Integrated 10BASE-FL Ethernet Transceiver

Features

- **Single chip Ethernet solution**
- **Complies with IEEE 802.3 10BASE-FL standard**
- **Pin compatible with the popular 4663**
- **110 mA LED current drive capability**
- **AUI interface allows both transformer and capacitive coupling**
- **Requires single 5 volt ±10% supply**
- **No external crystal or clock required**
- **Five network status LED pins**
- **28 pin PLCC package**
- **1 MHz idle signal, Jabber function, and SQE Test with enable/disable function integrated on chip**
- **Receive squelch function**
- **Integrated data quantizer**
- **Low power BiCMOS design**

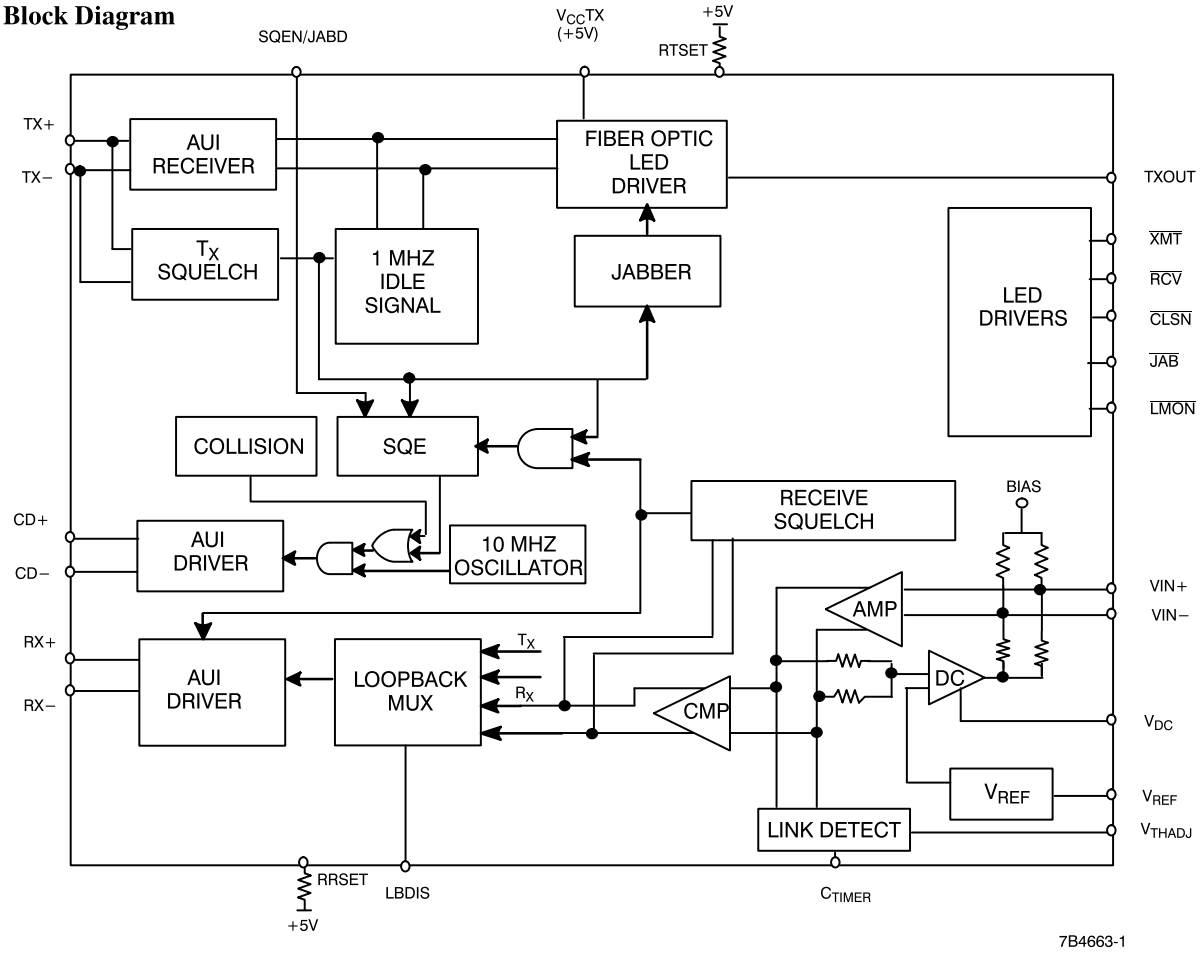
Functional Description

The CY7B4663 is a single chip solution low power fiber optic transceiver for 10BASE-FL applications. The CY7B4663 complies with IEEE 802.3 standards for fiber optic Ethernet.

The CY7B4663 has a current driven output which drives the fiber optic LED transmitter with a maximum current of 110 mA. The transmitter automatically inserts a 1 MHz signal during idle time. The 1 MHz idle signal, Jabber function, and SQE test are all internal functions of the chip. The receiver contains a data quantizer capable of accepting input signals as low as $2mV_{P-P}$ with a 55dB dynamic range.

The CY7B4663 is fabricated using an advanced, low power BiCMOS process. Typical standby current during idle is 35 mA.

Block Diagram



Pin Descriptions

CY7B4663

Pin Number	Name	Description
1	$\overline{CLSN}$	Active low LED driver which indicates that a collision is occurring. The collision event is extended with an internal timer for visibility.
2 3	CD+ CD−	AUI collision output pins. Differential driver that transmits a 10 MHz signal during collision events, jabber, and CD Heartbeat conditions. Also referred to as CI port.
4	C_{TIMER}	Tying a capacitor from this pin to V_{CC} determines the Link Monitor response time.
5	SQEN/JABD	SQE Test Enable, Jabber Disable. Tying this pin low disables the SQE test, tying high enables the SQE function. When tied between 1.5V and V_{CC}−2.0V both the SQE test and Jabber are disabled.
6 7	RX+ RX−	AUI receive output pins. Differential driver that outputs the signal received from the fiber optic. Also referred to as the DI port.
8	LBDIS	Loopback Disable. Tying this pin to VCC disables the loopback function. The AUI transmit pair data is not looped back to the AUI receive pair and the collision function is disabled. Tying this pin to ground or leaving it floating enables the loopback and collision functions.
9	V_{CC}	+5 volt supply.
10 11	TX+ TX−	AUI Transmit Input pins. Differential receiver that inputs the signal for transmission onto the cable.
12	RTSET	Sets the current level driven by the transmitter
13	RRSET	A 1% 61.9 kΩ resistor tied to V_{CC} sets the proper internal operating currents
14	$\overline{LMON}$	Active low LED driver indicating the Link Monitor status. If there are transitions on RXIN± indicating an idle signal or a packet transmission this pin will be pulled low. The threshold for input sensing by the Link Monitor circuitry is set with the V_{THADJ} pin.
15	$\overline{XMT}$	Active low LED driver which indicates that a transmission is occurring. The event is extended with an internal timer for visibility.
16	$\overline{RCV}$	Active low LED driver that indicates the transceiver is receiving a frame from the optical receiver. The event is extended with an internal timer for visibility.
17	V_{CC}TX	+5 volt supply for LED driver.
18	TXOUT	Fiber optic LED driver output.
19 20	GND GND	Ground Reference
21	V_{DC}	Tying a capacitor from this pin to ground alters the DC feedback loop pole. The value of this capacitor should be at least ten times larger than the input coupling capacitors.
22	V_{REF}	A 2.5V reference.
23	V_{THADJ}	Input pin which sets the link monitor threshold.
24	GND	Ground Reference
25 26	VIN− VIN+	These pins are capacitively coupled to the fiber optic receiver.
27	V_{CC}	+5 Volt Supply
28	$\overline{JAB}$	Active low LED driver. When Jabber occurs this pin is low to indicate the Jabber status.

CY7B4663 Description

The CY7B4663 contains:

1. Transmitter which drives the fiber optic LED.

2. Receiver with integrated quantizer which takes data from the fiber optic receiver module and passes it to the AUI.

3. AUI (Attachment Unit Interface) which consists of three signal pairs: the transmit pair, receive pair, and the collision pair.

4. Fiber media link monitor function with link status LED.

5. Collision, Loopback, Signal Quality Error (SQE) , and Jabber functions.

6. Five chip/system status LED pins with 10 mA nominal drivers.

Transmitter

The CY7B4663 transfers Manchester−encoded data from the AUI port of the DTE (TX+ and TX−) to the fiber optic media. The output meets IEEE 802.3 specifications for fiber optic Ethernet.

The fiber transmitter detects data on the TX± input and passes this data to the fiber media. If TX+ is positive with respect to TX−, then TXOUT is high impedance and no current flows through the transmitter. When TX+ is negative with respect to TX− then TXOUT will sink up to 110 mA of current into the

CY7B4663 and the fiber LED transmitter will light up. When in the non−transmitting state the CY7B4663 will transmit a 1 MHz link signal over the fiber network to maintain link integrity.

In order for data to be transferred from the AUI TX± inputs to the fiber output it must meet the squelch requirements for the DO pair. The squelch circuit prevents noise from reaching the LED driver. The circuit rejects signals with pulse widths less than 15 ns or smaller than (typically) 225 mV. After TX unsquelches it looks for the start of idle signal before turning on the squelch again. If the TX± signal exceeds 225 mV for more than 190 ns the squelch circuitry is turned on and the transmitter disabled.

Receiver

The CY7B4663 receiver has an integrated data quantizer which takes data directly from the fiber optic receiver. This data is sent out on the AUI over the RX± pins.

The device also contains an internal squelch function that discriminates noise from signal. The receive squelch will reject frequencies lower than 2.5 MHz, or any signal if the link monitor function indicates a link loss. When in the unsquelched state the receive circuitry looks for the start of idle signal. Any signal which exceeds 160 ns without transition will send the receiver into squelched state and the start of idle signal will be sent over the RX± AUI driver.

The V_{THADJ} pin can be used to adjust the sensitivity of the receiver. For 10BASE−FL V_{THADJ} can be tied directly to V_{REF} and achieve a bit error ratio of less than 1.0×10^{-9}. If greater sensitivity is desired a voltage divider can be used to adjust V_{THADJ}. The relationship between V_{THADJ} and V_{TH} is:

$$V_{THADJ} = 408V_{TH}$$

AUI Function

The AUI consists of three pairs of signals: TX±, RX±, and CD±. Manchester encoded differential data is sent from the MAC to the TX±. In the case of an external Medium Attachment Unit (MAU) the data is AC coupled through either an isolation transformer or through isolation capacitors. If the transceiver is internal the part may be either AC or DC coupled. Valid data from the fiber optic media is sent from the RX± differential pair to the DTE. In the case of a collision or Jabber the CD± drivers will send a signal to the MAC.

The AUI drivers are capable of driving a full 50 meters of AUI cabling. They have a typical rise and fall time of 4 ns. The RX± and CD± differential output voltage is minimized during idle time to prevent standing current in the isolation transformer.

Link Monitor Function

The link monitor function monitors the input signal voltage level and determines if it falls below a preset level. If the input voltage falls below a preset level the CY7B4663 enters the Low Light state. In this state the transmitter sends out the 1MHz link signal, but all data received at TX± is ignored. In addition, the loopback function and the receiver are disabled and the $\overline{\text{LMON}}$ LED pin goes high. To switch back to the Link Pass state the link monitor threshold must be exceeded by 20%. Once the CY7B4663 returns to Link Pass it waits 250ms to 750ms and then checks if TX± is idle and no data is being received before re−enabling the transmitter, loopback, and receiver, and bringing the $\overline{\text{LMON}}$ pin low.

Collision

If the transceiver is both receiving data and transmitting at the same time the collision AUI outputs will be activated. The collision ports will not be activated when the loopback is disabled. The collision signal consists of a 10 MHz −15%/+25% signal with a worst case 45/55 or 55/45 duty cycle. The collision signal is also activated during Jabber and at the end of packet for the SQE test.

Loopback

The CY7B4663 loopback function sends the transmit data from the DTE back over the AUI receive pair, RX±. Loopback can be disabled by tying LBDIS to V_{CC}. This allows the chip to act as a full duplex transmitter and receiver with collision detection disabled.

Heartbeat Test Function (SQE Test)

The Signal Quality Error (SQE) / Heartbeat function is enabled by tying the SQEN pin to V_{CC}. When enabled, a 10 MHz collision signal is transmitted to the MAC over the CD± pair after the transmission of a packet. The transmission lasts 10±5 BT. The heartbeat function should be disabled by tying the HBE pin to ground for repeater applications.

Jabber Function

The on chip timer prevents the DTE from locking up a network by transmitting continuously. When the transmission exceeds the jabber time limit, the Jabber function disables the transmitter and sends a 10 MHz signal over the CD± pair. Once the transmitter is in the jabber state, it must remain idle for 500 ms before it will exit the jabber state. The 1 MHz idle signal will be transmitted during jabber regardless of the transmitter being disabled. The jabber function is enabled by tying the SQEN/JABD pin to either VCC or ground. The function can be disabled by tying the pin between 1.5V and V_{CC}−2V.

LED Drivers

The CY7B4663 provides five LED status drivers. The LED drivers are active low, and the LEDs are normally off except for the $\overline{\text{LMON}}$ pin, which remains on until link is lost. The pins are tied to V_{CC} through the LED and a series 500Ω resistor.

Because the transmit, receive, and collision events occur so rapidly, the $\overline{\text{XMT}}$, $\overline{\text{RCV}}$, and $\overline{\text{CLSN}}$ pins have event extenders on them. The extenders allow the event to be visible. Whenever a transmission, reception, or collision occurs the respective pin will be visible for a typical period of 16 ms. If the event is repeated before the 16 ms period expires, the timer is reset and the LED timing period is restarted. The $\overline{\text{JAB}}$ and $\overline{\text{LMON}}$ LEDs do not have event extenders because they occur for a long enough period to be visible to the user.

Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested)

Storage Temperature ..... −65°C to +150°C

Ambient Temperature with Power Supplied ..... −55°C to +125°C

Supply Voltage to Ground Potential ..... −0.5V to +7.0V

DC Input Voltage ..... −0.5V to +7.0V

Output Current TXOUT ..... 110 mA

Input Current RRSET, RTSET, $\overline{\text{JAB}}$, $\overline{\text{CLSN}}$, $\overline{\text{XMT}}$, $\overline{\text{RCV}}$,, $\overline{\text{LMON}}$ ... 60 mA

Operating Range

Range	Ambient Temperature	V_{CC}
Commercial	0°C to +70°C	5V ± 10%

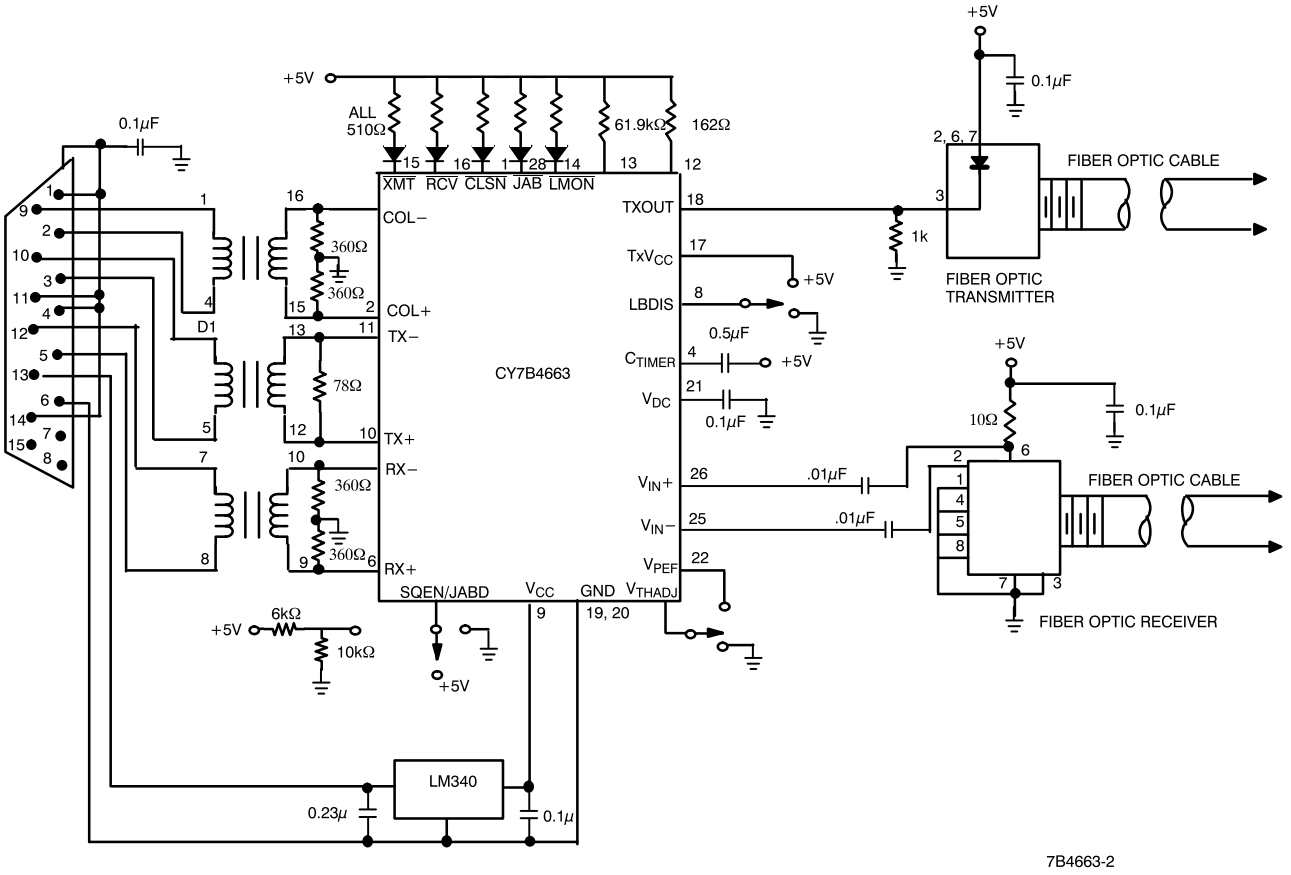


Figure 1. CY7B4663 Schematic Diagram

Electrical Characteristics

Parameter	Description	Min.	Typ.	Max.	Units
V_{CC}	Supply Voltage	4.5	5.0	5.5	V
I_{CC1}	Power Supply Current Non−Transmitting		35	50	mA
I_{CC2}	Power Supply Current Transmitting		80	100	mA
V_{OL}	LED Driver Low Voltage (I_{OL}=10mA)			0.8	V
I_{TXP}	Transmit Peak Output Current			110	mA
V_{TS}	Transmitter Squelch Voltage (TX±)	175	225	300	mV
V_{IC}	Common Mode Input Voltage (TX±, RXIN±)	2		V_{CC}−0.5	V
RX, CD	Differential Output Voltage	±500		±1200	V
V_{OC}	Common Mode Output Voltage (RX±, CD±)		2.5		V
V_{IMB}	Differential Output Voltage Imbalance			±40	mV
V_{SQED}	SQE Test Disable Voltage			0.3	V
V_{JD}	Jabber Disable Voltage	1.5		V_{CC}−2	V
V_{SQBE}	SQE/Jabber Both Enabled	V_{CC}−0.5			V
V_{LBD}	LBDIS Disable Threshold	V_{CC}−1			V
V_{LBE}	LBDIS Enable Threshold			1	V
V_{CTX}	Common Mode Voltage (TX±)		3.5		V
V_{CIN}	Common Mode Voltage (VIN+, VIN−)		1.65		V
V_{REF}	Reference Voltage	2.35	2.45	2.55	V
V_{RSC}	VREF Output Source Current			5	mA
G_{AMP}	Input Amplifier Gain		100		V/V
V_{ISR}	Fiber Input Signal Range	2		1600	mV_{P-P}
V_{SET}	External Voltage at V_{THADJ} to Set V_{TH}	0.5		2.7	V
V_{IOF}	Input Offset (V_{DC} = V_{REF})		3		mV
V_{IRN}	Input Referred Noise (50 MHz BW)		25		µV
R_{IN}	Input Resistance V_{IN}±	0.8	1.3	2.0	kΩ
I_{THADJ}	Input Bias Current of V_{THADJ}	−200	0	200	µA
V_{LPTV}	Threshold for Switching from Link Fail to Link Pass	5	6	7	mV_{P-P}
	Hysteresis of Link Fail to Link Pass		20		%

AC Electrical Characteristics

Parameter	Description	Min.	Typ.	Max.	Units
t_{TXNPW}	Transmit Turn On Pulse Width	10	20	40	ns
t_{TXFPW}	Transmit Turn−Off Pulse Width (TX to idle transitions)	500		2000	ns
t_{TXLP}	Transmit Loopback Startup Delay			400	ns
t_{TXODY}	Transmit Turn−On Delay			100	ns
t_{TXIDF}	Transmit Idle Frequency	0.85		1.25	MHz
t_{TXDC}	Transmit Idle Duty Cycle	45		55	%
t_{TXSDY}	Transmit Steady State Propagation Delay		15	50	ns
t_{TXI}	Transmitter Jitter Into 31 Ω			±1.5	ns
t_{RXSFT}	Receive Squelch Frequency Threshold	2.5		4.5	MHz
t_{RXODY}	Receive Turn−On Delay			150	ns
t_{RXFX}	Last Bit Received To Slow Decay Output	230	300		ns
t_{RXSDY}	Receive Steady State Propagation Delay		15	50	ns
t_{RXI}	Receiver Jitter		±1.5		ns
t_{AR}	Differential Output Rise Time (RX±, CD±)		4	7	ns
t_{AF}	Differential Output Fall Time (RX±, CD±)		4	7	ns
t_{CPSQE}	Collision Turn−On Delay			300	ns
t_{SQEXR}	Collision Turn−Off Delay			650	ns
t_{CLF}	Collision Frequency	8.5		11.5	MHz
t_{CLPDC}	Collision Pulse Duty Cycle	45	50	55	%
t_{SQEDY}	SQE Test Turn−On Delay After Transmission	0.7	1.1	1.5	µs
t_{SQETD}	SQE Test Duration	0.6	1.0	1.4	µs
t_{JAD}	Jabber Activation Delay	20	26	32	ms
t_{JRT}	Jabber Reset Time Out	300	420	550	ms
t_{JSQE}	Delay From Outputs Disabled to Collision Oscillator On		100		ns
t_{LED}	$\overline{RCV}$, $\overline{CLSN}$, $\overline{XMIT}$ On Time	8	16	32	ms
t_{LLPH}	Low Light Present to $\overline{LMON}$ High	3	5	10	µs
t_{LLCL}	Low Light Clear to $\overline{LMON}$ Low	250		750	ms

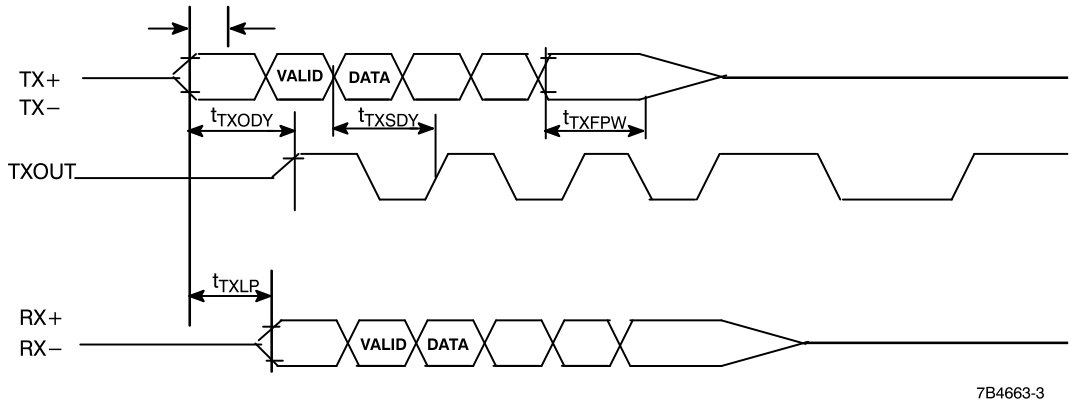


Figure 2. Transmit and Loopback Timing

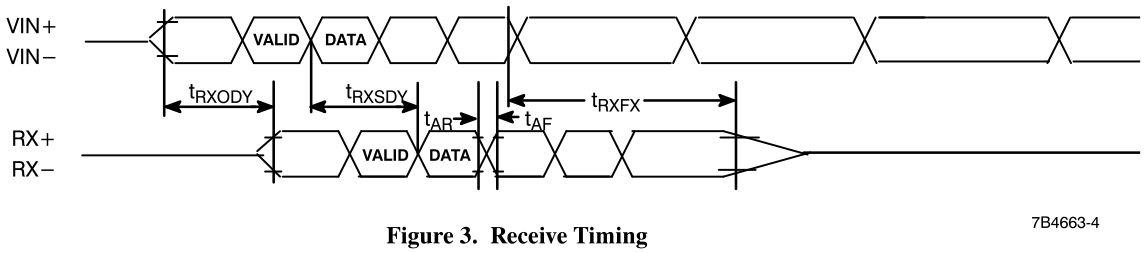


Figure 3. Receive Timing

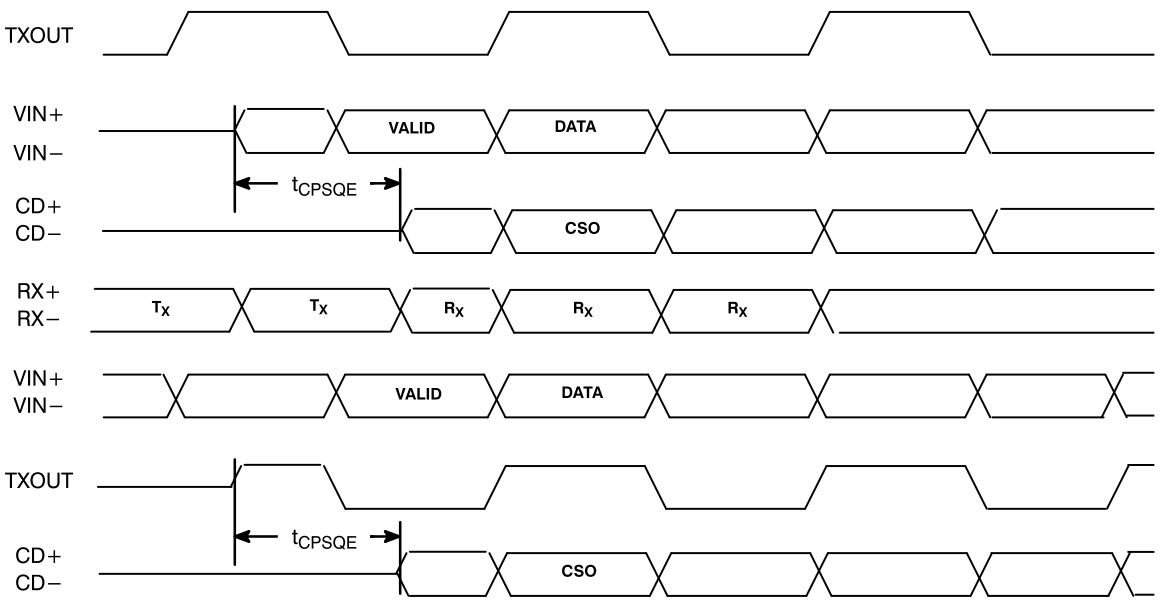


Figure 4. Collision Timing

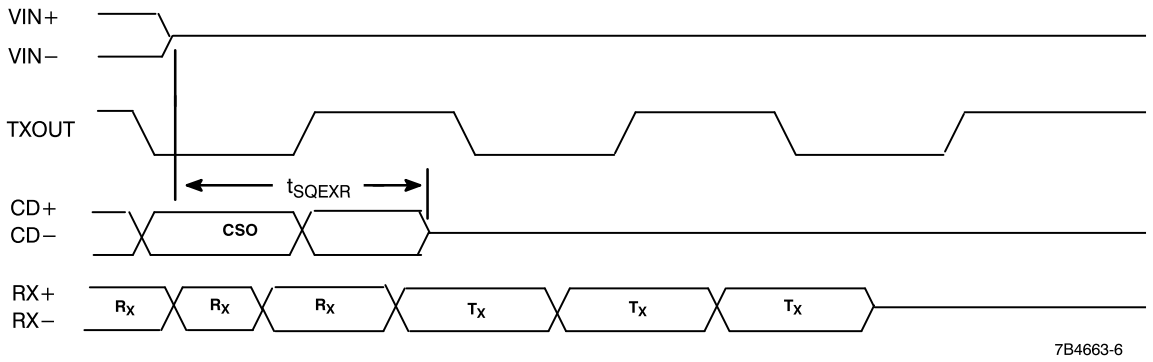


Figure 5. Collision Timing

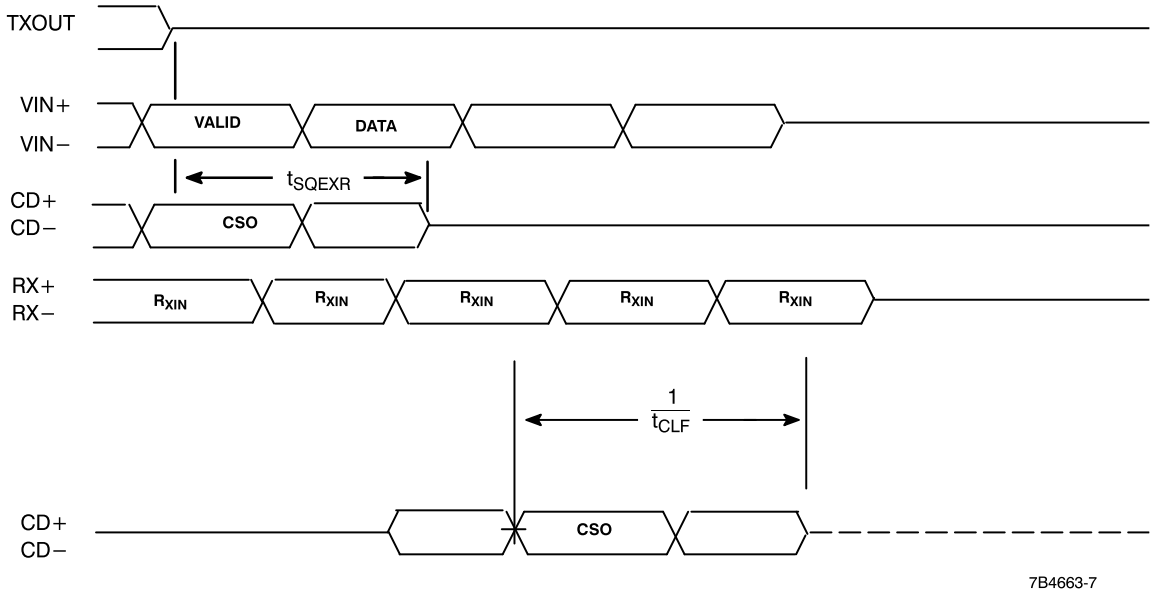


Figure 6. Collision Timing

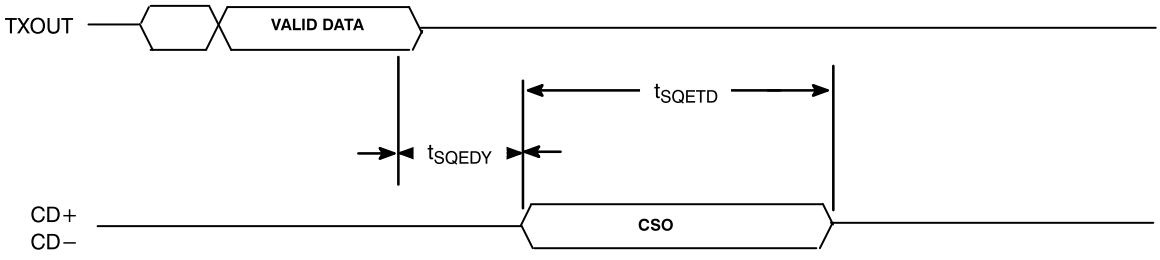


Figure 7. SQE Timing

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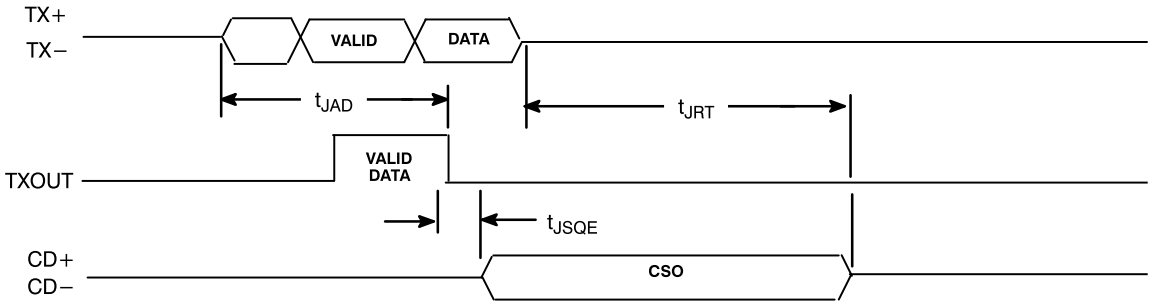

Figure 8. Jabber Timing

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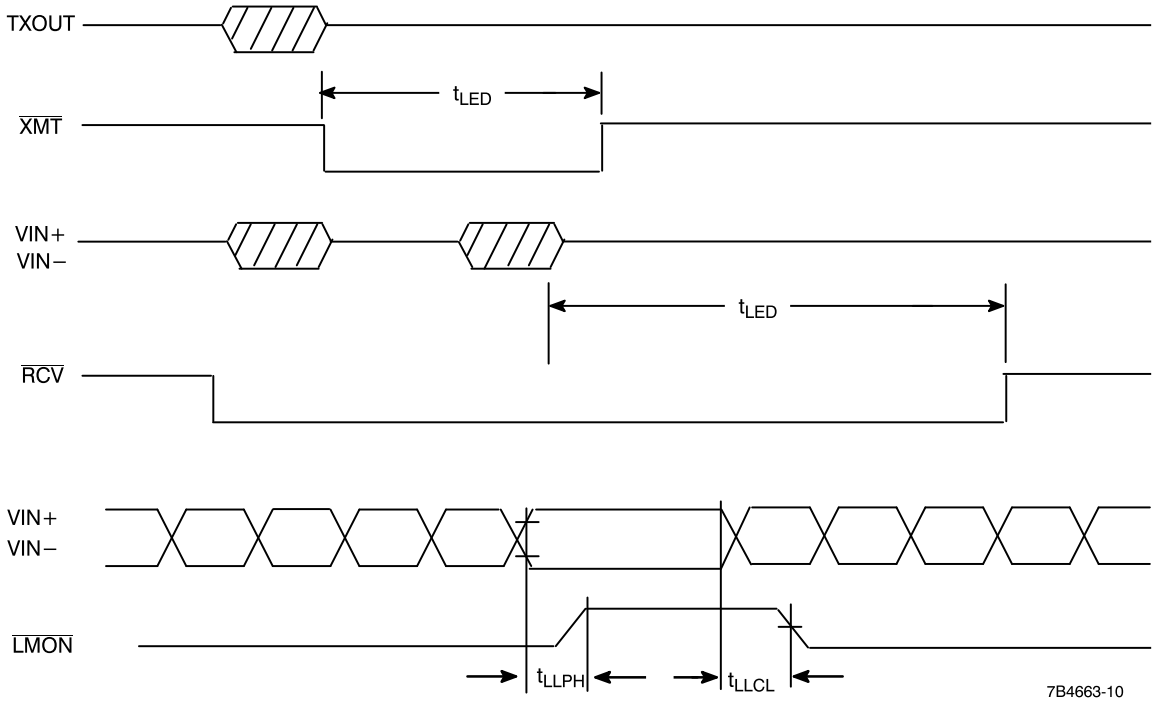

Figure 9. LED Timing

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