5.0 AC Characteristics

5.01 Command/Status Interface Read Timing

5.02 Command/Status Interface Write Timing

6.0 Ethernet Transmit and Receive Interface Timing

6.01 Ethernet Transmit Interface Timing

6.02 Ethernet Receive Interface Timing

7.0 Transmit Data Interface Timing

7.01 Transmit Data Interface Write Timing 1

7.02 Transmit Data Interface Write Timing 2

8.0 Receive Data Interface Timing

8.01 Receive Data Interface Read Timing 1

8.02 Receive Data Interface Read Timing 2

9.0 Transmit Data Interface Timing on Exception Conditions

10.0 Receive Data Interface Timing on Exception Conditions

Illustrations

Figure 1. Functional Block Diagram of the 84C30A

Figure 2. 84C30A Pin Configuration

Figure 3. Typical Application Example

1.0 Pin Description

Pin	Pin Name	I/O	Description
Chip Registers' Interface			
22	$\overline{\text{ENREGIO}}$	I	This active low input enables the chip for register operations. This input must be low before any port's registers can be written or read.
4	$\overline{\text{WR}}$	I	For a selected port within the chip, this input acts as a write strobe for one of the port's registers. The port is selected through the REGPS[1:0] inputs and the register is addressed through the A[2:0] address inputs. The data being written appears on the CDST[7:0] data lines and must be set up relative to the rising edge of the write strobe. This input is active low.
5	$\overline{\text{RD}}$	I	For a selected port within the chip, this input acts as a read strobe for one of the port's registers. The port is selected through the REGPS[1:0] inputs and the register is addressed through the A[2:0] address inputs. When the read strobe is active low, the output drivers for CDST[7:0] data bus are enabled. Valid register data appears on the data bus a specified time before the rising edge of the read strobe.
21, 20	REGPS[1:0]	I	These inputs are used to select which port's registers are read or written by asserting the $\overline{\text{RD}}$ or $\overline{\text{WR}}$ read or write strobe inputs. Binary values of 00 through 11 select channels 1 through 4 respectively with REGPS1 being the MSB of the binary value.
153, 6, 7, 8	A[3:0]	I	These inputs are the address lines used to select which register within a port is being read or written. A3 has an internal pull down.
5-8 9-12	CDST[7:0]	I/O	These bidirectional lines carry register data to or from the internal registers of each port in the chip. These lines are nominally high impedance until their output drivers are enabled by the $\overline{\text{RD}}$ and $\overline{\text{ENREGIO}}$ input pins being driven low.
7	INT_1	O	This output is driven high by a variety of port #1 transmit and receive interrupt conditions. It remains high until the port #1 status register containing the reason for the interrupt is read.
61	INT_2	O	This output is driven high by a variety of port #2 transmit and receive interrupt conditions. It remains high until the port #2 status register containing the reason for the interrupt is read.
68	INT_3	O	This output is driven high by a variety of port #3 transmit and receive interrupt conditions. It remains high until the port #3 status register containing the reason for the interrupt is read.
77	INT_4	O	This output is driven high by a variety of port #4 transmit and receive interrupt conditions. It remains high until the port #4 status register containing the reason for the interrupt is read.
49	$\overline{\text{RESET}}$	I	This input is an active low chip reset. During reset all registers are reset to zero, all FIFO's are cleared, all counters are reset to zero, and all the inputs to the output drivers for the RXDC and TXRET outputs are driven high.
Receive and Transmit FIFO Interface			
31	$\overline{\text{RXINTEN}}$	I	This is an active low input that acts as a chip enable to enable the receiver interface. Driving this pin active enables the output drivers for the RXDC_1, RXDC_2, RXDC_3, RXDC_4, RXRDY_1, RXRDY_2, RXRDY_3, and RXRDY_4 pins. Also, this pin must be driven active before receive FIFO reads can be performed.
32	$\overline{\text{TXINTEN}}$	I	This is an active low input that acts as a chip enable to enable the transmitter interface. Driving this pin active enables the output drivers for the TXRET_1, TXRET_2, TXRET_3, TXRET_4, TXRDY_1, TXRDY_2, TXRDY_3, and TXRDY_4 pins. Also, this pin must be driven active before transmit FIFO writes can be performed.

Pin Description (cont.)

Pin	Pin Name	I/O	Description
36	$\overline{\text{RXRDEN}}$	I	This is an active low input that, when driven active with the $\overline{\text{RXINTEN}}$ pin, enables read operations from one of the four receive FIFOs within the chip.
37	$\overline{\text{TXWREN}}$	I	This is an active low input that, when driven active with the $\overline{\text{TXINTEN}}$ pin, enables write operations to one of the four transmit FIFOs within the chip.
35	$\overline{\text{RXRD_TXWR}}$	I	This is the system clock acting as the chip's read/write strobe to any of the chips eight receive/transmit FIFO's. With the $\overline{\text{TXINTEN}}$ and $\overline{\text{TXWREN}}$ inputs active low, this input becomes the write strobe for writing transmit data to one of the chip's transmit FIFOs. Similarly, with the $\overline{\text{RXINTEN}}$ and $\overline{\text{RXRDEN}}$ inputs active low, this input becomes the read strobe for reading receive data from one of the chips receive FIFOs. This input must be connected to a continuous clock whose maximum frequency can be 33 MHz.
30, 29	$\text{RXTXPS}[1:0]$	I	These inputs are used to select a port's receiver or transmitter for one of the following operations: 1. Receive FIFO Reads 2. Transmit FIFO Writes 3. Clearing a TXRET Condition 4. Clearing a RXDC Condition 5. Aborting a Receive Packet
23, 24 25, 26	$\text{RXTXBE}[3:0]$	I	These are active low inputs that determine which bytes of the double word for a receive FIFO read are driven with valid data or which bytes of a double word being written to a transmit FIFO contain valid data.
44, 57 64, 73	$\text{TXRDY_}[1:4]$	O	These are active high three state outputs. When enabled, these outputs function as a flag that indicates whether the associated port's transmit FIFO has enough space available to meet the threshold value programmed in the FIFO threshold register. When enabled, a high value on any of these outputs indicates that the associated port's transmit FIFO has greater than or equal to the threshold number of double word spaces available in the FIFO and a low value indicates it does not. The tristate drivers for all these outputs are enabled by a low value on the $\overline{\text{TXINTEN}}$ input pin.
42, 56 63, 72	$\text{RXRDY_}[1:4]$	O	These are active high three state outputs. When enabled, these outputs function as a flag that indicates whether the associated port's receive FIFO has enough data available to meet the threshold value programmed in the FIFO threshold register. When enabled, a high value on any of these outputs indicates that the associated port's receive FIFO has greater than or equal to the threshold number of double words available in the FIFO or has a completed receive packet in the FIFO as indicated by the packets status double word being in the FIFO. The tristate drivers for all these outputs are enabled by a low value on the $\overline{\text{RXINTEN}}$ input pin.
39	SPDTAVL	O	This is an active high output that can be used for validating reads from the receive FIFO during a read operation and preventing over writes to the transmit FIFO during a write operation. For further details, please refer to the Transmit Data Write timing and the Receive Data Read timing diagrams.
40	RXTXEOF	I/O	This is a bidirectional pin that is used to signal the last double word of a transmit or receive packet. During receive FIFO reads, this pin is enabled as an output and when detected high indicates that the last double word of a receive packet has been read from the receive FIFO. During transmit FIFO writes, this pin is an input and when asserted high during a write it indicates that this is the final double word of a transmit packet. In the transmit FIFO write case, the value of this signal is stored as the 33rd bit in the FIFO. In the receive FIFO read case, the value of this signal is read out as the 33rd bit of the receive FIFO.

Pin Description (cont.)

Pin	Pin Name	I/O	Description
41	TXNOCRC	I	This active high input is used to control appending of a CRC to a transmit packet. A transmit packet can be made to exclude appending a CRC value if this input is held high during the first double word write of transmit data to the transmit FIFO. Transmission of all packets without CRC can be done by setting bit #4 of configuration register #1. It should be noted that TXNOCRC pin can be used to control CRC encapsulation only on a per packet basis.
80-84 86-89 91-94 96-101 107-112 115-121	RXRD_TXWR RXRD_TXWR	I/O	This is the bidirectional 32 bit data bus for reads or writes to the chips receive or transmit FIFO's. For receive FIFO reads it is enabled as an output with the assertion of the RXINTEN, RXRDEN, and a low value on the RXRD_TXWR input strobe. Otherwise it is used as an input.
Transmit and Receive Exception Indicators			
48, 62 71, 79	TXRET_[1:4]	O	These are active high tristate outputs. All four of these output pins are driven by tristate drivers enabled by an active low being driven onto the TXINTEN input pin. Once enabled, a high value on any of these inputs indicates that the associated port could not complete transmission of a packet due to one of the following conditions and that a retransmission of the packet is requested: <ol style="list-style-type: none"> 1. A late collision occurred during transmission. 2. Carrier sense never went high or dropped out during transmission. 3. During a transmission attempt a transmit FIFO underflow error occurred. 4. 16 attempts to transmit the packet all resulting in transmit collisions. Internally, the TXRET signal will remain high until it is cleared by the CLRTXERR pin, (See the text on clearing error conditions). As long as the internal TXRET signal for a port remains high, that port's transmit FIFO will remain cleared and no new transmissions can occur.
45, 58 65, 74	RXDC_[1:4]	O	These are active high tristate outputs. All four of these outputs pins are driven by tristate drivers enabled by a low value being driven onto the RXINTEN input pin. Once enabled, a high value on any of these inputs indicates that the associated port's discarded reception of a packet due to one of the possible receive discard conditions. Internally, a port's RXDC signal will remain high until it is cleared by the CLRRXERR pin, (See the text on "Receive Discard Conditions"). As long as the internal RXDC signal for a port remains high, that port's receive FIFO will remain cleared and no new packets will be received.
Special Purpose Pins			
38	CLRTXERR	I	This active high input is used to clear transmit retry flags within the chip. See the "Receive Discard Conditions" section for how this input is used.
50	CLRRXERR	I	This active high input is used to clear Receive Discard flags within the chip. See the "Receive Discard Conditions" section for how this input is used.
46	RXABORT_1	I	This input when pulsed high causes port #1 to abort reception of a receive frame and clear the Receive FIFO. It can be asserted at any time during the reception of a frame.
59	RXABORT_2	I	This input when pulsed high causes port #2 to abort reception of a receive frame and clear the Receive FIFO. It can be asserted at any time during the reception of a frame.

Pin Description (cont.)

Pin	Pin Name	I/O	Description
67	RXABORT_3	I	This input when pulsed high causes port #3 to abort reception of a receive frame and clear the Receive FIFO. It can be asserted at any time during the reception of a frame.
75	RXABORT_4	I	This input when pulsed high causes port #4 to abort reception of a receive frame and clear the Receive FIFO. It can be asserted at any time during the reception of a frame.
127	ADUPLX_1	I	This active low input is used to set port #1 into Full Duplex Mode. In this mode the transmitter will not defer to an active carrier sense signal.
125	ADUPLX_2	I	This active low input is used to set port #2 into Full Duplex Mode. In this mode the transmitter will not defer to an active carrier sense signal.
124	ADUPLX_3	I	This active low input is used to set port #3 into Full Duplex Mode. In this mode the transmitter will not defer to an active carrier sense signal.
123	ADUPLX_4	I	This active low input is used to set port #4 into Full Duplex Mode. In this mode the transmitter will not defer to an active carrier sense signal.
Encoder_Decoder Interface			
138	TXC_1	I	This is the transmit clock input for port #1. This is a 10 Mhz, 50% duty cycle transmit clock used to synchronize the transmit data from port #1 to the encoder. Transmit data appears serially on the TXD0_1 output and all transitions of transmit data and the TXEN_1 output occur from the falling edge of the clock.
161	TXC_2	I	This is the transmit clock input for port #2. This is a 10 Mhz, 50% duty cycle transmit clock used to synchronize the transmit data from port #2 to the encoder. Transmit data appears serially on the TXD0_2 output and all transitions of transmit data and the TXEN_2 output occur from the falling edge of the clock.
177	TXC_3	I	This is the transmit clock input for port #3. This is a 10 Mhz, 50% duty cycle transmit clock used to synchronize the transmit data from port #3 to the encoder. Transmit data appears serially on the TXD0_3 output and all transitions of transmit data and the TXEN_3 output occur from the falling edge of the clock.
197	TXC_4	I	This is the transmit clock input for port #4. This is a 10 Mhz, 50% duty cycle transmit clock used to synchronize the transmit data from port #1 to the encoder. Transmit data appears serially on the TXD0_4 output and all transitions of transmit data and the TXEN_4 output occur from the falling edge of the clock.
142	TXD_1	O	This input is the serial transmit data output from port #1 to the encoder.
166	TXD_2	O	This input is the serial transmit data output from port #2 to the encoder.
185	TXD_3	O	This input is the serial transmit data output from port #3 to the encoder.
202	TXD_4	O	This input is the serial transmit data output from port #4 to the encoder.
143	TXEN_1	O	This output from port #1 is used to activate the encoder. It becomes active when the first bit of the Preamble is transmitted and inactive when the last bit of the frame is transmitted.

Pin Description (cont.)

Pin	Pin Name	I/O	Description
167	TXEN_2	O	This output from port #2 is used to activate the encoder. It becomes active when the first bit of the Preamble is transmitted and inactive when the last bit of the frame is transmitted.
186	TXEN_3	O	This output from port #3 is used to activate the encoder. It becomes active when the first bit of the Preamble is transmitted and inactive when the last bit of the frame is transmitted.
203	TXEN_4	O	This output from port #4 is used to activate the encoder. It becomes active when the first bit of the Preamble is transmitted and inactive when the last bit of the frame is transmitted.
128	RXC_1	I	This input is a 10Mhz, 50% duty cycle nominal receive clock which is used to synchronize incoming data from the decoder to port #1. CSN and RXD0_1 are assumed to transition from the leading edge of this clock.
146	RXC_2	I	This input is a 10Mhz, 50% duty cycle nominal receive clock which is used to synchronize incoming data from the decoder to port #2. CSN and RXD0_2 are assumed to transition from the leading edge of this clock.
169	RXC_3	I	This input is a 10Mhz, 50% duty cycle nominal receive clock which is used to synchronize incoming data from the decoder to port #3. CSN and RXD0_3 are assumed to transition from the leading edge of this clock.
188	RXC_4	I	This input is a 10Mhz, 50% duty cycle nominal receive clock which is used to synchronize incoming data from the decoder to port #4. CSN and RXD0_4 are assumed to transition from the leading edge of this clock.
137	RXD_1	I	This input is the serial input data to port #1 from the decoder.
160	RXD_2	I	This input is the serial input data to port #2 from the decoder.
175	RXD_3	I	This input is the serial input data to port #3 from the decoder.
196	RXD_4	I	This input is the serial input data to port #4 from the decoder.
130	CSN_1	I	This is port #1's carrier sense input which indicates there is traffic on the transmission medium connected to port #1. Carrier sense becomes active with the first bit of the Preamble received, and inactive one bit time after the last bit of the frame is received. This is an active high input.
148	CSN_2	I	This is port #2's carrier sense input which indicates there is traffic on the transmission medium connected to port #2. Carrier sense becomes active with the first bit of the Preamble received, and inactive one bit time after the last bit of the frame is received. This is an active high input.
171	CSN_3	I	This is port #3's carrier sense input which indicates there is traffic on the transmission medium connected to port #3. Carrier sense becomes active with the first bit of the Preamble received, and inactive one bit time after the last bit of the frame is received. This is an active high input.
191	CSN_4	I	This is port #4's carrier sense input which indicates there is traffic on the transmission medium connected to port #4. Carrier sense becomes active with the first bit of the Preamble received, and inactive one bit time after the last bit of the frame is received. This is an active high input.

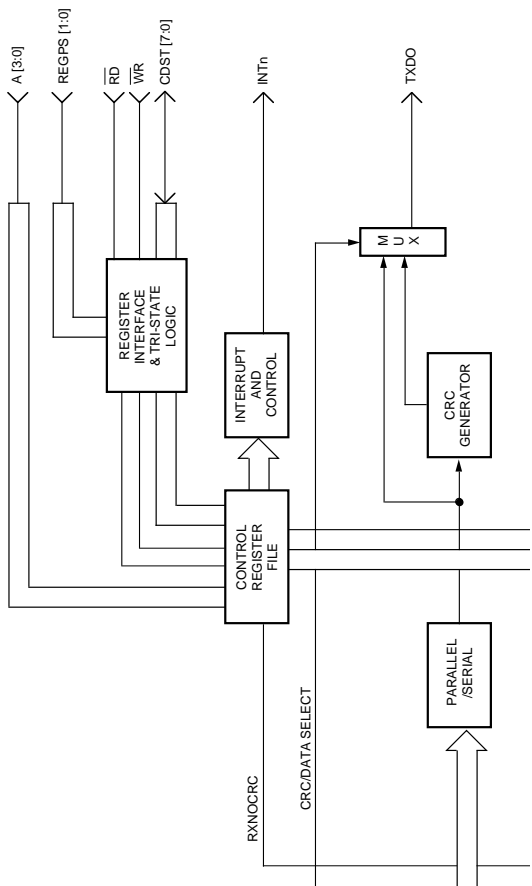
Pin Description (cont.)

Pin	Pin Name	I/O	Description
145	COLL_1	I	This input indicates that a transmission contention has occurred on the transmission medium connected to port #1. The collision input is latched internally. Sampled during transmission, Collision is set by an active high pulse on the COLL input and automatically reset at the end of transmission of the JAM sequence.
168	COLL_2	I	This input indicates that a transmission contention has occurred on the transmission medium connected to port #2. The collision input is latched internally. Sampled during transmission, Collision is set by an active high pulse on the COLL input and automatically reset at the end of transmission of the JAM sequence.
187	COLL_3	I	This input indicates that a transmission contention has occurred on the transmission medium connected to port #3. The collision input is latched internally. Sampled during transmission, Collision is set by an active high pulse on the COLL input and automatically reset at the end of transmission of the JAM sequence.
204	COLL_4	I	This input indicates that a transmission contention has occurred on the transmission medium connected to port #4. The collision input is latched internally. Sampled during transmission, Collision is set by an active high pulse on the COLL input and automatically reset at the end of transmission of the JAM sequence.
205	DAISY_OUT	O	This output is used for parametric test of the I/O's only. It should not be externally connected.

Pin Description (cont.)

Pin	Pin Name	I/O	Description
2, 14, 28, 33, 52, 53, 70, 78, 102, 104, 114, 126, 132, 135, 154, 157, 158, 178, 183, 189, 193	V _{DD}	—	Power Supply 5V +/- 5%
1, 3, 13 19, 27, 34, 43, 51, 54, 55, 60, 66, 69, 76, 85, 90, 95, 103, 105, 106, 113, 122, 129, 131, 133, 134, 136 144, 147, 149 150, 151, 155, 156, 159, 165, 170, 172, 173, 174, 176, 179, 184, 190, 192, 194, 195, 200, 207, 208	GND	—	Ground 0 Volts
139, 140, 141 152, 153 162, 163, 164 180, 181, 182 198, 199, 201 206	Do Not Connect	—	DO NOT CONNECT or run traces under these pins.

Note: All inputs with the exception of the “Do Not Connect” pins, must never be left floating even if they are not in use. Each pin must be driven either HIGH or LOW.



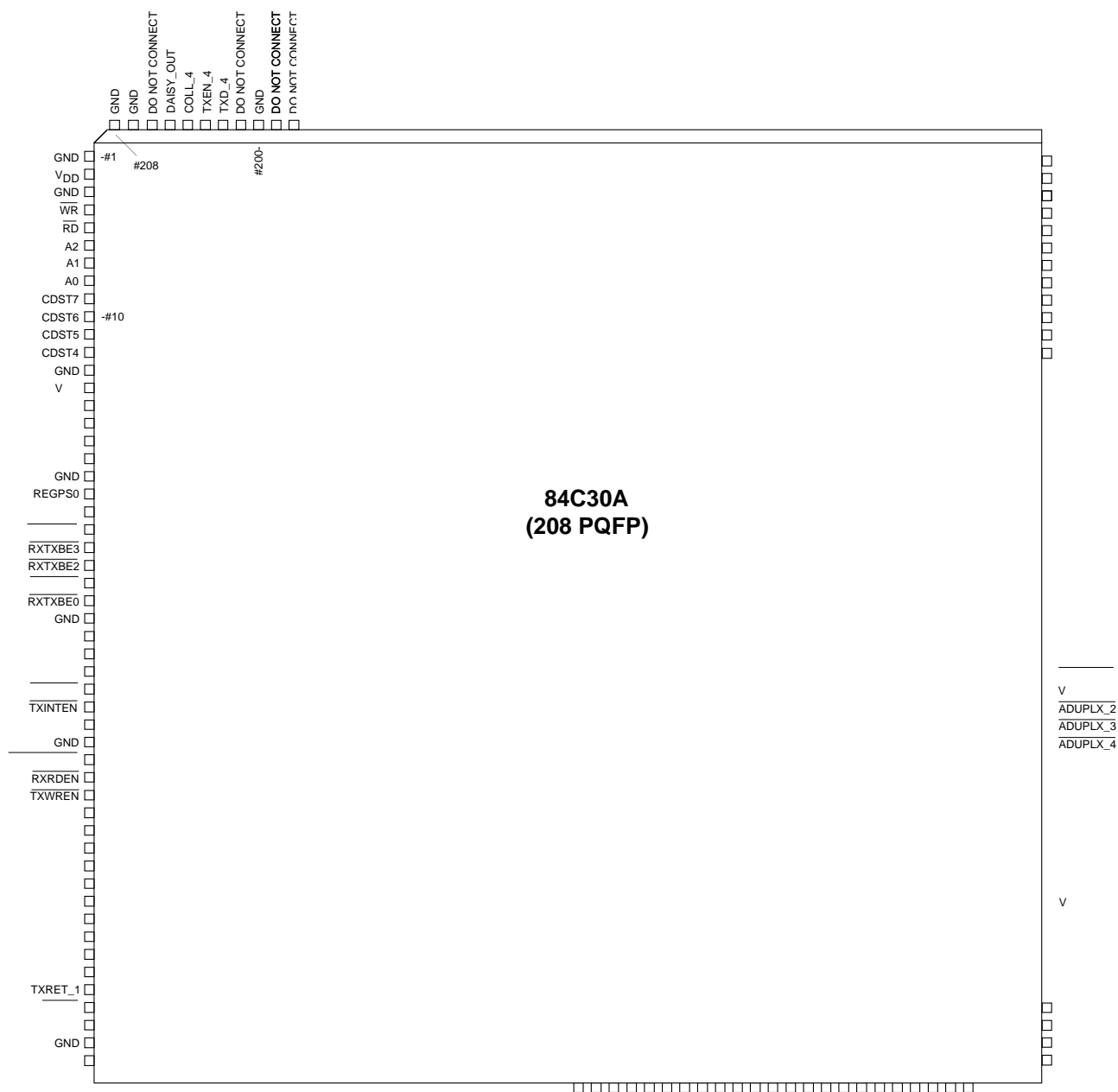


Figure 2. 84C30A Pin Configuration

2.0 Introduction

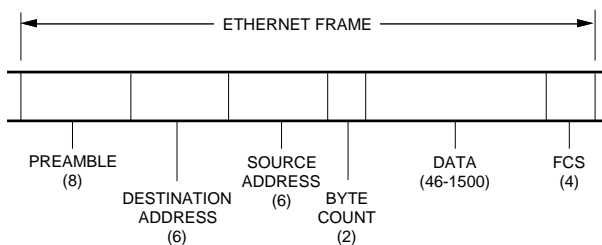
The 84C30A is a 4-Port Ethernet Media Access Controller (MAC) with a rich set of operating modes and features. It will directly connect with SEEQ's 84C24 (4-Port 10Base-T PHY) or four SEEQ 80C25's (single-channel 10Base-T PHY). It is manufactured as a single-chip VLSI device to simplify and enhance the development of multi-port Ethernet embedded systems such as bridges, switches, and routers.

Each port of the 84C30A is feature compatible with SEEQ's 80C03 Ethernet Media Access Controller. These features include: 64 bit Multicast filter, Transmit no CRC, Transmit no Preamble, Transmit Packet Autopadding, Receive CRC, Receive Own Transmit Disable, Receive Group Address Mode, Fast Receive Discard Mode, and Full Duplex Mode. Additionally, each port supports: programmable defer time between transmit packets, appending value of FCS on a packet-by-packet basis, and pin-controllable per-port receive packet abort.

A high-bandwidth universal system interface is provided which is compatible with many microprocessor or system busses, easing the integration of the 84C30A into many system architectures. Its 32-bit data path width is provided to provide the bandwidth necessary to maintain full duplex wire speed communications simultaneously through all four ports. Each port is provided with dual 128 byte FIFOs to ease bus multiplexing and interfacing to different clock domains.

3.0 Functional Description

3.1 FRAME FORMAT

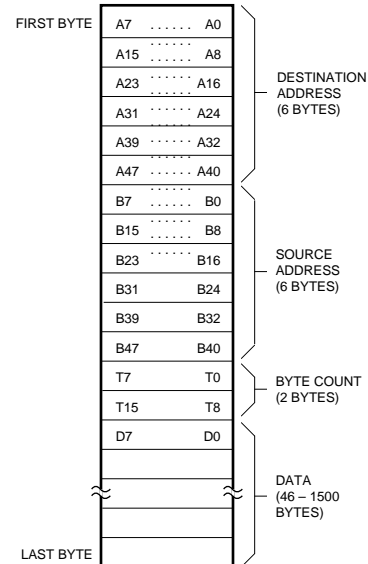


NOTE:

Field length bytes, in parentheses.

On an Ethernet communication network, information is transmitted and received in packets or frames. An Ethernet frame consists of a preamble, two address fields, a byte-count field, a data field and a frame check sequence

(FCS). Each field has a specific format which is described in detail below. An Ethernet frame has a minimum length of 64 bytes and a maximum length of 1518 bytes exclusive of the preamble. The Ethernet frame format is shown in the figure above.



Typical Frame Buffer Format for Byte-Organized Memory

Preamble: The preamble is a 64-bit field consisting of 62 alternating "1"s and "0"s followed by a "11" End-of-Preamble indicator.

Destination Address: The Destination Address is a 6-byte field containing either a specific Station Address, a Broadcast Address, or a Multicast Address to which this frame is directed.

Source Address: The Source Address is a 6-byte field containing the specific Station Address from which this frame originated.

Byte-Count Field: The Byte-Count Field consists of two bytes providing the number of valid data bytes in the Data Field, 46 to 1500. This field is uninterpreted at the Data Link Layer, and is passed through the EDLC chip to be handled at the Client Layer.

Data Field: The Data Field consists of 46 to 1500 bytes of information which are fully transparent in the sense that any arbitrary sequence of bytes may occur.

Frame Check Sequence: The Frame Check Sequence (FCS) field is a 32-bit cyclic redundancy check (CRC) value computed as a function of the Destination Address Field, Source Address Field, Type Field and Data Field. The FCS is appended to each transmitted frame, and used at reception to determine if the received frame is valid.

3.2 PACKET TRANSMISSION PER PORT

The transmit data stream consists of the Preamble, four information fields, and the FCS which is computed in real time by the port and automatically appended to the frame at the end of the data. The Preamble is also generated by the port and transmitted immediately prior to the Destination Address, Destination Address, Source Address, Type Field and Data Field are prepared in the buffer memory prior to initiating transmission. The port encapsulates these fields into an Ethernet frame by inserting a preamble prior to these information fields and appending a CRC after the information fields. A port can be programmed to exclude inclusion of the preamble and/or the FCS from the transmit data stream. In this case it is assumed that the preamble and FCS are provided as part of the data written to the port.

3.2.1 Controlling Transmit Packet Encapsulation

As was mentioned in the previous paragraph, a port can be programmed for exclusion of the FCS and/or the preamble when transmitting a packet. To program a port for transmitting a packet without creating a preamble, bit #2 of the port's Configuration Register #1 can be written high. Once this bit is set, all packets transmitted by the port will not include a preamble pattern unless it is part of the data written to the port's transmit FIFO by the system. Similarly, a port can be prevented from appending an FCS value to a packet by setting bit #4 HIGH in the Configuration Register #1. As long as this bit is high, any packet transmitted by the port will not include an FCS value unless it is written as part of the transmit data written to the port's transmit FIFO. Appending of a FCS value can be controlled on a packet per packet basis by using the TXNOCRC pin as long as the TXNOCRC Tx-Rx Configuration register bit has not been set high. If the TXNOCRC pin is held high when the first byte of data is written to a port's transmit FIFO, this will prevent the port from appending a FCS value to the packet. Only those packets for which the TXNOCRC pin is held high during the first data write will not have an FCS value appended by the port during transmission.

3.2.2 Transmission Initiation/Deferral

A transmission is initiated any time a double word of data is written to the transmit FIFO. "Transmit buffer to FIFO" transfers are coordinated via the Transmit FIFO Interface. When the chip is not in Full Duplex mode, actual transmission of the data onto the network will only occur if the FIFO has at least one double word of data to transmit, the network has not been busy for the minimum defer time, and any Backoff time requirements have been satisfied. Following the IEEE 802.3 specifications, the minimum defer time is measured from carrier sense going LOW to TXEN going HIGH. The default defer time for 10Mbit/sec serial mode is 9.6 μ s as measured from TXEN going LOW to TXEN going HIGH assuming that the delay from TXEN going LOW to CSN going LOW is within 5 TXC clock periods. When the chip is in full duplex mode, transmission of data onto the network occurs independent of whether carrier sense indicates a busy network condition or not. To adjust the defer time to some other value, the programmable defer register can be set using the formulas given in the section describing the defer register. When transmission begins, the chip activates the transmit enable (TXEN) line concurrently with the transmission of the first bit, of the Preamble and keeps it active for the duration of the transmission.

3.2.3 Collision on Transmit

On the occurrence of a transmit collision condition that does not represent the 16th transmission attempt for the packet or does not occur after 64 byte times into the transmission, the controller will automatically attempt to retransmit the packet. First, the controller will halt the transmission of data from the FIFO and begin transmitting a Jam pattern consisting of 55555555 hex. The controller will also reset the Transmit FIFO read address pointer back to the beginning of the transmit packet within the FIFO. At the end of transmitting the Jam pattern the controller will then begin the Backoff wait period. Once the backoff period is finished the controller will automatically retransmit the packet. If a packet reaches 16 retransmission attempts without success due to collisions, or if a collision occurs later than 64 Byte times after the beginning of a transmission, this is considered to represent a serious network error. Upon any one of these two error conditions occurring, the selected port's Transmit FIFO will be cleared and the corresponding TXRET output will be driven HIGH. If the TXRET signal was driven HIGH due to 16 transmission attempts, the T16COLL signal will also be driven HIGH. When either of the two above error conditions occurs, retransmission of any packets that were in the transmit FIFO requires first clearing the TXRET error condition and then reloading the packet or packets in the Transmit FIFO.

Scheduling of retransmission is determined by a controlled randomization process called Truncated Binary Exponential Backoff. The chip waits a random interval between 0 and 2^K slot times (51.2 μ s per slot time) before attempting retransmission, where "K" is the current transmission attempt number (not to exceed 10).

3.2.4 Transmit Termination Conditions

A port will terminate transmission under the following conditions.

Normal: The frame has been transmitted successfully without contention. Loading of the last data byte into a port's Transmit FIFO is signaled to the port by activation of its RxTxEOF signal concurrently with the last double word of data loaded into the Transmit FIFO. This line acts as a thirty-third bit in the Transmit FIFO. When the last valid byte of the last double word has been transmitted, if the port is not in Transmit No CRC mode, then the CRC is appended and transmitted concluding frame transmission. The Transmission Successful bit of the Transmit Status Register will be set by a normal termination.

Collision: Transmission attempted by two or more Ethernet nodes. The Jam sequence is transmitted, the Collision status bit is set, transmit Collision Counter is updated, the Backoff interval begun, and the Transmit FIFO address is set to point to the beginning of the packet for retransmission.

Underflow: Transmit data is not ready when needed for transmission. Once transmission has begun, a port on average requires one transmit double word every 3200 ns in order to avoid Transmit FIFO underflow (starvation). If this condition occurs, the port terminates the transmission, issues a TXRET signal, and sets the Transmit-Underflow status bit.

16 Transmission Attempts: If a Collision occurs for the sixteenth consecutive time, the 16-Transmission-Attempts status bit is set, the Collision status bit is set, the TXRET signal is generated, and the Backoff interval begun. The counter that keeps track of the number of collisions is modulo 16 and therefore rolls over on the 17th collision. Bits 15 to 11 of a port's transmit collision counter allow a user to determine how many transmission attempts were necessary to successfully transmit the packet.

Late Collision: If a Collision occurs greater than 64 byte times after the transmission begins this is considered a late collision error. Upon this condition the transmission is terminated, the TXRET output is driven HIGH, and the late collision status bit is set.

At the completion of every transmission or retransmission, new status information is loaded into the Transmit Status

Register. Dependent upon the bits enabled in the Transmit Command Register, an interrupt will be generated for the just completed transmission.

3.2.5 Conditions That Will Cause a Port's TXRET Pin to go High

Detection of a HIGH value on one of the chips 4 TXRET pins indicates that the associated port could not complete transmission of a packet due to one or more of the following conditions:

1. A transmit FIFO underflow occurred while transmitting the packet.
2. A late collision occurred while transmitting the packet.
3. Carrier sense never went active during transmission or went from an active to inactive state during transmission.
4. 16 attempts to transmit the packet all resulted in transmit collisions.

Any of the above conditions will cause the port to flush the transmit FIFO and initiate a transmit retry request. With initiation of a transmit Retry Request the port's TXRDY output will go low and stay low until the TXRET flag is cleared. Similar to a port's receive discard signal, a transmit retry signal going to the external TXRET pin is latched upon a transmit retry condition and held high until cleared. Until a port's transmit retry signal is cleared, no new transmit packets can be written to the transmit FIFO.

3.2.6 Detecting and Clearing a Transmit Retry Condition

To enable the output drivers for the four TXRET pins, the TXINTEN input is driven low. Once a Tx retry condition is detected, that port's internal Tx retry signal can be cleared by first setting the RXTXPS[1:0] inputs to point to that port. Then by driving the TXINTEN input low and then pulsing the CLRTXERR input high for a minimum of one RXRD_TXWR clock cycle, this will clear that port's TXRET signal. The RXTXPS [1:0] and TXINTEN inputs must not change during the high time of the CLRTXERR input.

3.3 Packet Reception Per Port

Each port within the chip continuously monitors the network. When activity is recognized via the Carrier Sense (CSN) signal, the port will then synchronize itself to the incoming data stream through recognition of the Start Frame Delimiter (SFD) at the end of Preamble. The destination address field of the frame is then examined. Depending on the Address Match Mode specified, the port will either recognize the frame as being addressed to itself in a general or specific fashion or abort the frame reception. The port can also be programmed to count all collisions on the network it's connected to.

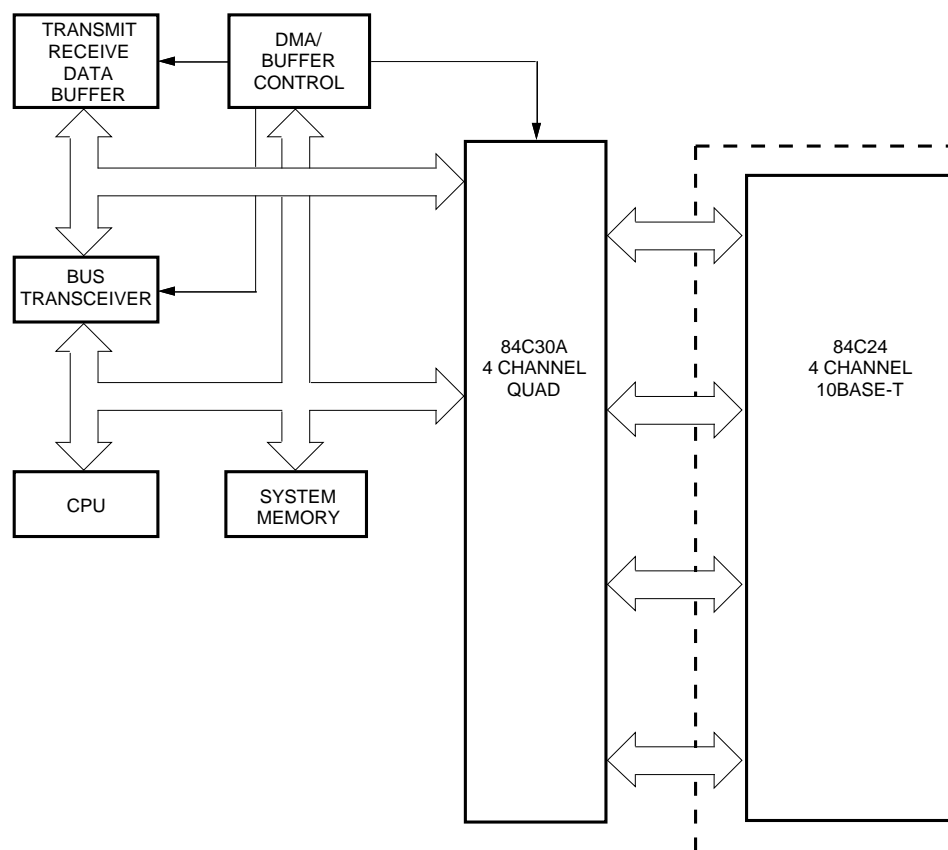


Figure 3. Typical Application Example

3.3.1 Preamble Processing

A port recognizes activity on the Ethernet via its Carrier Sense line. The end of preamble is detected by a double 1 serial receive data pattern preceded by 6 bits of alternating 1's and 0's.

Detection of a double 0 pattern 16 bit times after CSN goes high and before a proper Start Frame Delimiter pattern is received, will prevent reception of the packet by the receiver.

3.3.2 Address Matching

Ethernet addresses consist of two 6-byte fields. The first bit of the address signifies whether it is a Station Address or a Multicast/Broadcast Address.

First Bit	Address
0	Station Address (Physical)
1	Multicast/Broadcast Address (logical)

Address matching occurs as follows:

Station Address: All destination address bytes must match the corresponding bytes found in the Station Address Register. If Group Address mode is enabled, the last 4 bits of the station address are masked out during address matching.

After computing the FCS on the first six bytes of the address field (Destination address), a port uses bits 0 thru 5 as an address to its Multi-cast address filter register. Bit 0 of the FCS is assumed to be where receive data enters the FCS generation circuitry. If the corresponding bit addressed in the Multicast address filter register is a '1' the port will receive the frame, otherwise it will discard the frame. Addressing of the Multicast address filter register occurs using bits 0 thru 2 to determine which byte is selected and bits 3 thru 5 to determine which bit according to the following tables:

FCS Bits 0 1 2	Byte Selected	FCS Bits 3 4 5	Bit Selected
0 0 0	Byte 0	0 0 0	Bit 0
0 0 1	Byte 1	0 0 1	Bit 1
0 1 0	Byte 2	0 1 0	Bit 2
0 1 1	Byte 3	0 1 1	Bit 3
1 0 0	Byte 4	1 0 0	Bit 4
1 0 1	Byte 5	1 0 1	Bit 5
1 1 0	Byte 6	1 1 0	Bit 6
1 1 1	Byte 7	1 1 1	Bit 7

Multicast Address: If the first bit of the incoming address is a 1 and the port is programmed to accept Multicast Addresses without using Hash filtering, the frame is received. A port also can be programmed to use the hash filter for determining acceptance of multicast addresses.

Broadcast Address: The six incoming destination address bytes must all be FF hex. If a port is programmed to accept Broadcast or Multicast Addresses the frame will be received.

If the incoming frame is addressed to a port in the chip specifically (Destination Address matches the contents of the Station Address Register), or is of general or group interest (Broadcast or Multicast Address), the port will pass the frame exclusive of Preamble and FCS to the CPU buffer and indicate any error conditions at the end of the frame. If, however, the address does not match, as soon as the mismatch is recognized, the port will terminate reception and issue an RxDC.

A port may be programmed via the Match Mode bits of the Receive Command Register to ignore all frames (Disable Receiver), accept all frames (Promiscuous mode), accept frames with the proper Station Address or the Broadcast Address (Station/Broadcast), or accept all frames with the proper Station Address, the Broadcast Address, or all Multicast Addresses (Station/Broadcast/Multicast).

3.3.3 Terminating Reception

Reception is terminated when either of the following conditions occur:

Carrier Sense or Receive Data Valid Inactive: Indicates that traffic is no longer present on the Ethernet cable.

Overflow: The host node for some reason is not able to empty a port Receive FIFO as rapidly as it is filled, and an error occurs as frame data is lost. On average a port's Receive FIFO must be serviced every 3200 ns to avoid this condition.

3.3.4 Using the RXABORT Pins to Terminate Reception of a Packet

By pulsing the corresponding RXABORT pin high for a minimum of 1.5 RXC cycles, reception of a packet by a port can be terminated. When reception of a packet is terminated this way, the Receive FIFO will be cleared and will stay cleared until carrier sense transitions from high to low or from low to high indicating either the end of the packet being aborted or the beginning of a new receive packet. It is important to note that RXABORT will cause the RXDC pin to go high based on the conditions described under "Conditions that cause the RXDC pin to go high".

The assertion of RXDC is done so that an external processor will always have an indication of a packet abortion irrespective of whether it's aborted by the user or by an external PHY. However, the assertion of the RXDC signal can be avoided by setting bit 4 of configuration register #2. This will enable the reception of any packet irrespective of errors and also reduce the number of signals (RXDC1_4 and CLRRXERR) that need to be processed when the corresponding RXABORT goes high.

3.3.5 Receive Discard Conditions

Receive packets can be discarded for not meeting the minimum IEEE 802.3 requirements for a good packet, for address mismatches when the chip is not in promiscuous mode, and by user intervention. In the case of discards due to oversized packets, address mismatches, or the assertion of the RXABORT pin during packet reception, further writing of receive packet data to the receive FIFO is halted once the mismatch, receive abort or oversized packet condition is determined.

Except for discards due to address mismatches and oversized packets, all packet discards occur after carrier sense deasserts. The discarding of receive packets for error conditions can be controlled through bits 0 through 3 of the receive command register, and through bit 4 of configura-

3.6.1 Internal Port Register Addressing Table

Transmit Command Register Bits		Register Address				Register Description	
6	5	A3	A2	A1	A0	Read	Write
0	0	0	0	0	0	Station Address 0	Station Address 0
0	0	0	0	0	1	Station Address 1	Station Address 1
0	0	0	0	1	0	Station Address 2	Station Address 2
0	0	0	0	1	1	Station Address 3	Station Address 3
0	0	0	1	0	0	Station Address 4	Station Address 4
0	0	0	1	0	1	Station Address 5	Station Address 5
X	X	0	1	1	0	Rx Status Register	Rx Command Register
X	X	0	1	1	1	Tx Status Register	Tx Command Register
0	1	0	0	0	0	Hash Register 0	Hash Register 0
0	1	0	0	0	1	Hash Register 1	Hash Register 1
0	1	0	0	1	0	Hash Register 2	Hash Register 2
0	1	0	0	1	1	Hash Register 3	Hash Register 3
0	1	0	1	0	0	Hash Register 4	Hash Register 4
0	1	0	1	0	1	Hash Register 5	Hash Register 5
1	0	0	0	0	0	Hash Register 6	Hash Register 6
1	0	0	0	0	1	Hash Register 7	Hash Register 7
1	0	0	0	1	0	FIFO Threshold Register	FIFO Threshold Register
1	0	0	0	1	1	Configuration Register #2	Configuration Register #2
1	0	0	1	0	0	Configuration Register #1	Configuration Register #1
1	0	0	1	0	1	Defer Count Register	Defer Count Register
1	1	0	0	0	0	CRC Error Counter	—
1	1	0	0	0	1	Short Frame Counter	—
1	1	0	0	1	0	Oversize Frame Counter	—
1	1	0	0	1	1	Alignment Error Counter	—
1	1	0	1	0	0	Transmit Collision Counter	—
1	1	0	1	0	1	Receive Collision Counter	—
X	X	1	0	0	0	Transmit Control/Product I.D. Register	Transmit Control/Product* I.D. Register

*The upper four bits are read only.

tion register #2. Listed below are the required conditions for a receive discard to be produced:

1. Bit 0 of the Rx command register is LOW and a receive FIFO overflow occurred during reception.
2. Bit 1 of the Rx command register is LOW and a packet with a CRC error was received.
3. Bit 4 of Configuration register 2 is LOW and the RXABORT pin is driven high while CSN is high.
4. Bit 3 of the Rx command register is LOW and a packet with less than 64 bytes of data was received.
5. Bit 4 of the Rx command register is LOW and a packet of size greater than 1518 was received.
6. The Receiver is not in promiscuous mode and a address mismatch occurs.

Discarding of a receive packet by a port will cause any packet data that was written to that receive FIFO to be flushed from the FIFO. If no completely received packets are in the receive FIFO at the time a receive discard occurs, the receive FIFO will be completely flushed of data. If however, a completely received packet, as indicated by the packet's status double word having been written to the FIFO, is in the receive FIFO at the time of a receive discard, the FIFO will be flushed only up to the last completely received packet. To prevent a receive packet from being discarded due to an error condition, you can selectively enable the reception of errored packets as described in the section describing bit settings on configuration register #2.

Conditions that Cause the RXDC Pin to go HIGH

As packets are discarded due to the receive packet error conditions given in the section "Description of How Receive Packets are Discarded", the corresponding port's RXDC pin may or may not assert. If a receive packet's status has been written to the receive FIFO and the packet's status has not yet been read from the FIFO, discards caused by following packets with errors are handled within the chip and the RXDC pin will not go HIGH. If all status double words for all packets written to the FIFO have been read out, then the RXDC pin will go HIGH under the following condition:

1. Enough of a receive packet has been written to the FIFO to cause RXRDY to go HIGH before the packet is discarded due to an error condition.

2. If there are no status double words in the receive FIFO and if RXRDY goes HIGH just before a discard condition occurs, RXRDY may go LOW again before any FIFO reads have occurred. This is due to the receive discard clearing the FIFO of any receive bytes already written to the FIFO. In this case, RXRDY is guaranteed to remain HIGH for at least one RXRD_TXWR clock cycle.

Detecting and Clearing a Receive Discard Condition

To enable the output driver for the RXDC pins, the RXINTEN input must be driven low. Once a discard condition is detected, the receive discard can be cleared by driving the RXINTEN input low and then pulsing the CLRRXERR input high for a minimum of one RXRD_TXWR clock cycle. The RXINTEN input must not change state for the duration of the time that the CLRRXERR input is high.

Clearing Interrupts

Within one port, both receive and transmit interrupts are combined into a single interrupt signal which then goes to the INT output pin. The interrupt signal in the chip is actually the result of the receive/transmit status register outputs and the receive/transmit command register interrupt enable bits that are set. To clear an interrupt, the status that caused the interrupt needs to be cleared. This can be accomplished by reading the transmit status register and/or the receive status register.

3.4 SYSTEM INTERFACE

The chip system interface consists of one receive/transmit 32-bit bidirectional data bus, one 8-bit bidirectional command/status data bus, and each busses respective control signals. Receive FIFO data is read and Transmit FIFO data is written over the RXTXDATA[31:0] bus, and Command/Status data is written or read over the bidirectional CDST[7:0] data bus.

3.5 FIFO INTERFACE

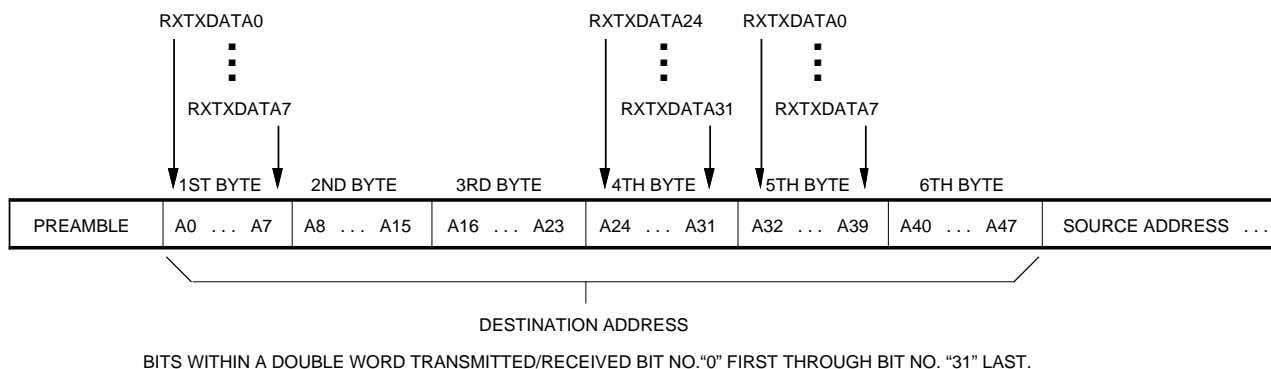
3.5.1 Little Endian and Big Endian Format

The FIFO interface control includes the *BUSMODE* bit 6 in configuration register #2, which sets the 84C30A FIFO interface to Big Endian or Little Endian byte transmit/receive data order. In Big Endian mode, data written to the transmit FIFO is transmitted most significant byte of the *RXTXDATA* bus first and least significant byte of the *RXTXDATA* bus last. In Little Endian mode, the least significant byte of each double word is transmitted first and the most significant byte of each double word is transmitted last. On the receive side, if Big Endian mode is in effect then the first data bytes received are assumed to be the most significant bytes of the double word and appear on the most significant portion of the *RXTXDATA* bus for receive FIFO reads. The receiver reverses this order if the chip is in Little Endian mode. The value of the *BUSMODE* bit has no effect on the operation of the 84C30A's register interface.

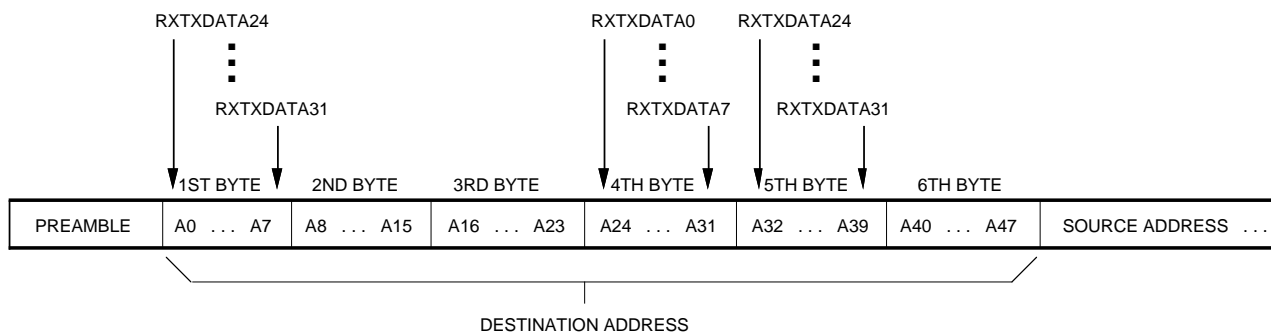
3.5.2 Transmit FIFO Interface

To determine if the transmit FIFO for any of the chip's ports has reached its threshold number of double words of space available, all four *TXRDY* outputs can be enabled by driving the *TXINTEN* input low. The *TXRDY* output for a port will be high if there is enough space available in the port's transmit FIFO to meet or exceed the programmed threshold value.

Once one of the *TXRDY* outputs is determined to be high, that port's Transmit FIFO can be written. To write to a port's Transmit FIFO, the *TXWREN* and *TXINTEN* inputs must be asserted low and at least one of the *RXTXBE* byte enables must be low for each write cycle. The value of the *RXTXPS* inputs determines which port is being written. All of the above inputs are clocked into the chip on the high going edge of the *RXRD_TXWR* clock input which also acts as the FIFO write strobe. Because of this pipe lining



Bit Serialization/Deserialization for Little Endian Format



Bit Serialization/Deserialization for Big Endian Format

the actual FIFO write will occur one $\overline{\text{RXRD_TXWR}}$ cycle after the assertion of the Transmit FIFO interface control signals. Valid combinations of the $\overline{\text{RXTXBE}}$ inputs for transmit FIFO writes are given below:

$\overline{\text{RXTXBE3}}$	$\overline{\text{RXTXBE2}}$	$\overline{\text{RXTXBE1}}$	$\overline{\text{RXTXBE0}}$
0	0	0	0
1	0	0	0
0	0	0	1
1	1	0	0
1	0	0	1
0	0	1	1
1	1	1	0
1	1	0	1
1	0	1	1
0	1	1	1

The TXRDY output for the port being read will remain high until the port's transmit FIFO no longer has enough double word space to meet the programmed threshold value.

While transmit FIFO writes are occurring the SPDTAVL output will remain high until the highgoing edge of the write to the second to the last remaining double word space in the FIFO. Because transmit FIFO writes are pipelined, there will always be one more write after TXWREN is deasserted.

Using the 84C30A in 8 bit or 16 bit mode.

The transmit and the receive FIFO are 128 bytes deep organized as double word (32 bits) rows. During writes to the transmit FIFO, the FIFO pointer gets incremented on every write to the FIFO, irrespective of whether all the four byte enables are asserted or not. Hence, during non double word writes to the FIFO, one entire row of the FIFO gets filled irrespective of whether all the bytes are valid or not. The 84C30A automatically ignores the invalid bytes when the data gets transmitted from the FIFO.

Effect of Auto Retransmission Upon TXRDY Behavior

As a packet is read out of a port's Transmit FIFO by the transmitter for transmission onto the network, the corresponding TXRDY signal will not reflect any reads that have occurred to the FIFO until enough bytes of data have been transmitted to get past the normal collision window of less than 64 byte times. This means that if a port's TXRDY goes low during the writing of a packet to the Transmit FIFO, it will not go HIGH again until both of the following conditions are true:

1. The packet has been completely transmitted or to a point 64 byte times from the beginning of the transmission has been reached.

2. The number of bytes taken out of the transmit FIFO for transmission subtracted from the number of bytes written to the FIFO leaves the FIFO with enough double word space available to meet the threshold setting.

It is important to note that until the packet is completely transmitted or until enough of the packet is transmitted to get past the normal collision window, the TXRDY output will only reflect how many writes have occurred and will not reflect how much of the FIFO data has been read out for transmission. Because of this, it is important to insure enough packet data has been written to prevent FIFO underflows if there exists a large latency between the TXRDY output being determined HIGH and the writing of more data to the FIFO.

3.5.3 Receive FIFO Interface

To determine if the receive FIFO has reached its threshold number of double words of data, the RXRDY output can be enabled by driving the RXINTEN input low. The RXRDY output for the chip will be high under one of the following conditions:

1. There are enough double words of data in the channel's receive FIFO to meet or exceed the programmed threshold value.
2. The status double word for a receive packet with an end of frame value of HIGH is in the receive FIFO.

Once the RXRDY output is determined to be high, the receive FIFO can be read. To read from the Receive FIFO, the RXRDEN and RXINTEN inputs must be asserted low and the $\overline{\text{RXTXBE}}$ byte enables must be low for each read cycle. Similar to the Transmit FIFO interface, all of the above Receive FIFO interface control signals are clocked into the chip on the high going edge of the $\overline{\text{RXRD_TXWR}}$ clock input which also acts as the FIFO read strobe. Because of this pipe lining the actual FIFO read will occur one $\overline{\text{RXRD_TXWR}}$ cycle after the assertion of the Receive FIFO interface control signals.

Using the 84C30A in 8 Bit or 16 Bit Mode

On the receive side, two different modes are possible.

On burst reads ($\overline{\text{Rxden}}$ being asserted for multiple clock cycles), if the first read is not a double word read, the second read will always increment the FIFO pointer irrespective of whether all the byte enables are enabled or not. In this mode, 16 bit reads are possible by muxing the LSB and the MSB of the data bus. 8 bit reads are not possible.

On single reads ($\overline{\text{Rxden}}$ being asserted for only one clock cycle), the FIFO pointer will get incremented only on a double word read. In this mode, the different bytes of the

data bus can be muxed to perform multiple 8 bit or 16 bit reads. But, all the reads of the bytes belonging to one row should be terminated with a double word read to increment the FIFO pointer.

When the chip is being read, the RXRDY output will remain high until the high going edge of the read that results in one of the following conditions:

1. The FIFO no longer has enough data to meet the threshold setting.
2. A packet's status double word with its associated HIGH end of frame value is read out.

In the case of RXRDY being driven LOW upon condition two given above, it will remain LOW for 8 RXRD_TXWR clock cycles and then goes back HIGH if one of the conditions for RXRDY being HIGH is met.

During reads from the FIFO, the SPDTAVL output will remain high until the high going edge of the read that causes one of the following conditions to occur:

1. The read that empties the FIFO completely.
2. The read that reads a packets status double word from the FIFO.

In the case of SPDTAVL being driven low upon the high going edge of the read that meets one of the above conditions, the SPDTAVL output will remain low for a period of 8 RXRD_TXWR clock cycles. For the time that SPDTAVL remains low, further reads are blocked within the chip even if external reads continue. This allows overreading the receive FIFO by a few cycles without, internal to the chip, reading an empty FIFO or reading new packet data before the present packet is processed. It is up to the processor doing the FIFO reads to determine on which read cycle the SPDTAVL went low and thereby which read cycles are over reads containing invalid data.

3.5.4 Special Conditions on the RXRD_TXWR input

This input is required to be tied to a continuous clock signal whose maximum clock frequency can be 33Mhz. The number of read or write cycles occurring to the chip is controlled through the TXWREN and RXRDEN inputs. All transitions of the TXRDY, RXRDY, RXTXEOF, SPDTAVL, RXDC, RXTXDATA[31:0], and TXRET outputs are synchronized internally to the RXRD_TXWR clock and are clocked to the output drivers on the highgoing edge of the clock.

3.6 Register Interface

Writing of Command, Configuration, and Station Address registers and reading of status registers is controlled by the ENREGIO, RD, WR, REGPS[1:0], and A[2:0] signals.

The ENREGIO signal is used as a general register interface enable and must be active low before any register operations can occur. The REGPS signals are used to select which port's registers are to be accessed. The A[2:0] are used to address which register within a port is being accessed. Initiation of a register read is controlled by the RD signal and initiation of a register write is controlled by the WR signal. A port's registers may be accessed at any time. However, it is recommended that writing to the command register, be done only during interframe gaps.

With the exception of the two Match Mode bits in the Receive Command Register, all bits in both command registers are interrupt enable bits. Changing the interrupt enable bits during frame transmission does not affect the frame integrity. Asynchronous error events, however, e.g., overflow, underflow, etc., may cause chip operation to vary, if their corresponding enable bits are being altered at the same time.

Reading the status registers may also occur at any time during transmission or reception.

Status Registers and all management counters are read only registers. The Rx and Tx Command Registers are write only and all other registers are writable and readable. Access to these registers is via the CPU interface: Control signals ENREGIO, RD, WR, REGPS [1:0], and the Command/Status Data Bus CdSt [7:0].

3.6.2 Station Address Register

The Station Address Register is 6 bytes in length. The contents may be written in any order, with bit "0" of byte "0" corresponding to the first bit received in the data stream, and indicating whether the address is physical or logical. Bit 7 of station address byte 5 is compared to the last bit of the received destination address. The Station Address should be programmed prior to enabling a port's receiver.

3.6.3 Transmit Command Register

The transmit command register is an 8 bit writable register. Bits 0 through 3 of the Transmit Command Register function as interrupt mask bits, which provide for control of the conditions allowed to generate transmit interrupts. Each of the four bits may be individually set or cleared. When set, the occurrence of the associated condition will cause an interrupt to be generated. The four specific conditions for which interrupts may be generated are:

1. A Transmit FIFO underflow occurred while transmitting the packet.
2. A collision occurred while transmitting the packet.

3. A transmit error condition occurred i.e., (Carrier sense never went active during transmission or went from an active to inactive state during transmission or 16 collisions occurred for a transmit packet or a late collision occurred).
4. The packet was transmitted successfully.

Interrupts are cleared by following the procedure given in the section entitled "Clearing Interrupts".

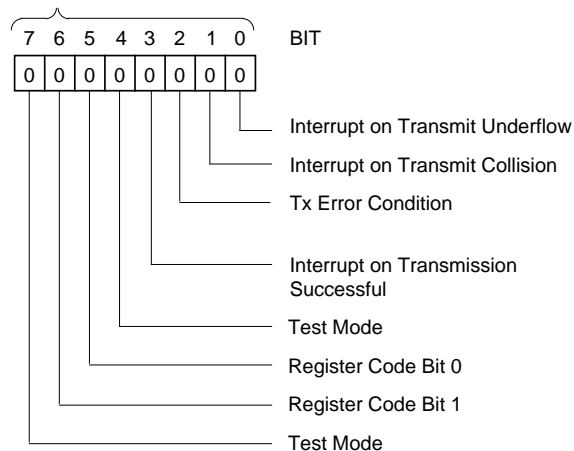
Bit 4 is used for testing purposes and **should not be written high under normal circumstances**.

Bits 5 and 6 are used in conjunction with the A[2:0] address pins to access registers other than the Receive and Transmit Command and Status Registers within a port. (See the Internal Port Register Addressing table).

Bit 7 is used for testing purposes and **should not be written high under normal circumstances**.

Transmit Command Register Format

Values After Reset



3.6.4 Transmit Status Register

Within each port's transmit section are 2 transmit status registers. These registers give the appearance of a single register to an external CPU. With each transmission attempt, whether successful or not, one of the status registers is written with the transmit status for that packet and bit 7 of that register is set to a 0 until both registers are full. When both registers are full, no new transmit status can be written until one of the registers is read. To an external CPU, both transmit status registers appear as a single register. If the CPU reads a LOW value for bit 7 of the transmit status register, this indicates that either one or both of the internal transmit registers contains new status.

A delay time after the highgoing edge of the read operation that reads new transmit status, one of the internal transmit status registers will be cleared and made available for new transmit status. Following are the types of transmit status given through status register:

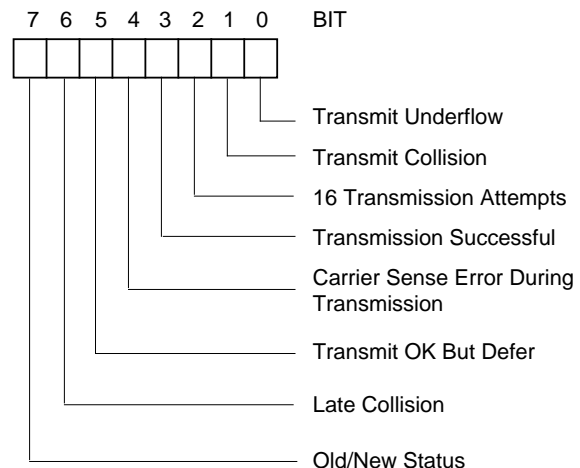
- Bit 0 - Transmit FIFO Underflow Occurred
- Bit 1 - Collision during transmission occurred.
- Bit 2 - 16 collisions occurred while attempting to transmit a packet.
- Bit 3 - Packet transmitted successfully.
- Bit 4 - Carrier Sense error during transmission attempt.
- Bit 5 - Transmit Deferred Due to Carrier Sense.
- Bit 6 - Late Collision
- Bit 7 - Old/New Status.

Bit 5 of the Transmit status register (transmit OK but defer) is an indication that the transmit state machine was ready to initiate a transmission but it has to defer due to carrier sense being HIGH. Bit 6 of the Transmit status register (Late Collision) is an indication that the transmitter encountered a collision contention 64 byte times after TXEN when HIGH.

A port can be programmed so that if both transmit registers are full, no new transmissions will occur until at least one of the register is cleared by reading it. To program this feature, bit #1 of configuration register #2 needs to be written to a 1 value.

Also a port can be programmed so that no new transmit status is loaded if the transmission is successful.

Transmit Status Register Format



3.6.5 Receive Command Register

A port's Receive Command Register has two primary functions, it specifies the Address Match Mode, and it specifies which types of receive frames will be received and if an associated interrupt will be produced. To set interrupt conditions the Receive Command Register uses bits 5 through 0 in conjunction with bit #7 of configuration register #1.

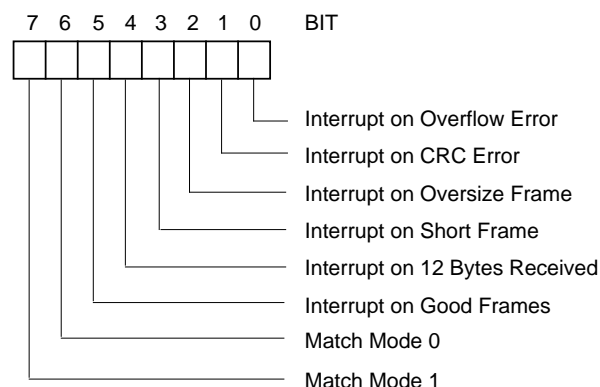
Bit 7 of configuration register #1 is a general receive interrupt disable. Setting this bit HIGH disables all receive interrupt conditions even if one of the bits 0 through 5 in the receive command register is set HIGH. This allows enabling reception of receive packets with errors without an interrupt being produced. With the general receive interrupt bit LOW, a receive interrupt can be produced on one or more of the following conditions by setting its associated interrupt enable bit in the receive command register:

1. Interrupt on good frames (Rx Command Bit 5)
2. Interrupt on receiving the 12 bytes of data for a packet. (Rx Command Bit 4)
3. Interrupt on reception of a short frame. (Rx Command Bit 3)
4. Interrupt on reception of oversize frame. (Rx Command Bit 2)
5. Interrupt on reception of a frame with a CRC error. (Rx Command Bit 1)
6. Interrupt on a receive FIFO overflow error. (Rx Command Bit 0)

For conditions 3, 4, 5 and 6 above, the associated interrupt enable bit also acts as a receive enable bit. This means for example that if bit 1 of the receive command register is written high, packets with CRC errors will be received and no receive discard will be asserted. By using a combination of the general receive interrupt disable bit 7 in configuration register #1 and bits 0 through 3 of the receive command register, a port can be programmed to accept packets with error conditions without the generation of an interrupt.

Bits 6 and 7 of the Receive Command Register are the receive match mode bits.

Receive Command Register Format



Bits 0-5 specify Interrupt and Frame-of-Interest when set.

	Match Mode 1	Match Mode 0	Function
0	0	0	Receiver Disable
1	0	1	Receive All Frames
2	1	0	Receive Station or Broadcast Frames
3	1	1	Receive Station, Broadcast/Multicast Frames

Match Mode Definition

Changing the receive Match Mode bits during frame reception may change chip operation and give unpredictable results.

Interrupt Enable and Frames-of-Interest

Bits 0-5 when set specify interrupt generation on occurrence of the corresponding frame reception condition.

3.6.6 Receive Status Register

Within each port's receive section, there is a receive status register that is written with the status of each receive packet whether it is discarded or not. Once the receive status register is written, bit 7 of the register is set to a 0 and the register is write protected from being overwritten with new status until it is read. Reading the receive status

register clears the register and enables it to be written with new status. The following packet status is reported in the receive status register:

- Bit 7 - Old/New status
- Bit 6 - 12 bytes of a frame received.
- Bit 5 - Received good frame.
- Bit 4 - Oversized frame received.
- Bit 3 - Short frame error.
- Bit 2 - Frame with dribble bits or nibbles.
- Bit 1 - Frame with CRC error.
- Bit 0 - Receive FIFO overflow error.

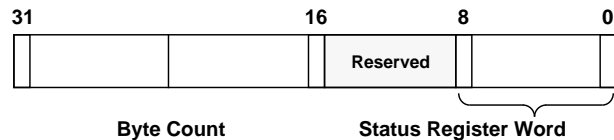
Receive packet status is also included as part of the final double word of receive data for a packet that is not discarded. The final double word of a packet as read from the receive FIFO contains the status and the byte count for that packet with the status appearing as the least significant word of the double word and the byte count appearing in the two most significant bytes of the double word. The status read through the FIFO has the same bit values as the receive status register except for the following:

- Bit 7: RXABORT During Reception
- Bit 8: Read Error Condition

Bit 7 is an indication that the RXABORT pin was pulsed HIGH while CSN was HIGH for the packet. Bit 8 Indicates that some type of error has occurred in the receive FIFO control circuitry with a result that the number of double words written to the FIFO as indicated by the byte count portion of the status double word does not equal the number of double words read from the FIFO for the packet. This type of error can only be caused by some type of noise glitch or other unusual occurrence within the receive section. Any packet read from the FIFO with Bit 8 of the

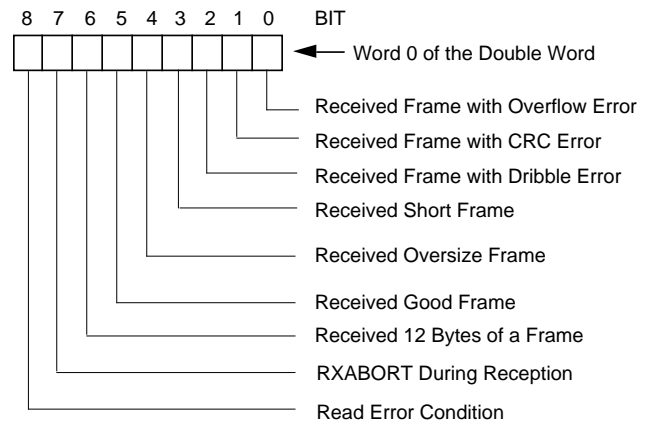
status set HIGH should be considered to have bad data. This condition should never occur in a properly designed application. If status is ever read with Bit 8 being HIGH, the receive section will automatically reset itself to provide a clean starting point for further packet reception.

Format of the Status Double Word



Note: This status double word gets appended to the packet in same format for both Little and Big Endian modes.

Status Register Word

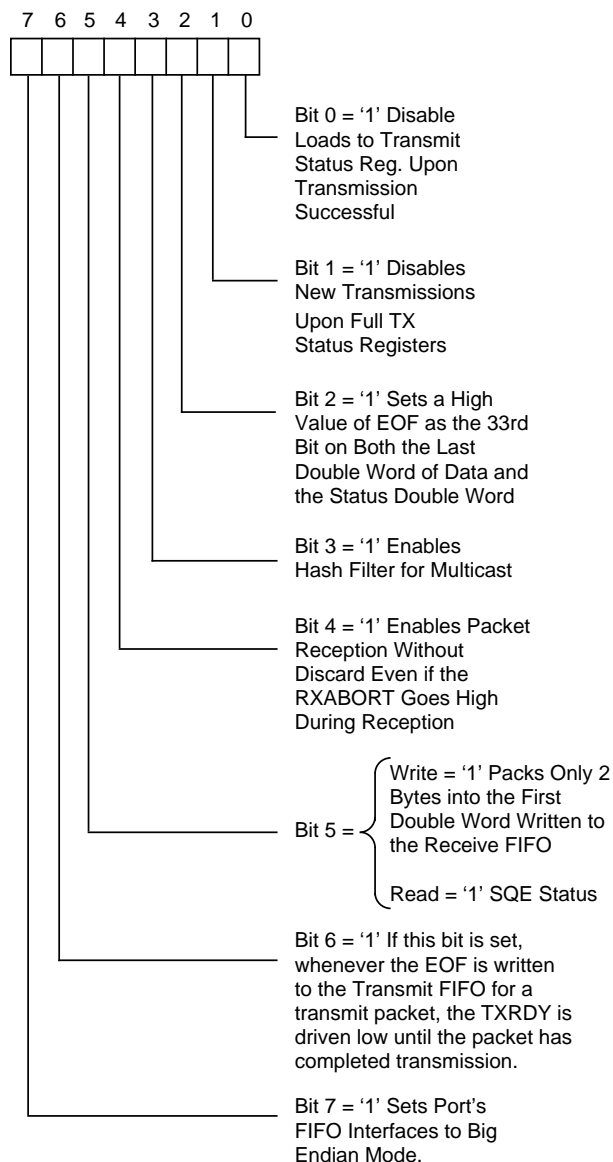


Clearing Interrupts

Both receive and transmit interrupts for a port are combined into a single interrupt signal which then goes to that port's INT output pin. The interrupt signal within a port in the chip is actually the result of the receive/transmit status register outputs and the receive/transmit command register interrupt enable bits that are set. To clear an interrupt the status that caused the interrupt needs to be cleared. This can be accomplished by reading the transmit status register and/or the receive status register.

3.6.7 Configuration Register #2

Allows for control of a port's transmission of one packet at a time, Busmode, Multi-cast hash filter, reception of runt frames, and halting new transmissions until one of the port's transmit status registers is cleared.



Don't Load Tx Status Upon Successful Transmit Mode

If bit #0 of configuration register #2 is set, then a packet that has been transmitted successfully will not have its status loaded into either of the two internal transmit status registers.

Disable Further Transmission Upon Full Tx Status Register Mode

If bit #1 of configuration register #2 is set, whenever both Tx Status Registers have been filled, no new transmissions will occur until one of the Tx Status Registers is cleared, even if the transmit FIFO has transmit data.

Successful Packet Transmission Complete Feature

This feature is programmable by setting bit 7 of configuration register #2 to a '1' value. If this bit is set, then, independent of the FIFO threshold setting, the corresponding port's TXRDY pin will go LOW once the final double word of data for a transmit packet is written to the transmit FIFO. Once a port's TXRDY has been driven LOW due to this condition, it will remain LOW until the packet has completed transmission without error or until a transmission exception condition causing the TXRET pin to go HIGH is cleared. This allows the user to determine when a packet has completed successful transmission by detecting when the corresponding port's TXRDY goes HIGH after the final double word of the packet has been written. After TXRDY goes LOW due to a double word write with the RXTXEOF pin HIGH, further writes to the transmit FIFO are allowed as long as the SPDTAVL pin indicates that there is still space available within the transmit FIFO.

Big Endian Mode

Writing this bit HIGH programs the port to Big Endian mode.

Pack Only Two Valid Bytes in First Receive Double Word, Bit 5

This is a read/write bit. When read, it indicates SQE status, the SQE function is always on, when reading this register it causes it to reset. If this bit is set then the first double word of data written to the receive FIFO for a receive packet will have only two valid bytes. When this first double word is read out of the receive FIFO, which two bytes are valid depends upon whether the port has been programmed for Big Endian or Little Endian mode. For the first double word read, only RXTXDATA[15:0] are valid if bit #6 is HIGH, otherwise only RXTXDATA[31:16] are valid. All subsequent double words of data read from the receive FIFO will contain 4 valid bytes except for the last double word which may not have all 4 bytes valid.

EOF on Data Bit 2

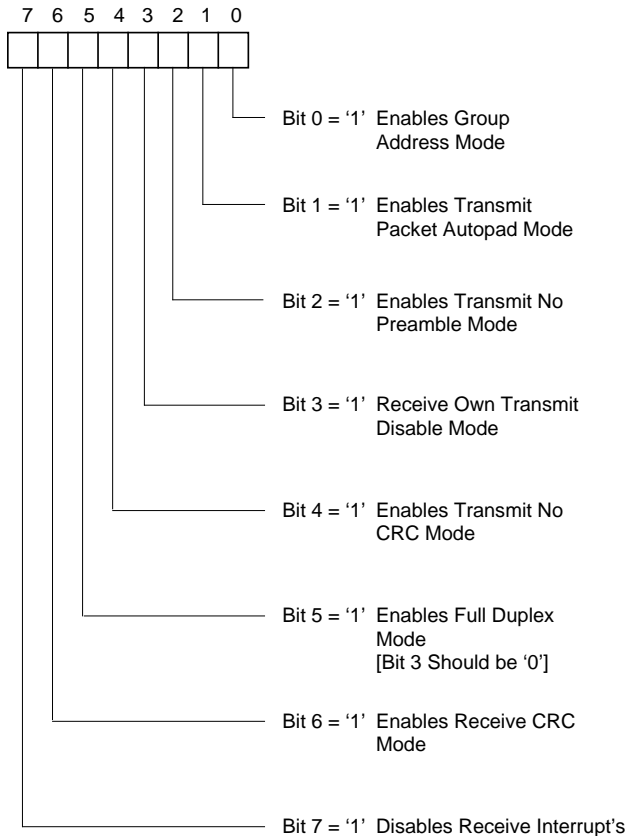
This function puts a HIGH EOF value on both the last double word of data and the status double word.

Multicast Mode

Each port has a 64 bit multicast address filter register which can be accessed as shown in the Internal Port Register Addressing Table (page 18). When a port is programmed to receive multicast frames (match mode 3), after computing the CRC on the address field of the receiving frame (first 6 bytes), it will index to the multicast address filter register depending on bits 0 to 5 of the CRC. If the corresponding bit is a '1' it will receive the frame, otherwise it will discard the frame.

Configuration Register #1

Allows for control of a port's various transmit and receive features. Set to all 0's after reset.



Group Address Mode

In this mode the last 4 bits of the serial receive data stream for the destination address are masked out in address comparison. This means that when the destination address is compared against the value programmed in the station address register that the packet will not be rejected due to incorrect address even its last 4 bits did not match.

Transmit Packet Autopad Mode

This feature automatically pads packets to be transmitted with less than 60 bytes of data out to a minimum IEEE 802.3 standard packet length of 60 bytes excluding FCS. Padding is done with bytes of 00 hex.

Transmit No Preamble Mode

This mode prevents the transmitter from adding a preamble pattern at the beginning of data to be transmitted.

Disable Loopback Mode

Description on the Loopback mode (Bit #3 of Config 1)

The following description assumes that a transceiver is connected to the MAC.

Configuration Register #1

Bit 3	Bit 5	Mode	Functional Description
1	0 Delay	Half Duplex	In this mode, the transmit data looped back from the transceiver is ignored by the controller. The data does not get written into the receive FIFO and the Rxrdy does not reflect the incoming data.
0 Delay	1	Full Duplex	In this mode, the transceiver (In Full Duplex mode), will not loopback the transmitted data. However, since data reception is possible during transmission, bit 3 should be written with '0' so that the data gets written to the Receive FIFO.

Half Duplex Mode

Bit 3 = '1', Bit 5 = '0'

In this mode, the transmit data looped back from the transceiver (connected to a port of the 84C300) is ignored by the controller. The data does not get written into the receive FIFO and the Rxrdy does not reflect the incoming data.

Full Duplex Mode

Bit 3 = '0', (default), Bit 5 = '1'

In this mode, the transceiver (in Full Duplex mode), will not loopback the transmitted data. However, since data reception is possible during transmission, bit 3 should be written with a value of '0' so that the data gets written to the receive FIFO.

Transmit No CRC Mode

This mode prevents a port's transmitter from appending transmit data with an FCS.

Full Duplex Mode

In this mode a ports transmitter will ignore carrier sense and will not defer to it if it is ready to transmit a packet.

The software bit setting and the hardware setting (pin #108) have an OR relationship. This means that either the hardware or software setting will enable Full Duplex.

Receive CRC Mode

In this mode a ports receiver loads the 4 bytes of FCS into the receive FIFO along with the data allowing the FCS value to be read out.

Disable Receive Interrupts

With this bit set, a port's receiver is disabled from producing receive interrupts.

3.6.8 FIFO Threshold Register

This register allows programming of the threshold of Space Available and/or Data Available double word counts that cause assertion of the TxRDY and/or RxRDY signals respectively. Bits 4 through 7, when written with a binary value, indicates the minimum number of double words necessary in the receive FIFO before RxRDY is asserted. Similarly, bits 0 through 3, when written with a binary value, indicate the minimum number of double word wide spaces necessary in the transmit FIFO for TxRDY to be asserted. On page 28 is a table showing how many double words of space/data are required to cause the TXRDY/RXRDY signals to go high for each threshold setting.

3.6.9 Defer Register Calculations for the 84C30A**Defer Time Definitions**

In the standard Half Duplex Mode, Defer time is defined as the time from the falling edge of carrier sense to the rising edge of TXEN. In full duplex mode, the defer time is measured as the time from the falling edge of TXEN to the next rising edge of TXEN. The binary value programmed into the defer count register is used to determine how many byte times the defer time will be set to. The algorithms below illustrates how the defer time is calculated.

Algorithm for Defer Time Calculations for 10 Mbit Serial Mode

$$\text{Defer Time} = \text{Int} \{ \{ \text{Int} (\text{Delay} / 100) + 17 + \text{DefRegSet} \} / 8 \} + 2$$

Defer Time = The transmit defer time in byte times

$$\begin{aligned} \text{Delay} &= \text{Delay from the down going edge of TXEN to the} \\ &\quad \text{down going edge of CSN. (Half Duplex)} \\ &= 0 \text{ (Full Duplex)} \end{aligned}$$

DefRegSet = The transmit defer register setting

Int = Using the Whole Number Portion

Example Calculations

To find out the value that needs to be programmed into the defer register for a defer time of 9600 ns, the following steps need to be taken

Assume Delay = 3400 ns

Desired Defer Time = 9600 ns = 12 byte times

The desired byte times should be a multiple of 800

Step 1: Calculation of the Actual Defer Time

Let's assume a Defer Register Setting Value of 21

$$\begin{aligned} \text{Defer Time} &= \text{Int} \{ \{ \text{Int} (\text{Delay} / 100) + 17 + \text{DefRegSet} \} / 8 \} + 2 \\ &= \text{Int} \{ \{ \text{Int} (34) + 17 + 21 \} / 8 \} + 2 \\ &= \text{Int} \{ 9 \} + 2 \\ &= 9 + 2 = 11 \text{ byte times} \end{aligned}$$

Step 2: Calculation of the Actual Defer Register Setting

Since we know that the value derived from the previous step is 1 byte time lower than what is desired we will increment the assumed defer register setting by 8 and do the calculations again.

Let's assume a Defer Register Setting Value of 29

$$\begin{aligned} \text{Defer Time} &= \text{Int} \{ \{ \text{Int} (\text{Delay} / 100) + 17 + \text{DefRegSet} \} / 8 \} + 2 \\ &= \text{Int} \{ \{ \text{Int} (34) + 17 + 29 \} / 8 \} + 2 \\ &= \text{Int} \{ 10 \} + 2 \\ &= 10 + 2 = 12 \text{ byte times} \end{aligned}$$

Please note that you might have to do this process several times before you can get the actual defer register setting for a desired defer time based on your delays.

3.6.10 Transmit Control/Product I.D. Register

The lower four bits can be used to set a threshold value on the transmit FIFO that can be used to control the packet transmission and the upper four bits of this register con-

tains the product I.D. When the lower four bits are written with a decimal value ranging from 1 to 15, packet transmission from the FIFO will begin only when the count of the double words of data written into the transmit FIFO equals or exceeds twice the register value. For example, when the lower four bits are written with a decimal value of 15, data transmission will begin only after the FIFO is written with 30 or more double words of data. This threshold value is valid only at the beginning of frame transmission and it will take effect again when the user starts to load the beginning of the next frame. The default decimal value of the lower four bits is '0' and packet transmission will begin automatically when the FIFO is loaded with a minimum of one double word of data. The upper four bits are read only and contain a value of 'A'.

3.7 COUNTERS

CRC Error Counter

This is a 16 bit read only counter that counts the number of frames received or discarded with CRC errors but no framing errors. Upon reaching its maximum count value of FFFF hex, this counter will stop counting. To read this counter, two consecutive reads must be performed to the same address location. The first read, reads out the high byte and the second read, reads out the low byte. Upon reading the high byte, the count value of the low byte is frozen to prevent the low byte count value from rolling over

before it is read. Normally, once the low byte has been read the counter is reset to zero. Should the 84C30A attempt to increment the counter while it is frozen, then reading the low byte of the counter causes it to be loaded with 0001 hex thereby preventing the counter from missing a count.

Runt Frame Counter

This is a 16 bit read only counter that counts the number of frames received or discarded less than the minimum valid frame time (64 bytes). Upon reaching its maximum count value of FFFF hex, this counter will stop counting. To read this counter, two consecutive reads must be performed to the same address location. The first read, reads out the high byte and the second read, reads out the low byte. Upon reading the high byte, the count value of the low byte is frozen to prevent the low byte count value from rolling over before it is read. Normally, once the low byte has been read the counter is reset to zero. Should the 84C30A attempt to increment the counter while it is frozen, then reading the low byte of the counter causes it to be loaded with 0001 hex thereby preventing the counter from missing a count.

Receive Oversize Frame Counter

This is a 8-bit counter that counts the number of receive frames with greater than the 1518 byte maximum frame size of data. Upon reaching its maximum count value of FF

3.6.6.1 FIFO Threshold Register Settings Table

Fifo Threshold Register Bits								Minimum # of Double Words of Data for RXRDY High	Minimum # of Double Word Spaces for TXRDY High
7	6	5	4	3	2	1	0		
0	0	0	0	0	0	0	0	1	1
0	0	0	1	0	0	0	1	2	2
0	0	1	0	0	0	1	0	3	3
0	0	1	1	0	0	1	1	4	4
0	1	0	0	0	1	0	0	5	5
0	1	0	1	0	1	0	1	6	6
0	1	1	0	0	1	1	0	7	7
0	1	1	1	0	1	1	1	8	8
1	0	0	0	1	0	0	0	9	9
1	0	0	1	1	0	0	1	10	10
1	0	1	0	1	0	1	0	11	11
1	0	1	1	1	0	1	1	12	12
1	1	0	0	1	1	0	0	13	13
1	1	0	1	1	1	0	1	14	14
1	1	1	0	1	1	1	0	15	15
1	1	1	1	1	1	1	1	16	16

hex, this counter will stop counting. During reading of this counter the count value will be frozen to prevent incrementing while being read. Should the 84C30A attempt to increment the counter while it is frozen, then the counter will be loaded with 01 hex upon completion of the read. Otherwise, completing the read will reset the counter to 00 hex.

Alignment Error Counter

This is a 16 bit read only counter that counts the number of frames received or discarded with a framing error and a CRC error both. Upon reaching its maximum count value of FFFF hex, this counter will stop counting. To read this counter, two consecutive reads must be performed to the same address location. The first read, reads out the high byte and the second read, reads out the low byte. Upon reading the high byte, the count value of the low byte is frozen to prevent the low byte count value from rolling over before it is read. Normally, once the low byte has been read the counter is reset to zero. Should the 84C30A attempt to increment the counter while it is frozen, then reading the low byte of the counter causes it to be loaded with 0001 hex thereby preventing the counter from missing a count.

Transmit Collision Counter

This is a 16 bit read only counter. Bits 15 through 11 of this counter count the number of retransmission attempts a packet required before being transmitted successfully. Bits 10 through 0 count the number of transmit collisions a port has experienced. Upon reaching its maximum count

value of FFFF hex, this counter will stop counting. To read this counter, two consecutive reads must be performed to the same address location. The first read, reads out the high byte and the second read, reads out the low byte. Upon reading the high byte, the count value of the low byte is frozen to prevent the low byte count value from rolling over before it is read. Normally, once the low byte has been read the counter is reset to zero. Should the 84C30A attempt to increment the counter while it is frozen, then reading the low byte of the counter causes it to be loaded with 0001 hex thereby preventing the counter from missing a count.

Receive Collision Counter

This is a 16 bit read only counter that counts the number of collisions other than transmit collisions that occur. Collisions due to the SQET test are not counted. Upon reaching its maximum count value of FFFF hex, this counter will stop counting. To read this counter, two consecutive reads must be performed to the same address location. The first read, reads out the high byte and the second read, reads out the low byte. Upon reading the high byte, the count value of the low byte is frozen to prevent the low byte count value from rolling over before it is read. Normally, once the low byte has been read the counter is reset to zero. Should the 84C30A attempt to increment the counter while it is frozen, then reading the low byte of the counter causes it to be loaded with 0001 hex thereby preventing the counter from missing a count.

Absolute Maximum Ratings

Ambient Temperature
 Under Bias -10°C to $+80^{\circ}\text{C}$
 Storage Temperature -65°C to $+150^{\circ}\text{C}$
 All Input or Output Voltages
 with Respect to Ground $+6\text{V}$ to -0.3V
 Package Maximum Power Dissipation 1.5 Watts

Operating Conditions

Ambient Temperature Range 0°C to 70°C
 V_{CC} Power Supply 4.75 V to 5.25 V

4.0 DC Characteristics $T_A = 0^{\circ}\text{C}$ to 70°C , $V_{CC} = 5\text{V}$ to 5%

Symbol	Parameter	Limits ^[1]			Units	Condition
		Min.	Typ.	Max.		
I_{IN}	Input Leakage Current			10	μA	$V_{IN} = 0.45\text{V}$ to 5.25V
I_O	Output Leakage Current			10	μA	$V_{OUT} = 0.45\text{V}$ to 5.25V
I_{CC}	V_{CC} Current		250	300	mA	
V_{CH}	Clock Input High Voltage	4.0		6	V	
V_{CL}	Clock Input Low Voltage			0.8	V	
V_{IL}	Input Low Voltage			0.8	V	
V_{IH1}	Input High Voltage	2.0		6	V	
V_{OL}	Output Low Voltage RXTXDATA [31:0], RXTXEOF, SPDTAVL, TXRDY_[1:4], RXRDY_[1:4], TXRET_[1:4], RXDC_[1:4]			0.4	V	$I_{OL} = 8\text{mA}$
V_{OH}	Output High Voltage RXTXDATA [31:0], RXTXEOF, SPDTAVL, TXRDY_[1:4], RXRDY_[1:4], TXRET_[1:4], RXDC_[1:4]	2.4			V	$I_{OH} = 8\text{mA}$
V_{OL}	Output Low Voltage TXD [0:3]_[1:4], TXEN_[1:4]			0.4	V	$I_{OL} = 4\text{mA}$
V_{OH}	Output High Voltage TXD [0:3]_[1:4], TXEN_[1:4]	2.4			V	$I_{OH} = 4\text{mA}$
V_{OL}	Output Low Voltage All Other Outputs			0.4	V	$I_{OL} = 2\text{mA}$
V_{OH}	Output High Voltage All Other Outputs	2.4			V	$I_{OH} = 2\text{mA}$

NOTE:

1. Typical values are for $T_A = 25^{\circ}\text{C}$ and nominal supply voltages.

AC Test Conditions

Output Load: 1 Schottky TTL Gate + $CL = 100\text{ pF}$
except where specifically given otherwise in the condition column.

Input Pulse Level: 0.4 V to 2.4 V

Timing Reference Level: 1.5 V

Capacitance $T_A = 25^\circ\text{C}$, $F_C = 1\text{ MHz}$

Symbol	Parameter	Maximum	Condition
C_{IN}	Input Capacitance	15 pF	$V_{IN} = 0\text{ V}$
C_{IO}	I/O Capacitance	15 pF	$V_{IO} = 0\text{ V}$

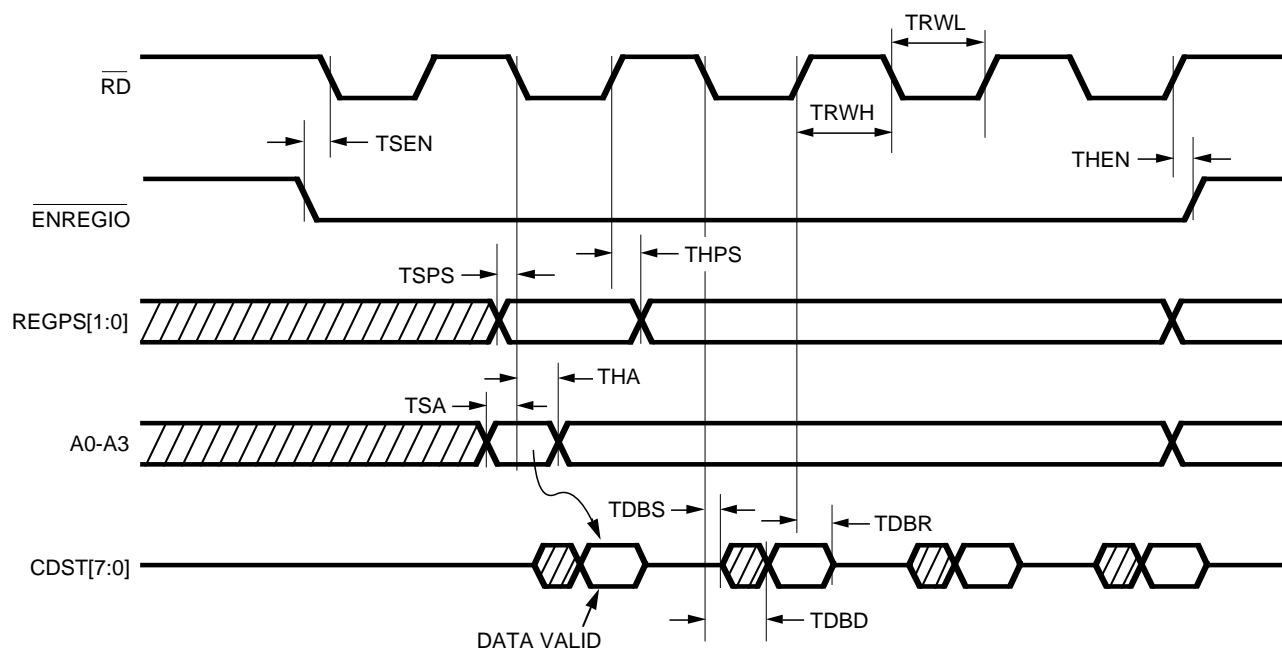
5.0 AC Characteristics $T_A = 0^\circ\text{C to } 70^\circ\text{C}$, $V_{CC} = 5\text{ V} \pm 5\%$

Symbol ^[1]	Parameter	Limits			Units (ns)	Condition
		Min.	Typ.	Max.		
COMMAND/STATUS INTERFACE READ AND WRITE TIMING						
TDBD	Receive/Transmit Command Status, and Management Counters	0.5 RXC/TXC Cycles + 10 ns		1.5 RXC/TXC Cycles + 50 ns	ns	RXC, TXC = 10 MHz
	All Other Registers	10		50	ns	
TDBR	CDST [7:0] Bus Release Delay	1.5		5.5	ns	
TDBS	CDST [7:0] Bus Seizure Delay	6		32	ns	
THA	A[3:0] Hold	10			ns	
THDA	CdSt Bus Hold	0			ns	
TSA	A[3:0] Setup	15			ns	
TSCS	CdSt Bus Setup	10			ns	
THCS	CdSt Bus Hold	0			ns	
TRWH	\overline{RD} / High Width	1 TXC/RXC Cycle			ns	RXC, TXC = 10 MHz
TRWL	\overline{RD} / Low Width	1.5 TXC/RXC Cycles + 70 ns			ns	RXC, TXC = 10 MHz
TWWH	\overline{WR} High Width	30			ns	
TWWL	\overline{WR} Low Width	30			ns	

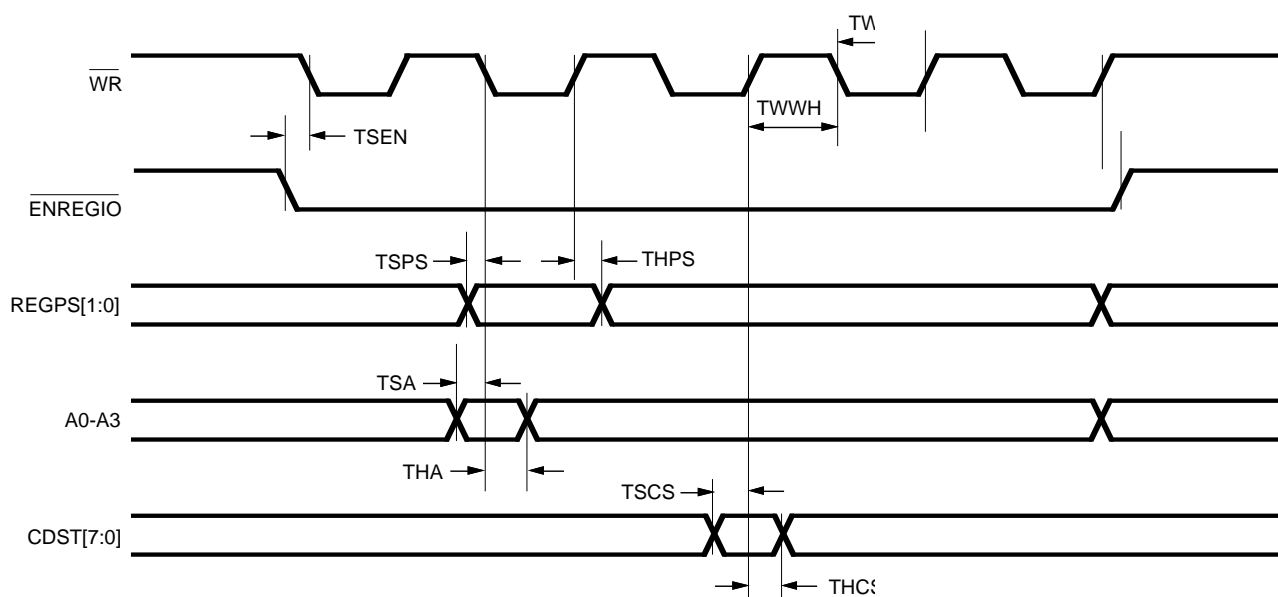
NOTES:

1. Italics indicate input requirement, non-italics indicate output timing.

5.01 Command/Status Interface Read Timing



5.02 Command/Status Interface Write Timing



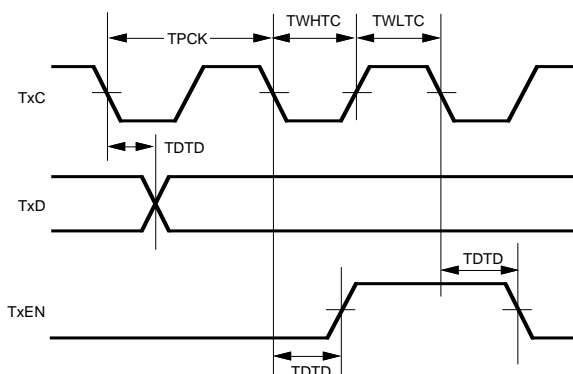
6.0 Ethernet Transmit and Receive Interface Timing

AC Characteristics $T_A = 0^\circ\text{C to } 70^\circ\text{C}$, $V_{CC} = 5\text{ V} \pm 5\%$

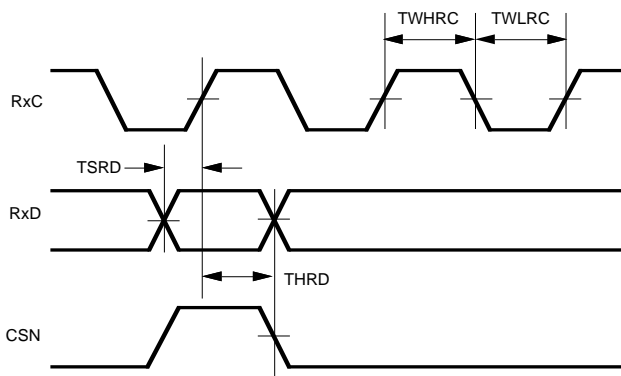
ETHERNET TRANSMIT INTERFACE TIMING					
Symbol	Parameter	Limits			Condition
		Min.	Typ.	Max.	
TDTD	TXD/TXEN Delay	5 ns		20 ns	
TWHTC	TXC High Width	45			
TWLTC	TXC Low Width	45			

ETHERNET RECEIVE INTERFACE TIMING					
THRD	RxD Hold	5 ns			
TSRD	RxD Setup	5 ns			
TWHRC	RxC High Width	45			
TWLRC	RxC Low Width	45			

6.01 ETHERNET TRANSMIT INTERFACE TIMING



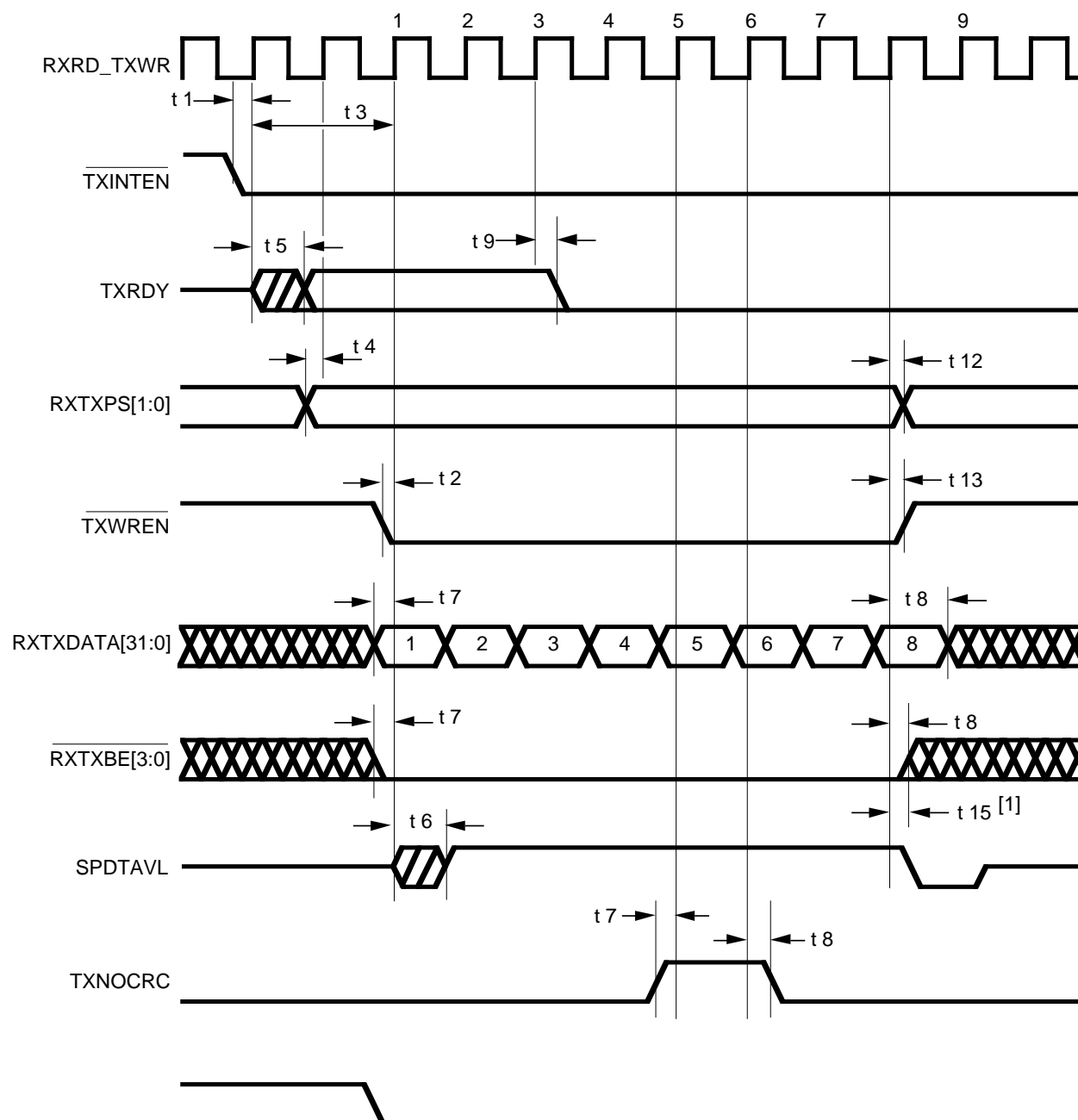
6.02 ETHERNET RECEIVE INTERFACE TIMING



7.0 Transmit Data Interface Timing

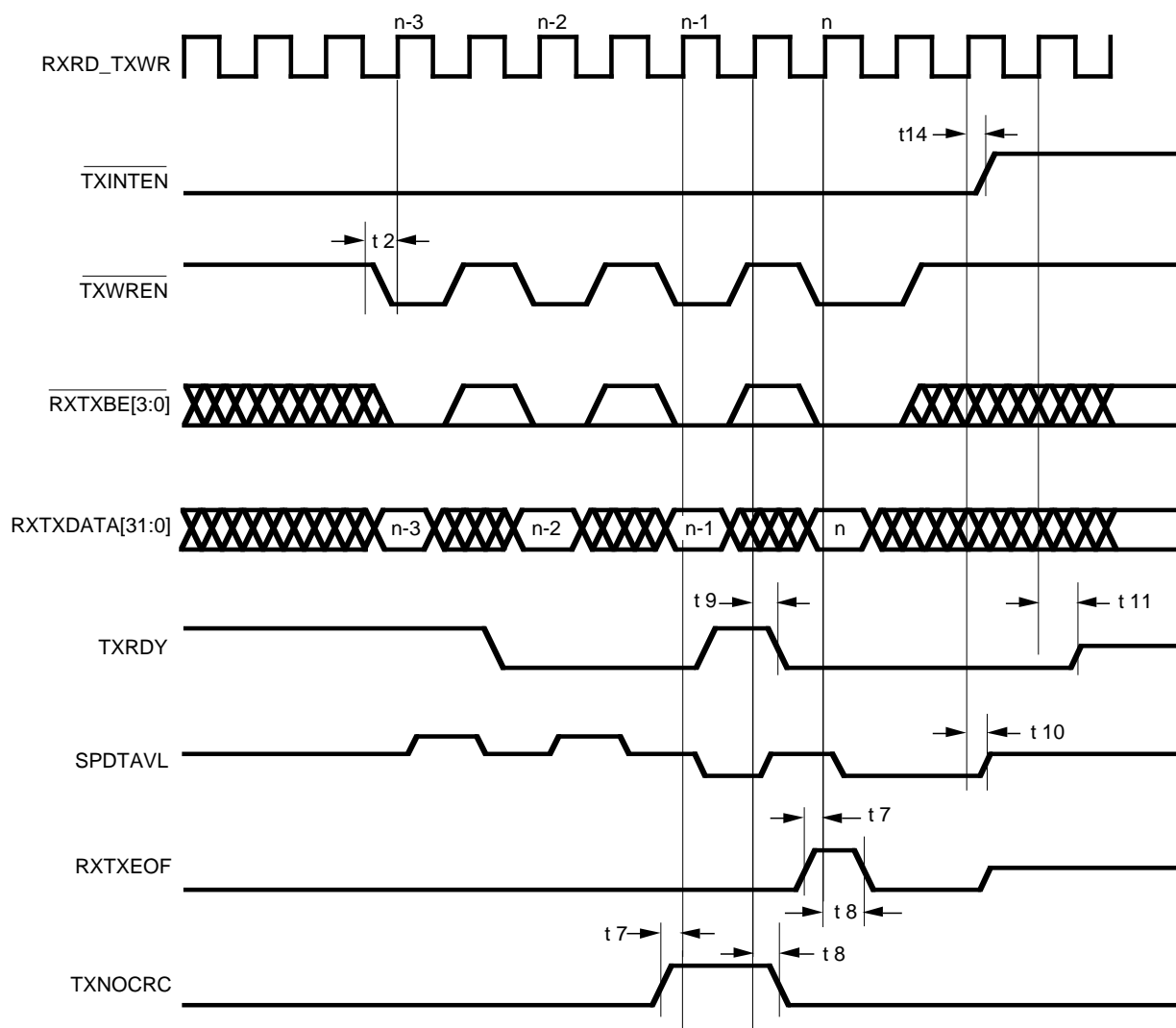
Symbol	Parameter	Min.	Typ.	Max.
t_1	Transmit Interface Enable to Clock Setup Time	5ns		
t_2	Transmit Write Enable to Clock Setup Time	5 ns		
t_3	Transmit Interface Enable to Transmit Write Enable Timing Skew	0 ns		
t_4	Port Select Inputs to Clock Setup Time	5 ns		
t_5	TXRDY Output Enabled to Output Valid Delay	5 ns		25 ns
t_6	SPDTAVL Output Enable to Output Valid Delay	4 ns		24 ns
t_7	Transmit Data, Byte Enables, TXEOF, TXNOCRC to Clock Setup Time	5 ns		
t_8	Transmit Data, Byte Enables, TXEOF, TXNOCRC Hold Time	1.5 ns		
t_9	TXRDY Deassert Due to Threshold Being Met	5 ns		25 ns
t_{10}	SPDTAVL Output Disabled to Hi-Z Delay	3 ns		14 ns
t_{11}	TXRDY Output Disabled to Hi-Z Delay	3 ns		13 ns
t_{12}	Port Select Inputs Hold Time	0 ns		
t_{13}	Transmit Write Enable Hold Time	0 ns		
t_{14}	Transmit Interface Enable Hold Time	0 ns		
t_{15}	SPDTAVL Deassert Due to Transmit FIFO Reading an almost Empty Condition	4 ns		24 ns

7.01 Transmit Data Interface Write Timing 1



Notes: 1. SPDTAVL gets deasserted because of the 7th double word write to the transmit FIFO indicating that the 8th double word write will fill the FIFO completely. It is important to note that the data gets pipelined internally, hence the 7th external double word write (The 7th Clock Edge that latches in the active low TXWREN) actually happens on the 8th clock cycle internally.

7.02 Transmit Data Interface Write Timing 2

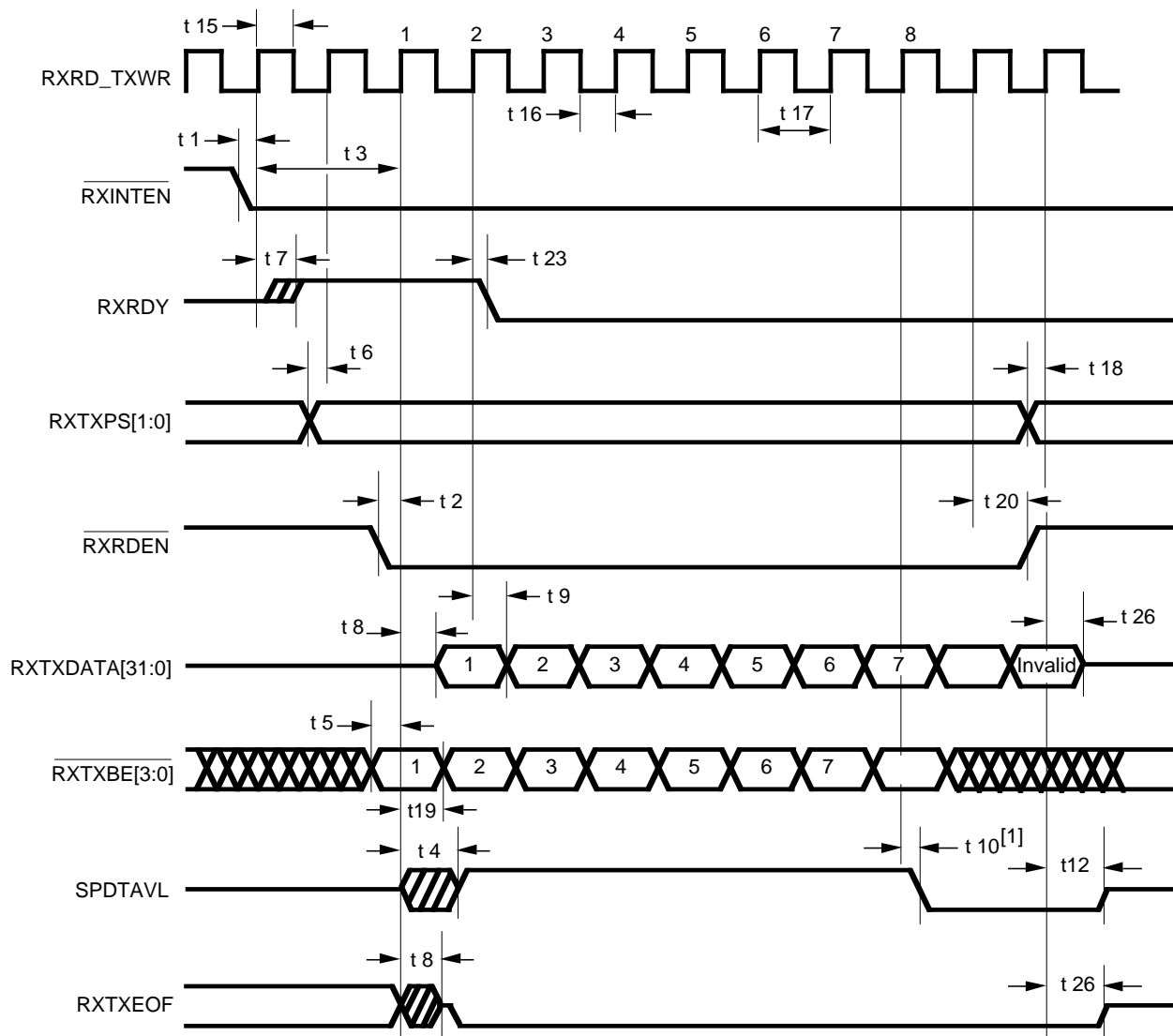


8.0 Receive Data Interface Timing

Symbol	Parameter	Min.	Typ.	Max.	Condition
t_1	Receive Interface Enable to Clock Setup Time	5ns			
t_2	Receive Read Enable to Clock Setup Time	5 ns			
t_3	Receive Interface Enable to Receive Read Enable Timing Skew	0 ns			
t_4	SPDTAVL Output Enabled to Output Valid Delay	4 ns		24 ns	
t_5	Receive Byte Enables to Clock Setup Time	5 ns			
t_6	Port Select Inputs to Clock Setup Time	5 ns			
t_7	RXRDY Output Enabled to Output Valid Delay	4 ns		26 ns	
t_8	RXTXDATA [31:0], RXTXEOF Outputs Enabled to Outputs Valid Delay	5 ns		22 ns	
t_9	FIFO Read Strobe High to RXTXEOF, RXTXDATA[31:0] FIFO Data Out Delay	5 ns		24 ns	
t_{10}	Clock to SPDTAVL Low Delay			22 ns	
	SPDTAVL Deassert to Assert Minimum Low Time	8 $\overline{\text{RXRD_TXWR}}$ Cycles			
t_{12}	SPDTAVL Output Disabled to Hi-Z Delay	3 ns		14 ns	
t_{13}	RXRDY Output Disabled to Hi-Z Delay	3 ns		12 ns	
t_{14}	Receive Data and RXTXEOF Outputs Disabled to Hi-Z Delay	3 ns		13 ns	
t_{15}	RXRD_TXWR Clock Pulse Width High	12 ns			
t_{16}	RXRD_TXWR Clock Pulse Width Low	12 ns			
t_{17}	$\overline{\text{RXRD_TXWR}}$ Clock Period	30 ns		180 ns	
t_{18}	Port Select Inputs Hold Time	0 ns			
t_{19}	Byte Enables Hold Time	0 ns			
t_{20}	Receive Read Enable Hold Time	0 ns			
t_{21}	Receive Interface Enable Hold Time	0 ns			

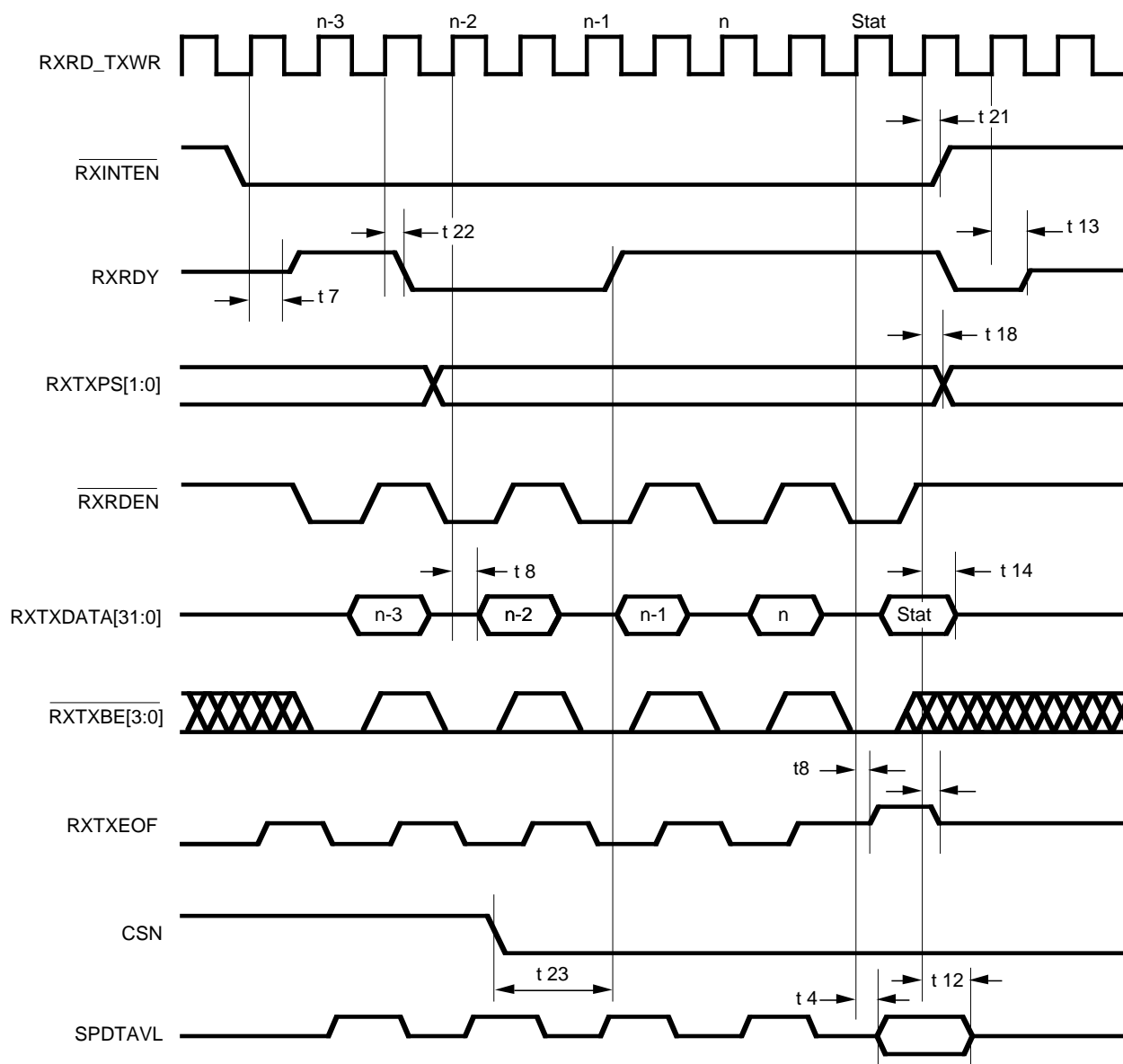
Receive Data Interface Timing (cont'd)

Symbol	Parameter	Min.	Typ.	Max.	Condition
t_{22}	RXRDY Deassert Due to Emptying RX FIFO Below Threshold	4 ns		26 ns	
t_{23}	RXRDY Assert from CSN Going Low Due to Status Write	9 RXC Cycles + 2.5 RXRD_TXWR Cycles + 4 ns		17 RXC Cycles + 3.5 RXRD_TXWR Cycles + 22 ns	

8.01 Receive Data Interface Read Timing 1

Notes: 1. SPDTAVL gets deasserted because of the 7th double word read from the receive FIFO indicating that there is no more data available in the receive FIFO and further reads will cause invalid reads. Here, it is important to note that the 7th read is referred to the 7th clock edge that latches in the active low RXRDEN and the resultant data can be latched out on the 8th clock edge because of the pipelining effect.

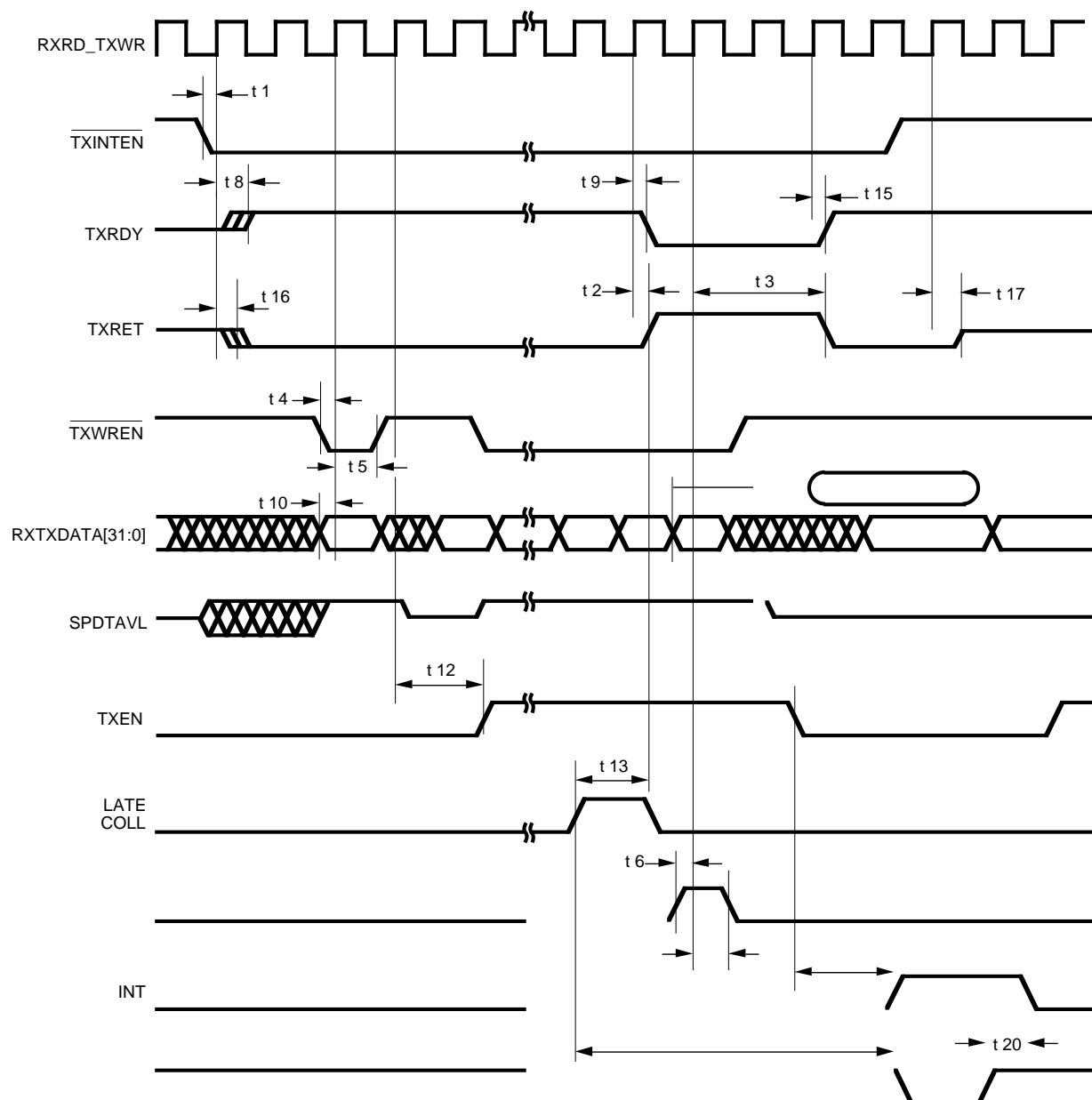
8.02 Receive Data Interface Read Timing 2



9.0 Transmit Data Interface Timing on Exception Conditions

Symbol	Parameter	Min.	Typ.	Max.
t_1	TXINTEN Setup Time	5 ns		
t_2	RXRD_TXWR to TXRET Delay	9.5 ns		38 ns
t_3	TXRET Deassert from CLRTXERR	1 TXC Cycle + 1 RXRD_TXWR Cycle + 7 ns		2 TXC Cycles + 2 RXRD_TXWR Cycles + 28 ns
t_4	TXWREN Setup Time	5 ns		
t_5	TXWREN Hold Time	0 ns		
t_6	CLRTXERR Setup Time	12 ns		
t_7	CLRTXERR Hold Time	0 ns		
t_8	TXRDY Output Enabled to Output Valid Delay	5 ns		25 ns
t_9	TXRDY Deassert Due to TXRET Going HIGH Because of an Exception Condition	5 ns		1 RXRD_TXWR Cycle + 25 ns
t_{10}	RXTXDATA Setup Time	5 ns		
t_{12}	TXEN Assert from First Data Write to the Transmit FIFO (Assuming Defer Time Has Been Met)	0.75 RXRD_TXWR Cycles + 18.5 TXC Cycles + 5 ns (10 Mbit/sec Serial Mode)		0.75 RXRD_TXWR Cycles + 26.5 TXC Cycles + 20 ns (10 Mbit/sec Serial Mode)
t_{13}	TXRET Set Delay Due to Late Collision or 16 Collisions	25 TXC Cycles + 1 RXRD_TXWR Cycle + 9.5 ns		34 TXC Cycles + 2 RXRD_TXWR Cycles + 38 ns
	TXRET Set Due to Underflow	8 TXC Cycles + 1 RXRD_TXWR Cycle + 9.5 ns		8 TXC Cycles + 2 RXRD_TXWR Cycles + 38 ns
t_{15}	TXRDY Going HIGH Due to TXRET Going Low	5 ns		25 ns
t_{16}	TXRET Output Enabled to Output Valid Delay	9.5 ns		38 ns
t_{17}	TXRET Output Disabled to Hi-Z Delay	3 ns		12 ns
t_{18}	INT High to TXEN Low Delay Due to Underflow	1 TXC Cycle + 15 ns		1 TXC Cycle + 40 ns
	TXEN Low to INT HIGH Delay Due to Carrier Sense Dropout	2 TXC Cycles + 15 ns		2 TXC Cycles + 40 ns
	TXEN Low to INT High Delay Due to Successful Transmission	10 ns		20 ns
t_{19}	COLL High to INT High Delay	20 TXC Cycles + 15 ns		27 TXC Cycles + 40 ns
t_{20}	INT Clear Delay	1.5 TXC Cycles + 15 ns		2.5 TXC Cycles + 40 ns

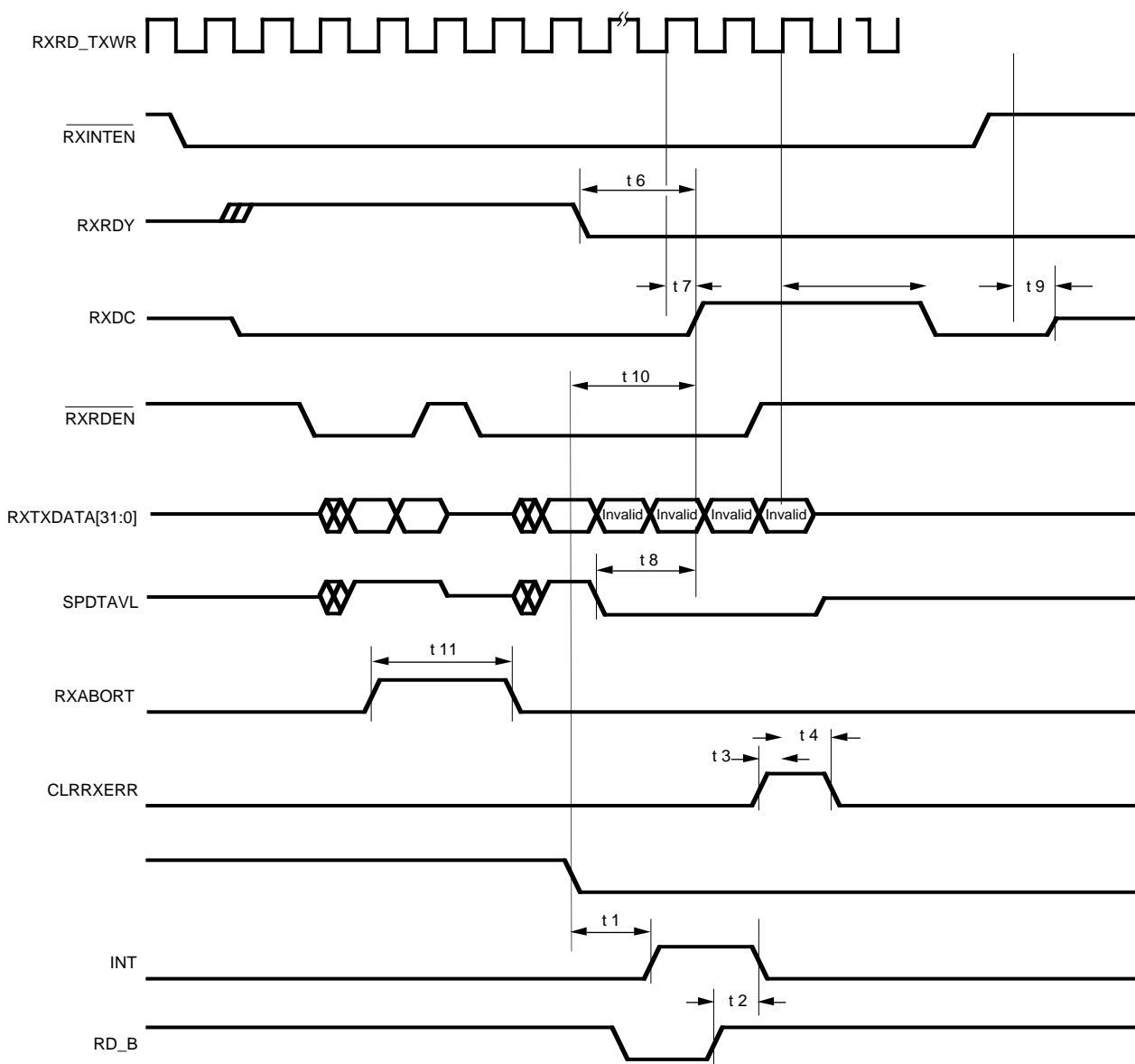
9.0 Transmit Data Timing On Exception Conditions



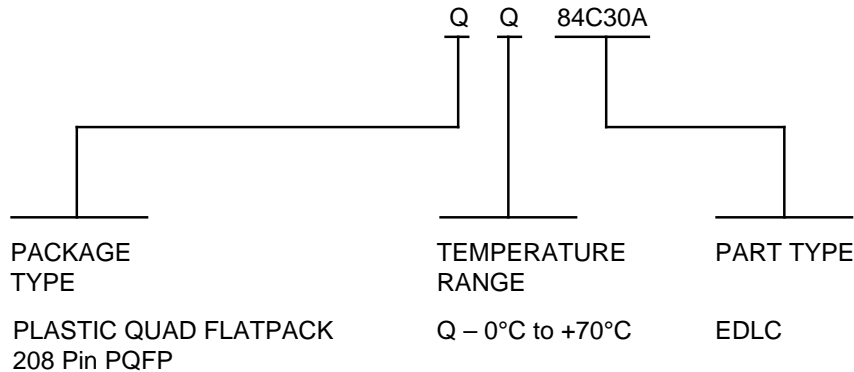
10.0 Receive Data Interface Timing on Exception Conditions

Symbol	Parameter	Min.	Typ.	Max.	Condition
t_1	Receive INT Delay Due to Shortframe, CRC, Good Frame, or Oversized Packet	2 RXC Cycles + 15 ns		2 RXC Cycles + 40 ns	
	Receive INT Delay Due to Overflowed Packet	2 RXC Cycles + 15 ns		18 RXC Cycles + 40 ns	
t_2	INT Clear Delay	1.5 RXC Cycles + 15 ns		2.5 RXC Cycles + 40 ns	
t_3	CLRRXERR Setup Time to RXRD_TXWR	6 ns			
t_4	CLRRXERR to RXRD_TXWR Hold Time	0 ns			
t_5	CLRRXERR High to RXDC Low Delay	1 RXC Cycle + 3 RXRD_TXWR Cycles + 6 ns		2 RXC Cycles + 4 RXRD_TXWR Cycles + 27 ns	
t_6	RXRDY Deassert Due to Discard to RXDC High Delay	5 ns		1 RXRD_TXWR Cycle + 11 ns	
t_7	RXRD_TXWR to RXDC Delay	9 ns		37 ns	
t_8	SPDTAVL Deassert Due to Discard to RXDC High Delay	5 ns		1 RXRD_TXWR Cycle + 13 ns	
t_9	RXRD_TXWR to RXDC Hi-Z	3 ns		11 ns	
t_{10}	CSN Deassert to RXDC High Due to Shortframe Error, CRC Error, or Receive Abort	2 RXC Cycles + 3 RXRD_TXWR Cycles + 9 ns		2 RXC Cycles + 4 RXRD_TXWR Cycles + 37 ns	
	CSN Deassert to RXDC High Due to Receive Overflow Condition	2 RXC Cycles + 3 RXRD_TXWR Cycles + 9 ns		18 RXC Cycles + 4 RXRD_TXWR Cycles + 37 ns	
t_{10a}	RXDC High From Point of Detection of Receive Packet with Greater than 1518 Bytes	2 RXC Cycles + 3 RXRD_TXWR Cycles + 9 ns		2 RXC Cycles + 4 RXRD_TXWR Cycles + 37 ns	
t_{11}	RXABORT Pulse Width	1.5 RXC			RXABORT is Asynchronously Asserted with Respect to RXC
	RXABORT to RXC Setup Time	5 ns			RXABORT is Synchronously Asserted with Respect to RXC
	RXC to RXABORT Hold Time	5 ns			

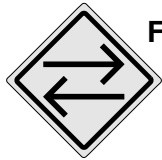
10.0 Receive Data Timing On Exception Conditions



Ordering Information



Full Duplex Designation



Full Duplex

Symbol identifies product as Full Duplex device.

Revision History

4/19/96

Page 20, Section 3.5.2:

- Using the 84C30A in 8 Bit or 16 Bit Mode, sub section has been added to this section.

Page 20, Section 3.5.3:

- The end of the second paragraph in this section has been replaced with the new sub section Using the 84C30A in 8 Bit or 16 Bit Mode.

Page 26: Receive Own Transmit Disable Mode has been deleted and replaced with new sub section Disable Loopback Mode and new table Configuration Register #1.

Page 27: Section 3.6.9 has been entirely replaced with new copy.

9/25/96

Page 31, AC Characteristics:

- TDBD (min) has been changed from 100 to 0.5 RXC/TXC Cycles + 10 ns.
- TDBD (max) has been changed from 200 to 1.5 RXC/TXC Cycles + 50 ns.
- TDBD, All Other Registers (min) is now 10.
- TDBR (min) has been changed from 7 to 1.5.
- TDBR (max) has been changed from 20 to 5.5.
- TDBS (min) has been changed from 10 to 6.
- TDBS (max) has been changed from 20 to 32.
- Symbol THAR has been changed to THA.
- THA Parameter has been changed from A₀₋₂/Reg PS[1:0] Hold to A[3:0] Hold.

Revision History

Page 31, AC Characteristics:

- Symbol *TSAR* has been changed to *TSA*.
- *TSA* Parameter has been changed from A_{0-2}/Setup to $A[3:0] \text{ Setup}$.
- *THCS* row is new.
- Symbol *TWCH* has been changed to *TRWH*.
- *TRWH* Parameter has been changed from $\overline{RD}/\overline{WR}$ High Width, to \overline{RD} High Width.
- *TRWH* (min) has been changed from 200 to 1 TXC/RXC Cycle.
- Symbol *TWCL* has been changed to *TRWL*.
- *TRWL* Parameter has been changed from $\overline{RD}/\overline{WR}$ Low Width to \overline{RD} Low Width.
- *TRWL* (min) has been changed from 200 to 1.5 TXC/RXC Cycles + 70 ns.
- *TWWH* row is new.
- *TWWL* row is new.

10/23/96

Page 4, Pin Description:

- Pin 35 Description now reads; This is the system clock acting as the chip's ...
- Pin 39 Description now reads; This is an active high output that can be used for validating reads from the receive FIFO during a read operation and preventing over writes to the transmit FIFO during a write operation. For further details, please refer to the Transmit Data Write timing and the Receive Data Read timing diagrams.

Page 12 - Section 2.0 Introduction has been deleted and replaced with new Section 2.0 Introduction.

Page 16 - Section 3.3.5 Second paragraph, now reads; Except for discards due to address mismatches and oversized packets, all packet ...

Page 24 - Format of the Status Double Word, illustration has been added.

Page 26 - Configuration Register #1 Illustration has been changed; now reads, Bit 5 = '1' Enables Full Duplex Mode [Bit 3 should be '0'].

Page 28-29 - In Sections: CRC Error Counter, Runt Frame Counter, Alignment Error Counter, Transmit Collision Counter, Receive Collision Counter; copy has changed ... To read this counter, two consecutive reads must be performed to the same address location. The first read, reads out the high byte and the second read, reads out the low byte. Upon reading ...

Page 30, DC Characteristics:

- Clock Input High Voltage (Limits Min.), has been changed from 3.5 to 4.0.

Pages 32 to 39, has been deleted and replaced with new Tables and Timing Diagrams, also the pagination has changed.

- Page 32, New Timing Diagrams, 5.01 Command/Status Interface Read Timing, and 5.02 Command/Status Interface Write Timing.
- Page 33, New Timing Diagrams, 6.01 Ethernet Transmit Interface Timing, and 6.02 Ethernet Receive Interface Timing.
- Page 33, New Table 6.0 Ethernet Transmit and Receive Interface Timing.
- Page 34, New Table, 7.0 Transmit Data Interface Timing.
- Page 35, New Timing Diagram, 7.01 Transmit Data Interface Write Timing 1.
- Page 36, New Timing Diagram, 7.02 Transmit Data Interface Write Timing 2.
- Page 37, New Table, 8.0 Receive Data Interface Timing.
- Page 38, New Timing Diagram, 8.01 Receive Data Interface Read Timing 1.
- Page 39, New Timing Diagram, 8.02 Receive Data Interface Read Timing 2.
- Page 40, New Table, 9.0 Transmit Data Interface Timing on Exception Conditions.
- Page 41, New Timing Diagram, 9.0 Transmit Data Timing on Exception Conditions.
- Page 42, New Table, 10.0 Receive Data Interface Timing on Exception Conditions.
- Page 43, New Timing Diagram, 10.0 Receive Data Timing on Exception Conditions.

12/5/96

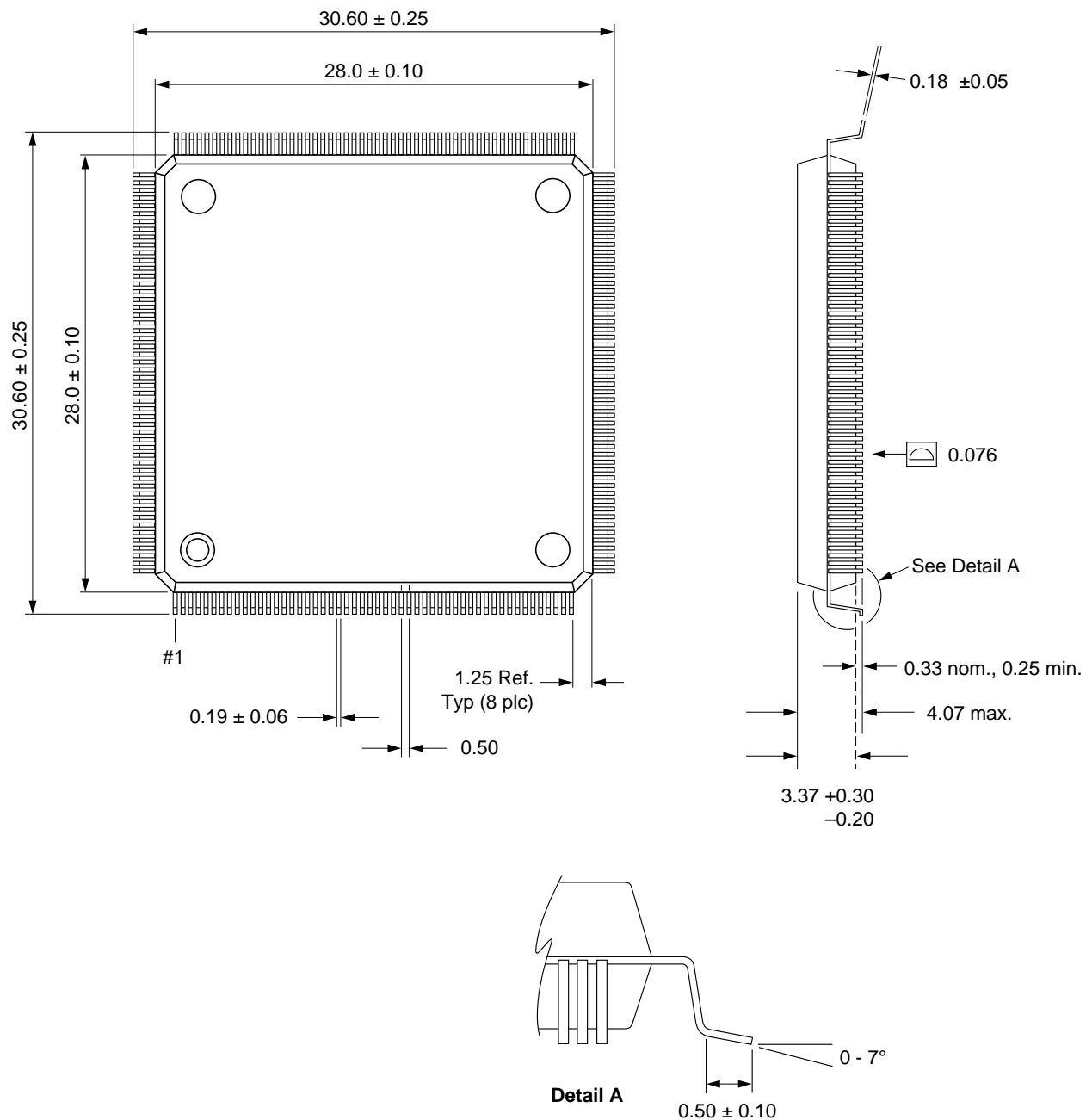
Page 17; Internal Port Register Addressing Table

- Register Description Read, Dribble Error Counter has been changed to Alignment Error Counter.

Page 46; 208 Pin PQFP Dimension Diagram, illustration has changed.



208 Pin PQFP



1. All dimensions are in millimeters.