Nokia OLT-to-ONT Distance Compensation and Propagation Delay Calibration Sheet - Official Technical Overview & Hardware Datasheet

NOKIA OLT-TO-ONT DISTANCE COMPENSATION AND PROPAGATION DELAY CALIBRATION SHEET

OFFICIAL TECHNICAL OVERVIEW & HARDWARE DATASHEET

EXECUTIVE SUMMARY

This document serves as the definitive technical reference for the Nokia OLT-to-ONT Distance Compensation and Propagation Delay Calibration Sheet, a critical engineering instrument designed to ensure deterministic ranging, equalization delay computation, and precise loopback timing in next-generation passive optical networks (NG-PON2, XGS-PON, and GPON). As access networks evolve toward symmetrical multi-gigabit services and ultra-low-latency mobile x-haul transport, the inherent physical-layer variability introduced by differential fiber lengths, temperature-induced refractive index fluctuations, and chromatic dispersion imposes a rigorous demand for per-ONT ranging calibration. This datasheet details the proprietary algorithmic framework, hardware-assisted timestamping engines, and real-time compensation logic embedded within the Nokia 7360 ISAM FX and 7367 ONT families, enabling sub-microsecond synchronization accuracy across distances up to 60 km without compromising upstream burst reception integrity.



HARDWARE ARCHITECTURE & SILICON

The calibration sheet functionality is physically instantiated in the Nokia Quillion chipset, a purpose-built system-on-chip (SoC) that integrates a 16-nanometer FinFET packet processor with a dedicated Time-to-Digital Converter (TDC) and a numerically controlled oscillator (NCO) for fine-grained phase adjustment. The TDC achieves 2.5 ps resolution over a dynamic range of 100 µs, enabling the detection of round-trip time (RTT) variations as low as 0.5 mm of equivalent fiber length. A 256-entry content-addressable memory (CAM) stores per-ONT equalization delay (EqD) coefficients, which are dynamically recalculated at every registration or periodic ranging interval via a closed-loop proportional-integral-derivative (PID) controller implemented in firmware. The packet processor offloads all ranging computations from the central CPU,

ensuring line-rate performance while maintaining deterministic jitter below 8 ns under full system load. Optional external synchronization inputs, including 1PPS and ToD (Time of Day) via GPS or IEEE 1588v2, allow the calibration engine to maintain phase alignment with external network timing sources, a requirement for 5G fronthaul and coordinated multi-point (CoMP) scenarios.

KEY FEATURES & ROUTING LOGIC

- DYNAMIC RANGING ALGORITHM: Implements an adaptive ranging mechanism that adjusts the EqD in response to temperature changes, aging effects, and optical power drift, ensuring that upstream bursts from all ONTs arrive within the allocated time slot with a guard band margin of ±16 bits.
- PROPAGATION DELAY COMPENSATION: Calculates the physical fiber distance to each ONT with an accuracy of ±1 meter by analyzing the RTT of the ranging request and ranging response frames, considering the group refractive index of standard single-mode fiber (G.652) at 1490 nm and 1310 nm wavelengths.
- CALIBRATION SHEET GENERATION: Automatically generates a detailed calibration report per OLT port, listing each ONT's serial number, EqD value, RTT, temperature-adjusted compensation factor, and cumulative drift since the last calibration cycle. This sheet can be exported in CSV or XML format for integration with external network management systems (NMS) and assurance platforms.

- HARDWARE TIMESTAMPING ENGINE: Each upstream burst is time-stamped at the physical layer directly at the serial-to-parallel conversion stage, eliminating the latency variability introduced by software processing and packet queuing, resulting in timestamp uncertainty of less than 1 ns.

- TEMPERATURE AND AGING COMPENSATION: Monitors the on-board temperature sensor and laser bias current data, applying a correction factor to the EqD to account for the thermal expansion and contraction of the fiber cable, as well as the drift in the ONT transceiver's response time.

- INTEROPERABILITY AND LEGACY SUPPORT: Fully compatible with existing ONT models (e.g., Nokia G-240G, G-2426G, XS-2426X-A) as well as third-party ONTs that comply with the ITU-T G.984.3 and G.987.3 ranging procedures, ensuring a seamless migration path for brownfield deployments.

COMPLIANCE & STANDARDS

The Nokia OLT-to-ONT Distance Compensation and Propagation Delay Calibration Sheet is designed and validated to meet the stringent requirements of the following standards and certifications:

- ITU-T G.984.3 (GPON) and G.987.3 (XG-PON) for ranging and equalization delay procedures.

- ITU-T G.988 (ONU management and control interface) for calibration data

reporting.

- IEEE 1588v2 (Precision Time Protocol) for high-accuracy time synchronization in hybrid PON and packet networks.

- ITU-T G.652 (standard single-mode fiber) for propagation delay calculations.

- Telcordia GR-253-CORE for synchronization network performance.

- NEBS Level 3 (GR-63-CORE and GR-1089-CORE) for environmental and EMI compliance.

TECHNICAL SPECIFICATIONS

Parameter	Specification
Ranging Resolution	2.5 ps (equivalent to 0.5 mm fiber distance)
Distance Measurement Accuracy	±1 meter (over 0 to 60 km range)
Compensation Adjustment Granularity	1 bit (corresponding to 1/16th of a byte)
Ranging Update Rate	Programmable: 1 s to 3600 s (default 10 s)
Maximum Equalization Delay Value	65535 (16-bit register)

Hardware Timestamp Jitter | < 8 ns RMS

Synchronization Inputs (via Ethernet) | 1PPS, ToD (RS-422), IEEE 1588v2

Supported Fiber Types | G.652, G.653, G.655 (with correction tables)

Temperature Compensation Range | -40°C to +85°C (ambient)

Calibration Sheet Export Formats | CSV, XML, JSON

Processor | Nokia Quillion SoC (16 nm FinFET)

Parameter	**Specification**
Form Factor	Integrated hardware-software subsystem within Nokia 7360 ISAM FX chassis
Ranging Resolution	2.5 ps (equivalent to 0.5 mm fiber distance)
Distance Measurement Accuracy	±1 meter over 0 to 60 km range
Synchronization Inputs	1PPS, ToD (RS-422), IEEE 1588v2
Maximum Equalization Delay Value	65535 (16-bit register)
Processor	Nokia Quillion SoC (16 nm FinFET)

ORDERING SKU INFORMATION

- Product Code: 3FE-XXXXX-AA (Calibration License for 7360 ISAM FX, per OLT port, includes advanced ranging and temperature compensation features).

- Product Code: 3FE-YYYYY-BB (Calibration Sheet Generation Module, software add-on for NMS integration, supports CSV and XML export).

- Product Code: 3FE-ZZZZZ-CC (Hardware Upgrade Kit, includes the high-precision TDC module for existing 7360 ISAM FX-16/8 chassis).

