

APPLICATION NOTE

Importance of accurate phase reference lock when using The UltraTEV Plus²



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Importance of Phase Reference, UltraTEVPlus²

It is very important to achieve a phase reference whilst taking readings on site and also whilst taking recordings within Survey mode of the UltraTEVPlus² unit. This will provide the User with a much clearer Phase Plot that can be analysed later and compared to other readings / phase plot patterns. A properly 'phase referenced' Phase Plot will assist in the classification of potential partial discharge activity that has been recorded.

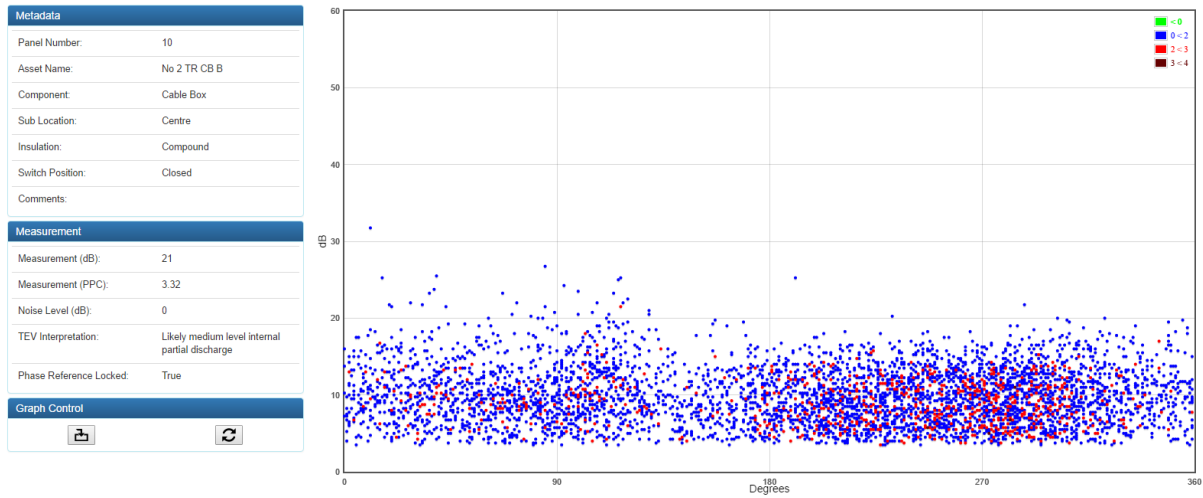
The aim of this activity is to 'match' the 50/60Hz reference of the UltraTEVPlus² unit to the system/mains frequency that is present at the exact time of the recording. System frequency at any electrical installation will tend to slow down and speed up or 'drift' away from its intended setting of usually 50/60Hz, all day every day. Power Generation Companies make their best efforts to keep the system frequency at the intended 50/60Hz but for a range of factors, it will inherently drift.

This drift is enough to affect the Phase Plot recordings of the UltraTEVPlus² unit because each TEV, Ultrasonic and Cable PD recording captures 10 seconds of data.

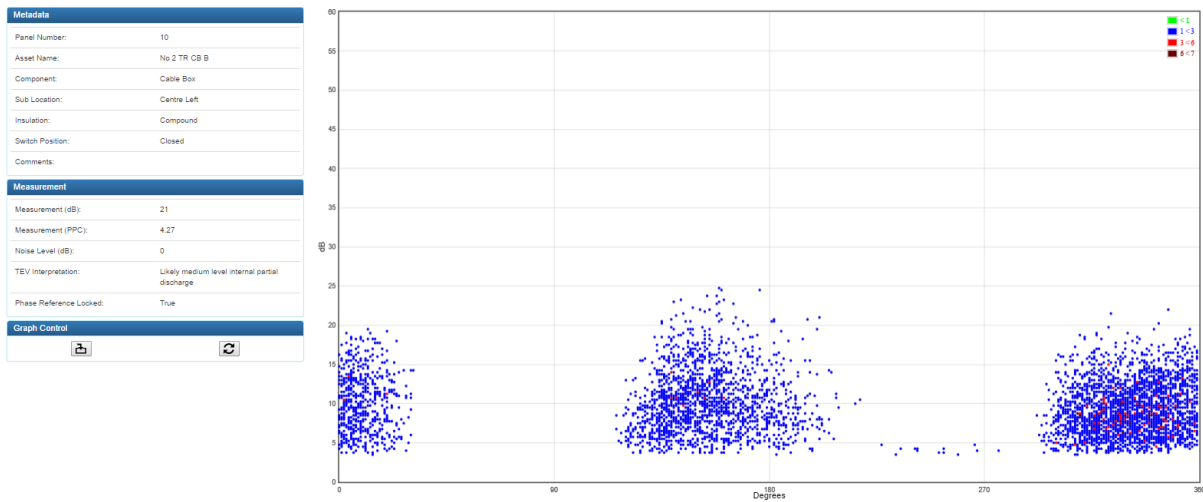
This document will instruct the UltraTEVPlus² User how to properly achieve 'phase referenced' Phase Plot recordings.

Example

Below are two separate readings taken from the same spot on an 11kV pitch filled cable box inside a switchroom. The first screenshot (taken from the captured survey data,) gives a phase plot trace that would indicate 'noise.' By looking at this trace, no assumptions or pattern recognition analysis techniques can be used to determine the presence of partial discharge. It was taken in 'manual' mode but the phase reference was not properly locked onto the system frequency at the substation.

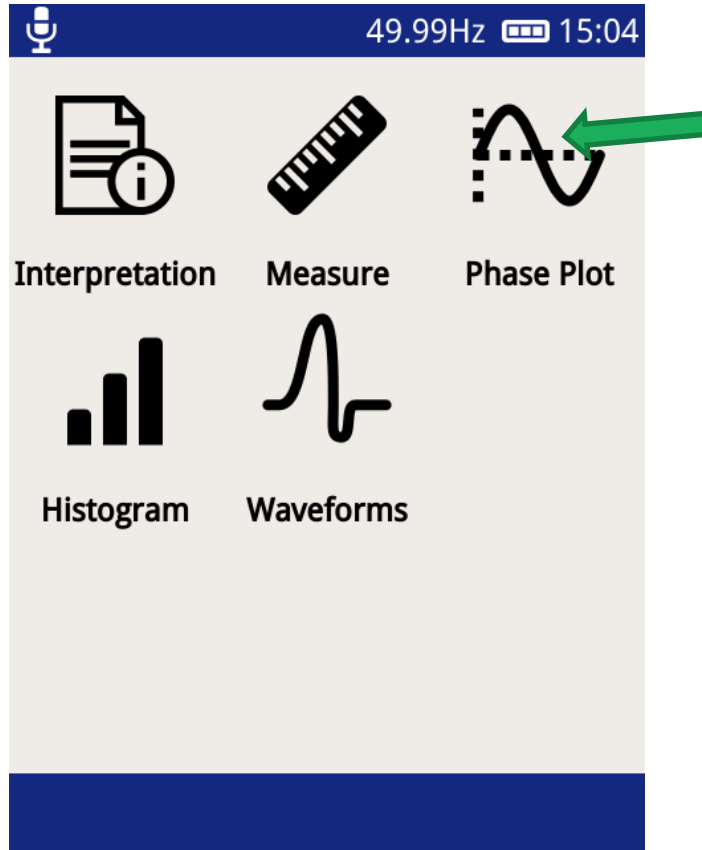


The below data was captured shortly after in the same spot but this time, the phase reference was locked onto the system frequency at the substation. The below pattern would indicate an internal void type discharge is occurring inside the 11kV pitch filled cable box.

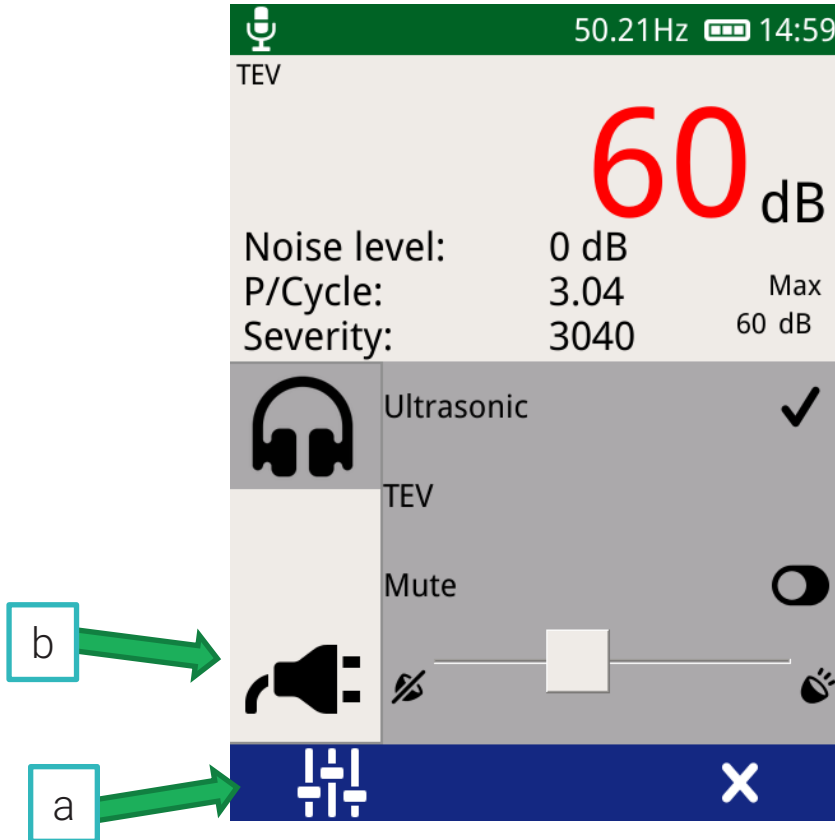


Instructions

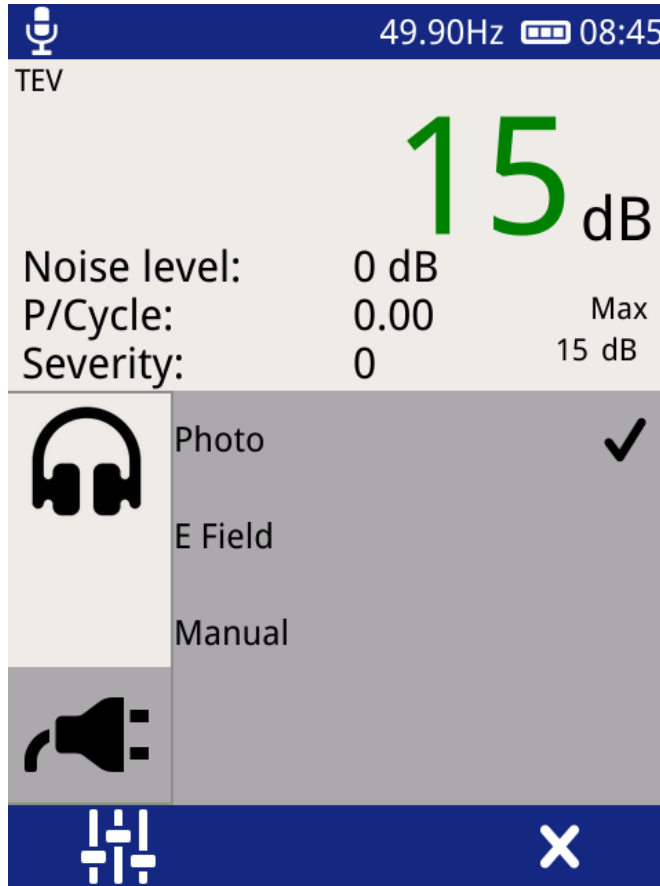
When taking a recording in either TEV, Ultrasonic or Cable PD mode, it is beneficial to use the Phase Plot interface which can be selected from below in TEV and Cable PD modes, it will automatically be selected in Ultrasonic mode:



Once in the Phase Plot interface screen, select the icon on the context menu in the bottom left hand corner to access the phase reference settings page (a) and then select the icon that looks like an electrical power lead (b.)



This will bring you to the following screen:



Mode Preference

The mode to use in order of preference is as follows:

- 1 'Photo' or 'E Field' should be used if they can be achieved.
- 2 'Manual' mode should then be used if the first two cannot be achieved.

Photo mode

By default, 'Photo' will be selected (it will have a 'tick' next to it.) This mode is very handy to use if it can be achieved, usually indoors where there is electrical lighting that runs off the system frequency. Make sure that the lights are running at the same frequency as the HV equipment that you are testing – some sites have 50Hz lighting and 60Hz equipment in the one room. The unit will use a photo-sensor that is physically located on the front upper section of the UltraTEV Plus², just above the centre of the touch screen to pick up the system/mains frequency from a nearby electrical light source such as a fluorescent light provided that the sensor has a direct line of sight to the light source.



If the photo-sensor is 'locked on' to the system/mains frequency, the 50.00Hz writing at the top of the touch screen will be 'white' in colour. If the unit is not locked on, this number will be 'red' in colour. This number will drift up and down as the system frequency drifts up and down or slows down and speeds up, do not worry if the number is continually changing.

A simple test whilst on site to check whether the unit is phase referenced or not is to point the sensor at a fluorescent light source and see that the 50Hz number has gone 'white' in colour. Then, cover the photo-sensor with your finger whilst still pointing it at the fluorescent light source and see that the 50Hz number turns 'red' in colour.

Tip: have a co-worker shine a fluorescent light at the UltraTEVPlus² unit as readings are being taken if you are in a dark environment.

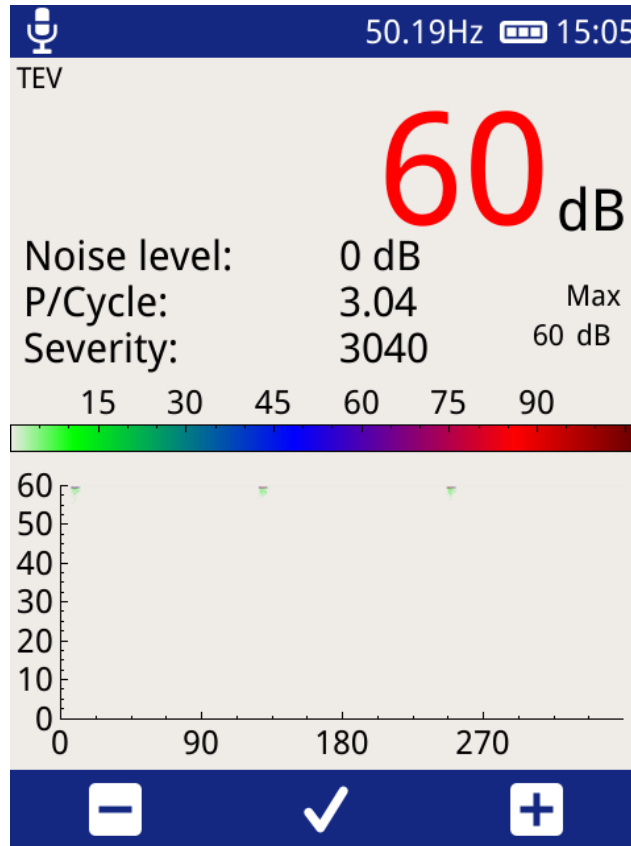
E Field mode

This option selects the in-built electromagnetic field sensor as the source of phase reference. The sensor detects the system frequency from stray electro-magnetic fields within the substation or area that is being surveyed. This mode is handy when being used in outdoor switchyards where there are no lights. The unit may not 'lock on' to the system frequency in an area that lacks electro-magnetic fields. The higher the voltage level of the equipment and the more electrical infrastructure around you, the better chance you have of locking on to the system frequency.

Manual mode

This option allows the User to manually adjust the phase reference. This is the least desired mode but often the most used due to the physical conditions of the site, i.e. the lack of fluorescent lighting (being outdoors) and a lack of a strong enough electro-magnetic field in the area.

Once 'Manual' mode is selected, the following screen is displayed with a 'plus,' 'minus' and a 'tick' icon on the bottom of the touchscreen:



Stay on this screen and use the unit in a manner as you would whilst taking a recording (TEV, any ultrasonic accessory or the Cable PD RFCT.) Now notice the activity on the touchscreen within the Phase Plot section. The activity that you can see on the screen is the events that are being captured by the unit as time goes by, and these events are filling up the screen.

Firstly, you are trying to get the activity or dots on the screen to stay still. This will mean that the unit is in phase with the system frequency.

If the activity appears to be drifting to the left, press the 'Plus' button in the bottom right hand side of the screen. By pressing this button, you will notice that the screen has been refreshed and the unit is capturing the events again. Also, you will notice that the 50.00Hz in the top corner has changed to 50.01Hz. You will find that the activity will be drifting slower to the left than it was before the button was pushed. By pressing it again and again, the activity on the screen will eventually 'stay still.'

Vice versa for when the events on the screen are drifting to the right, press the 'Minus' button in the bottom left hand corner of the screen continually until the events on the screen are stationary.

It may not be possible to achieve a completely stable set of events over time but in this case the slower that the events are moving, the better the end phase plot will be.

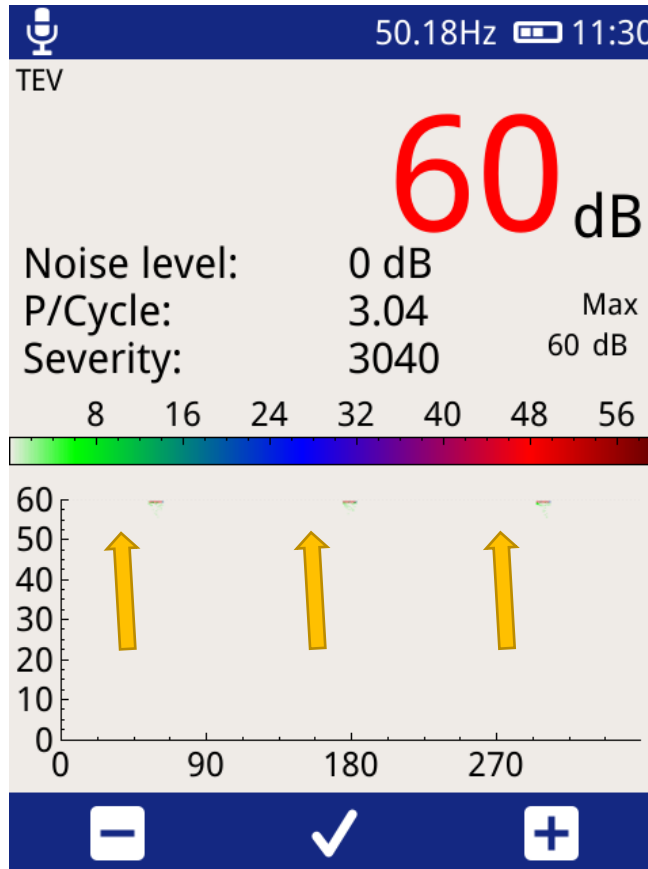
Once you are happy with the trace that is seen on the screen, press the 'tick' button located in the centre bottom of the touch screen.

Your UltraTEVPlus² unit is now phase referenced to the system frequency in the area and is ready to take recordings or to interpret the phase plot on the screen on site.

Example

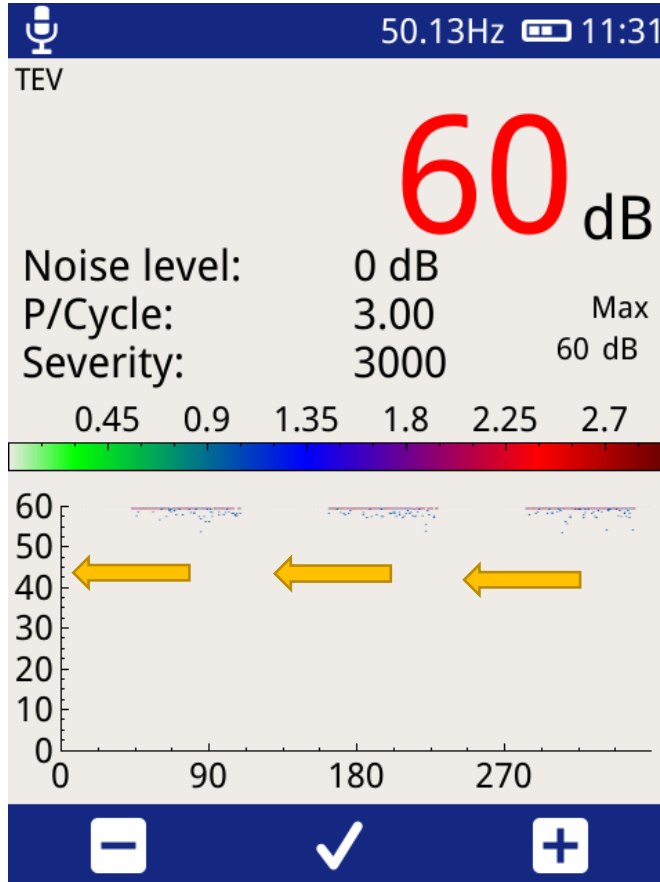
Below is an example of setting up the phase reference on the unit in Manual mode.

This data was captured from a PD Test source that runs at 50.18Hz, 60dB and 3.00 pulses per cycle. When the frequency is manually set to 50.18Hz, the screen will look like this:

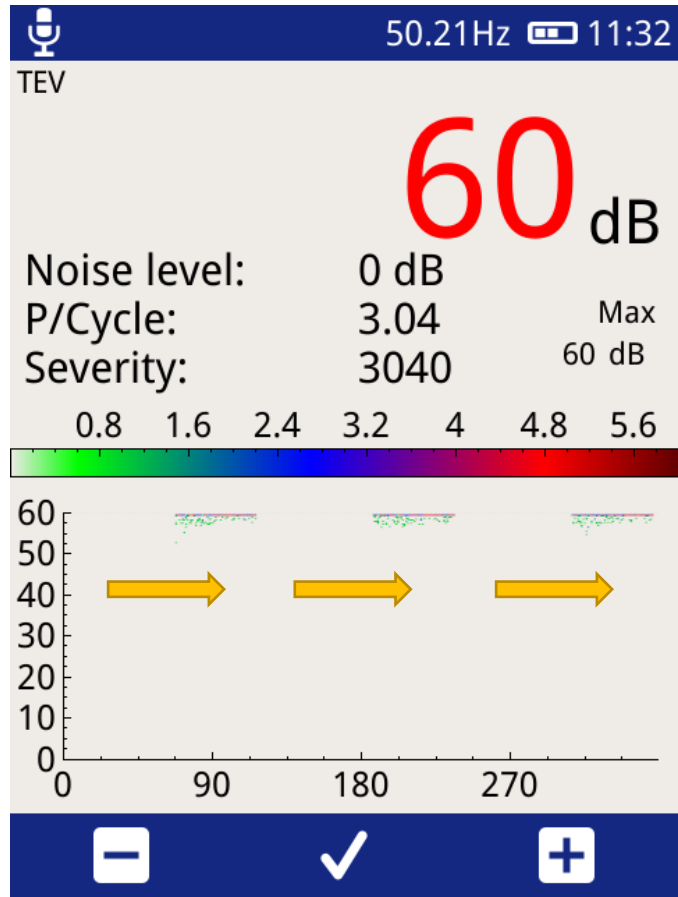


Notice the 3 clusters of dots shown above. These dots are representing an electromagnetic source that is 60dB in amplitude and happening 3 times every sine wave (this is where 3 pulses per cycle comes from because the 60dB of activity is occurring 3 times per cycle.) These clusters are 'still' on the screen when the frequency is set to 50.18Hz.

Let's see what happens when we change the frequency manually. Below is a screenshot taken when the frequency has manually been set to 50.13Hz. The 3 clusters of activity are 'drifting' to the left of the screen over time because the unit is set to 50.13Hz but the system frequency is effectively 50.18Hz. Because they are drifting, the phase plot that the User sees is not a true representation of what is happening in real life – it cannot be compared to other phase plots for pattern recognition analysis. In this case, the frequency would need to be sped up by pressing the 'plus' button until the activity is still on the screen



The same thing happens in the opposite direction when the frequency is set too high. Below, the frequency has manually been set to 50.21Hz. The clusters of activity are now drifting to the right hand side of the touch screen. In this case, the frequency would need to be slowed down by pressing the 'minus' button until the activity is still on the screen.



Conclusion

Achieving a phase reference either by using the 'Photo,' 'E Field' or 'Manual' modes while capturing data will help with record keeping and pattern analysis of the partial discharge scans that are possible with the UltraTEVPlus² unit. This can be done in TEV, ultrasonic or cable PD data capture.



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