



## TRANSCEIVER FOR COAXIAL CABLE (TCC)

### GENERAL DESCRIPTION

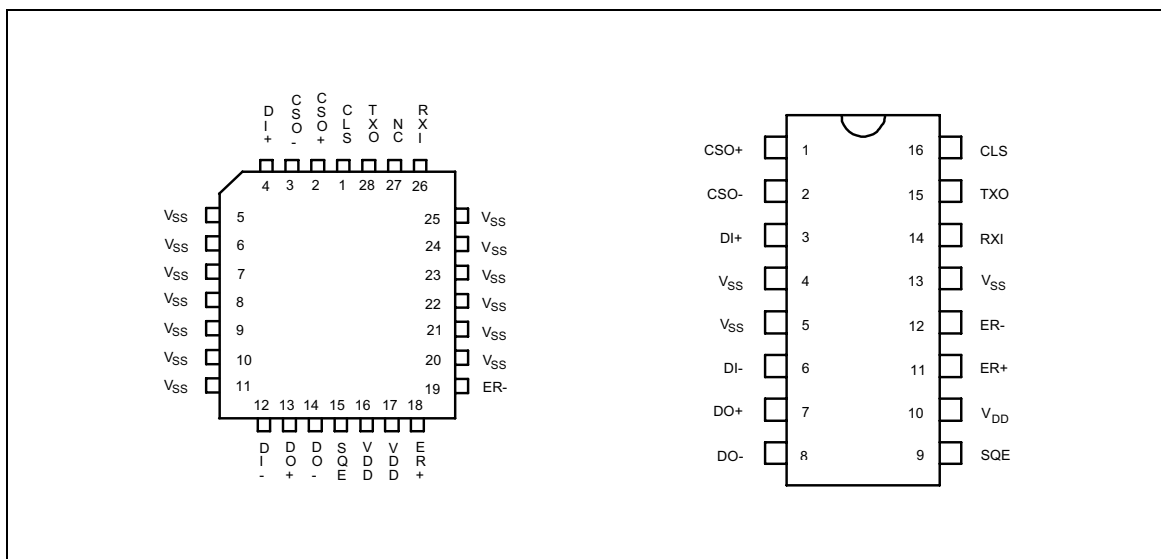
The W89C92 Transceiver for Coaxial Cable (TCC) serves as an interface between the Attachment Unit Interface and coaxial cable and implements the MAU functions required by a 10BASE2 or 10BASE5. The W89C92 provides transmit, receive, jabber lockup, SQE test, and collision presence functions.

The W89C92 provides a functional solution for a 10BASE2 or 10BASE5 MAU. The power isolation requirement of the MAU is met by using a DC-to-DC converter and a one-to-one ratio transformer.

### FEATURES

- Compatible with IEEE 802.3 10BASE2 and 10BASE5
- CMOS process provides low power consumption
- Mixed-mode circuit design integrates all transceiver electronics except signal and power isolation and minimizes external component count
- On-chip jabber timer and state machine meet the requirements for IEEE 802.3 MAU function
- External selective SQE test function allows operation with IEEE 802.3 compatible repeater
- Precision detection circuit design implements transmit mode collision detection
- External selective jabber lockup function allows infinite data transmission
- Standard 16-pin DIP and 28-pin PLCC package provide easy implementation of a MAU

### PIN CONFIGURATIONS





## PIN DESCRIPTION

### Attachment Unit Interface Pins

CSO+, CSO- (DIP 1, 2/PLCC 2, 3) (O/P): Collision Output Positive, Collision Output Negative

CSO+/CSO- are a differential signal pair that drives 10 MHz signals to the DTE (data transmit equipment) when a collision is detected on the segment, the DTE transmits an excessively long packet, or the cable is disconnected. CSO+/CSO- are also active for a period of time after the end of every transmission. CSO+ and CSO- should be pulled down by a 510 ohm resistor.

DI+, DI- (DIP 3, 6/PLCC 4, 12) (O/P): Data-in Output Positive, Data-in Output Negative

DI+/DI- are also a differential signal pair. Signals received from the network segment that meet the bandwidth requirement and carrier sense levels will be transferred into differential format and driven out from DI+/DI-. A 510 ohm pull-down resistor is also required for DI+/DI-.

DO+, DO- (DIP 7, 8/PLCC 13, 14) (I/P): Data-out Input Positive, Data-out Input Negative

Data transmitted from the DTE are received on DO+/DO- and transferred into a current signal on the coaxial cable.

### Coaxial Media Interface Pins

TXO (DIP 15/PLCC 28) (O/P): Transmit Output

The current signal on the coaxial cable is sunk into TXO. TXO is pulled up to VDD internally. A diode should be used to isolate the TXO capacitance loading from the coaxial cable.

RXI (DIP 14/PLCC 26) (I/P): Receive Input

The signal on RXI is filtered by a low-pass filter and transferred to DI+/DI- with differential format. The RXI should be connected directly to the coaxial cable.

CLS (DIP 16/PLCC 1) (I/P): Collision Sense Input

The collision detection threshold is determined by the level of the CLS pin. The transmit mode collision detection of 10BASE2 is implemented when CLS is connected directly to VDD.

### Control Pins

ER+, ER- (DIP 11, 12/PLCC 18, 19) (I/P): External Resistor Positive, External Resistor Negative

A fixed 1K 1% ohm resistor should be connected between ER+ and ER- to establish the internal operating current.

SQE (DIP 9/PLCC 15) (I/P): Signal Quality Error Test

The signal quality error test will be enabled when SQE is tied to VDD. The jabber lockup function can be disabled by changing the SQE bias.

### Power Pins

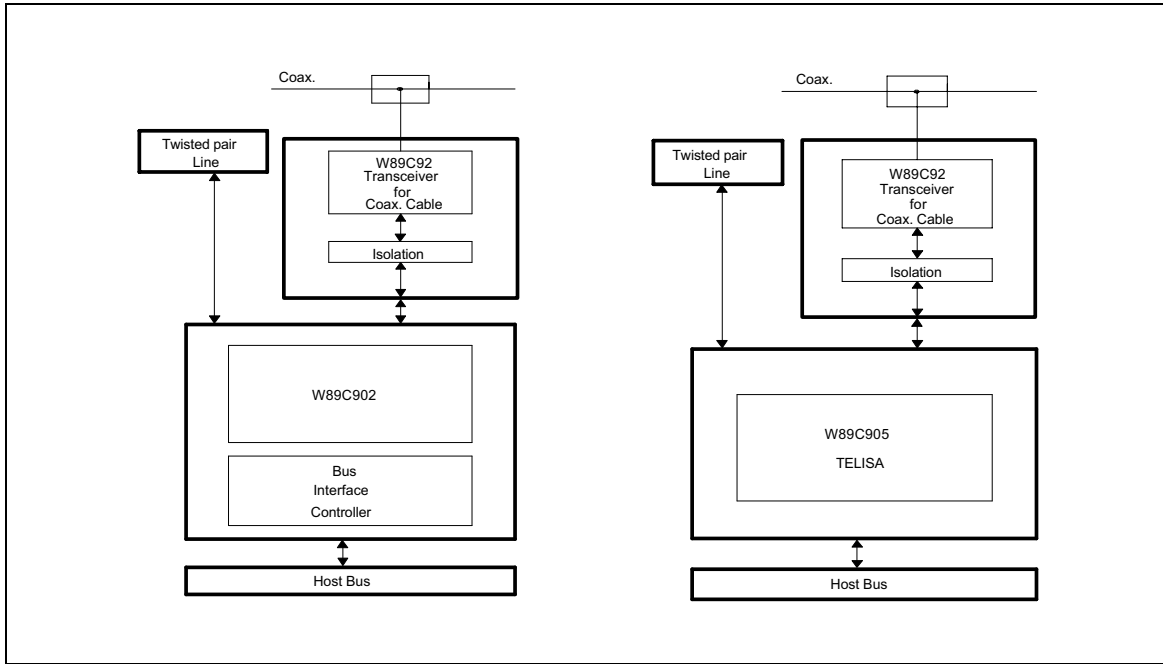
VDD (DIP 10/PLCC 16, 17) (I/P): Positive Power Supply

A9 VDC power supply is needed.

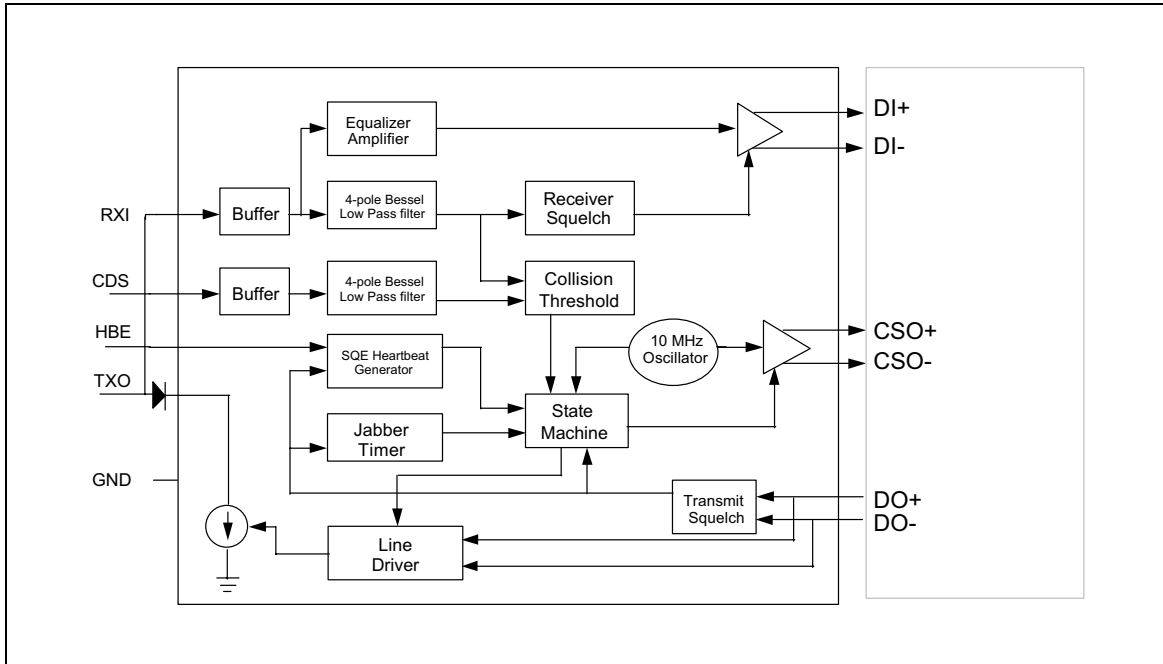
VSS (DIP 4, 5, 13/PLCC 5 to 11, 20 to 25) (I/P): Negative Power Supply



**SYSTEM DIAGRAM**



**BLOCK DIAGRAM**





## FUNCTIONAL DESCRIPTION

### Transmit Function

The W89C92 transmits data received from the DTE onto the coaxial cable in a current format. The signal current is sunk from the coaxial cable. The internal current control switch responds to the activity of the DTE (DO+/DO-) output data. DTE differential output signals meeting the squelch threshold will be decoded into digital signals without logical inversion to control the internal current switch. The transmitter output is pulled up to VDD when the current sink source is turned off.

### Receive Function

The W89C92 translates signals on the coaxial cable into differential signal format and sends the data to the DTE. The AC component of the coaxial cable signal carries the data message and is converted into a digital signal format. The differential pair driver (DI+/DI-) then sends a differential signal corresponding to the AC signal on the coaxial cable. The receiver of the W89C92 receives the signal on the coaxial cable regardless of whether the signal is sent by the W89C92 itself or by another MAU. The receiver of the W89C92 performs a loopback function when the W89C92 is transmitting.

### Jabber Lockup Function

The W89C92 will inhibit its transmitter when the transmitter is activated for a time longer than the jabber activation delay. Excessively long packets sent from the DTE cannot be sent out completely if the packet length exceeds the jabber activation delay. The jabber lockup function protects the network segment from a malfunctioning station or invalid traffic requirements. The jabber lockup function can be disabled for certain special applications, such as when an infinite data packet is to be transmitted. In a 9V DC power system, the jabber lockup function may be disabled by setting the SQE pin to between -3.4V and -5.4V.

### Collision Presence Function

A collision condition occurs when two or more stations are transmitting data at the same time. The W89C92 detects collision conditions by monitoring the DC level of the signal on the coaxial cable. A signal with a DC level lower than the collision threshold forces the W89C92 to send the collision signal (a 10 MHz differential signal) on CSO+/CSO-. The collision detection scheme of the W89C92 meets the transmit mode requirements specified by the IEEE 802.3 10BASE2 MAU function. The CSO+/CSO- differential pair driver is also active when the coaxial cable is disconnected.

### SQE Test Function

The W89C92 implements the SQE test function by sending out a collision signal from CSO+/CSO- for a short time CSO+/CSO- after the end of every transmission. The SQE test function can be disabled to meet the IEEE 802.3 repeater unit requirements. The SQE test function remains enabled when the jabber lockup function is disabled.

## ABSOLUTE MAXIMUM RATINGS

SYMBOL	DESCRIPTION	MIN.	TYP	MAX.	UNIT
TA	Ambient temperature	0	-	70	°C
Ts	Storage temperature	-65	-	150	°C
VSS	Supply voltage	-	-	-12	V
VIN	Input voltage	0	-	-12	V

Note: Exposure to conditions beyond those listed under Absolute Maximum Ratings may adversely affect the life and reliability of the device.



## DC CHARACTERISTICS

(V<sub>SS</sub> = -9V ± 5%, T<sub>a</sub> = 0° C to 70° C) (Notes 1, 2)

SYMBOL	DESCRIPTION	MIN.	TYP	MAX.	UNIT
V <sub>CD</sub>	Collision threshold (in transmit mode)	-1.43	-1.53	-1.70	V
V <sub>DO</sub>	Differential output voltage	±500	±800	±1500	mV
V <sub>DOI</sub>	Diff. output voltage imbalance	-	-	±60	mV
V <sub>CMO</sub>	Diff. common mode output voltage	-3.0	-3.5	-4.0	V
V <sub>TS</sub>	DO+/DO- transmit squelch threshold	-175	-225	-330	mV
I <sub>SSN</sub>	Supply current out of V <sub>SS</sub> (non-transmitting)	-	-80	-100	mA
I <sub>SST</sub>	Supply current out of V <sub>SS</sub> (transmitting)	-	-120	-150	mA
I <sub>RXI</sub>	Receive input bias current	-1	-	+1	μA
I <sub>TDC</sub>	Transmit out current DC level	37	41	45	mA
I <sub>TAC</sub>	Transmit out current AC level	±30	-	±I <sub>TDC</sub>	mA
R <sub>RXI</sub>	RXI shunt resistance non-transmitting	-	5	-	MΩ
R <sub>TXO</sub>	TXO shunt resistance transmitting	7.5	10	-	KΩ
C <sub>RXI</sub>	RXI shunt capacitance	-	1.2	-	pF

## AC CHARACTERISTICS

(V<sub>SS</sub> = -9V ± 5%, T<sub>a</sub> = 0° C to 70° C) (Notes 1, 2)

SYMBOL	DESCRIPTION	MIN.	TYP	MAX.	UNIT
T <sub>CON</sub>	Collision turn-on delay	7	8	9	bits
T <sub>COFF</sub>	Collision turn-off delay			10	bits
F <sub>CD</sub>	Collision signal frequency	8		12	MHZ
T <sub>CP</sub>	Collision signal pulse width	35		70	nS
T <sub>SQEON</sub>	SQE test turn-on delay	0.6		1.4	μS
T <sub>SQED</sub>	SQE test duration	0.8	1.0	1.5	μS
T <sub>JA</sub>	Jabber activation delay	20		60	mS
T <sub>JR</sub>	Jabber recovery time	250		750	mS
T <sub>TST</sub>	Transmit start-up delay		1	2	bits
T <sub>TD</sub>	Transmit propagation delay		25	60	nS
T <sub>TR</sub>	Transmit rise time, 10% to 90%		25		nS
T <sub>TF</sub>	Transmit fall time, 90% to 10%		25		nS



## AC Characteristics, continued

SYMBOL	DESCRIPTION	MIN	TYP	MAX	UNIT
T <sub>TM</sub>	T <sub>tr</sub> and T <sub>tf</sub> mismatch		1		nS
T <sub>TS</sub>	Transmit skew		±1		nS
T <sub>TON</sub>	Transmit turn-on pulse width on DO+/- at V <sub>TS</sub>		20	50	nS
T <sub>TOFF</sub>	Transmit turn-off pulse width on DO+/- at V <sub>TS</sub>	140	250	360	nS
T <sub>RON</sub>	Receive turn-on delay		4	5	bits
T <sub>RD</sub>	Receive propagation delay		30	50	nS
T <sub>RR</sub>	Diff. output rise time		4		nS
T <sub>RF</sub>	Diff. output fall time		4		nS
T <sub>RJ</sub>	Receiver jitter		±2		nS

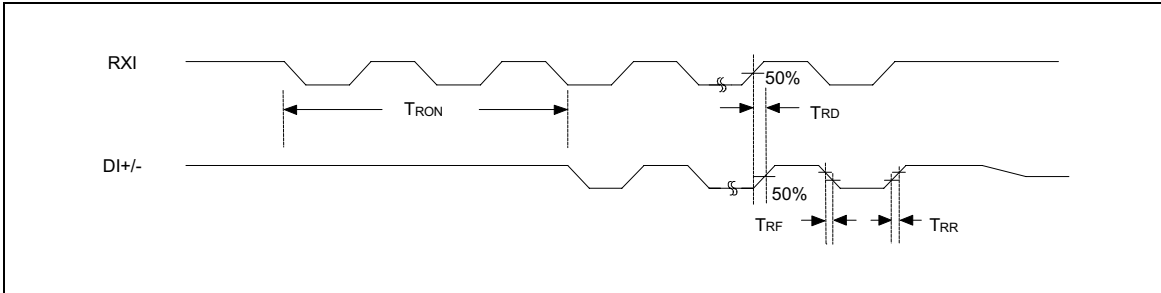
## Notes:

1. All voltages are referenced to ground. All currents into device pin are defined as positive.
2. All typical values are given for V<sub>SS</sub> = -9V and T<sub>a</sub> = 25° C.

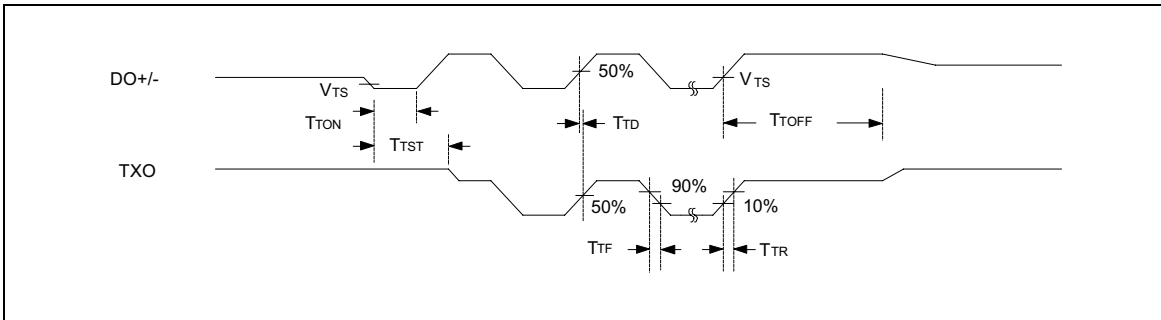


**TIMING WAVEFORMS**

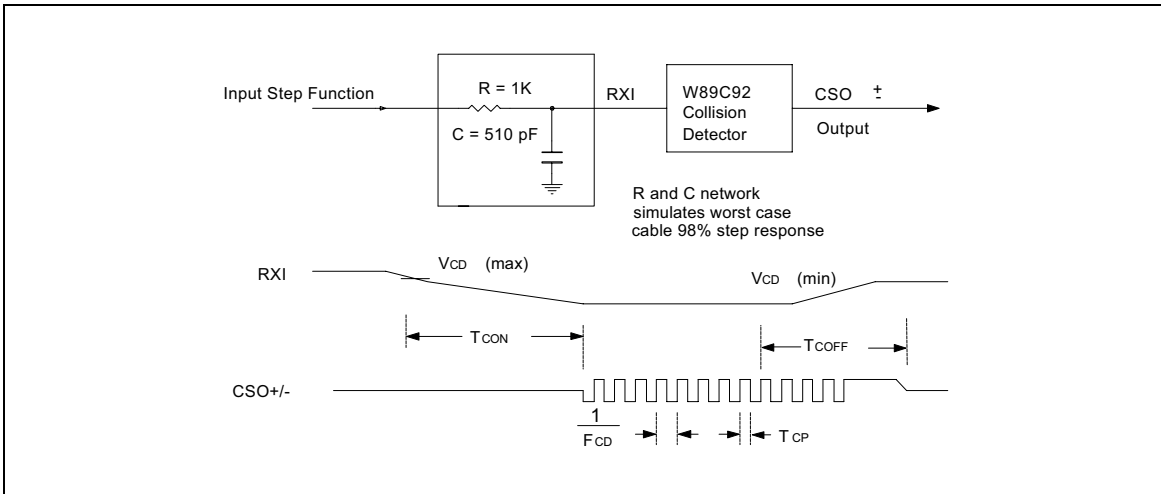
**Receiver Timing**



**Transmitter Timing**



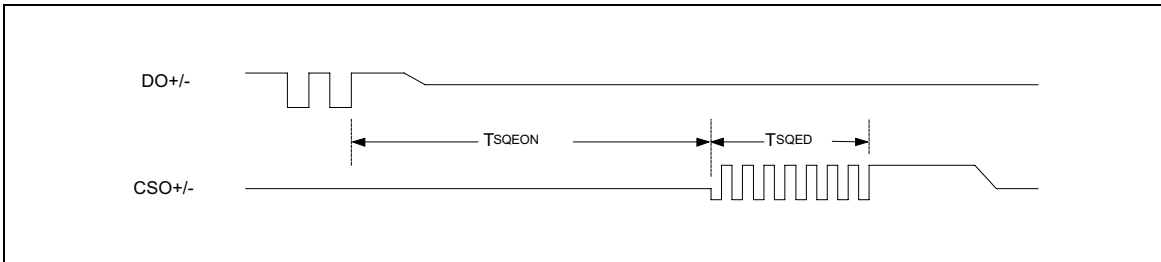
**Collision Timing**



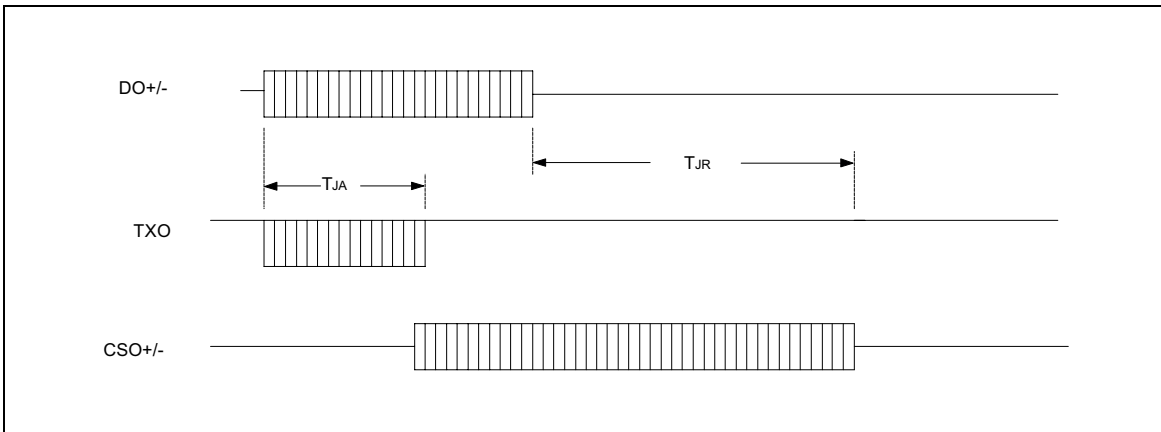


Timing Waveforms, continued

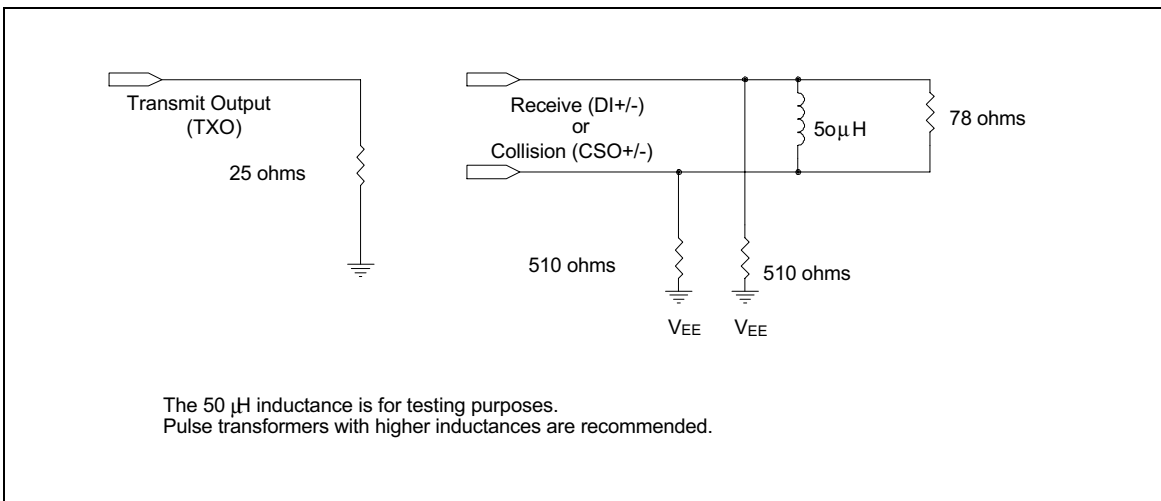
**SQE Test Timing**



**Jabber Lockup Timing**



**Test Load**

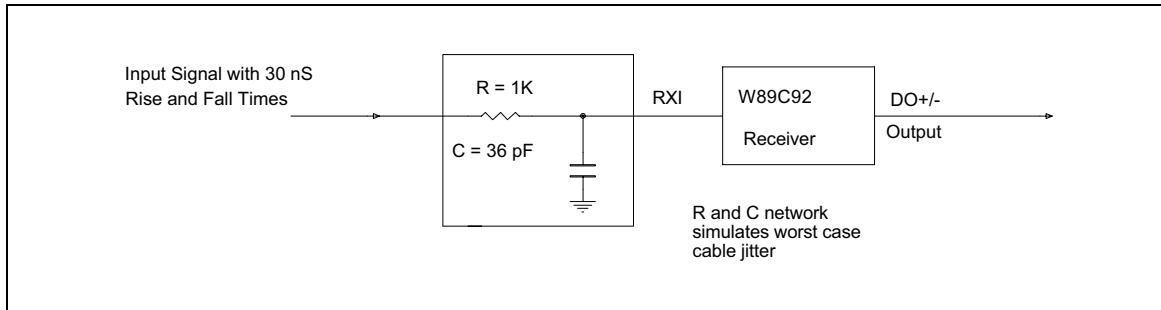






Timing Waveforms, continued

### Test Conditions



## APPENDIX

### External MAU Implementation

An external MAU can be implemented using the W89C92 and a 9V DC power supply, which may be a DC-to-DC converter. A 12V to 9V DC-to-DC converter is recommended for recovering the voltage drop through the 50-meter AUI twisted pair cable. A 0.1  $\mu\text{F}$  decoupling capacitor connected between the 9V output and ground of the converter is recommended.

The isolation requirement between DTE and MAU can be met using a one-to-one ratio pulse transformer or a set of coupling capacitors. Recommended transformers are Pulse Engineering #64103, Valor Electronics #1101, or an equivalent, and the recommended capacitor is 0.1  $\mu\text{F}/1\text{KV}$ .

The pull-down resistor for the differential output pair (CSO+/-, DI+/-) should be 500 ohms to drive the 78 ohm AUI twisted pair line with sufficient voltage swings. A 78 ohm resistor should be shunted between the differential receive pair (DO+/-) to match the impedance of the AUI cable. To establish the proper operating point of the W89C92, a precision 1K 1% ohm resistor should be connected between ER+ and ER-.

A voltage divider is used to program the SQE test function and the jabber lockup function. The SQE test function can be disabled by connecting SQE to Vss. The jabber lockup function is disabled when the SQE is set to between -3.4V and -5.4V. The CLS of the W89C92 should be connected to VDD to allow the W89C92 to detect collision conditions in transmit mode. Other settings on CLS will not guarantee that the W89C92 will detect collisions correctly.

A diode should be used to isolate the capacitance loading from the cable. The input capacitance of the 1N4148 diode is 2pF, which meets the input impedance required for the IEEE 802.3 10BASE5 MAU function. A 1M shunt resistor and a 0.01  $\mu\text{F}/1\text{KV}$  shunt capacitor between the coaxial cable ground and DTE ground will provide the DC and AC discharge path for the external MAU.

### Internal MAU Implementation

An internal MAU is embedded in the DTE, so the AUI cable and 78 termination resistor are not needed. A 5V to 9V DC-to-DC converter can be used as the power supply instead of the 12V to 9V converter.

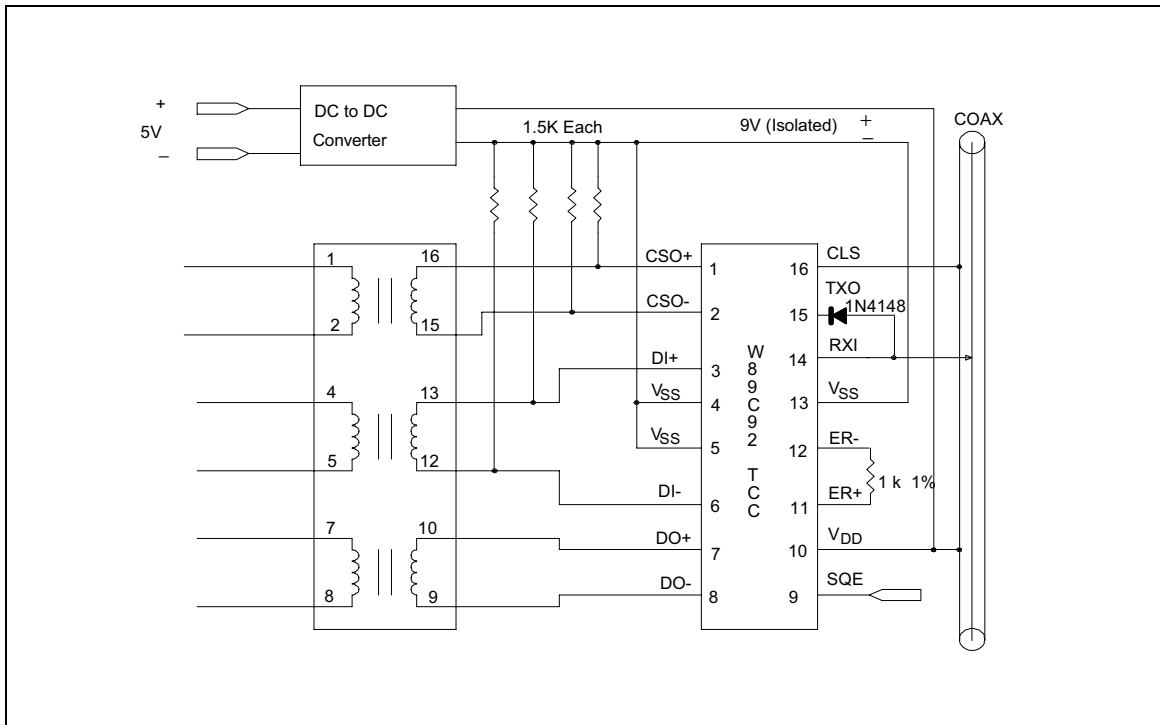


## PCB Layout Guidelines

(1) VDD and VSS should be connected to ground and a -9V DC copper plane, respectively, to dissipate the power heat. The overlapped power and ground copper plane form a coupling capacitor that can decouple high frequency noise on the power line. The -9V DC and ground must be as close as possible to VDD and VSS of the W89C92 to reduce line inductance. A good power plane layout will improve the MTBF of the W89C92.

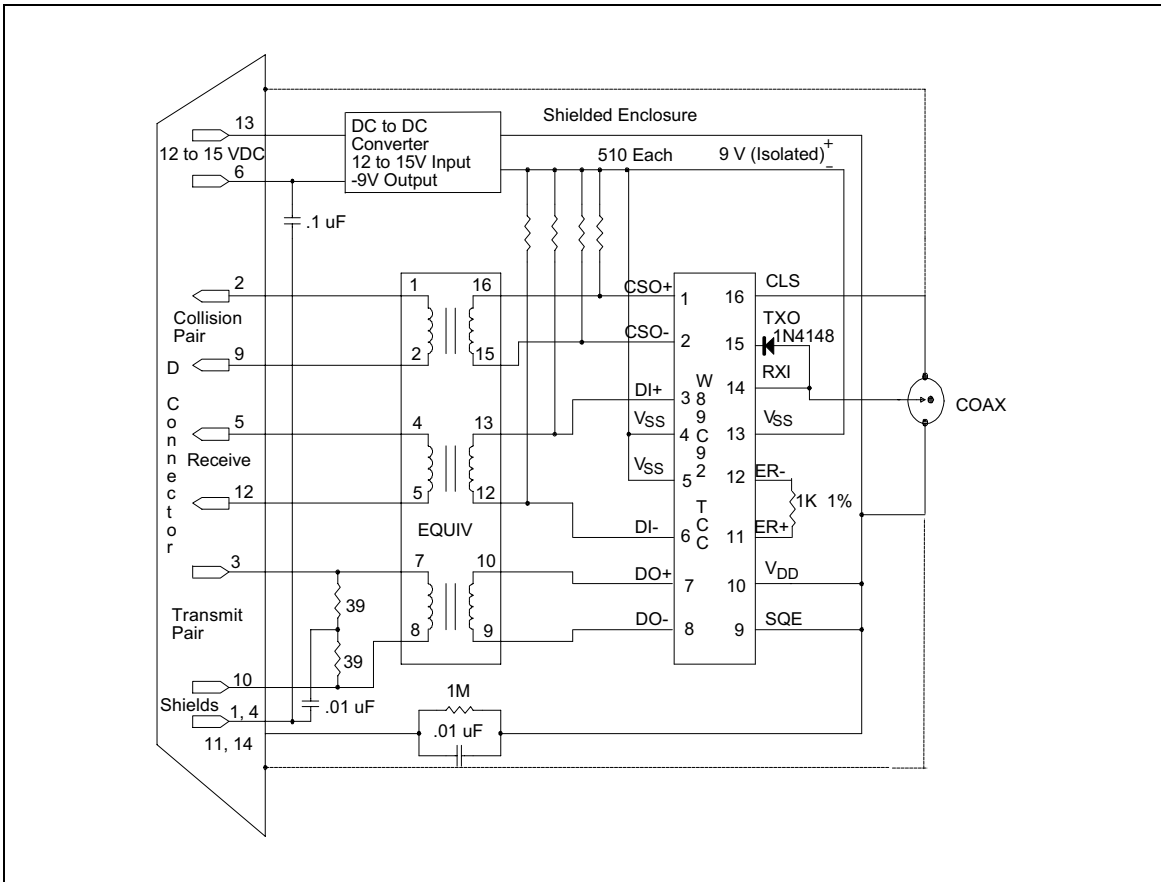
(2) The trace between the coaxial cable and RXI and the isolating diode should be made as short as possible. All the metal traces and the copper plane should be as far as possible from the RXI trace. A longer RXI trace will induce more shunt capacitance loading, while closer traces induce larger capacitance. This extra capacitance may overload the coaxial cable beyond the 2 pF stated in the IEEE 802.3 specification. The RXI trace should be made as thick as possible to reduce the line inductance. The maximum length of the RXI trace, 4 cm, is recommended.

## A Cheapernet MAU implementation with the TCC





An external MAU implementation with the TCC



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Note: All data and specifications are subject to change without notice.