rakon

# Synchronous Ethernet

## Introduction

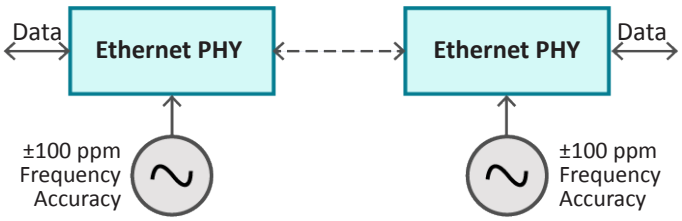
Ethernet is the ubiquitous communication platform for computer networking in the home and enterprise. The simplicity, performance and cost effectiveness has made Ethernet technology a viable choice for transport networks as well. There are challenges in adapting Ethernet technology to carrier class, highly reliable managed networks. The inherently asynchronous nature of Ethernet has the primary challenge of carrying time sensitive traffic such as real time voice or video data.

Rakon's TCXOs, Mercury/+™ ASIC based OCXOs and conventional discrete OCXOs are ideal for use in Synchronous Ethernet applications. They support ITU-T G.8262 standards for Synchronous Ethernet.

## From Asynchronous to Synchronous

Traditionally, Ethernet nodes were running asynchronously to each other, with a defined ±100 ppm accuracy to the nominal frequency. Consequently, most of the traffic carried over Ethernet was asynchronous and "bursty" in nature. Synchronisation in its strictest sense was not required because of the nature of the traffic passing through. The transceiver buffers were used to take care of the unexpected variations in the data flow. Moreover, the protocol layer implemented flow control using "Pause Frames" which halted the transmission for a specific period of time.

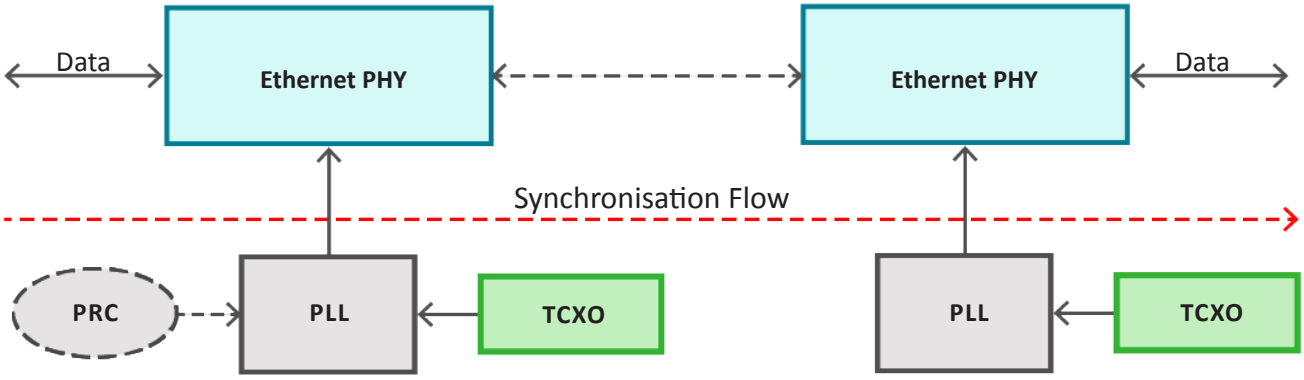
As Ethernet started to carry real time voice and video, the traffic patterns changed. Such services demanded Constant Bit Rate or Variable Bit Rate but contiguous traffic, which demanded




all nodes in a network from source to destination to have the same average frequency. The timing and synchronisation techniques that were applied to the traditional circuit switched networks became relevant to the Ethernet networks as well. The equipment based on Ethernet networks that support synchronous timing are described as Synchronous Ethernet (SyncE) networks.

## Synchronised Clocks in Physical Layers

The G.8261 describes synchronisation chains including Synchronous Ethernet. A Primary Reference Clock (PRC) traceable reference is introduced into the chain and the clock drives the physical layer, transferring synchronisation in the network. At the receiving node, the physical layer extracts the clock and filters and conditions the clock according to the requirements of the G.8262 Synchronous Ethernet Equipment Clock (EEC) specifications. G.8264 defines Ethernet Synchronisation Messaging Channels (ESMC) to support the physical layer clock transfer.



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## Synchronous Ethernet Requirements

G.8262 defines Option 1 and Option 2 for clocks, optimised for 2.048M interfaces and 1.544M interfaces, respectively. The loop filter bandwidth defined for Option 1 clocks is 1Hz to 10Hz. The loop filter bandwidth required for Option 2 clocks is 0.1Hz and therefor the short term stability of the TCXO used is important to achieve wander generation compliance with temperature variation effects.

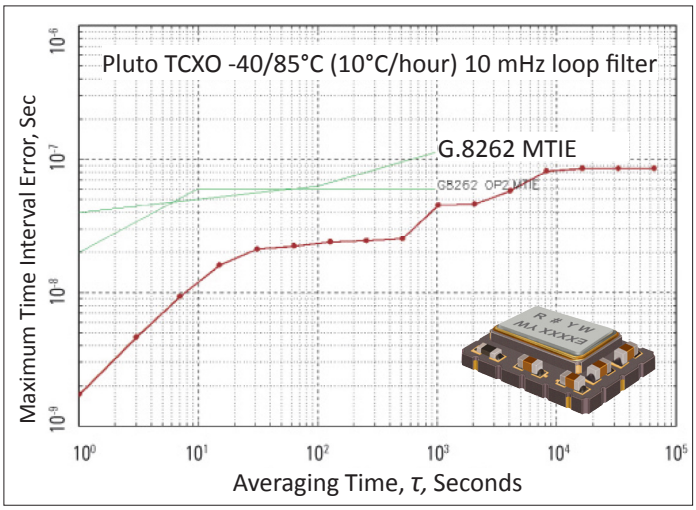
The jitter compliance is tested on the system interface outputs and is a function of the PLL and the oscillator used in the system. Thus low jitter oscillators are important in Synchronous Ethernet implementations.

## Rakon Oscillator Solutions

Rakon provides G.8262 compliant TCXOs for Synchronous Ethernet applications. After extensive time domain performance analysis of the clocks at various frequencies, a series of ultra-stable TCXOs for G.8262 has been developed and qualified.

Rakon's TCXO family has excellent short term stability capability and ultra low jitter performance. Applications that are required to support more extreme temperature environments or better holdover performances may use Rakon's tighter stability OCXO solutions.

Rakon's TCXOs are tested and used in the reference solutions of the industry's leading G.8262 synchronisation solutions and PHYs.




## Rakon Oscillators for Synchronous Ethernet

| Oscillator Family | Frequency Range | Stability (FvsT) | Temperature Range | Jitter at 20 MHz (10 kHz – 5 MHz offset) | Standard Compliance |
|---|---|---|---|---|---|
| **Pluto+™ TCXO** - RPT7050J | 10 to 40 MHz | ±50 to 250 ppb | -40 to 85°C | 290 fs | Stratum 3 |
| **Mercury/+™ IC OCXO** - RFPO45/55/65 | 10 to 26 MHz | ±10 to 100 ppb | -40 to 85°C | 360 fs | Stratum 3 |
| - ROM1490E | 10 to 50 MHz | 10 ppb pk-pk | -40 to 85°C | 360 fs | Stratum 3E |
| **Discrete OCXO** - ROX2522S | 5 to 40 MHz | ±5 to 10 ppb | -40 to 85°C | 550 fs | Stratum 3E |

## Additional Rakon Products for Complete Synchronous Ethernet Design

| Product Family | Product Series | Key Capabilities |
|---|---|---|
| TCXOs | High Stability | 10 to 52 MHz, ±0.5 to 5 ppm over -40 to 85°C and in 3.2 x 2.5, 2.5 x 2.0 or 2.0 x 1.6 mm packages. |
| VCXOs | M / P / R | 8 to 1500 MHz with low phase-noise and CMOS/PECL/LVDS in 7.0 x 5.0, 5.0 x 3.2 or 2.5 x 2.0 mm packages. |
| | X | 10 to 50 MHz commercial CMOS output in 7.0 x 5.0 or 5.0 x 3.2 mm packages. |
| XOs | M / P / R | 8 to 1500 MHz with <1 ps jitter and CMOS/PECL/LVDS in 7.0 x 5.0, 5.0 x 3.2 or 2.5 x 2.0 mm packages. |
| | Q | 8 to 1500 MHz electable frequency, 1.0/2.0 ps jitter and CMOS/PECL/LVDS output in 2.5 x 2.0 mm packages. |
| | X | 10 to 50 MHz commercial CMOS output in 7.0 x 5.0 or 5.0 x 3.2 mm packages. |
| Crystals | RSX / RTF | ***RSX:*** 12 to 48 MHz for Ethernet, WiFi and USB. ***RTF:*** 32 kHz for real time clocks. |