Testing Sync-E Wander to ITU-T G.8262

This document outlines the test process for testing Wander of FE and 1GbE SyncE network elements to G.8262 using the Calnex Paragon Sync.

Covered in this document is;

1. **Wander Generation – G.8262 Section 8**
2. **Wander Tolerance – G.8262 Section 9**
3. **Wander Transfer – G.8262 Section 10**

Appendix 1 - G.8262 Wander Testing; Practical interpretation guidance

Appendix 2 - Using a Wander Generator as the Reference Source

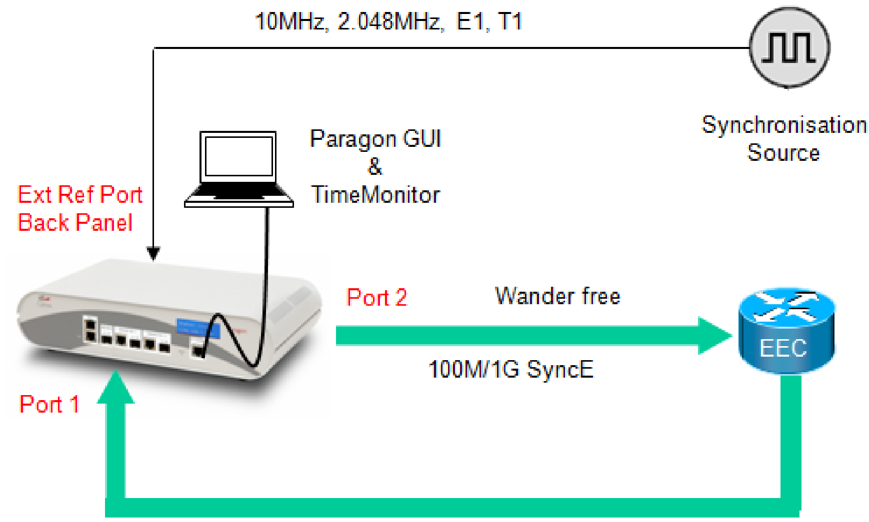
Appendix 3 - Using a Function Generator as the Reference Source

Hardware and Software required.

- Paragon Sync
  - Option 110 – 1GbE (Optical and electrical support)
  - Option 203 – SyncE features
  - Paragon S/W version x87.1 or higher
- Wander Generator (JDSU ANT-20) OR Function Generator for Wander Tolerance and Wander Transfer tests
- Synchronisation Source

1. Wander Generation – G.8262 Section 8

Test Setup



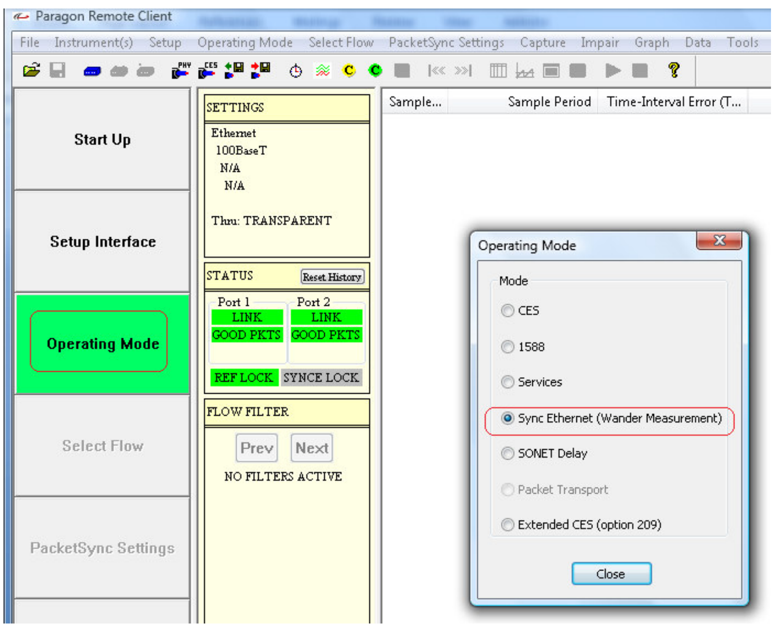
Measurement Setup

Paragon Setup

a) Start the Paragon GUI

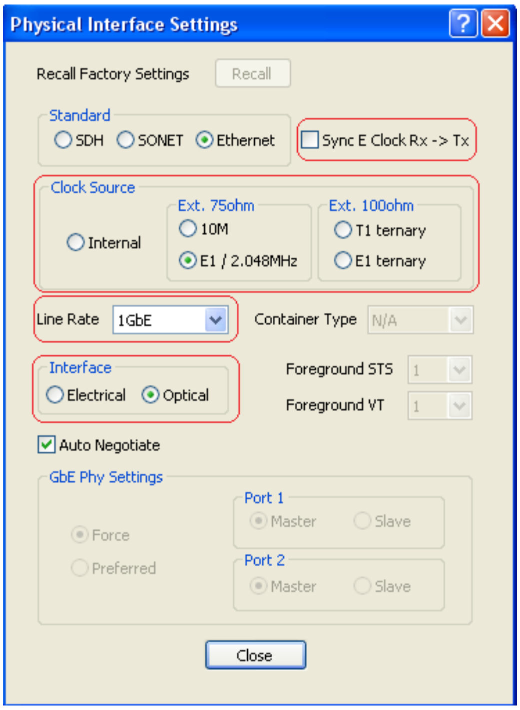
b) Select “Operating Mode”

c) Select “Sync Ethernet (Wander Measurement)”



d) Close the “Operating Mode” Window.

e) Select “Setup Interface” and then “Physical Settings”



f) Uncheck “Sync E Clock Rx->Tx” – (Locks Port 2 to the External Reference Clock)

g) Select the External Clock source being used

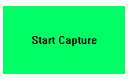
h) Select the Line Rate (100BaseT or 1GbE)

i) If 1GbE, select Electrical or Optical Interface

j) Close the Window

Measurement Process

Refer to Appendix 1 for G.8262 testing guidance

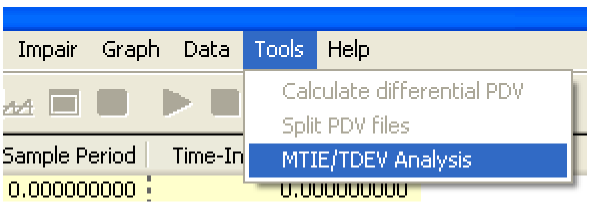
a) Select the “Start Capture” 

button to start measurement.

b) For the graph to auto update, select from the menu ”Graph” => “Auto Graph Refresh” => “On”

c) To stop the measurement select “Stop Capture”

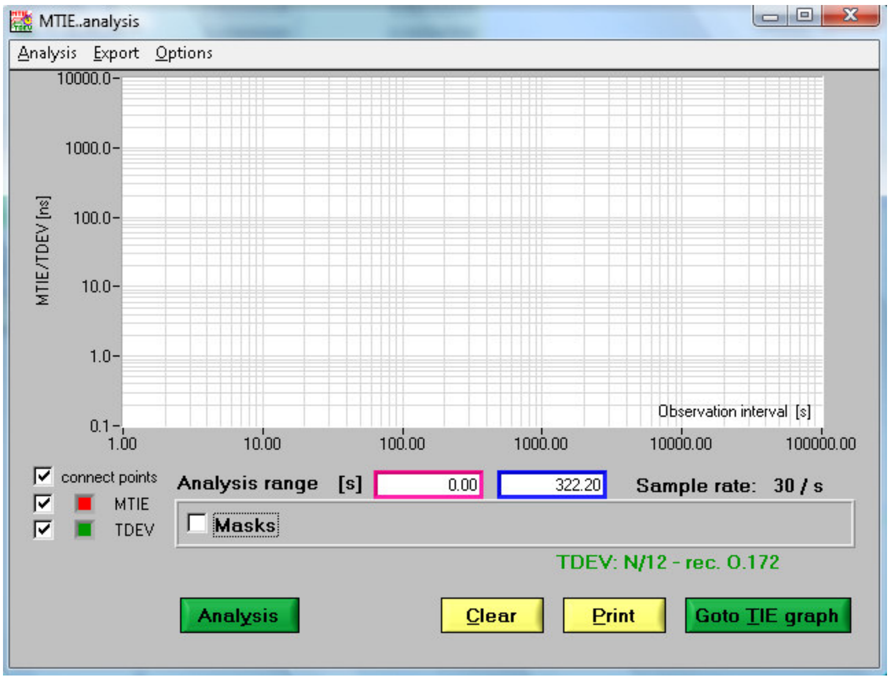
d) To evaluate MTIE and TDEV, select “Tools” => “MTIE/TDEV Analysis”.



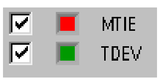
e) The TIE graph will be displayed.

f) Click the MTIE/TDEV 

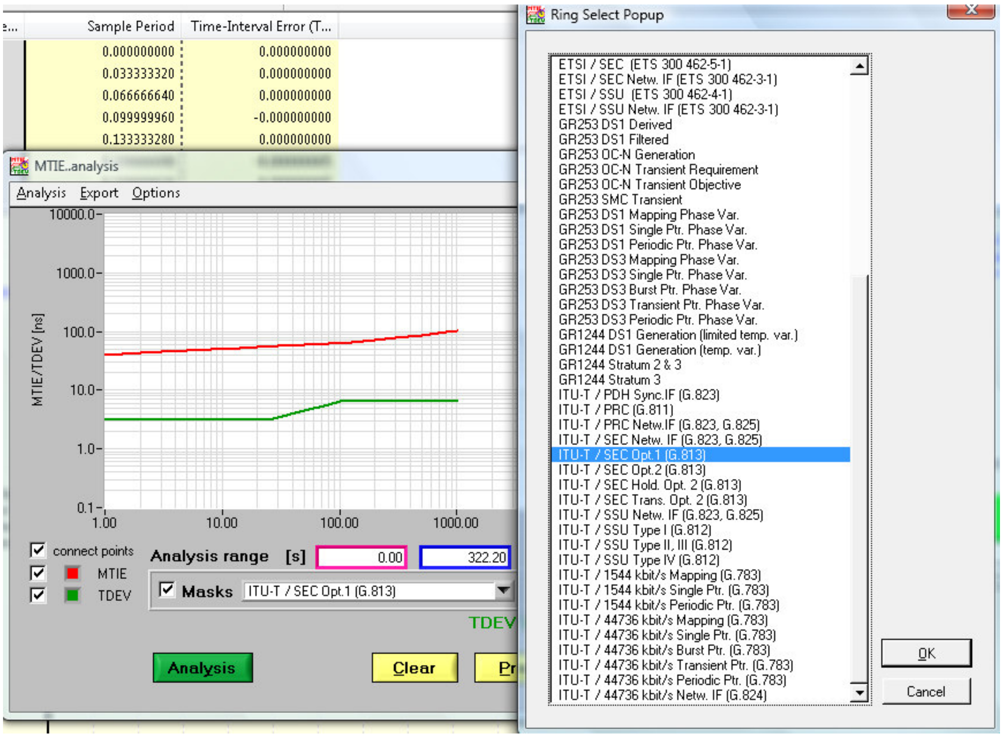
button at the bottom of the Window and the following window will be displayed



g) Ensure the boxes for "MTIE" and "TDEV" are ticked

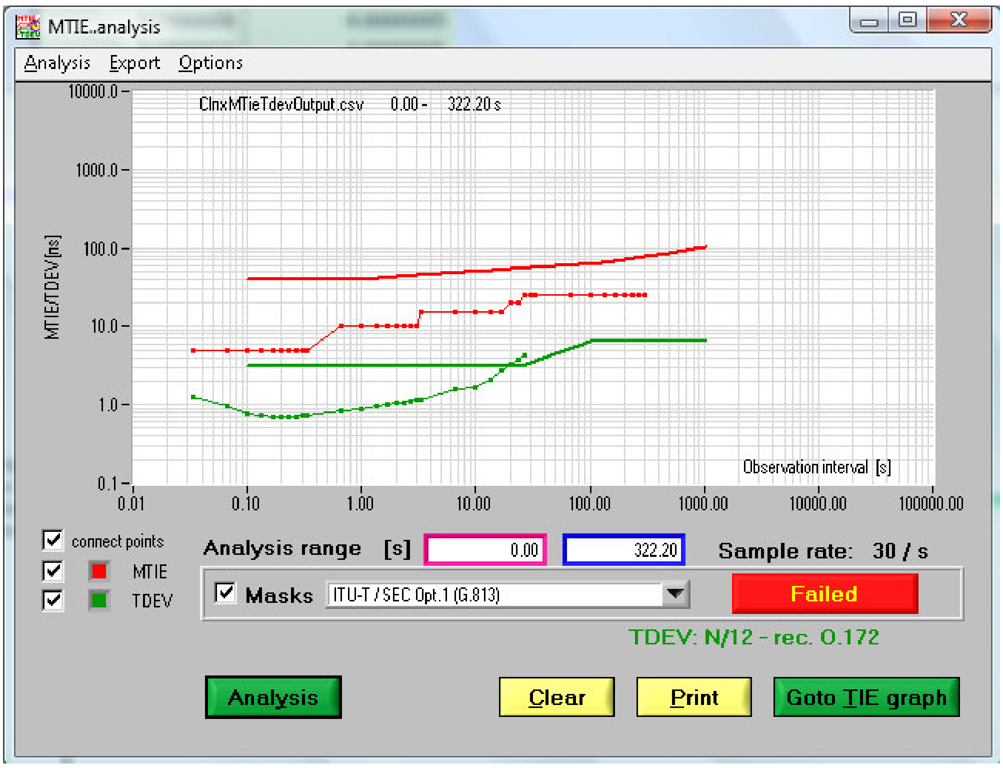


h) Tick the “Masks” box and select either ITU-T/SEC Opt 1 (G.813) or ITU-T/SEC Opt 2 (G.813) and click OK.
These G.813 masks are the same as ITU-T/EEC Opt 1 (G.8262) and ITU-T/EEC Opt 2 (G.8262)



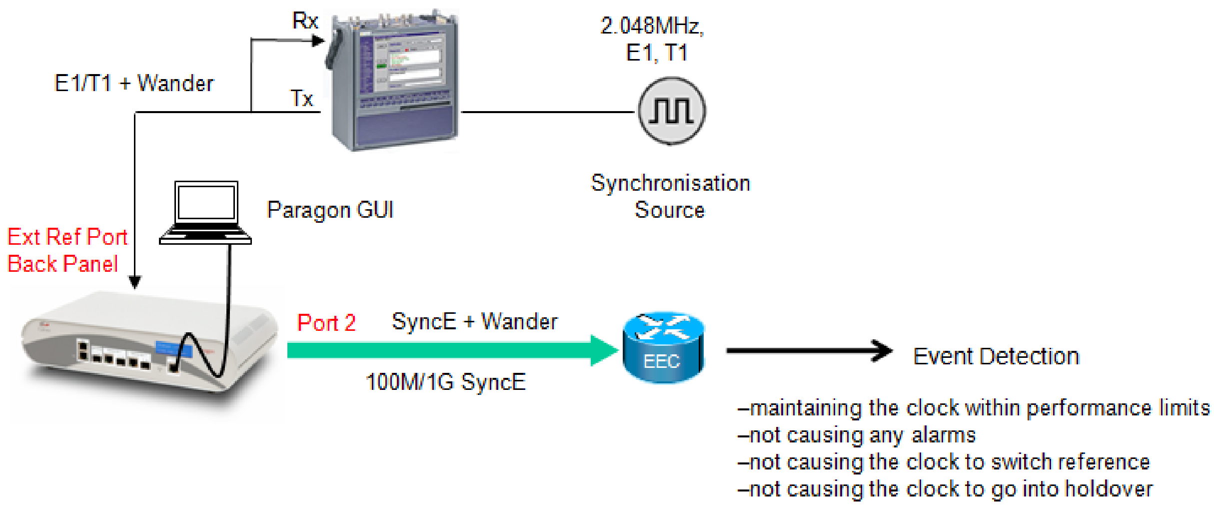
i) Click the Analysis 

button and the MTIE and TDEV measurements will be shown and can be analysed against the masks. With the screen also showing a Pass/Fail indication.



2. Wander Tolerance – G.8262 Section 9

Test Setup



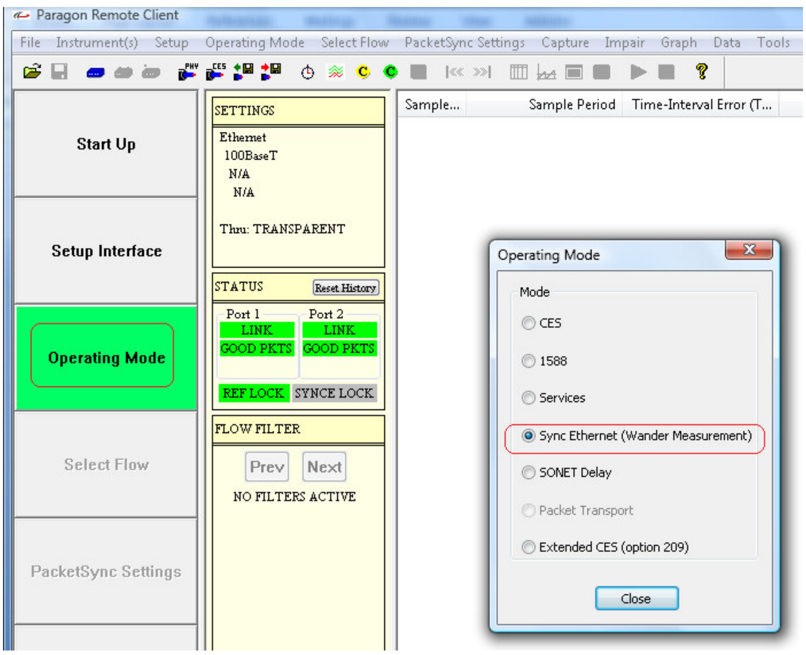
Measurement Setup

Paragon Setup

a) Start the Paragon GUI

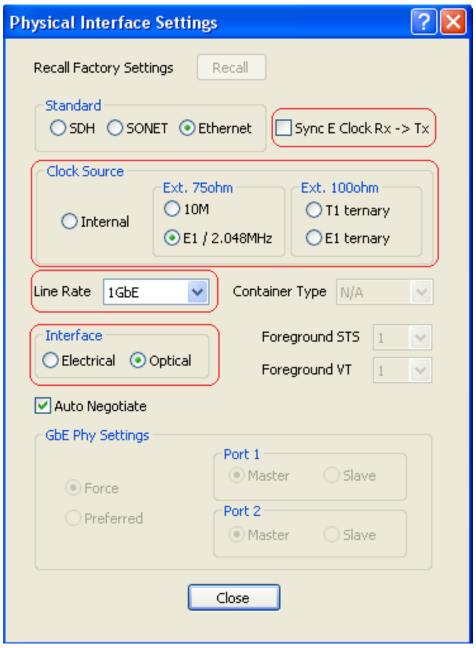
b) Select "Operating Mode"

c) Select "Sync Ethernet (Wander Measurement)"



d) Close the "Operating Mode" Window.

e) Select “Setup Interface” and then “Physical Settings”



f) Uncheck “Sync E Clock Rx->Tx” - (Locks Port 2 to the External Reference Clock)

g) Select the External Clock source being used

h) Select the Line Rate (100BaseT or 1GbE)

i) If 1GbE, select if using Electrical or Optical Interface

j) Close the Window

Setup of the Wander Generator

a) An E1/T1source with a Wander Generator such as a JDSU ANT20 should be used

b) For setup refer to Appendix 2

c) Note – alternatively a Function Generator can be used to perform this measurement. Refer to Appendix 3 for instructions.

Measurement Process

Refer to Appendix 1 for G.8262 testing guidance

a) Start the Wander test (eg. MTW) on the Wander Generator

b) Check that with the wander at the input, the EEC is

   i. Maintaining the clock within performance limits

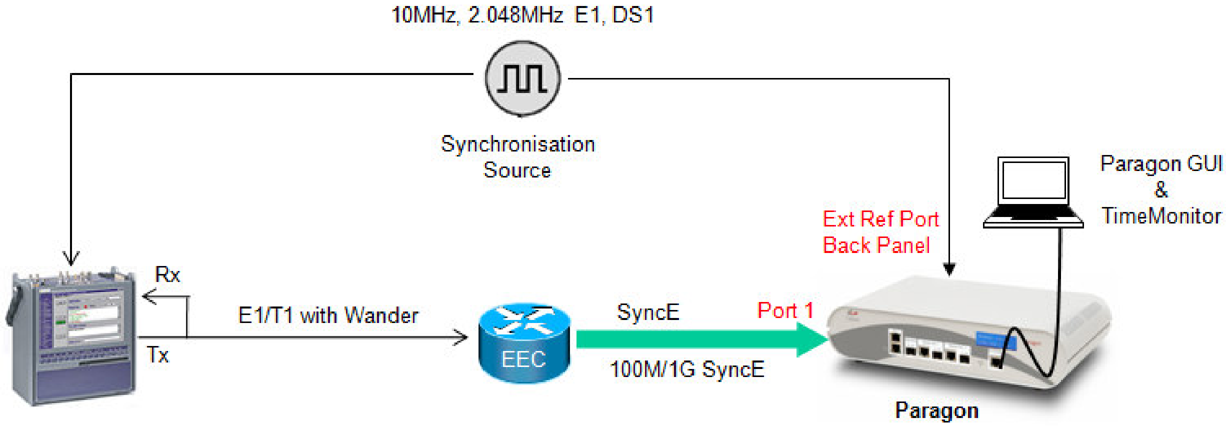
   ii. Not causing any alarms

   iii. Not causing the clock to switch reference

   iv. Not causing the clock to go into holdover

3. Wander Transfer – G.8262 Section 10

Test Setup



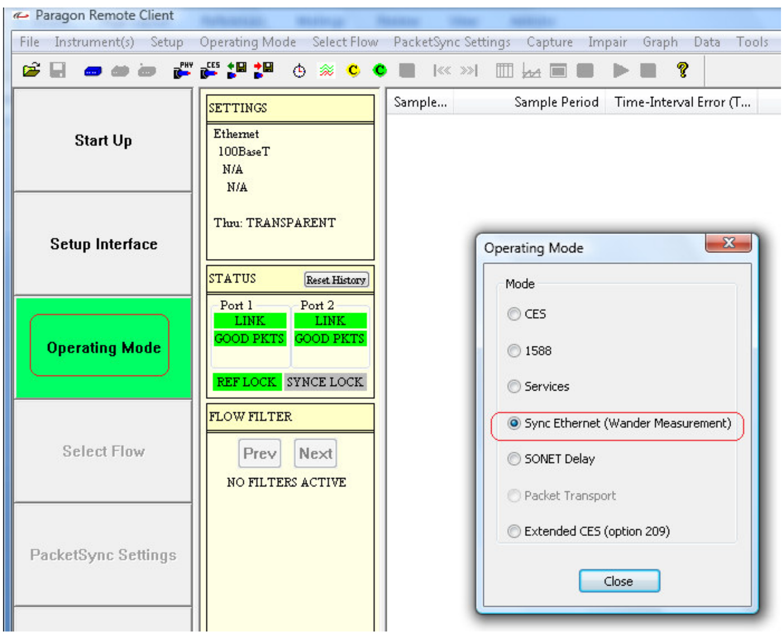
Measurement Setup

Paragon Setup

a) Start the Paragon GUI

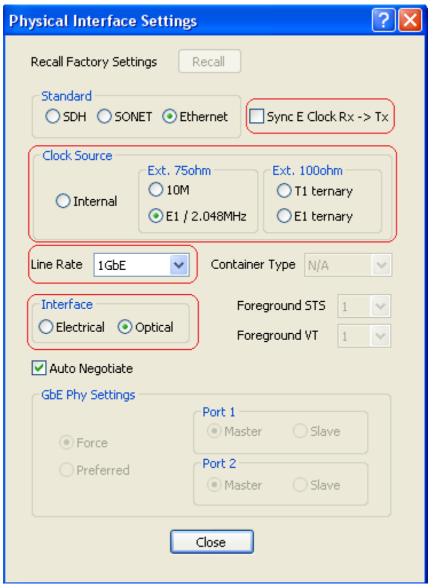
b) Select “Operating Mode”

c) Select “Sync Ethernet (Wander Measurement)”



d) Close the “Operating Mode” Window.

e) Select “Setup Interface” and then “Physical Settings”



f) Uncheck “Sync E Clock Rx->Tx”

g) Select the External Clock source being used

h) Select the Line Rate (100BaseT or 1GbE)

i) If 1GbE selected select if using Electrical or Optical Interface

j) Close the Window

Setup of the Wander Generator

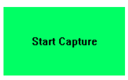
a) An E1/T1source with a Wander Generator such as a JDSU ANT20 should be used. For set up refer to Appendix 2

b) Alternatively a Function Generator can be used. Refer to Appendix 3 for instructions.

Measurement Process

Refer to Appendix 1 for G.8262 testing guidance

a) Start the Wander test (eg. MTW) on the Wander Generator

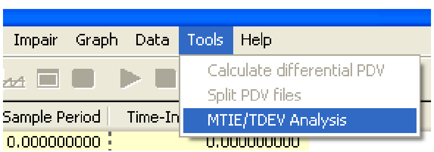
b) On the Paragon, select the “Start Capture” 

button to start measurement.

c) For the graph to auto update select from the menu ”Graph” => “Auto Graph Refresh” => “On”

d) To stop the measurement select “Stop Capture”

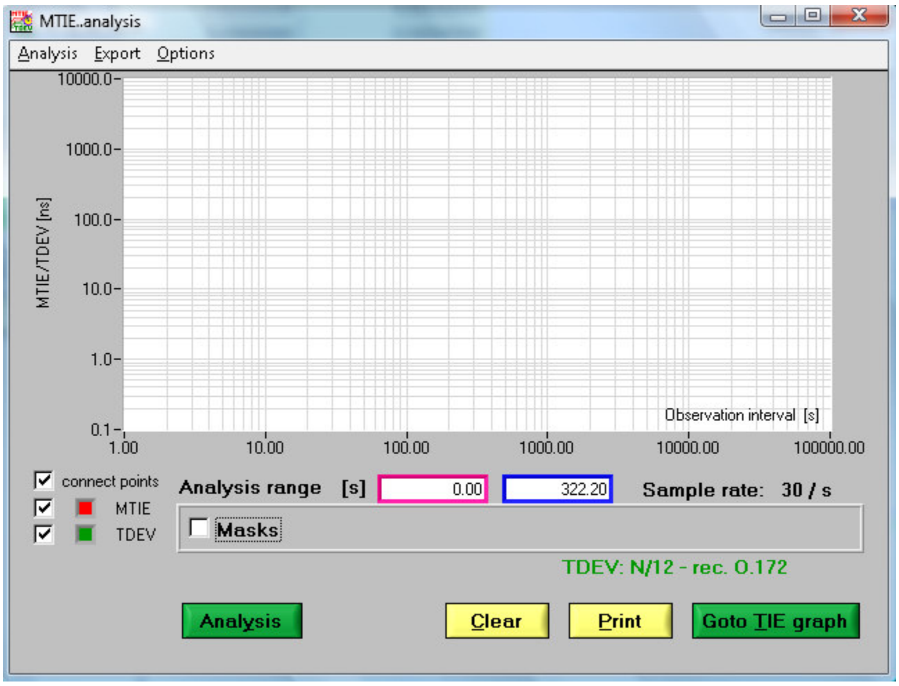
e) To evaluate MTIE and TDEV, select “Tools” => “MTIE/TDEV Analysis”.



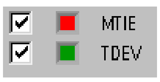
f) The TIE graph will be displayed.

g) Click the MTIE/TDEV 

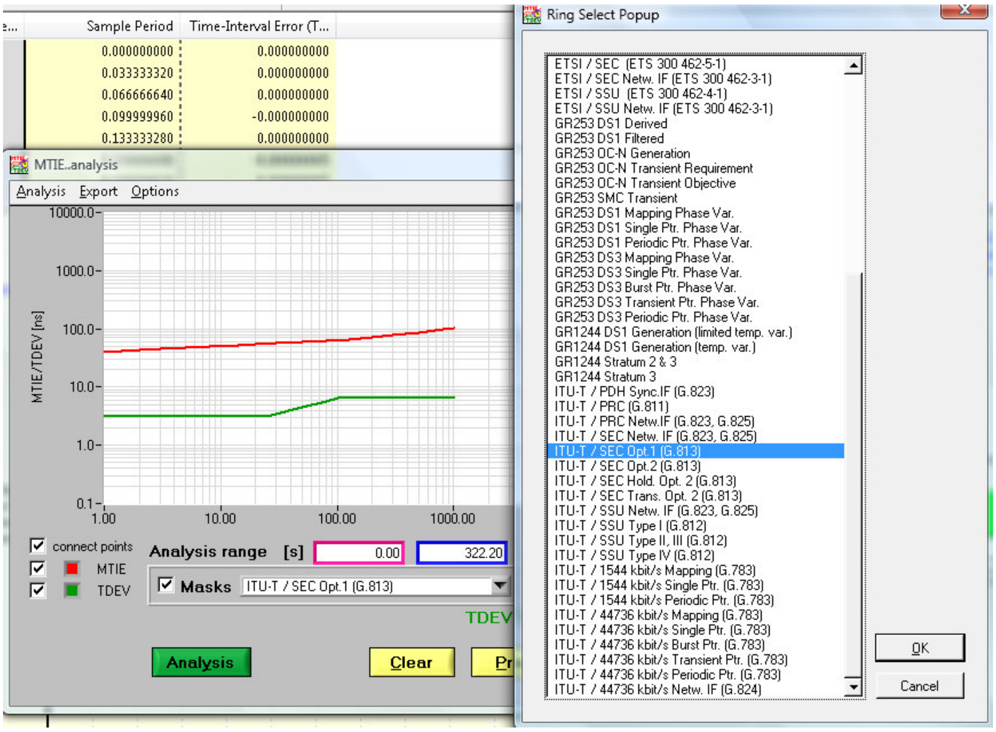
button at the bottom of the Window and the following window will be displayed.



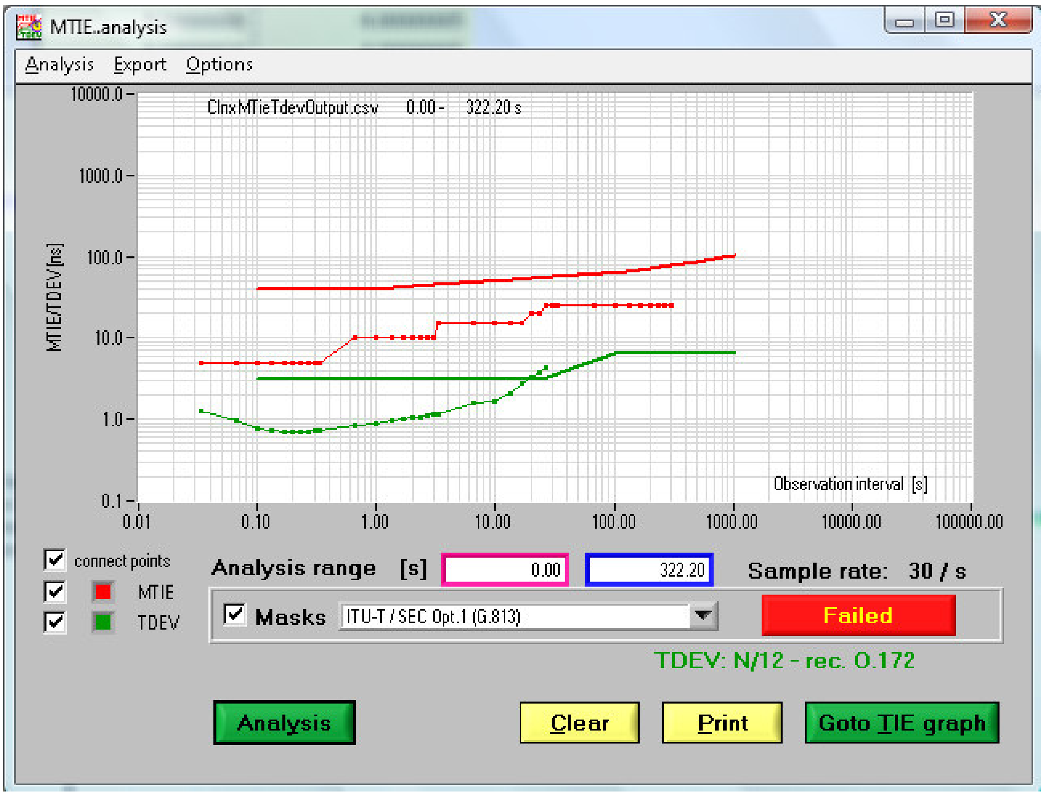
h) Ensure the boxes for "MTIE" and "TDEV" are ticked



i) Tick the “Masks” box and select either ITU-T/SEC Opt 1 (G.813) or ITU-T/SEC Opt 2 (G.813) and click OK.
These G.813 masks are the same as ITU-T/EEC Opt 1 (G.8262) and ITU-T/EEC Opt 2 (G.8262)



j) Click the Analysis  button and the MTIE and TDEV measurements will be shown and can be analysed against the masks. With the screen also showing a Pass/Fail indication.



Appendix 1 – G.8262 Wander Testing; Practical interpretation guidance

EEC-Option 1: E1 based hierarchy			
Test	**Input Stimulus**	**Pass/Fail Criteria**	**Interpretation Notes**
Wander Generation	not applicable	MTIE & TDEV pass/fail masks shown in G.8262 Section 8.1.1.	
Wander Tolerance	Sinusoidal stimulus. Defined in G.8262 Section 9.1.1, Table 8 & Figure 7.	The EEC is; i. Maintaining the clock within performance limits ii. Not causing any alarms iii. Not causing the clock to switch reference iv. Not causing the clock to go into holdover {G.8262 Section 9}	For item i. of the Pass/Fail Criteria, the Standard states that "The exact performance limits are for further study." (G.8262, Section 9) Without further guidance from the Standards, it is suggested that items ii - iv are the primary methods used for determining conformance.
Wander Transfer (Note)	Not defined.	Gain ≤ 0.2dB (2.3%) {G.8262 Section 10}	There is no definition of the input stimulus to be used in G.8262. Without further guidance from the Standards, it is suggested that the amplitude and frequency values associated with mask points labelled f1, f2 & f3 on G.8262 Section 8.1.1, Table 8 & Figure 7 are used.

<table>
<tr><th colspan="4">EEC-Option 2: T1 based hierarchy</th></tr>
<tr><th>Test</th><th>Input Stimulus</th><th>Pass/Fail Criteria</th><th>Interpretation Notes</th></tr>
<tr><td>Wander Generation</td><td>not applicable</td><td>MTIE & TDEV pass/fail masks shown in G.8262 Section 8.1.2.</td><td></td></tr>
<tr><td rowspan="2">Wander Tolerance</td><td rowspan="2">TDEV stimulus.

Defined in G.8262 Section 9.1.2, Table 9 & Figure 8.</td><td rowspan="2">The EEC is;
i. Maintaining the clock within performance limits
ii. Not causing any alarms
iii. Not causing the clock to switch reference
iv. Not causing the clock to go into holdover

{G.8262 Section 9}</td><td>Input Stimulus:
A TDEV graph is defined in the input stimulus in G.8262. General purpose modulation sources capable of this output are not readily available.
Without further guidance from the Standards, the following approaches are suggested;
A) In general, the Wander Tolerance requirements are more severe for Option 1 type networks than Option 2 type networks in G.8262 and in G.812. Therefore, if the equipment is being designed for both networks, testing to Option 1 requirements as specified above will suffice.
B) If the equipment only requires to comply with Option 2 type networks, comparing the limits in G.812 to G.8262, they are very similar. In the absence of guidance from the Standards, it is suggested that a set of points with amplitude and frequency values from the mask defined in G.812 Section 9.1.3, Table 14 & Figure 5 are used as the stimulus.</td></tr>
<tr><td>Pass/Fail Criteria:
For item i. of the Pass/Fail Criteria, the Standard states that "The exact performance limits are for further study." (G.8262, Section 9)
Without further guidance from the Standards, it is suggested that items ii - iv are the primary methods used for determining conformance.</td></tr>
<tr><td>Wander Transfer

(Note)</td><td>Not defined.</td><td>Gain ≤ 0.2dB (2.3%)
{G.8262 Section 10}</td><td>A TDEV graph is defined in the input stimulus in G.8262. General Purpose Modulation Sources capable of this output are not readily available.
In the absence of guidance from the Standards, it is suggested that a set of points with amplitude and frequency values from the mask defined in G.812 Section 9.1.3, Table 14 & Figure 5 are used as the stimulus.</td></tr>
</table>

Testing configuration for the Wander Transfer Measurement.

The figure below from G.8264 shows the conceptual block diagram for an Ethernet Equipment Clock (EEC). It shows that the selection between the various sources of the reference input is performed before the configured source is applied to the Synchronous Equipment Timing Generator (SETG) i.e. the internal clock generation function.

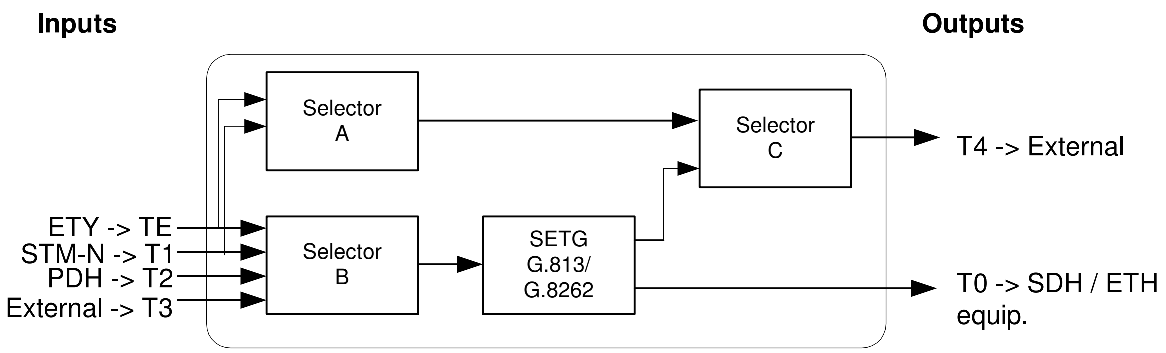


Figure A.2/G.8264: Hybrid SDH/Synchronous Ethernet "SETS" function

Each input will have its own clock recovery circuit to recover frequency from the input signal. It is reasonable to assume that while these input functions are sensitive to jitter, that they will be transparent to Wander.

This means that when doing a Wander Transfer measurement, it is effectively the transfer function of the SETG block that is being assessed. Therefore to perform an assessment of the Wander Transfer of the UUT, the input wander can be modulated on to any of the inputs that can be selected as the reference input to the internal SETG function.

The configuration diagram in ***Chapter 3: Wander Transfer - G.8262 Section 10*** of this document proposes the approach of modulating the Wander on to the BITS clock input. (The UUT would be configured to use the BITS input as the source of the reference clock.)

If there is concern that a different internal topology has been adopted to that shown in the block diagram below or that the input stages may be impacting the Wander Transfer, an alternative configuration can be used, where a Paragon is utilised to modulate Wander on to the SyncE input to the UUT. For this testing approach, the UUT would be configured to use the SyncE input as the source of the reference clock. Refer to the diagram in ***Chapter 2: Wander Tolerance - G.8262 Section 9*** of this document for guidance on how to modulate Wander on to the SyncE input.

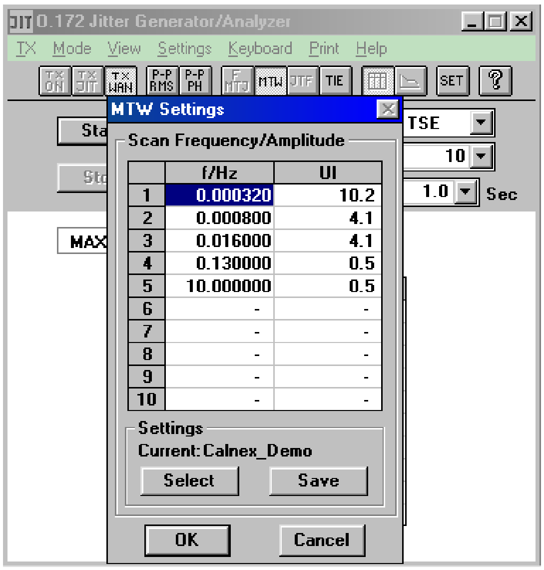
Appendix 2 - Using a Wander Generator as the Reference Source

Below are the wander frequencies and UI values that should be used, if a Wander Generator such as an ANT20 is used, to supply the reference Frequency to the Paragon for the Wander Transfer and Wander Tolerance tests. Note the UI values are calculated assuming an E1 or 2MHz link is used

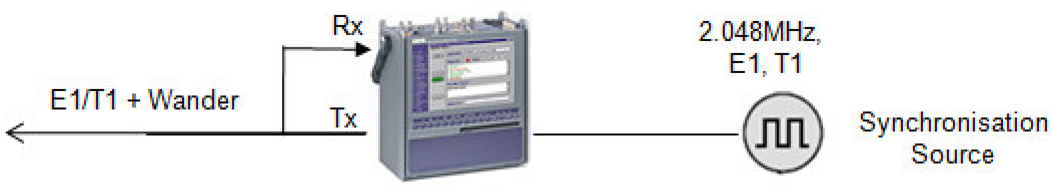
Wander Frequency (Hz)	0.00032	0.0008	0.016	0.13	10
Amplitude (UI) on 2MHz/E1	10.2	4.1	4.1	0.5	0.5

ANT20 Configuration

It is possible for the ANT20 to automatically sweep through the values in the table above using the MTW function.



The Sync port of the Paragon should be connected to the ANT20 TX port via a T adapter as it is necessary to also feed the TX signal back into the RX port of the ANT20, otherwise an alarm will be seen and the MTW measurement will not start



Appendix 3 - Using a Function Generator as the Reference Source

Frequency Modulation is defined by the carrier frequency, the modulating frequency and the peak frequency deviation.

Below are the modulating frequencies and peak frequency deviation values that should be used to supply the reference Frequency to the Paragon for the Wander Transfer and Wander Tolerance tests. This assumes a carrier frequency of 10MHz.

Modulating Frequency (Hz)	0.00032	0.0008	0.016	0.13	10
Peak Frequency Deviation (Hz)	0.05026	0.05026	1.0053	1.0210	78.539
Resultant Amplitude on 10MHz carrier (us)	5.0	2.0	2.0	0.25	0.25

The Voltage output should be set to nominal amplitude of 1.5V peak.

If additional values on the G8262 profile are required, the Frequency deviation setting can be calculated by solving the following equation for fdev:

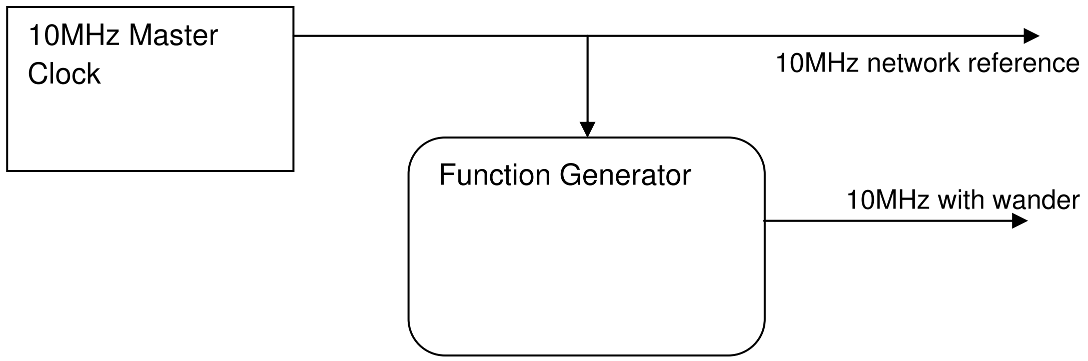
$$Wander\ amplitude = \frac{(\frac{fo}{fo + fdev} - 1)}{fmod * \pi}$$

Where: fo = carrier frequency

fdev = peak deviation frequency

fmod = modulation or wander frequency

Synchronise the Function Generator to the Master Reference to ensure the Wander is always locked to the Reference clock.



For more information on the Calnex Paragon Sync, and to take advantage of Calnex's extensive experience in sync and packet testing technologies, please contact Calnex Solutions on +44 (0) 1506 671 416 or email: info@calnexsol.com

Calnex Solutions Ltd
Springfield, Linlithgow
West Lothian EH49 7NX
United Kingdom
tel: +44 (0) 1506 671 416
email: info@calnexsol.com

www.calnexsol.com

This information is subject to change without notice

Calnex Solutions Ltd