CX4010 v5.0
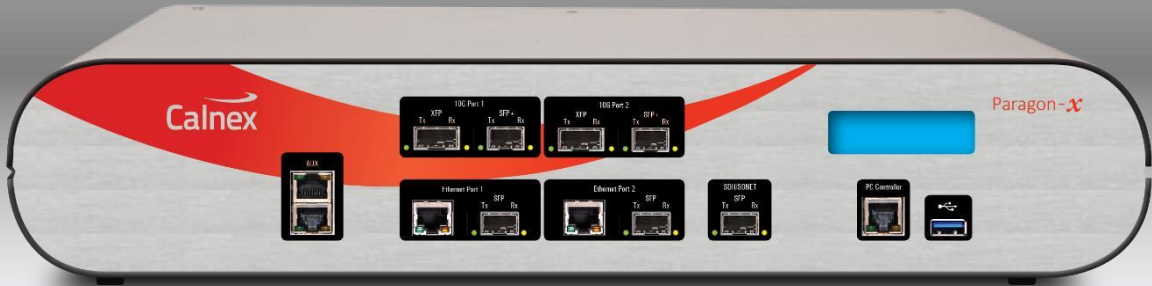
**Calnex**
Insight and Innovation

# Calnex Paragon-X
## Ethernet Synchronization Test Solution

Paragon-x

# GETTING STARTED GUIDE

# Notices

This document refers to Calnex Paragon-X GUI Software Revision X.10.43.xx and higher.

Last Updated: February 2024

## Warranty

The information contained in this document is subject to change without notice.

**Calnex Solutions plc makes no warranty of any kind with regards to this material, including but not limited to, the implied warranties or merchantability and fitness for a particular purpose.**

Calnex Solutions plc shall not be liable for errors contained herein and for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

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**WARNING:**

**To prevent fire or shock hazard, do not expose the unit to rain or moisture.**

**To avoid electrical shock:**

- **Use only power cord supplied, or one with adequate ratings, and connect only to a properly grounded power socket outlet. Ensure the power socket outlet is easily accessible and near the unit.**
- **Do not open covers. Refer servicing to qualified personnel only.**

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## Power Requirements

The unit requires a power source of:
**Voltage**: 100 - 240Vac
**Current**: 1.5A @ 100Vac
**Frequency**: 50 – 60Hz

## Weight

**Paragon-X**: 3.6kg (max)
**Power Supply and Power Cord:** 1.2kg
**Gross Packed Weight (shipping carton):** 6.2kg (max). Paragon-X plus Power Supply and Power Cord packed in Cardboard Shipping Carton.
**Gross Packed Weight (carry case):** 13.4kg (max). Paragon-X plus Power Supply and Power Cord fitted in Carry Case (option 501/502).

## Dimensions

**Paragon-X:** 45cm x 24cm x 9cm (W x D x H)
**Power Supply:** 17cm x 13cm x 9cm
**Cardboard Shipping Carton:** 55cm x 45cm x 22cm
**Carry Case:** 57cm x 27cm x 47cm (Option 501/502)

## Equipment Installation

Equipment is bench portable and operates stand alone in a normal laboratory environment.

Always operate the equipment with unrestricted access to the AC power connector.

**CAUTION:**

- **The instrument is air cooled by pulling air in a right to left direction as viewed from the front of the instrument. The fans are positioned on the left-hand side of the instrument. The air vents on both sides of the instrument must not be obstructed.**

- **External heat sources (e.g. other instruments, test equipment) must not be placed in a manner that will generate heat into the Calnex instrument. For example, blowing hot air from another instrument into the cool air inlet of the Calnex instrument.**

- **The maximum ambient temperature around the instrument must not exceed 40°C**

- **If the equipment is installed in a cabinet or rack enclosure, special attention should be given to:**

  o **The enclosure should be bonded to a clean earthing point.**

  o **The internal ambient temperature of the enclosure may be greater than room ambient temperature. The internal temperature of the enclosure must be kept within the maximum ambient temperature above.**

  o **The enclosure may restrict air flow to the instrument, ensure the amount of air flow required for safe operation of the equipment is not compromised.**

# Welcome to the Calnex Paragon-X Getting Started Guide

This guide shows how to install and operate the Calnex Paragon-X hardware and User Interface. There is also information on using the Rb/GPS Frequency Reference and 1pps/ToD/frequency converter accessories (available as options with Paragon-X or separately).

The operational guidance is generic. Please refer to appropriate Calnex application notes and software release notes for detailed operational steps and result interpretation in relation to specific tests.

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## Introduction

For technologies up to 10Gb/s, the Calnex Paragon-X offers direct insight into actual device and service behaviour, and the ability to generate a broad range of real-world disruption scenarios to validate the operation of your network devices.

Paragon-X functions (with appropriate licence options installed):

- T1/E1/2MHz wander measurement
- 1pps accuracy and wander measurement
- Time of Day display from serial interface to multiple standards
- Ethernet interface rates of 100M, 1G and 10Gb/s
- 1588: PDV Measurement
- 1588: One-box BC, TC & OC Test including Master/Slave Emulation and Time Error Measurement
- 1588: Through-Mode Time Error Measurement
- 802.1as: Through-Mode Time Error Measurement
- 802.1as: One-box GM, Time Aware Bridge & Time Aware End Station Test including Master/Slave Emulation and Time Error Measurement
- Sync-E jitter tolerance and generation measurements to G.8262/O.174
- Sync-E wander tolerance, transfer and generation measurement to G.8262/O.174
- External references: frequency and 1pps
- Y.1731 OAM
- MPLS-TP OAM
- CES
- Edit and replay captured PDV
- Through-mode packet delay and corruption

## Supplied Accessories

After unpacking the Paragon-X unit, make sure that the accessories below are present. If anything is missing, contact Calnex Solutions by telephone: +44 (0)1506 671416 or by email: support@calnexsol.com.

### Paragon-X

- AC adaptor (1)
- Power cord (1)
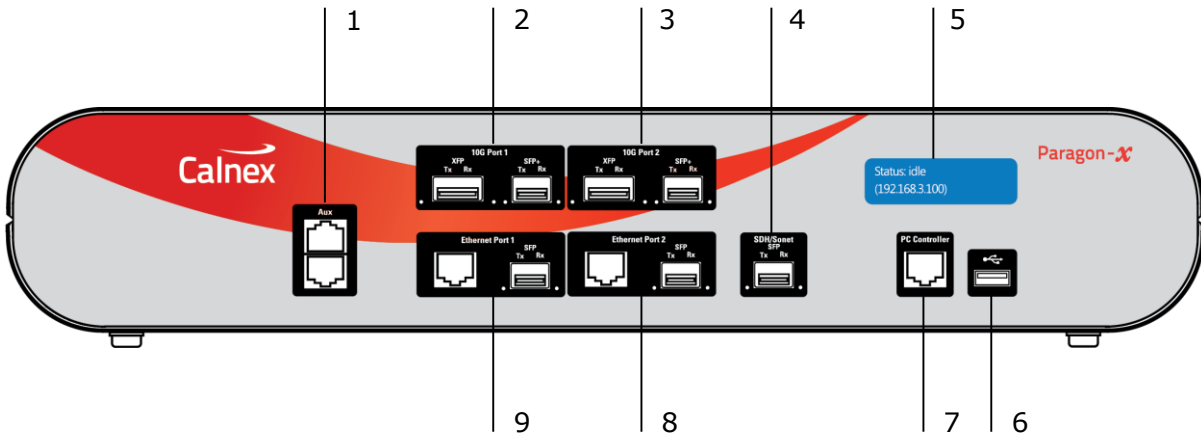- USB memory stick (1)
- Getting Started Guide (1)

### Option 132 Rb/GPS External Reference

- AC adaptor (1)
- Power cord (1)
- GPS antenna (1)
- Antenna connecting cables and lightning arrestor (1)

### Option 133 1pps/ToD/Frequency Converter

- AC adaptor (1) – note, device may also be powered from PC or other live USB connector

# Front Panel Description



**1.** Aux ports (RJ45)

**2 and 3.** 10G Ethernet ports

**4.** This connector is not used

**5.** Display

**6.** Paragon-X version Generation 3: Supplies USB power to the External 1pps/ToD Frequency Converter accessory.

Paragon-X version Generation 1 and 2: This connector is not used and does not supply USB power.

**7.** PC Controller (RJ45)

**8 and 9.** 1GbE and 100M Ethernet ports

# 1. Auxiliary ports (RJ45)

**Top Front Aux Port:** Time of Day 1pps input, single-ended signal with adjustable threshold. Input impedance 50Ω. Threshold range 0.5V to 2.5V. Use external 1pps/ToD/Frequency converter accessory to convert from high-impedance single-ended signal or RS-422 balanced signal. The pinout is detailed in the table below:

| Top Front Aux Port 1pps Pinout |
| --- |
| Pin 1: V+ Pin 2: GND |

**Lower Front Aux Port:** The Lower Front Aux Port function depends on the hardware version of Paragon-X. The version can be determined from the **Instrument -> Details** section of the Paragon-X Remote Client GUI.

The table below shows the Lower Aux Port functionality of all hardware versions of Paragon-X:

| Paragon-X | 10 MHz Output | 10 MHz Pinout | Adaptor Colour [3] | 1pps Output | 1pps Pinout | Adaptor Colour [3] |
| --- | --- | --- | --- | --- | --- | --- |
| Generation 3 | Yes [1] | Pin 1: V+ Pin 2: GND | Black | Yes | Pin 3: V+ Pin 6: GND | Red |
| Generation 2 | Yes [2] | Pin 1: V+ Pin 2: GND | Black | Yes [2] | Pin 1: V+ Pin 2: GND | Black |
| Generation 1 | No | | | No | | |
| Note 1: 1PPS and 10 MHz are available concurrently. | | | | | | |
| Note 2: 1PPS *or* 10MHz output is selectable, both cannot be output concurrently. | | | | | | |
| Note 3: Refers to the Calnex RJ45 to BNC adaptor that ships with Paragon-X. | | | | | | |

10MHz output signal is locked to the current Paragon-X reference (internal or external).

1pps output signal is locked to the current Paragon-X reference (internal or external). 1pps output signal is present when Paragon-X is in PTP Emulation Mode and generating packets, the rising edge of the 1pps pulse is aligned to the 1 second rollover of the generated PTP timestamps.

Both outputs use an in-line or series 50Ω resistor and can drive high impedance inputs as well as 50Ω inputs.

The pinout of the Auxiliary Ports are shown in the diagram below:
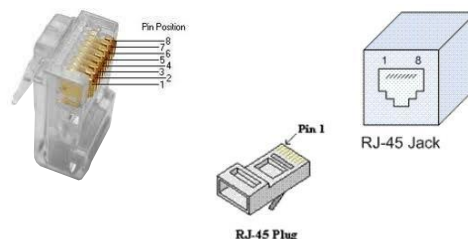
**2 and 3. 10G Ethernet ports**

This is for connections to 10G interfaces on Ethernet devices. There are two types of pluggable interface supported, SFP+ and XFP (both, customer supplied). Only SFP+ interface is supported for Sync-E jitter measurements.

**5. Display**

During the power up process, the display will show the Calnex logo then information regarding the IP address and port number Paragon-X is configured to use. After approx. 90s the unit will be available for operation.

**6. USB port**

Not used.

**7. PC Controller RJ45**

This is a 100Mb Ethernet port used for directly connecting Paragon-X to a PC or laptop running Microsoft Windows 7 or Windows 10 OS (the 'host PC').

Connection over a network is possible but not recommended; see Calnex Application Note CX5006 on Paragon PC specification and management for more details.

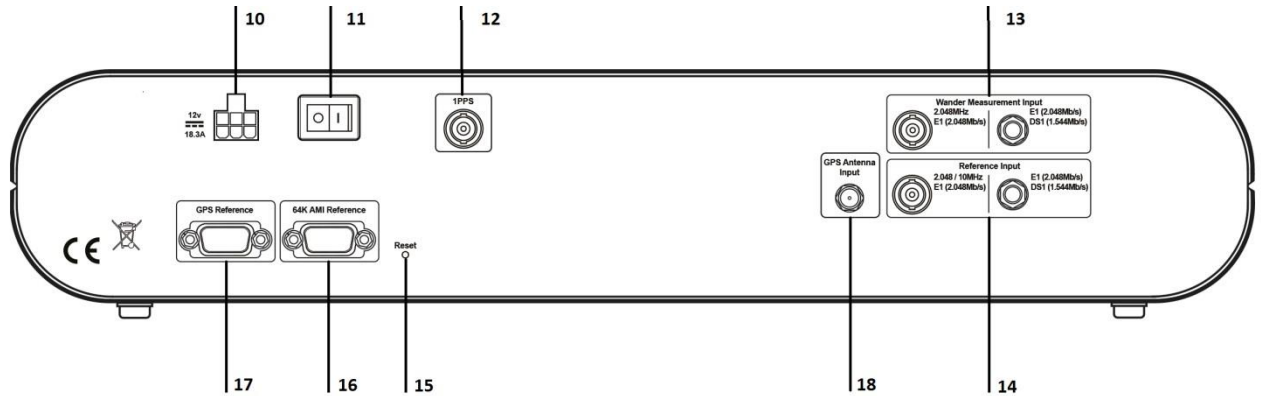**8 and 9. 1GbE and 100M Ethernet ports**

For connection to an Ethernet device to be tested. The left port in each block 8 and 9 is a 100M or 1GbE RJ45 electrical port; the right side is a 100M or 1GbE optical port. Optical ports require the use of SGMII-type SFPs (not supplied).

# Rear Panel Description

Paragon-X Generation 1
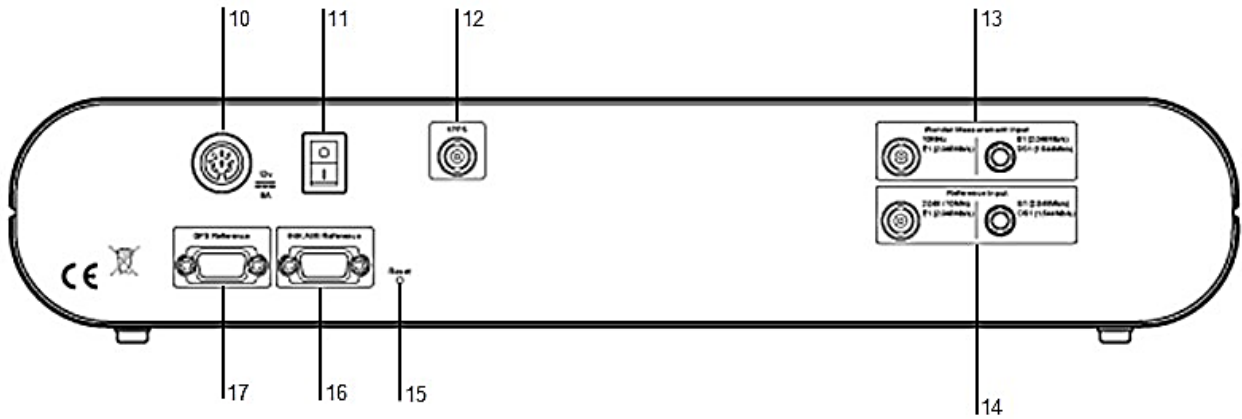


Paragon-X Generation 2 and 3:



**10.** DC Power Input

**11.** Power Switch

**12.** 1PPS Reference Input

**13.** Wander Measurement Inputs

**14.** Reference Inputs

**15.** Reset Switch

**16.** 64K AMI Reference Input

**17.** GPS Reference

**18.** GPS Antenna Connector (not used)

## 10. DC Power Input

For connection to supplied AC power adaptor only.

Power supply: AC input 100 - 240V, 1.5A, 50 - 60Hz.

### 11. Power Switch

Switches mains input to Paragon-X on or off.

### 12. 1PPS Reference Input

Typically, sourced from an external GPS receiver (e.g. Paragon-X option 132). Alternative to 1PPS input on connector 17. Single-ended 75Ω BNC connector.

### 13. Wander Measurement Inputs

Accept T1, E1 (75Ω unbalanced or 100Ω balanced) and 2.048MHz inputs. In external wander generation mode, accepts T1, E1, 2.048MHz and 10MHz wander-modulated signals from an external source.

Input signal amplitude range: 1V–3V peak to peak into 50Ω.

### 14. Reference Inputs

For connection to T1, E1, 2.048MHz or 10MHz clock reference signals.

Clock input amplitude range: 0.6V-3V peak to peak.

See also connectors 16 and 17 below.

### 15. Reset Switch

Resets Paragon-X to its power-on condition and resets IP address to factory default 192.168.3.100

### 16. 64K AMI Reference Input

For connection to 64kb/s external system reference clock.

Pin 2 = tip (+), pin 6 = ring (-), pin 1 = GND.

### 17. GPS Reference

An alternative to connector 12, accepts a 1PPS reference input signal on pin 9 (pin 5 GND).

Accepts Time of Day (ToD) message input as RS-232 on pin 2 (pin 5 GND) and can generate ToD message output as RS-232 on pin 3 (pin 5 GND). Paragon-X can display ToD messages directly as received, or qualified by 1PPS signal.

### 18. GPS Antenna Input

Not used.

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### Labels and Disposal Information

The Waste Electrical and Electronic Equipment regulations label indicates that the equipment should only be disposed of through an approved method. At the end of life please dispose of the equipment through a recognized and approved scheme fulfilling the local environmental requirements. Alternatively contact Calnex to have them arrange for return and disposal.

The CE mark indicates that the product meets all the appropriate provisions of the relevant legislation contained in the European Directives.

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# Connecting Power and Your Computer to Paragon-X

1. Connect your computer to the **PC Controller** port on the front panel of Paragon-X.

2. Connect the AC adaptor to the rear panel DC power input connector.

3. Connect the power cord to the AC adaptor and plug into an AC outlet.

4. Use Paragon-X's rear panel power switch, marked I/0, to switch on Paragon-X.

5. The blue display on the front panel will turn on. Paragon-X is initialised and ready to use after approximately 90 seconds. Note that on first power up, the IP address shown on the display is factory-preset and can be changed to meet your network requirement. To do this, install the Paragon-X application software (as described in 'Installing the Application Software'), then click on **Instrument(s)** then **Change IP Settings**.
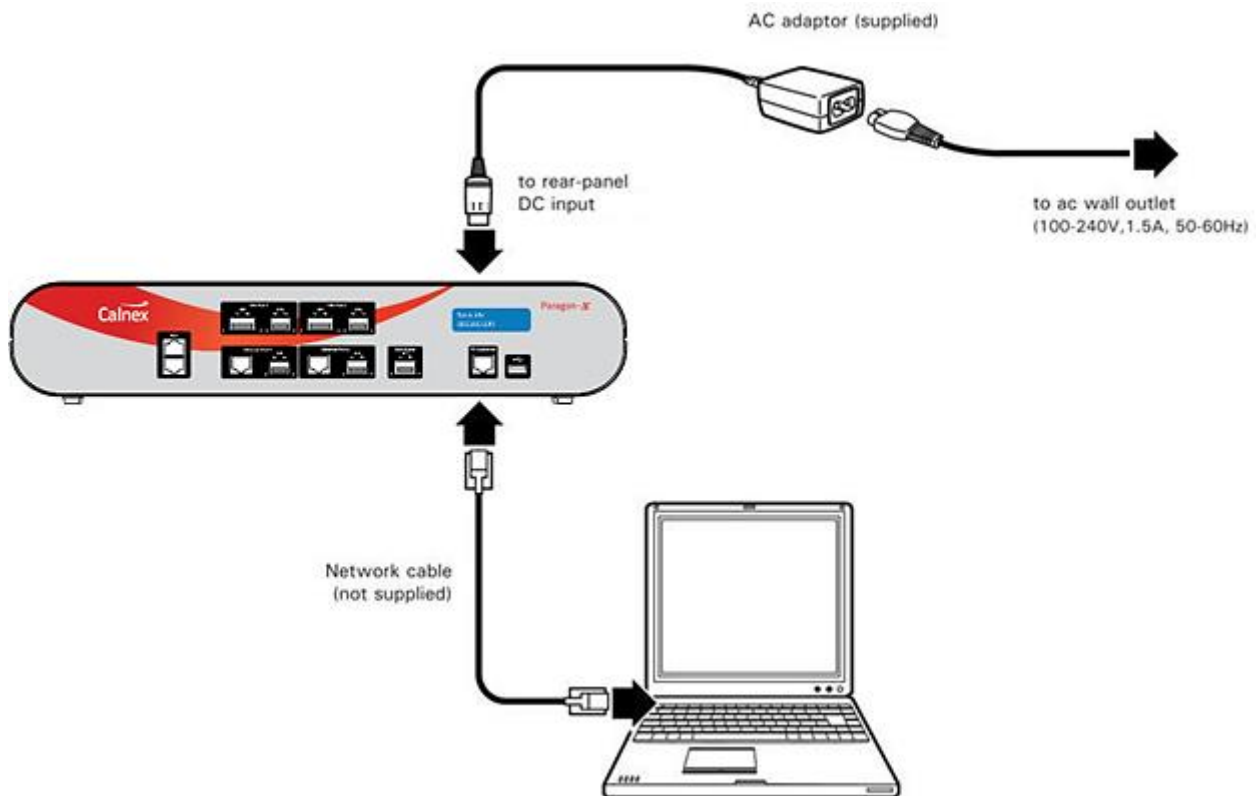


**Power Cycling** – When power cycling the Paragon-X, allow 20 seconds between switching off and switching back on so that all power inside the instrument dissipates.

# Configuring Your Computer

You must modify the computer network settings as described in the instructions below.

Note that the instructions below refer to a direct connection to Paragon-X: the recommended configuration deploys a host PC running the Paragon-X application connected directly to the Paragon-X. The host PC has two Ethernet ports to allow connection directly to the Paragon-X and to the network. Control of Paragon-X is then enabled by a remote desktop connection to the host PC from any accessible PC.

Calnex ship Paragon-X instruments with a default IP address of 192.168.3.100. Paragon-X IP addresses can be changed from the GUI. Paragon-X requires a static IP address, DHCP address allocation is not supported.

When connecting to the network, be aware of the IP address range used in that network and any associated subnet mask and default gateway addressing requirements. If in doubt, contact your System Administrator for the appropriate information.

While it is possible to connect to Paragon-X over a network, performance in this situation is not guaranteed and so this should be avoided if possible.

> **Windows Firewall settings** may need to be modified to allow connection to Paragon-X as this communication requires access to the following ports. If issues are found trying when to connect to Paragon-X or run the associated software, first confirm that these ports are available:
>
> Paragon-X remote client application: **ports 9990** and **9000**
>
> CAT and PFV: **ports 1337** and **1338**
>
> If Paragon-X is connected via a LAN you may need to contact your local system administrator. For direct connections, it may be possible to disable Windows Firewall, but before doing so relevant local IT security policies and controls should be confirmed.

# Installing the Application Software

The Paragon-X software comprises two parts: embedded software which is pre-installed on the Paragon-X hardware prior to delivery, and application software supplied on a USB memory stick requires installing on the host PC to allow control of Paragon-X. Updates to the Paragon-X software are released through the Calnex Software Server, please contact your local Calnex representative to request an account on the server.

To install the Paragon-X application software:

1. Insert the USB stick into a USB port on the host PC. Depending on the PC configuration, Windows Explorer may launch automatically. If it does not, open Windows Explorer. Browse to the USB device, double click the **setup.exe** file then follow the on-screen instructions. Several applications will be installed in sequence, allow them all to install.
2. Once the installation process is complete, click on **Start > All Programs > Calnex > Paragon-X** to launch the Paragon-X Remote Client app as shown below (note that the path may be different if the settings were changed from default during the installation process):
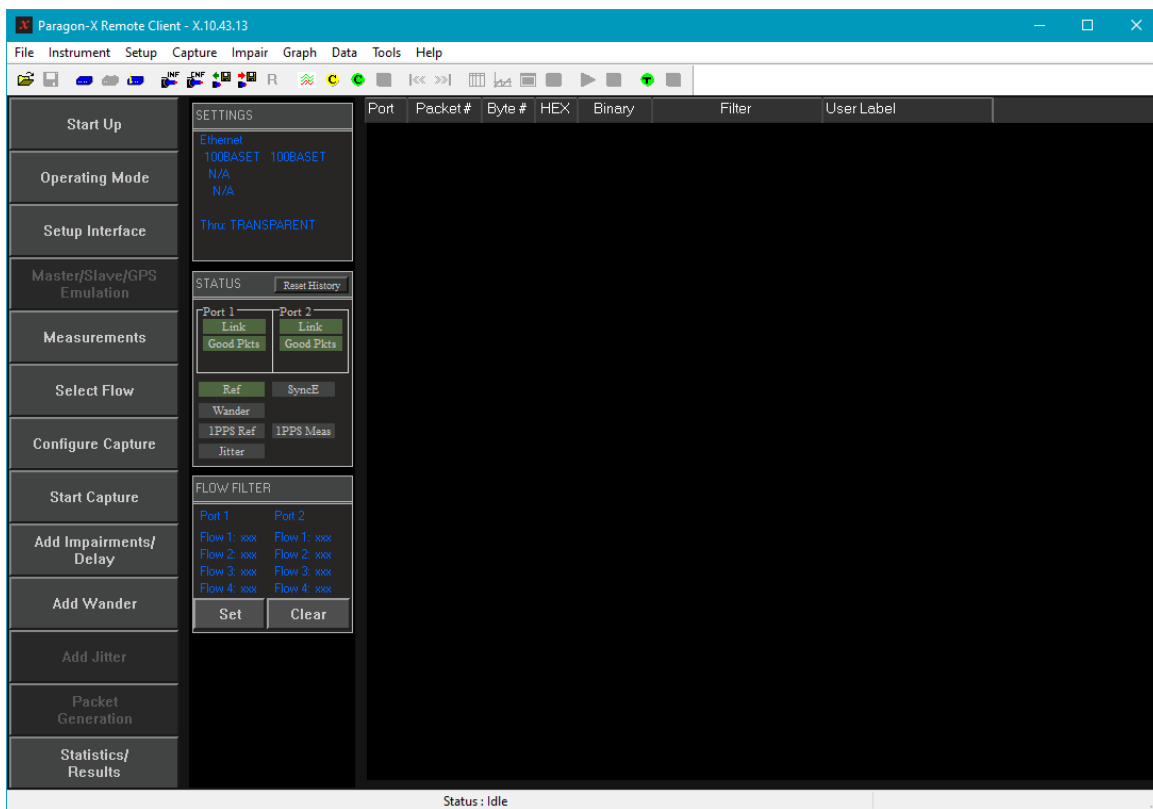


The software version of the Paragon-X application can be found by clicking on **Help > About Paragon Remote Client**.

3. For full functionality, Wireshark should also be installed on the host PC. A Wireshark installer is included on the installation USB stick provided with Paragon-X, or the latest version may be downloaded from www.wireshark.org. Once obtained, double click on the Wireshark***.exe file and follow the onscreen prompts.

4. It is possible to use the Paragon-X Remote Client app without being connected to an instrument. This allows existing capture and replay files to be manipulated without requiring access to the Paragon-X hardware, or, by clicking **Help** then **Demo**, a demo mode which uses pre-configured demo capture files to simulate measurements may be accessed.

# Graphical User Interface Basics
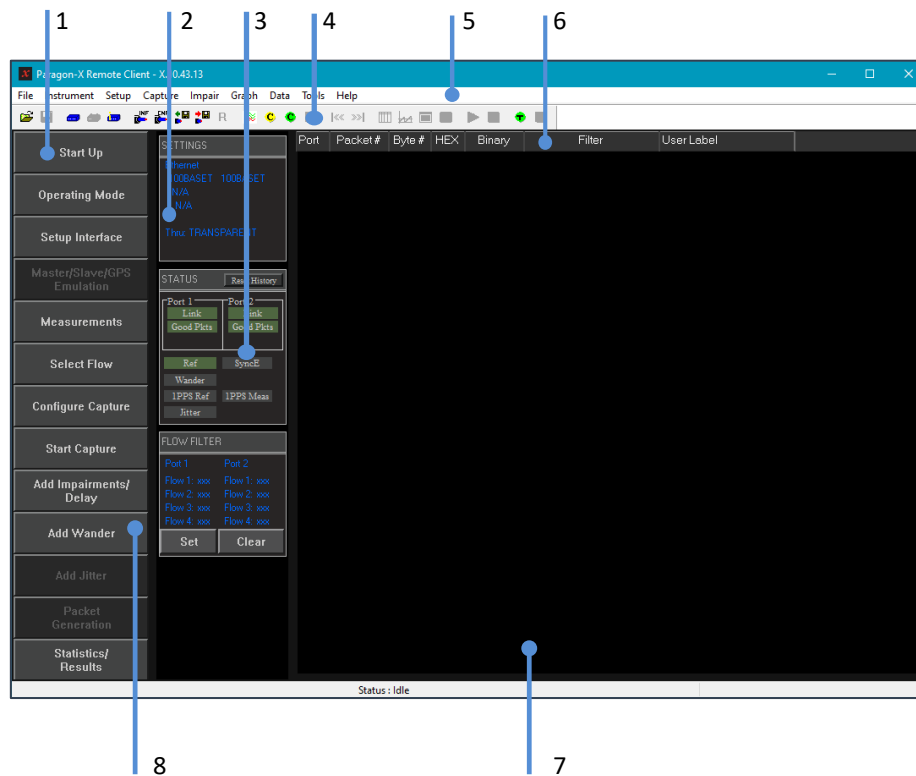


## 1. WORKFLOW

Use these buttons in top-to-bottom sequence to configure Paragon-X, capture data and apply impairments as required. Further information on each is available below.

## 2. SETTINGS

Shows current Paragon-X interface settings.

## 3. STATUS

For each item below, the colour indicates the status:

       green    - no alarms

       red       - current alarm

       yellow   - historic alarm (i.e. alarm has occurred within the current test duration)

       grey     - not active in the current configuration

- **Link**: indicates if there is a physical Ethernet connection to Paragon-X by detecting transitions on the selected port Rx side.

- **Good Pkts**: indicates Paragon-X is receiving Ethernet packets with no PCS or checksum errors. Legend changes to BAD PACKETS and red indicator if condition fails.

- **Ref**: indicates if Paragon-X is locked to the selected frequency reference source as configured in the **Setup Interface** window.

- **SyncE**: active when **Sync-E Clock Rx** > **Tx** selected in the **Setup Interface** window. Indicates Paragon-X Tx clock is locked to the incoming Sync-E line signal.

- **Wander**: indicates Paragon-X is locked to the selected wander measurement input signal (see 'Wander Measurement Input' rear panel connector description).

- **1PPS Ref**: indicates Paragon-X is locked to the 1PPS reference (see '1PPS and 64K AMI' panel connector descriptions).

- **1PPS Meas**: indicates Paragon-X is receiving a 1PPS measurement input (see 'Aux ports RJ45' front panel connector description).

- **Jitter**: indicates Paragon-X is locked to the selected jitter measurement input signal.

## 4. Icon Menu Bar

Provides quick access to various Paragon-X functions.

## 5. Main Menu

Enables access to dropdown menus for configuration, settings and measurement modes of the Paragon-X. Many provide access to functions also available via workflow buttons and icon menu bar items, allowing alternative methods for controlling Paragon-X depending on user preference.

## 6. Mode Title Bar

Identifies the type of decoded information displayed; column names are dependent on the type of data shown. Alarms, errors and sequence anomalies in captured data (live or pre-captured) are highlighted by a red exclamation mark.

## 7. Tabulated Captured Data

Displays decoded information from the data captured by Paragon-X, either live or loaded from a saved capture file. Actual display depends on the type of data being decoded, but may include message and timing information.

## 8. Flow Filter

Indicates whether any active filters have been set for capturing or replaying packets. Values displayed are xxx for no filter and SET if a filter is configured. Filters can be viewed and set manually using the **Set** button, or set automatically using **Flow Wizard** accessed via the **Select Flow** button. Active filters may be cleared by clicking the **Clear** button in this section.

# Paragon-X Workflow

From the Workflow buttons:

1. The first step is to connect to Paragon-X. Click on **Start Up** then **Connect**.

2. Enter the Paragon-X IP address and your username, if required (the default is your PC username) then click on **OK**. If failure to connect occurs, check your network connection and host PC network adapter settings (see details in previous section).
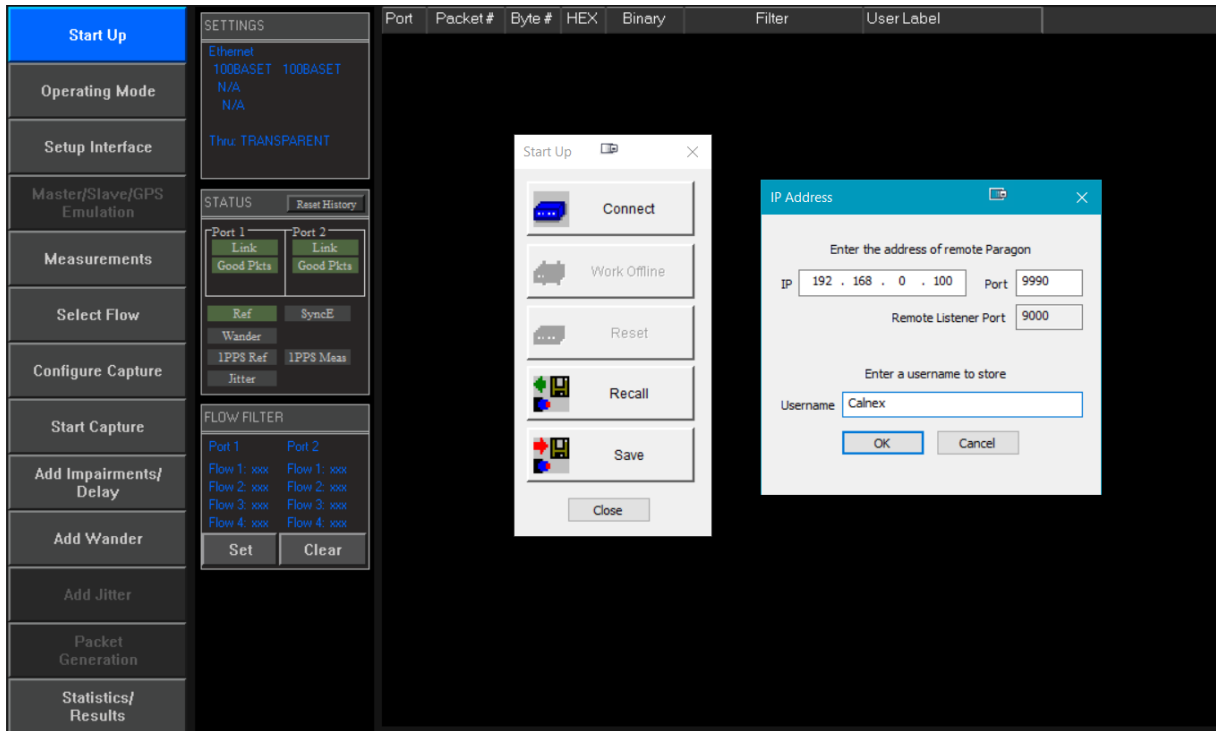


3. Click on **Operating Mode**.

4. Select the traffic type.

   Note: available modes will depend on the options fitted (licenced) on Paragon-X:

   - **CES**: Circuit Emulation Service, for example, CESoP, SAToP, TDMoIP. (Requires Option 202)
   - **1588v2**: IEEE1588v2 advanced analysis features
     **Enable Master/Slave Emulation**. (Requires Option 250 or 252)
   - **Services**: Analyse and impair any Ethernet or IP traffic (available on all instruments).
   - **Sync-E**: Synchronous Ethernet (Requires Option 213)
   - **NTP:** NTP Capture, Header decode & Timing Analysis (Requires Option 404)
   - **Ethernet OAM:** OAM capture, overwrite and impairment generation to 802.1ag and Y.1731 (Requires Option 301)
   - **MPLS-TP OAM**: MPLS Transport Profile OAM (PTN version using Y.1731) capture, overwrite and impairment generation (Requires Option 302)
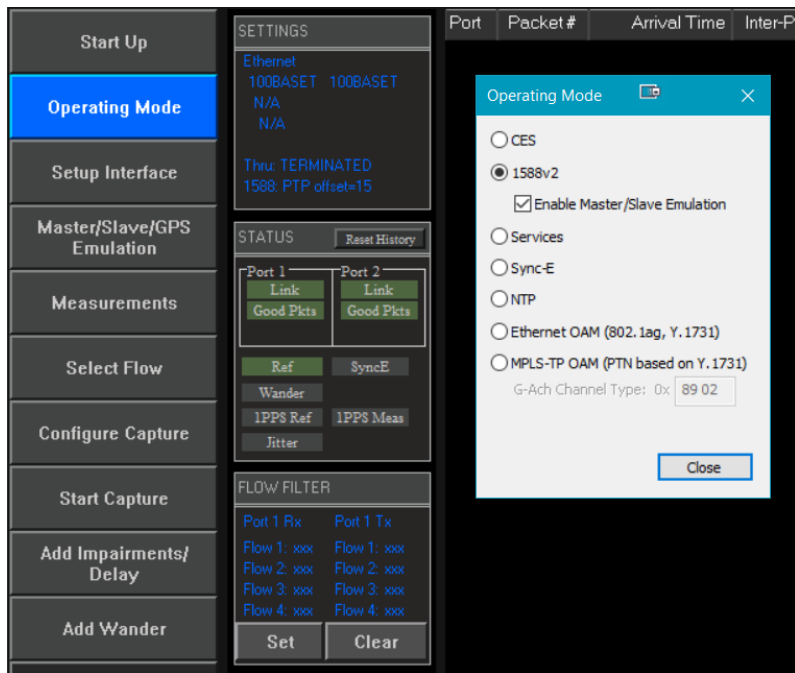
5. Click on **Measurements.** Select the required measurements from the displayed list (available options are dependent on the configuration and traffic type selected). An example selection is shown below:
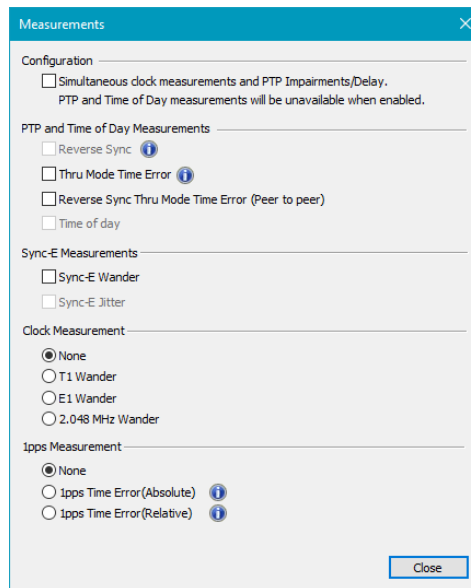


6. Click on **Close** to close the dialog box.

7. The **Configure Capture** workflow button may then be used to configure detailed settings for the selected measurements.

8. Click on **Setup Interface** to configure the ethernet interfaces, references and measurement parameters to match the requirements of the device to be tested and inputs available to Paragon-X. Suitable SFP/SFP+ or XFPs must be inserted into the relevant Paragon-X ports to allow the selection of the associated optical interface:
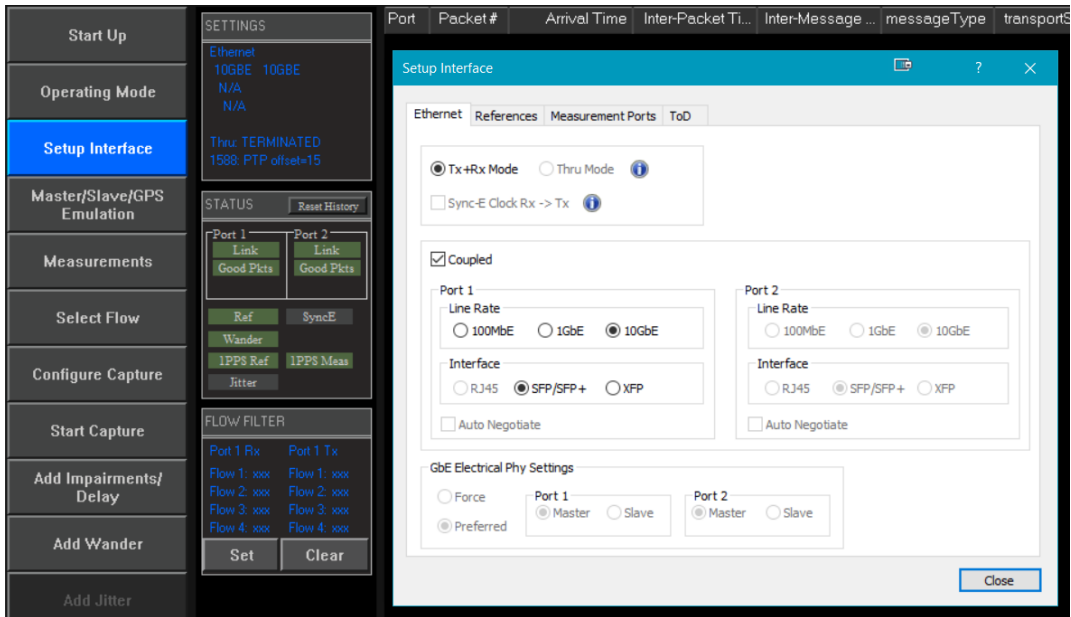
9. Click on **Close** to close the dialog box.

10. To manually set filters, click on **Select Flow**. Note: this step is *not* required for testing using 1588 Master/Slave Emulation, and that this button becomes **Set Flow Filter** when the operating mode is Ethernet OAM.

11. Click on **Capture Packets** then **Stop Capture**.

12. Click on **Flow Wizard** to display all captured flows, then select those of interest by clicking on each. Multiple lines may be selected by ctrl-clicking. **Set Impair** to set the filters for packet impairments, and **Set Capture** for packet decode and measurement filter setting. The **Set impair** option is only available in Master-Slave Emulation mode when capturing on the Paragon-X Master port, or in Thru mode.
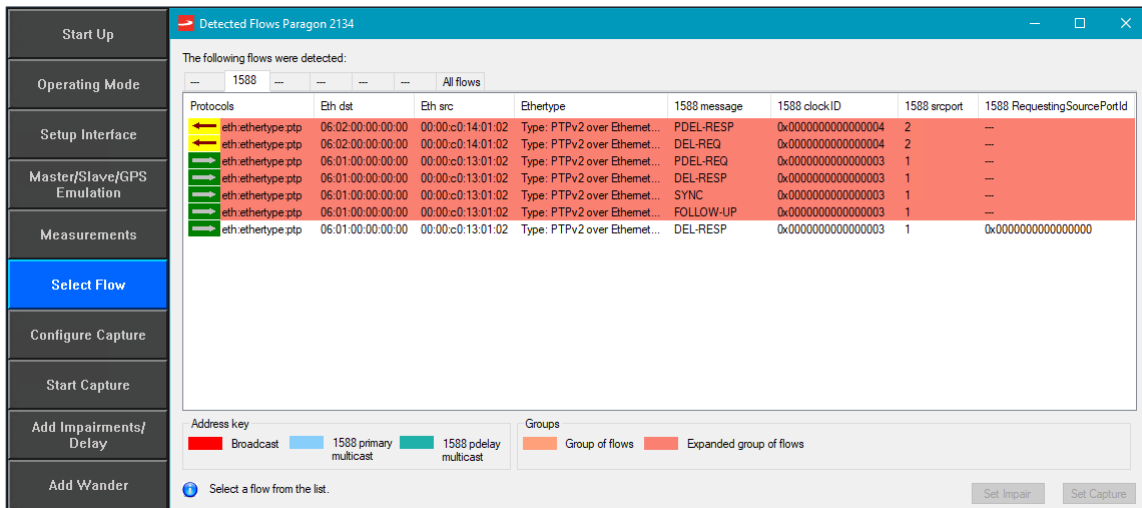


13. Click on the window control X in the top-right corner to close the dialog box.

14. For CES, 1588v2, Service and Sync-E operating modes, click on **Configure Capture**. Note that this button becomes **All Packet Capture and Analysis** in Ethernet OAM operating mode.

Please refer to appropriate Calnex application notes and Paragon-X software release notes for detailed operational steps and result interpretation in relation to specific tests. These may be accessed from the Help menu in the Paragon-X application.

# Paragon-X Constant Time Error (cTE) measurement

This section details how to perform a Time Error test. This requires Paragon-X to have Opt. 250 (Master/Slave Emulation End to End) or Opt. 252 (Master/Slave Emulation Peer to Peer) fitted.

1. In **Operating Mode**, select **1588v2** and tick the **Enable Master/Slave Emulation** box.

2. On the **Setup Interface** screen, configure the ethernet interface to match the device under test e.g. **1GbE optical***.

3. Click the **Master/Slave Emulation** button on the main GUI then configure for the device under test e.g. select **Boundary Clock** in the Test Configuration dropdown menu. Select a suitable profile from the dropdown menu above the test set-up graphic, or use the **Configure** button to access manual settings. Note that the displayed image will change depending on which type of test has been selected and so provides a convenient checkpoint for device connectivity requirement.

4. Press the **Start** button in the Measurement section. This will start master-slave emulation, set up the appropriate capture filters, and start a capture.

   N**ote:** when configured to use 100M line rate, instead of using the **Start** button, first enable the required PTP filters by using **Capture > Flow Filter** menu option then start MSE by using the green **Master+Slave** button before starting capture. This allows Paragon-X to adjust for clock-cycle offsets inherent at this rate.



5. Allow to run for 30s (or longer if desired).
6. Stop the capture by clicking the red **Stop Capture** button, then stop master-slave emulation by clicking the red **Master+Slave** button at the bottom of the master-slave screen.

7.  Select **Time Error Measurement** from the **Tools** > **Calnex Analysis Tool (1588v2)** menu. This will start CAT, which allows the observation and analysis of data captured by the Paragon-X hardware and application.

8.  When CAT launches, the **Select file** page is initially displayed and the live capture file pre-selected. The **Select Metrics** button presents a list of available clock, packet and time error metrics, with those appropriate for the current test pre-enabled. for further information on any given metric, including their meaning, any relevant Standards, and the maths used in their calculation, select the '?' icon beside its entry.

9.  The **View Results** button will display graphs and statistics for the currently-loaded data. Each type of metric is presented in its own tab, and may be viewed by clicking on each as appropriate.

*Please note that it is expected that idle symbols are transmitted in pairs. If testing using 100M interfaces, please confirm with the PHY vendor that their implementation uses this technique. At 100M rate, the presence of odd idle symbols will result in timing measurements being offset by one clock cycle (40ns).

# Option 132 Rb/GPS Frequency Reference

The Calnex external Rb/GPS Frequency Reference may be supplied as an option to Paragon-X or ordered separately. The device provides a 10MHz and a 1PPS measurement reference that may be used by Paragon-X or other equipment.

To use the external Rb/GPS Frequency Reference simply connect a GPS Antenna to the rear panel GPS Antenna Input connector, switch it on and wait until all the LEDs are green. Then connect either the 1PPS Ref Output to the Paragon-X 1PPS rear panel connector and/or the 10M Ref Output to the Paragon-X 10MHz Reference Input rear panel connector.

**Note: Care must be taken to install the GPS antenna in a safe and suitable manner – more information is available below.**



The Rb/GPS Frequency Reference has the following physical features:

• Front panel LED indicators for the status of
      o Power On
      o Rb Locked
      o Track/Sync
• Front panel connectors for
      o 10MHz Reference Output
      o 1PPS Reference Output
      o RS232 time of day (ToD) Reference Output
• Rear panel:
      o DC Power Input
      o Power switch
      o GPS Antenna Input

## Power On

The Power ON LED is green when the power switch is on and power is connected.

## Rb Locked

The Rb Locked status LED is green when the internal crystal oscillator is locked to the rubidium source.

### Track/Sync

The Track/Sync status LED is green when the 1PPS output of the rubidium source is aligned to the GPS signal's 1PPS.

### 10M Ref Output

50Ω BNC connector. Output: 10MHz sinusoidal signal of 4.0Vpp/50Ω.

### 1PPS Ref Output

50Ω BNC connector. Output: 1PPS pulse (0/5V CMOS), pulse width 100μs.

### RS232

ToD Message: NMEA format $GPRMC (see screenshot below for message format).

ToD message output is transmitted on pin 3 as RS-232 Transmit 0-5V. Pin 5 is GND. Pin 2 is RS232 Receive 0-5V.

```
$GPRMC,085331.00,A,5558.8958,N,00337.7333,W,,,140312,,,E*43
$GPRMC,085332.00,A,5558.8958,N,00337.7333,W,,,140312,,,E*40
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$GPRMC,085353.00,A,5558.8958,N,00337.7333,W,,,140312,,,E*47
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### DC Power Input

For connection to supplied AC power adaptor only.

Power supply: ac input 100-240V, 1.5A, 50-60Hz. dc output: 8.3A @ 12V (100W) [8-pin DIN]

### Power Switch

Use this switch to switch the Rb/GPS Frequency Reference On or Off.

### GPS Antenna Input

This is for direct connection to an external GPS Antenna. Guidelines for Antenna installation are below:

#### Locating the GPS Antenna:

For optimal operational performance, the GPS antenna must have a direct view of satellites with an unobstructed line of sight to the sky. Sites such as rooftops clear of overhanging natural or manmade structures, ideally with views to the horizon, are good candidates.

Installations with obstructed views may experience reduced reception quality and may not be able to track the maximum number of satellites. An observation angle of 70° from the vertical axis (i.e. to 20° above the horizon) usually offers good performance. The antenna should not be placed in a position where it can become obstructed due to e.g. weather conditions or plant growth.

Whenever possible, avoid placing the antenna in close proximity to broadcast antennas or high-power transmitters.

**Connecting to the Antenna:**

The antenna cable must be clear of any potential standing water to avoid the risk of the cable jacket being breached over time. If installed on a flat roof, the cable should be within a sealed conduit or raised using cable hangers. GPS antenna cable can be installed through a conduit either by itself or with other cables. The conduit dimensions must be large enough to accommodate the GPS cable, which has a diameter of about 0.2" (5mm). Using a conduit that is too small or with a bend radius that is too tight may cause difficulties during installation (and may damage the cable). A bend radius of at least 5 times the cable diameter (i.e. of at least 1" / 25mm) is recommended.

An EMP protector is provided to protect indoor equipment against lightning damage. Install the EMP protector and properly connect it to earth (ground) at the point where the antenna cable enters the building.

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WARNING

It is essential the GPS Antenna input is connected properly and safely to the GPS antenna. The GPS antenna and associated cables require an EMP Protector to be fitted for safety reasons. The EMP Protector should be professionally fitted as per the manufacturer's instructions which are provided with the EMP Protector.

Observe all local regulations on the fitting, grounding and specification of lightning or surge arrestors on the antenna cable.
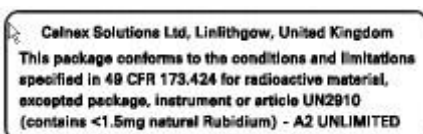
Disconnect or switch off in-line equipment when installing, checking, disconnecting and connecting EMP protectors. This includes during the exchange of gas discharge tubes. Avoid performing such activities during thunderstorms.

Be aware that only a complete protection system according to IEC 62305-1 can protect your equipment and personnel against the impact of lightning. This includes an external lightning protection system with air terminal, down conductor and grounding system, and bonding of all incoming and outgoing lines, not only RF lines (e.g. includes protectors for mains, data and telephone lines).

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## Labels and Disposal Information

The Waste Electrical and Electronic Equipment regulations label indicates that the equipment should only be disposed of through an approved method. At end of life please dispose of the equipment through a recognized and approved scheme fulfilling the local environmental requirements. Alternatively, contact Calnex to arrange for return and disposal.

Calnex Solutions Ltd, Linlithgow, United Kingdom
This package conforms to the conditions and limitations specified in 49 CFR 173.424 for radioactive material, excepted package, instrument or article UN2910 (contains <1.5mg natural Rubidium) - A2 UNLIMITED

A low hazard warning label indicates that this package conforms to the conditions and limitations specified in 49 CFR 173.424 for radioactive material, excepted package, instrument or article UN2910 (contains <1.5mg natural rubidium) - A2 UNLIMITED.

# Option 133 1PPS/ToD/Frequency Converter

The Calnex external 1PPS/ToD/Frequency converter may be purchased as an option to use with Paragon-X.
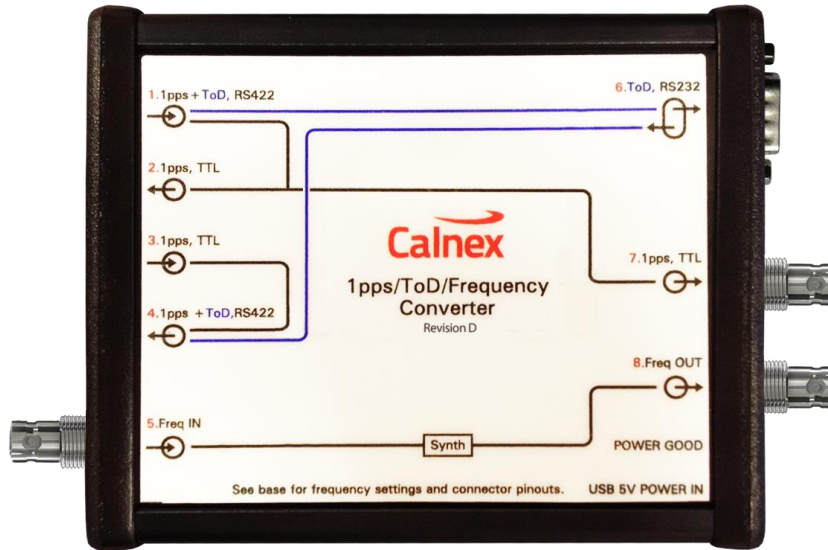


| Function | Input | Output |
|---|---|---|
| Split balanced 1PPS+ToD signals to separate unbalanced 1PPS and ToD RS232 signals | RJ48 connector port 1. Balanced 1PPS and RS422 ToD. | Unbalanced 1PPS on RJ48 connector (port 2) and on BNC (port 7). ToD RS232 signal on DB9 connector (port 6). |
| Convert ToD RS232 signal to RS422 | RS232 on DB9 connector (port 6) | RS422 on RJ48 connector (port 4) |
| Convert unbalanced 1PPS signal to balanced 1PPS signal | Unbalanced 1PPS on RJ48 connector (port 3) | Balanced 1PPS on RJ48 connector (port 4) |
| Frequency conversion. See picture below for conversion options. | BNC connector (port 5) | BNC connector (port 8) |

**Size**: 140x35x105mm.
**Weight**: 320g.
**Power Supply**: USB 5Vdc/3W direct.
**Environmental Specifications:** Same as Paragon-X.

The peak-peak frequency input to the converter should be in the range of 200mV–3V into 50Ω. The converter can accept either sinusoidal or square waveform. The frequency output is 1.5Vp-p square wave into 50Ω.

The **POWER GOOD** LED is on when power is supplied to the converter. There is no power switch. Power can be supplied from an active USB port.

Switches SW1 and SW2 are the only controls on the device. Set these switches according to the table printed on the rear panel and desired input/output frequencies.

| Freq IN | SW2 | SW1 | Freq OUT |
|---------|-----|-----|----------|
| 10M | ON | ON | 2.048M |
| 5M | OFF | ON | 10M |
| 25M | ON | OFF | 10M |
| 10M | OFF | OFF | 25M |

| Pin | Port 1 | Port 2+3 | Port 4 | Pin | Port 6 |
|-----|--------|----------|--------|-----|--------|
| 1 | – | Signal | – | 1 | – |
| 2 | – | GND | – | 2 | RXD |
| 3 | 1pps N | – | 1pps N | 3 | TXD |
| 4 | GND | – | GND | 4 | – |
| 5 | GND | – | GND | 5 | GND |
| 6 | 1pps P | – | 1pps P | 6 | – |
| 7 | ToD N | – | ToD N | 7 | – |
| 8 | ToD P | – | ToD P | 8 | – |
| | | | | 9 | – |

To reduce sources of inaccuracy Calnex recommend that 1PPS measurement signals are not passed through the converter. If 1PPS measurement signals are passed through the converter, great care must be exercised to determine the precise propagation delay and add this into the cable compensation value in Paragon-neo.

If the precise port-to-port propagation delays are not printed on the converter, a method to determine the delays is provided in the Calnex FAQ (keyword "Option 133") accessed through the support pages at www.calnexsol.com.