Energy Efficient Ethernet
10GBASE-T LPI Frequency Stability

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IEEE P802.3az Task Force 10G ad hoc

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Overview

- A specification for the maximum allowable symbol frequency drift rate is proposed.
- This new specification is required for the 10GBASE-T Low Power Idle mode of operation since during the quiet period it is intended that timing loops be frozen and therefore clock drift will not be tracked.
- The specification must be testable and reflect an “extreme case” to enable implementers flexibility in choosing low-cost components, airflow and heat-dissipation methodologies.

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Reference Specification

- Specification, “SCTE 79-1 DOCSIS 2.0 Part 1: Radio Frequency Interface” has a +/- 5 ppm clock frequency accuracy requirement and a drift rate specification of 1e-8 per second over a temperature range of 0 to 40 degrees C.
  - Stringent synchronization requirements for 128QAM S-CDMA. (Same constellation as DSQ128).
  - Corresponds to a ramp over the entire operating frequency range in 17 minutes.
  - This specification relates to an enterprise cable modem aggregation system that typically sits in a temperature-controlled head-end.

- Extrapolating for 10GBASE-T EEE, consider a ramp over the entire scaled frequency range of +/- 50 ppm in 10 minutes, yielding a 0.17 ppm per second drift rate.

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Proposed Specification

- Existing symbol rate specification:

55.5.3.5 Transmit clock frequency

The symbol transmission rate on each pair of the MASTER PHY shall be within the range 800 MHz ± 50 ppm.

- Proposed additional specification for maximum allowable drift rate:

For EEE mode, the rate of change of the symbol transmission rate on each pair of the MASTER PHY shall not exceed 0.17 ppm/sec.

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System Design Considerations

- A transmit symbol rate drift specification of 0.17 ppm/sec requires input from system vendor component and mechanical engineers to verify that this does not unnecessarily constrain designs considering the following:
  - Expected operating ambient temperature range.
  - Airflow assumptions.
  - Crystal and/or oscillator stability over temperature.

- Proposed transmit symbol rate drift is assumed to be linear. Transient thermal responses are likely non-linear. These should be characterized and/or measured.

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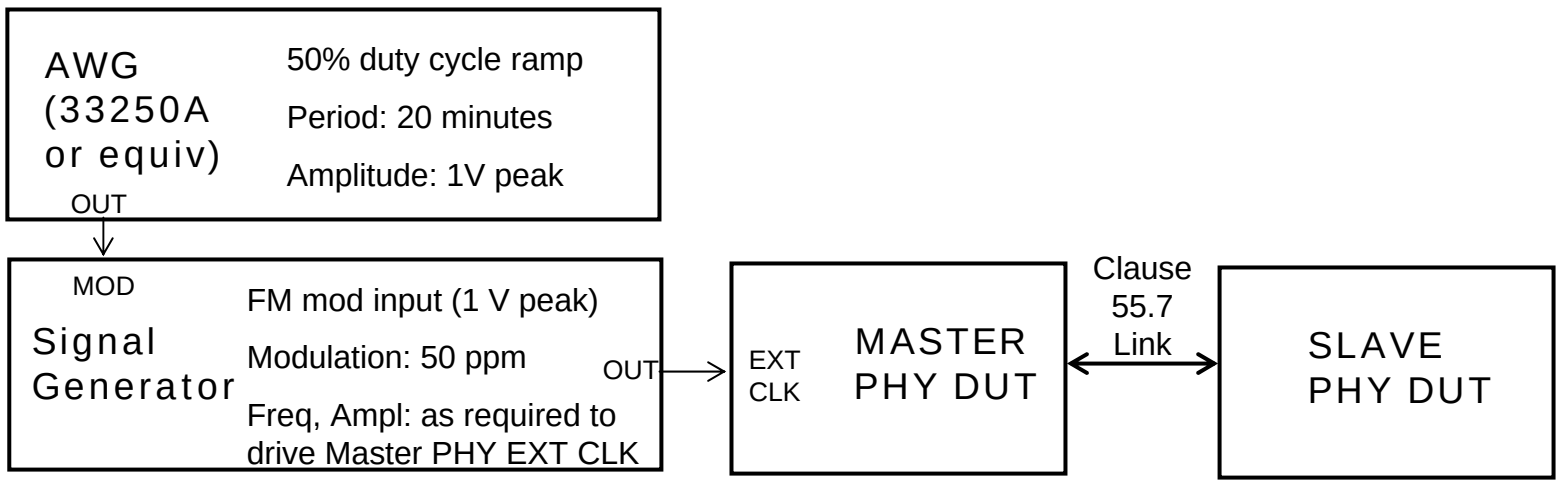
Example Test Configuration

- Implement as a “white-box” test in which a 10GBASE-T EEE-compliant device has the capability to accept an external clock such that the resulting transmit symbol clock meets all accuracy, stability, and jitter specifications.
- With external clock having a linear drift of 0.17 ppm/s, meet IEEE802.3an 55.5.4.1 Ethernet frame error rate specification (< 6.4e-9 for 800 octet frames).



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Summary

- An extreme-case symbol frequency drift rate of 0.17 ppm/sec is proposed.
- This rate corresponds to a linear drift over the entire 100 ppm transmit symbol clock operating range in 10 minutes.
- A test configuration has been proposed to enable validation of the symbol frequency drift rate requirement.
- System vendor component and mechanical engineers need to review their requirements to ensure that the transmit symbol frequency drift rate requirement does not overly constrain their thermal designs.

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