TC3196N

ETHERNET COMBO TRANSCEIVER

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Ethernet Combo Transceiver

1. Features

- Compatible with IEEE 802.3 10BASET standards for Twisted-pair (TP) interface
- Supports Full-Duplex Ethernet function to double channel band width
- Interface to TMI TC3092HN module, can compatible with IEEE 802.3 standards for 10BASE5, 10BASE2 (cheapernet)
- Auto detect media interface TP, COAX transceiver (from TMI TC3092HN module)
- Jabber timer function included
- Externally selectable Heartbeat function disable or enable
- Squelch circuitry at all inputs rejects noise
- Internal predistortion generation
- LED driver for transmit, receive, collision, link indicators
- Fully integrated link test logic
- Auto polarity detect and correction
- 52 pin QFP package
- Single+ 5V power supply, CMOS technology
- TP/COAX signal converter

2. General Description

The TC3196N TP & COAX Transceiver Interface is a coaxial cable or twisted pair line driver/receiver for Ethernet. The chip also includes functions for IEEE 802.3 10BaseT standards. TC3196N has digital functions to interface TC3092HN analog module, so can compatible with IEEE 802.3 standards for 10Base2 (cheapernet).

2.1 10BaseT Mode

In 10BaseT unshielded Twisted Pair Mode, the transmit and receive signals are separated, and collision is indicated by simultaneous transmission and reception on the 2 pair of twisted pair cables. Auto signal polarity detector function is included, and polarity correction is done internally in case of reversal.

2.2 Full-duplex function

The full-duplex function enables simultaneously transmission and reception on twisted-pair link to a full-duplex Ethernet switching HUB.

2.3 COAX Mode

TC3092HN supplys isolation from coax cable and converts digital signal to analog signal. TC3196N implements digital functions for jabber timer, collision detector, receive and transmitter. During transmitting a jabber timer is initiated to disable the transmitter in the event of a longer than legal length data packet. Collision Detector circuitry monitors the signal on the coax to determine the presence of colliding packets and signals the DTE in the event of the collision.

2.4 TP/COAX Signal Converter

When the converter function enabled, it convert 10BaseT signal into 10Base2 signal to connect coaxial cable.

2.5 Auto Switch Function

The chip can detect which mode in use among the 10Base2, 10Base5, and 10BaseT modes, by checking each port for connectivity and switching accordingly. When no cable is connected, it defaults to 10Base2. When all cables are connected, 10BASET has the highest priority. The following Table shows the details :

TC3196N FUNCTIONAL DEFINITION TABLE

LINKLOSS = 1...Twisted-Pair Not Connected

= 0...Twisted-Pair Connected

RESULT	LINKLOSS	AUICB
10BASET	0	1
10BASE2	1	1

10BASET = TP Transceiver

10BASE2 = COAX Transceiver

AUICB = 1...Enable Transceiver

= 0...Disable Transceiver

3. Functional Description

Logic blocks of TC3196N, as follow :

⇒ The Oscillator
⇒ The Receiver (coax)
⇒ The Transmitter (coax)
⇒ The Collision Detect Circuitry
⇒ The Jabber Timer
⇒ The Differential Driver/Receiver
⇒ The Coaxial Cable Signal converter and Isolator
⇒ The Receiver-(Twisted Pair) with polarity reversal capacity
⇒ The Transmitter (Twisted Pair) with pre-distortion
⇒ LED status logic
⇒ Full-Duplex Control Logic
⇒ TP/COAX Converter

3.1 OSCILLATOR

The oscillator is controlled by a 20MHz parallel resonant crystal connected between X1--and X2 or by external clock on X1. The 20MHz output of the oscillator is divided by 2 to generate the 10MHz transmit clock for the controller. The oscillator also provides internal clock signals to the encoding and decoding circuits.

The 20mhz crystal connection to TC3196N requires special care. The IEEE802.3 requires a 0.01% absolute accuracy on the transmitted signal frequency. Stray capacitance can shift the crystal's frequency out of range, causing the transmitted frequency to exceed its 0.01% tolerance.

CRYSTAL SPECIFICATION	
Resonant Frequency	20MHz
Tolerance	±0.001% at 25℃
Stability	±0.005% 0-70℃
Type	AT-Cut
Circuit	Parallel Resonance

3.2 RECEIVER FUNCTIONS

The Receiver includes an input buffer, a squelch circuit.
The buffer provides high input impedance and low capacitance to minimize loading and reflections on the coax.
The squelch circuit prevents noise on the coax from falsely triggering the Receiver in the absence of the signal.

3.3 TRANSMITTER FUNCTIONS

The transmitter has a differential line driver and a squelch circuit.
The differential line driver transfers the MOS level signals to the ECL level for the coax transmitting.
The Transmitter squelch circuit rejects noise caused by internal or external disturbance to ensure correct transmitting to the coax.

3.4 COLLISION FUNCTIONS

The collision circuitry consists of a comparator, a heartbeat generator, and a 10MHz oscillator.
The collision comparator monitors the signal from the Receiver. If the Receiver is active, the collision detect function is enabled after a few cycles. At the end of every transmission, the heartbeat generator creates a pseudo collision for a short time to ensure that the collision circuitry is properly functioning. This burst on collision output occurs typically 1.1 uS after the transmission, and has a duration of about 1 uS. The function can be disabled externally wish the HBE (Heartbeat Enable) pin to allow operation with repeaters. The 10MHz oscillator generates the signal for the collision and heartbeat functions. It is also used as the timebase for all the jabber functions.

3.5 JABBER FUNCTIONS

The jabber Timer monitors the Transmitter and inhibits transmission if the Transmitter is active for longer than 26mS (fault). It also enables the collision output for the fault duration. After the fault is removed, the Jabber Timer waits for about 500mS (unjab time) before re-enabling the Transmitter. The transmit input must stay inactive during the unjab time.

3.6 DIFFERENTIAL LINE DRIVER/RECEIVER

The Differential Line Drivers and Receivers are used in the separate mode to transmit ECL level signal to the transceiver cable and receive ECL level signal from the transceiver cable for he ETHERNET applications.

3.7 COAXIAL CABLE SIGNAL CONVERTER AND ISOLATOR (TC3092HN)

The converter and isolator block provides necessary signal conversion and power isolation. An ECL-like signal on the coaxial cable is converted into a CMOS compatible signal for internal processing purpose. Power isolation is also done within this block to avoid any ground current or damage due to potential difference.

3.8 THE TWISTED PAIR RECEIVER (WITH POLARITY REVERSAL CAPABILITY)

In 10BaseT mode, the signal comes in through an internal filter to the receiver. A squelch function distinguishes noise from link pulses and valid data streams.
Only valid data activates the receiver. In case of polarity reversal of the incoming data, the receiver can detect the situation and reverse the connection internally to maintain a valid reception situation.
This feature safeguards a possible field mistake and is thus foolproof.

3.9 THE TRANSMITTER (TWISTED PAIR) WITH PREDISTORTION

The output signal is pre-distorted to meet 10BaseT jitters Template, and then going through an external filter to meet FCC requirements. During idle periods, the transmitter sends out link integrity test pulses.

3.10 LED STATUS LOGIC

4 LED Driver circuits are provided to give status indication on Transmission, Reception, Collision and Link integrity.

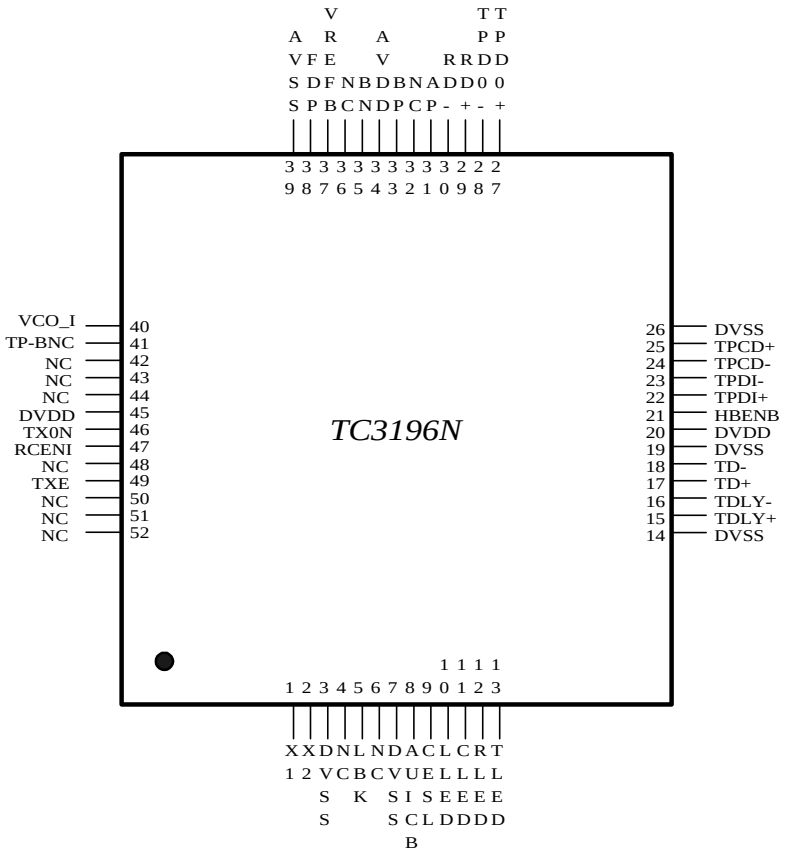
3.11 FULL-DUPLEX CONTROL LOGIC

When TC3196N is set to the full-duplex mode, which disable collision output and internal loopback.

3.12 TP/COAX CONVERTER

When TC3196N is in TP/COAX converter mode, the AUI interface will be disabled. A single TC3196N is sufficient to convert from 10BaseT signals in twisted pair cable to 10Base2 signals in coaxial cable.

TC3196N Connection Diagrams (52 QFP)



4. Pin Description

(1 of 2)

Pin No.	Pin Name	I/O	Description
1	X1	I	Crystal or external clock source input (20MHz)
2	X2	O	Crystal feedback output, this output is used in the crystal connection
5	LBK	I	Loopback mode, active high, always connect to GND
8	AUICB	I	High to enable 3196N transceiver, low to disable
9	CESL	I	Cheapnet/Ethernet selection, always connect to GND
10	LLED	O	Link pulse LED. During link loss, output high
11	CLED	O	Collision detect LED

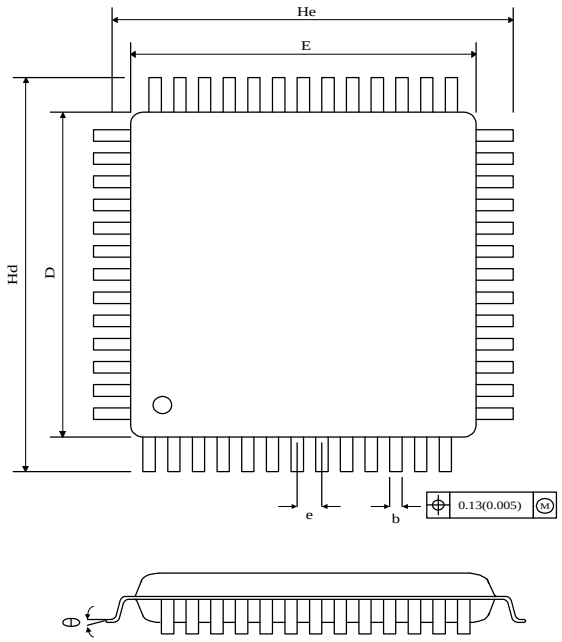
(2 of 2)

Pin No.	Pin Name	I/O	Description
12	RLED	O	Receiver LED, During Receiving, output pulse low
13	TLED	O	Transmit active LED, During transmitting, output pulse low
15,16	TDLY+/-	O	Predistortion control for twisted pair
17,18	TD+/-	O	Twisted pair transmit driver
21	HBENB	I	Heartbeat (SQE) signal low enable
22,23	TPDI+/-	O	For MAU application, Differentially drived transmit to AUI cable
25,24	TPCD+/-	O	For MAU application, Differentially drived collision to AUI cable
27,28	TPDO+/-	I	For MAU application, Differentially drived receive signal from AUI cable
29,30	RD+/-	I	10Base-t receive signal from RJ45 Phone Jack
31	AP	I	Coax Mode, receive buffer input
33,35	BP/BN	I	Coax Mode, collision detect buffer input
37	REFB	O	DC voltage Bias for detecting collision
38	FDP	I	When this pin is low, TC3196N is set to the full-duplex mode which enables simultaneously transmission and reception on twisted pair link to a full-duplex Ethernet switching HUB.
41	TP-BNC	I	When this pin is low, TC3196N is set to the TP/COAX converter.
40	VCO-I	I	Filter input for data recover analog PLL
46	TXON	O	For COAX Mode, Transmit digital output to TC3092HN
49	TXE	I	Transmit ebable signal from controller, always connect to GND
34	AVDD		Analog power, 5V
39	AVSS		Analog ground
20,45	DVDD		Digital power, 5V
3,7,14,19,26	DVSS		Digital ground
OTHERS			Test pin for TMI, do not connect

5. Absolute Maximum Ratings

Power Supply Voltage	-0.5V	to	7V
Input Voltage (TTL)	0V	to	5.5V
Input Voltage (Differential)	-5.5V	to	16V
Output Voltage (Differential)	0V	to	16V
Output Current (Differential)			40mA
Storage Temperature	-40°C	to	125°C
Package Power Rating at 25°C			TBD

6. Physical Dimensions



SYMBOL	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A_1	0.05	0.25	0.50	0.002	0.010	0.020
A_2	1.90	2.05	2.20	0.075	0.081	0.087
b	0.20	0.30	0.40	0.008	0.012	0.016
c	0.10	0.15	0.20	0.004	0.006	0.008
D	9.90	10.00	10.10	0.390	0.394	0.398
E	9.90	10.00	10.10	0.390	0.394	0.398
e		0.65			0.026	
Hd	13.65	13.90	14.15	0.537	0.547	0.557
He	13.65	13.90	14.15	0.537	0.547	0.557
L	0.65	0.80	0.95	0.025	0.031	0.037
L_1		1.95			0.077	
Y			0.08			0.003
θ	0		10	0		10

7. D.C. Characteristics

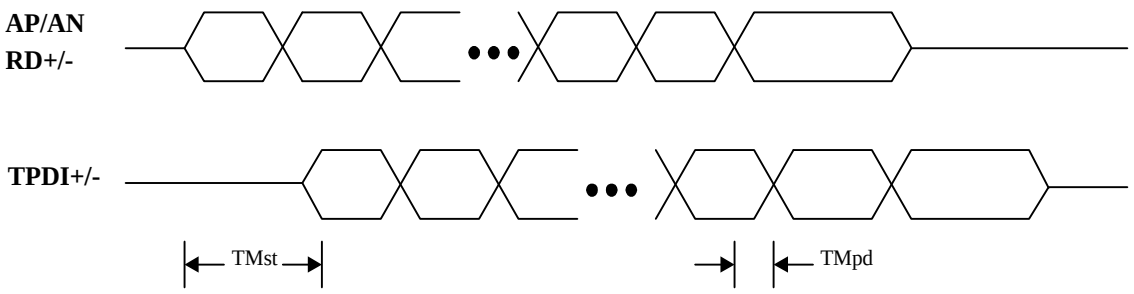
Symbol	Parameter	Min.	Max.	Units	Conditions
VIL	INPUT LOW VOLTAGE	VSS	0.8V	V	VCC=5V
VIH	INPUT HIGH VOLTAGE	2.0	VCC	V	VCC=5V
IIL	INPUT LOW CURRENT	-	0.5	uA	VIN=1.0V
IIH	INPUT HIGH CURRENT	-	20	uA	VIN=VCC
VOL	OUTPUT LOW VOLTAGE	-	0.4	V	IOL=8.0mA
VOH	OUTPUT HIGH VOLTAGE	2.4	-	V	IOH=4.0mA
ICC	SUPPLY CURRENT	20	70	mA	

8. Timing Characteristics

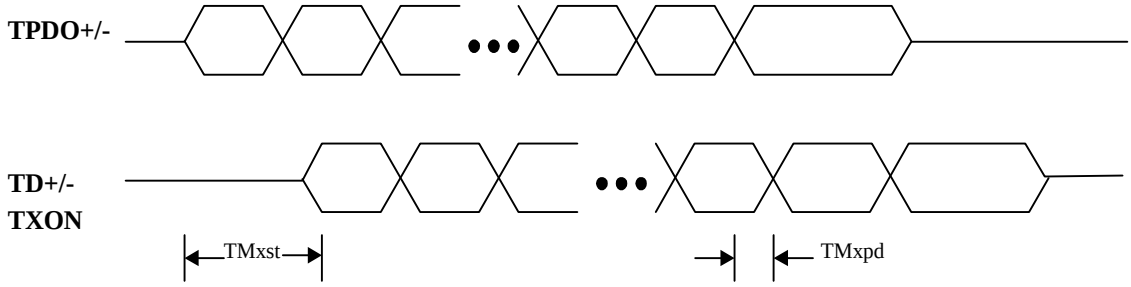
TABLE 1. TIMING FOR MAU APPLICATIONS

Symbol	Parameter	Min.	Typ.	Max.	Units
TMst	Receive start delay		450	900	ns
TMpd	Receive propagation delay		25	50	ns
TMxst	Transmit output start delay		175		ns
TMxpd	Transmit output propagation delay		25	50	ns
TMcon	Collision turn on delay time		50		ns
TMcoff	Collision turn off delay time		350		ns

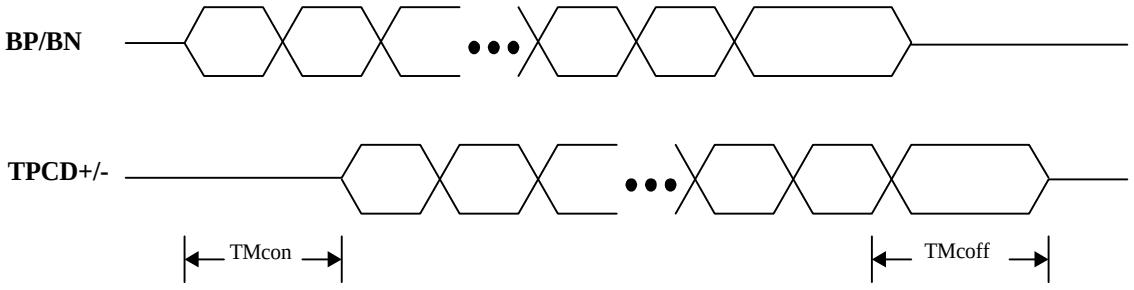
TIMING FOR MAU APPLICATION



Receive Timing for Ns mode



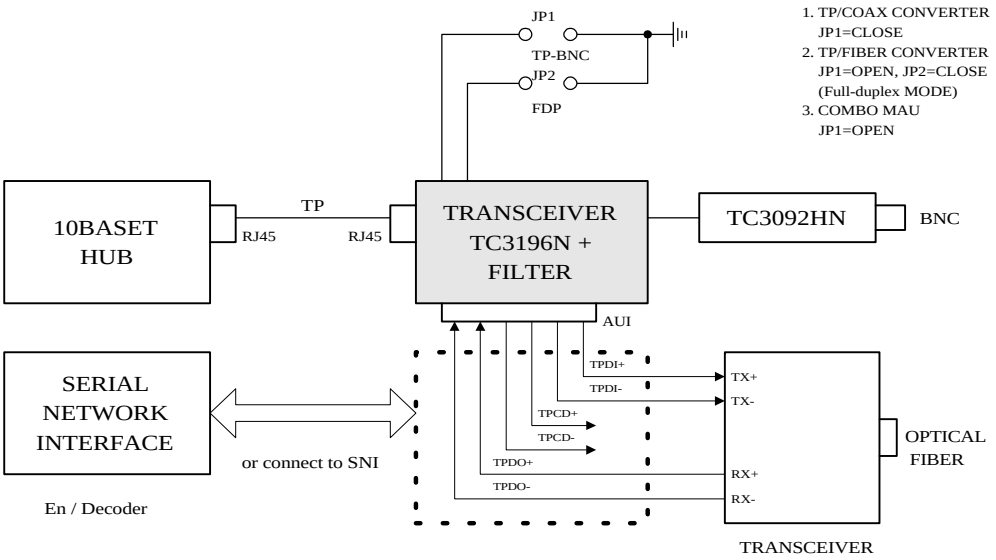
Transmit Timing for NS mode



Collision Timing for NS mode

9. TC3196N Application Diagram

TC3196N APPLICATION BLOCK DIAGRAM



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