Calnex **Sentinel**

Calnex
Insight and Innovation

GETTING STARTED GUIDE

ITU-T **G.8275.1 Measurement**

## Initial Power On

Upon initial power on of Sentinel, the following screen appears. The **Recall Settings** option allows previously saved configuration files to be re-loaded, automatically setting up Sentinel to the state defined in the preset file and move to the main operating screen. Selecting the **Manual Setup** option moves directly to the main operating screen.
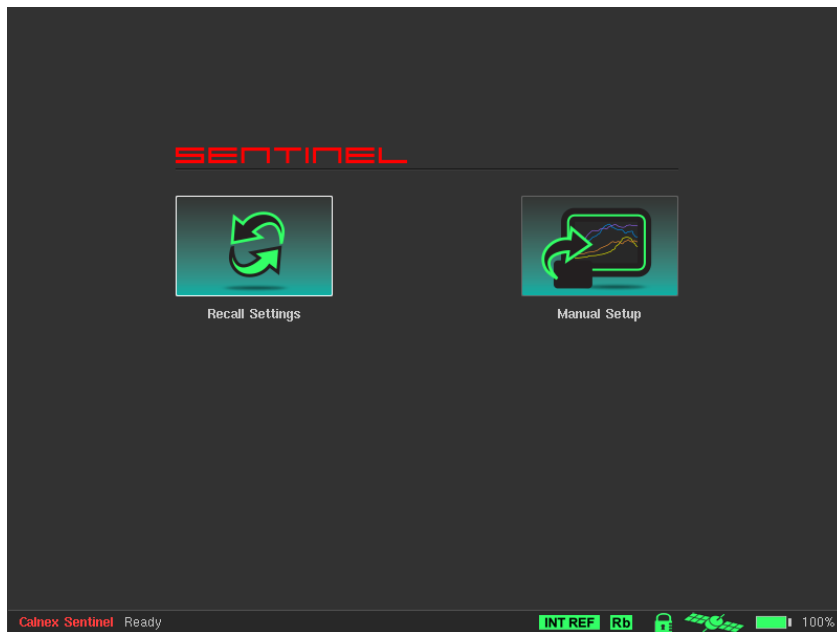


## Main Screen
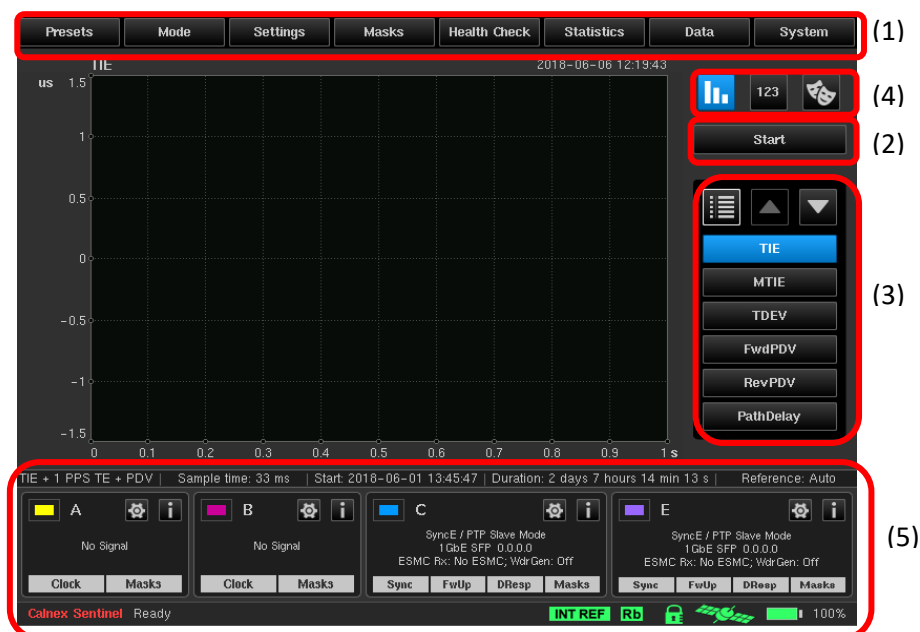


The main screen contains controls to allow simple, ordered configuration (1) and operation (2) of Sentinel. Navigation buttons allow movement between each measurement result graph (3) and change the mode of viewing results (4). The status of the measurement sub system is shown in widgets and icons at the bottom of the screen (5).

**Measurement Setup**

Manual configuration of Sentinel is simply a process of working through the tabs on the main screen as detailed below.



The mode screen allows the Sentinel measurement subsystem to be configured as required by the type of testing being performed. In this example Sentinel is performing a G.8275.1 time / phase measurement and requires a clock channel to measure the 1pps signal from the DUT and an Ethernet connection to an output from the edge router. This Ethernet connection will be used to communicate with the PTP GM and can additionally perform a TIE measurement on the SyncE recovered clock. Here clock channel B is chosen for the 1pps input and Packet card E for the PTP connection. Sentinel can also be configured to run in monitor mode through this screen.
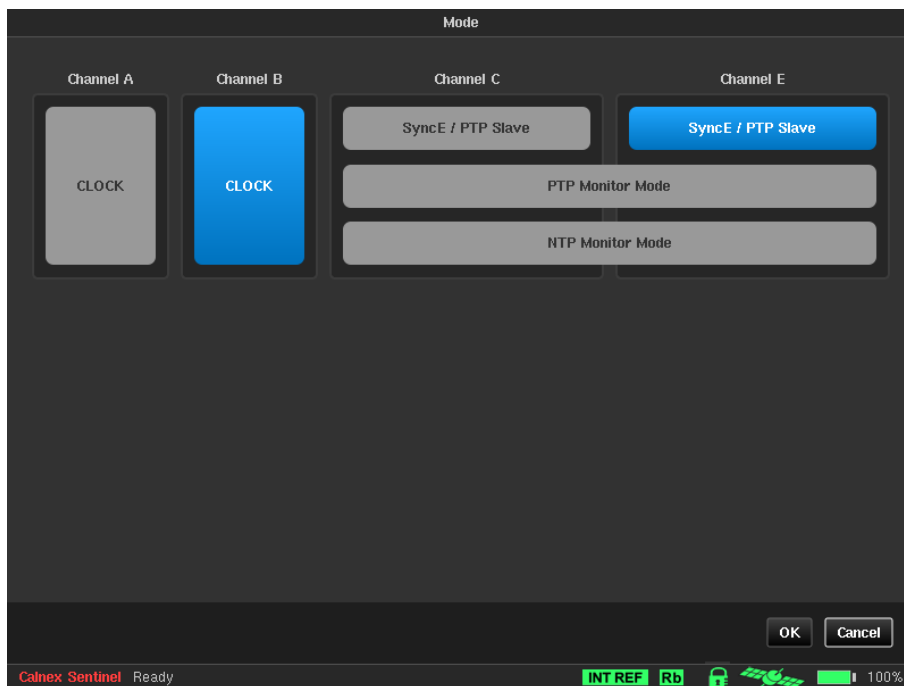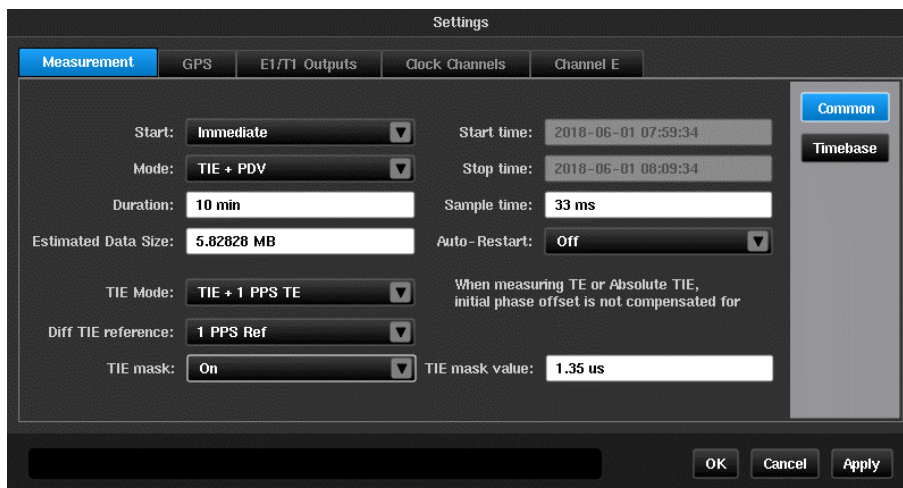


Disabling unused channels simplifies configuration and result viewing by removing these channels from the configuration and results screens.



The settings screen contains tabs to configure all of the relevant measurement subsystems selected through the mode screen.

The measurement common screen allows the measurement duration and type to be defined.



The measurement can be started immediately or deferred to a specific **Start time** and optionally stopped at a specific **Stop time**. The **Sample time** for TIE measurements can be set in the range 5ms to 6.5535s. For a G.8275.1 measurement the **Mode** must be set to **TIE + PDV** and the **TIE mode** set to **TIE + 1pps TE**. The **Diff TIE reference** is set to the internal Rb **1pps Ref**. To get an automatic PASS/FAIL check on the 1pps of the DUT the **TIE mask** is set to **On** and the value set to 1.35μs.

Sentinel has an internal Rb oscillator and for phase measurements it requires disciplining prior to the measurement taking place. The measurement timebase screen allows configuration of the reference used for the measurement.
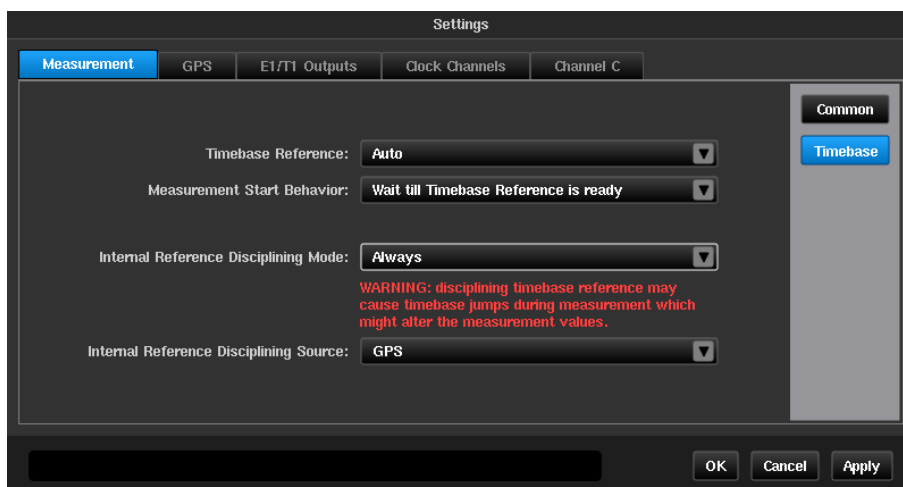


**Timebase Reference** can be set to **Auto**, **Internal** or **External**. If an external 10MHz reference is supplied and Auto or External is selected then this will be used rather than the internal Rb oscillator. The measurement can be deferred until the timebase reference is ready, aborted if it is not ready or started even if the timebase is not ready through the **Measurement Start Behavior** setting. As the G.8275.1 DUT is likely to be referenced to GPS this should be selected as the **Internal Reference Disciplining Source**. If the last disciplining was less than 1 week ago, Sentinel should be disciplined for at least 6 hours, otherwise Sentinel should be disciplined for at least 12 hours.

Disciplining can be suspended during a measurement or completely by setting the **Internal Reference Disciplining Mode** to **Never** or **Not during measurement**. Sentinel will only discipline if the disciplining source selected is producing a valid disciplining output and Internal Reference Disciplining Mode can be left to **Always** even if the source is not available. If the source is re-connected during a measurement then there may be a phase shift in the timebase reference.

The channel used for the PTP connection was selected on the mode screen and a **Channel** *x* tab will be present for each PTP connection chosen: in this case only Channel E was enabled.

The Ethernet screen allows the physical media and link transport properties to be selected. G.8275.1 specifies Ethernet multicast as the transport and the IP parameters can be left un-initialised, however the **Gateway** field must be on the same subnet as the **IP Address**.
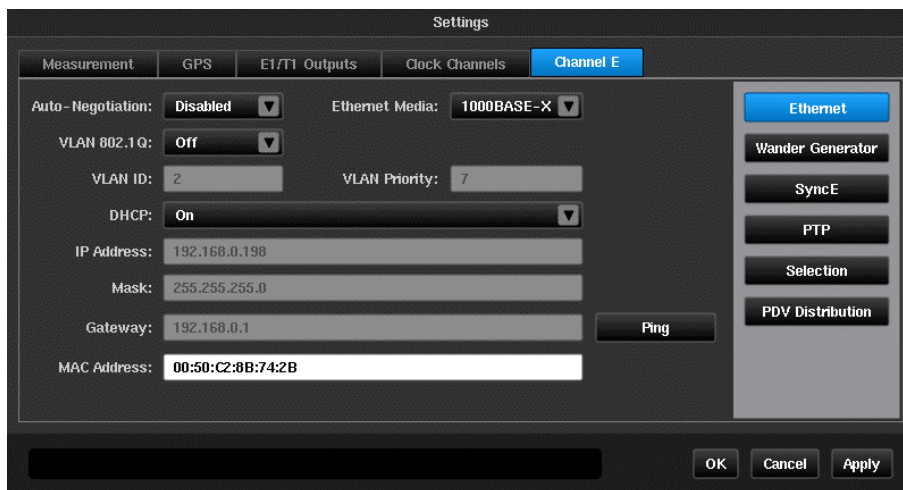


The PTP screen allows configuration of the PTP profile. Selecting **G.8275.1 Time/Phase Profile** sets up all the relevant fields with the default values specified in the ITU-T G.8275.1 profile. Fields with blue text are defined in the ITU-T specification, other fields are set to enable 2Way TE measurements. Context sensitive help is shown when specific fields are selected. For example, the **Domain** can be set to a value between 24 and 43 and still be compliant to the G.8275.1 profile.
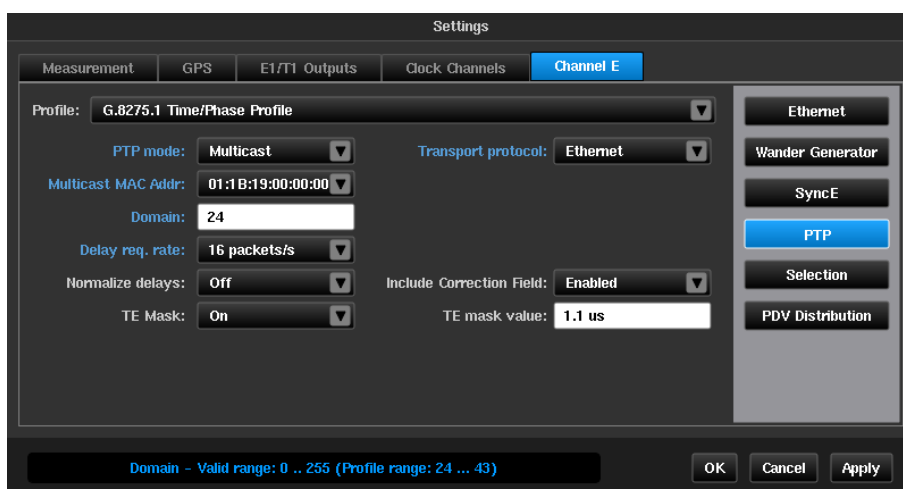
The **Clock Channels** screen allows information to be entered about the clock of the DUT, i.e. the **Signal Type**, **Trigger level**, **Slope**, **Input Impedance** and **Filter** to be used. These values are normally automatically populated when a Signal Check is run (see later).

Compensation for cable lengths and whether the Calnex 1pps Converter is used can be entered here when the **Signal Type** is **1 PPS**.
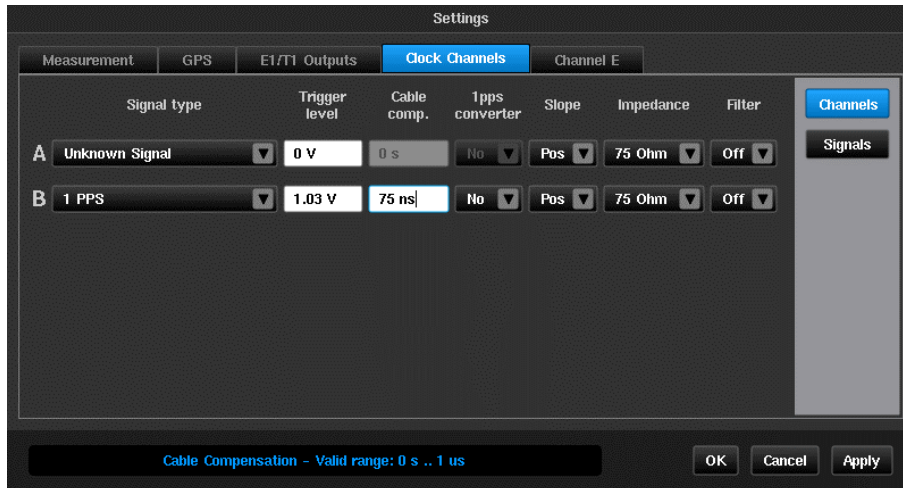




The masks screen allows selection of standard masks to be applied to MTIE and TDEV graphs. ITU-T G.8271.1 defines a Network Limit mask for MTIE of any recovered clock and this can be found by scrolling through the **Available Masks** and pressing the **Add** button when **G.8271.1 Network limit** is highlighted.
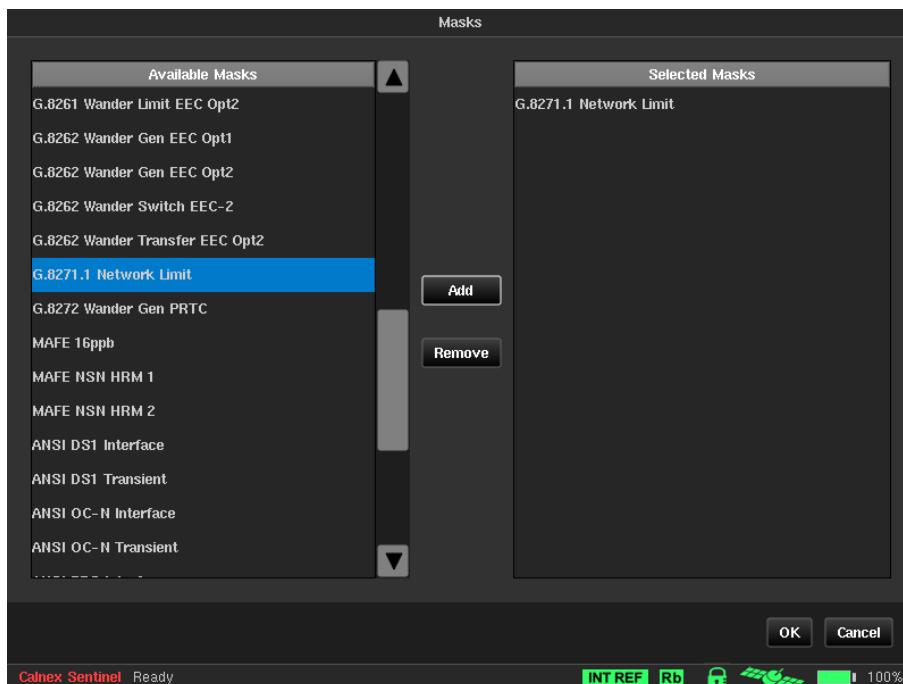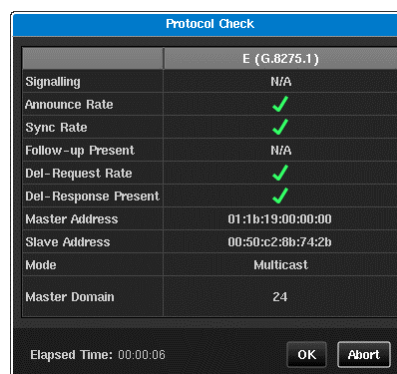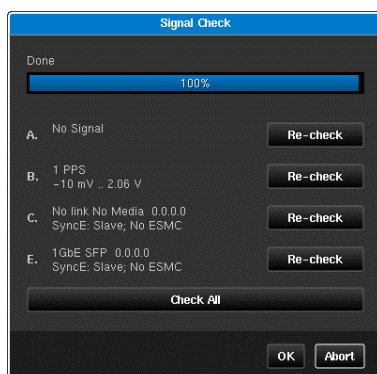
# Running a Measurement

Prior to running a measurement the measurement subsystem and PTP connection should be checked for correct configuration using the health check screen.
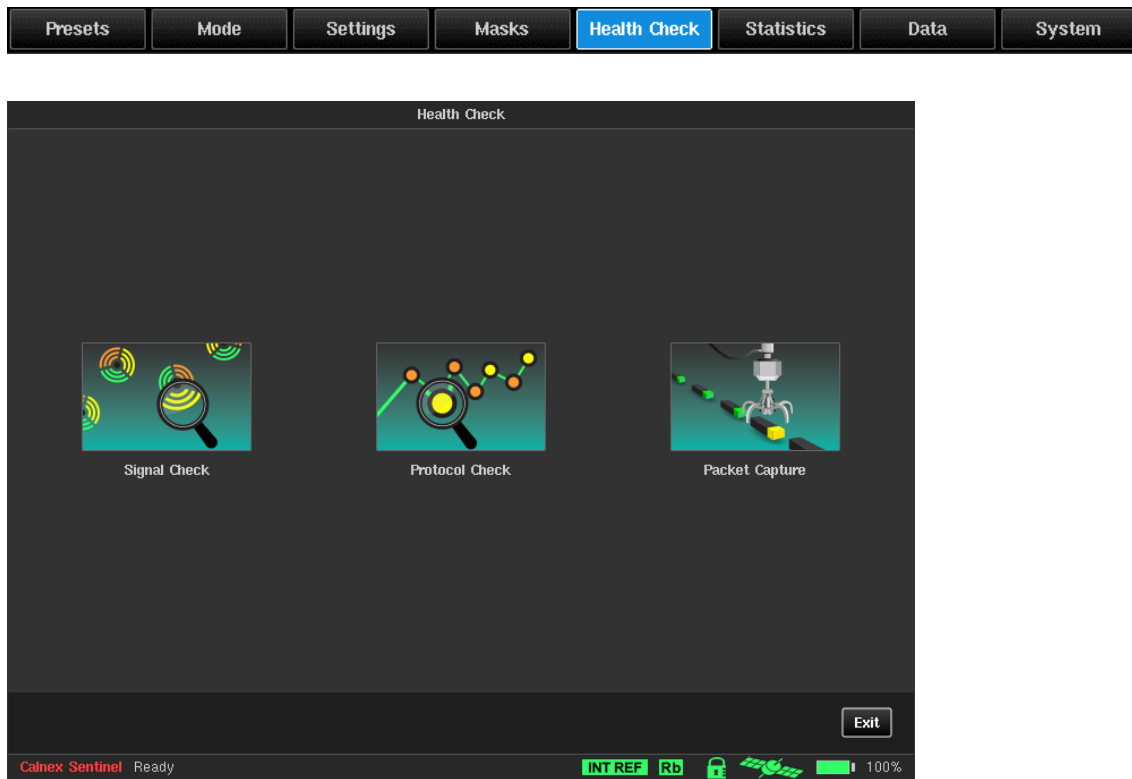




Running **Signal Check** will detect all clocks and Ethernet links connected to Sentinel and set up the measurement subsystem. If a signal check is not performed then TIE and 1pps TE measurements may display erroneous data.

For this measurement the results should show a 1pps signal connected to channel B and an Ethernet link on channel E. If this is not the case, check the physical connections then press the **Re-check** button beside the failing channel.





Running protocol check is optional but will verify that Sentinel can communicate with the PTP GM and that the expected message rates are correct.

The measurement can now be run by pressing the **Start** button on the main screen.
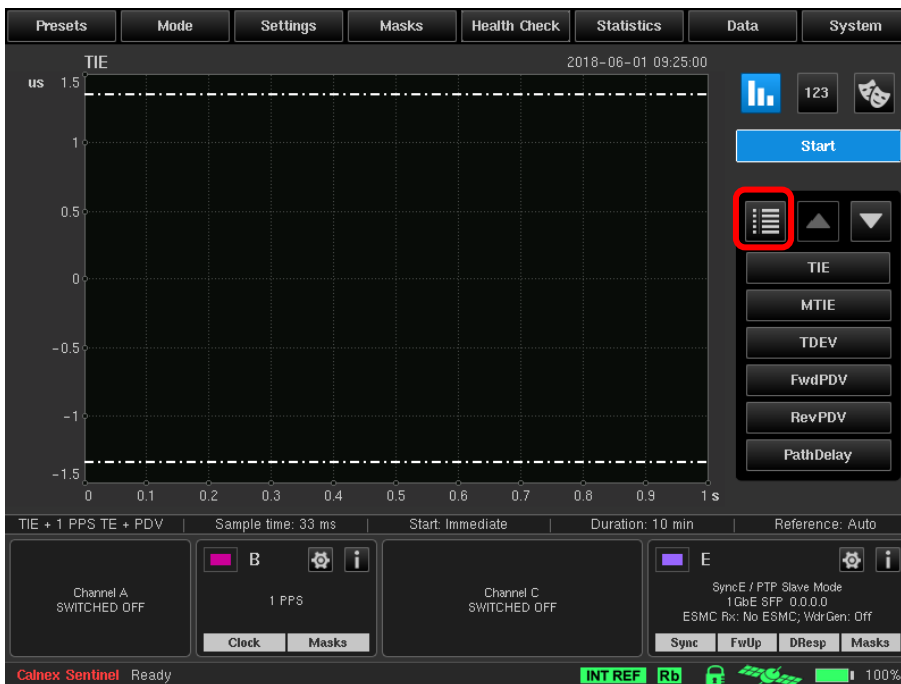


Sentinel creates a graph for every measurement and its associated metric. The graphs that are displayed and the order that they appear in the navigation panel can be configured by pressing the **Graph Selection** button.
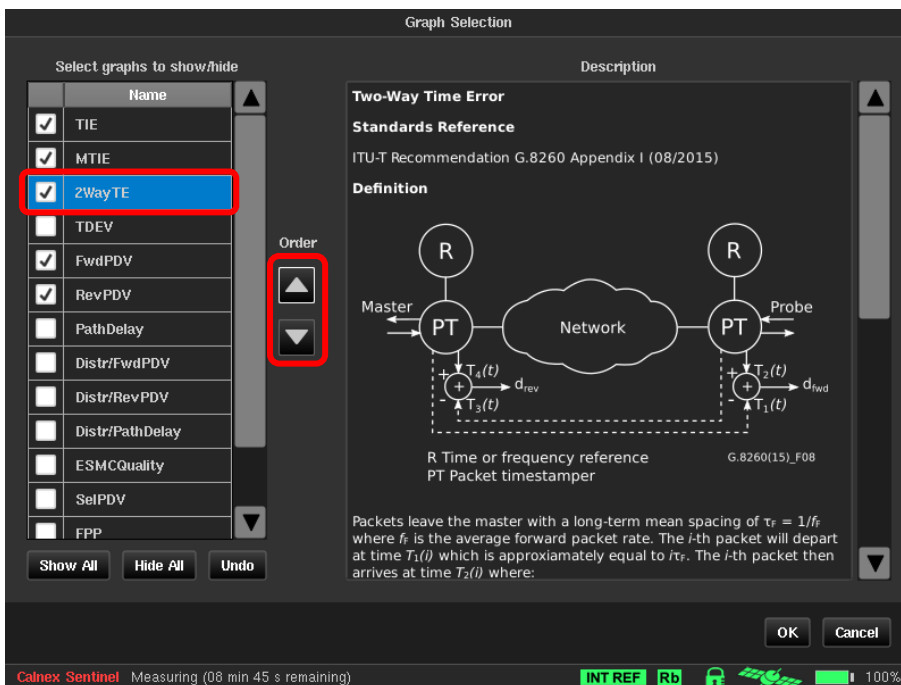


A **Hide/Show** checkbox and associated measurement description is available for each graph. Graph ordering can be changed by highlighting the graph name and pressing the **Order** arrow buttons

ITU-T G.8271.1 limits apply to 1pps TE, SyncE MTIE and 2WayTE. The PTP PDV graphs may also be of interest so in this example the TIE, MTIE, 2WayTE, FwdPDV and RevPDV are selected.

When the test completes a popup box appears giving the overall test PASS/FAIL status. A text report file can be viewed by pressing the **View Report** button.
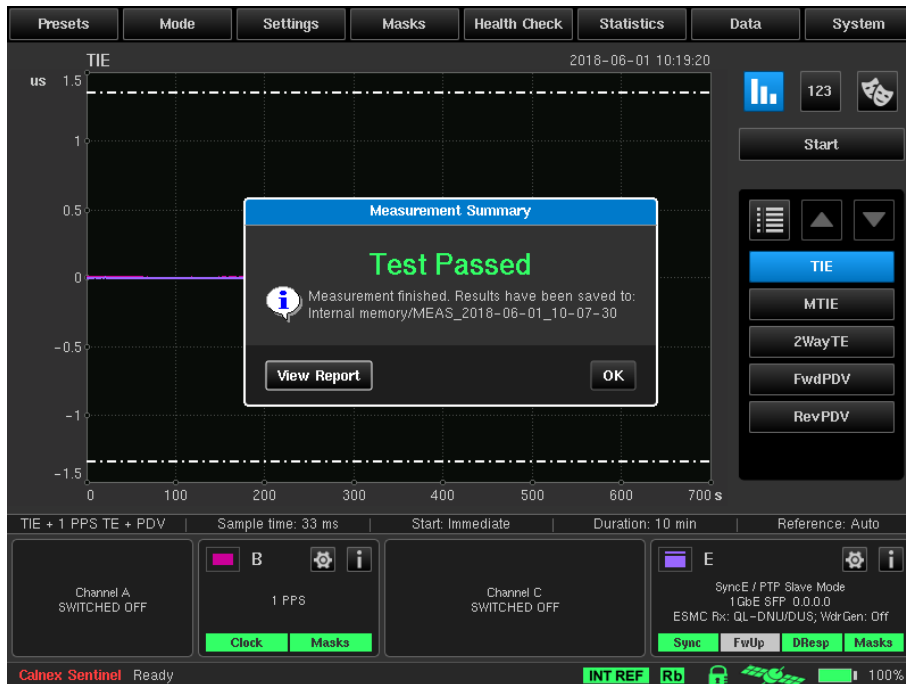


The 1pps TE graph is included on the TIE graph along with the SyncE TIE. To hide the SyncE TIE graph, press the **Hide/Show** button in the channel widget and select **Hide**. The test passes if the 1pps TE remains within the upper and lower limits of the TE mask.

The MTIE of the 1pps and SyncE is shown on the MTIE graph along with the ITU-T G.8271.1 Network limits mask. The signal passes if its MTIE values remain below the limit line.



The 2Way TE test passes if the 2Way TE graph remains within the TE mask limits.

The PTP message statistics for the measurement duration can be viewed by pressing the **Statistics** button on the main screen.



This shows totals for Valid packets, packets with PTP Sequence ID errors, Lost packets and Errored packets. The totals can also be displayed as a percentage.



Measurement analysis can be toggled on/off by pressing the **Analysis** button. This displays the mean, standard deviation, initial phase offset and final value of the measurement for the currently displayed graph.

A summary of the PASS/FAIL of individual MTIE and TE masks is available by pressing the **Masks Summary** button on the main screen. MTIE masks are individually named, TE and TIE limit masks refer to 2Way TE and 1pps TE respectively.
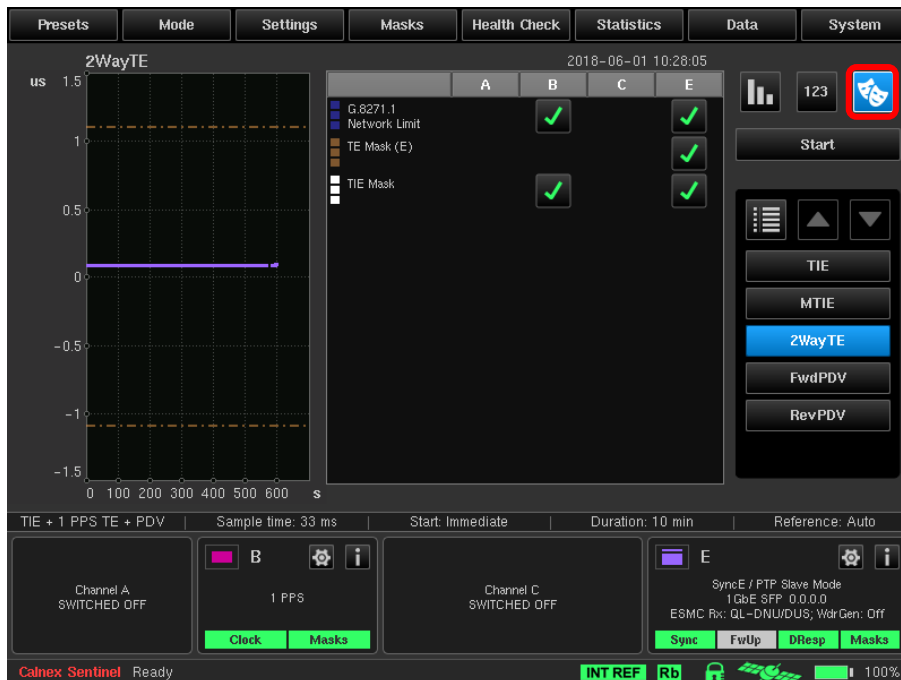


Each populated measurement channel has an associated widget to indicate the status and configuration of the channel and to allow quick access to the channel settings.

Loss of signal LEDs and Mask pass fail results are displayed at the bottom of the widget.



- A green LED indicates that the associated clock signal or PTP message is present or that the mask has passed.

- A red LED indicates that the associated clock signal or PTP message is absent or that the mask has failed.

- A yellow LED indicates that the associated clock signal or PTP message has been absent but is now present again.

- A grey LED indicates that the associated PTP message is not relevant (e.g. Follow Up when running in 1 step mode) or the test has not run long enough to validate the mask.

The **settings** button on a widget will navigate directly to the settings page for that channel.



The **Info** button will display more detailed information on the selected channel.
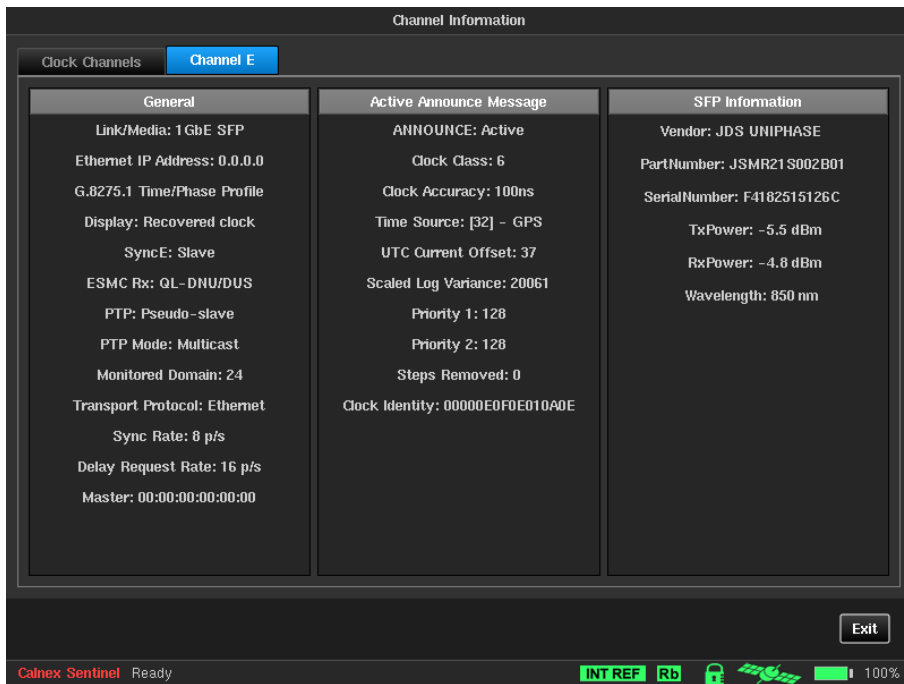
## Post Measurement Report Generation using CAT

Sentinel provides results for 1pps max|TE|, PTP max|2WayTE| and G8271.1 network limits for recovered clock MTIE. To generate a report on full G.8271.1 compliance the results should be loaded into the Calnex Analysis Tool (CAT).

For this particular example (1pps connected to channel B and Ethernet on channel 1), Sentinel stores the measurement results in the following files:

- 1pps TE – channelC.dset
- 2WayTE – channel1_FWD_PDV.dset and channel1_REV_PDV.dset
- SyncE recovered clock TIE – channel1.dset

These files can be retrieved to the local computer through FTP or by copying on to a USB stick. After opening CAT the relevant .dset files should be dragged and dropped onto the CAT window. Should you attempt to download files not recognised by CAT, an error message will be generated. If this happens, close the message and continue.

When measuring to the requirements of ITU G.8271.1 at reference point C, we are interested in three metrics:

1. Constant Time Error which is the maximum absolute low pass filtered time error (max|TE$_L$|). Set this value to ±1.1µs.
2. Dynamic Low pass filtered time error (dTE$_L$). The limits are specified in terms of MTIE and this MTIE limit as specified in the ITU recommendations is available in CAT.
3. Dynamic High pass filtered time error (dTE$_H$). Set this value to ±200ns.

It is recognised in the ITU recommendations that these measurements can be made in either directly from the two-way PTP flow or from a 1pps signal derived from the two-way PTP flow. In this example, the PTP flow is channel 1 on Sentinel and the 1pps in channel C.

CAT generates a wide range of metrics from the input data and to simplify the report the appropriate G.8271 metrics can be selected by clicking on the **Select Metrics** button on the left hand menu and selecting only the following metrics:

- Time Error (Filtered)
  - 1 – 2Way Avg Time Error (Filtered)
  - C – 1pps TE Absolute Avg Time Error (Filtered)

- Dynamic Time Error
  - 1 – 2Way Dynamic TE HF
  - C – 1pps TE Absolute Dynamic TE HF
  - 1 – 2Way Dynamic MTIE LF
  - C – 1pps TE Absolute Dynamic MTIE LF

Note: If measuring SyncE recovered clock, leave the **Clock Measurements** > **TIE / ESMC** check box ticked.
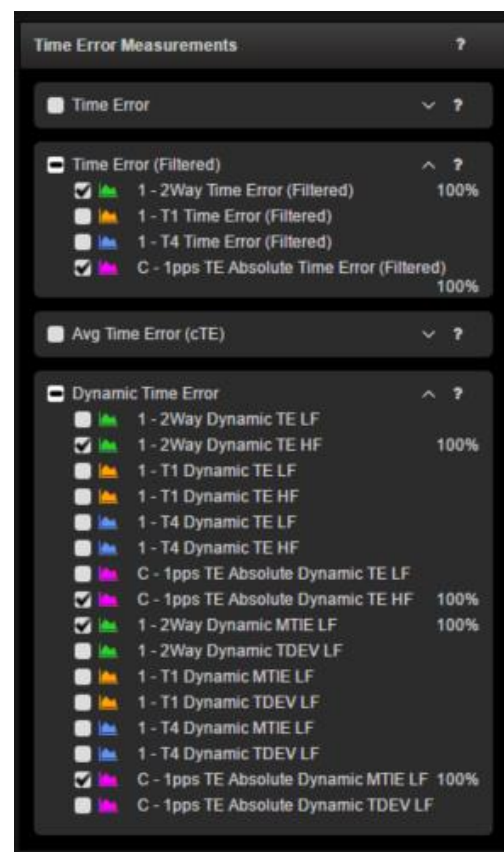
Press the **Calculate** button at the lower left of the screen and wait for the status bar to reach 100%.
Press **View Results.** The results are displayed on two tabs.



Selecting the **Time Error (Filtered)** tab displays the time error data smoothed with a 0.1Hz low pass
filter. The ±1.1µs limit specified in ITU-T G.8271.1 is entered under parameters. The measured data is
then compared to this limit and PASS/FAIL status is displayed in the upper right portion of the display.

The **Dynamic Time Error** tab shows 0.1Hz high pass filtered TE results and the MTIE of the 0.1Hz low pass filtered TE results as defined in the ITU-T G.8271.1 recommendation.



Select the **G.8271.1 Network Dynamic TE, point C** mask under Dynamic MTIE LF in the lower right of the display and set the Dynamic TE Limit +/- to **0.2μs**, tick the box and select **Apply**. Press the **Calculate** button at the lower left of the screen and wait for the status bar to reach 100%.

The Dynamic TE LF data for both the 1pps and PTP inputs are graphed as is the MTIE mask as specified in the ITU G.8271.1 recommendation. The high pass filtered data for the PTP and 1pps are graphed separately.

The status of each mask and limit is displayed in the upper right of the display.

To produce a PDF measurement report, simply click on the **Generate Report** button.

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