



10 Mb/s Single Twisted Pair Ethernet 10BASE-T1L Auto-Negotiation Timing Changes (Update)

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Timing Values

- 10BASE-T1L uses low speed (LSM) Auto-Negotiation.
- The current timer values in D3.1 are based on a maximum link segment length of 1589 m assuming a NVP of 0.6, thus leading to a maximum link segment delay time of $t_{dly} = 8834$ ns (see 146.7.1.3).
- The intention is to add some margin for the maximum link segment length (supporting 2500 m @ 5 ns/m)
- This will increase the link segment delay time to **$t_{dly} = 12500$ ns.**
- The current low speed mode Auto-Negotiation also does not take the dispersion of the signal over the link segment into account.
- The minimum “blind_timer” duration is exactly two times the link segment delay time t_{dly} and does not provide some additional time before re-enabling the receiver to allow for signal dispersion on the link segment.
- To add some margin for dispersion, the intention is to adapt the timing to allow for a additional dispersion of maximum 2 bit times.
- The intended modifications for the Clause 98 LSM Auto-Negotiation timers are seen on the next page.
- Additionally the **failure_timer** of the speed selection state diagram in Figure 98-11 is intended to be increased from 150 ms \pm 1 ms to **250 ms \pm 1 ms** to allow the management entity more time to load the needed data over a slow MDIO in case these pages are not preloaded into the PHY (this allows up to 98 ms for the Auto-Negotiation procedure to complete, assuming that both PHYs Auto-Negotiation cycles are not synchronized).

Timing Values

- The following table shows possible timer values for a 625 kBit/s communication (a bit time is $t_{bit} = 1600$ ns, the maximum link segment delay time is $t_{dly} = 12500$ ns, blue are the numbers, which have changed or are new compared to the D3.1 draft):

Timer	Min	Max	Unit	Remarks
blind_timer	28200	31400	ns	$2 \times t_{dly} + 2 \times t_{bit} \rightarrow 2 \times t_{dly} + 4 \times t_{bit}$
break_link_timer	8000	8133	μ s	Time to disable PHY and release the bidirectional data lines for auto-negotiation.
clock_detect_max_timer	1680	2000	ns	5 – 25 % more than time T2 (t_{bit})
clock_detect_min_timer	1200	1520	ns	5 – 25 % less than time T2 (t_{bit})
data_detect_max_timer	880	1200	ns	10 – 50 % more than time T3 ($t_{bit} / 2$)
data_detect_min_timer	400	720	ns	10 – 50 % less than time T3 ($t_{bit} / 2$)
interval_timer	799.96	800.04	ns	$800 \text{ ns} \pm 0.005 \% (t_{bit} / 2)$
link_fail_inhibit_timer [10BASE-T1L]	3030	3090	ms	$3060 \text{ ms} \pm 30 \text{ ms}$ (3030 ms is the maximum time for link training of a 10BASE-T1L PHY)
page_test_max_timer	128000	131200	ns	$80 t_{bit} \rightarrow 82 t_{bit}$ (a nominal DME frame is 78 bit long)
receive_DME_timer	156200	159400	ns	$\text{page_test_max_timer} + 2 \times t_{dly} + 2 \times t_{bit}$
rx_wait_timer	330 (D3.1: 300)	370 (D3.1: 340)	μ s	Time after which at least a new DME frame has to be received before going into receive IDLE state (time to handle the half-duplex state diagram plus headroom).
silent_timer	31400	34600	ns	$2 \times t_{dly} + 4 \times t_{bit} \rightarrow 2 \times t_{dly} + 6 \times t_{bit}$

- backoff_timer:

If T[4] bit is 1, the duration is (156200 ns to 159400 ns) + (random integer from 0 to 15) x (31400 ns to 34600 ns).

(this is equal to: receive_DME_timer + (random integer from 0 to 15) x silent_timer)

If T[4] bit is 0, the duration is (172700 ns to 175900 ns) + (random integer from 0 to 15) x (31400 ns to 34600 ns).

(this is equal to: receive_DME_timer + $t_{dly} + t_{bit} + 3 t_{bit} / 2$ + (random integer from 0 to 15) x silent_timer)

Thank You