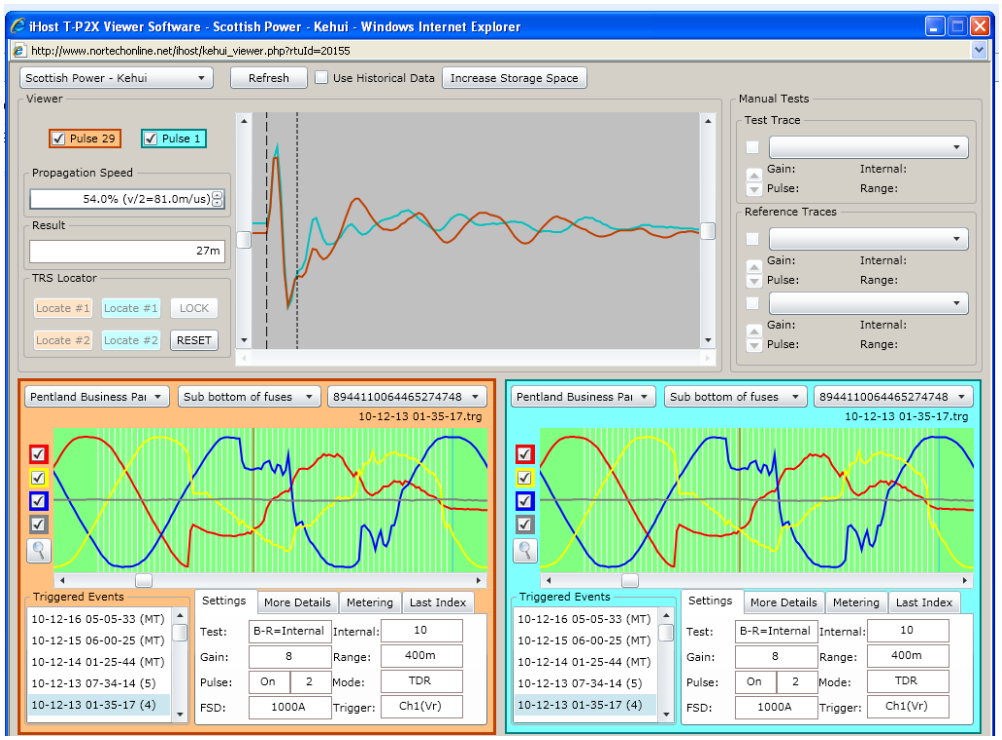
T-P2X Low Voltage Fault Locators

T-P22 Low Voltage Cable Fault Locator

T-P22 & Accessories



T-P22 Software Screen

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1. CONTENTS

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2. SAFETY

2.1 General notes

2.1.1 Safety precautions

This manual contains basic instructions on commissioning and operating the T-P2X. For this reason, it is important to ensure that the manual is available at all times to authorised and trained personnel. Any personnel who will be using the devices should read the manual thoroughly. The manufacturer will not be held liable for any injury or damage to personnel or property through failure to observe the safety precautions contained in this handbook.

2.1.2 Labelling of safety instructions

Important instructions concerning personal, operational and technical safety are marked in the text as follows:

Symbol	Description
	The notes contain important information and useful tips for using the system. Failure to observe them can render the measuring results useless.

2.1.3 Working with products from Kehui (UK)

It is important to observe the general electrical regulations of the country in which the device will be installed and operated, as well as the current national accident prevention regulations and internal company rules (work, operating and safety regulations).

Use genuine accessories to ensure system safety and reliable operation. The use of other parts is not permitted and invalidates the warranty.

2.1.4 Operating staff

This system and its peripheral equipment may only be operated by authorised or trained personnel. Anyone else must be kept away.

2.1.5 Repair and maintenance

Repairs and service must only be done by Kehui (UK) or authorised service departments of Kehui (UK). Kehui (UK) recommends having the equipment serviced and checked once per year at a Kehui (UK) service location.

Kehui (UK) also offers direct on-site support. Please contact our service office for more information.

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3. INTRODUCTION

The T-P2X is a sophisticated low voltage cable fault locator capable of finding permanent, intermittent and transient faults. The instrument is operated through a PC interface either directly through a Bluetooth serial port or remotely through a GSM/GPRS modem. The latter method allows the fault to be monitored and interrogated without having to return to site and therefore maintain a lower profile while actively pursuing the fault. It is also not intrusive as far as our customers are concerned.

The main feature is that it can capture faults, which need not necessarily blow a fuse and the information can be retrieved without further site visits after the initial installation. It can store up to 20 separate voltage or current triggered waveforms in internal memory, which can be downloaded as required.

A very powerful feature of the T-P2X is the voltage monitor. This continuously monitors the three-phase voltage and captures twelve cycles immediately before and fifty two after the point of trigger. This gives the operator a view of the actual fault condition that initiated the trigger and allows the T-P2X to be armed in the most convenient manner.

Through the base station software the T-P2X can be configured/re-configured on site depending on the fault condition from wherever the base station software is located. This may be on a desktop or a laptop located anywhere.

The acquisition of transient fault locations remotely is a huge benefit to both the fault cost and customer service but it does lead to dispersed data and the distinct possibility that the location of units differs between users PC's. A Web based system has been developed on the iHost platform. This keeps a register of all units' current locations, auto polls at regular intervals and stores the records on its own database. Connection to individual locators can be made through iHost without the need to know the connection details. The base station software has been embedded into iHost. All users have the ability communicate and analyse all locators data allowing better use of operator experience to assist with locations outwith their own zone and to coach/mentor others.

There is still however a chance that if the discipline in keeping iHost updated a correct fault location from a device may be in the wrong town.

One important point to note is that when connected to the T-P2X the instrument will dis-arm and change into communications mode and **will not** monitor cable activity until re-armed at the end of the session.

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4. TECHNICAL

4.1 Technical data

Parameter	Value
Operational voltage / Power supply	230 V AC, 50 Hz
Interfaces	Bluetooth, GSM, GPRS
Transient recorder	3 Voltage channels, 1 Current channel
Data storage	20 Events with 64 TDR-Traces, 10 200 msec records of system voltages & current
Operating temperature	-10 °C ... +40 °C
Dimensions (W x H x D)	270 x 120 x 250 mm
Weight	2,8 kg

4.2 Intended application

4.2.1 Description

The T-P22 has been designed for the location of all types of low voltage cable faults but especially the difficult and troublesome intermittent fault. It can be controlled locally from a portable PC by Bluetooth or remotely through its internal GSM / GPRS modem.

Unlike currently available TDR fault locators, the T-P22 is connected simultaneously to all 3 phases of an energised LV cable to allow the local or remote operator to perform TDR testing on any combination of phases. Power for the T-P22 is taken through the 3 phase test lead and the unit requires at least 1 phase to be energised.

The T-P22 includes a 4 channel transient recorder (3 voltages and 1 current) which is used to acquire information about the exact nature and behaviour of intermittent faults. The signals acquired by the transient recorder are also used to detect “trigger” conditions for the TDR system based on voltage distortion and/or over-current. Recordings from 2 units can be used for fault location by transient travelling waves using a special synchronising feature.

By providing total control from a remote location the T-P22 can be connected to a faulty cable by field staff who are not necessarily familiar with the analysis of TDR waveforms - the expertise in adjustment and interpretation being provided by a centrally located specialist. This becomes particularly beneficial when the equipment has to be left on-site awaiting the (re)-occurrence of an intermittent fault.

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4.2.2 Types of LV cable fault

LV cable faults can be separated into 4 categories:

Transient	Irregular, short duration voltage depressions without any fuse operations
Intermittent	Irregular operation of fuses at long intervals
Persistent	Repeated operation of fuses at short intervals
Permanent	Open circuits and ‘solid’ short circuits

4.2.3 Characteristics of LV cable faults

Many LV cable faults change from transient to permanent ("flickering lights" are possible signs of a transient fault).

In addition, LV cable faults are often unstable/non-linear and can therefore only be located when the cable is energised.

Only once a fault has become permanent can it be located using conventional techniques with the cable often requiring to be de-energised.

All unstable LV cable faults require a change in their condition in order to be located. The only way of doing this – with consumer units connected – is to reconnect the supply voltage.

If it takes a long time between switching on the supply voltage and the fault occurring, the most economical and convenient method is to connect the T-P22 at the main supply fuse. If the intervals are shorter, and where there is sufficient space, automatic fault re energising device can be used to maintain the mains supply and effect a change in the fault state.

4.2.4 Operating modes

The T-P22 can be operated in two basic modes.

In **TDR mode**, a conventional TDR test is made using one device.

Fault location using the TDR method is limited on long cables due to the attenuation of the TDR signals caused by the properties of the cable itself and by the installed joints. With the TDR method, the test pulse must travel to the fault location and the reflected part of it must return along the same path.

TRS mode also uses test pulses, but only to synchronise the second device which is used for the measurement. In other words, the pulses must only travel one way between the two installed devices, thus doubling the range compared to the TDR method.

Two T-P22s are installed in the network in such a way that the suspected location of the fault is between them. For a detailed description of the TRS method, see section **Error! Reference source ot found.**.

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4.3 Record Types

The T-P22 has three different record types. In each case the file name is in the format

2010-11-30 13-55-12 i.e. date and time record captured but the name extension is dependant on the type of record.

*.vlt

This record type is generated from a manual trigger and is a snapshot of the voltage at point in time. They are listed and viewed in the events window and are shown events list as (MT)

*.tdr

These are generated from the test button and capture a steady state TDR waveform as in the standard TDR instruments and are viewed in the Manual Tests window. Up to three waveforms can be selected at any one time and are switched on/off via the check box on the left hand side of the window. This allows comparison of all three Ph-E or Ph-Ph waveforms simultaneously for comparison purposes.

*.trg

These are the records that are automatically captured when the T-P22 senses the change in the voltage waveform beyond the configured threshold. The trigger point should be the twelfth of the sixty four TDR in the events window ensuring the operator has twelve healthy waveforms for comparison with those after the trigger point. The are listed in the events window and have an associated number e.g. 16 which is the memory cell it was stored in. These are numbered from 1 through 20 and are overwritten as the number of records recovered increases.

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5. PHYSICAL CONNECTION TO SUSPECT CABLE

5.1 General

The T-P2X is connected to and monitors all phases of the cable under test. There are several options for connecting the device to the faulty cable and the chosen connection point can impact on the chance of a successful location.

Regardless of the point of connection the sequence is always the same

5.2 Connection

First connect the black voltage lead to the neutral/earth

The three phase red, yellow and blue voltage leads can then connected in turn to the relative phases. The T-P2X is powered via the voltage leads and there will be a small spark when the first voltage lead is connected. In the event of a loss of supply to one phase the T-P2X will automatically draw from one of the two remaining LIVE phases. Should a second phase lose supply then the T-P2X will be powered from the remaining phase. If all three fail then the unit will power down.

5.3 Disconnection

Before removing the voltage leads the reset button should be depressed for a few seconds. This will allow the voltage leads to be removed without losing any of the events held in memory.

First disconnect the phase leads and then lastly remove the neutral lead. Disconnecting the neutral while the voltage leads are connected and the T-P2X is LIVE may cause some damage to the instrument or lose the contents of the memory.

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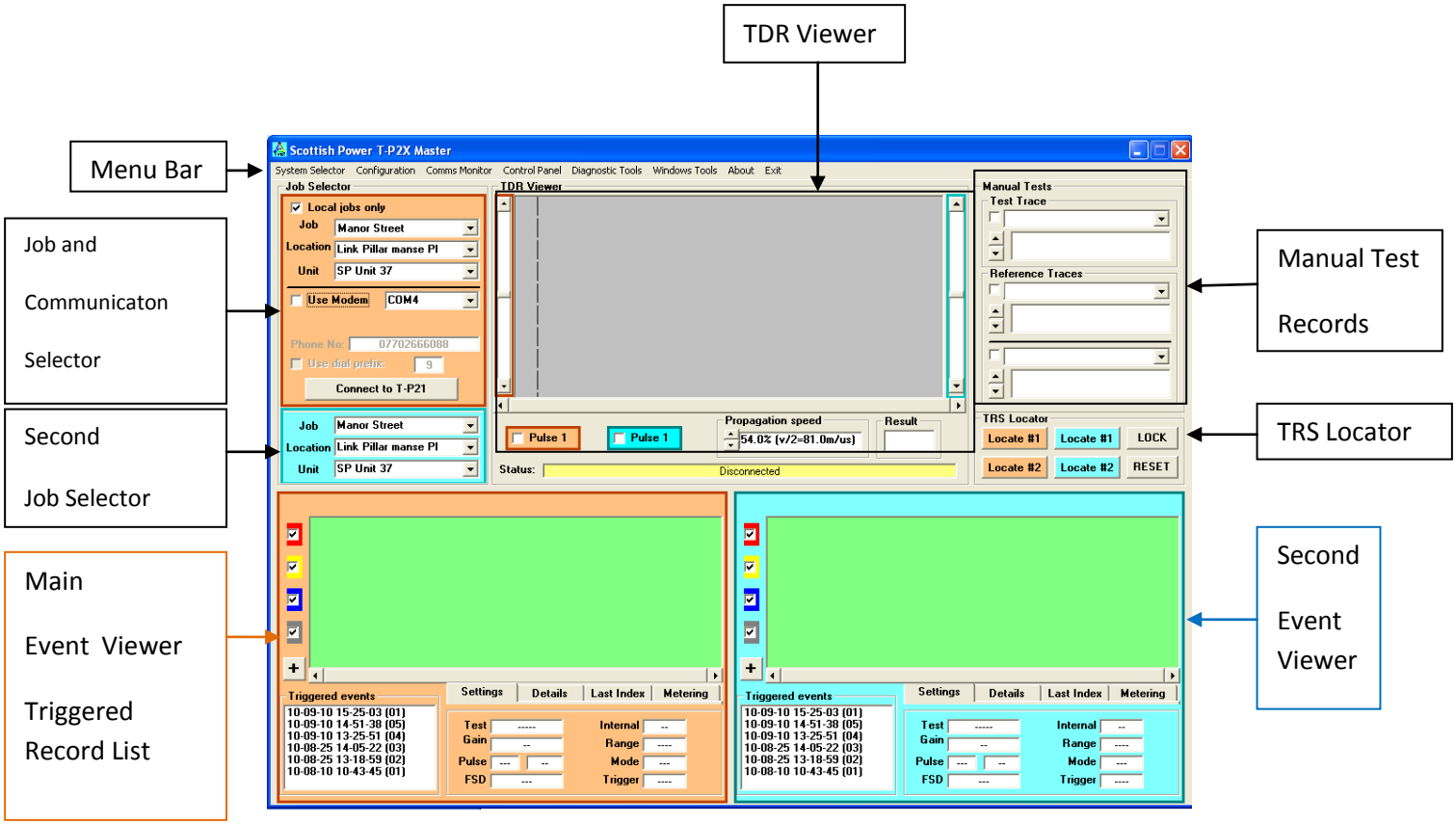
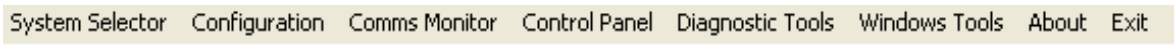
6. T-P2X BASE STATION SOFTWARE

6.1 Main Display



This is a screenshot of the base station software when the application is launched. It initially looks very busy and complicated however, in use, only one window at a time is normally used when setting up and carrying out the fault location analysis. All the above windows will be covered in this section from an initial connection through to record recovery and analysis.

6.2 Menu bar



Of these options only System Selector, Configuration and Control Panel will normally be used.

6.2.1 System selector

It is possible to have more than one system in use on one PC. It may be that an operator has more than one area to cover e.g. area 1 and area2. Rather than have a large list of recorders they can be contained in two systems Area 1 and Area 2 in order that the recorders can also be kept in the area that they are assigned to. Clicking on System Selector in the Menu Bar will show the systems available in a drop down box.

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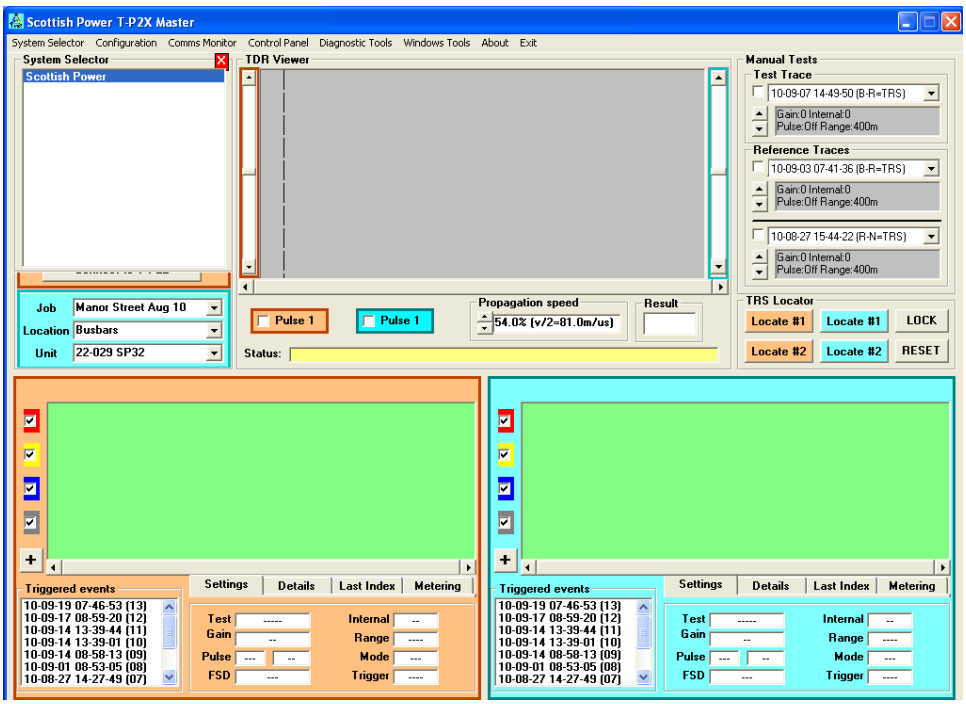
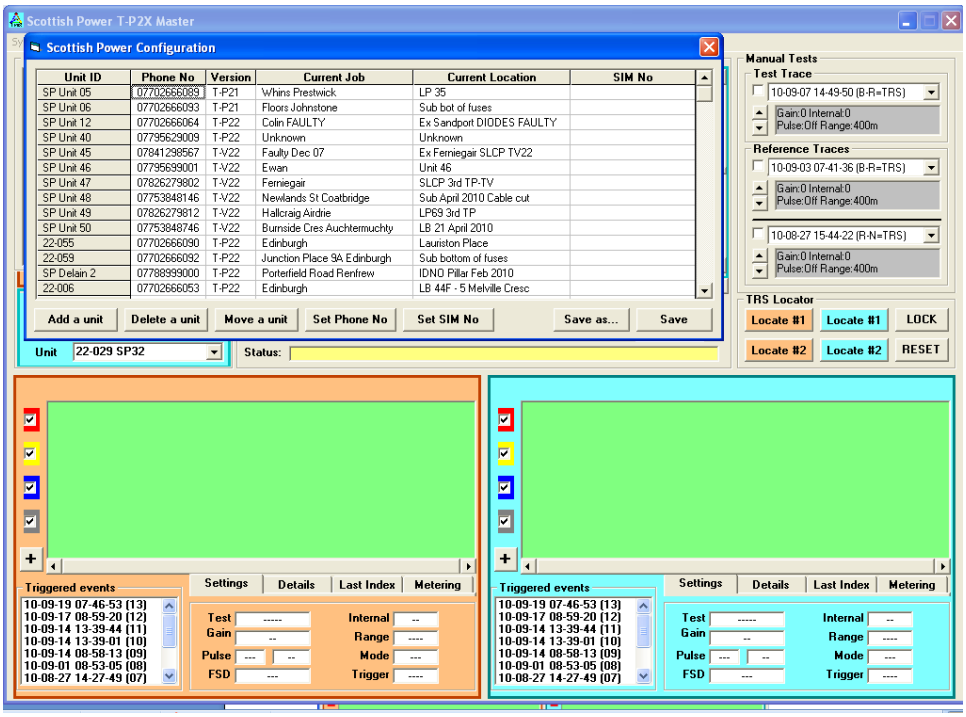
In this case there is only one option and the base station software will automatically default to Scottish Power.



6.2.2 Configuration

The configuration window is probably the most important widow in the software as it is the register of the T-P2X recorders attached to, in this case, Scottish Power System. Clicking on Configuration on the Menu Bar displays the screen below



For each recorder allocated to the system this file holds the Unit ID, Phone number, T-P2X model, current job, current location and the option for the Sim card number. There are control buttons at the bottom of the window that allow the user to modify the file.

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Control Button Functions

Add This allows a new unit to be added to the configuration file starting with the Unit ID and progressing through to the sim card number.

Delete The user must first select the unit that is to be deleted by clicking on the Unit ID in the configuration file. This will highlight the details with a blue background. A left click on the delete box will prompt the user with an option 'Do you really wish to delete unit'. Selecting Yes will delete the unit from the configuration file while no will not alter the file.

Move A Unit Again the unit to be moved must first be selected in the configuration file and then left clicking on the Move A Unit button. On choosing this option the user will be prompted to determine if they really want to move the unit. If the answer is Yes then the user will be prompted to enter new details for the Job and location to reflect where the unit has been/is about to be connected. All new fault records will now be attached to the new job/location. ***This is a critical piece of information as if it not up to date then excavations may be taken out in completely the wrong location.***

Set The Phone Number This is done in the same manner as the previous changes and is not one that is done on a regular basis.

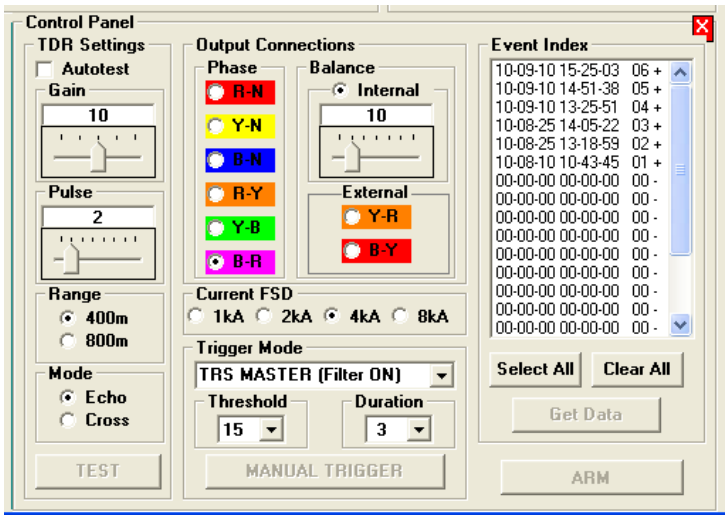
Set SIM No Again changed as previously and this will keep track of the SIM card No.

Save Save any amendments made to the configuration file.

Save As Useful if a backup is to be made of the configuration file or if a new System is to be generated.

6.2.3 Control panel

This option in the menu bar will open the control panel and place it over the window of the secondary event viewer. It is here that that unit is configured for the fault it is to be connected to and where the current records in memory are displayed. This will be covered in a later section.



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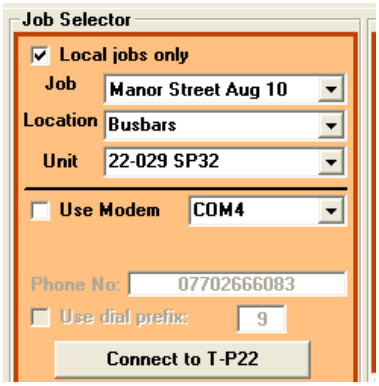
6.3 Job Selector

The job selector allows the user to select which device that they either want to connect to or analyse existing records. It displays the information held in the configuration file



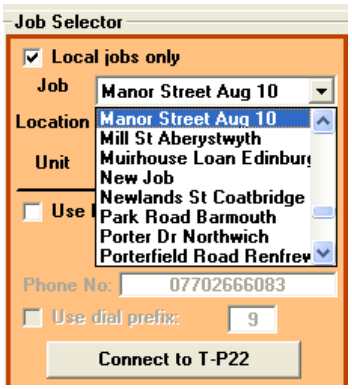
Local jobs selector

Checked The Job drop down list will only show the jobs currently held in the configuration

Unchecked The job drop down list will show all jobs that T-P2X's have been connected to in the selected System. This allows a historical view of faults and may be useful for training purposes.

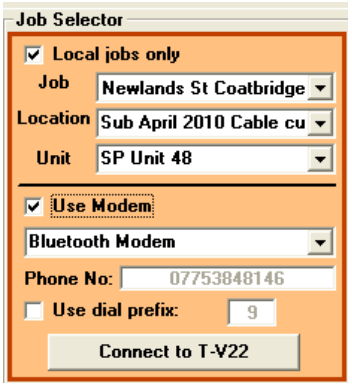
Job

In the Job Selector above the Local jobs only box is checked so a left click on the drop down box will list the jobs held in the configuration file



The list will position at the last job used and it will be highlighted in a blue background, in this example Manor Street Aug 10. This can now be scrolled until the instrument required is viewable in the list. A left click on Newlands St Coatbridge will select it

Location



Note now that the location has changed and that it displays the location associated with the job in the configuration file. In the majority of cases there will only be one location. In a double ended location there will be two locations. It is possible on very rare occasions that there may two recorders associated with the same job. The location is selected in the same way as the job.

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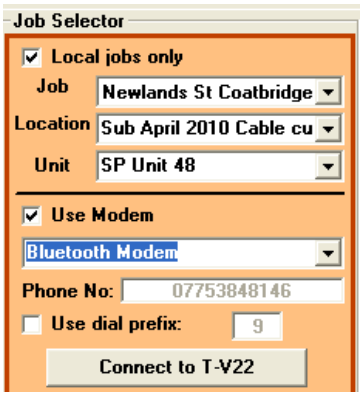
Unit

This again will default to the unit associated with the job selected and only needs to be selected where there is more than one recorder used on the job.

Use Modem

Checked

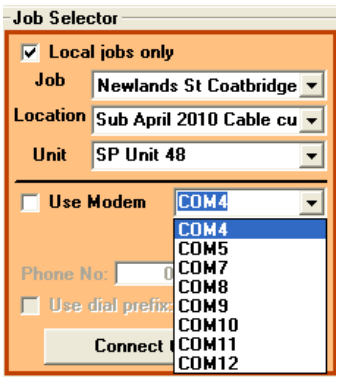


This will display a list of modems available to use for remote operation - select the modem to be used.

The caption Phone No will change from grey to black. The phone number displayed is the one held in the configuration file for the selected Job.

Clicking Connect To T*.2X button will initiate connection.

Unchecked



This is used when making a direct connection. This will normally be a Bluetooth connection on site. Simply select the comm. Port associated with the T-P2X and click on connect to communicate with the instrument

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6.4 Control Panel

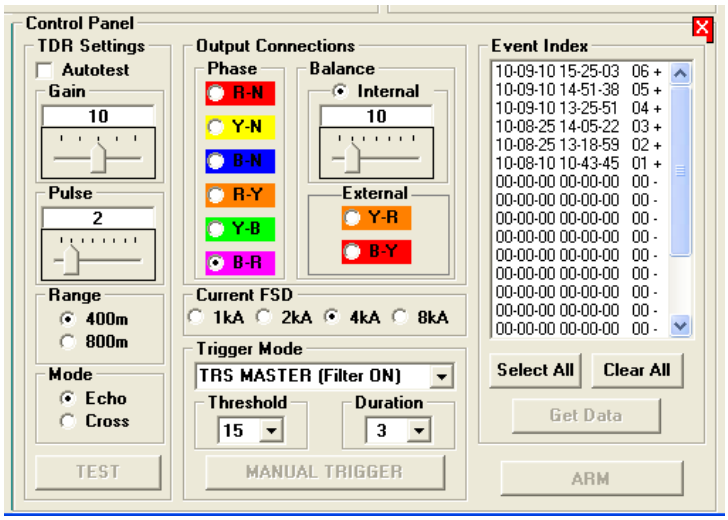
6.4.1 Overview

The control panel is the interface between the user and the T-P22 and is used to

1. Select range
2. Select cores for pulse injection
3. Condition pulse through testing
    a. Gain
    b. Width
    c. Balance
4. Select both operating and trigger modes
5. Recover records from T-P22 to computer

The control panel will open automatically on when connection to the T-P22 is made.

The following steps will demonstrate how to set up a T-P22



6.4.2 Range

As on any TDR the range should initially be set to a value that is longer than the length of the cable under test. Low voltage cables by nature are normally short lengths and there are only two ranges available. Simply click the radio button on the length that is to be used – either the 400m or 800m button.

6.4.3 Output Connections

The test lead is connected to all three phases and neutral and therefore there are six possibilities for pulse injection from the Phase-earth and phase- phase combinations. While it is important to select the correct pair i.e. the most active, it has to be remembered that the fault condition can change

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and it may be necessary to select a different combination. In the Output connections box select the radio button for the pair to be tested.

The internal balance is a numerical value between 0 and 60 and is used to match the T-P22 to the cable under test to ensure that the maximum energy is passed from the T-P22 into the cable. This will normally be between around 10 – 25. At this stage the external balancing method will not be considered.

6.4.4 Gain

This is the factor by which the reflected pulse is amplified for display in the TDR Viewer. The TDR waveform should always be fully visible in the viewer and the negative trough should be around ¾ of the available axis. The gain is adjusted using the slider bar and can be set at a value between 0 and 20.

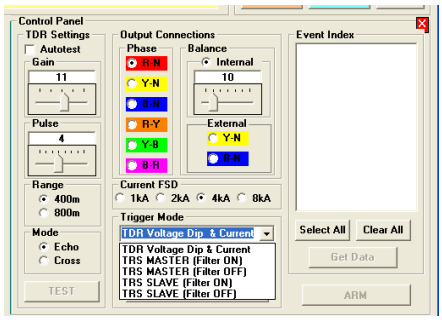
6.4.5 Pulse

This will determine the pulse width and can be set between a value of 1 and 8. The pulse width will set to a default value for the range but can be increased as a means of injecting more energy into the cable. It should be used with care.

6.4.6 Mode

Select echo.

6.4.7 Trigger Mode



Select the trigger mode from the drop down list.

6.4.8 Event index

This will populate when connection is made and will list the last twenty records that have been captured by the T-P22. Records that are marked with a + have already been downloaded and saved to the host computer. Those that are marked with a – are new and require to be downloaded. Records for download can be selected using normal windows techniques and can be recovered by left clicking on get data button. Records with a blue background will be recovered.

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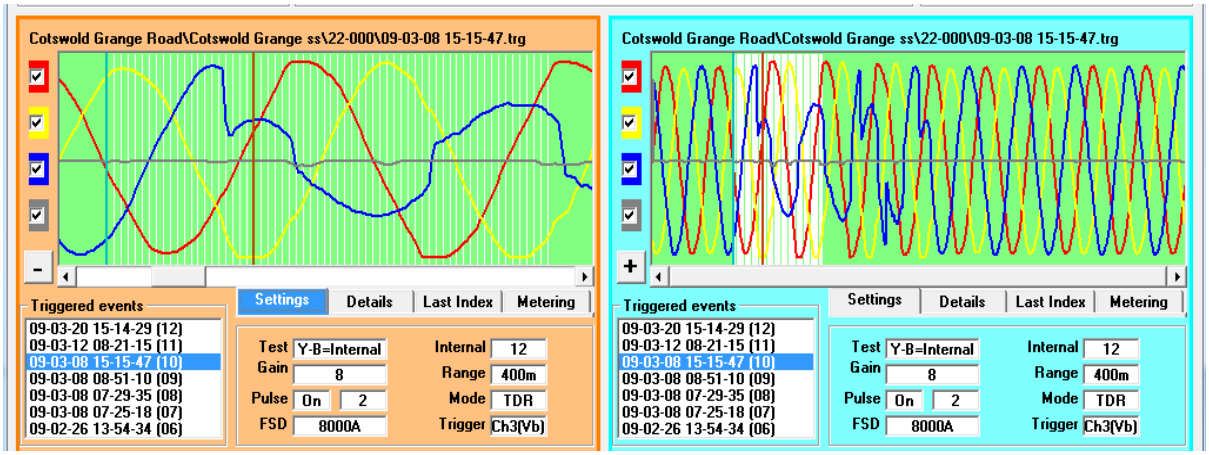
6.5 A.C. Event Viewer



There is a great deal of information in the AC waveform window that might not be appreciated at first glance.

In this instance the two A.C. waveform viewers are displaying the dame waveform with the left hand window displaying the full ten cycles of the event while the left hand viewer displays the trigger point i.e. the area of interest.

The full event shows a Blue phase fault that is transient in nature with the voltage fully recovering.

The title bar details the job/location/unit/record date time. The record being viewed is highlighted in the Triggered Event list. Different records can be selected for display and analysis by left clicking on the date/time.

The left hand window shows the trigger point in detail and has sixty four vertical white lines. Each of these lines represents a TDR record with the change in voltage at approximately the twelfth TDR record. The blue cursor is in the healthy part of the waveform while the brown is in the faulty. Both cursors can be moved at will within the window to compare healthy/faulty sections of the wave form. The associated TDR waveforms are shown in the TDR viewer for analysis.

The check boxes on the left hand side of the viewers allow individual phases to be switched on/off.

The settings tab shows the control panel settings for this record.

7. MANUAL TEST – TEST TRACES

These default to switched off. Every manual test made from the Control Panel is saved to file but is displayed in the test trace window rather than the event window. These waveforms are the same as those from a traditional TDR. Test traces are normally acquired when configuring optimum settings on the T-P22 after connection at a new job. The can be used to locate a permanent fault but can also be overlaid on a triggered record to extract additional information as shown in example XXXXXX.

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8. TDR VIEWER

This is where all TDR waveforms are displayed and analysed whether obtained manually through test button or automatically from triggered records.

The waveforms can be moved vertically to get the best possible alignment for comparison purposes and can also be switched on/off to improve clarity. There are two vertical cursors that can be moved. There is normally one fixed at the start of the waveform while the other is moved to the point of departure to determine the distance from the start. However the both cursors can be moved and in some circumstances where a point on a waveform is a known point on the cable then one of the cursors can use that as a reference and a distance obtained from that to the point of departure.

Combinations of manual and fault records can be displayed simultaneously if required.

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9. OPERATION

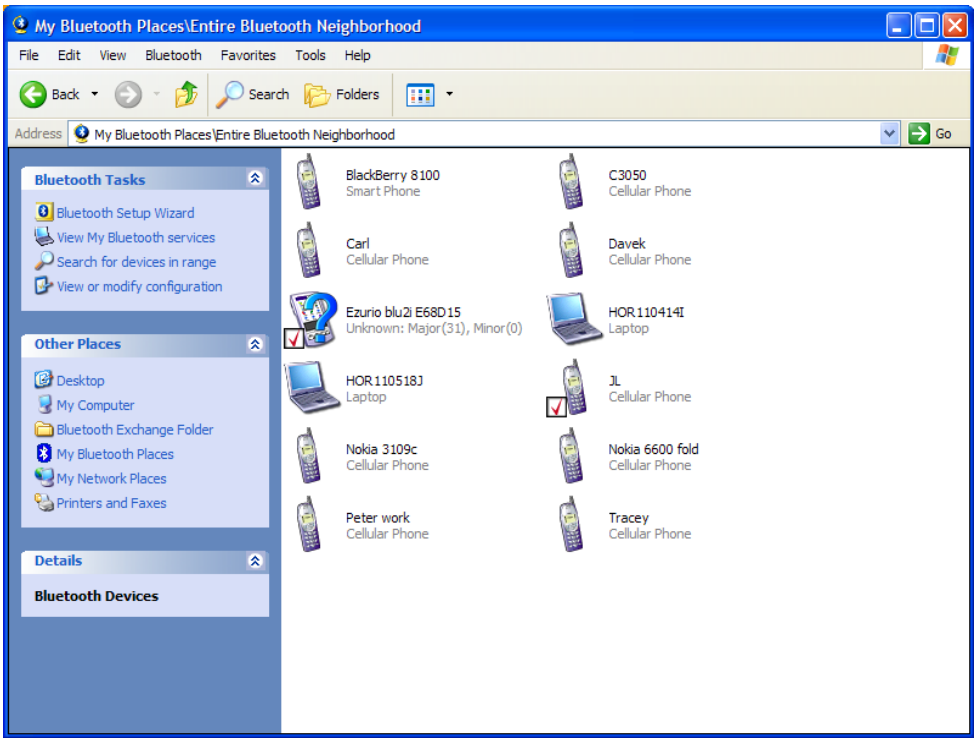
In this section we will step through a fault location from connection to recovery of a triggered record.

Connect the T-P2X to cable under test trying to get an open cable end in the first instance with the bottom side of the fuses supplying the cable the last option for connection.

Ensure that the unit connected is in the configuration file and is set to the current job/location. If it is not add the instrument as per or change its job/location.

9.1 Setting Up Bluetooth Connection (lap top)

Open ‘My Bluetooth places’ and click on ‘View devices in range’.



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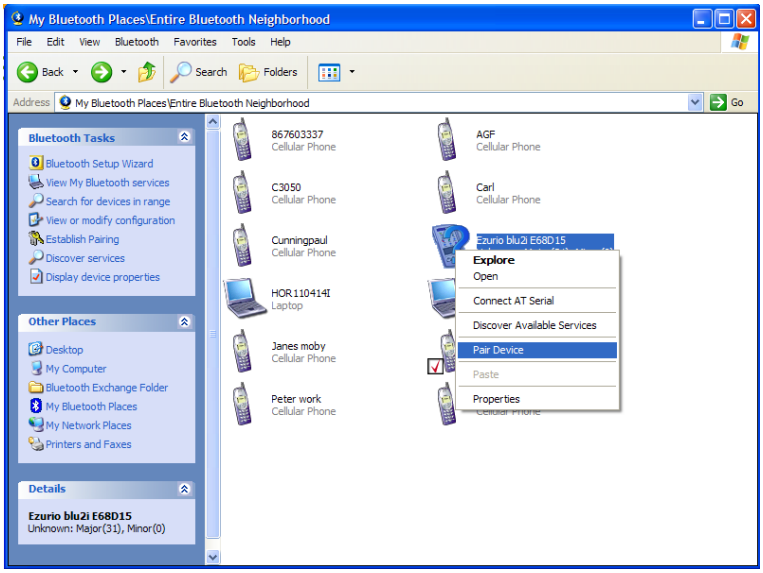
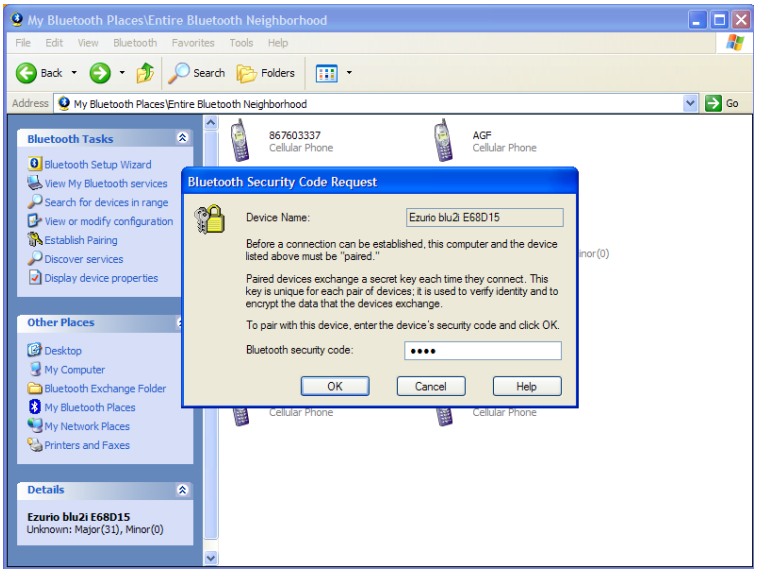
Right click on the device and click on ‘Pair Device’



Type the code “1234” which is the default code for all devices and click OK.



Right click on the device and click on ‘Connect to AT Serial’.

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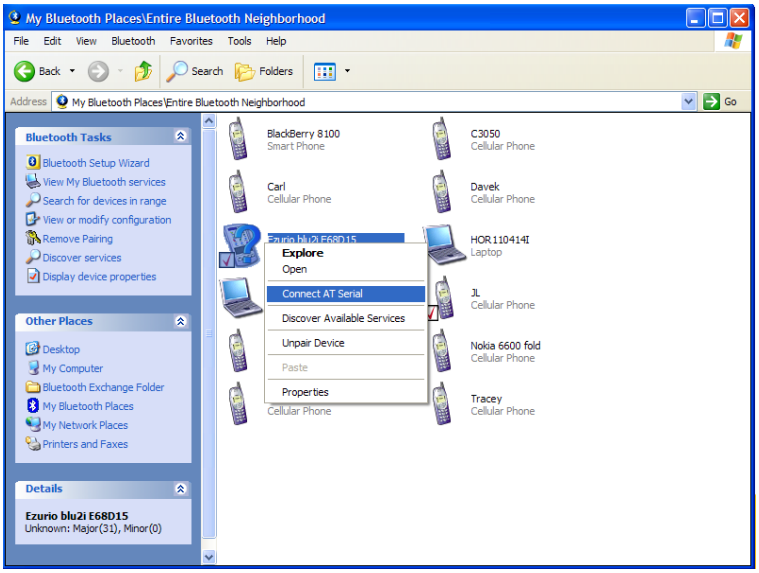
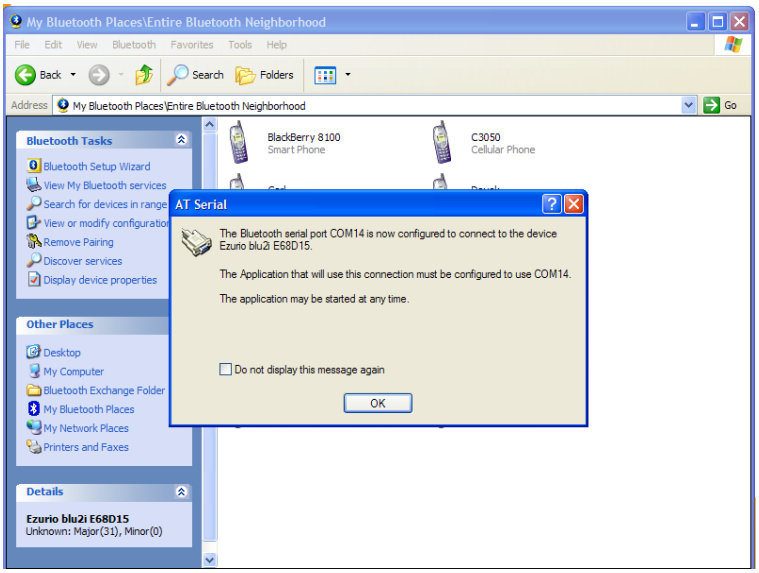


Note the Bluetooth serial port.



Click OK

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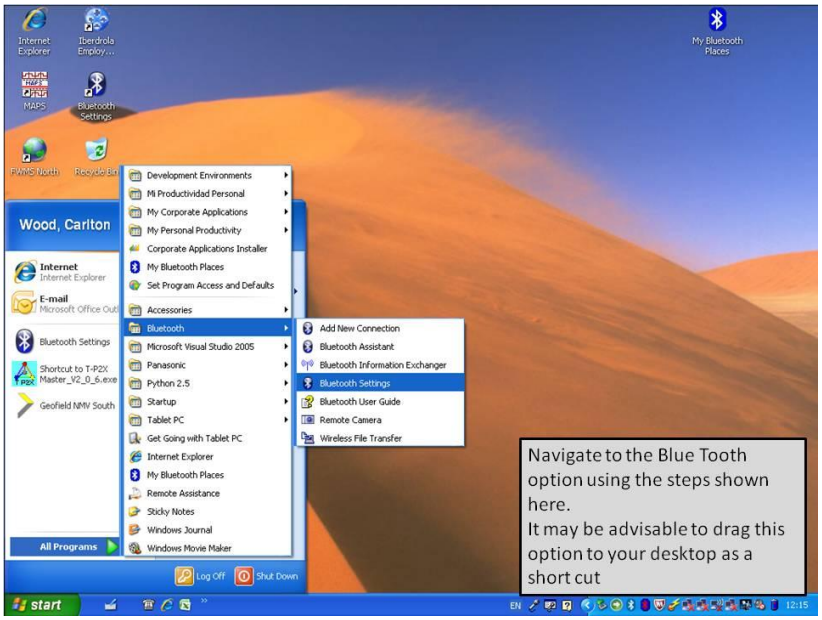
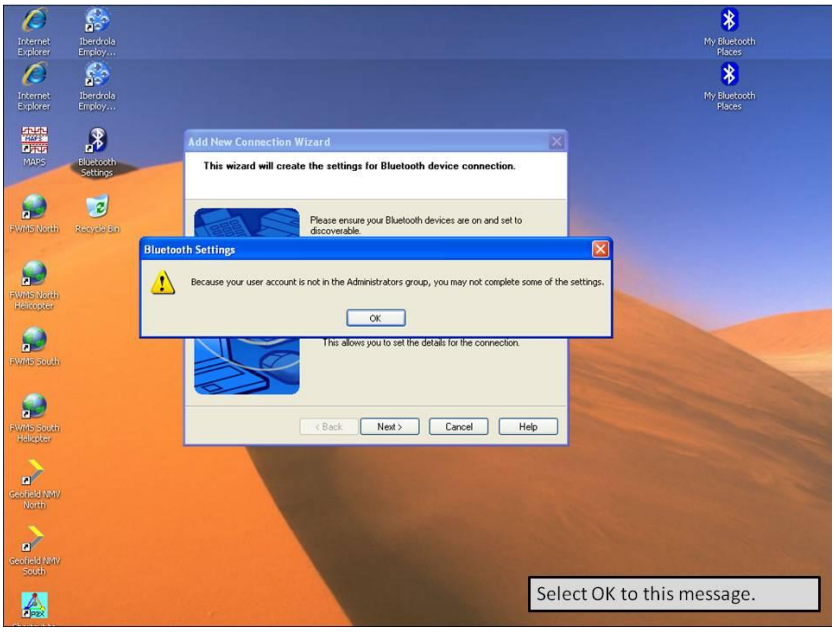
9.2 Setting Up Blue Tooth Connection (Toughbook/Tablet)





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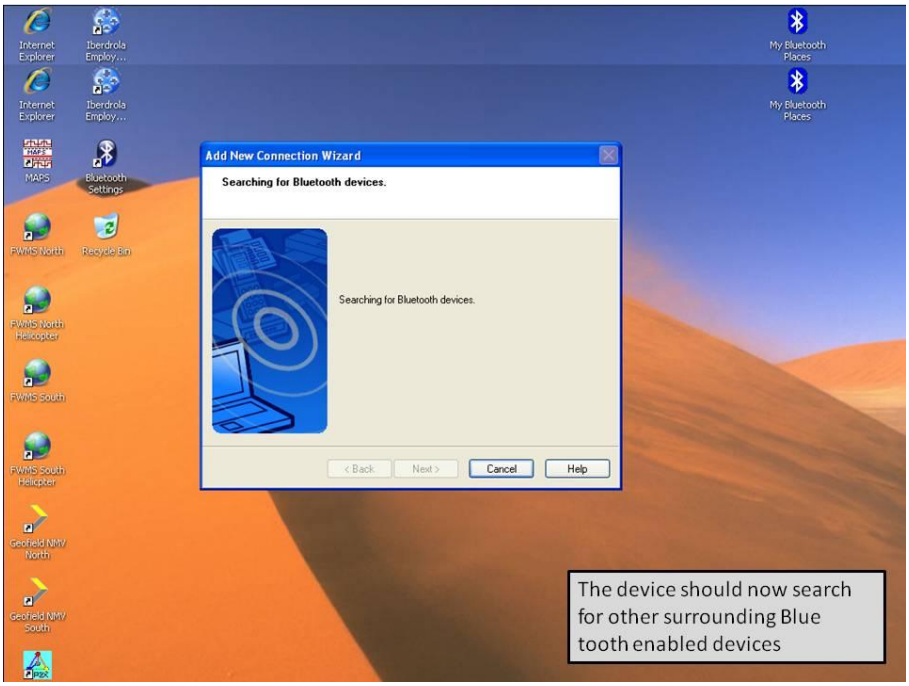

Add New Connection Wizard
Searching for Bluetooth devices.
Searching for Bluetooth devices.
< Back
Next >
Cancel
Help
The device should now search for other surrounding Blue tooth enabled devices


Add New Connection Wizard
Select a device
Please choose the Bluetooth device you wish to use.
Bluetooth device
Device Name
Audie
Nokia 2323c-2
SnowyC902
Ezurio blu2i EA2A01
Fi
Mabel
Refresh
< Back
Next >
Cancel
Help
The TP22 unit should be found and will be displayed as shown in this window.
Select this icon and click next

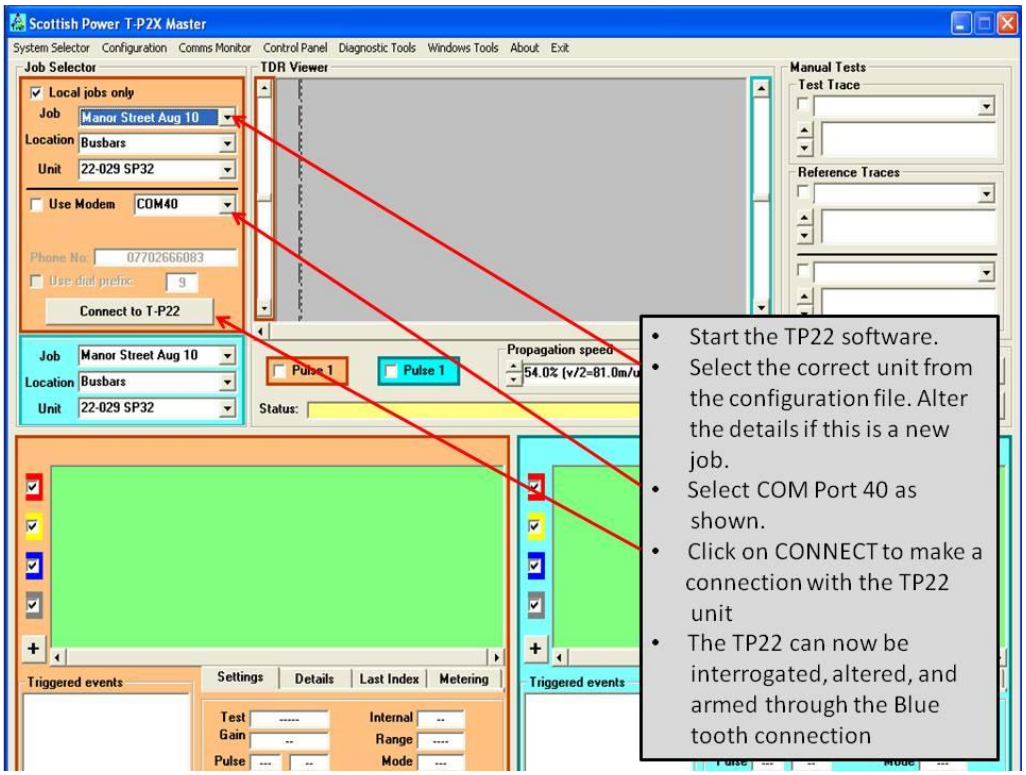
`


Add New Connection Wizard
COM port setting
Setup of COM40 complete.
Setup application software and driver if needed.
< Back
Next >
Cancel
Help
Make a note of the COM Port that has bee selected for a Blue Tooth connection.
This will be used when using the TP22 software


Bluetooth Settings
Bluetooth View Help
Bluetooth
Ezurio bluCi EA2A01
New Connection
Detail...
Delete
Select the TP22 unit by clicking on the icon shown here

`


Bluetooth Settings
Bluetooth View Help
Bluetooth
Ezurio blu2i EA2A01
New Connection
Detail...
Delete
When a Blue Tooth connection has been established the icon should look like this.


Scottish Power T-P2X Master
System Selector Configuration Comms Monitor Control Panel Diagnostic Tools Windows Tools About Exit
Job Selector
Local jobs only
Job Manor Street Aug 10
Location Busbars
Unit 22-029 SP32
Use Modem COM40
Phone No: 07702666083
Use dial prefix: 9
Connect to T-P22
TDR Viewer
Manual Tests
Test Trace
Reference Traces
Pulse 1
Propagation speed
Status:
Triggered events
Settings
Details
Last Index
Metering
Test
Gain
Pulse
Internal
Range
Mode
• Start the TP22 software.
• Select the correct unit from the configuration file. Alter the details if this is a new job.
• Select COM Port 40 as shown.
• Click on CONNECT to make a connection with the TP22 unit
• The TP22 can now be interrogated, altered, and armed through the Blue tooth connection

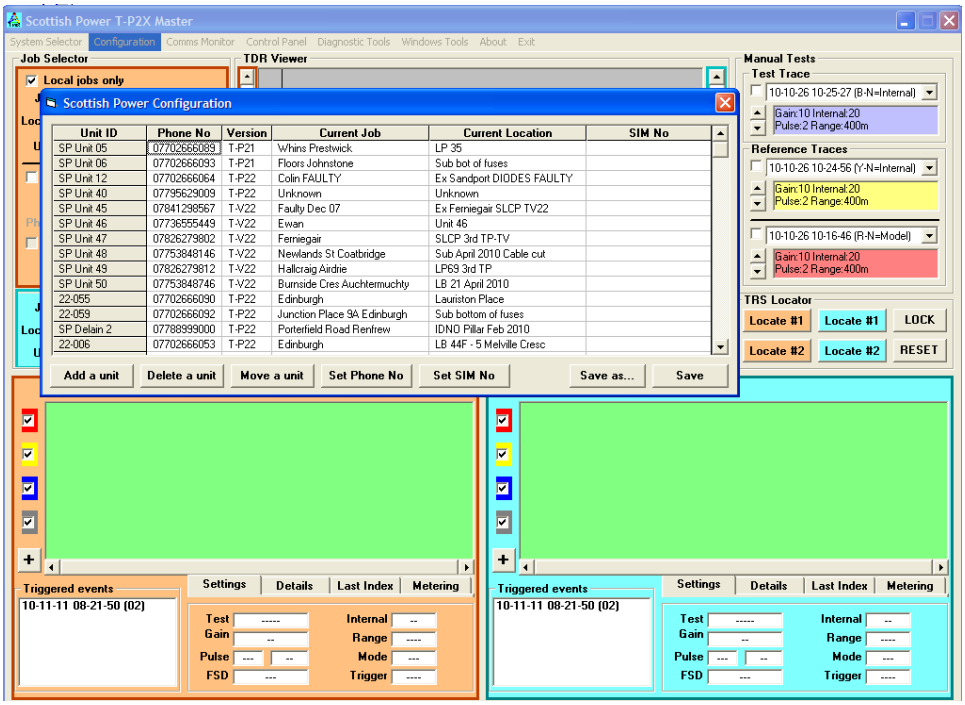
`

9.3 Configuration

9.3.1 Adding a unit

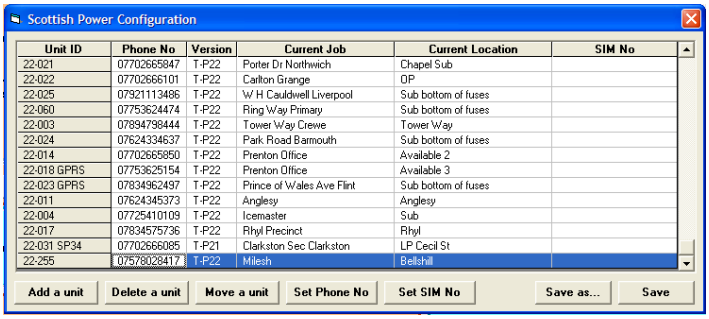
Open the T-P2X by double clicking the .exe file.

Click on ‘Configuration’ on the TDR view to bring up the configuration menu.



Click on ‘Add a unit’

Enter the name on the unit and click ok. Follow the same steps to set the phone number, version, job name, location and sim number.

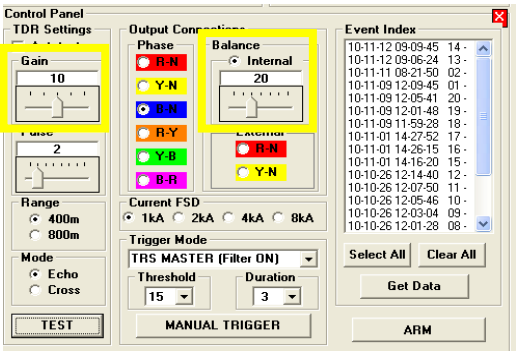


As seen here the Unit 22-255 was just added.

Click on save and the yes to finish configuring the unit.

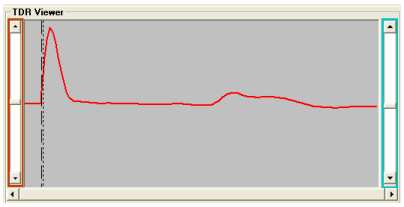
`

9.3.2 Balancing



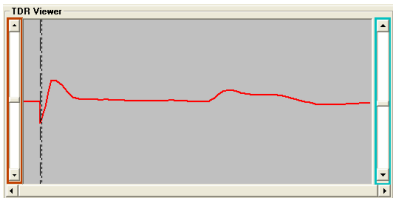
The objective is to get the flattest line at the start of the graph. This is done by balancing the monitor to the cable using the 'Internal Balance'. The 'Gain' can be used to get the optimal graph on the TDR Viewer.

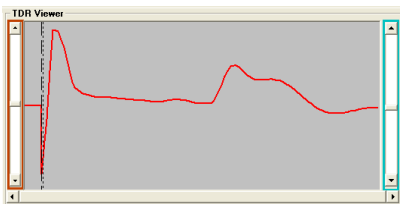
You can start off with a low gain and a low value for the internal balance.



Internal = 0 Gain = 7

Internal = 7 Gain = 7



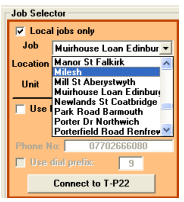


Internal = 30 Gain = 11

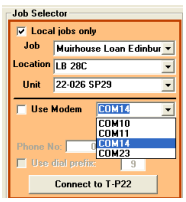
A perfect flat line is hard to obtain so as seen in the last 'TDR viewer' a graph with an "S" shape at the start is good enough.

9.3.3 Connecting

From the Job Selector use the Job drop down menu to select the job you are doing at the moment.



Select comport that was noted when connection to the unit via Bluetooth from the drop down menu.

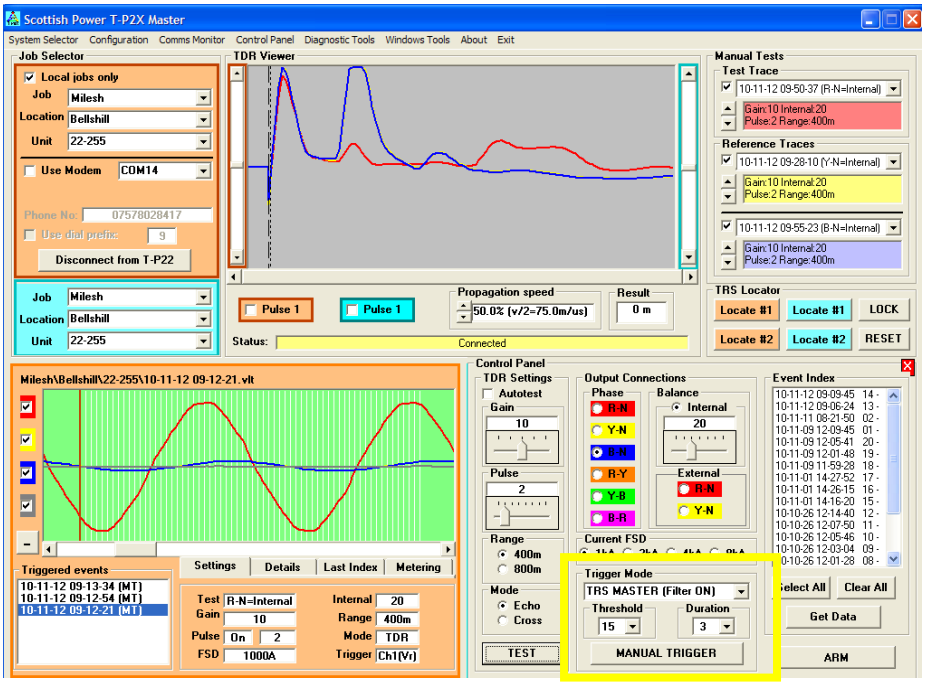


Click on the 'Connect to T-P22' button to connect to the unit.

`

9.4 Fault Location using Standard TDR Mode

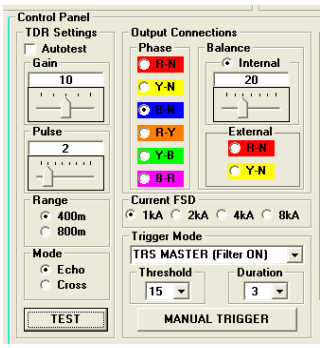
When using the T-P22 you need one healthy phase to power the unit and to compare your results from the faulty phases. We will be using the Red phase as the healthy phase. For the following steps we have induced an open circuit on the Yellow and Blue phase at about the same distance from the unit.



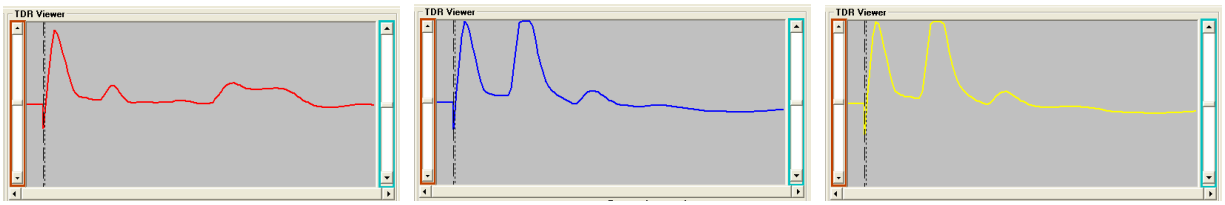
First from the ‘Control Panel’ > ‘Trigger Mode‘ use the drop down menu and select ‘TDR Voltage Dip & Current’

On the ‘Control Panel’ > ‘Output Connections’ and look at ‘Phase’

From this menu you can select from one of three phases to earth options Red Yellow Blue to Earth. Or one of three Phase to Phase potions.

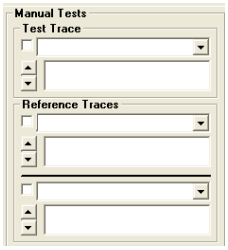


First select the Red to Neutral (or what ever the healthy phase it to Neutral) and click test and you should get a graph that looks like the following on the TDR Viewer. Next do the same by selecting the one or two faulty phases. In this situation Yellow to Neutral and Blue to Neutral and you should see graphs that look like the following on an open circuit fault. ******



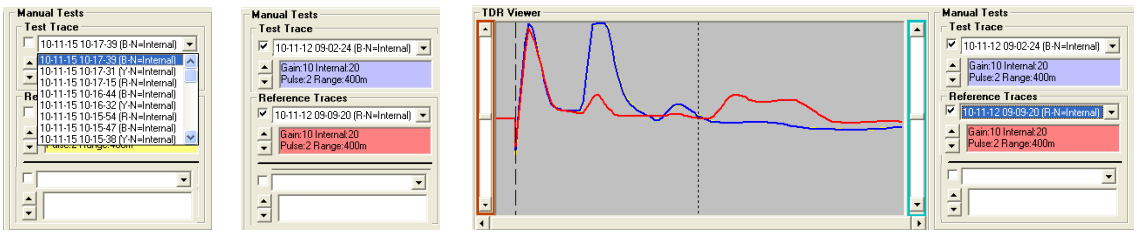
`

After recording the data on the three phases we can then bring up the three graphs on the same view so that we can compare the three phases to each other and use that data to locate the fault.



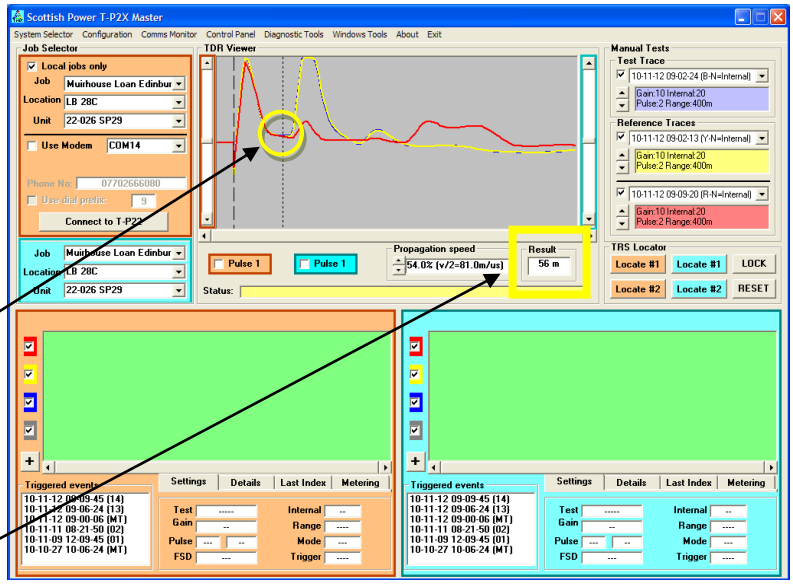
This is done using the manual test window.

First from the 'Test Trace' drop down menu pick out the phase you want to test and tick the box next to it. Next from one of the 'Reference Traces' drop down menu pick the health phase and tick the box. This will bring up both graphs on the 'TDR Viewer'.



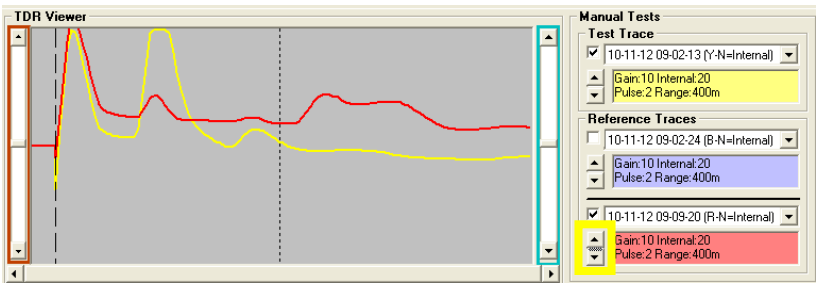
In the same way we can bring up all three phases on the same 'TDR Viewer' and compare them to each other.

By clicking on the point that the waves start to separate a dotted line will appear. This is the location of your fault. This graph shows both the Blue and Yellow separating from the Red phase which reflects the open circuit we have induced on the Blue and Yellow phases.



The distance to the fault from the fault locator is displayed in the result box in meters.

After testing if the graphs don't align they can be adjusted on the horizontal axis by the up and down buttons.



`

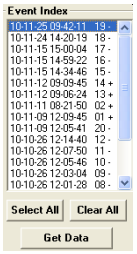
9.5 Intermittent / Transient Fault Location

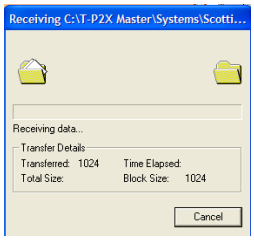
After successfully connecting to the T-P22 you should always record all three phase to neutral graphs and all three phase to phase graphs. When recording phase to phase the Balance should be reset as the parameters are different for phase to phase faults. This helps when finding the distance to fault as you have all the possible combinations of healthy wave forms and can compare them to the graphs obtained through fault conditions.

Click on 'ARM' and you will see a message asking if you want to arm the device use the current settings and if the settings are correct. Click 'Yes' to arm the device.

For the following steps we have induced a Transient Fault between the Red phase and Neutral to trigger the device.

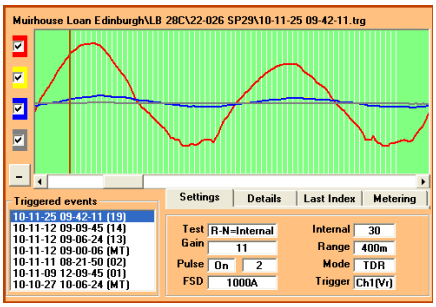
Connect to device then using the 'Event Index' pick the most recent event. The T-P22 can hold up to 20 records on its internal memory. The (-) in front of the record shows that the record **has not been** down loaded to the PC. The (+) in front of the record shows that the record **has been** downloaded to the PC.





To download the record double click the record or click on the record and click then on 'Get Data'. The software will then start to download the record on to the PC. After the record finishes downloading the (-) will change to a (+) showing that the record has been downloaded.

Next using the Main Event Viewer click to select the last record off the 'Triggered events' Record list. This will bring up a graph on the Event Viewer.

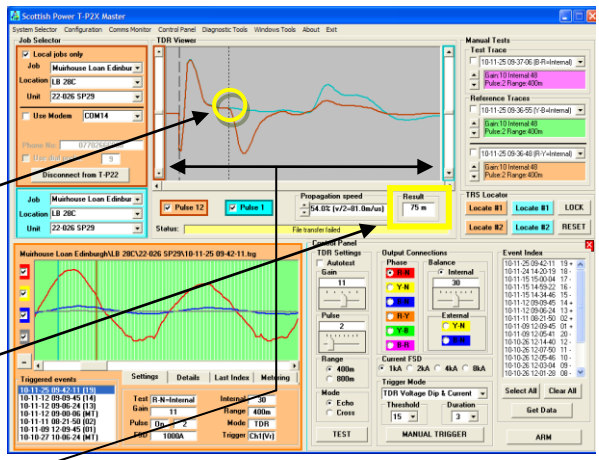


Next you can Right click at any point on the graph to move the brown cursor along the graph and observe how the graphs on the 'TDR viewer' changes. The curser can be moved to one of 64 pulses injected in to the cable shortly before and through the fault.

The blue curser can also be moved along the graph just like the brown curser. This is normally kept at a point on the graph where the circuit was still healthy.

We can view both graphs side by side and find the point where the waves start to separate. This is the start of the fault.

The distance to fault from the fault locator is displayed in the result box in meters.



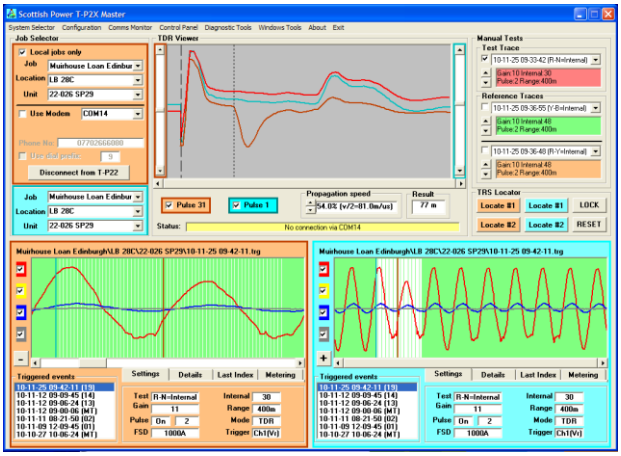
If the graphs don't align as you move along the wave on the Event Viewer you can offset the graph using the two scrollbars highlighted in brown and blue.

`

The location of / distance to the fault can be confirmed by,

1. Going through the range of Pulses and confirming the point that the two graphs start to separate.

2. By using one of the graphs recorded before arming the device and comparing it to the graph obtained under fault conditions.



A zoomed out version of the graph is on the 'Second Event Viewer'. In this you can see the waveform before and after the fault. You can also see how the voltage dropped during the fault and recovered after the fault.

`

Connect through either Bluetooth or GSM/GPRS in this case we will use the Bluetooth connection as the laptop and T-P22 are at the same location.

In the Job Selector

- Select the connection medium
- Click on connect
- On connection the Control Panel should appear over the secondary event window
- The current settings and index file will be populated automatically

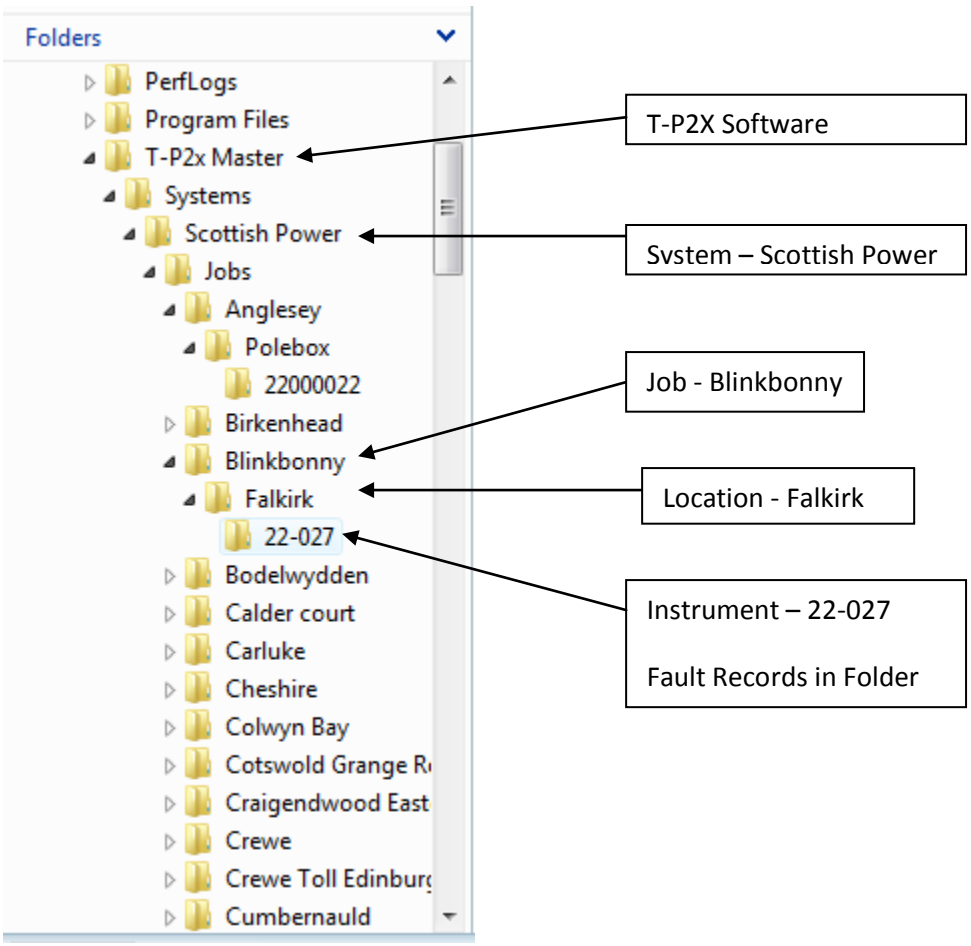
Before starting to configure the locator the operator should have at hand the cable length and the fault condition or at least the best estimate of the fault condition.

`

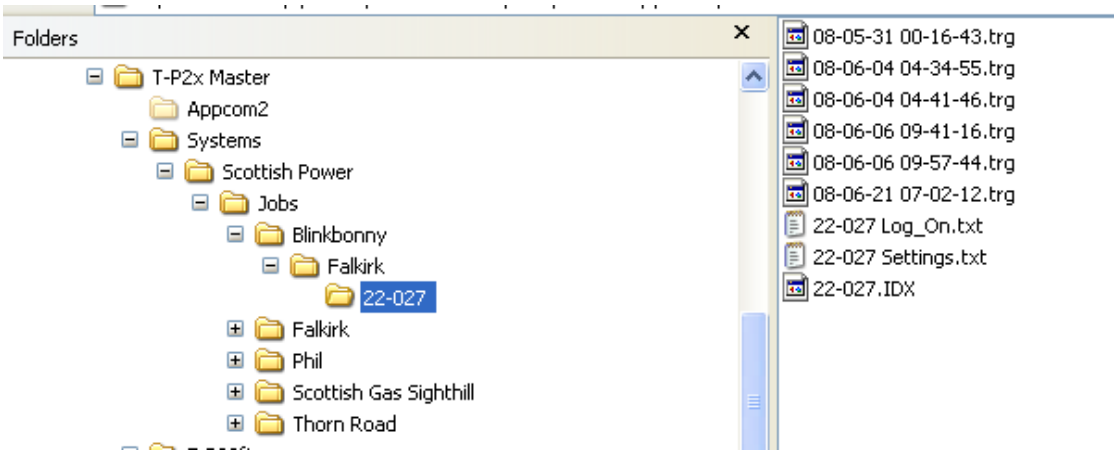
10. FILE STRUCTURE

10.1 Folder Tree

Located in D:\



10.2 Example of Files in Instrument Folder



`

11. CONNECTION

11.1 Bluetooth serial port

`

12. TRS MODE

This is a two ended method using travelling wave technology. It can only locate a fault on the direct cable route between the two T-P22's. If a fault is down a teed cable then the location would be the breeches joint for the tee.

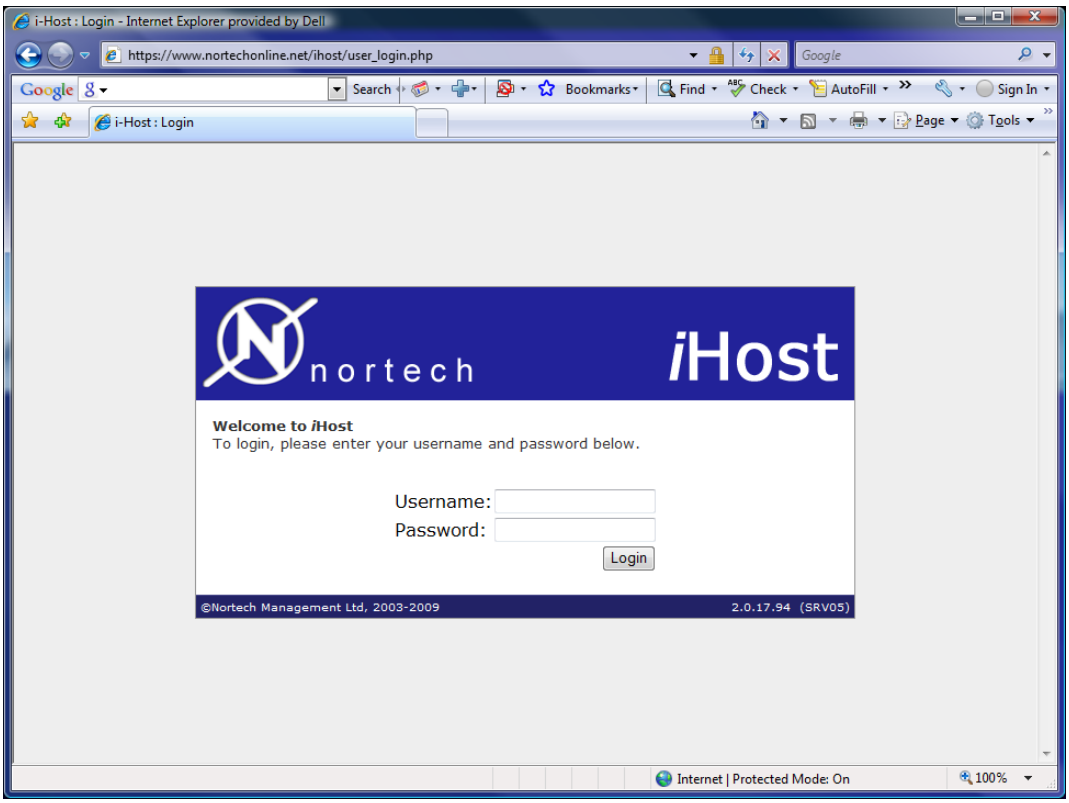
This is a specialised mode of operation and is not intended for general use at this point in time.

`

13. IHOST

13.1 Logging In

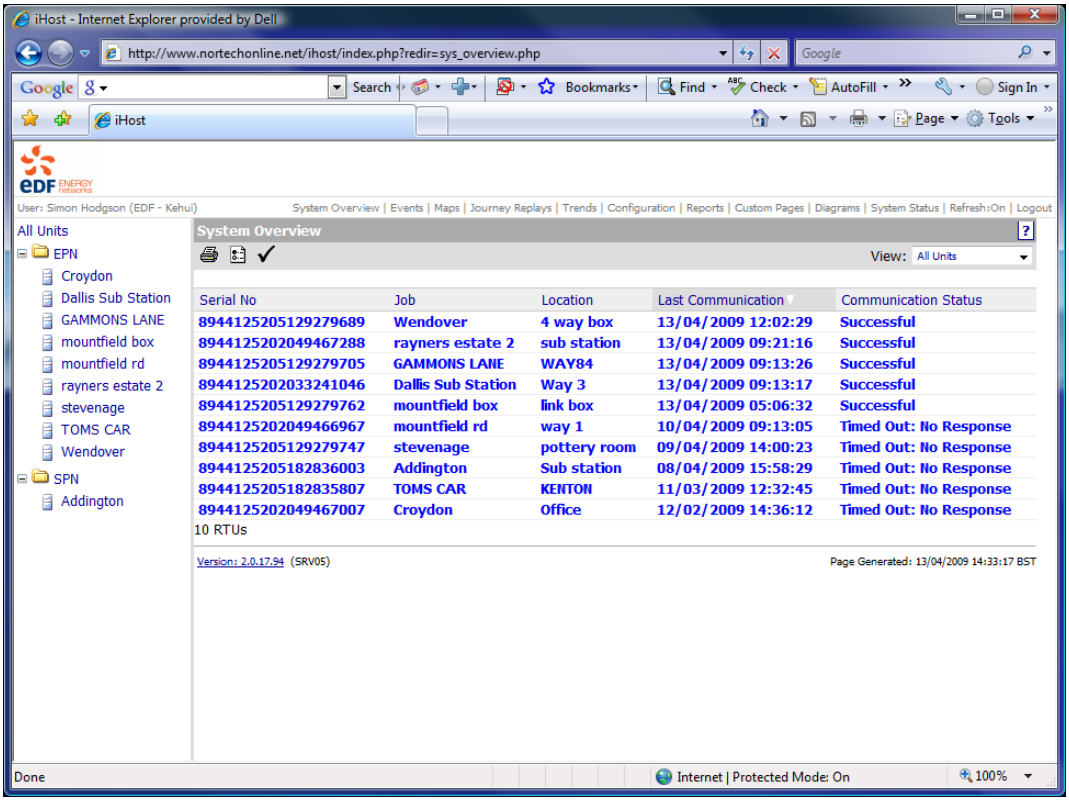
The address of iHost is **http://www.nortechonline.net/ihost/**



Usernames are **not** case sensitive, passwords **are case sensitive.**

`

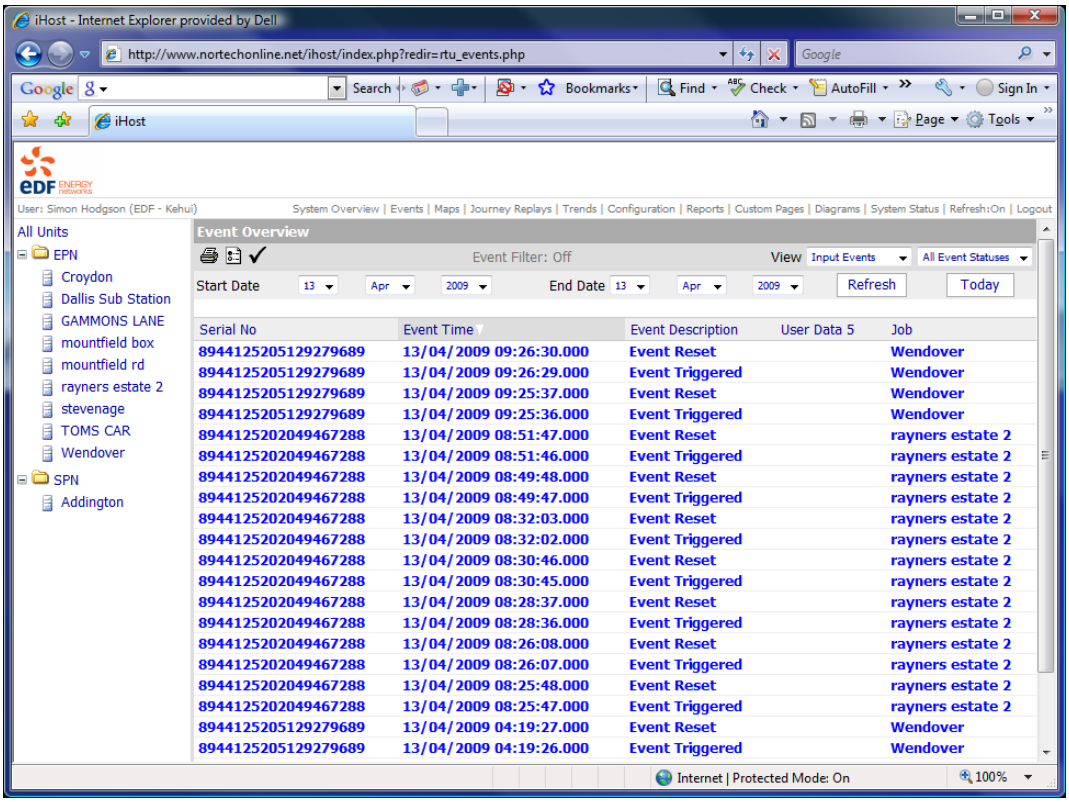
13.2 System Overview



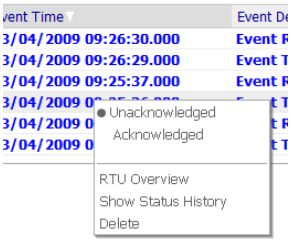
- Folders on left hand side filter the main list
- Units listed in **bold** have unacknowledged events
- Clicking on column titles sorts by that column
- Use the  button to change which columns are displayed and the order they are displayed in.
- Use the  button to acknowledge all events for all units.
- Click on a unit to view the **Unit Overview** Screen
- View the date/time of last poll and the current status of a device.

`

13.3 Event Log View



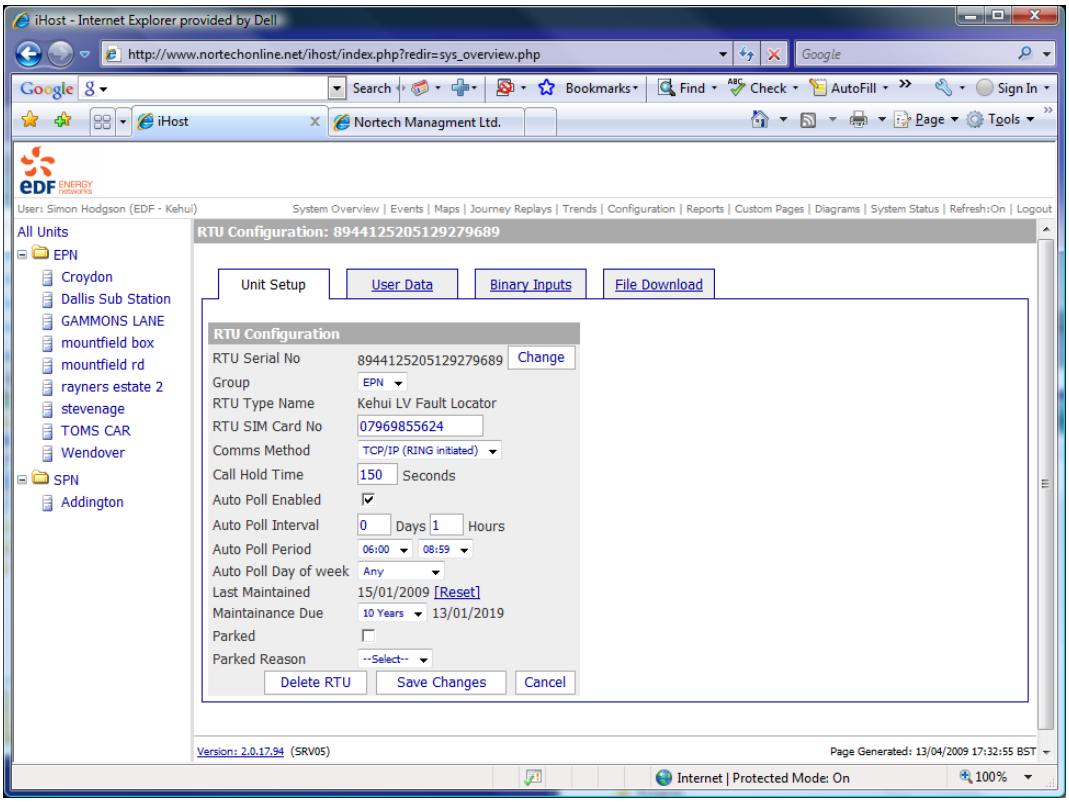
- Page works in a similar manner to the System Overview screen.
- Right clicking on an event allows it to be acknowledged



- Toolbar provides several methods of filtering events
- Pair of event triggered/reset events created every time the device detects a disturbance. Each pair has a trigger file associated with it that may be used to locate the cable fault location.

`

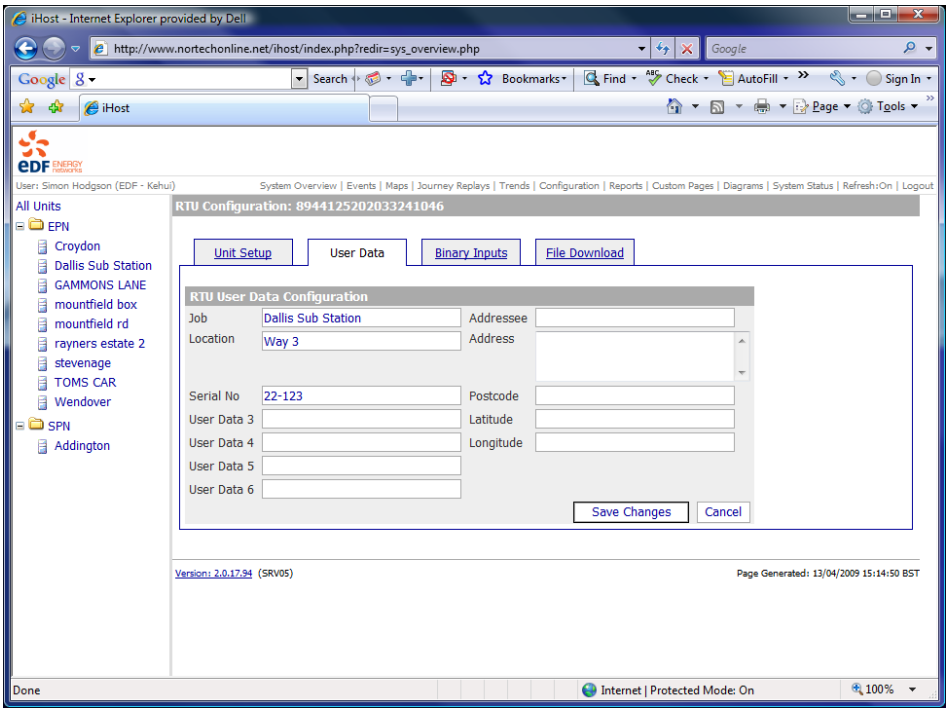
13.4 Unit Setup



- Most settings won't need to be changed.
- Group is probably the most used setting on this screen, affects which group the T-P22 appears in down the left hand side.
- Can increase/decrease device polling interval if required
- Use **Parked** to disable a unit from polling and notifications if required

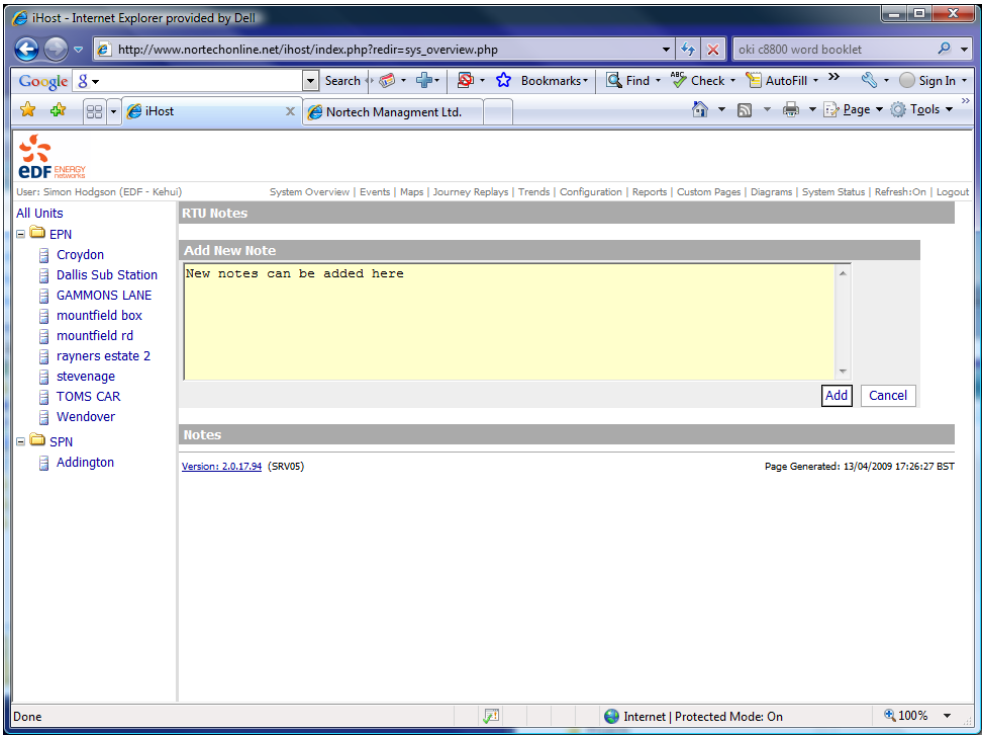
`

13.5 Unit User Data Setup



- Several customer definable data fields are provided.
- Important that Job and Location are updated when device is moved.
- A history of changes to this data is automatically kept by iHost
- Other fields are currently unused by EDF

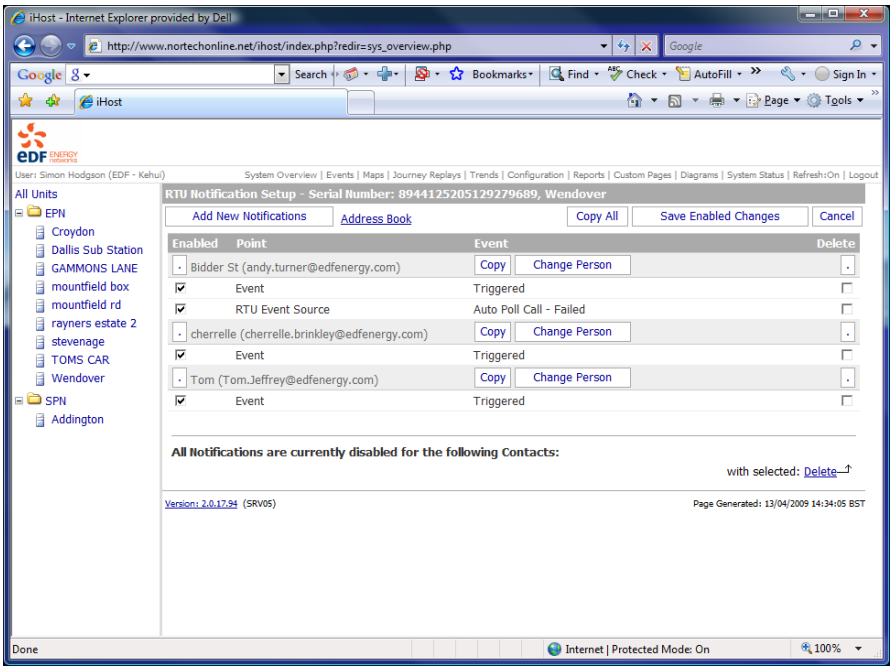
13.6 Notes Screen



- The notes screen allows a narrative to be recorded for a device.

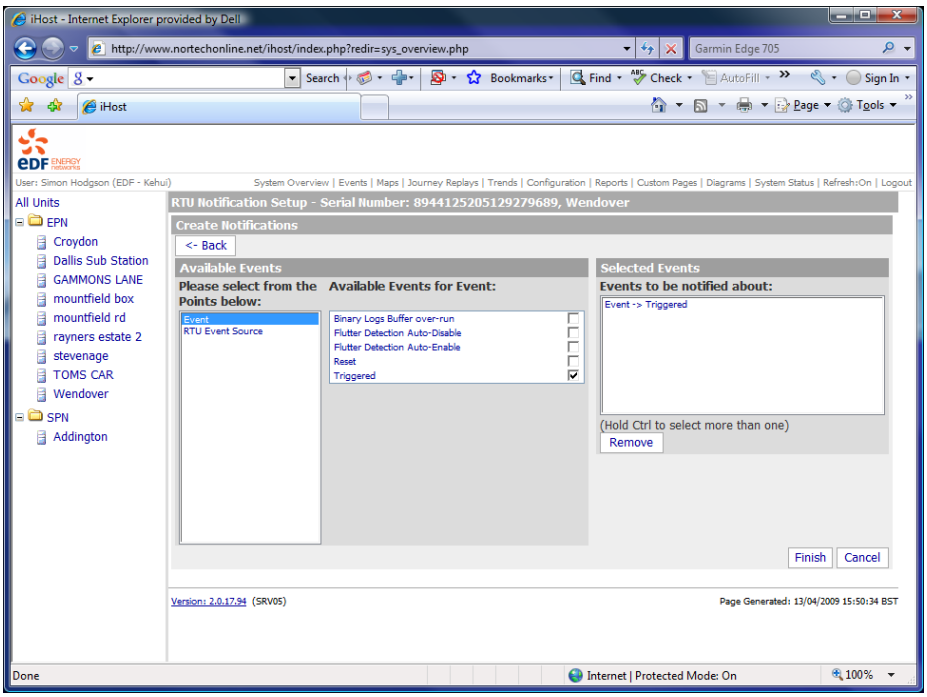
`

13.7 Notifications



- iHost can send SMS and/or e-mail notifications when the device has triggered.
- Means system doesn't have to be continuously monitored.

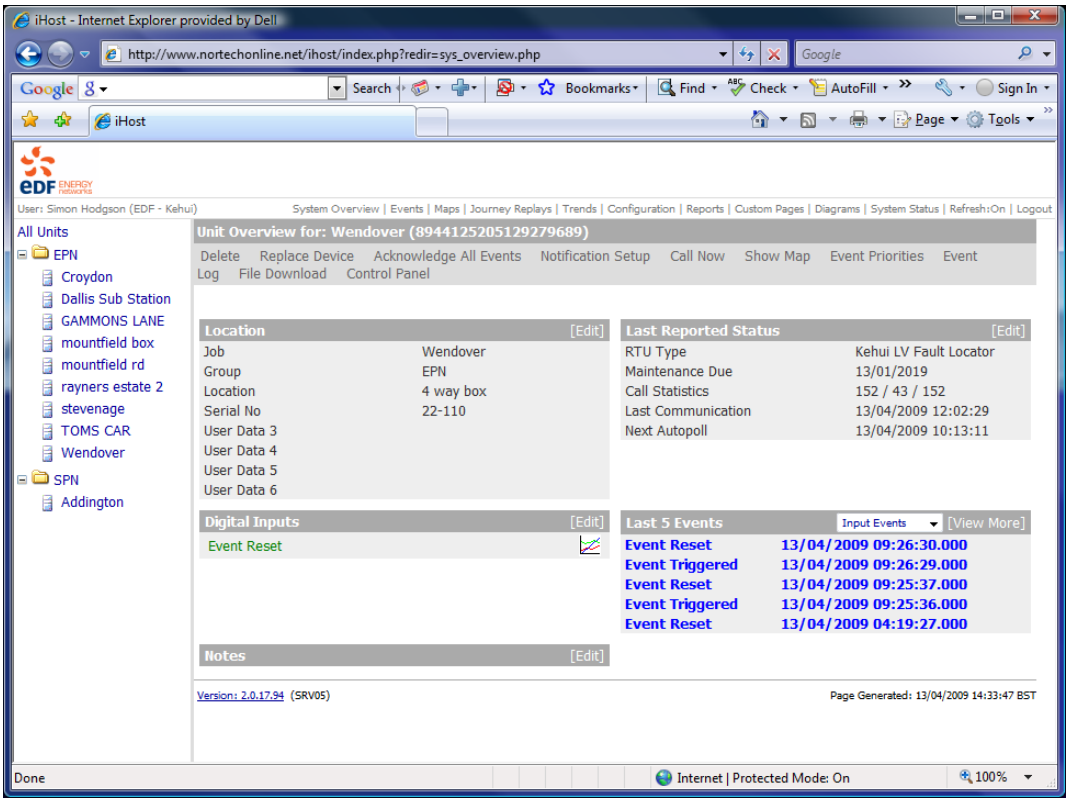
13.8 Adding new notifications



- Add users to the address book before creating new notifications.

`

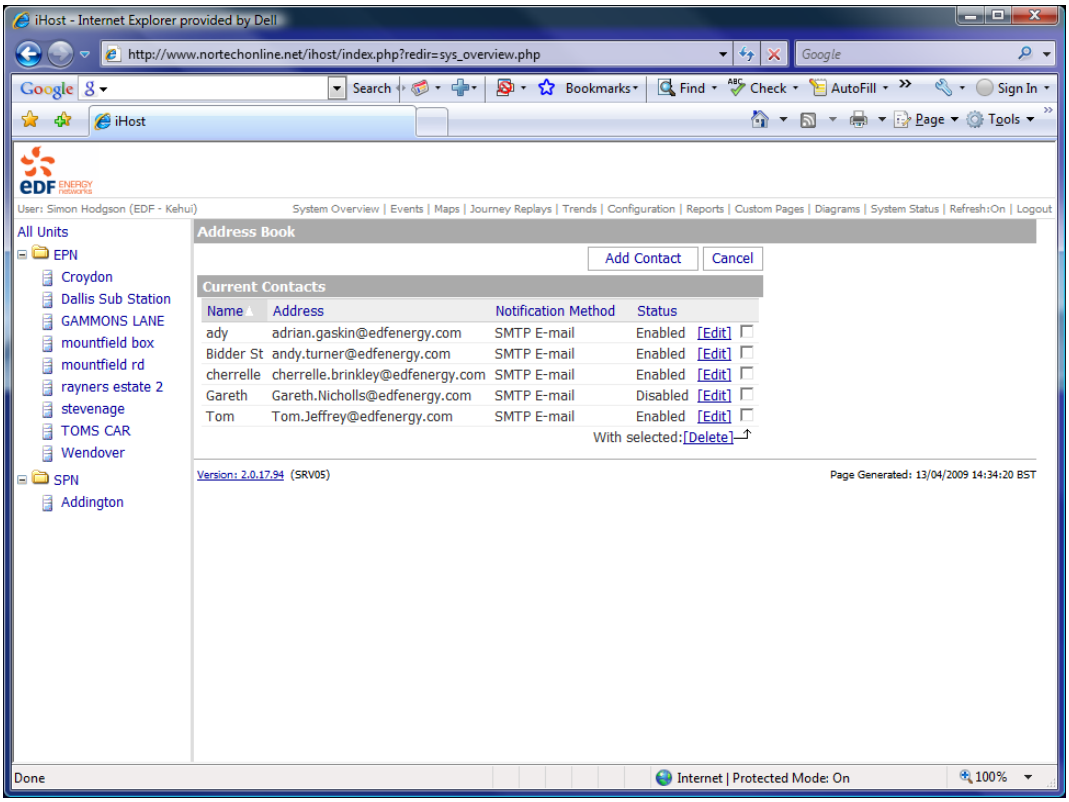
13.9 Unit Overview



- Provides the entry point into:
    - Location setup
    - Notification Setup
    - Event View
    - Control Panel
    - File Download

`

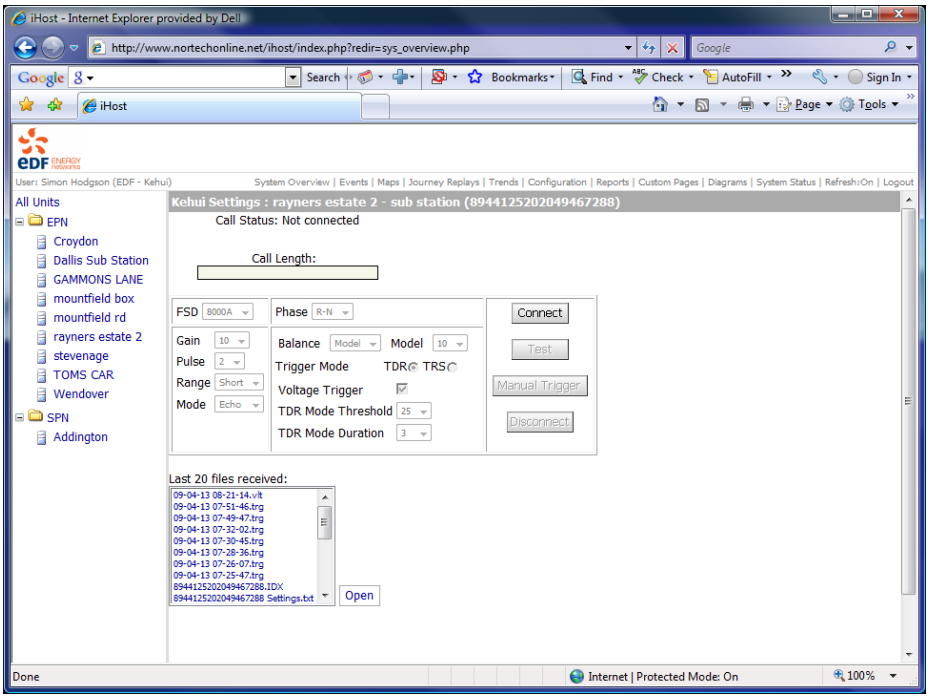
13.10 Address Book



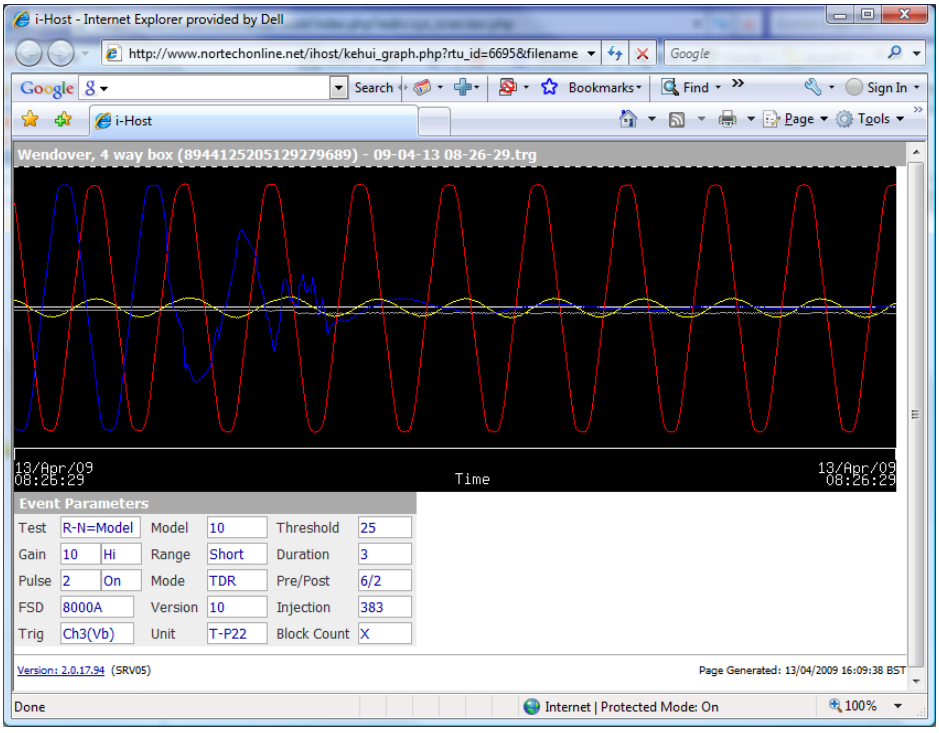
- List of e-mail/SMS addresses that can be used for notification.
- An address book entry must be defined before new notifications can be created
- Possible to disable all notifications for a user (e.g. when that user is on holiday)

`

13.11 Kehui Control Panel



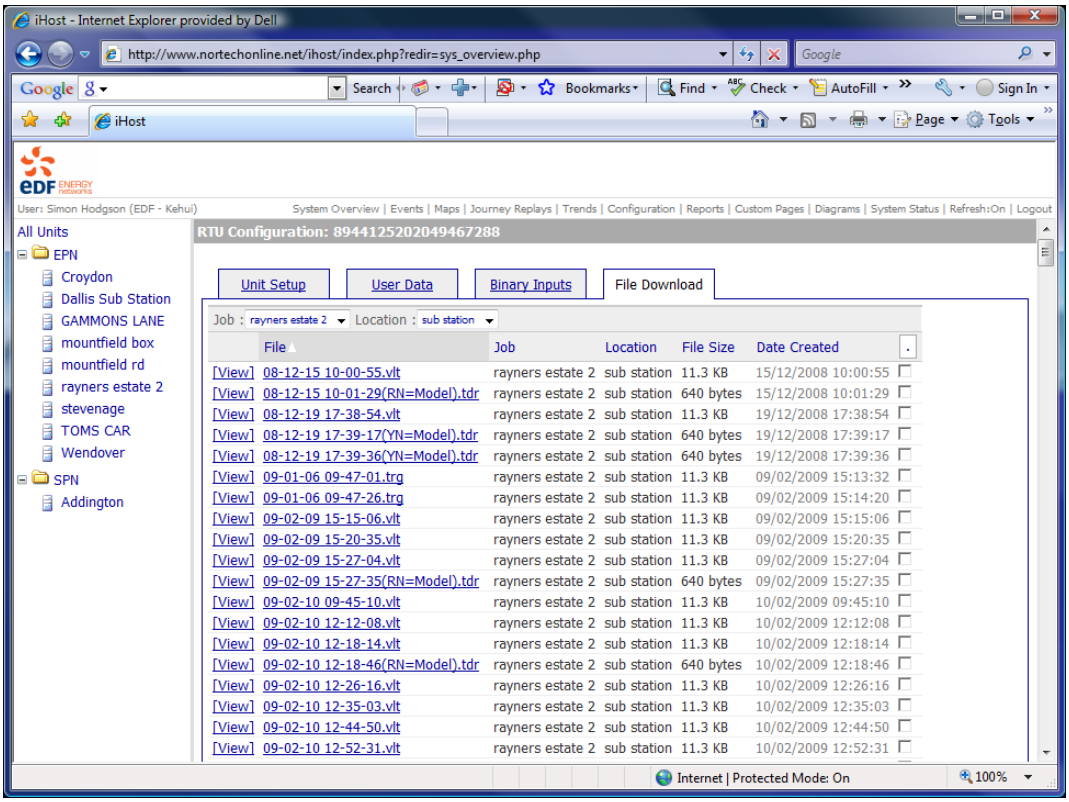
- Used to configure the T-P22
- Once a connection has been established, configuration parameters can be updated and tests run to view the effect of the changes.



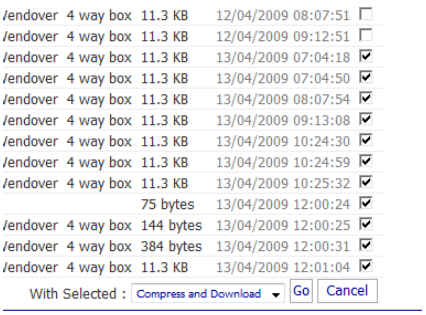
- Double click a .vlt or .trg file to view the AC Waveform

`

13.12 Downloading Files



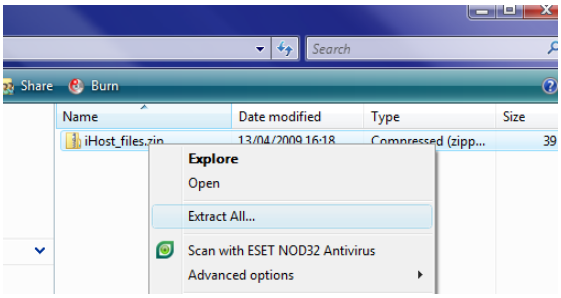
- Individual files can be downloaded by clicking on the file name, or viewed by clicking [View]
- Job and location filters can be set to view files for a particular installation
- Files must be imported into the Windows Application **T-P2X Master** for analysis.



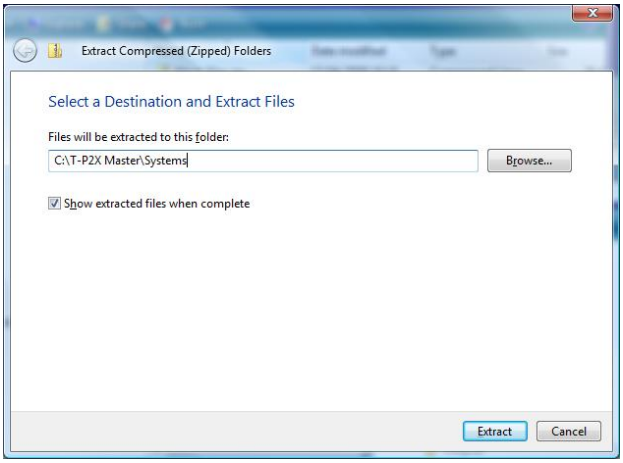
- Select several files and click ‘Go’ to download as a single .zip file

`

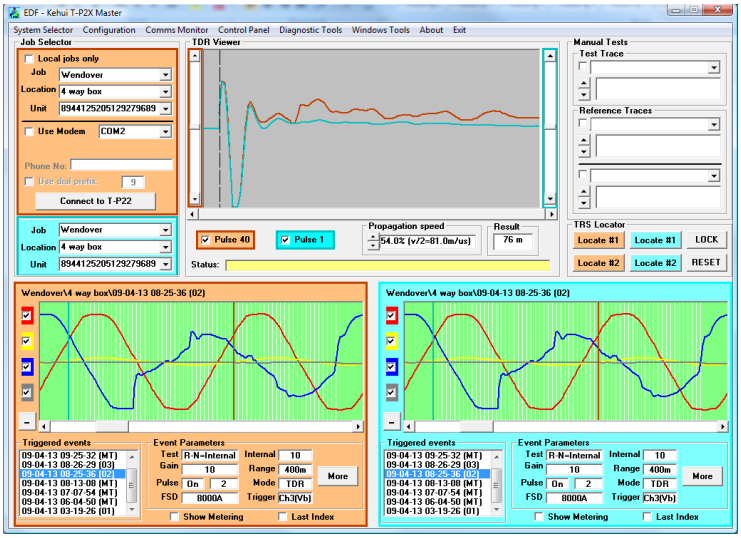
13.13 Import Data into T-P2X Master Software



- Once the .zip file has been download it should be extracted to **C:\T-P2X Master\Systems** by right clicking on the .zip file and selecting 'Extract All'



- Uncheck 'Local jobs only' to view the data in T-P2X Master Station Software



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13.14 Technical Support

We’re here to help…

Phone: 08700 111992 (9am – 5pm Weekdays)

E-mail: support@nortechonline.co.uk

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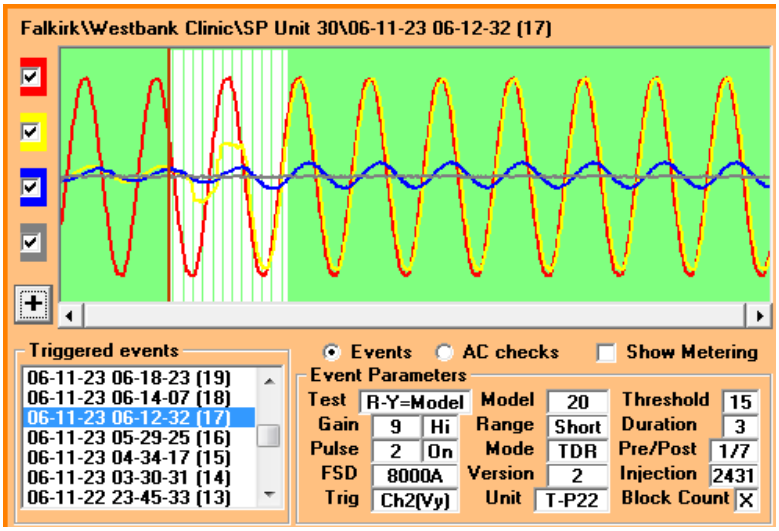
14. FAULT CHARACTERISTICS

14.1 Permanent fault

There are three permanent fault conditions

1) Solid phase to earth
2) Open Circuit
3) Phase to Phase

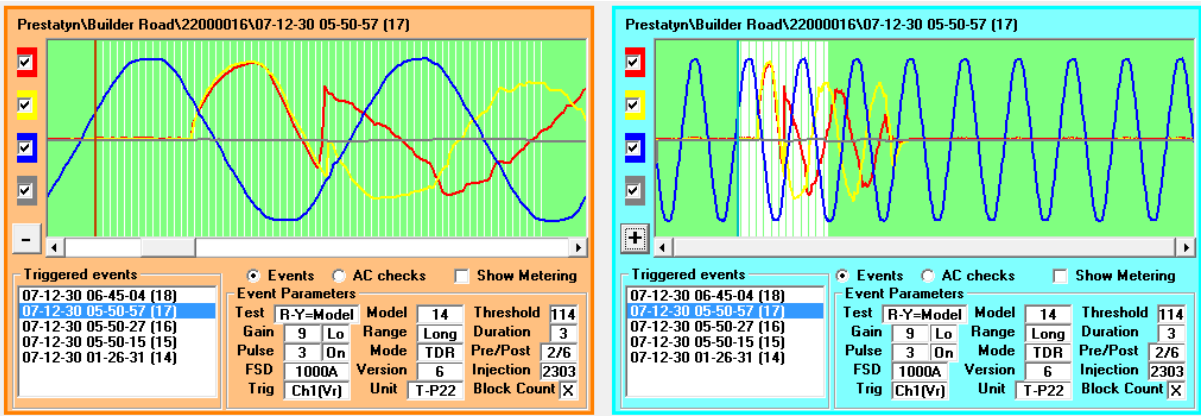
There may also be combinations of the above.



In this example the yellow phase has permanently shorted to the red phase some time after the yellow and blue fuses have blown.

14.2 Persistent fault

In many cases to the operator there is a permanent fault on the system as a fuse will blow immediately on replacement. This is not normally the case as there may be a number of healthy cycles before the voltage breaks down and the subsequent fault current to flow before the fuse blows. This is enough to be able to get a fault location



This is an example of a persistent fault the yellow phase has been reenergised while phase to phase with the red. The red phase has been energised at almost the same time and the fault condition

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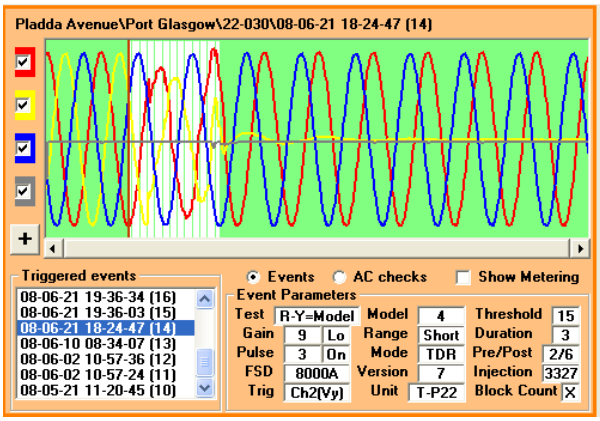
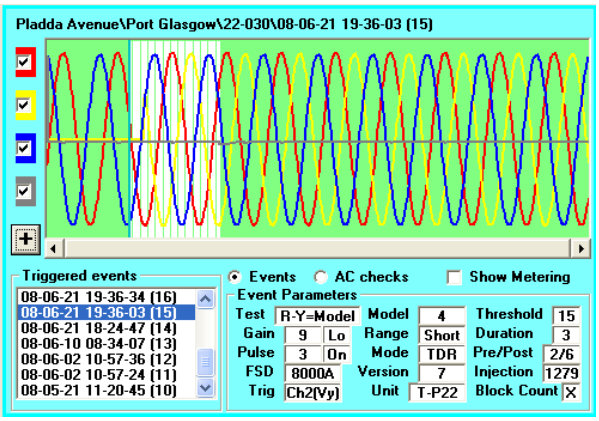
caused both the red and yellow fuses to blow. To the operator this would appear as instant failures but there was nearly i/2 a cycle of ‘healthy’ condition to capture the fault.

14.3 Intermittent Fault

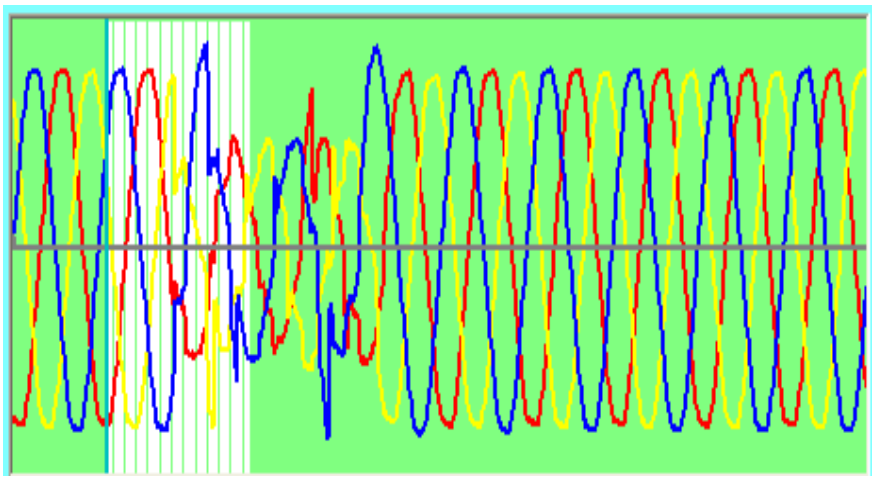
An intermittent fault is when the fuse will blow due to a fault condition but is successfully replaced. This can be anything from thirty seconds when using a fault re-energising device to several hours if a manual replacement. This tends to be the majority of operations. In this example the yellow phase was re-energised just over an hour after the fuse failure.





14.4 Transient Fault

A transient is a fault condition that may be from a sub cycle event to one lasting several cycles that does not blow a fuse. This may not even be noticed by the customer but often results in the flickering lights complaint that may be the first indication of a developing fault. All three phases are involve and all three recover.



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15. TECHNIQUES

15.1 Service Faults

There is only one method of locating the service fault and that is to look for the open or short circuit features on the TDR waveform.

15.2 Distributor Faults

15.2.1 Comparison Method

This method allows a comparison to be made between a healthy core and a faulty core by displaying the two TDR waveforms simultaneously on the screen and determining the point of departure. The first waveform e.g. the healthy core is captured and stored in memory and then the second waveform e.g the faulty is captured and displayed on screen. The instrument is then set to display the two waveforms on the screen and the point of departure is the fault location.

It is vital that the cores being compared are the same i.e. Ph-E with Ph- E OR Ph-Ph with Ph-Ph and that the instrument settings are not changed when capturing the two waveforms. Although comparing like with like the cores are not identical as there are normally service cable connected at various points along the route.

While the fault condition may influence whether the operator may choose to use Ph-E or Ph-Ph it should be noted that Ph-Ph will eliminate some of the reflections caused by the connection of single phase services.

15.2.2 Difference Method

This method uses two sets of test leads and does not require the TDR to be balanced on connection.

The negative test leads are connected to a common core with the positive leads are connected to a healthy and faulty core. This results in a single waveform with the fault location being determined in the same manner as a service fault.

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16. EXAMPLES

The examples of actual fault locations have been included to demonstrate what is possible but more importantly they are intended to provide some additional awareness of techniques that can be employed and the useful information that can be extracted from the fault waveforms.

Ideally there will be an example covering all the modes of operation highlighting how to use the T-P2X but also how to maximise the use of the functionality available.

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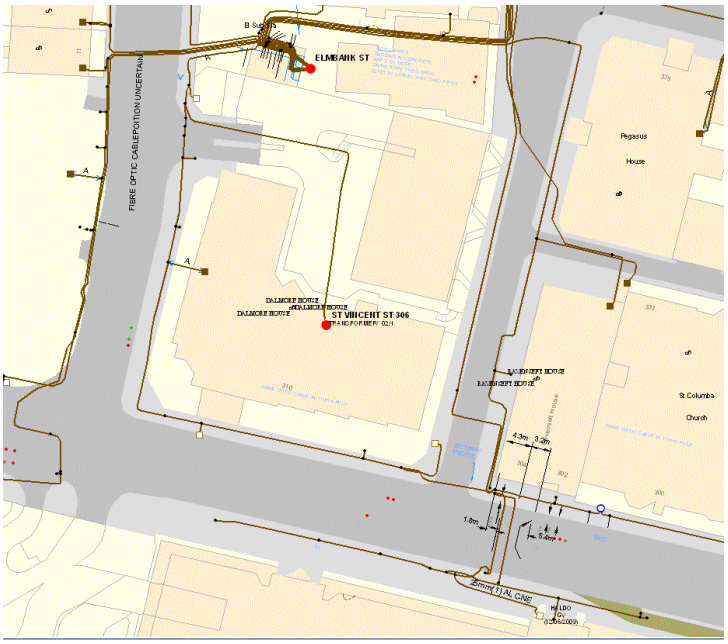
16.1 Glasgow – Elmbank Street

Fault Condition

This was a fault that could be counted on to be active when all three fuses were in circuit with the Red and Blue phases being the cause of the instability. The cable only provides supply to a single-phase street lighting pillar and has no customers supplied from it that have regularity constraints. The cable is supplied from Elmbank indoor substation. In addition there is a tee off that lies in St Vincent St also an indoor substation. This fault was expected to be active and provide many triggers over a short period of time.

T-P20 Set Up



The T-P20 is looking into the fault from an open cable end and will only therefore be triggered by voltage. There is no need for a blocking coil and the cores will all be similarly balanced.

Triggered Waveforms

This fault was expected to produce a large number of triggers from the day it was installed. This was not the case and this proved to be a very stable fault for about three months. It was only on the day before it was due to be removed that the fault was active blowing the Red phase fuse.

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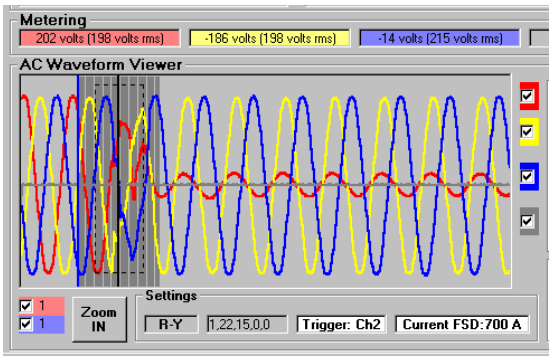
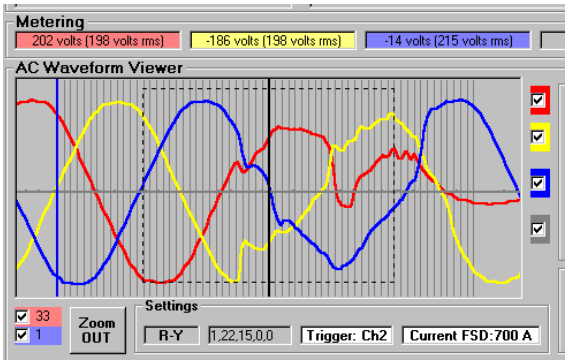
This is the triggered waveform and clearly shows the fault and the Red fuse blowing. The Yellow and Blue phases are both involved but recover after the Red phase fuse ruptures. The Red phase has a high resistance contact to the Yellow.



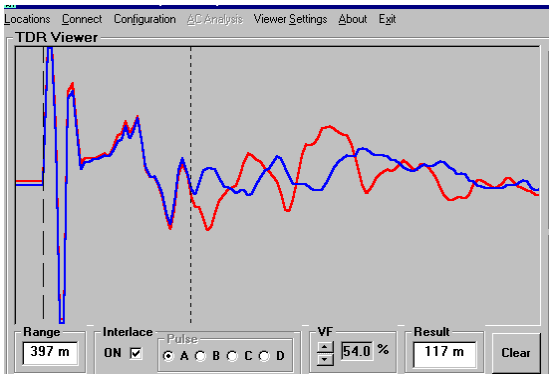
Waveform Analysis

The waveform to the right shows the sixty-four-pulse portion of the above waveform expanded. In the corresponding TDR view the Blue line (healthy) will be pulse 1 and the Red (faulty) pulse 33. This captures the fault while in the Red-Yellow condition.

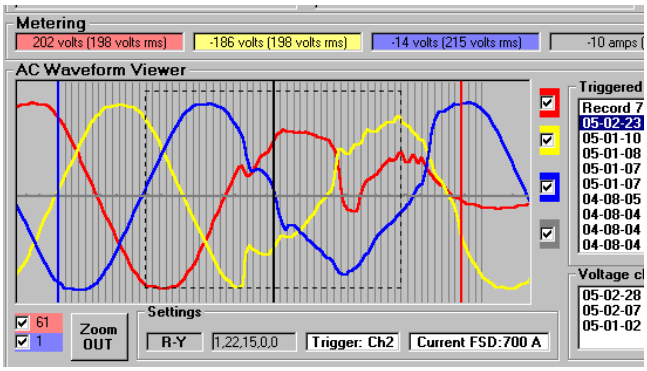


This is the TDR waveform for the above pulses.

The faulty waveform can be seen to be going in a negative direction to the healthy waveform at the point of departure approximately 117m from the substation. The fault is therefore 117m from St Vincent Street Substation.



This is still the same trigger but the cursors are healthy – pulse 1 and faulty – pulse 61. Pulse 61 has been positioned to a point on the waveform after the fuse has blown.



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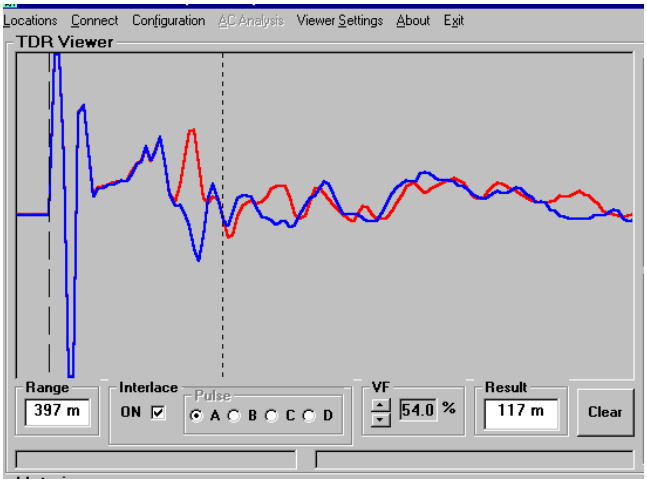
This time the split is at 87m and is positive relative to the healthy. This is because at this point the departure point is the cable termination at Elmbank at the blown fuse.



The open circuit created by the blown fuse is also an opportunity to calibrate the T-P21 accurately for the cable under test. Knowing the distance from the test point to the fuse allows the Velocity Factor to be set accurately for this particular cable by setting the cursor on the open circuit and adjusting the velocity factor until the correct distance is in the result box.

Conclusion

The fault position can be clearly identified relative to the T-P20. In addition the fault distance is greater than that to the open circuit created by the blown fuse, which means that it has to be down the cable that goes to the pot ends.

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16.2 Edinburgh – Blackwood Crescent

Summary

A location of sorts had been provided previously on this fault but not acted on. This was a new attempt. Not only to locate the fault but to test new developments on both the T-P22 and iHost functionality. The T-P22 used in this instance had several new features as listed below

1) –ve voltage triggering – it will only trigger on a negative going voltage.
    a. It will not trigger on energisation. This means that there is a much better chance of capturing a fault condition on a fuse replacement as it will not have to write the energising trigger during which time it cannot monitor the cable.
    b. This will use the memory space for more records that contain fault condition information.
2) It will connect to the Nortech test iHost server to allow field trials with the analysis software embedded in a web page.

Fault Condition

This was an intermittent fault that had repeatedly been flashing Blue – Yellow phases and blowing the Yellow phase fuse only. In most cases it is preferable to inject phase- phase to increase chances of a successful fault location.

T-P22 Configuration

The T-P22 was set for a Y-B injection with other parameters set normally. It was connected to the open end of the suspect cable, in a link box, looking towards the tee to the substation and the cable beyond the tee as shown on page 4. While this is the best connection arrangement for fault location, it is not ideal for mobile communication. This particular T-P22 was registered on the Nortech test iHost server and polled from there. It is a GPRS unit and has to be polled by a GSM call which it drops before connection. It then initiates connection with iHost through GPRS which is company policy. It cannot be connected directly from iHost as static i.p. addresses for sim cards will not be issued by ITBS.

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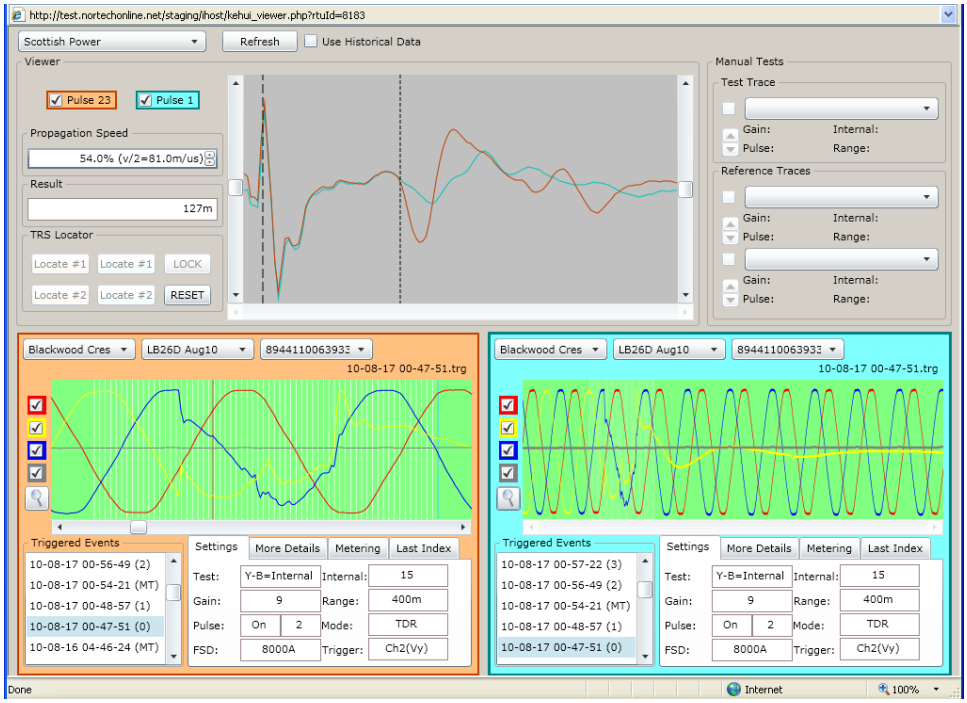
First Results

The T-P22 had been installed for about seven days and had not missed a daily connection before there were two fault triggers in close succession. Both resulted in the Yellow phase being lost and re-energised automatically by the electronic fuse.

The analysis software screenshot is shown below and the highlights are

1) The AC waveform in the bottom left box shows a Y-B fault
2) The AC waveform in the bottom left shows a Y phase fuse blowing
3) The TDR viewer , top centre, shows a departure between healthy and faulty waveforms at 127m. This is the fault location relative to the T-P22.



There are no triggers for the electronic fuse closing indicating that the negative triggering is working as intended.

Fault Progression

As this fault has been ongoing for some time and is becoming political it was decided to cut the cable as this was considered, from experience and same location from three subsequent triggered waveforms, to cut the cable close to the location. The next step would normally be to wait and see whether the next activity is from the substation or the link box. In this case it was possible to look for the cut using the T-P22 in a normal manual test rather than a triggered one. The next TDR waveform shows the test to see if the cut can be seen. It can at about 117m. This is not considered an accurate position and can be a few metres out as it is difficult to position the cursor on the upwards point of the positive reflection. There are no ac waveforms required as no triggered record has been selected and the ‘fault’ TDR cursors switched off.

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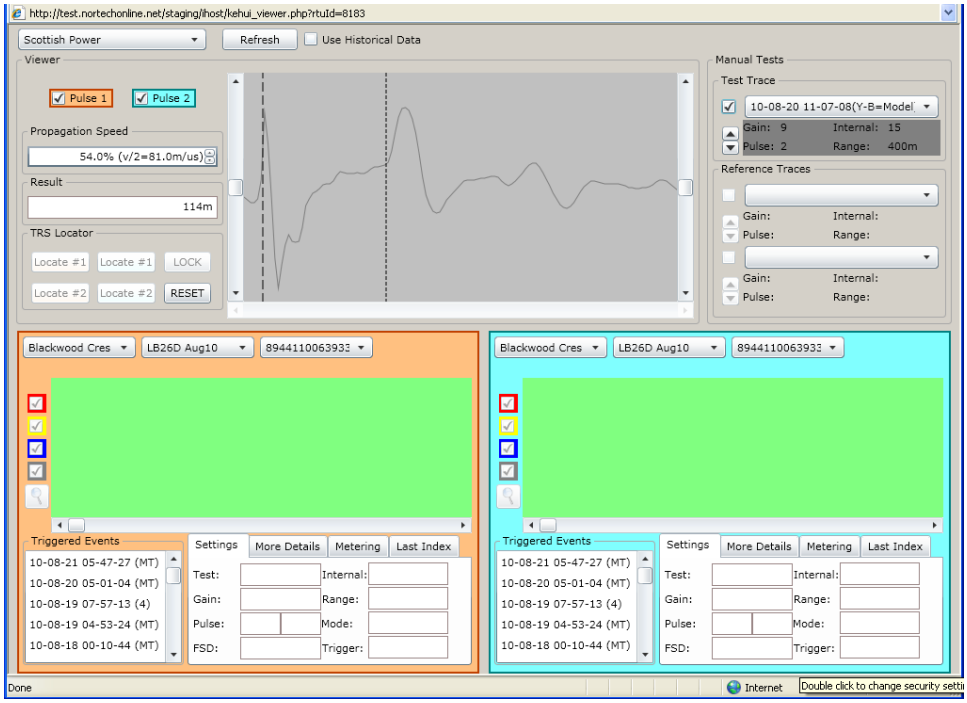
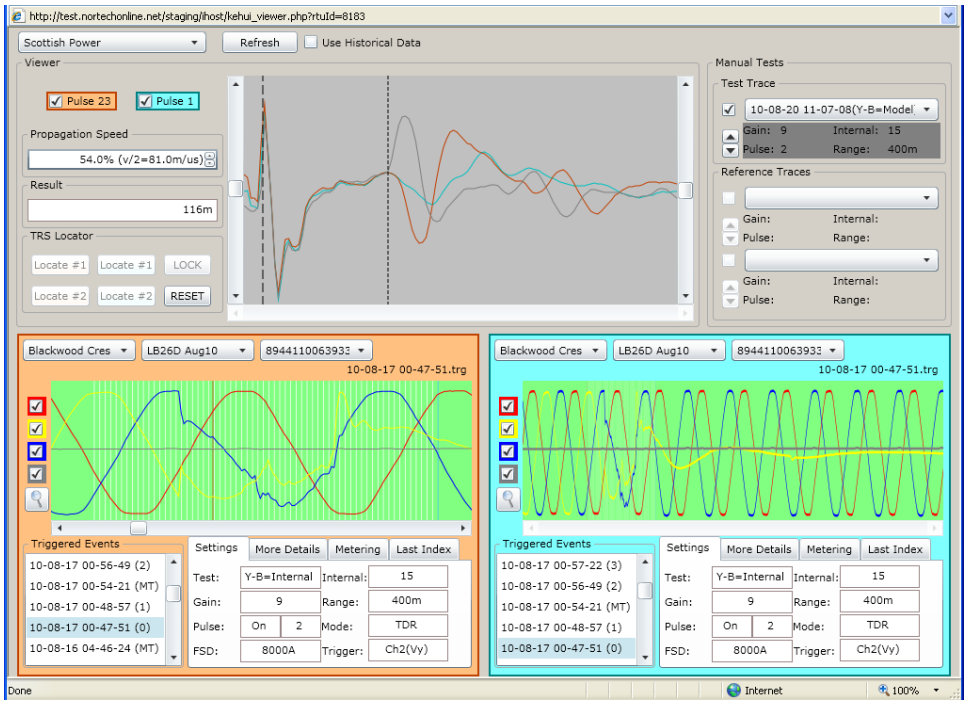


However, the above record can be super imposed on a fault condition record within the analysis software and this is shown below



The fault can now be seen to be beyond the known reference position of the cut when comparing the cut waveform with a pre-cut fault record and the distance to the cut can be more accurately measured as we have a comparison waveform. This can further improved by using the moving cursors to measure the distance between the cut and the fault and is shown on the next page

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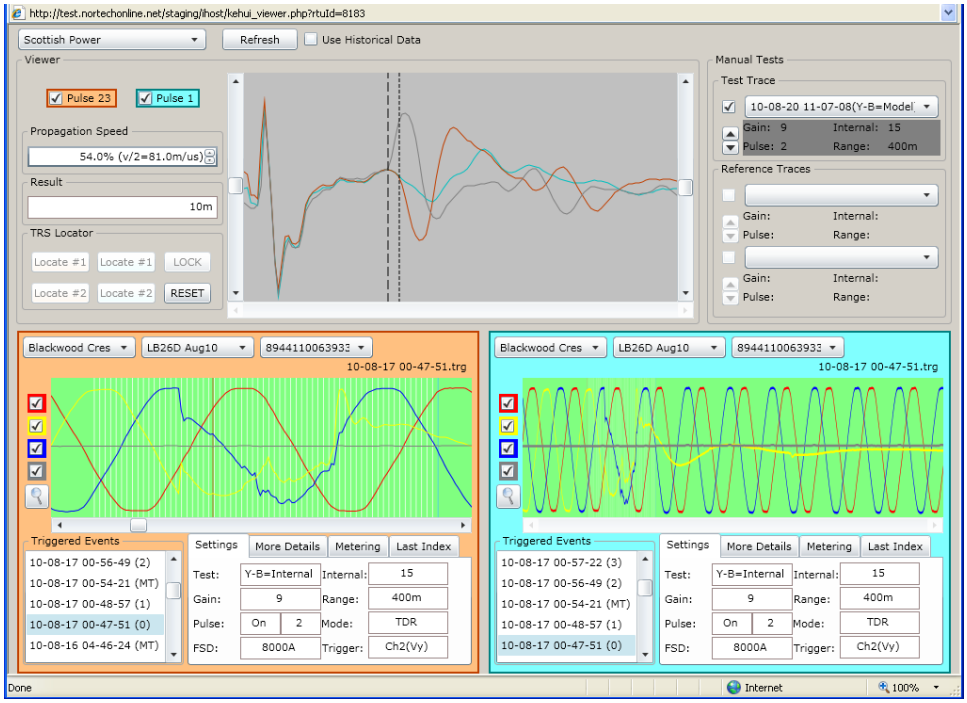
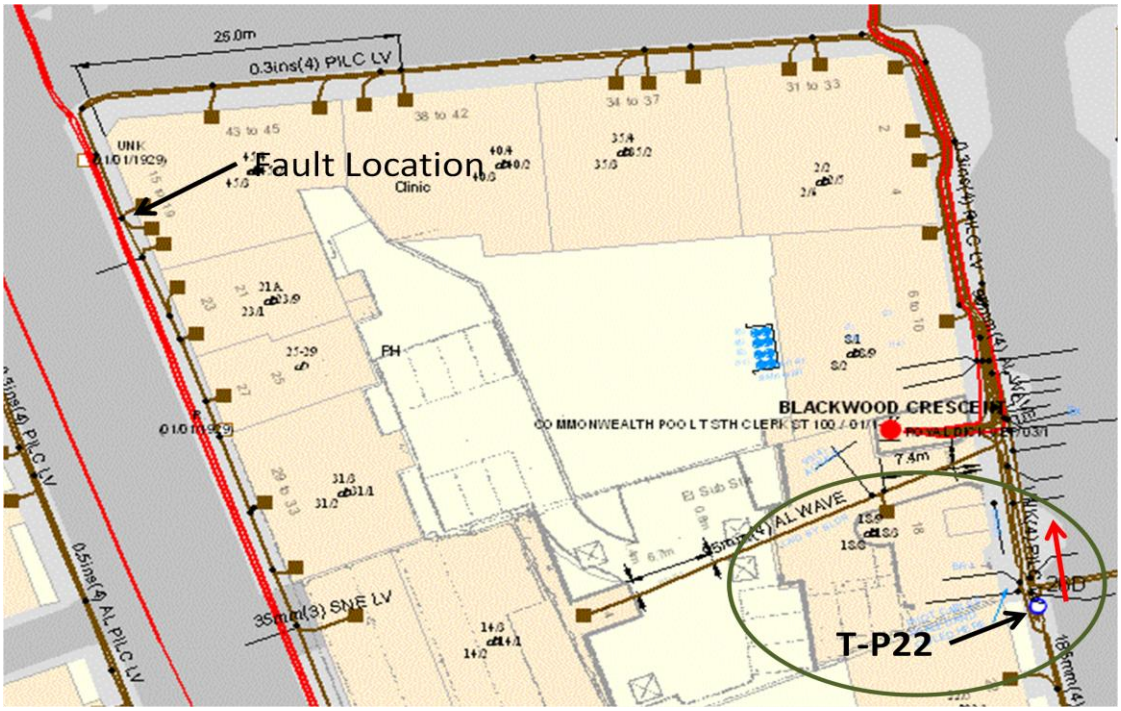


This identifies the fault location accurately as 10m from the cut on the substation side. It also confirms that the distance from the locator is only a target area due in some part to operator error but more usually to the exact route that the cable takes (compared to the records) and in how it is measured on site.

Geographic Layout and Cable Records



There is a known error in the cable records as they indicate 25m from the T-P22 to the substation. Two different instruments have indicated a distance about 41m and this may explain why the cut is 10m from the predicted location.

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Site results

The fault blew a fuse the following day. The confirmed location relative to the cut was as predicted some 10m beyond the first cut. No fault location device was monitoring that cable.

Conclusion

This has been a successful outcome for the following reasons

1) The fault repair will be in one excavation
2) Ihost embedded software worked exactly as intended
3) T-P22 –ve voltage trigger operated as expected
4) T-P22 manual test was successful
5) Different techniques used to progress fault in planned and timely manner.
6) It proves that the distance from the locator is indicative and will provide a target area.