Configuration Software

USER MANUAL

TEKRON

Contents

Version Information

Release Date	Software Version	Manual
08/05/15	4.1.0.3	1.0
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10/08/16	4.1.1.0	1.2
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22/03/17	4.2.1.10	1.4
10/11/17	4.2.1.16	1.5
12/12/17	4.3.1.0	1.6
25/01/18	4.3.1.0	1.7
30/01/18	4.3.1.1	1.8
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15/05/18	4.4.1.1	2.0
05/08/19	4.5.1.0	2.1 (Current Document)

1. Introduction

Tekron's proprietary Configuration Software is designed to communicate with all Tekron Ethernet configurable Clocks supporting the latest security and encryption communications, as well as legacy communication over Ethernet. Tekron's Configuration Software also supports USB configuration for Clocks manufactured from 2013 onwards which have a USB interface. This User Manual describes the functionality of Tekron's Configuration Software, its operation, system requirements and dependencies. It is not intended to provide a technical resource on Ethernet networking or cyber security best practices.

This manual refers to Clocks running in "Secure Mode" and "Legacy clocks". The definitions of which are as follows:

"Secure Mode": A Tekron Clock running a Clock or Ethernet module (RCM) firmware version beginning with 3 with "Security enabled".

"Legacy clock": A Tekron Clock running an Ethernet module (RCM) with a firmware version beginning with 2 or 1.

2. Obtaining Tekron's Configuration Software

Tekron's Configuration Software is free to download from the resources tab on the product page on Tekron's website: www.tekron.com

3. System requirements

Tekron's Configuration Software is a standalone executable compatible with the following Operating Systems:

Microsoft Windows XP
Microsoft Windows Vista
Microsoft Windows 7
Microsoft Windows 8
Microsoft Windows 10

Tekron's Configuration Software requires the host to be running Microsoft ™ .NET Framework 4 or later. It is also required to be able to install the USB Driver, in cases where USB configuration is possible.

4. Dependencies

Tekron's Configuration Software is designed to communicate via the Ethernet network or USB for Tekron products which support this feature. To communicate with a Clock, the Windows based machine running the executable and intermediary connected devices are expected to be configured to allow communications traffic to transition through each device. Tekron's Configuration Software should not be inhibited by the firewall, Anti-Virus or other communications software. Intermediary switches and routers should also be checked to ensure that they are not blocking network traffic flowing in either direction on the relevant connected network links. Refer to your Network Administrator if you are unsure.

In the case of an Ethernet network connection on a secure network, it should be noted that the following UDP ports may be used:

Port number	Used for
67, 68	DHCP
123	NTP and SNTP
161, 162	SNMP
319, 320	PTP
514	Syslog
9990, 9992, 9997, 9999	Configuration and management

5. Communication

Tekron's Configuration Software uses a combination of UDP Unicast and Broadcast packets for communication. It has been designed to minimize network traffic to reduce network bandwidth requirements. UDP Broadcast packets are user initiated using the "Discover" function described in the next section. If a network configuration problem exists (e.g. Incorrect Network settings), then Broadcasts may continue to be used to communicate between the Clock and Tekron's Configuration Software until the issue is resolved. All other communication is via Unicast. When Tekron's Configuration Software is open and connected to a clock via Unicast, the expected network traffic between Tekron's Configuration Software and Clock is 4 packets (2 transmit, 2 receive) per second, until the connection is closed.

6. Connecting to a Clock via Ethernet for the first time

Install the Clock according to the Installation instructions in the Clock's User Manual. Connect the Clock direct to the Windows based machine, or to a network switch located on the same LAN using a CAT5e, CAT6, or Multimode Fibre (where applicable) Ethernet cable. Run Tekron's Configuration Software on the Windows based machine. Once it has opened, the "Discovery Window" shown in Figure 1 will appear.
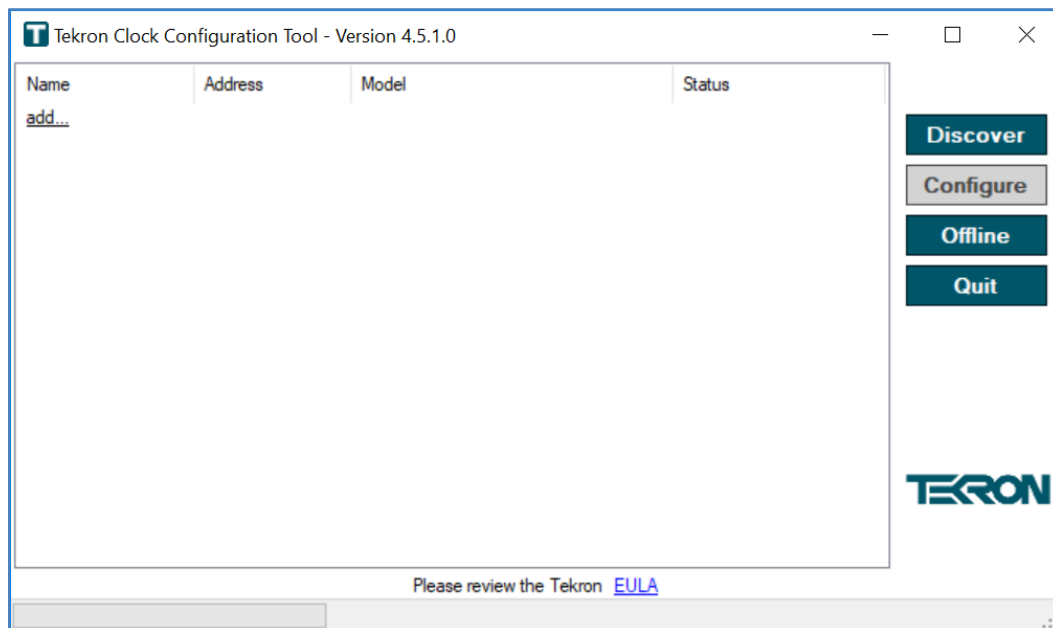
Figure 1 - Discovery Window

To find the clock on the network, click the "Discover" button. Tekron's Configuration Software will send out a UDP broadcast message to the LAN. Any Clocks which receive the message will respond with a Unicast UDP message to announce their presence. The response includes basic information about the clock including its name ("Clock designation"), port name, model, firmware versions, and status.

Note: In some network environments, broadcast packets are undesirable. In the event that you do not want broadcast packets on your network, it is recommended that you configure the Clock for the first time via direct connection, or by interrogating the network devices (such as the DHCP Server) to establish the initial IP address of the clock. Once valid network settings have been set, there is no further need for broadcast communication.

Any Clocks which responded will be listed in the Discovery Window clock list as shown in Figure 2. Highlight the clock you wish to configure and click the "Configure" button which will initiate a UDP Unicast communication with the highlighted clock. As of version 4.5.1.0, the Configuration Software prepends the Clock's Serial Number to the Clock Name of the discovered clock.

Tekron Clocks are by default shipped with all Ethernet interfaces set to DHCP enabled. In the event that the Ethernet Interface is set to DHCP and there is no DHCP Server running on the network, the Ethernet interface will fall back to a link local address (169.254.xxx.xxx). Legacy Tekron Clocks running older firmware may revert to IP address 0.0.0.0.
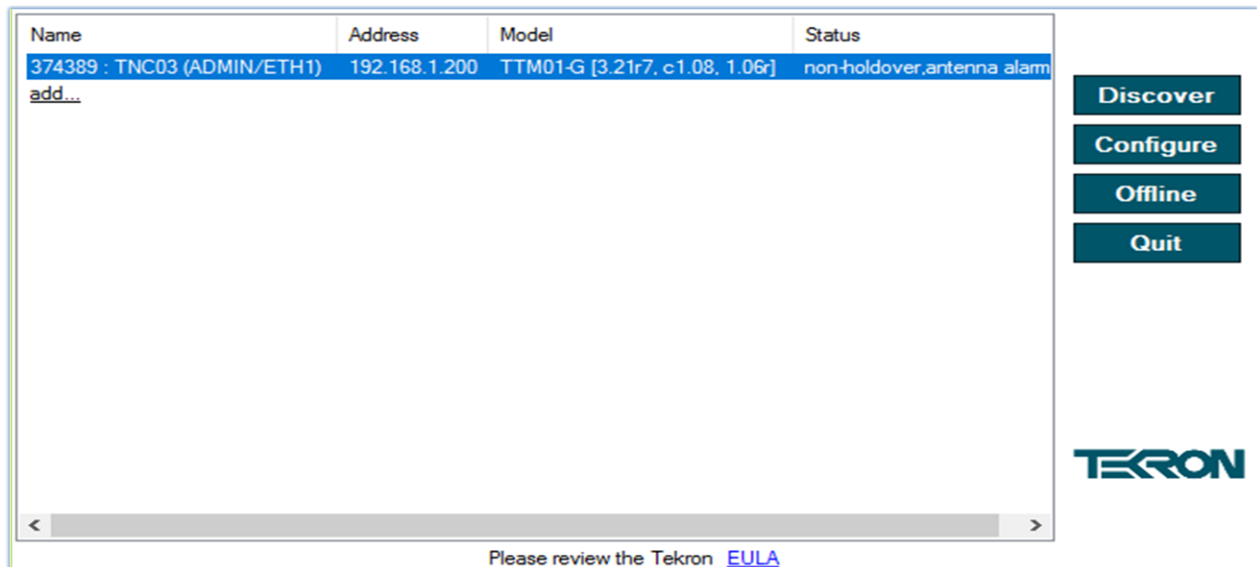
Figure 2 - Discovery Window clock list

If after **clicking "C**onfigure**" a "login" window opens** (Refer to Figure 3 below), then security has been enabled on the selected clock. You will need to enter a correct username and password to proceed.
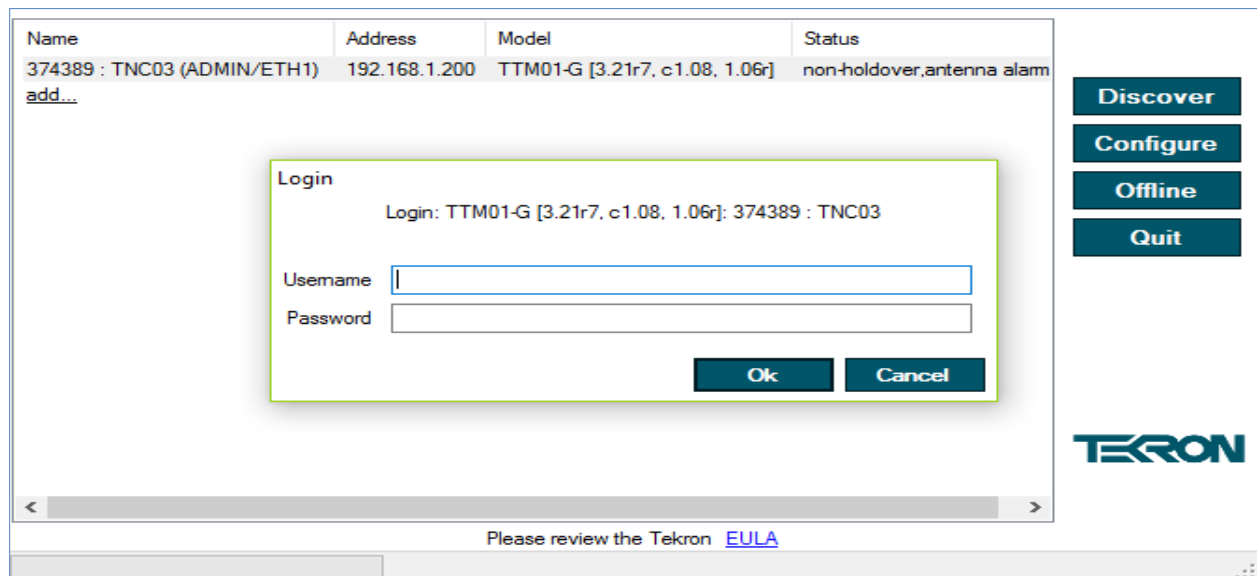
Figure 3 - Login window

If the clock has been configured with security disabled, or is a legacy clock, no Login is required. The configuration tool will display the Time Tab Window.

Legacy Clocks with password protection enabled will only require the correct password to be entered when storing **changes. The password is not required to view the Clock's configuration.**

If you are configuring a new clock for the first time, when you are prompted to login, you will use the factory default username and password which can be found in the product quick start guide or hardware manual. The typical login credentials are:

Factory default username: admin

Factory default password: Password

Note: the username and password are case sensitive.

Once logged in with the factory default credentials, you will be prompted to change the password.

Important! Ensure that the password is securely recorded. If the administrator of the clock loses the login username and password, the unit will need to be returned to Tekron for re-programming at the customer's cost. To avoid this, some clocks support a factory reset procedure that can be enabled once logged in. Refer to section 7.5.1.

Once you have set up a new password and you are logged into the clock, you can proceed to configure its settings.

7. Configuring a Clock

7.1. Toolbar

"Reload" button:

Reloads (Retrieves) the current configuration from the connected Clock. Note: unsaved changes will be lost.

"Store" button:

Stores the displayed configuration to the connected Clock. If the button is greyed out, the configuration displayed is the same as the connected Clock. If the button is green, the configuration displayed has one or more changes from the stored configuration of the connected Clock.

If the connected Clock is a legacy clock with password protection enabled, attempting to store settings will cause a password prompt to appear. The correct password must be entered before changes will be stored.

As of version 4.5.1.0, a dialog box will appear after storing the configuration, confirming that the configuration was stored successfully.
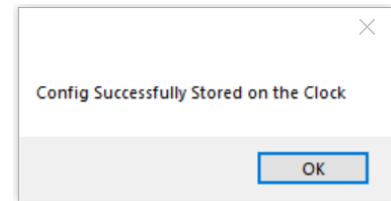
Figure 4 - Confirmation dialog box

"Save" button:

Save the current configuration to a file. This allows a back-up copy of the configuration file to be stored. The file format is XML and non-encrypted sections can be edited with common text editing software packages such as MS Notepad and Word. Refer to section 8 for further information on editing XML files.

When saving a file, a **"Write Password" window will open, allowing the level of encryption to be selected. "Whole File" encrypts the entire file, preventing it from being read or modified without the password. "Sensitive Sections Only" will only** encrypt security-**related sections, such as password changes. "Not Encrypted"** will not use any encryption, and a password is not required. Once selected, a file directory window will open to allow you to select the location to save the file.
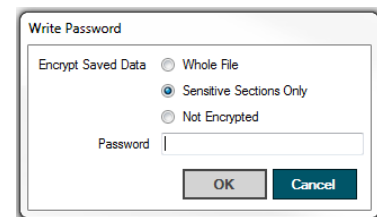
Figure 5 - "Encrypt Config" window

"Load" button:

This feature allows you to load existing configuration files into Tekron's Configuration Software from a local drive on the PC, for the purpose of editing standard configuration settings.

Once this button is clicked, a file directory window will open to allow you to select the location of the file and load it into Tekron's Configuration Software. If the selected file contains any encrypted sections, the Software will prompt for the password. If the password entry is cancelled, the Software will skip the encrypted sections and attempt to load only the non-encrypted sections. A Change Window (refer to Figure 6) will then open giving a comparison between Current Values and New Values in the xml file. As of version 4.5.1.0, the "Load settings from basic network tab" check box is checked by default to include the Basic Ethernet network settings when loading the file. The checkbox can be unchecked for not loading basic network settings, allowing corporate users to have one standard generic settings file that can be loaded to all Clocks, without changing the IP address of the Clock.

The "Report" button allows the user to print the contents of this window as a configuration report.

Select "Cancel" to cancel loading the selected file into Tekron's Configuration Software, or "Accept" to accept the changes.

Note: Once the "Accept" button has been pressed, the new configuration is loaded into Tekron's Configuration Software only. To load the new configuration into the clock, the "Store" button should be clicked.

Figure 6 - "Change" window

"Change Password" button:

Click this button to change the password of the currently logged in User. Once clicked, a new window will open prompting you to enter the current password, enter the new password, and re-type the new password. Click "OK" to confirm or "Cancel" to cancel the change.

On legacy clocks, click this button to enable or disable password protection, or change the password. Once clicked, a new window will open. Check the "Password Enabled" box and enter the new password, and re-type the new password. Click "OK" to confirm or "Cancel" to cancel the change.

Figure 7 – Legacy "Password Set" window

"Print Clock Configuration" button:

This button allows the user to print a text copy of the Clock settings. If the statistics function is being logged, a summary of the statistics is appended to the report for commissioning purposes. Refer to section 10 - Recommended Commissioning procedure.

"About" button:

This button opens a window which displays the Tekron Logo, Copyright information, web address and build version of Tekron's Configuration Software.

7.2. Clock Tab

The Clock Tab is separated into five sections: Time, Localization, Clock Source Priorities, Test Source, and System Information (Refer to Figure 8).

Figure 8 - Time Tab

7.2.1. "Time" section

This section shows the current UTC Time and Date, and the Local Standard Time and Date (or Local Daylight Time if daylight savings is enabled and is in effect) which is programmed and being output by the connected clock.

By clicking on the displayed time, you can change between digital 12 Hr, 24 Hr, and Analogue formats as shown in .
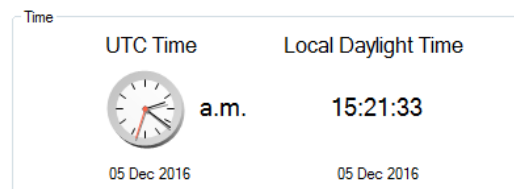
Figure 9 – "Time" displays

If "Time not available" is displayed in place of the digital or analogue displays, then the clock is either in the process of start-up or does not currently know the time as it doesn't have a sync source.

Note: The time displayed is indicative only and may differ from the connected Clock's time by up to a second or more. This is because, unlike NTP or PTP, it does not include compensation for network delay.
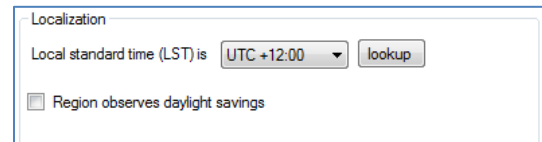
7.2.2. **"Localization"** section

The localization section contains the Clocks Local Standard Time and Local Daylight Time Settings.

Local Standard Time (LST)
This drop-down list provides the facility to apply the regional time zone offsets from UTC to the clock. A positive offset means that the local time is ahead of UTC.

Figure 10 - "Localization" section

Lookup
The "Lookup" button provides a convenient way to automatically set time offset and daylight savings parameters simply by selecting a geographical location.

Note: The lookup function is derived from Windows™ Date and Time settings on the host PC running Tekron's Configuration Software, and should be verified as being correct before use.
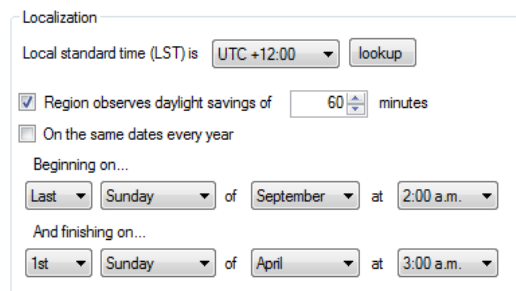
Region observes daylight savings
Selecting this option allows the clock to be configured to make daylight savings changes automatically. Once selected, additional options will appear. Refer to Figure 11.

The offset in minutes can be set which will be added when LST (Local Standard Time) transitions into DST (Daylight Savings Time).

By default, the fixed rule method is selected, however by checking the check box "On the same dates every year" the fixed date method can be applied.

Once the method is set, the daylight savings date and time can be set to suit the requirement of the User.

Figure 11 – "Region observes daylight savings"

7.2.3. **"Clock Sour**ce Priorities**"** section

When a Clock has the capability to synchronise to multiple time sources, the options shown will update appropriately. The priority in which each source is used is based on its position from top (highest priority) to bottom (lowest priority), and the default Time Source Priority is ranked as follows:

GNSS (or GPS where applicable)
IRIG
SNTP
PTP
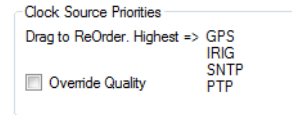
Figure 12 – "Clock Source Priorities" section

The Clock will automatically switch to the next preferred time source if the current time source is lost, and will automatically switch back to the preferred source when it is regained.

To configure the priority settings, click on a time source and drag it to the desired position in the list. Other sources in the list will be automatically moved down if necessary. Refer to Figure 12.

"Override Quality" checkbox: By default, the clock source with the best accuracy is always used, with the configured priorities only used if two or more clock sources have the same accuracy. Check this box to force the configured priorities to always take effect regardless of the accuracy of the sources.

Note: Not all Clock products have the capability to synchronise to multiple time sources. Tekron's Configuration Software will omit the time source options not supported by the Clock hardware. Time sources that are supported, but not available or enabled, will still appear in this list.

Note: The PTP time source cannot be set above the lowest priority when the PTP Forced Slave (Class 255) option is not set. Refer to section 7.4.5. The configuration software will display a message dialog if setting the PTP source above the lowest priority is attempted.

7.2.4. **"Test Source"** section

The test source section is for use in configuring the clock to operate under "Test Mode", to enable the user to set the clock to an arbitrary time. Refer to Figure 13.

This can be used for pre-commissioning tests, or for laboratory testing when no other sync source is available.

Important! Under normal operating conditions the test source feature should never be used.
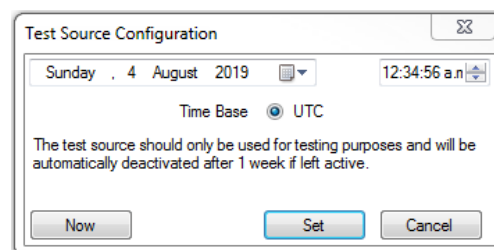
Figure 13 - "Test Source" configuration

To use the test source, the following conditions should be met:

1. If the clock is running firmware prior to 3.13r, there cannot be any other sync source present. If an alternative sync source is present, the clock will revert to that source. For firmware versions 3.13r and later, it is not necessary to ensure that all other time sources are disabled. The test source will override any other active time sources.
2. The timing ports on the clock will report the status as per the settings configured in the "Sync" section of the I/O tab. Refer to section 0.
3. The selection/settings for Test Source/Test Mode are not stored as part of the settings file. Setting Test Mode takes immediate effect on the connected clock – you do not need to store settings to enable/disable Test Mode.
4. It is possible to exit test mode using Tekron's Configuration Software by clicking the "Disable" button in the "Test Source Configuration" window. For legacy clocks, the clock must be restarted by removing and reapplying power to exit Test Mode.

UTC/Local time: Using the radio buttons, choose the time base you would like to set. The local time is the time settings as per the Windows based machine Tekron's Configuration Software is being run on.

"Now" button: This button retrieves the current time from your Windows based machine and updates the date and time fields.

Date field: The day, month and year can be manually edited, or alternately the calendar icon can be selected and used to pick a date from the calendar.

Time field: The time field can be manually edited by selecting the hour, minute, seconds and a.m. / p.m. fields.

"Set" button: Once you have selected the time you wish to set the Clock to, press the "Set" button to change the Clock to the selected time.

"Cancel" button: The "Cancel" button closes the test source configuration window without making any changes to the Clock.

Test Status

The Test Status shows whether the connected Clock's time has been set and whether it is currently being used.

Offline: Test Mode is not enabled.

Active: The clock is in Test Mode. Time output has been manually set.

Available: The clock has been configured for Test Mode, but Test Mode is not yet active due to a valid alternative sync source being available. Note that the clock will toggle in/out of Test Mode as the alternative sync source(s) become available. As the clock toggles in/out of Test Mode, the time will alternate between that of the sync sources. This status will not occur for clocks running firmware versions 3.13r and later, as the test source overrides all other sources.

A clock in "Test Mode" is indicated by:

1. **"Test Mode"** is present between the time displays in the Time section of the Clock tab.
2. Synced (TEST) is indicated in the System Information section of the Clock tab.
3. Synced (TEST) is reported by the Tekron Configuration Software in the Status field of the Discovery Window when the **"Discover" button is clicked.**
4. **"TST" appear**s on the clocks front panel LCD (where fitted).

7.2.5. **"System Information" s**ection

This section provides an at a glance look at the clock, including its status, model, order code, serial number(s), and current firmware version(s) running in the device. Refer to Figure 14.

"Status": Indicates the current sync status of the clock. A summary of the sync status values and their definitions are listed in the table below.

Figure 14 - "System Information" section

Sync Status Message	Definition
Synced(GPS)	Clock is synced to GPS Constellation.
Synced(GNSS)	Clock is synced to at least one of the available Constellations.
Synced(IRIG-B)	Clock is synced to an external IRIG-B source.
Synced(PTP)	Clock is synced to an external PTP source.
Synced(NTP)	Clock is synced to an external NTP source.
Synced(TEST)	Clock is in test mode and has been set with an arbitrary time.

"Clock Name": This is the Clock Designation as configured on the Maintenance tab. Refer to section 7.5.1.

"User": This is the username of the currently logged in user.

"Model": The model name of the clock being configured.

"Product Code": The order code of the clock being configured.

"Clock Serial": The serial number of the clock being configured.

"Eth Serial": The serial number of the Ethernet module of the clock being configured. This only appears if the clock contains an Ethernet module. Not all clocks with Ethernet ports contain an Ethernet module.

"Clock Firmware": The version number of the firmware running in the main board of the clock.

"Eth Firmware": The version number of the firmware running in the Ethernet module. This only appears if the clock contains an Ethernet module.

"UTC -> TAI offset": This indicates the current number of seconds between TAI time and UTC time as used by the clock. This increases by 1 each time a leap second is added, and can be used to check that a leap second has been applied correctly. As of the 30th June 2015 leap second, the current UTC -> TAI offset is 36.

"GPS Version / GNSS Version": This indicates the version number of the firmware running in the GPS/GNSS receiver module of the clock.

"Frequency Reference": This indicates the type of oscillator installed in the clock. This can be TCXO (Temperature Compensated Crystal Oscillator), VCTCXO (Voltage Controlled Temperature Compensated Crystal Oscillator), OCXO (Oven Controlled Crystal Oscillator), or Rubidium (rubidium atomic oscillator).

When alarm conditions are active, alarm messages will appear in red text in the System Information section. A summary of the alarm messages and their definitions are listed in the table below.

Alarm Messages	Definition
No Power A	No power source is detected on Power inlet A.
No Power B	No power source is detected on Power inlet B.
Satellites Low	The number of satellites currently being used for time and position calculations is below the threshold.
No Sync	Clock is not synchronised to any source and holdover period has expired.
Holdover	Clock has lost sync and is now in holdover.
No Antenna	The antenna circuit current drain is low (typically under 3mA). This could be caused by poor connections, or if the connected antenna has a lower current drain specification or if a component in the antenna system is providing power to the antenna and therefore the Clock is not seeing a connected load.
Factory Reset Armed	This Alarm comes up when the Factory Reset Process is initiated by the user.
Antenna Short	The antenna circuit current drain is high (typically over 100 mA). This is caused by a short in the antenna circuit, or by moisture ingress in the circuit, or if the antenna connected has a higher current drain specification.
No IRIG-B Input	No valid IRIG-B source is detected on the clock input. (This message only appears if the Clock is configured with IRIG-B monitoring enabled. Refer to Inputs section.)
Link A Down	This message appears when the clock is configured with PRP link enabled on ETH2 and ETH3, and there is no link on ETH2. This could be caused by the cable being unplugged from ETH2, or the network switch connected to ETH2 losing power.
Link B Down	This message appears when the clock is configured with PRP link enabled on ETH2 and ETH3, and there is no link on ETH3. This could be caused by the cable being unplugged from ETH3, or the network switch connected to ETH3 losing power.
Overcurrent	The clock supports output current monitoring, and has detected excessive current on one or more outputs. Check the I/O tab to identify which output is experiencing the fault.
IPv4 Address Fault	This alarms comes up when the DHCP server is unavailable or when the IP address is assigned to some other node in the network and cannot be assigned to the clock. Under such situations the clock defaults to a link local address.

7.3. I/O Tab

The I/O tab provides information on the fitted inputs, outputs, and alarms, and their configured settings (refer to Figure 15).

Figure 15 - I/O Tab

7.3.1. "I/O Ports" section

Tekron's Configuration Software automatically populates the list of ports based on the order code which is obtained from the connected clock. Refer to Figure 16.

Figure 16 - "I/O Ports" section

The list conveys from left to right:

> Port designation on the Clock
> Whether it is an output/ input or alarm
> The description of the configuration of the port.
> If the port is an output, an indicator of when it will be suppressed – when the holdover timeout expires
> > (holdover), when the inaccuracy threshold is exceeded (inaccuracy), or never (no indicator).
> If the port supports current monitoring, the approximate output current.

Note: Click on the line to see further configuration information for the selected port.

The highlighted example shows:

> P6 as the port on the Clock
> The port is an Output
> The port is programmed to output IRIG-B DCLS using Stream A content
> The output is configured to be suppressed when the holdover timeout expires
> Approximately 70 milliamperes of current is being drawn from this port

When an output port is selected, the corresponding settings are displayed underneath the list.

The most common output types and configurable options are as follows:

Programmable output

A programmable output can be configured by selecting one of the following options from the drop-down list:

> User defined pulse
> DCF-77 Simulation
> IRIG-B

Figure 17 – **"User defined pulse" configuration**

User defined pulse

The user can configure a pulse to be **output every "second", "minute", "hour", or "day". Specify the frequency of pulses** under the **"Every" and "Pulses" fields.** Refer to Figure 17.

The table below shows the valid entries for each field:

Period **"Every"**	**Number of "Pulses"**
Second	1, 2, 4, 5, 10, 20, 25, 50, 1000
Minute	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30
Hour	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30
Day	1, 2, 3, 4, 6, 8, 12

"Offset": is the delay (in hundredths of a second) from the start of the day, hour, minute, or second to the start of the pulse.

"Duration": is the length of time (in hundredths of a second) the pulse stays asserted.

"Inverted": Check this box to invert the polarity of the pulse. DCF 77 Simulation

The user can configure a DCF 77 signal to be output out of the programmable port. Refer to Figure 18.

The only configuration options for this output type are Local Standard Time or UTC, and Inverted signal option. Refer to the DCF 77 sub-tab section for Local Time and UTC settings.

Figure 18 - "DCF 77 simulation" configuration

"Inverted": Check this box to invert the polarity of the DCF 77 pulses.

IRIG-B

The IRIG-B output options on the programmable output are DCLS (sometimes referred to as DC Level Shift, unmodulated or demodulated IRIG-B) or Modified Manchester. Refer to Figure 19.

The IRIG-B time code includes Local (or UTC) Time in the form of Seconds, Minutes and Hours fields, together with

Figure 19 - "IRIG-B" configuration

Day-of-Year and a two-digit Year field. Additional data can be selected for transmission in all of the outputs that are programmed for IRIG-B using the IRIG-B sub-tab situated to the right of the I/O Ports section on the I/O Tab. This setting applies to all AM IRIG-B, DCLS IRIG-B, and Modified Manchester outputs driven off this stream. Refer to the IRIG-B sub-tab section for further information.

"DCLS" radio button: Selecting the radio button will enable an IRIG-B B00x signal to be output from this port.

"Modified Manchester" radio button: Selecting the radio button will enable an IRIG-B B22x signal to be output from this port.

"Inverted": Check this box to invert the polarity of the IRIG-B pulses.

"Payload" radio button: On Clocks which support multiple IRIG-B channels, an additional field called "Payload" will be present. Refer to Figure 20. This feature allows the clock to be configured with two different IRIG-B streams which are generated independently from each other. This is sometimes used when two IRIG-B time bases are required (Local Time and UTC Time), or when different IRIG-B extensions are required on each stream. The user can select "Stream A" or "Stream B" using the applicable radio button. Refer to the IRIG-B sub-tab section for more information.

Figure 20 - IRIG-B "Payload" and multiple streams

Serial String Outputs

A Serial String can be configured to be output on this port. The configurable options include the String format, the Time Source (e.g. UTC or LST), the Parity, and the Baud rate. Information about the configured string is contained in the Information box below the configurable fields (refer to Figure 21).

Figure 21 – "Serial String" configuration

"Serial String: The "Serial String" format is selected by using the drop-down list. The options are:

Name	String format
No String	Not applicable
NGTS	TYYNNDDWHHMMU<CR><LF>
IRIG J-17	<SOH>DDD:HH:MM:SS<CR><LF>
String A	<SOH>DDD:HH:MM:SS:YY<CR><LF>
String B	<SOH>DDD:HH:MM:SSQ<CR><LF>
String C	<CR><LF>Q_YY_DDD_HH:MM:SS.000
String D	<SOH>DDD:HH:MM:SSQ<CR><LF>
String E	<SOH>YYYY:DDD:HH:MM:SSQ<CR><LF>
String F	<BEL><CR><LF>1100<CR><LF>44hhmmss<CR><LF>54ddd<CR><LF>45hhmmss<CRLF>55ddd<CR><LF><BEL>
String G	<STX>SWhhmmssddmmyy<LF><CR><ETX>
String H	<STX>D:dd.mm.yy;T:w;U:hh.mm.ss;uvxy<ETX>
NMEA ZDA	$GPZDA,hhmmss.ss,dd,mm,yyyy,xx,yy*CC<CR><LF>
NMEA RMC	$GPRMC,hhmmss.ss,a,ddmm.mmmm,n, dddmm.mmmm,w,z.z,y.y,ddmmyy,d.d,v*CC<CR><LF>

Other Proprietary String formats are configurable, but are not standardised and the format is subject to change without prior notice.

"Time Source": Select the output time source by using the marked drop-down list. The options are:

> Local Time
> UTC Time

"Format": Select the number of data bits, parity, and number of stop bits of the serial string using the marked drop-down list. The options are as follows:

Configuration Option	No. Data Bits	Parity	No. Stop Bits
8-N-1	8	None	1
7-O-1	7	Odd	1
7-E-1	7	Even	1
8-O-1	8	Odd	1
8-E-1	8	Even	1

"Baud" rate: The Baud rate of the selected string can be configured using the marked dropped down list. The options are:

> 1200
> 2400
> 4800
> 9600
> 19200
> 38400

Refer to Appendix C for further information on specific Serial String Formats, the Transmission rate, and the "On Time" mark.

AM IRIG-B Outputs

The AM IRIG-B output typically has very few configuration options. An information box typically appears and provides an overview of the outputs characteristics. Refer to Figure 22.

The IRIG-B time code includes Local (or UTC) Time in the form of Seconds, Minutes and Hours fields, together with Day-of-Year and a two-digit Year field. Additional data can be selected for transmission in all of the outputs that are programmed for IRIG-B using the IRIG-B sub-tab situated to the right of the I/O Ports section on the I/O Tab. This setting applies to all AM IRIG-B, DCLS IRIG-B, and Modified Manchester outputs driven off this stream. Refer to the IRIG-B sub-tab section for further information.

Figure 22 - "AM IRIG-B" configuration

"Payload" radio button: On Clocks which support multiple IRIG-B channels, an additional field called "Payload" will be present. Refer to Figure 23. This feature allows the clock to be configured with two different IRIG-B streams which are generated independently from each other. This is sometimes used when two IRIG-B time bases are required (Local Time and UTC Time), or when different IRIG-B extensions are required on each stream. The user can select "Stream A" or "Stream B" using the applicable radio button. Refer to the IRIG-B sub-tab section for further information.

Figure 23 - IRIG-B "Payload" and multiple streams

Note: On some Clocks, there are hardware configurable options enabled via a physical switch. Tekron's Configuration Software will list the ports as present and will provide help on what configuration options are available through the Information box under the "I/O Ports" section on the "I/O Tab".

Telecom T1/E1/J1 and Frequency Outputs

Clocks fitted with Telecommunications options have options for frequency outputs and framed frequency outputs.

"Frequency" outputs: The frequency outputs are configured using dropped down boxes. For frequencies other than 10 MHz, the drop-down box top right of Figure 24 should also be correctly configured with the required frequency setting. The configurable options are:

> 10 MHz
> 1.544 MHz
> 2.048 MHz

Figure 24 - Frequency Outputs configuration

"Framed Frequency" outputs: The framed frequency outputs (refer Figure 25) have configurable options for:

> Framing Format
> Encoding
> Waveform Shaper
> Transmitter Impedance Matching
> Fill Pattern
> High Impedance Output
> Long Haul
> SSM

Figure 25 - Framed Frequency Outputs configuration

The following Tables list the possible configurations for each frequency.

T1 Parameter	Configurable Options
Framing Format	Super-frame (SF)
	Extended super-frame (ESF)
	Digital multiplexer (DM)
	Switch line carrier – 96 (SLC-96)
Encoding	AMI
	B8ZF
Waveform Shaper	0 ~ 133 ft.
	133 ~ 266 ft.
	399 ~ 533 ft.
	533 ~ 655 ft.
Transmitter Impedance Matching	Internal 75 Ω
	Internal 100 Ω
	Internal 110 Ω
	Internal 120 Ω
Fill Pattern	None
	All Zeros
	All Ones
High Impedance Output	Unchecked
	Checked
Long Haul	Unchecked (Short Haul)
	Checked
SSM (Only available for Extended Super Frame)	Unchecked
	Checked (This enables synchronization status messages to be transmitted)

J1 Parameter	Configurable Options
Framing Format	No Framing
	Super-frame (SF)
	Extended super-frame (ESF)
Encoding	AMI
	B8ZF
Waveform Shaper	0 ~ 655 ft.
Transmitter Impedance Matching	Internal 75 Ω
	Internal 100 Ω
	Internal 110 Ω
	Internal 120 Ω
Fill Pattern	None
	All Zeros
	All Ones
High Impedance Output	Unchecked
	Checked
Long Haul	Unchecked (Short Haul)
	Checked
SSM (Only available for Extended Super Frame)	Unchecked
	Checked (This enables synchronization status messages to be transmitted)

E1 Parameter	Configurable Options
Framing Format	Basic frame
	CRC multi-frame
	Modified CRC multi-frame
	Channel associated signalling (CAS) multi-frame
Encoding	AMI
	HDB3
Transmitter Impedance Matching	Internal 75 Ω
	Internal 100 Ω
	Internal 110 Ω
	Internal 120 Ω
	External resistor 9.4 Ω
Fill Pattern	None
	All Zeros
	All Ones
High Impedance Output	Unchecked
	Checked
Long Haul	Unchecked (Short Haul)
	Checked
SSM (Only available for CRC multi-frame)	Unchecked
	Checked (This enables synchronization status messages to be transmitted)

Inputs

Clocks fitted with Event recording/IRIG-B Inputs can be configured with the input options below using the drop-down list shown in Figure 26. The Inputs are in pairs and generally marked with a Port number and corresponding A & B markings. The configurable options are:

Port A Function	Port B Function
IRIG-B	IRIG-B
IRIG-B Monitor	IRIG-B Monitor
Event Record	Event Record
Event Record	IRIG-B Monitor
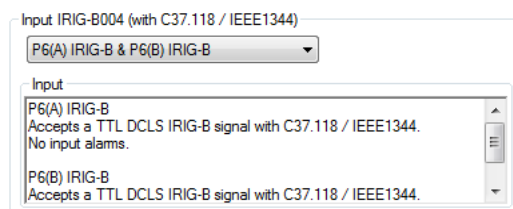
The definition of the functions is as follows:

IRIG-B Monitor: The IRIG-B input is monitored. If a Clock is synchronised to a source, and the IRIG-B signal connected to this port fails, an alarm will be raised.

IRIG-B: The IRIG-B input is not monitored. If a Clock is synchronised to a source other than IRIG-B, and the IRIG-B signal connected to this port fails, no alarms will be raised. If all forms of sync are lost, an alarm may be raised, dependent on **the "Sync"** Settings (Refer to **"Sync" section**).

Event Record: The Clock will record time tags in accordance with the rising edge of an incoming pulse. Refer to the Clock hardware User Manual for further information on its operation and the commands.

Note: If you are using the event recording function, the **"Enable Serial Config" setting on the Maintenance Tab** should be checked. Refer to **the "Maintenance" section** for further information.

Alarms

Tekron's Configuration Software will list the Alarm ports fitted to the connected clock. When selected, an Information box **under the "I/O Ports"** section **on the "I/O Tab"** will appear and give an overview of its functionality. Refer to Figure 27.

"Delay Alarm Signal": If the selected alarm output supports a user-configurable delay, this field will be present. The activation of the selected alarm can be delayed by a user-defined time period of 0 to 25.5 seconds, specified in tenths of a second.
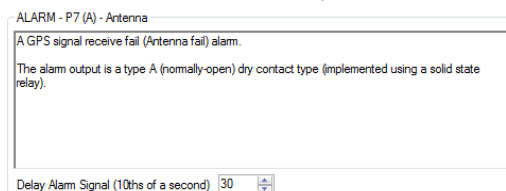
Figure 27 - Alarm information box

Some Clock models, such as the TSC100 and NTS100, feature a configurable alarm relay output. When selected, the information box will show a list of alarm conditions and their current state. Check the box next to an alarm condition to configure the alarm relay to signal an alarm when that condition is active. When multiple conditions are selected, the alarm relay will signal an alarm when any of those conditions are active. Refer to Figure 28.
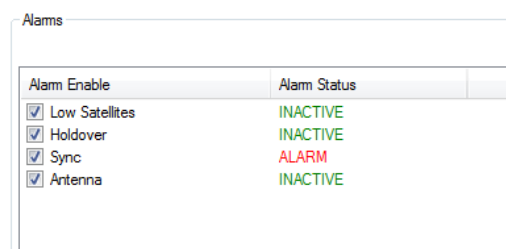
Figure 28 - Alarm relay configuration

IRIG-B sub-tab

The IRIG-B sub-tab is situated to the right of the I/O Ports section on the I/O Tab. Refer to Figure 29. It contains the settings for the IRIG-B Extensions that can be added to the IRIG-B String. Options include Binary Seconds, C37.118.1 extensions, or AFNOR S87-500 extensions.

The settings in this section apply to all outputs configured to output IRIG-B.

"Binary seconds in code": This field is an option specified by IRIG standard 200-04. If this option is selected, all of the outputs programmed for IRIG-B code – including the amplitude-modulated output - **will include the "Binary Seconds of Day" data.**

Figure 29 – **"IRIG-B"** sub-tab

"Use UTC Time": By default, IRIG-B is output in Local Standard Time. If you wish to output IRIG-B in UTC time, check this box.

"C37.118.1" extensions: Outputs programmed for IRIG-B code will additionally output: impending leap second information, local time offset, impending daylight savings change, and time-quality information all in accordance with C37.118.1 specification. In addition; the Parity field can also be set.

> **"Parity":** This option enables the selection of even or odd parity checking within the C37.118.1 extensions of the IRIG-B code. If AFNOR S87-500 extensions are configured, this option will be removed.

"AFNOR S87-500" extensions: If this option is selected, all of the outputs programmed for IRIG-B code will also output: day of week, month, and day of month in accordance with the European AFNOR S87-500 specification.

Note: On Clocks which support multiple IRIG-B streams, two sub-tabs which are labelled "IRIG-B (A)" (IRIG-B Stream A) and "IRIG-B (B)" (IRIG-B Stream B) will appear. Refer to Figure 30. Under "Payload" in the individual port settings, the user will be able to configure the port to use either IRIG-B stream.

Figure 30 - IRIG-B sub-tab with multiple streams

DCF 77 sub-tab

The DCF 77 sub-tab is situated to the right of the I/O Ports section on the I/O Tab. Refer to Figure 31.

The settings in this section apply to all outputs configured to output DCF 77.

Figure 31 – **"DCF 77"** sub-tab

"Use UTC Time": By default, DCF 77 is output in Local Standard Time. If you wish to output DCF 77 in UTC time, check this box.

"Sync" section

The sync section contains configuration settings which determine the behavior of the Clock when it loses sync. Refer to Figure 32.

"Outputs always report 'Good' Quality": Output signals (e.g. IRIG-B with C37.118.1 extensions) will maintain Good quality for use by the connected IEDs until the clock loses Sync.

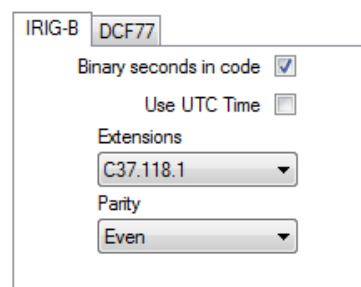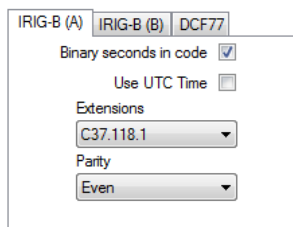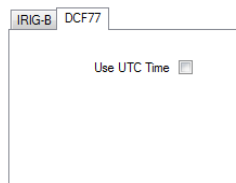*"Suppressed outputs before first sync":* If this option is checked, on start-up, the Clock outputs do not begin to output time signals until the clock has received a valid time. If not checked, the Clock outputs immediately begin to output time signals on start-up. The sync relay operation is unaffected by this option and will indicate the true sync state of the Clock.

Figure 32 - "Sync" section

"Never leave Sync (Test Mode)": Enabling this option forces the Clock to output time sync signals as if it were synced to GPS, even if this is not true (e.g. there is no antenna attached). In this mode, the sync relay will be on at all times (i.e. it will never enter alarm state).
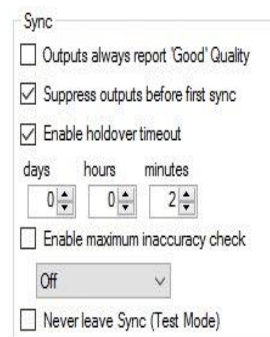
"Suppress Output When: Never, Holdover timeout expires, Inaccuracy threshold is exceeded": *Depiction in Figure 32.* This option is used to suppress the output. Selecting "Never" would not suppress the output even when the clock is out of sync. Selecting "Holdover timeout expires" would suppress the output when the clock is out of sync and the time set for Holdover timeout (set in the clock by Enable holdover timeout) also expires. The selection of "Inaccuracy threshold is exceeded" would suppress the output when the clock is out of sync and the reported inaccuracy exceeds the maximum inaccuracy threshold configured in the clock through "Enable maximum inaccuracy check".
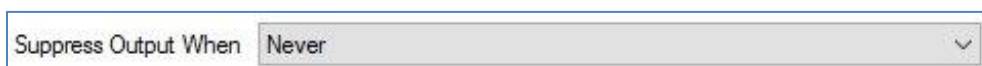
Figure 32 (a)– Suppress Output When: Never
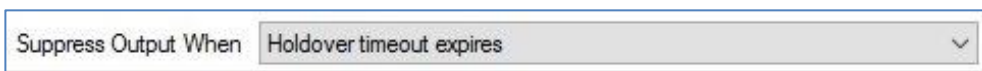
Figure 32 (b) – Suppress Output When: Holdover timeout expires

Figure 32 (c)- Suppress Output When: Inaccuracy threshold is exceeded

"Enable holdover timeout": This option is used to control the period after loss of all time sources that will be tolerated before the Clock will suppress outputs that have been set to supress when holdover timeout expires.

"Enable maximum inaccuracy check": The option provides maximum inaccuracy as a drop-down list of times that can be selected. In the event of loss of sync, the clock time would slowly start drifting and when the drift time becomes greater or equal to the maximum inaccuracy time the clock moves from holdover to non-holdover.

NOTE: If both "Enable Holdover Timeout" and "Enable Maximum Inaccuracy Check" are checked, then the clock will show the loss of sync status and release the "sync" relay when both the holdover timer has expired and the inaccuracy threshold has been crossed. If only one option is checked then only that option will trigger loss of sync status and release the "sync" relay. If neither option is checked the clock will never enter the loss of sync state but will instead remain in the holdover state until a sync source becomes available again. Correct installation will make the "loss of sync" event rare; although in areas with poor GNSS satellite coverage there can be occasions where satellite tracking is momentarily lost the "holdover" features are used to mask temporary effects.

7.4. Network Tab

The network tab contains the communication and Time Server settings of the fitted Ethernet ports. Refer to 33.
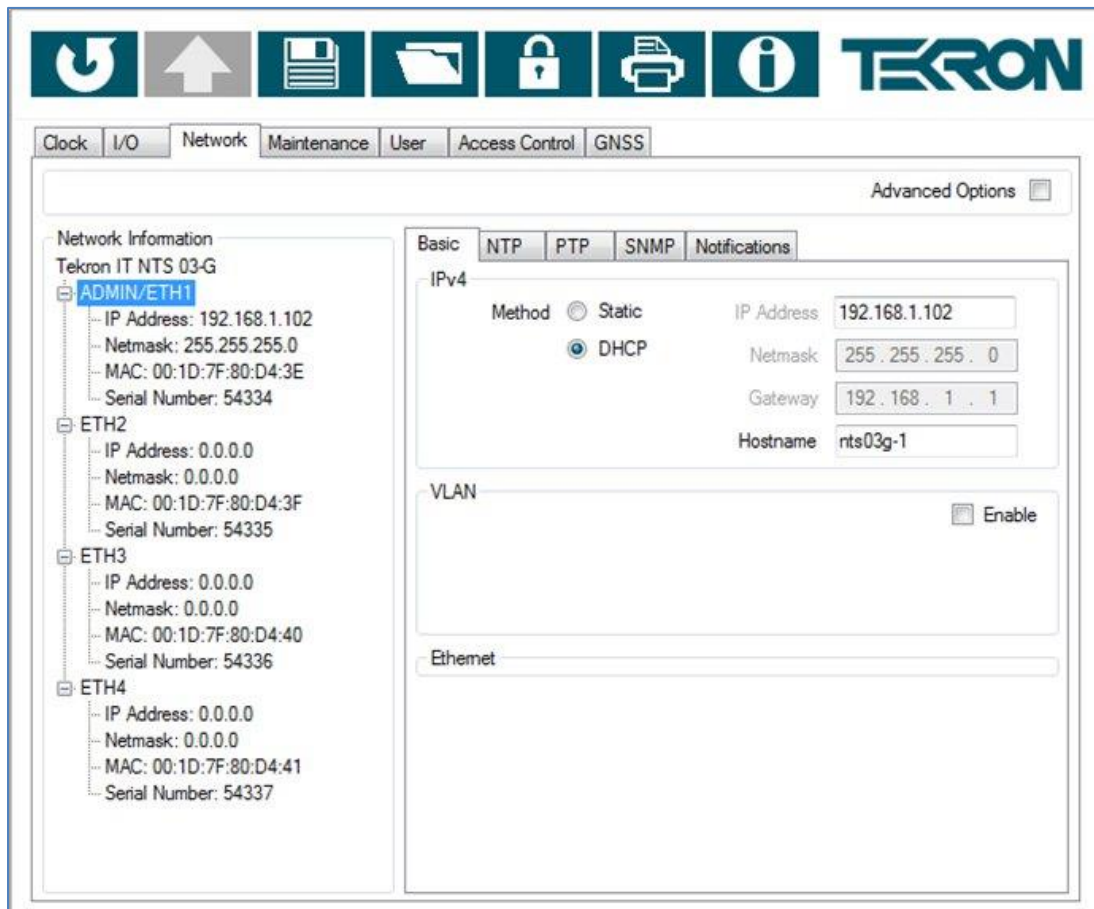
Figure 33 - Network Tab

7.4.1. "Network Information" section

This section is dynamically populated depending on the number of Ethernet interfaces fitted within the Clock. The name of each interface is based on the marking on the relevant port on the Clock. Selecting an interface name will display the Ethernet settings of the selected interface in the sub-tabs to the right of the Network Information section. Underneath the name, the IP Address, Netmask, MAC Address, and Ethernet module serial number is also listed. Refer to Figure 33(a).
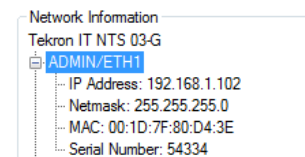
Figure 33(a) - "Network Information" section

7.4.2. "Advanced Options" settings

When the advanced options box has been checked, additional Ethernet configuration options appear on the Basic, NTP and PTP tabs. Refer to Figure 34. It is recommended that only advanced users with a thorough knowledge of IP networks should use these options. The additional options in the sections below have a Prefix "Adv.".

Figure 34 - "Advanced Options" configuration

7.4.3. Basic sub-tab

The "Basic" sub-tab contains the Ethernet network settings of the selected Ethernet interface.

IPv4 section

"Method": This setting allows the selected Ethernet Interface to be configured with a Static IP address or set to Dynamic Host Configuration Protocol (DHCP) via the radio buttons.

"Static": If "Static" is selected, then a valid IP Address, Netmask and Gateway (if applicable) should be assigned to that Clock Ethernet port. In addition, a plain text "Hostname" can be set in accordance with IETF RFC 952 guidelines to enable connection through networks configured with Domain Name System (DNS).

"DHCP": The Clock is by default shipped with all Ethernet interfaces set to DHCP enabled. In the event that the Ethernet Interface is set to DHCP and there is no DHCP Server running on the network, the interface will fall back to a link local address (169.254.xxx.xxx). Legacy clocks will not revert to link local and instead will assume the IP address 0.0.0.0.

Adv. "DHCP Retries": This option is a dependent of "DHCP". This is the number of attempts the selected Ethernet port will attempt to make to obtain network information from a DHCP server. If after all attempts a DHCP server is not detected, the IP address will revert to the link local address. Legacy clocks do not have this feature.

Adv. "Link Local": If this option is selected, the IP address is randomly chosen from the Link Local Address range 169.254.0.0 to 169.254.255.255. Addresses are tested using ARP until a vacant address is identified. Legacy clocks do not have this feature.

VLAN section

"Enable": As shown in Figure 33, Check this box to Enable checkbox to enable Virtual Local Area Network (VLAN).

"ID": This parameter sets the ID inside the VLAN tag, (as shown in Figure 35), used by the selected packets. If the ID is not known, a value of 0 is set by default. Otherwise, the input range is 0 to 4095

"Priority": This parameter sets the priority inside the VLAN tag as shown in Figure 35. If the priority is not known, a value of 0 is set by default. Otherwise the input range is 0 to 7.

"Block zero ID": This setting, as shown in Figure 35, cannot be enabled unless the clock has already been configured with VLAN enabled, and Tekron's Configuration Software is connected to the clock via VLAN. If this option is enabled, packets received on the selected interface on VLAN ID 0 will be blocked. Legacy clocks do not have this feature.

"Tagged Traffic": VLAN Traffic Tagging (as shown in Figure 35) can be configured for "PTP" and/ or "NTP" and/ or "Other" (i.e. all other Ethernet packets), or all three options (All Ethernet packets). Legacy clocks do not have this feature.

Note: It is not recommended that you configure "Other" traffic to operate on VLAN, unless you are an advanced user who has a thorough knowledge of VLAN tagging and Ethernet networks.

Ethernet section

Adv. "Link Settings": This is the Ethernet port override settings for Auto-negotiate. Configurable settings are:

> Auto
> 10Mbps + Half Duplex
> 10Mbps + Full Duplex
> 100Mbps + Half Duplex
> 100Mbps + Full Duplex

Legacy clocks do not have this feature.

Adv. "PRP Link": This option appears when the Parallel Redundancy Protocol (PRP) License has been activated, and the selected port is capable of being linked to an adjacent port (shown in brackets, for example "PRP Link (Eth3)" when ETH2 is selected), to form a PRP redundant pair. When enabled, the linked port will disappear from the Network Information section, and [PRP] will appear next to the selected port. The settings configured for the selected port will also be applied to the linked port.

Figure 35 (a): To Activate PRP

Redundancy section

This section only appears when configuring a PRPTP Translator.

"Protocol": This option is used to select the Ethernet redundancy protocol. The PRPTP Translator supports Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR). **This can also be set to 'None' to allow the PRPTP Translator to operate without using redundancy.**
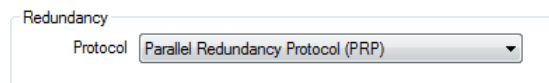
Note: When the PRPTP Translator is configured to use redundancy, it may not be possible for the Configuration Software to discover it when not connected to a redundant network. In this case, it is possible to force the PRPTP to revert to no redundancy by removing one of the SFP modules. Refer to the PRPTP Translator User Manual for further information.

SFP section

This section only appears when configuring a PRPTP Translator. The PRPTP Translator uses Small Form-factor Pluggable (SFP) transceiver modules for its Ethernet interfaces. This section

Figure 37: SFP module information

displays manufacturer, model number, serial number and connector type information for the currently installed SFP modules.

7.4.4. NTP sub-tab

If **Tekron's** Configuration Software is connected to a Clock which supports Network Time Protocol (NTP), and the NTP License has been activated, then the NTP sub-tab will be present. Refer to Figure 38.

"Enable" NTP: Check this box to enable Network Time Protocol (NTP).

NTP "Server" settings:

"Ignore requests when unsynced": If this option is checked, the port will not respond to NTP time sync requests unless the Clock is synchronised to an external time source referenced to UTC time.

"Broadcast/Multicast Version": Select the preferred NTP version for Broadcast and/or Multicast traffic. Legacy clocks do not have this feature, and by default output NTPv3.

Configurable options are:

> NTPv1
> NTPv2
> NTPv3
> NTPv4

"Send broadcasts": By default, this option is set to off. If the user wishes to configure the port to send periodic NTP Broadcast messages within the subnet, the user can select from the drop-down list one of the following pre-set options as shown in Figure 38(a) I or the newer method available in Configuration Software 4.3.1.1 and later is to select a specific interval in Hours, Minutes and Seconds as shown in Figure 38(a) II. Setting an interval of 0 disables the sending of **broadcast messages. The "Clear" button resets the interval to 0.**

(a) I   (a) II
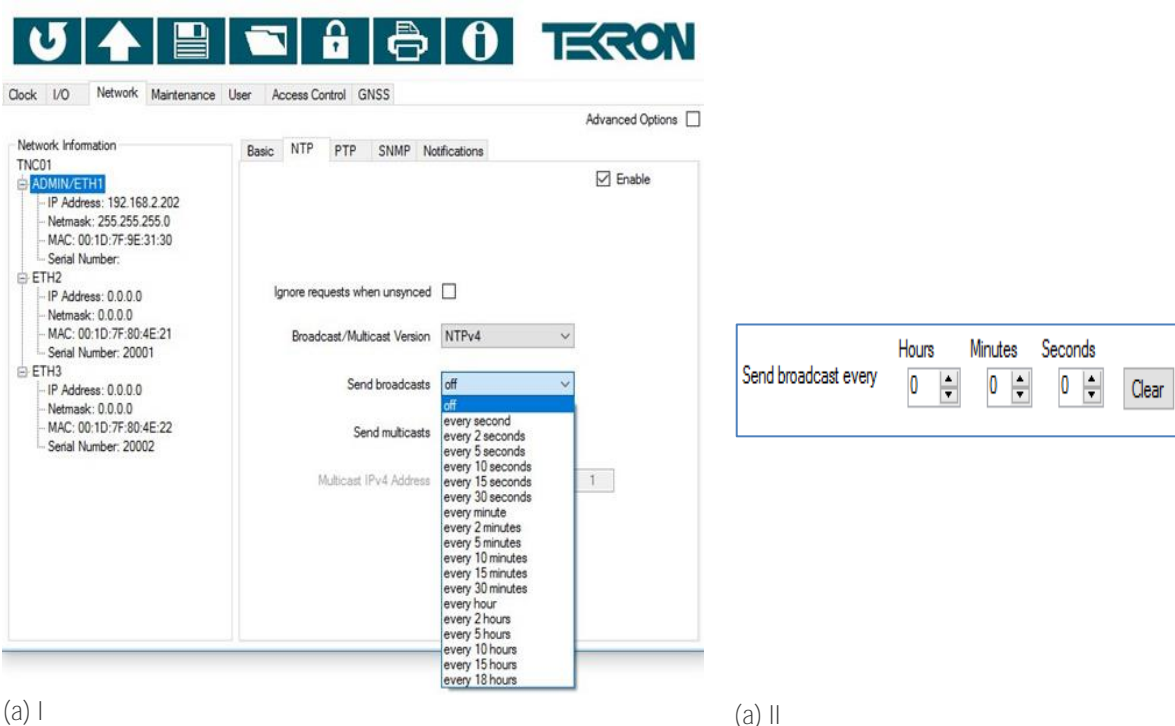
Figure 38 (a) I - "NTP" sub-tab with Broadcast Drop-down (Old Style), (a) II - "NTP" sub-tab with Broadcast Drop-down (New Style)

Legacy clocks may have different pre-set options for Broadcast and multicast intervals. The software will display the valid options for the connected Clock.

"Send multicasts": By default, this option is set to off. If the user wishes to configure the port to periodically output NTP multicast messages to a multicast group, the user can select from the drop-down list one of the following pre-set options and configure the appropriate multicast IP Address as shown in Figure 38(b) I or the newer method available in Configuration Software 4.3.1.1 and later is to select specific delay in Hours, Minutes and Seconds as shown in Figure 38(b) II. Setting an interval of 0 disables the sending of broadcast messages. The "Clear" button resets the interval to 0.
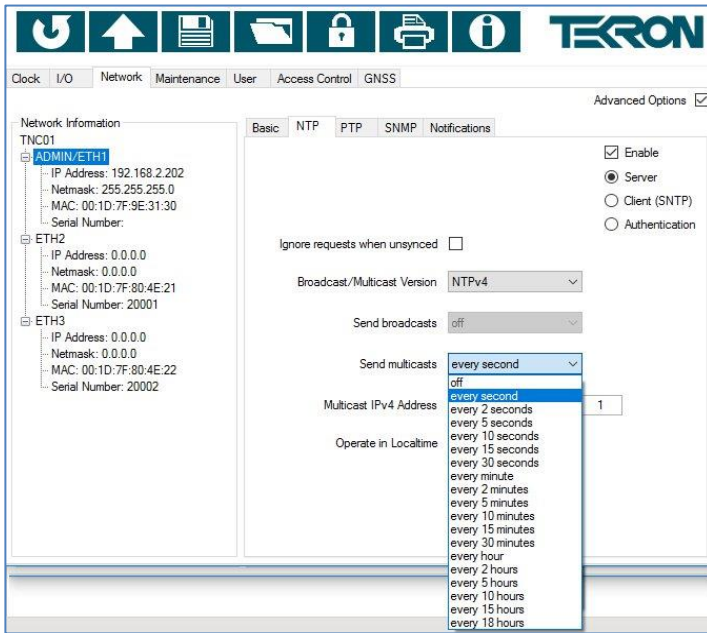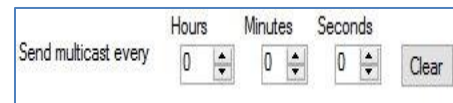
(b) I   (b) II

Figure 39 (b)I - "NTP" sub-tab with Multicast Drop-down (Old Style), (b)II - "NTP" sub-tab with Multicast Drop-down (New Style)

Adv. SNTP "Client" Settings

Figure 40 - "Client (SNTP)" configuration

Figure 41 - "Client (SNTP)" configuration with PRP enabled

The SNTP Client function allows the Clock to synchronize to an NTP/SNTP Master Clock. This feature has been added for testing purposes. This feature is not available on legacy clocks. It is recommended that the SNTP Client functionality be restricted to a laboratory or controlled environment, and should not be used on corporate LANs or in Ethernet networks on a permanent basis, as some configuration options do not comply with the published RFC. The SNTP Client operation is also dependent on the Sync Priorities configured for the clock. Refer to the **"Clock Sour**ce Priorities**"** section for further information.

When PRP is active the details of both NTP ports is shown on the SNTP Client as shown in Figure 38(b).

Adv. "Server Address": Enter the IP Address of the NTP/SNTP Server.

Adv. "Server Version": Select the NTP version the Ethernet port will use when polling the server. Configurable options are:

      NTPv1
      NTPv2
      NTPv3
      NTPv4

Note: Ensure that the NTP/SNTP Server supports the NTP Server version you have configured.

Adv. Accept Broadcasts: When this option is checked, the Ethernet port will sync to incoming NTP broadcasts.

Adv. "Poll Interval": This is the frequency of time requests between the Ethernet port and the server. Configurable options are:

      Off
      1/8 second
      ¼ second
      ½ second
      1 second
      2 seconds
      4 seconds

8 seconds
16 seconds
32 seconds
64 seconds

Note: Although shorter poll intervals will provide higher levels of accuracy in reference to the Server, the network traffic is subsequently higher.

Adv. "Offset from the Server": Shows the offset between the Ethernet port and the NTP Server in nanosecond (ns).

Adv. "Broadcasts Received": Is the number of NTP/ SNTP Broadcasts received.

Adv. "Requests Sent/Received": Is the number of time requests sent and responses received.

Adv. Authentication

Tekron Clocks support MD5 Authentication. Clocks can be configured with up to 8 keys consisting of up to 16 ASCII characters or hexadecimal values in length. When the "Advanced Options" box is checked, the "Authentication" radio button will appear. Refer to Figure 42.

Adv. "Enable MD5 Authentication": Checking this field will enable MD5 authentication for NTP, using the keys entered below.

Adv. "Broadcast": If the Clock is configured to output periodic NTP Broadcast packets, checking the Broadcast field next to the corresponding keys will enable MD5 Authentication in the Broadcast packets.

Figure 42 - "MD5 Authentication" section

Adv. "Hex": Checking this field will convert the corresponding key from ASCII to hex, or vice versa.

7.4.5. PTP sub-tab

The PTP sub-tab is present when connected to a clock which supports PTP and has an activated PTP license.
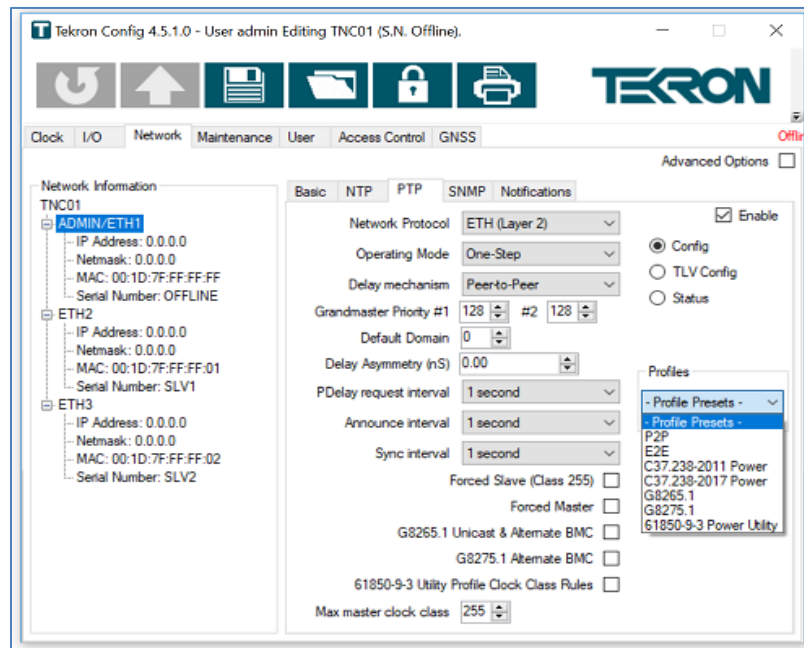
Figure 43- PTP sub-tab

"Enable" PTP: Check this box to enable Precision Time Protocol (PTP) and to access the "Config", "TLV Config", "Status" and PTP Profile settings and status information.

"Profiles"

The PTP sub-tab contains a **"Profiles"** drop-down list which enables the user to quickly configure a port to meet a published profile by simply selecting the appropriate profile from the list. In many cases, all that is needed to configure PTP is to select a profile, after which there is no need to change any other settings on the PTP sub-tab.

"P2P": Configures PTP settings to comply with IEEE 1588-2008 Peer-to-Peer Default PTP Profile.

"E2E": Configures PTP settings to comply with IEEE 1588-2008 Delay Request-Response Default PTP Profile.

"C37.238-2011": Configures PTP settings to comply with IEEE C37.238-2011 Power Profile.

"C37.238-2017": Configures PTP settings to comply with IEEE C37.238-2017 Power Profile.

"G8265.1": Configures port as a Telecom Slave Clock to comply with ITU-T G.8265.1 "Telecom Profile for Frequency Synchronization". Master Clocks will need to be configured in the G8265.1 (Telecom) Masters section.

"G8275.1": Configures port as a Telecom Clock to comply with ITU-T G.8275.1 "Telecom Profile for Phase/Time Synchronization". G.8275.1 Alternate BMCA settings will need to be configured in the G8275.1 section.

"61850-9-3": Configures PTP settings to comply with IEC 61850-9-3 Power Utility Profile.

"Config" radio button: This is the default settings section which appears when PTP has been enabled. It contains the basic PTP settings.

"Network Protocol": The network protocol should be consistent across the entire subnet. Configurable options are:

> UDP (Layer 3)
> ETH (Layer 2)

Note: UDP is the most common PTP Network Protocol.

"Operating Mode": Operating mode is a network wide parameter. In any given network, only one mode of operation will be present. Configurable options are:

> One-Step
> Two-Step

Note: Select Two-Step operation if the Operating Mode is unknown.

"Delay Mechanism": Delay mechanism is a network wide parameter. The delay mechanism selected should be consistent across the network. Configurable options are:

> End-to-End
> Peer-to-Peer
> Fixed-Manual

Note: The Peer-to-Peer option requires the network to use PTP v2 transparent switches.

"Grandmaster Priority": These parameters modify the automatic selection of Master Clocks in PTP networks. Lower values indicate higher probability that the unit will be selected as master clock. The first value overrides all other selection criteria, whereas the second value gives a finer-grained priority used for selection between otherwise-equal clocks. The input range is 0 to 255, where 0 is the highest priority. The default setting is 128.

"Default Domain": A domain consists of one or more PTP devices communicating with each other. By default, PTP aware devices are configured with domain "0". Changing the domain will cause only devices with the specified domain to communicate using the PTP protocol. The input range is 0 to 127.

"Delay Asymmetry": PTP cannot automatically measure and compensate for delay asymmetry, which means that the presence of delay asymmetry reduces the time accuracy of PTP. Delay asymmetry is the difference between the sending path delay and the receiving path delay. If the delay asymmetry is known, entering it manually will allow it to be compensated for, and improve time accuracy. The input range is -5,000,000,000.00 to 5,000,000,000.00 nanoseconds (-5 to 5 seconds).

"Fixed Path Delay": When using the Fixed-Manual delay mechanism, the path delay is not automatically measured, and so must be specified. The accuracy of this value will determine the PTP synchronisation accuracy. This option only appears when the Fixed-Manual delay mechanism is selected. The input range is 0.00 to 5,000,000,000.00 nanoseconds (0 to 5 seconds).

"Forced Slave (Class 255)": Check this box to force the port to become a PTP slave. In this mode, the port will never become a master clock. The PTP Slave operation is also dependent on the Sync Priorities configured for the clock. Refer to section 7.2.3 for further information.

"Forced Master": Check this box to prevent the port from entering the Slave state. In this mode, the port will only operate in the Master or Passive states.

"G8265.1 Unicast & Alternate BMC": Check this box to force the port to become a PTP G8265.1 (Telecom) slave. When checked, a radio button called "G8265.1" will appear top right of the PTP sub-tab (refer to **Error! Reference source not found.**) which contains the G8265.1 (Telecom) Master Clocks configuration settings section. Legacy clocks do not have this option. In this mode, the port will become a unicast slave and will negotiate using unicast to establish sync with one of the Master Clocks configured in the G8265.1 (Telecom) Masters section.

"G8275.1 Alternate BMC": Check this box to use the alternate BMCA defined in ITU-T G.8275.1. When checked, a radio button called "G8275.1" will appear top right of the PTP sub-tab (refer to Figure 42(b)) which contains the configurable attributes defined in the alternate BMCA. Legacy clocks do not have this option.

"61850-9-3 Utility Profile Clock Class Rules": Check this box to use 61850-9-3 Power Utility Profile setting. Selecting the 61850-9-3 Profile as shown in Figure 43, automatically selects this option.

"Delay Request Interval": Delay request interval specifies the time interval between successive Delay Request messages being sent to other PTP devices on the network. This option only appears when the End-to-End delay mechanism is selected. This option does not appear when the port is configured as a Forced Slave.

"PDelay Request Interval": PDelay request interval specifies the time interval between successive Peer Delay Request messages being sent to other PTP devices on the network. This option only appears when the Peer-to-Peer delay mechanism is selected.

"Announce Interval": Announce interval specifies the time interval between successive Announce messages from ports acting as a Master. This option is replaced by the "Master announce interval" setting when the port is configured as a Forced Slave.

"Master Announce Interval": Master announce interval specifies the expected time interval between successive Announce messages from the PTP Master Clock. This allows the port to determine when the Master Clock is no longer sending Announce messages. This option only appears when the port is configured as a Forced Slave. When the port is configured as a G.8265.1 (Telecom) Slave, this field represents the requested rate of announce messages.

"Sync Interval": The sync interval specifies the time interval between successive Sync messages. When configured as a G.8265.1 (Telecom) Slave; this field represents the requested rate of sync messages.

"Max master clock class": Maximum master clock class specifies the maximum advertised clock class that the port will synchronise to as a slave. When the master's clock class exceeds this value, the port will stop synchronising to it. For example, setting this to 6 will cause the port to stop synchronising to the master as soon as the master enters holdover (class 7).

"TLV Config" radio button: This section contains PTP TLV settings. Refer to Figure 44.
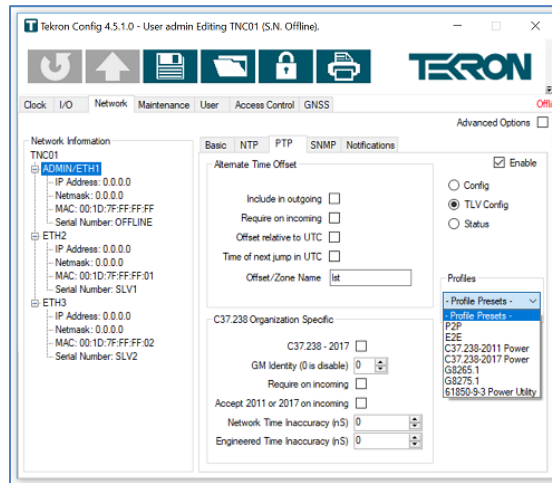
Figure 44 - "TLV Config" settings

"Alternate Time Offset" TLV: (As per IEEE 1588-2008 section 16.3)

"Include in outgoing": If checked, the ALTERNATE_TIME_OFFSET_INDICATOR will be added to announce messages. Legacy clocks do not have this option.

"Require on incoming": If checked, announce messages not containing the ALTERNATE_TIME_OFFSET_INDICATOR TLV will be ignored.

"Offset relative to UTC": If checked, the "currentOffset" field of the ALTERNATE_TIME_OFFSET_INDICATOR TLV will be the UTC offset from Local Time, as opposed to TAI. This option is non-standard, but may be required by some non-compliant C37.238 client implementations. Legacy clocks do not have this option.

"Time of next jump in UTC": If checked, the "timeOfNextJump" field of the ALTERNATE_TIME_OFFSET_INDICATOR TLV will be in reference to UTC Time as opposed to TAI. This option is non-standard, but may be required by some non-compliant C37.238 client implementations. Legacy clocks do not have this option.

"C37.238-2017" Organization Specific TLV:

"GM Identity": This is the "GMIdentity" (or "Grandmaster Identity") as defined in C37.238-2011. Grandmaster Identity is transmitted in IEEE_C37_238 TLV (2 bytes). The configurable range is 0 to 254. If the value is set to less than 3, then the TLV will not be appended to announce messages. Legacy clocks do not have this option.

"Require on incoming": If checked, announce messages which do not contain the C37.238-2011 TLV will be ignored.

"Accept 2011 or 2017 on incoming": If checked, the clock would accept packets of either C37-328 – 2011 (Power Profile) or C37.238-2017 (Power Profile).

"Network Time Inaccuracy": This configurable field sets the "networkTimeInaccuracy" as defined in C37.238-2011. It provides an estimate of the worst-case error in nanoseconds from the Grandmaster. This is the sum of the source clock's uncertainty and the uncertainties of all the other PTP aware devices (e.g. Transparent clocks) transporting the messages. The configurable range is 0 (default) to 2147483647 ns. Legacy clocks do not have this option.

"Engineered Time Inaccuracy": This configurable field sets the "Engineered networkTimeInaccuracy" as defined in C37.238-2011. This value is set at the end device to represent the worst-case error in nanoseconds from this device to all preferred grandmasters. The configurable range is 0 (default) to 2147483647 ns. Legacy clocks do not have this option.

"G8265.1" radio button: This section of **Tekron's** Configuration Software contains the G8265.1 (Telecom) Master clock configuration settings (Refer to Figure 45). It only appears if the selected Ethernet port has been configured as a G8265.1 (Telecom) Slave.
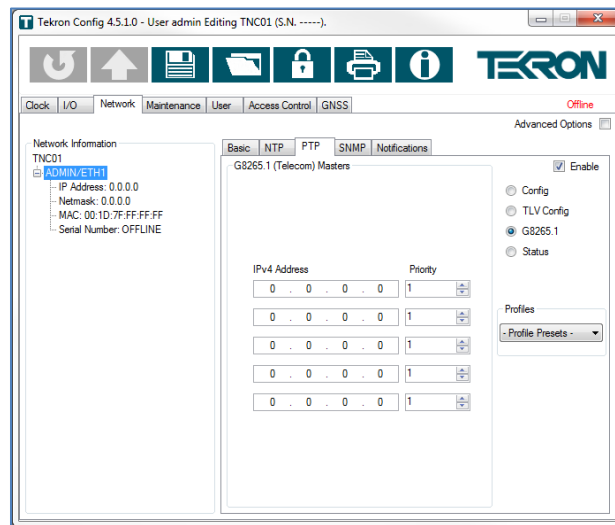
Figure 45 - "G8265.1" settings

"IPv4 Address": Enter the IP Address of the Telecom Master. Up to 5 Master Clocks can be configured. The clock will communicate via Unicast messages and sync to the best available master clock.

"Priority": Slave devices sync to the highest Quality Master Clock available. If multiple Masters have the same highest quality level, the Master with the highest priority is selected. If the quality level and priority are the same, then the order in the G8265.1 (Telecom) Masters list dictates which Master is used.

8275.1" radio button: This section of Tekron's Configuration Software contains the G.8275.1 (Telecom) alternate BMCA configurable attributes (Refer to Figure 46). It only appears if the selected Ethernet port has been configured as a G.8275.1 (Telecom) Clock.

"Default Local Priority": This priority is applied to the local clock when comparing the local clock to a foreign master. Setting this to a lower value will give preference to the local clock over foreign masters. The input range is 1 to 255, where 1 is the highest priority. The default setting is 128. This attribute is not used when operating as a Grandmaster.

"Port Local Priority": This priority is applied to the Announce information received on this port from a potential master when comparing that potential master to the local clock or other potential masters. Setting this to a lower value will give preference to foreign masters connected to this port over the local clock or foreign masters connected to other ports, if present. The input range is 1 to 255, where 1 is the highest priority. The default setting is 128. This attribute is not used when operating as a Grandmaster.

"Port - Not Slave": When selected, the port will never enter the Slave state. This must be selected in order to meet Telecom Grandmaster requirements and advertise good clock accuracy in outgoing Announce messages. This must not be selected in order for the port to operate as a Telecom Slave Clock.
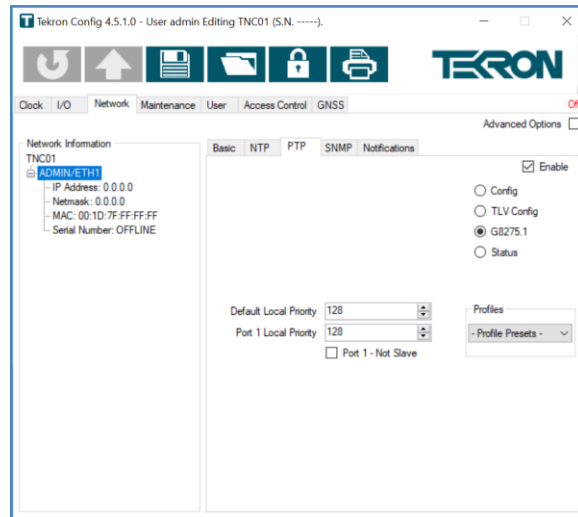
Figure 46 - "G8275.1" settings

"Status" radio button: This section of **Tekron's** Configuration Software is for informational purposes only. Refer to Figure 47. Legacy clocks do not have this feature.
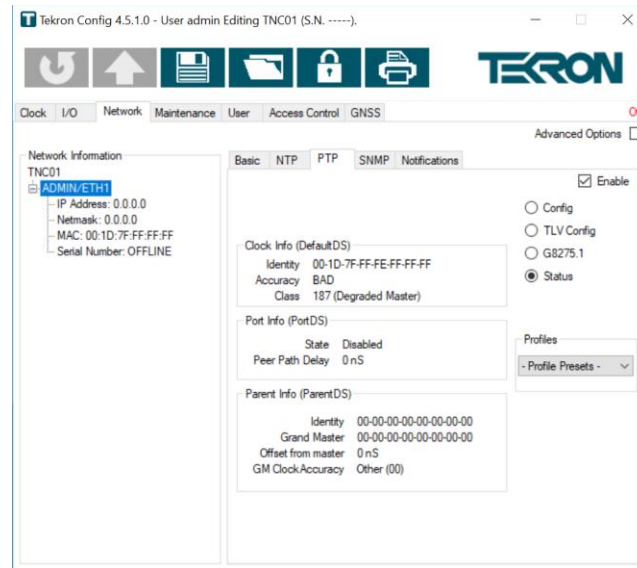
Figure 47 - "Status" information

"Clock Info (DefaultDS)" section:
"Identity": Is the PTP Clock Identity of this port.

"Accuracy" This is an estimate of the accuracy of the Master Clock based on the sync source, and the characterisation of its internal oscillator as defined under clockAccuracy in IEEE 1588-2008.

"Class": Is the clockClass as defined in IEEE 1588-2008.

"Port Info (PortDS)" section:

"State": Is the portDS.portState as defined in IEEE 1588-2008.

"Peer Path Delay": The calculated latency between this port and the connected network node. The second peer path delay value shows the calculated latency of the second path to the peer clock for Clocks that have PRP or HSR enabled. Refer to section 7.4.3 for PRP or HSR configuration.

"Parent Info (ParentDS)" section:

"Identity": Is the PTP Clock Identity of the Master.

"Grand Master": Is the PTP Clock Identity of the Grand Master.

"Offset from Master": Is the calculated offset from the current Master.

"GM Accuracy": is the clockAccuracy advertised by the Grand Master.

7.4.6. SNMP sub-tab

The SNMP sub-tab contains the configuration and access settings for Simple Network Management Protocol functionality. Refer to Figure 48. Legacy clocks do not have this feature.

"Maximum Authenticated Access": This field sets the access limits for authenticated clients using SNMPv3 with USM Authentication. Configurable options are:

>   None
>   Read only
>   Read/ Write

"Require Privacy": Check this box to require SNMPv3 USM privacy on SNMP requests.

Figure 48 – "SNMP" sub-tab

Note: When **"Require Privacy"** is enabled, SNMP v1 and v2c are disabled.

"Maximum Un-authenticated Access": This field sets the access limits for un-authenticated clients using SNMPv1, SNMPv2c and SNMPv3 without USM Authentication. Configurable options are:

>   None
>   Read only
>   Read/ Write

"Community Strings (v1, v2c)" section: This section contains the configuration settings for private and public access.

"Name 1": This field is the "Private" string access key. The maximum number of characters the clock can accept is 32.

"Security Group 1": This field sets the group who governs the access rights for the "Private" string. Access can be further restricted using the "Maximum Unauthenticated Access" field.

"Name 2": This field is the "Public" string access key. The maximum number of characters the clock can accept is 32.

"Security Group 2": This field sets the group who governs the access rights for the "Public" string. Access can be further restricted using the "Maximum Unauthenticated Access" field.

Note: SNMPv1 and v2c use an unencrypted 'community string' as the only authentication mechanism. Packet analyzers such as Wireshark can be used to read the community string.

7.4.7. Notifications sub-tab

Clocks which support SNMP and Syslog have the ability to act as an SNMP Agent or Syslog Originator. The settings for this functionality are managed in this section. Refer to Figure 49.

"Subscriptions" section:
"Add": To add a subscriber (SNMP Manager or Syslog collector), click the add button and a new window will open (refer to Figure 50).

"Type": Select the SNMP or Syslog message type which the subscriber is expecting. Configurable options are:

SNMPv1
SNMPv2c
SNMPv3
Syslog
Historic SNMPv1[1]
Historic Syslog[2]

For legacy clocks, the configurable options are:

Historic SNMPv1
Historic Syslog

Figure 49 - "Notifications" sub-tab

"IP Address": Enter the IP Address of the subscriber.

"Security name": This field is the security key. When the "Type" selected is SNMPv2, the key can consist of any character combination, up to 32 characters maximum length.

If the "Type" selected is SNMPv3, and a "Username" set-up in under the "User" tab is input as the key, then the authentications settings of the user will be applied.

"Remove": Select the subscriber you wish to remove and click the "Remove" button.

Figure 50 - "Subscriptions" window

"Edit": Select the subscriber you wish to edit and click the "Edit" button.

"Syslog facility": This is the setting for the Syslog Facility Number. It represents the "Local Use" value range 0 to 7 (i.e. Facility Number range 16 to 23).

"Report Low Satellites": If one or more subscribers have been set-up, then this feature will be enabled and this Ethernet port will send out a warning to all subscribers if the number of satellites that the Clock syncs to drops below the set threshold.

7.5. Maintenance Tab

This section contains features for the purpose of identification of the Clock, conveying its purpose, and any other information relevant to the ongoing operation and maintenance of the Clock. It also provides the facility to add features to the Clock via license keys, and contains various other features which are product dependent. Refer to Figure 51.

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[1] Historic SNMPv1 refers to the early implementation of SNMP Traps in older Tekron products. It is not recommended that this setting is used.

[2] Historic Syslog refers to the early implementation of Syslog in older Tekron products. It is not recommended that this setting is used.

Figure 51 - Maintenance Tab

7.5.1. "Maintenance" section:

"Clock Designation": A user configurable 255-character text field which can be used to name Clocks on a LAN or WAN for purpose of **differentiation of purpose or location. The "Clock Designation" appears in the "Name" Column in the discovery window**, as well is in saved configuration files.

"Clock Contact": A user configurable 255-character text field which can be used to enter a Contact person and/or contact information for enquiries regarding the Clock. Legacy clocks do not have this option.

"Clock Location": A user configurable 255-character text field which can be used to describe the location of Clocks on a LAN or WAN for purpose of differentiation of purpose or location. Legacy clocks do not have this option.

Figure 52 - "Maintenance" section

"Enable Supervisor Mode": This option is available if one or more individual users have been configured as Supervisors in the "Group Policy" section under the "User Tab". Refer to User Tab section for further information.

Once Enabled, Users who are not Supervisors will have to arrange for a "Supervisor" to store changes. When a clock setting change is made, and the "Store" button is clicked, a warning box will pop up advising the user that Supervisor Mode is enabled, and that changes will need to be sent to a supervisor for verification. Refer to Figure 53.

Figure 53 - Supervisor mode warning box

A new window will open and will allow the changes to be saved to an XML file. The file can then be electronically sent to a Supervisor who will then connect to the clock, load the file, review the changes made, and accept or cancel the changes. Refer to section 7.1 "Load button" for further information.
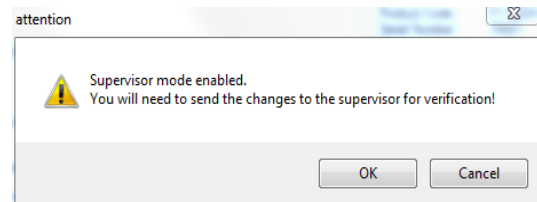
"Enable Serial Config": This option appears if the clock is capable of being configured via the serial port using Tekron's legacy serial configuration tool. Ethernet settings cannot be changed using the serial configuration tool.

By default, configuration via the serial port is disabled on Clocks running in "Secure Mode". This is implemented by turning off the Receive Line (Rx) on the serial port. On Clocks which support Event Recording or other features which require two-way serial communications, the Enable Serial Config box should be checked for those functions to operate.

"Enable Ethernet Config": This option appears if the configuration software is connected to the clock via the USB port. Once unchecked, the clock is *only* able to be configured via a local connection through the USB interface using Tekron's Configuration Software. Not all clocks feature a USB port.

"Enable GPS": This feature appears when a clock is fitted with a GPS or GNSS receiver. When the box is unchecked, the time signals from the GPS or GNSS receiver are ignored. Legacy clocks do not have this option.

"Enable Security": By default, Security is turned on unless the clock was ordered with Security turned off, in which case the clock runs in "Unsecure Mode". If Security is turned off, a user can configure the device as described in section 7. Security can be enabled again at which point the clock will revert to the original factory default username and password. Refer to section 6. Secure Mode is not available on legacy clocks.

"Enable Power Alarms": This configurable setting appears if connected to a Clock which supports multiple power supply modules. By default, this option is checked, if unchecked the power alarm relays do not report the true state.

"Enable Unauthorized Factory Reset": This setting appears if connected to a Clock that supports it. When enabled, this setting allows the Clock to be reset to factory defaults in order to recover from a forgotten administrator password. Physical access is required to perform the reset procedure. This reset procedure is different from the factory reset performed by the Factory Reset button, as that reset does not require physical access, but requires an administrator password.

"License entry": This section facilitates the addition of features on applicable products by way of a License Key. If options such as NTP or PTP are ordered at some point after a clock has been commissioned, the License Key can be copied into the License Entry box and activated by clicking the "Add Licence" button.

"Licenses": This is an information only section which lists the activated licenses in the clock.

"Login Banner" button: A Login banner can be created to open when a user connects to a Clock. To setup a banner; Click the **"Login Banner"** button **and the "Edit Login Banner" window will** appear. Enter the text that you wish to appear upon connection to the clock. If the clock is running in Secure Mode, the text will appear after correct login credentials have been entered.

Below is an example of the Edit Login Banner window (refer to Figure 54) and the corresponding message (refer to Figure 55) that appears when a user attempts to connect to the Clock.
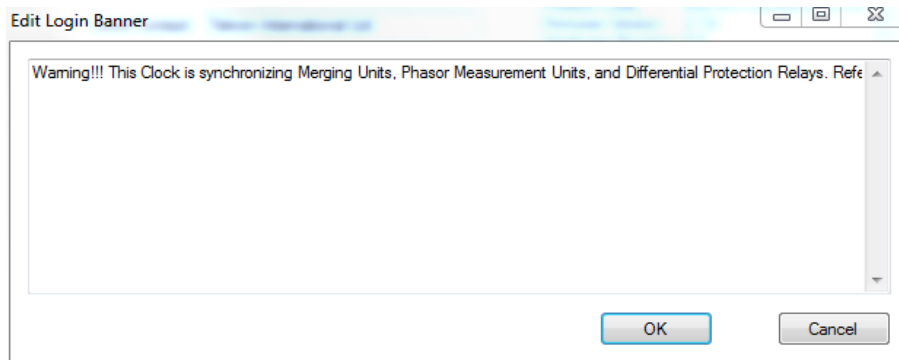
Figure 54 - Edit Login Banner
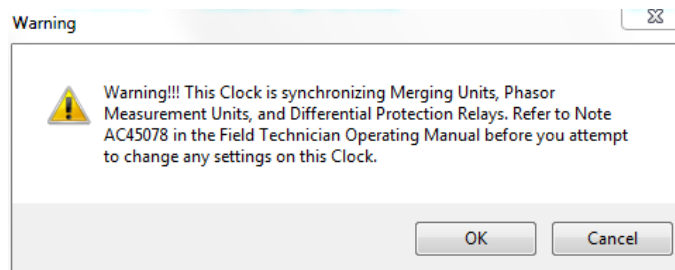
Figure 55 - Login Banner

To dismiss the Login Banner, **press the "OK" Button**, and you will continue to the configuration window of the Clock.

"Factory Reset" button: The Factory Reset button returns the clock to the Factory Settings, and removes all of the Groups and Users configured in the device. When clicked, the **"Factory Reset" warning window appears. Refer to** Figure 56.

The reset also resets the Network settings and reverts to DHCP.

After a reset, the Clock closes the connection with **Tekron's** Configuration Software.

To re-connect, the procedure in Section 6 should be followed.

The username and password will revert to the default setting. Refer to the product manual or quick start guide to confirm the login credentials.
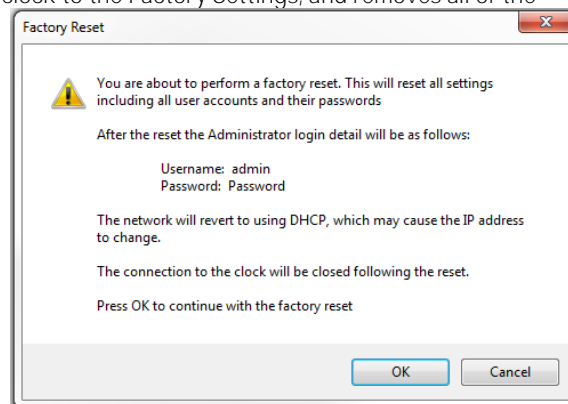
Figure 56 - "Factory Reset" window

The typical login credentials are:

Factory default username: admin

Factory default password: Password

Note: the username and password are case sensitive.

"Restart Unit" button: The Restart Unit button reinitiates the Clock in a manner similar to removing and re-applying the power. No configuration settings are changed when performing this action. Legacy clocks do not have this option.

When the button is clicked, a new window will appear to confirm your action (Refer to Figure 57). By clicking the "OK" button, the unit will proceed to restart, and the Clock will close the connection with **Tekron's** Configuration Software. To reconnect, return to the discovery Window and select the Clock and click Configure. Refer to section 7 for more detailed instructions.

Figure 57 - "Restart Unit" window

"View Log" button: The View Log button retrieves and shows the configuration change log from the clock. A window containing a list of configuration changes will appear. Refer to Figure 58 for an example.

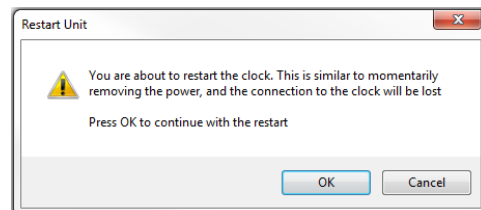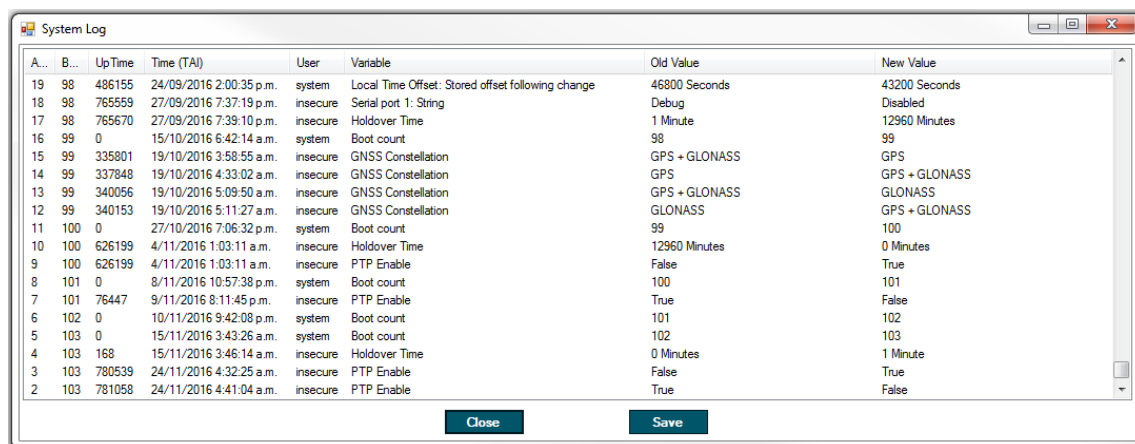| A...	B...	UpTime	Time (TAI)	User	Variable	Old Value	New Value
19	98	486155	24/09/2016 2:00:35 p.m.	system	Local Time Offset: Stored offset following change	46800 Seconds	43200 Seconds
18	98	765559	27/09/2016 7:37:19 p.m.	insecure	Serial port 1: String	Debug	Disabled
17	98	765670	27/09/2016 7:39:10 p.m.	insecure	Holdover Time	1 Minute	12960 Minutes
16	99	0	15/10/2016 6:42:14 a.m.	system	Boot count	98	99
15	99	335801	19/10/2016 3:58:55 a.m.	insecure	GNSS Constellation	GPS + GLONASS	GPS
14	99	337848	19/10/2016 4:33:02 a.m.	insecure	GNSS Constellation	GPS	GPS + GLONASS
13	99	340056	19/10/2016 5:09:50 a.m.	insecure	GNSS Constellation	GPS + GLONASS	GLONASS
12	99	340153	19/10/2016 5:11:27 a.m.	insecure	GNSS Constellation	GLONASS	GPS + GLONASS
11	100	0	27/10/2016 7:06:32 p.m.	system	Boot count	99	100
10	100	626199	4/11/2016 1:03:11 a.m.	insecure	Holdover Time	12960 Minutes	0 Minutes
9	100	626199	4/11/2016 1:03:11 a.m.	insecure	PTP Enable	False	True
8	101	0	8/11/2016 10:57:38 p.m.	system	Boot count	100	101
7	101	76447	9/11/2016 8:11:45 p.m.	insecure	PTP Enable	True	False
6	102	0	10/11/2016 9:42:08 p.m.	system	Boot count	101	102
5	103	0	15/11/2016 3:43:26 a.m.	system	Boot count	102	103
4	103	168	15/11/2016 3:46:14 a.m.	insecure	Holdover Time	0 Minutes	1 Minute
3	103	780539	24/11/2016 4:32:25 a.m.	insecure	PTP Enable	False	True
2	103	781058	24/11/2016 4:41:04 a.m.	insecure	PTP Enable	True	False

Figure 58 - Configuration change log retrieved from clock

7.5.2. "System Information" section

This is an information only section which lists the Model, Product Order Code, Firmware revision, and Hardware Revision of the Clock.

7.6. User Tab

This Tab contains the Group and User settings configured in the connected Clock. This tab is only visible when the connected clock is running in Secure Mode. Refer to Figure 59.
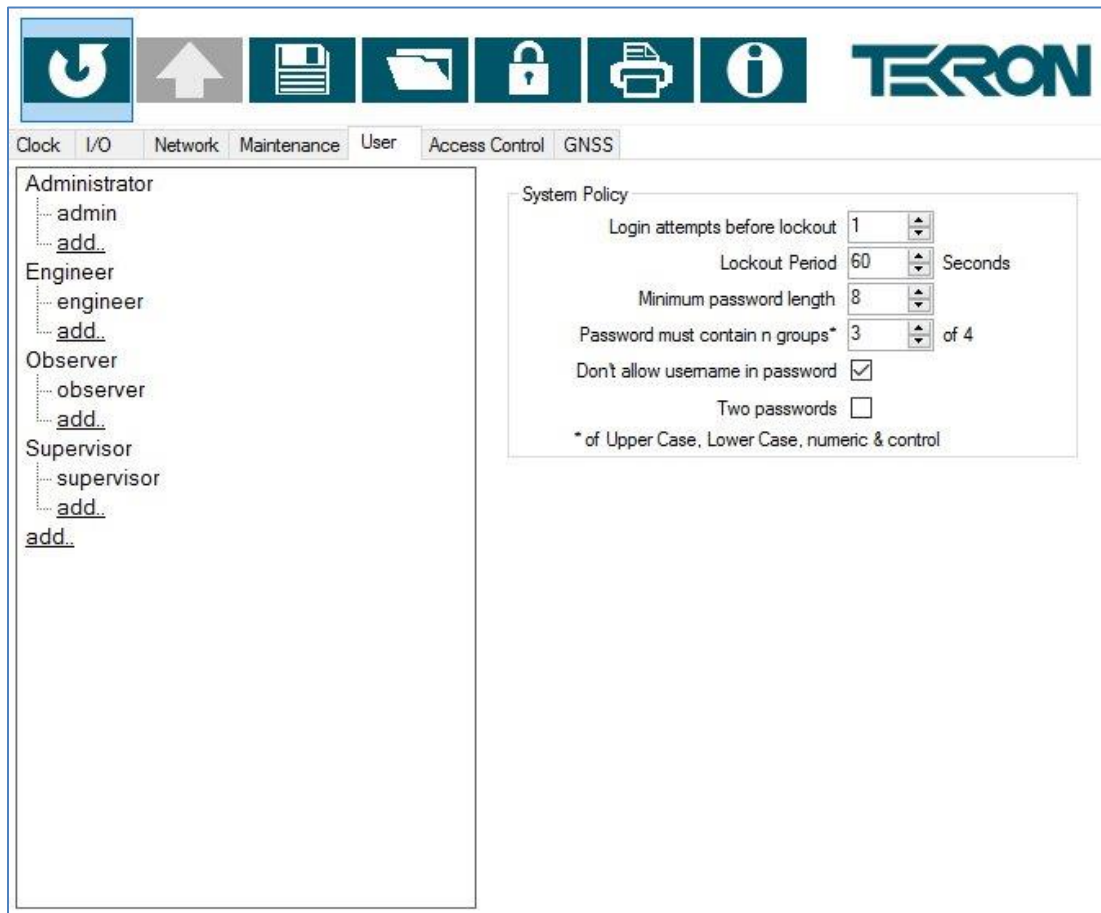
Figure 59 - "User" Tab

7.6.1. Group and User Directory:

The Group and User Directory are presented in a tree structure. On the first level of the tree is the "Group", and the second level of the tree contains "Users" which belong to the group.

Adding or editing Groups:

Adding a Group:
To add a Group, click the "add…" button on the first level of the tree. This button is always appended at the bottom of the Group and User Directory. Once the "add…" button is clicked, a new window will appear (refer to Figure 60).

Group Name: Enter into the Group Name text field, the name of the group you wish to create.
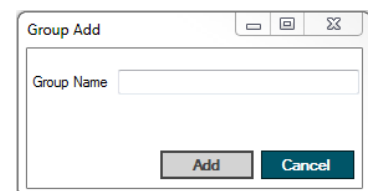
Figure 60 - "Group Add" window

Editing an existing Group:

Changing the name of an existing group:
Select the Group Name you wish to change. Click the Group Name again to edit the name.

Changing the Policy settings of an existing Group:
The policy for the Group can be set by selecting the applicable Group. Once selected, the "Group Policy" section will appear to the right of the directory as well as the name of the group which is displayed in brackets (refer to Figure 61). The Group Policy Settings apply to all Users who belong to the Group.
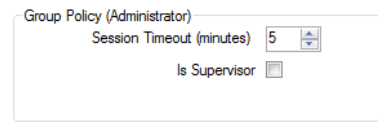
Figure 61 - "Group Policy" configuration

"Session Timeout": This is the Timeout setting for a "group". If a user within the Group does not interact with Tekron's Configuration Software after the set period of time, the session will prompt the User and if ignored, will close the connection. Setting the Session Timeout to zero will disable session timeout for that group.

 *"Is Supervisor":* This setting is the first mandatory step to enable Supervisor Mode. At least one or more Groups containing one or more users should be configured with "Is Supervisor" box checked. Once checked, "Supervisor mode" under the "Maintenance" Tab can be enabled.

Note: Supervisors cannot make changes to the clock configuration, they can only store changes made by a non-supervisor User.

Adding or editing Users:

Adding a User:
To add a User, click the "add..." button on the second level of the tree. This button is always appended after the last user in the applicable Group. Once the "add..." button is clicked, a new window will appear (refer to Figure 62).

Username: Enter into the Username text field, the name of the User you wish to create.

Password: This field is for informational purposes only and contains the initial Password for the User.

Figure 62 - "User Add" window

Group: This field is for informational purposes only and is the Group that the User belongs to.

Must Change Password: This is for informational purposes only. New Users must change their password when they first login.

Editing an existing User:

Changing the name of an existing User:
Select the User Name you wish to change. Click the User Name again to edit the name.

Changing the User Preferences of an existing User:
The User Preferences can be set by selecting the applicable User. Once selected, the "User Preferences" section will appear to the right of the directory as well as the name of the User which is displayed in brackets. The Group Policy Settings apply to all Users who belong to the Group.
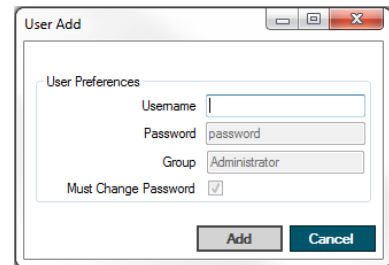
Authentication Protocol: Select the Authentication Protocol type using the drop-down list. Configurable options include MD5 and SHA.

"Set Password": This option enables the Password of an Existing User to be changed. Check the Set Password Check box and a New Window will open (refer to Figure 64) prompting for a New Password and to Re-Type the New Password to validate it and click "OK". The New Password should abide by the System Policy settings. Refer to System Policy for further information.

Privacy Protocol: Select the Privacy Protocol type using the drop-down list. Configurable options include None, DES and AES.

"Must Change Password": Check this option to force the selected user to change their password the next time they attempt to Login to this Clock.
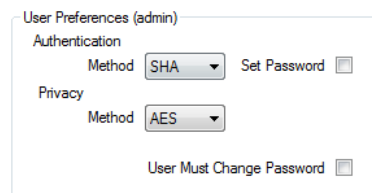
Figure 63 - "User Preferences" settings
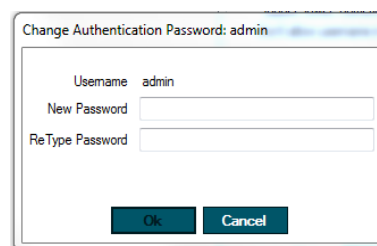
Figure 64 - "Change Authentication Password" window

7.6.2. System Policy

This section contains the Password Login Attempts, Policy Settings for the connected Clock.

"Login attempts before lockout": This is the maximum number of attempts a user is allowed to try passwords before they are locked out of the clock. If set to 0, it allows infinite attempts. To prevent the leaking of security information, there is no notification to the user that the lockout is in place, and the standard login failed message will be displayed.

"Lockout Period": This is the time period for which the user is locked out of the clock when they have exceeded the configured number of login attempts before lockout. Subsequent incorrect login attempts during the lockout period will not increase that period.

"Minimum password length": This is the minimum number of characters a password should contain. The configurable setting is from 3 to 20 characters.

Note: the maximum Password length is 32,000 Characters.

"Password must contain n groups": This is the number of character types that should be contained within the password. Valid Types include:

        Upper case Letters
        Lower case Letters
        Numbers
        Symbols

"Don't allow username in password": Check this option to decline passwords which contain the username, or a prefix of the username over three characters long.

"Two Passwords": Check this option to enable a user configurable Password for Authentication Communication and Privacy Communication.

By default, a Single Password is used at Login and is used for both Authentication and Privacy Protocols (where applicable). When the Two Passwords option is initially enabled; the Set Password check boxes appear next to the Authentication and Privacy Settings. This enables the user to configure two independent passwords. To change a Password, both Authentication and Privacy Passwords should be entered into the applicable fields; otherwise the change will not be saved.

If this feature is enabled initially, and disabled at a future time, the Single sign in Password will be the Authentication Password saved in the unit.

7.7. Access Control Tab

The Access Control Tab contains the access settings for each Group, which apply to the Users within the Group. This tab is only visible when the connected clock is running in Secure Mode. Refer to Figure 65.

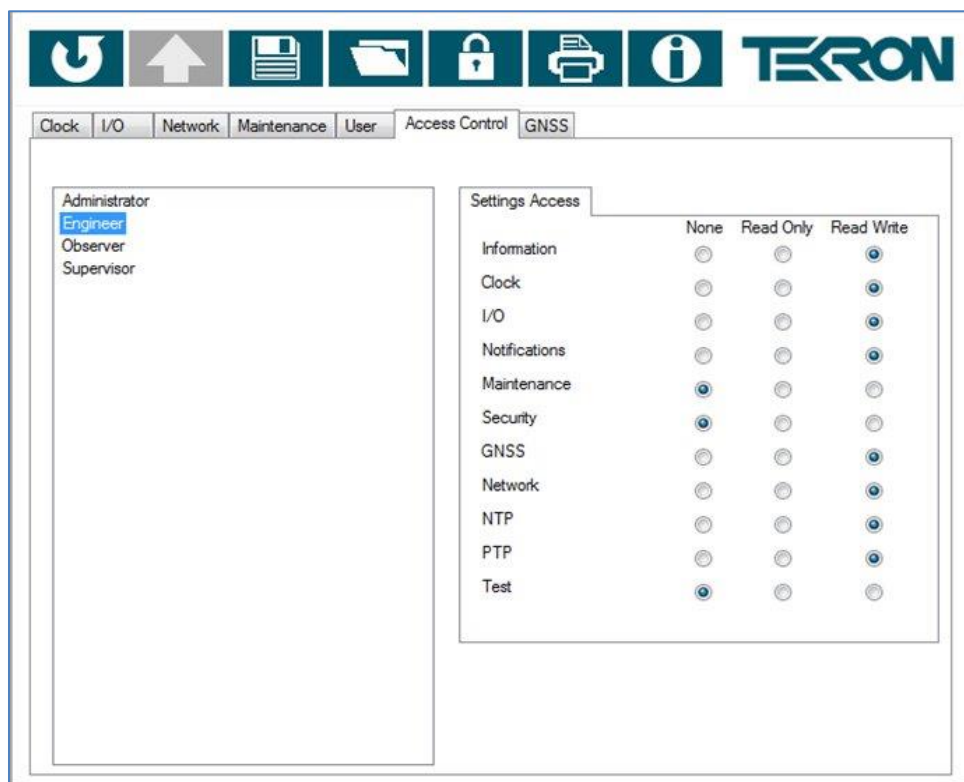
Figure 65 - "Access Control" Tab

7.7.1. Group Directory

The Group Directory lists in Alphabetical order the Groups configured in the connected Clock. Refer to Figure 66. To edit the Settings Access or Port Access rights of a Group, click on the applicable Group and change the settings in the adjacent **"Settings Access" and "Port Access" sub**-tab.

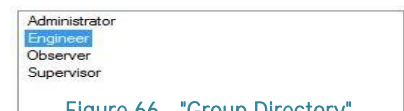Figure 66 - "Group Directory" section

"Settings Access":

This section enables the Clock to be configured to allow or remove access to the applicable configuration settings. The settings are independently configured for each Group, and apply to subsequent Users which belong to the Group. The access levels are:

> None (No access)
> Read Only
> Read Write

"Information": Allows access to the System Information section of the "Clock" Tab.

"Clock": Allows access to the Time, Localization, System Information and Clock Sources sections on the "Clock" Tab. This setting does not provide access to the Test Source configuration settings.

"I/O": Allows access to all Time and Frequency input and output settings on the "I/O" Tab.

"Notifications": Allows access to the Alarm ports on the "I/O" Tab, and SNMP and Syslog Notification settings on the Network Tabs.

"Maintenance": Allows access to the "Maintenance" tab and settings.

"Security": Allows access to the User and Access Control tabs and settings.

"GNSS" or "GPS": Allows access to the "GNSS" or "GPS" tab and settings.

"Network": Allows access to the Network Information and Basic sub-tab settings located on the "Network Tab".

"NTP": Allows access to NTP sub-tab settings located on the "Network Tab".

"PTP": Allows access to PTP sub-tab settings located on the "Network Tab".

"Test": Allows access to the Clock Sources section and configuration of the Test Source function on the Clock Tab.

Note: All of the Access settings are conditional on the "Port Access" settings of the Group which the user belongs to.

"Port Access":

This section is dynamically populated depending on the number of Ethernet interfaces fitted within the Clock. The name of each interface is based on the marking on the relevant port on the Clock. This section enables the Clock to be configured to allow or remove access to the applicable ports. The settings are independently configured for each Group, and apply to subsequent Users which belong to the Group. The access levels are:

> None (No access)
> Read Only
> Read Write

7.8. GNSS/GPS Tab

This Tab contains GNSS or GPS Configuration settings and real-time information on the constellation status. If the Clock selected supports more than one constellation, the Tab will be labelled GNSS (refer to Figure 67). On Clocks which only support GPS, the Tab will be named GPS.
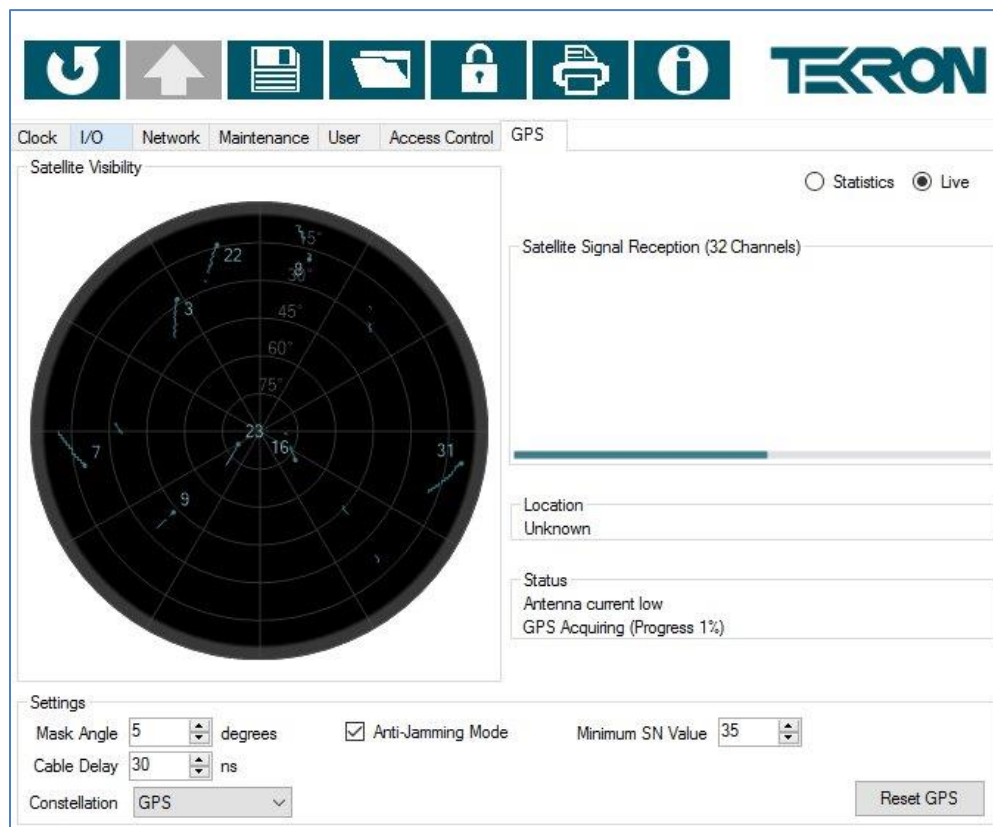
Figure 67 - GNSS Tab

7.8.1. Satellite Visibility

This section contains a satellite map and over time plots each tracked satellites orbital path (refer to Figure 68). GPS satellites and their trails are in blue, and GLONASS satellites and their trails are in red. The present location of the satellite is represented by the marker "⊙", and the Satellite Vehicle Identifier is located adjacent to it.

The top of the satellite map marked as 0° degrees is the bearing in relation to North. The 90°, 180° and 270° markings represent East, South and West respectively.

The concentric circles on the satellite map represent the angle above the horizon. Therefore; the centre of the map represents the space directly above the antenna looking up into orbit.

Figure 68 - "Satellite Visibility" section

Refer to Figure 69 for a graphical representation.
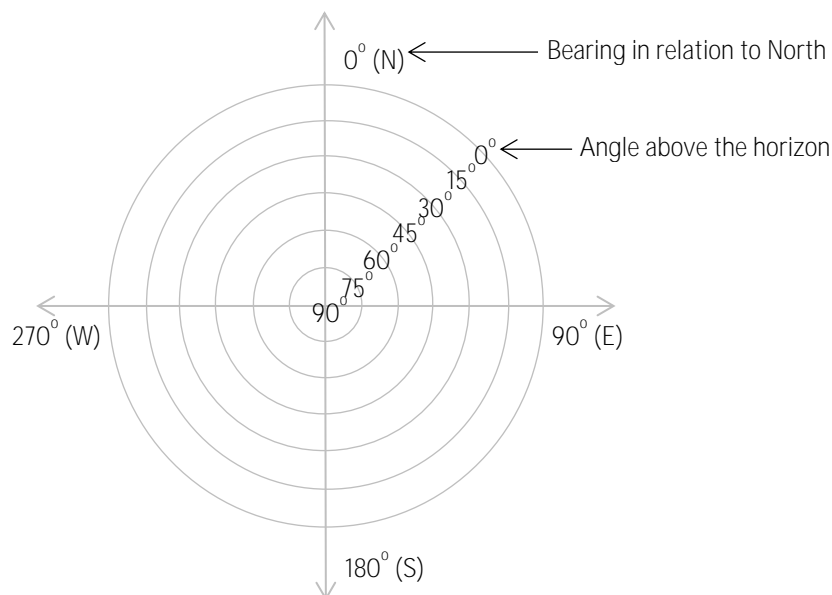
Figure 69 – Satellite Map Orientation

7.8.2. Live

By default, the "Live" radio button is selected. When selected; the "Settings", "Satellite Signal Reception", "Location", and "Status" sections appear.

"Settings" section

This section contains the Mask Angle, Cable Delay, Anti-Jamming Mode and Constellation settings where applicable. Refer to Figure 70.

Figure 70 – GNSS/GPS "Settings" section

"Mask Angle":
This is the angle (in degrees) from the horizontal plane (horizon) below which satellite signals will not be used in calculating time and position. Increasing the mask angle will avoid errors caused by ionosphere, troposphere and multipath affects; however this will also limit the number of satellites being tracked. The default setting is 5 degrees. The configurable range is 0 to 90 degrees.

When the mask angle is modified, the satellite map is dynamically updated with grey shading which indicates the masked section of the horizon.

"Cable Delay" compensation:
All antenna systems introduce signal delay (depending on the cable length). To optimize the precision of the output signals at the clock output terminals, enter a value in this field corresponding to approximately 4 ns per meter of antenna cable. For example, if the antenna cable is 30 meters long, the cable compensation should be set to "120 ns".

"Constellation":

This setting allows the user to select the constellation(s) which the connected clock will synchronize to. Configurable options include:

> GPS
> GLONASS
> GPS + GLONASS

Note: The "Constellation" configuration settings only appear on Clocks which support multiple constellations.

"Mobile GPS/GNSS":

When the connected clock is designed to be installed on stationary sites or moving platforms (such as moving vehicles or vessels), this check box appears. When this option has been checked, the position and timing solution is constantly updated. Clocks designed for stationary applications do not update the position on such a frequent basis.

"Anti-Jamming Mode":

This option only appears when it is supported by the connected Clock. Anti-Jamming mode avoids some signal jamming and/or spoofing attempts by preventing the tracking of only a single satellite. When this option has been checked, a minimum of two satellites are required to maintain synchronisation. When this option has not been checked, one satellite operation is allowed, which helps maintain synchronisation on sites where there is poor satellite coverage.

"Satellite Signal Reception" section:

This section is for information purposes only, and displays the real-time signal strength of satellites being tracked (refer to Figure 71). Satellites showing excess of 35 dBHz with good health reported in the almanac, and which are not below the antenna mask angle, are used for time and position calculations and are displayed as solid coloured bars. Satellites that are being tracked but do not meet the criteria above are displayed as faded coloured bars.

Blue bars indicate GPS Satellites, and Red bars indicate GLONASS Satellites.

The number above each bar is the signal strength (in dBHz). The number below each bar is the Space Vehicle (SV) Number. If you select a bar, the SV Number and marker in the adjacent satellite map will be highlighted.

The number of channels indicated in the title of the Satellite Signal Reception section is the number of channels supported by the GPS/GNSS receiver. The number of channels determines the maximum number of satellites that can be tracked simultaneously.

Figure 71 - "Satellite Signal Reception" section

"Location" section:

This section is for information purposes only, and is the current stored position reported by the GPS/ GNSS receiver. The Position is displayed in degrees, minutes and milli-minutes, and the elevation is displayed in metres. Refer to Figure 72.
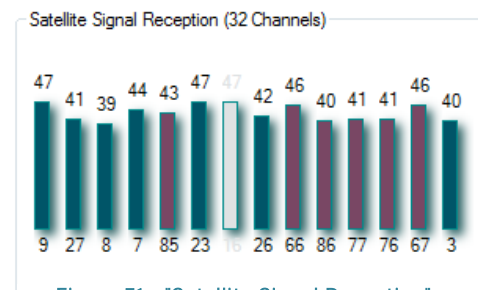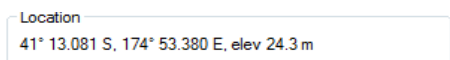

Figure 72 - "Location" information

"Status" section:

This section provides real-time information on the status of the clock. Refer to Figure 73.

The top line of this section gives information on the antenna connection. Below are a list of valid messages and their interpretation.

Message	Definition
Antenna current low	The antenna circuit current drain is low (typically under 3mA). This could be caused by poor connections, or if the connected antenna has a lower current drain specification or if a component in the antenna system is providing power to the antenna and therefore the Clock is not seeing a connected load.
Antenna current high	The antenna circuit current drain is high (typically over 100 mA). This is caused by a short in the antenna circuit, or by moisture ingress in the circuit, or if the antenna connected has a higher current drain specification.
Antenna OK	Antenna system is connected and is perceived to be operating normally.

Note: If an antenna fault is detected, the connected Clock may not report that is synced, even though it can track satellites.

The second line of this section gives information on the GPS/GNSS receiver status.

Message	Definition
GPS/GNSS Position Hold	Almanac has been downloaded. Position is known, and the GNSS is providing its most accurate time
Doing Fixes	Synced to one or more satellites and now calculating position and timing solution. Downloading Almanac.
Acquiring	Searching for satellites.
Bad Geometry	Insufficient satellite distribution to calculate an accurate position.

"Reset GPS" or "Reset GNSS" button: This button appears on Clocks which are referenced to GPS or GNSS. Click this button to reset the GPS or GNSS receiver, clear **the receiver's memory** and discard the stored almanac.

7.8.3. Statistics

The **"Statistics" radio button contains the "GPS Availability", "Average strength of usable satellites" and "Control"** sections.

While connected to a Clock, **Tekron's** Configuration Software monitors the GPS/GNSS status and presents the information in the form of a Pie Chart and Bar Chart.

Note: GPS/GNSS statistics are only recorded while the Configuration window remains open. When the Configuration window is closed, any statistics that have not been printed out or logged to file will be lost.

"GNSS Availability" section:

The Pie Chart provides statistics on the average number of satellites tracked, and if during the logged period the receiver momentarily could not track any satellites, it will indicate the duration of the longest of the occurrences. Refer to Figure 74.
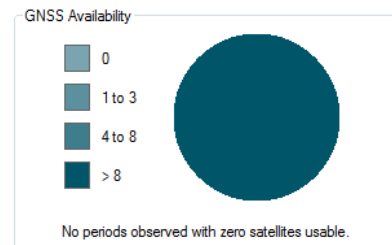

Figure 74 - "GNSS Availability" pie chart

"Average Strength of usable satellites" section:

The bar Chart gives an indication as to the average strength in dBHz of the usable satellites that were logged. Refer to Figure 75.
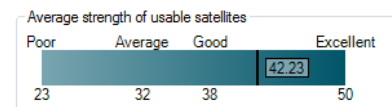
Figure 75 - "Average strength of usable satellites" bar chart

"Control" section:

This section contains the settings for logging GPS/GNSS Statistics. Refer to Figure 76.

"Log to File": Check this box to log information on tracked GPS/GNSS satellites to a text file. Once this option is checked, a new window will open to allow the location of the file on the local hard drive to be selected. Deselect this checkbox to stop logging to file.

Figure 76 - "Control" section

The information logged to file consists of: Date, Time, Latitude, Longitude, Height, GPS/GNSS receiver state, and the Satellite Vehicle Identifier, used / not used for timing status, signal strength, azimuth and elevation of each tracked satellite. The date and time used in the log file is in UTC and is derived from the date and time settings on the host PC.

"Disable Automatic Logout": Check this box to override the Session Timeout enforced by the Group Policy, allowing logging to occur over a longer time period. If this box is not checked, statistics gathering may be interrupted by the connection closing due to inactivity.

"Schedule" button: Click this button to schedule a time at which statistics will be gathered. When clicked, a new window will open prompting for a begin time and duration. Refer to Figure 77.

Figure 77 - "Schedule Statistics Gathering" window

> **"Begin" time:** Enter the local time at which statistics gathering is to **begin. The default is "Immediately".** Many time formats are accepted. Examples of valid times:
>
> 11:30
> 5/02/2016 11:30
> 11 pm
> 23:30
> 11:30 a.m.
> Friday, 11:30
> 5 Feb 2016 11:30 p.m.
>
> **"Duration":** Enter the length of time that statistics gathering is to continue for. The default is "Indefinite", which will continue until manually stopped. Examples of valid durations:
>
> 1 Minute
> 2 Hours
> 1d 10h 30m
> 1D 10:30
> 1 Day, 10 Hours, and 30 Minutes

Existing statistics will be cleared, and the "Disable Automatic Logout" checkbox will be automatically selected to avoid interruption of statistics gathering. Statistics gathering will begin automatically at the specified time, and continue for the specified duration. After statistics gathering is complete, the "Print clock configuration" button in the toolbar can be used to obtain a printout that includes the gathered statistics.

 "Reset" button: Click the reset button to clear existing statistics. The software will prompt for confirmation before clearing the statistics.
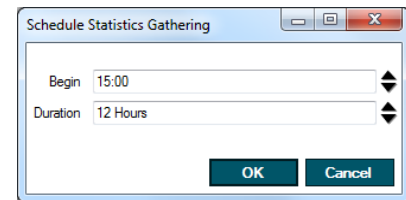
8. Editing XML Configuration files

This version of **Tekron's** Configuration Software loads and stores configuration files in .xml format. The configuration files can be edited using text editing software such as MS Notepad and Word, however due to the complexity of the settings it is recommended that only **Tekron's** Configuration Software is used to create and save configuration files. Tekron may not be able to support xml files edited outside its software. Note that encrypted sections of configuration files cannot be edited using text editing software.

Older .tcf configurations can be loaded into **Tekron's** Configuration Software, but not edited and saved in the original format. They can however be saved as .xml configuration files.

Note: If you are trying to load a .cfg file, it is recommended that you use Tekron's Configuration Software version 3.x.y.z to convert from .cfg to .tcf format, and then load the file into this software version.

Tekron has checked backwards compatibility with as many Ethernet configurable older generation products as practicable, which used older .tcf file formats. We cannot guarantee that the conversion will be 100% accurate, and advise you to verify the settings are correct, before loading the settings into a clock or saving for future use.

9. Creating and Editing **Configuration files in "Offline" mode**

Tekron's Configuration Software has provision to create and edit configuration files without being connected to a Clock.

Creating a Clock configuration file
Click the "Offline" button in the discovery window.

Select the Clock type from the tree directory and subsequent branches. Refer to Figure 78.
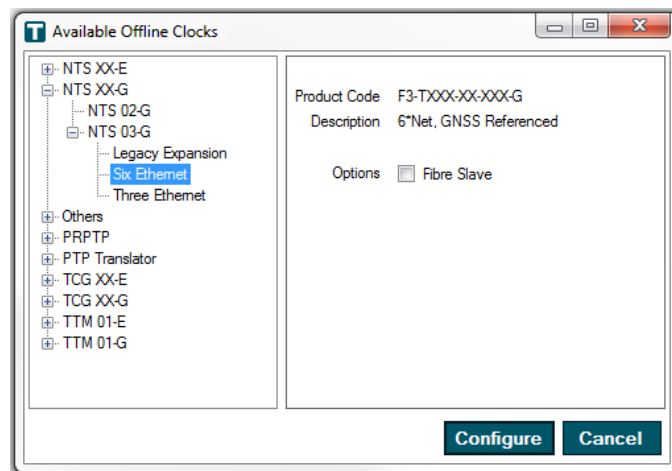
Figure 78 - "Available Offline Clocks" window

Select the desired **Clock and click the "Configure" button. A ne**w window will open and the default configuration settings will be set-up. Edit the clock settings as described in section 7. The configuration file may be saved for later uploading to a connected clock.

Opening a stored configuration file
To open a stored setting file, without the clock being connected, first select offline mode and choose the correct clock type that the file was created for. Then use the Load button as described in section 7.1 to load the stored configuration file.

10. Recommended Commissioning procedure

When commissioning a GPS/GNSS clock, it is recommended that once the antenna system is installed and the clock has been configured with the required settings, the Satellite Statistics should be logged for 12 hours to confirm the suitability of the antenna position.

Method: Once connected to the Clock, navigate to the GPS/GNSS Tab, select the Statistics radio button, and click the Schedule button. Schedule logging to last for a duration of 12 hours, as described in the **"Control" section** of this manual under Section 7.8.3.

After the 12-hour period has concluded, analyze the satellite map for GPS/GNSS blind spots. In the Southern hemisphere, a blind spot due south will be observed as the GPS and GLONASS constellations do not pass over the South Pole (Vice versa is also true for locations in the Northern Hemisphere). Below are two examples of antenna installations. Figure 79 shows a Good antenna installation. Figure 80 shows a poor installation where an obstruction is blocking the view to the East.

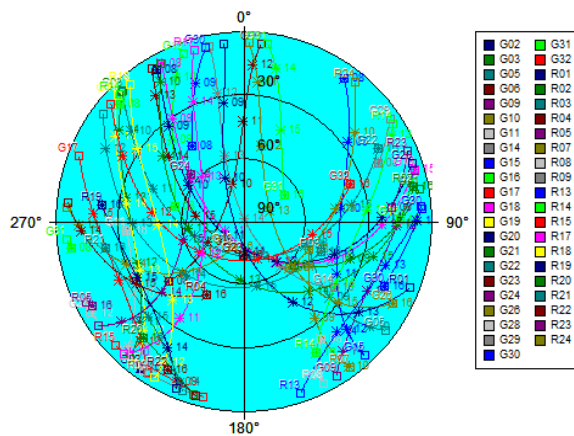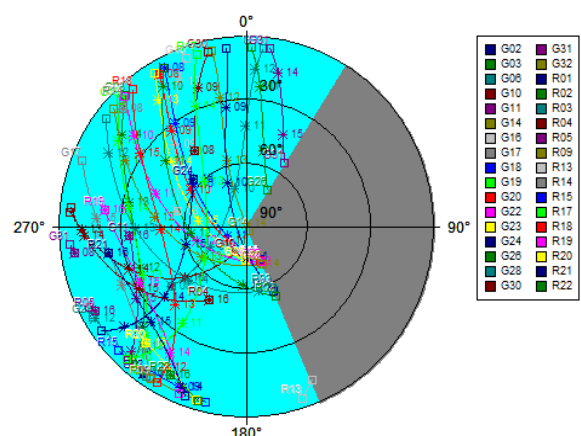Figure 79 - Example A

Figure 80 - Example B

Once 12 hours of logging has been completed, click the "Print Clock Configuration" button to print out a summary of the configuration settings and the GPS/ GNSS Statistics over the 12-hour logging interval.

11. Connecting to a clock via a WAN

Tekron Clocks that have already been configured with the appropriate IP Address, Netmask and Gateway settings support remote configuration over one or more network routers (WAN). The user can communicate with the target clock **by clicking the "Add" button i**n the clock list, or by right clicking in the clock list section **and clicking "Add" from the** drop-down list (refer to Figure 81) , **and then entering the Clock's** IP address in the IP Address Window (refer to Figure 82). The availability of the remote configuration feature over a WAN is dependent on the WAN configuration. It is likely that port forwarding and/or firewall exceptions will be required (refer to section 4 for port numbers). Refer to your Network Administrator if you are unsure.

Once connected to the target clock, follow the instructions in section 7.

Figure 81 - Add Clock

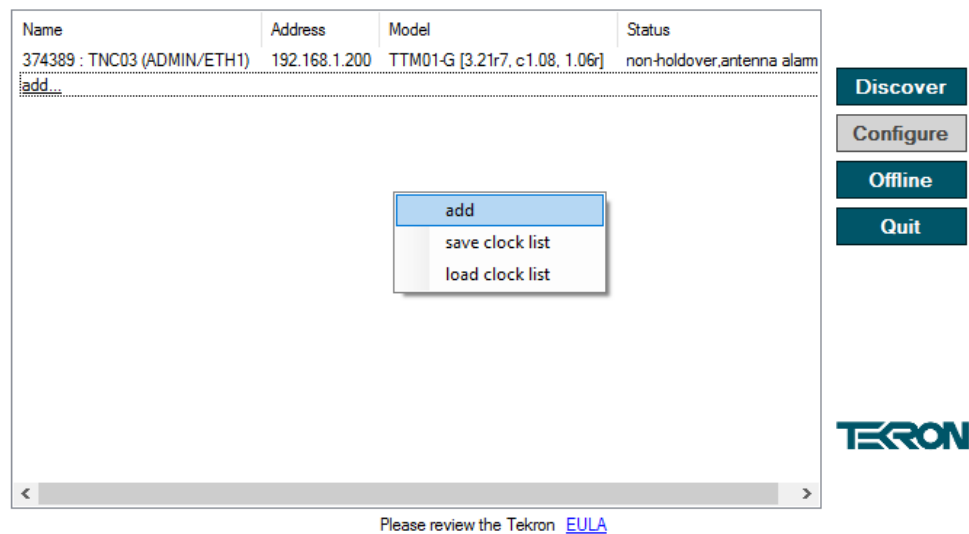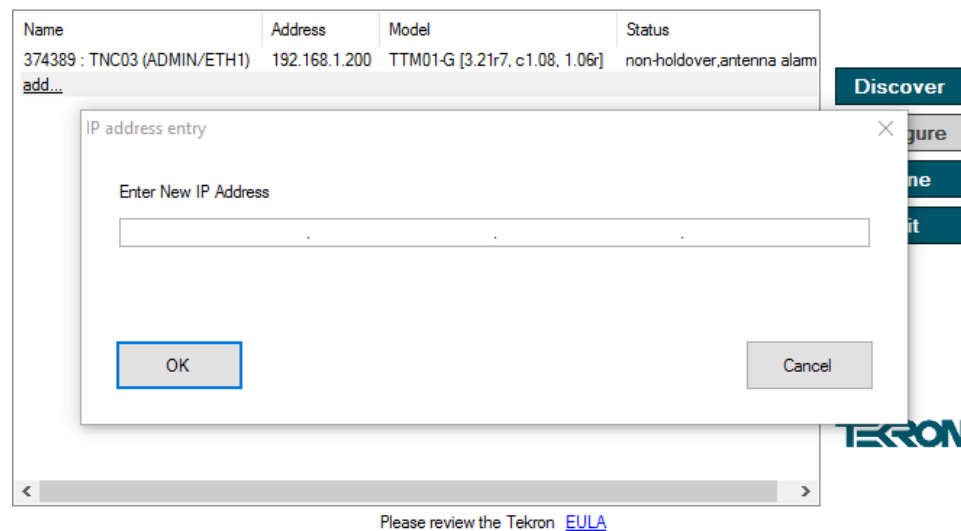Figure 82 - IP Address Window

12. Remote Management

As an administrator, you may wish to access all Clocks remotely via a WAN to obtain real-time information on their status. To facilitate this without manually having to enter in the IP Address of the Clocks each time, the software **provides functionality to save Clocks to a list in .txt format. The file can then be loaded using the "load clock list"**

function. It can also be edited using the "add" and "remove" options, and then the list can be re-saved (Refer to Figure 83).

Note that when loading a saved clock list, the IP address of a clock may have since been changed by a third party who has access to the clock. In this case, the configuration software will be unable to contact that clock.
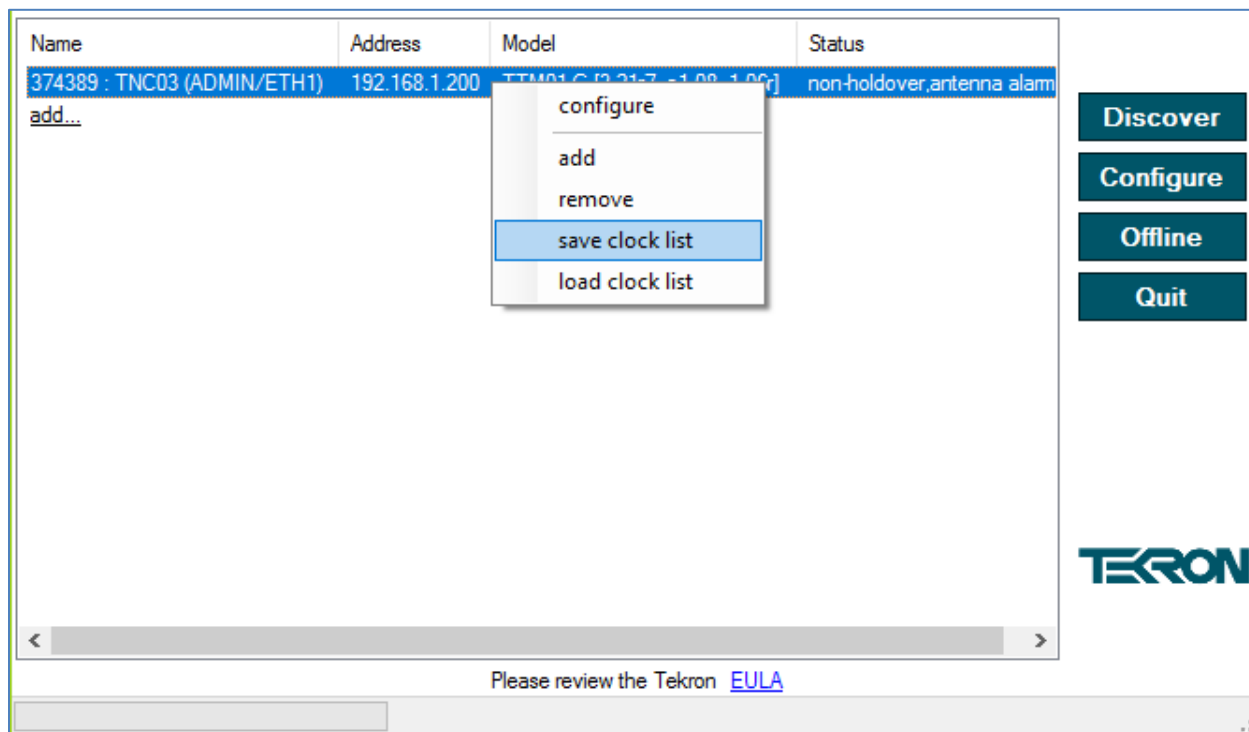
Figure 83 - Clock List Options

Automatically loading a clock list

The configuration software supports a command line option that allows a specified saved clock list to be automatically loaded when launching the configuration tool. Appending the file name of a saved clock list to the command used to launch the configuration tool will cause that list to be loaded automatically.

It is possible to create a shortcut that will automatically load a saved clock list. Create a shortcut to the configuration software executable and add a space, then the file name of the saved clock list to the end of the Target of the shortcut. Refer to Figure 84 for an example.

Figure 84 - Clock List Shortcut Example

13. Glossary

This manual contains commonly used abbreviations (acronyms and initialisms) which are used industry wide. Below is a list of the abbreviations used, their meanings and corresponding definitions.

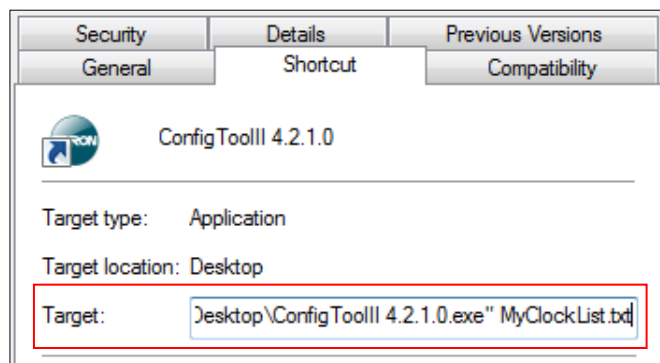|	
ARP	Address Resolution Protocol
BMC	Best Master Clock
BMCA	Best Master Clock Algorithm
Clock	A Tekron Ethernet configurable clock
DCF-77	D (Deutschland)
	C (signifies long range transmitter)
	F (location identifier)
	77 (carrier frequency)
	Follows the ITU Article 19 of Radio Regulations, "Identification of Stations"
DCLS	Direct Current Level Shift
DNS	Domain Name System
GLONASS	GLObal NAvigation Satellite System
	(Operated by the Russian Aerospace Defence Forces)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
	(Operated by the US Department of Defence)
HSR	High-availability Seamless Redundancy
IED	Intelligent Electronic Device
IP	Internet Protocol
IRIG-B	Inter Range Instrumentation Group
	IRIG STANDARD 200-04 time code format B
LAN	Local Area Network
LDT	Local Daylight Time
LST	Local Standard Time
MAC Address	Media Access Control Address
NAVSTAR	NAVigation System using Timing And Ranging
NMEA	National Marine Electronics Association
NTP	Network Time Protocol
PRP	Parallel Redundancy Protocol
PTP	Precision Time Protocol
SFP	Small Form-factor Pluggable
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
TAI	International Atomic Time
UDP	User Datagram Protocol
USB	Universal Serial Bus
USM	User-based Security Model
UTC	Coordinated Universal Time
VLAN	Virtual Local Area Network
WAN	Wide Area Network
XML	Extensible Markup Language

Appendix

A. Troubleshooting

Failed to Discover or connect to Clock

Retry Discover
If the clock is connected to the local subnet, then try the Discover button again. Any Clocks that were not found during the first discovery attempt will be added to the list.

Clock Add
If the clock is connected via a WAN, then click on 'Add…' and enter the IP address of the Clock.

Check Network settings
If the clock is on the same subnet as your PC, you will need to check that the clock and PC have the same netmask and appropriate IP addresses. For example, if your PC has IP address 192.168.1.1 and netmask 255.255.255.0 then the clock should be given an IP address in the range 192.168.1.2 to 192.168.1.254 and the netmask 255.255.255.0. Use the PC "ping" feature to see if a connection can be made to the clock, or if IP address conflicts exist. If the Clock features a front panel LCD, it may be capable of displaying the current IP address when the front panel button is pressed, depending on firmware version.

Check Firewall settings
Your PC firewall or Antivirus software may be blocking the Tekron Configuration Software. To allow the software to communicate through your firewalls, you will need to make Tekron's Configuration Software an exception in the Firewall Settings. Refer to your Network Administrator if you are unsure. Refer to Appendix B for a guide to creating an exception in Windows Firewall.

Check for other Third Party Communications Software
In some cases, third party communications software installed for remote connectivity to a corporate Network via a WAN can inhibit Tekron's Configuration Software from binding to the host's Ethernet port. Consult your Network Administrator if you feel this may be an issue.

Check the settings on all switches and routers on the WAN and/or LAN
Some network devices will block, in either one direction or both directions, the UDP ports which Tekron's Configuration Software uses to communicate. Check your settings on all switches and routers to ensure they are not blocking communication. Consult your Network Administrator if you are unsure.

Clock IP Address may have been changed
If you have loaded a copy of a clock list from a local file, check that the Clock's network settings have not been changed by a third party who has access to the clock. Connect to the same LAN as the clock and run Tekron's Configuration Software and click the "Discover" button to find the Clock.

Check your Network Cabling
Check that the link (lnk) LED is illuminated on the Clock and intermediary network devices. If the lnk LED is not illuminated on the clock, ensure that the cable is plugged in properly, and that is the correct type. Older Clocks may require an Ethernet Crossover cable if you are directly connected.

Clock will not store changes

It is sometimes possible for Tekron's Configuration Software to connect to a clock on a network despite having incorrect network settings configured in the Clock or the Host PC. However; in these circumstances, connectivity is often intermittent causing issues storing configuration changes. The most effective way to resolve this is to correct the network configuration issues.

If the Clock has incorrect network settings, try configuring via direct connection and changing the network adaptor settings for the host to the appropriate settings to match the Clock's subnet settings. Once you have a successful connection; change the Clock's Network settings to match the network it is being installed in and revert the host's network adaptor settings to its original configuration.

Cannot see features described in this manual

If a clock is configured in "Secure Mode", administrators can configure individual Groups with various levels of access to control what Users who belong to the Group can view and edit. If you cannot see features described in this manual, it is either because they are unsupported on the Clock that you are connected to, or you do not have sufficient administrative rights. In this case, verify that the feature should be supported and contact your Clock administrator. If you still cannot resolve the issue, contact your local Tekron Partner for assistance.

Not all clocks feature all screens/options shown in this manual, or may not be licenced for that feature. 'Online' information will not be available if using the Tekron Configuration Tool 'offline'.

Features available in earlier versions of Tekron's Configuration Software are not available in this version

Due to substantial changes in technology, some of the older features may not be configurable using the latest Tekron Configuration Software version. It is recommended that you revert to an earlier version to use these features. These features may be added in a later version as the Tekron Configuration Software is constantly being developed and improved.

Clock has an unexpected IP address

If the Clock is configured for DHCP, and it does not receive a response from a DHCP server on the network, it will revert to a link local address (169.254.xxx.xxx). Check that there is a working DHCP server on the same subnet as the Clock, or alternately configure the Clock to use a static IP address.

If a DHCP server is present but obtaining an address via DHCP is unreliable, increasing the number of DHCP retries may help. Refer to section 7.4.3.

Clock has no IP address

Clock Ethernet ports that have no link will indicate an IP address of 0.0.0.0. Check that the Ethernet cable is plugged in properly, and that the link LED is illuminated.

If the Clock is a legacy clock configured to use DHCP, and it does not receive a response from a DHCP server on the network, it may revert to an IP address of 0.0.0.0. In this case, the Clock will need to be connected to a network with a working DHCP server in order to configure it.

B. Creating a firewall exception for the Tekron Configuration Software

Firewall software running on your PC can block the Configuration Software from communicating with your network, causing it to be unable to discover or connect to Clocks. To resolve the problem, the Configuration Software must be allowed access through the firewall by adding a firewall exception.

The following procedure outlines how to create a firewall exception in Windows Firewall on Windows 7. The following procedure is provided as a guide only, as the required steps may differ from those described here, depending on your version of Windows.

If your PC is a member of a domain, your Network Administrator may have restricted access to Windows Firewall settings. Refer to your Network Administrator if you are unsure.

If your PC is running third-party firewall software, please refer to the documentation provided by the vendor of that software. Refer to section 4: "Dependencies", if port numbers are required to create a firewall exception.

Procedure:
1. Go to Windows Firewall settings. This can be done by clicking the Start button, then click "Control Panel", then click "Windows Firewall". If the "Windows Firewall" option is not visible, first click "System and Security".
2. In the left sidebar, click the "Allow a program or feature through Windows Firewall" link. Refer to Figure 85.
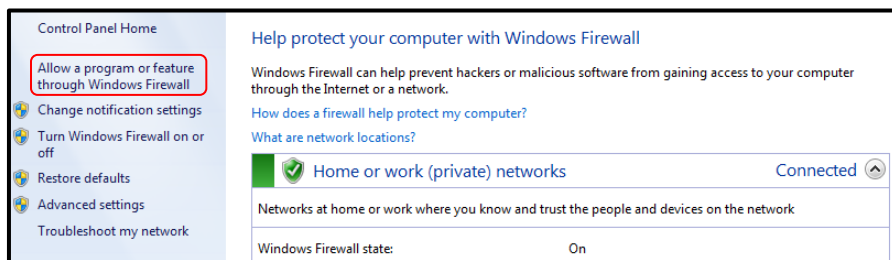

Figure 85 - Allowing a program through Windows Firewall

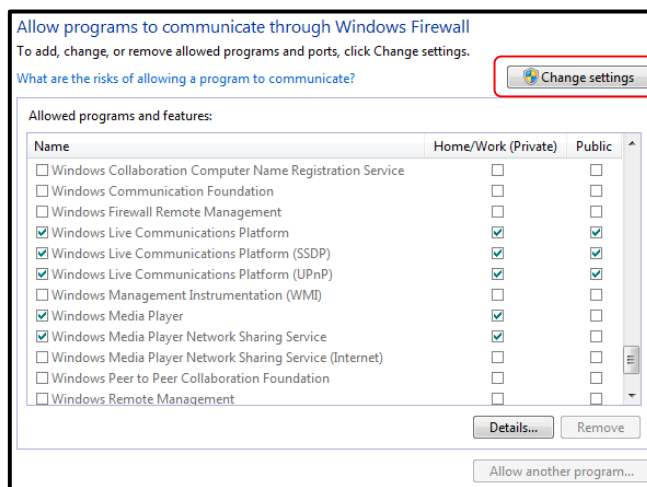3. Click the "Change settings" button. Refer to Figure 86.

Figure 86 - Enabling firewall settings changes

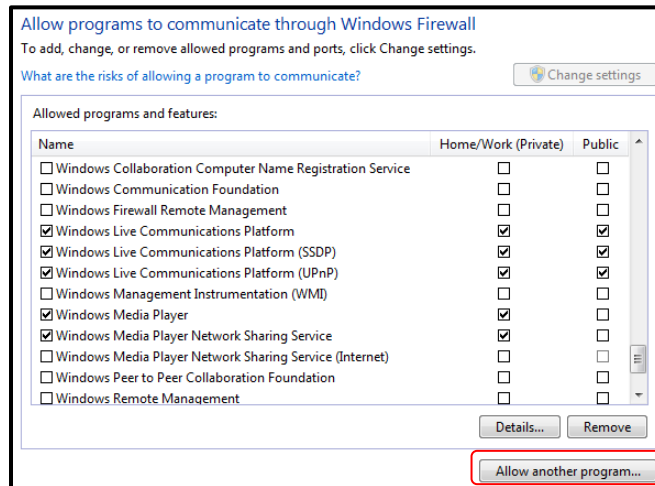4. Click the "Allow another program..." button. Refer to Figure 87.

Figure 87 - Adding another program to allowed list

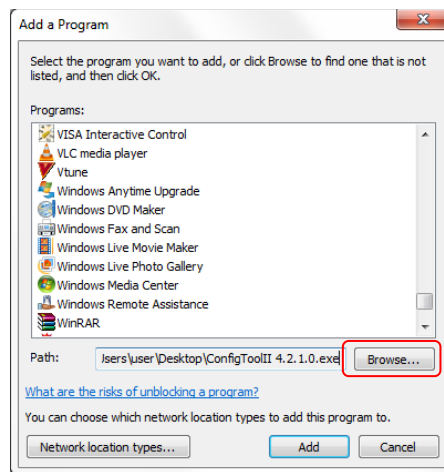5. Click the "Browse..." button. Refer to Figure 88.

Figure 88 - Browsing for executable to add

6. Browse to the location of the Configuration Tool executable, select it, and click the "Open" button.

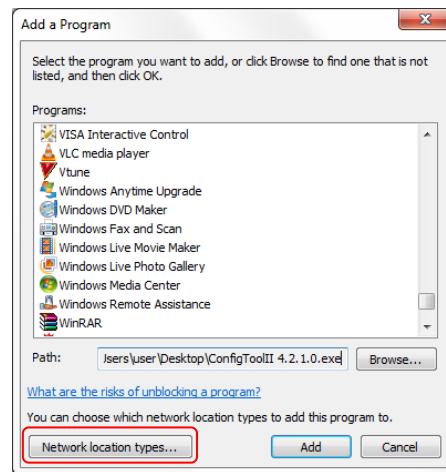7. **Click the "Network location types..."** button. Refer to Figure 89.

Figure 89 - Choose network location types

8. Check all checkboxes next to the Domain (if present), Home/Work, and Public network locations, and click the "OK" button.
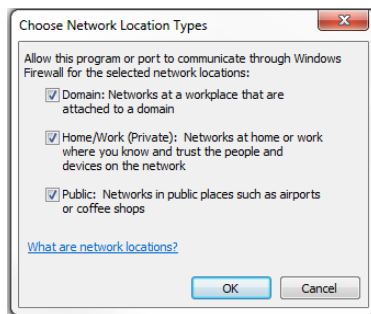

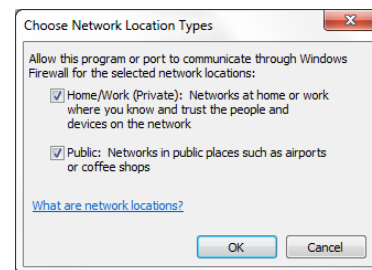Figure 91 - Selecting network location types (non-domain network)

Figure 90 - Selecting network location types (domain network)

This is necessary to ensure that the Configuration Software can communicate with a directly connected Clock. Windows will be unable to determine the network type when connected directly to a Clock, and so will use the "Public" network type by default.

9. Click the **"Add" button. "Tekron Clock Config II"** should now appear in the allowed programs list. Refer to Figure 92.
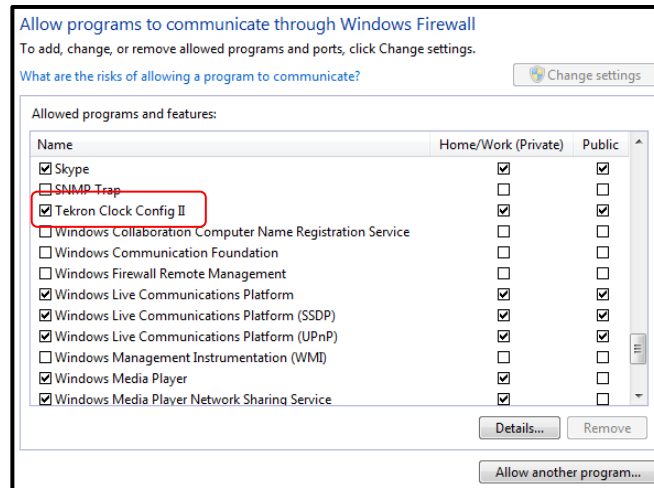

Figure 92 - Configuration software added to allowed programs list

10. **Click the "OK" button.**
11. Close the Windows Firewall settings window.

The Configuration Software should now be allowed through the firewall and able to connect to Clocks.

C. Serial String Formats

NGTS Time Code

About	Normally used in conjunction with 10 ms pulse on P4 pin 1 that finishes precisely on the minute.
Timing	Transmitted once per minute. Sent during the last second before the minute rollover to which the data in the string refers.
Recommended Settings	9600bps, 8-bit ASCII, no parity
Definition	TyyMMDDwhhmmx<CR><LF>

Placeholder	Content
T	"T"
yy	Last two digits of the year: e.g. "12" = the year 2012
MM	Month: "00" = January … "12" = December
DD	Day of Month: 01…31
w	Day of week: "1"=Monday … "7"=Sunday
hh	Two digit hour
mm	Two digit minute
x	Time mode: "0" = Local time, "1" = UTC time
<CR>	Carriage Return: HEX 0D
<LF>	Line Feed: HEX 0A

Example	Interpretation
T020422112340<CR><LF>	Monday 22 April 2002 – 12:34 local time

IRIG J-17 Time Code

About	This code is compatible with IRIG Standard 212-00.
Timing	Transmitted once every second. The leading edge of the "start" bit of the first character <SOH> is exactly on the second that the message describes.
Recommended Settings	9600bps, 7-bit ASCII, odd parity
Definition	<SOH>ddd:hh:mm:ss<CR><LF>

Placeholder	Content
<SOH>	HEX 01
ddd	Day of year: range "001" – "366"
:	HEX 3A
hh	hour: "00" – "23"
mm	minute: "00" – "2
ss	Seconds: "00" – "59"
<CR>	HEX 0D
<LF>	HEX 0A

Example	Interpretation
<SOH>112:12:34:36<CR><LF>	day 112, time 12:34:36

String-A Time Code

About	This code is very similar in data content to the IRIG J-17 code, but adds a two-character field containing the year, and uses 8-bit ASCII, no parity data format.
Timing	**Transmitted once every second. The leading edge of the "start" bit of the first character <SOH> is exactly on the second that the message describes.**
Recommended Settings	9600bps, 8-bit ASCII, no parity
Definition	<SOH>ddd:hh:mm:ss:yy<CR><LF>

Placeholder	Content
<SOH>	HEX 01
ddd	**Day of Year: range "001" – "366"**
:	HEX 3A
hh	**hour: "00" – "23"**
mm	**minute: "00" – "59"**
ss	**seconds: "00" – "59"**
yy	**year: "00" – "99" representing the last two digits of the year**
<CR>	HEX 0D
<LF>	HEX 0A

Example	Interpretation
<SOH>112:12:34:36:10<CR><LF>	day 112, time 12:34:36, year (20)10

String-B Time Code

About	This code substitutes a "Quality" indicator byte for the year field, but otherwise is identical in form, function and timing to String-A.
Timing	Transmitted once every second. The leading edge of the "start" bit of the first character <SOH> is exactly on the second that the message describes.
Recommended Settings	9600bps, 8-bit ASCII, no parity
Definition	<SOH> DDD:hh:mm:ssQ<CR><LF>

Placeholder	Content		
<SOH>	HEX 01		
ddd	Day of Year: range "001" – "366"		
:	HEX 3A		
hh	hour: "00" – "23"		
mm	minute: "00" – "59"		
ss	seconds: "00" – "59"		
Q	Character		Meaning
	HEX	ASCII	
	20	' ' (space)	Clock in sync, timing accuracy is better than 60 ns
	2E	'.' (full stop)	Clock is accurate to 1 μs
	2A	'*'	Clock is accurate to 10 μs
	23	'#'	Clock is accurate to 100 μs
	3F	'?'	Clock accuracy may be worse than 100 μs
<CR>	HEX 0D		
<LF>	HEX 0A		

Example	Interpretation
<SOH>112:12:34:36?<CR><LF>	day 112, time: 12:34:36, >100 μs sync error

String-C Time Code

About	This code is effectively a combination of String-A and String B. It provides both year information and a sync indicator field.
Timing	**Transmitted once every second. The leading edge of the "start" bit of the first** character, <CR>, is exactly on the second to which the message data refers.
Recommended Settings	9600bps, 8-bit ASCII, no parity
Definition	<CR><LF>Q yy ddd hh:mm:ss.000

Placeholder	Content
<CR><LF>	HEX 0D,0A
Q	**Quality indicator: " " = in-sync, "?" = out**-of-sync
(space)	HEX 20
yy	**Year: "00" – "99" representing the last two digits of the year**
(space)	HEX 20 (space)
ddd	**Day of year: range "001" – "366"**
(space)	HEX 20 (space)
hh	**hour: "00" – "23"**
mm	**minute: "00" – "59"**
Ss	**seconds: "00" – "59"**
.000	**ASCII ".000"**
(space)	HEX 20 (space)
(space)	HEX 20 (space)
(space)	HEX 20 (space)

Example	Interpretation
<CR><LF>? 02 112 12:34:36.000	day 112 of year (20)02, time: 12:34:36, out-of-sync

String-D Time Code

About	String-D is IDENTICAL in content to String-B, but the second mark is at the leading edge of the start-bit of the (<CR>).
Timing	**Transmitted once every second. The leading edge of the "start" bit of the first** character, <CR>, is exactly on the second to which the message data refers.
Recommended Settings	9600bps, 8-bit ASCII, no parity
Definition	<SOH> DDD:hh:mm:ssQ<CR><LF>

Placeholder	Content		
<SOH>	HEX 01		
ddd	**Day of Year: range "001" – "366"**		
:	HEX 3A		
hh	**hour: "00" – "23"**		
mm	**minute: "00" – "59"**		
ss	**seconds: "00" – "59"**		
Q	Character		Meaning
	HEX	ASCII	
	20	' ' (space)	Clock in sync, timing accuracy is better than 60 ns
	2E	'.' (full stop)	Clock is accurate to 1 μs
	2A	'*'	Clock is accurate to 10 μs
	23	'#'	Clock is accurate to 100 μs
	3F	'?'	Clock accuracy may be worse than 100 μs
<CR>	HEX 0D		
<LF>	HEX 0A		

Example	Interpretation
<SOH>112:12:34:36?<CR><LF>	day 112, time: 12:34:36, >100 μs sync error

String-E Time Code

About	This provides time, year information, and a sync indicator field.
Timing	The string is transmitted once every second, with the leading edge of the **"start" bit** of the <CR> exactly on the second.
Recommended Settings	9600bps, 8-bit ASCII, no parity
Definition	<SOH>YYYY:ddd:hh:mm:ssQ<CR><LF>

Placeholder	Content
<SOH>	HEX 01
YYYY	4-digit year
:	HEX 3A
ddd	**Day of year: range "001" – "365"**
hh	**hour: "00" – "23"**
mm	**minute: "00" – "59"**
ss	**seconds: "00" – "59"**
Q	Quality character, as defined in String-B (above)
<CR>	HEX 0D
<LF>	HEX 0A

Example	Interpretation
<SOH>2004:112:12:34:36?<CR><LF>	2004, day 112, 12:34:36pm, >100us sync error

String-F Time Code

About	This string complies with the protocol required to drive Vorne type Time Displays.
Timing	The string is transmitted once every second, with the **leading edge of the "start" bit** of the last <BEL> exactly on the second.
Recommended Settings	9600bps, 8-bit ASCII, no parity
Definition	<CR><LF>
	1100<CR><LF>
	44hhmmss<CR><LF>
	54ddd<CR><LF>
	45HHMMss<CR><LF>
	55DDD<CR><LF><BEL>

Placeholder	Content
<CR>	HEX 0D
<LF>	HEX 0A
1100	ASCII "1100"
44	ASCII "44" (means local time follows)
hh	Local hour of day: "00" – "23"
mm	Local minute of day: "00" – "60"
ss	seconds: "00" – "59"
54	ASCII "54" (means local day of year follows)
ddd	Local day of year: "001" – "365"
45	ASCII "45" (means UTC time follows)
HH	UTC hour: "00" – "23"
MM	UTC minute: "00" – "59"
55	ASCII "55" (means UTC day of year follows)
DDD	UTC Day of year: "001" – "365"
<BEL>	HEX 07
<CR>	HEX 0D
<LF>	HEX 0A

String-G Time Code

About	This general time string is used predominantly in Europe.
Timing	**The string is transmitted once every second, with the leading edge of the "start" bit of the last <ETX> exactly on the second.**
Recommended Settings	9600bps, 8-bit ASCII, no parity
Definition	<STX>swhhmmssddMMyy<LF><CR> <ETX>

Placeholder	Content
<STX>	HEX 02
s	**The s "Clock Status" is an ASCII character in the range 0-9, A-F representing a single** hex digit. To interpret the value, the Hex digit should be converted to a Nibble (half a byte) and referenced against the state chart below which contains the bit position **and subsequent definition ("x" is a place holder).**

Bit 3	Bit 2	Bit 1	Bit 0	Definition
x	x	x	0	No announcement for time change
x	x	x	1	Announcement for time change – active for an hour before
x	x	0	x	Local Standard Time (LST)
x	x	1	x	Daylight Saving Time (DST)
0	0	x	x	Time/date invalid – clock is out of sync
0	1	x	x	Hold-over mode – running on local Oscillator
1	0	x	x	GNSS / IRIGB controlled mode
1	1	x	x	GNSS / IRIGB controlled mode (high accuracy)

Placeholder	Content
w	**The w "Day of Week" is an ASCII character in the range 0-9, A-F representing a** single hex digit. To interpret the value, the Hex digit should be converted to a Nibble (half a byte) and referenced against the state chart below which contains the bit **position and subsequent definition ("x" is a place holder).**

Bit 3	Bit 2	Bit 1	Bit 0	Definition
1	x	x	x	UTC time
X	0	0	1	Monday
X	0	1	0	Tuesday
X	0	1	1	Wednesday
X	1	0	0	Thursday
X	1	0	1	Friday
X	1	1	0	Saturday
X	1	1	1	Sunday

Placeholder	Content
hh	hour of day: "00" – "23"
mm	minute of day: "00" – "60"
ss	seconds: "00" – "59"
dd	day of month: "01" – "31"
MM	month of year: "01" – "12"
yy	year: "10" – "99"
<LF>	HEX 0A
<CR>	HEX 0D
<ETX>	HEX 03

Example	Interpretation
<STX>E3123456170410<LF><CR><ETX>	High Accuracy Mode, DST, Wed, 12:34:56, 17/4/2010

String-H Time Code

About

Timing	Transmitted once every second. **The leading edge of the "start"** bit of the first character <STX> is exactly on the second that the message describes.
Recommended Settings	9600bps, 8-bit ASCII, no parity
Definition	<STX>D:dd.MM.yy;T:w;U:hh.mm.ss;uvxy<ETX>

Placeholder	Content
<STX>	HEX 02
D	ASCII "D"
:	HEX 3A
dd	day of month: "01" – "31"
.	HEX 2E
MM	month of year: "01" – "12"
yy	year: "10" – "99"
;	HEX 3B
T	ASCII "T"
w	day of week: "1" – "7", "1" = Monday
U	ASCII "U"
hh	hour: "00" – "23"
mm	minute: "00" – "59"
ss	seconds: "00" – "59"
u	ASCII "#" if out of sync or space (HEX 20) if in sync
v	ASCII "*" if out of sync or space (HEX 20) if in sync
x	ASCII "U" if UTC time, ASCII "S" if DST, or space (HEX 20) if standard time
y	ASCII "!" if DST change pending, ASCII "A" if leap second pending, space (HEX 20) otherwise
<ETX>	HEX 03

Example	Interpretation
<STX>D:17.04.10;T:6;U:12:34:56;#*S!<ETX>	17/4/2010, Sat, 12:34:56, out of sync, DST, DST change pending

NMEA ZDA Time Code

About	This string is in accordance with the NMEA-0183 standard in content, but is transmitted at 9600bps.
Timing	**Transmission is once every second. The leading edge of the "start" bit of the "$" is exactly on the second.**
Recommended Settings	9600bps, 8-bit ASCII, no parity
Definition	$GPZDA,hhmmss.00,dd,mm,yyyy,s,xx,yy*CC<CR><LF>

Placeholder	Content
$GPZDA	ASCII "$GPZDA"
,	ASCII "," (comma)
hh	**UTC hour of day: "00" – "23"**
mm	**UTC minute of day: "00" – "60"**
ss	**UTC Seconds: "00" – "59"**
.00	**ASCII ".00"**
dd	**UTC day of month: "01" – "31" depending on which month**
mm	**UTC month: "01" – "12", "01" =** January
yyyy	UTC year, 4 digits.
s	Local time zone offset sign (positive means local time leads UTC)
xx	Local time zone offset from UTC in hours
yy	Local time zone offset from UTC in minutes
*	**ASCII "*"**
CC	2-digit hex representation of the result of XORing the 8 data bits of each character between, but not including the "$" and "*". (00-FF)
<CR>	HEX 0D
<LF>	HEX 0A

Example	Interpretation
$GPZDA,123456.0023042010+1200*	UTC time is 12:34:56, 23 April 2010, the local time offset is +12:00

NMEA RMC Time Code

About	This string is compatible with and defined by the NMEA-0183 standard.
Timing	**Transmission is once every second. The leading edge of the "start" bit of the "$" is exactly on the second.**
Recommended Settings	9600bps, 8-bit ASCII, no parity
Definition	$GPRMC,hhmmss.00,a,tttt.tttt,N,ggggg.gggg,W,0.0,0.0,DDMMYY,0.0,E *CC<CR><LF>

Placeholder	Content
$GPRMC	**ASCII "$GPRMC"**
,	**ASCII "," (comma)**
hhmmss	UTC hour of day, minute of day, seconds
.	**ASCII "." (full stop)**
0	**ASCII "0"**
a	**Status: "A" = valid, "V" = invalid**
tttt.tttt	**Latitude (degrees, minutes): "0000.0000" – "8959.9999"**
N	**Latitude (north/south): "N" = north, "S" = south**
ggggg.gggg	**Longitude (degrees, minutes): "00000.0000" – "35959.9999"**
W	**Longitude (east/west): "E" = east, "W" = west**
ddmmyy	UTC day of month, month, 2-digit year:
E*	**ASCII "E*"**
CC	2-digit hex representation of the result of XORing the 8 data bits of each character between, but not including, the "$" and "*".
<CR>	HEX 0D
<LF>	HEX 0A

NOTES

The information in this manual may change without notice. The manufacturer assumes no responsibility for any errors that may appear in this manual.

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