NovaTech®

Kronos Series 2

User Manual

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Data classification: Public use

Any repairs should be performed by NovaTech.

Disclaimer

This manual contains information that is correct to the best of NovaTech's knowledge. It is intended to be a guide and should be used as such. It should not be considered a sole source of technical instruction, replacing good technical judgment, since all possible situations cannot be anticipated. If there are any questions as to the installation, configuration, or use of this product, contact NovaTech, LLC at (913) 451-1880.

To ensure that the equipment described in this User Manual, as well as all equipment connected to and used with it, operates in a satisfactory and safe manner, all applicable local and national codes that apply to installing and operating the equipment must be followed. Since these codes can vary geographically and can change with time, it is the user's responsibility to determine which codes and standards apply, and to comply with them.

Failure to follow the instructions provided in this manual, and/or failure to comply with applicable codes and safety standards can result in damage to this equipment, damage to connected devices, and/or serious injury to personnel.

The Kronos Series 2 is not designed nor approved for installation or operation in nuclear facilities.

All links to external websites have been verified as correct and appropriate at the time of the publication of this document. However, these links and websites, being outside of NovaTech LLC's control, are subject to change by their respective owners and may no longer be correct. In this case, please contact support@novatechautomation.com.

The documentation for the Kronos products is structured as follows.

Manual name (see cover page of each manual)	**Purpose**
Quick Start Guide	Describes out-of-the-box setup for quick installation.
User Manuals ▪ Kronos Series 2 ▪ Kronos Series 3	• Description of Kronos hardware and hardware options. • List of software options.

Styles and Symbols

In this document, fonts, text styles and symbols are used to distinguish standard text from keyboard input, program text, GUI messages, and hyperlinks as follows. Warnings and safety notices are indicated with ANSI symbols.

Displayed text or symbol	Description
This is normal text.	Standard text.
See Access Passwords (Online)	Hyperlink to text in same document.
www.novatechautomation.com	Hyperlink to website.
support@novatechautomation.com	Clicking this link starts email client on the PC.
See *Kronos Series 2 User Manual*	Document name.
`Minimum value`	Menu item or text displayed by software.
`Name of the data point`	Text to be entered in input field or window.
Save	GUI button to be clicked.
`if frequency < 60.0 then`	Program code.
<Enter>, <Ctrl>+<G>, <G>	Key to be pressed.
	This yellow triangle indicates a warning that must be observed by the users in order to avoid possible equipment damage or personal injury.
	This yellow triangle indicates an electrical hazard.
	Electrostatic sensitive device requires proper handling and grounding procedures to avoid equipment damage.
	DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
	WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or severe injury.
	CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

Note that depending on the Windows® display settings on the computer running NCD, some of the screen shot details may appear differently than shown in this manual.

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1 Introduction

1.1 Product Description

Kronos Series 2 satellite clocks are specifically developed for applications in protection, automation, and control of power systems.

These clocks provide GNSS-derived synchronization signals in different formats and protocols for use by, among others, protection relays, phasor-measurement units, revenue meters, fault recorders, and fault locators.

Signals can be distributed over a dedicated wiring (coax, twisted pair, fiber optic) and NTP/SNTP.

A bright dot matrix display on the front of the Kronos clock provides feedback to substation personnel and allows for easy checking of correct configuration of time zones and daylight saving times.

The clock can be monitored and configured remotely using a web browser.

The Kronos clocks are available in two chassis versions:
- Kronos Series 2P: Narrow model that supports one expansion card and one power supply.
- Kronos Series 2R: Model for 19” rack that supports three expansion cards and redundant power supplies.

The part number and serial number are stated on the label on the enclosure of the clock.

The datasheets for each model are available at:

Series 2P	https://www.novatechautomation.com/community/products/kronos-series-2p
Series 2R	https://www.novatechautomation.com/community/products/kronos-series-2r

Table 1: Links to Datasheets

1.2 Firmware Version

The firmware revision is displayed on the unit’s dot matrix display for a few seconds immediately after power up.

2 Installation

2.1 Rear Panel

Due to the modular architecture, Kronos clocks have different rear panels. Refer to your clock's part number and to the information in Appendix A – Options to determine the installed options. The label on the back of the clock shows the particular configuration of the clock and can be used to determine the correct allocation of all connectors and signals.

2.2 Mounting

Kronos clocks have been designed to be mounted in a 19" rack or on a panel. In both cases, the clock should be mounted using four M6x15 screws (not included). If mounting the clock on the front panel of a cabinet, refer to Appendix C – Enclosure Dimensions and Panel Cutouts for the recommended panel cutout.

2.2.1 Clearances

Allow adequate clearance for all connections on the rear panel. Make sure that the clearances provided for the antenna cable respect the specified minimum bending radius. Minimum bending radius depends on the cable used. See cable specifications for details.

Note: If the minimum bending radius of the antenna cable is not observed, its impedance might be altered which may compromise the unit's performance.

2.2.2 Environment

Note: Make sure that temperatures inside the cabinet do not exceed the limits stated in datasheets (see Table 1).

2.3 Power Connections

There are two power supply options available for Series 2 clocks, a wide range and a low voltage option.

Make sure that the voltage provided by the power source is within the limits specified in the datasheets (see Table 1).

All power connections should use 16 AWG (1.5 mm^2) insulated flameproof flexible cables and use the header connector supplied with the clock. To reduce the risk of electrical shock, pre-insulated pin terminals should be used on the ends of the power connections.

If using a clock with redundant power supplies, repeat the above steps for the second power supply.

⚠WARNING

A 16 AWG (1.5mm^2) ground lead shall be connected to the terminal marked with the protective ground symbol to protect the operator against the risk of electrical shock.

2.3.1 Fusing Requirements

⚠WARNING

If compliance with IEC 61010 is required, install an external bipolar circuit breaker or switch near the clock so that both current-carrying conductors of the power supply are interrupted. DO NOT interrupt the protective ground conductor.

The use of a 10A, category C, IEC 60947-2 compliant, bipolar circuit breaker with an interruption capacity of at least 25kA is recommended.

If using a clock with redundant power supplies, use a separate circuit breaker or switch for the wiring of the second power supply.

2.3.2 Grounding

For optimal electromagnetic compatibility, use a grounding wire with at least 10 AWG (6mm^2) cross section to connect the grounding bolt at the rear panel of the clock to a good ground point on the mounting cabinet (Figure 1 and Figure 2).

Figure 1: Series 2P ground bolt location

Figure 2: Series 2R ground bolt location

2.4 Antenna Installation

Clocks require an active antenna in order to track satellites. NovaTech recommends using antennas available from NovaTech, but any other active antenna that can be powered with 3.3V dc and 100mA maximum consumption can be used. Contact NovaTech for further information if you wish to use a different antenna.

2.4.1 Antenna Location

Mount the antenna outdoors, with the radome pointing skywards and with an unobstructed view of the sky. As far as possible, mount the antenna above any surrounding buildings.

Note: A partially obstructed sky view might delay or even prevent the initial satellite fix required to start operation of the clock.

2.4.2 Antenna Mounting

The NovaTech antenna mounts are described in the datasheets (see Table 1).

2.4.3 Antenna Cable

The antenna has to be connected to the clock by using a coaxial cable with male connectors at both ends.

Note: The antenna cable should be routed through a conduit, shielded from rain and/or solar radiation. The conduit should not be shared with any power cabling.

Total cable attenuation should be less than 40dB which can be determined from the cable length and the attenuation per foot.

2.4.4 Surge Arrester

To avoid lightning damages to the clock, a gas discharge surge arrester is included with Kronos and must be installed at the building or cabinet entrance. See also the datasheets in see Table 1.

Note: Mount the surge arrester using a 'L' shaped bracket and ground it using a cable with a cross section of at least 10 AWG (6mm^2). Use the same ground point as the clock to avoid ground-rise-potential damage.

2.5 IRIG-B Cables

Twisted pair and coax cabling for connecting the IEDs to the clock output cards must be wired as follows:

- One main cable.
- Short connections to IEDs.
- Termination resistor at the end. The terminator should match the impedance of the cable being used, which is 50 Ohm for coax, and 100 to 200 Ohm for twisted pair.

See also the following figure for best installation practices.

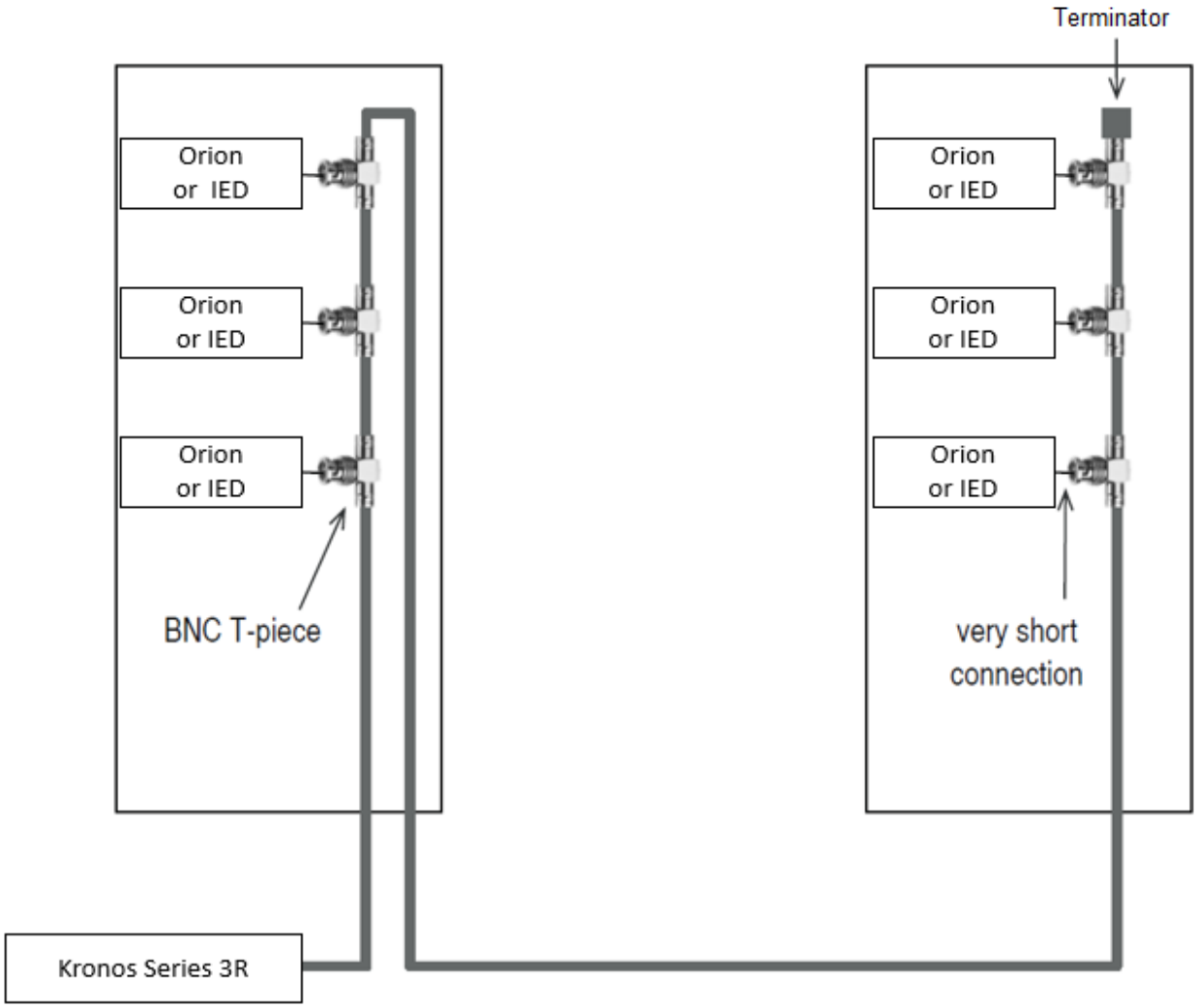


Figure 3: IRIG-B wiring to IEDs

2.6 Initial IP Address

At the initial power up, the IP address of the Ethernet port A is 192.168.0.1 with netmask 255.255.0.0 unless you have specified another IP address and netmask in your order.

The address of port A can be changed in one of two ways in the following two sections.

2.6.1 Change in Network Settings

Point your browser to the above IP address and change the IP address and netmask of port A as required. See sections Network Settings (Online) and Network Settings (Offline) for a detailed description. In these sections, you may also enable or disable the front rotary knob to set the IP address.

2.6.2 Change Using Front Rotary Knob

The address can also be set by pressing the front rotary knob. First, “Change IP: y/n” will be displayed. Then you can proceed to change the address by turning the rotary knob until the desired address class A (10.0…), class B (172.16…), or class C address (192.168…) is displayed. Press the knob to select that address class. Now turn the knob to set the first octet, and press to confirm octet. Then move to next octet. Repeat until all octets are set. Now the IP address is set.

The clock’s webpage is available about 60 seconds after setting the new IP address.

Note: If a wrong IP address has been set, reset the clock to the factory default settings by pressing the reset button on the back of the clock which is labeled “WIPE_CFG”. Press the button until "Wipe cfg y/n” is shown on the display, then confirm by selecting YES and pressing the rotary knob.

2.7 Decommissioning and Disposal

There are no batteries inside of the clocks. Dispose of the clock in a safe, responsible, and environmentally friendly manner, observing all applicable country-specific regulations. Avoid incineration or disposal to water courses.

3 Operation

3.1 Front Panel Indicators

The unit's front panel comprises a dot matrix display and three LED indicators.

3.1.1 Dot Matrix Display

The dot matrix display displays different information, depending on the clock state.

Startup

Immediately after power-up, the display shows the boot progress in percent.

Figure 4: Clock boot – Progress display

When the boot is complete, the firmware version displays for a few seconds.

Figure 5: Clock boot – Version display

At the end of the startup sequence, the clock displays the IPv4 address assigned to port A. This may be:

- The address defined in section **Initial IP Address**, Network Settings (Online), or Network Settings (Offline).
- A self-assigned link-local address in the address block 169.254.0.0/16 (as defined in RFC 3927) if no address is defined in the configuration file.

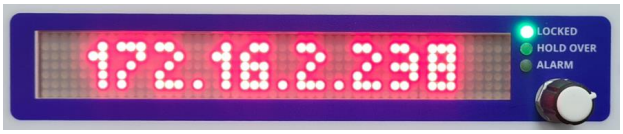


Figure 6: Clock boot – IP address display

The whole startup process takes about 45 seconds.

First Lock

After startup, the dot matrix display displays the number of currently tracked satellites. At least four satellites are needed to obtain a first fix. Additionally almanach and ephemeris data must be downloaded from the satellites and the UTC offset must be determined.

Ephemeris data has to be downloaded from each satellite. This requires several minutes of strong signal from the tracked satellites.

The UTC offset is broadcast only once every 12 minutes, so that additionally up to 12 minutes may pass before first lock is achieved. It may take longer if the sky view is partially obstructed.

Normal Operation

During normal operation the display will show date, time and/or time zone information. Several formats are available. See section Display Settings (Online) or Display Settings (Offline) for details.

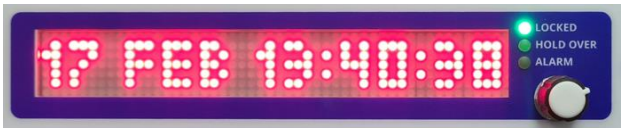


Figure 7: Normal operation

Alarm

If an alarm is detected, the display shows the corresponding alarm message.

3.1.2 Locked Indicator

Blinking green: The clock is searching for satellites for the first satellite fix. Dot matrix display shows number of satellites currently tracked.

Solid green: Time reported by the clock is locked to atomic clocks on board the satellites. Dot matrix display shows local time, date and/or time zone, as configured.

3.1.3 Holdover Indicator

Solid yellow: Time reported by the clock is derived from the internally temperature compensated crystal oscillator. Error estimates are continuously compared to the user defined thresholds.

If the first error threshold is exceeded, the clock will generate a LOW QUALITY alarm but will continue to report and show time.

If the second error threshold is exceeded, the clock will generate a BAD TIME alarm and stop showing and reporting time.

3.2 Power Up Sequence

The power up sequence is shown in Figure 8.

After power is applied to the unit, a brief short test is performed whereby the Alarm indicator lights up for less than a second. Then the firmware version is briefly shown on the dot matrix display, while the Holdover indicator is lit.

After that, the firmware will be loaded. This takes around 30 seconds. During this time a progress bar and a percentage indicator will be shown on the dot matrix display.

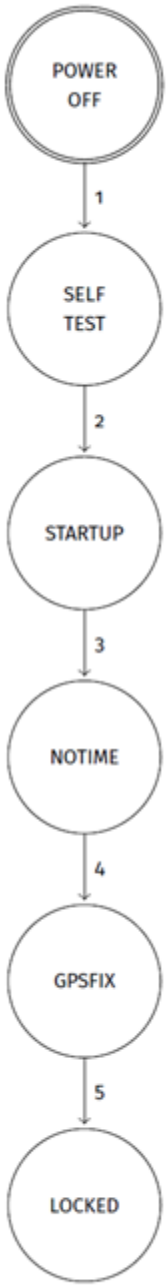
At the end of the firmware load, the IP address assigned to Ethernet port A will be briefly shown on the dot matrix display, but only if a network cable is plugged in.

The clock will now start tracking satellites. During this phase, the number of satellites being tracked is shown on the dot matrix display. At least four satellites are needed to obtain the initial fix. Additionally almanach and ephemeris data must be downloaded from the satellites and the UTC offset must be determined.

Ephemeris data has to be downloaded from each satellite which requires several minutes of strong signal from the tracked satellites.

The UTC offset is broadcast only once every 12 minutes, so that additionally up to 12 minutes may pass before the first lock is achieved. This takes longer if the sky view is partially obstructed.

Once all needed information is obtained and the internal oscillator is adjusted in phase and frequency, the clock will enter the Locked state. Only now will the clock start to display the local time on the dot matrix display and distribute time over the outputs, as configured.



	INDICATORS	DISPLAY	OUTPUTS	ALARM CONTACT
POWER OFF	off	off	none	open
SELF TEST	ALARM blinks once HOLDOVER on	firmware version	none	open
STARTUP	off	progress bar followed by IP address	none	open
NOTIME	LOCKED blinks	number of satellites being tracked	none	open
GPSFIX	LOCKED blinks	number of satellites being tracked	none	open
LOCKED	LOCKED on	local time	as configured	closed

1. power applied
2. self test (2 seconds)
3. firmware load and initialization (approximately 30 seconds)
4. satellites acquired, almanach and ephemeris data downloaded
5. determined UTC offset (up to 12 minutes, longer if antenna poorly located or weak signal)

Figure 8: Power up sequence

3.3 Clock States

After first lock has been achieved (see section Power Up Sequence), the clock will be in one of four states (Figure 9):

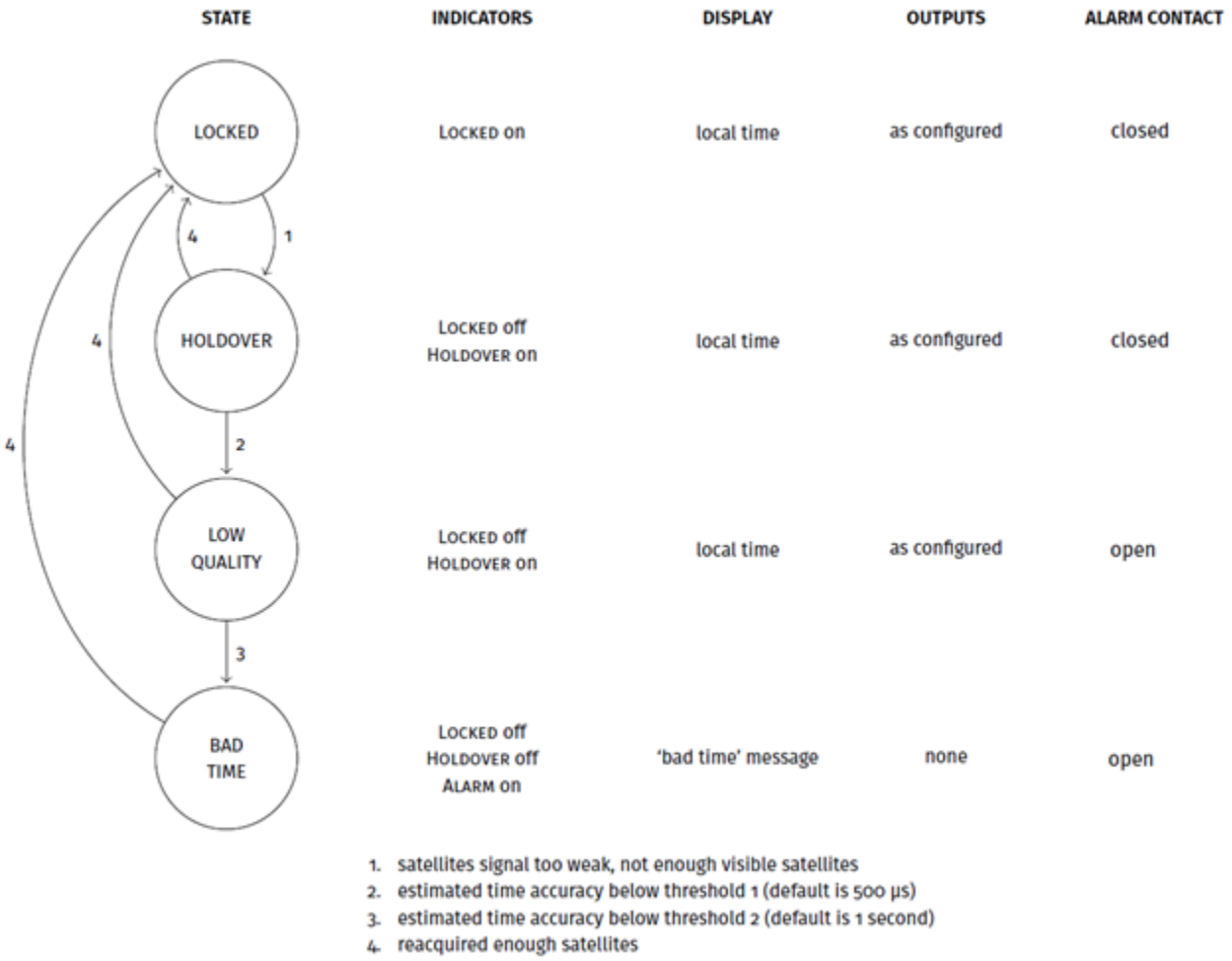


Figure 9: Clock states

Clock State	Description
Locked	Enough satellites are being tracked, the internal oscillator is locked in time, frequency, and phase to the atomic clocks on board the satellites. Calibration factors for the internal oscillator are derived and kept up to date.
Holdover	Not enough satellites can be tracked to compute a solution. Time, frequency, and phase are derived from the internal oscillator. An error estimate is constantly updated and compared against two user-defined thresholds.
Low quality	Time, frequency, and phase are still derived from the internal oscillator. However, the error estimate is greater than the first user-defined threshold value. A level 1 alarm is raised to signal to the user that the first error limit has been exceeded. The default value for this threshold is 500µs. See section GNSS Settings (Online) or Out-of-bound Limits (Offline) for information about how to change this to a different value.

Clock State	Description
Bad time	The error estimate is greater than the second user-defined threshold value. The clock will raise a level 2 error and stop generating time signals. The dot matrix display will show a corresponding message. The default value for this threshold is 1s. See section GNSS Settings (Online) or Out-of-bound Limits (Offline) for information about how to change this to a different value. Normal operation, with time signal generation and display, is resumed as soon as enough satellites are re-acquired and the error estimate drops below the user-defined threshold.

Table 2: Clock states

3.4 Web Interface

The clock provides a web interface with a dashboard showing all relevant information (Figure 11). This is a read-only page. No sensitive information is displayed. The page can be accessed by pointing a web browser to the IP address of the clock. The only requirement is that the browser supports HTML5 and Java script.

If desired, access to this page can be password-protected as described in section Access Passwords (Online) .

The information in the fields `Identifier`, `Location`, and `Contact` is set in General Settings (Online) or in General Settings (Offline).

Clicking on the fields `10 min` and `60 min` next to `NTP clients` lists the NTP clients including their IP addresses which have obtained NTP time from the clock in the last 10 or 60 minutes.

Satellite Color	Description
Green	Satellite is used for time calculation. The size of the circle indicates the signal strength.
Yellow	Satellite is locked but not used for time calculation.
Gray	Satellite is tracked.

Table 3: Satellite visualization

The webpages can be set to light or dark mode by clicking the mode button in the upper right corner.

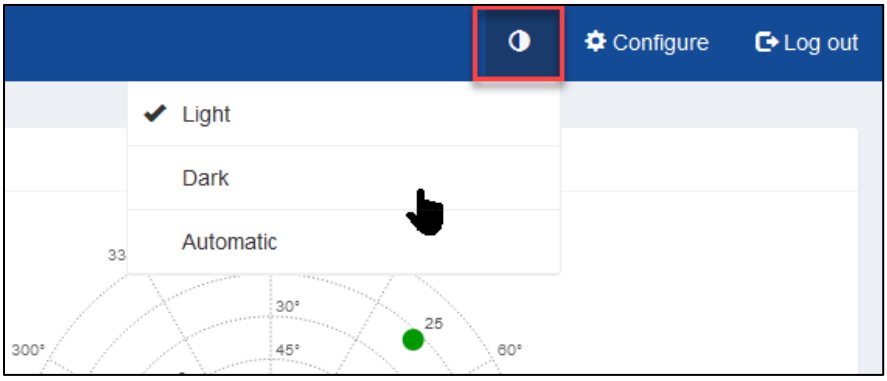


Figure 10: Set Light or Dark Mode

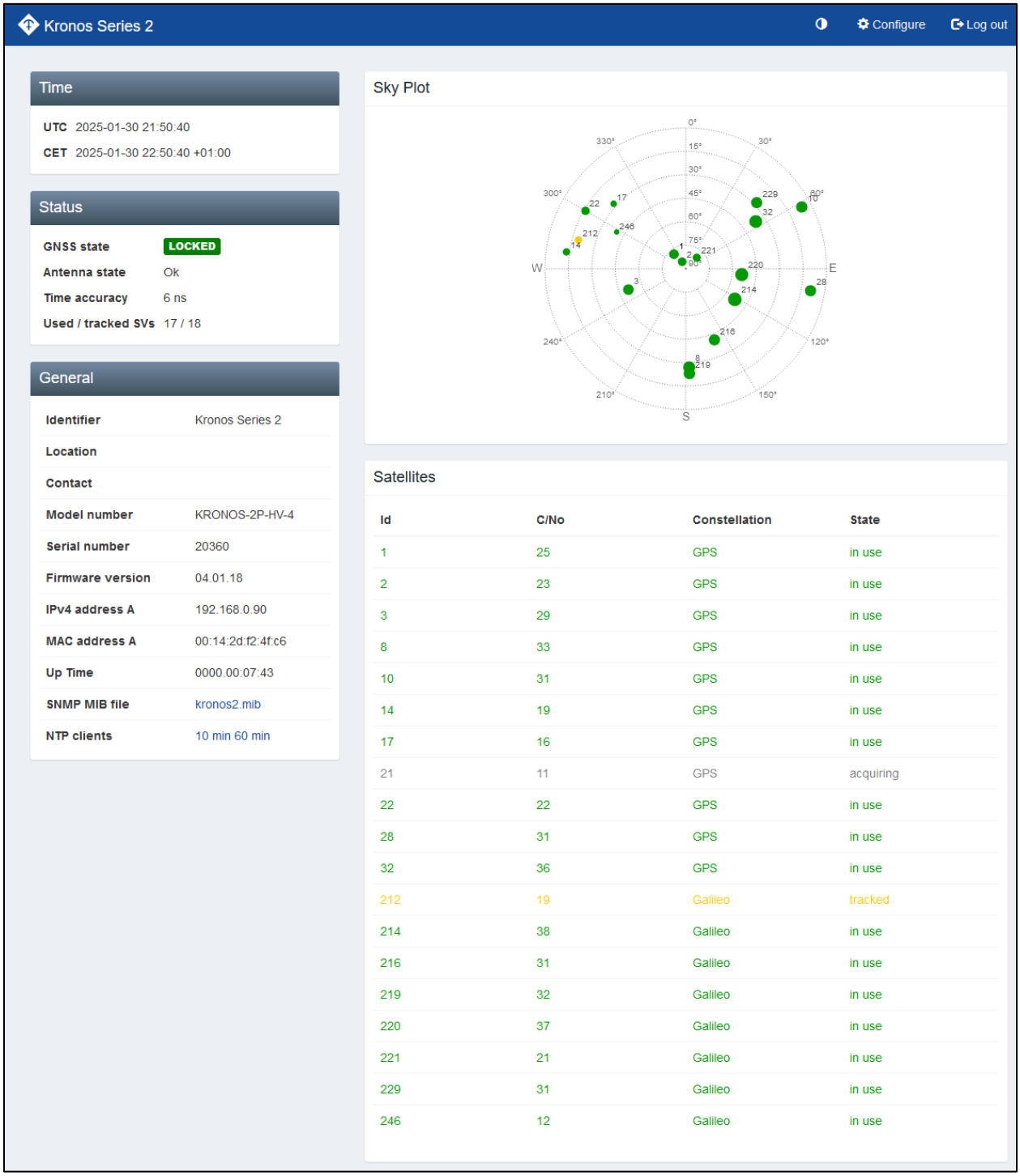


Figure 11: Clock dashboard

4 Online Clock Configuration with Web Interface

This section describes the online configuration of the Kronos clock using a web browser.

In the webpage shown in Figure 11, click `Configure` in the upper right corner to configure the clock. The default password is `novatech` which should be changed as soon as possible. The configuration pages have a non-activity timeout of 20 minutes.

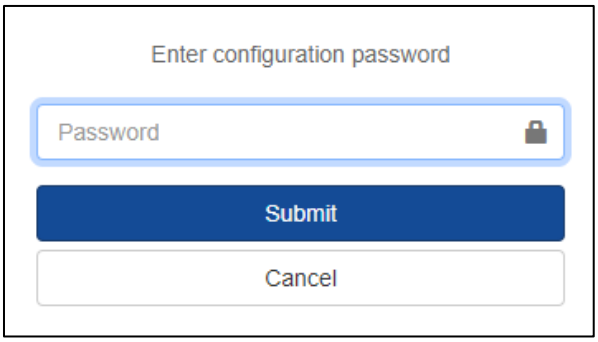


Figure 12: Enter configuration password

Then the clock parameters can be configured via the navigation pane on the left side in the following figure.

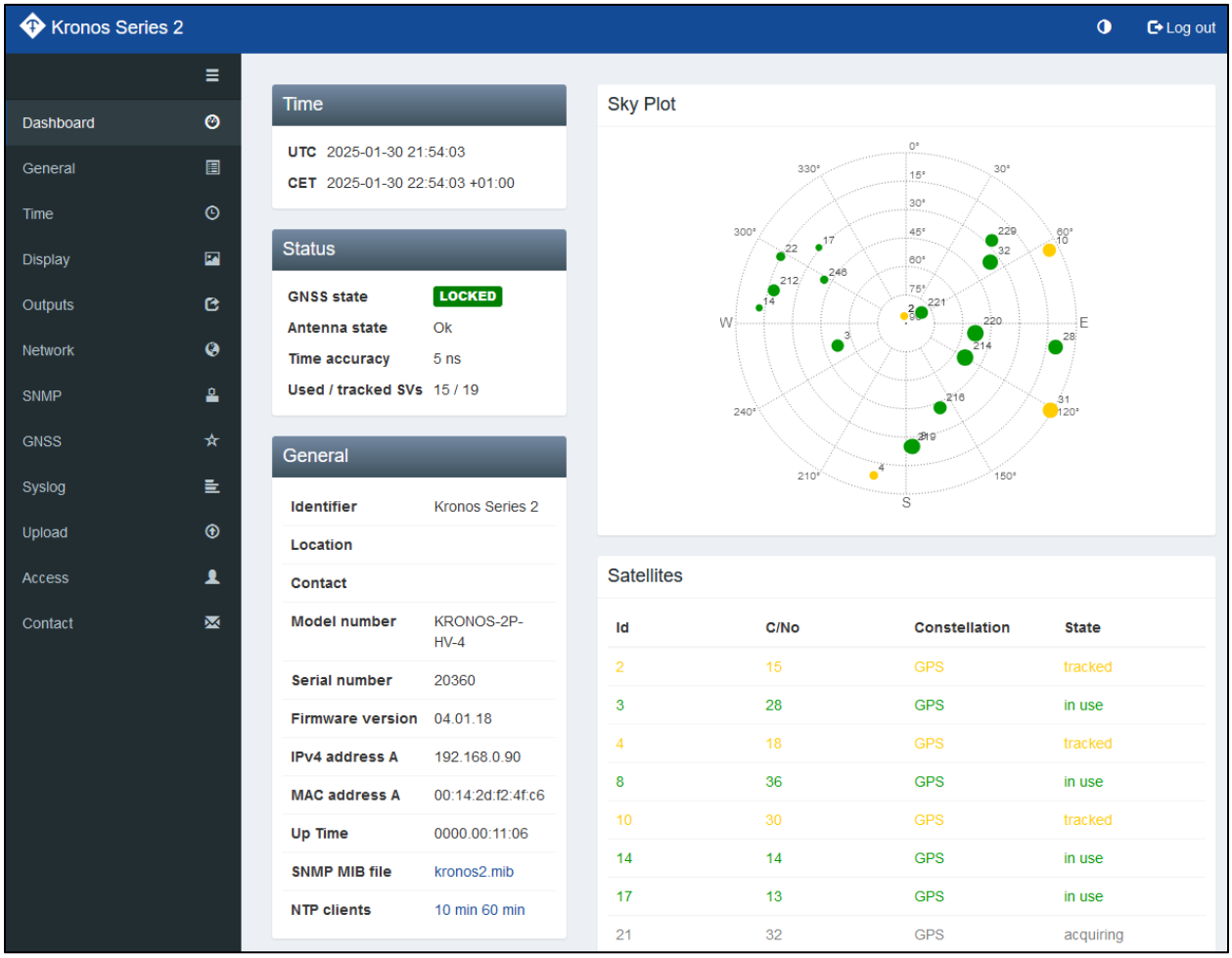


Figure 13: Clock configuration page

Note that currently the virtual LAN settings can only be configured in Virtual LAN Settings (Offline) but not in the webpage. Likewise, the optional serial port output can also only be configured in Serial Port (Offline) but not in the webpage. The Access Passwords can only be configured in the webpage in Access Passwords (Online).

4.1 General Settings (Online)

The general settings are configured on the following webpage tab. The same settings can be made offline as described in General Settings (Offline). These strings are reported as sysName, sysLocation, and sysContact over SNMP. They are also included in all log files.

Figure 14: General settings

Item	Description
`Identifier`	The identifier is shown on the dashboard web page and reported as sysName when using SNMP.
`Location`	The location is shown on the dashboard web page and reported as sysLocation when using SNMP.
`Contact`	The contact is shown on the dashboard web page and reported as sysContact when using SNMP.

Table 4: General settings

4.2 Time Zone Settings (Online)

The time zone and daylight savings time settings are configured on the following webpage tab. The same settings can be made offline as described in Time Zone Settings (Offline).

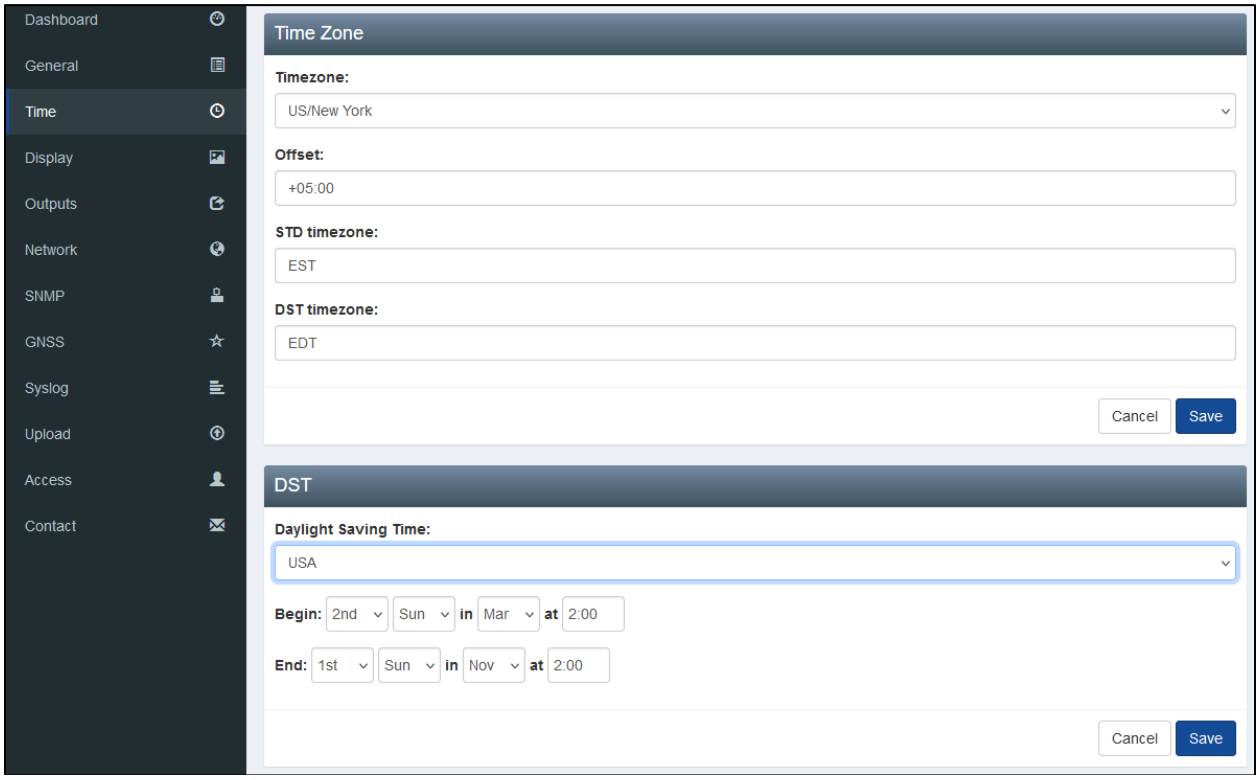


Figure 15: Time settings

Item	Description
`Timezone`	Select UTC or the time zone in which the clock is installed. Then the fields `Offset`, `STD timezone`, and `DST timezone` display the UTC offset, the standard time zone name, and the daylight saving time zone name.
`Daylight Saving Time`	Select the desired daylight saving time. The available selections are `Custom`, `Off`, `Eastern Europe`, `Central Europe`, `Western Europe`, `USA`, and `Brazil`. If your selection is not listed, select `Custom` and set the daylight saving begin and end in `Begin` and `End`.
`Begin`	Specify the desired weekday, month, and time when the daylight saving time begins. If a defined value such as `USA` is selected in `Daylight Saving Time`, the values in `Begin` are preset but can still be customized.
`End`	Specify the desired weekday, month, and time when the daylight saving time ends. If a defined value such as `USA` is selected in `Daylight Saving Time`, the values in `End` are preset but can still be customized.

Table 5: Time settings

4.3 Display Settings (Online)

The display settings determine how the time is shown on the display at the front of the clock. The same settings can be made offline as described in Display Settings (Offline).

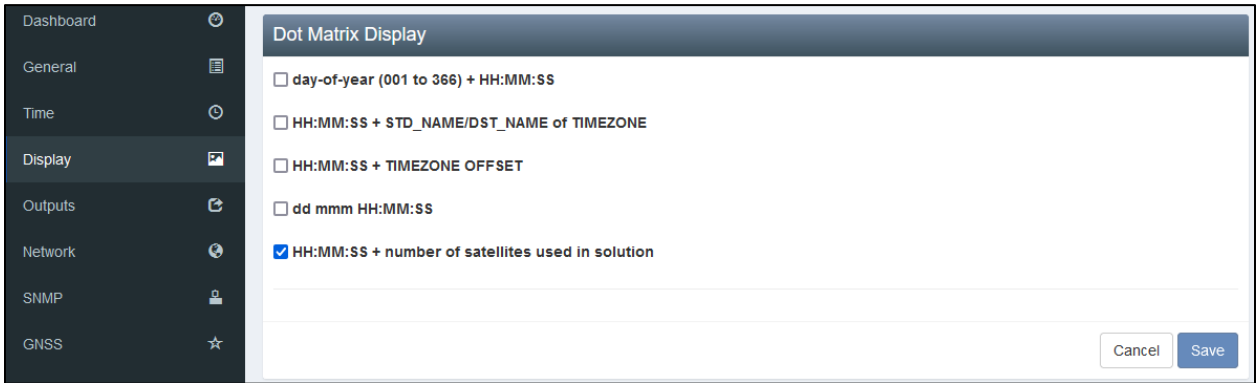


Figure 16: Display settings

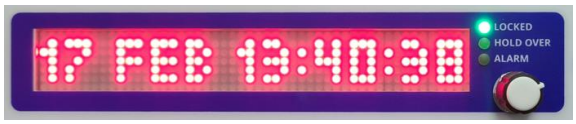
Item	Description
`day-of-year (001 to 366) + HH:MM:SS`	Displays day of year and current time. 
`HH:MM:SS + TIMEZONE`	Displays current time and time zone. 
`HH:MM:SS + TIMEZONE OFFSET`	Displays current time and time zone offset. 
`dd mmm HH:MM:SS`	Displays day, month, and current time. This is the default setting. 
`HH:MM:SS + number of satellites`	Displays current time and number of used satellites. 

Table 6: Display settings

4.4 Output Settings (Online)

The output settings are configured on the following webpage tab. The same settings can be made offline as described in Output Settings (Offline).

Note: The polarity (normal, inverse) can only be configured offline as described in Output Settings (Offline).

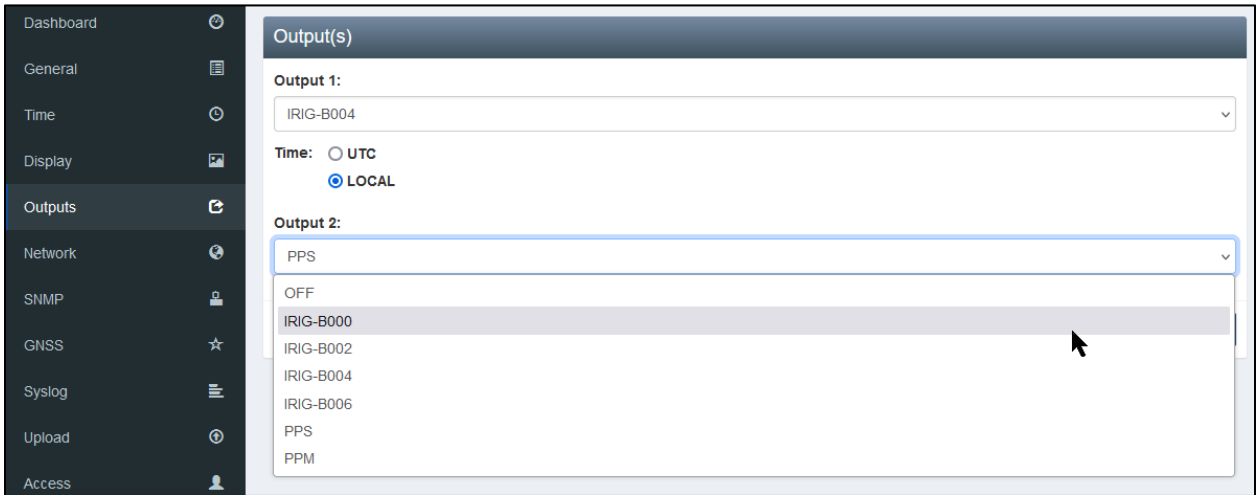


Figure 17: Outputs settings

The single unmodulated output cart (-1) has one output. The dual unmodulated output card (-2), the dual modulated output card (-A), and the fiber output card (-F) have two outputs each. The quad output card (-4) has four outputs. For each output, the output type and the time setting can be configured.

The example in Figure 17 shows a Kronos Series 2P with one quad unmodulated output card. On this card, the outputs are configured in pairs labelled `a/b`. In this example, output 1 configures the two outputs labelled `1a/1b`, and output 2 configures the two outputs `2a/2b`. On the outputs cards with one or two outputs, the outputs are configured individually.

See Appendix A – Options for information about how to interpret the SKU and determine the number and type of outputs available in your unit.

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Output type</td><td>Depending on the card, the following output types can be selected:

<table>
<tr><th>Card Name</th><th>Card Type</th><th>Signals</th></tr>
<tr><td>-1
-2
-4
-F</td><td>Single unmodulated output
Dual unmodulated outputs
Quad unmodulated outputs
Dual fiber outputs</td><td>OFF
PPM
PPS
IRIG-B000
IRIG-B002
IRIG-B004
IRIG-B006</td></tr>
<tr><td>-A</td><td>Dual modulated outputs</td><td>OFF
IRIG-B120
IRIG-B122
IRIG-B124
IRIG-B126</td></tr>
</table>

Default: OFF</td></tr>
<tr><td>Time
UTC
Local</td><td>The output can be set to send either UTC time or local time.</td></tr>
</table>

Table 7: Outputs settings

4.5 Network Settings (Online)

The network settings are configured on the following webpage tab. The same settings can be made offline as described in Network Settings (Offline).

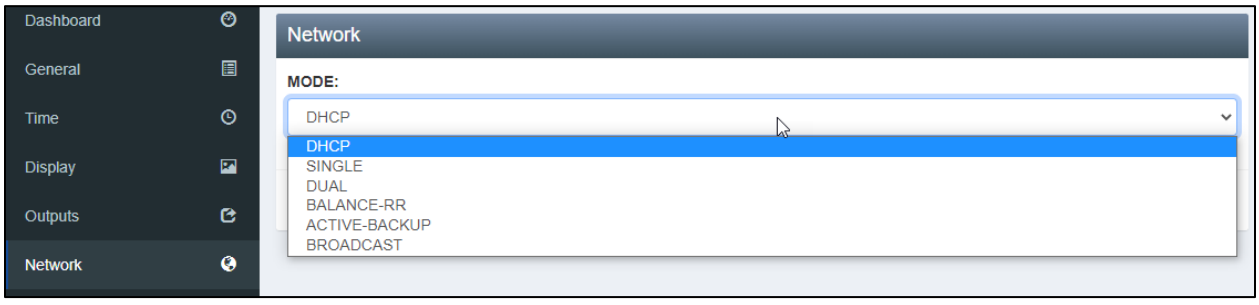


Figure 18: Network mode selection

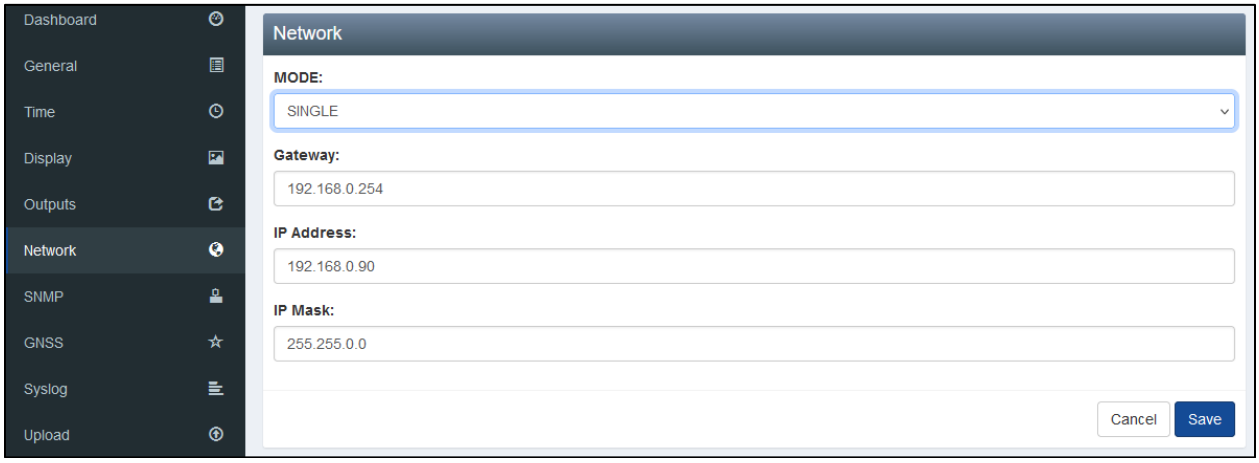


Figure 19: Network settings

Item	Description	Required Ethernet Port Setup
Mode	If one Ethernet port is installed, the following Mode options can be selected: DHCP SINGLE	None. Use only if DHCP server is present. IP address, mask, gateway
	If two Ethernet ports are installed, the following additional modes can be selected: DUAL BALANCE-RR (port bonding) ACTIVE-BACKUP (port bonding) BROADCAST (port bonding)	IP address and mask for each port; gateway IP address, mask, gateway IP address, mask, gateway IP address, mask, gateway

Table 8: Per settings

4.6 SNMP Settings (Online)

The SNMP settings are configured on the following webpage tab. The same settings can be made offline as described in SNMP Settings (Offline).

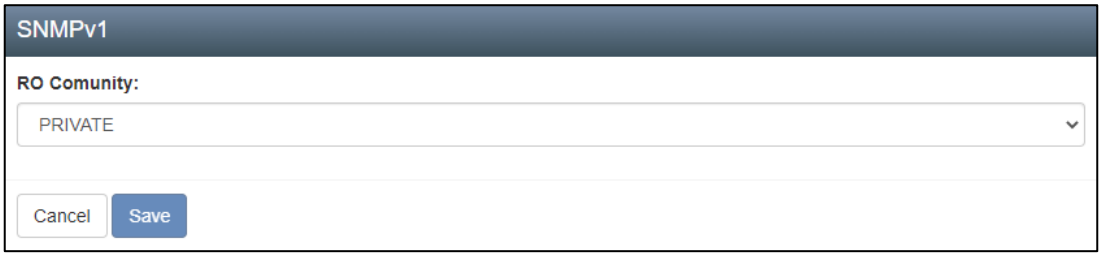


Figure 20: SNMPv1 settings

Item	Description
RO Community	The supported values are PUBLIC and PRIVATE.

Table 9: SNMPv1 settings

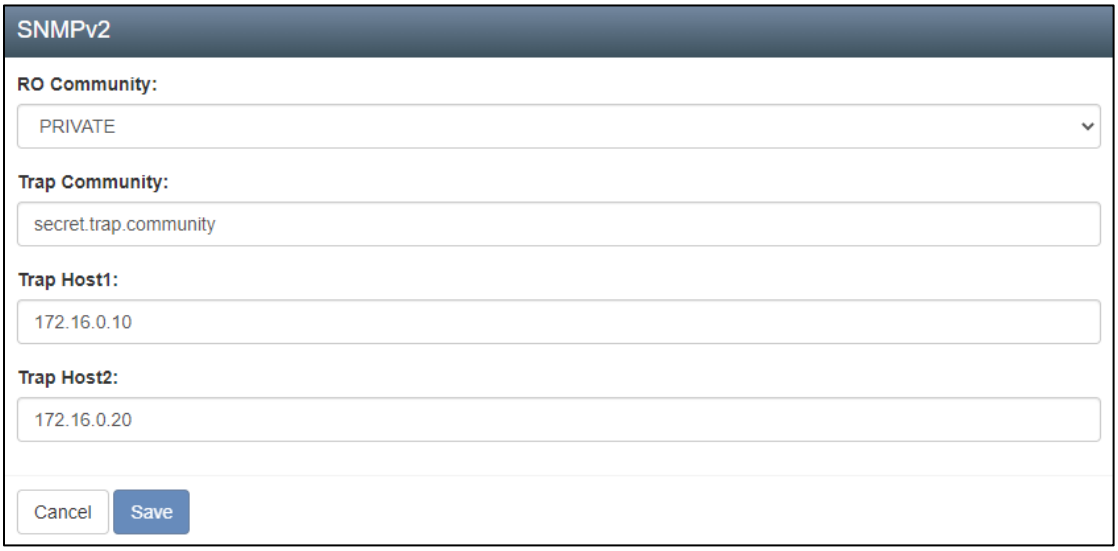


Figure 21: SNMPv2 settings

Item	Description
RO Community	The supported values are PUBLIC and PRIVATE.
Trap Community	Name of trap community
Trap Host 1	IP address of trap host 1.
Trap Host 2	IP address of trap host 2.

Table 10: SNMPv2 settings

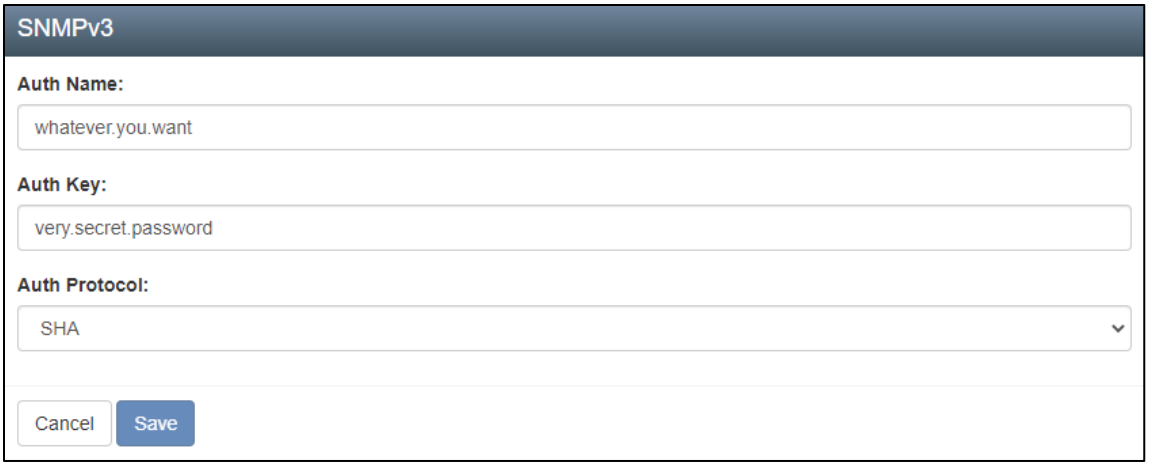


Figure 22: SNMPv3 settings

Item	Description
Auth Name	Enter authentication name.
Auth Key	Enter authentication key.
Auth Protocol	Select SHA or MD5.

Table 11: SNMPv3 settings

4.7 GNSS Settings (Online)

The GNSS constellations and out-of-bond limits are configured on the following webpage tab. The same settings can be made offline as described in GNSS Settings (Offline).

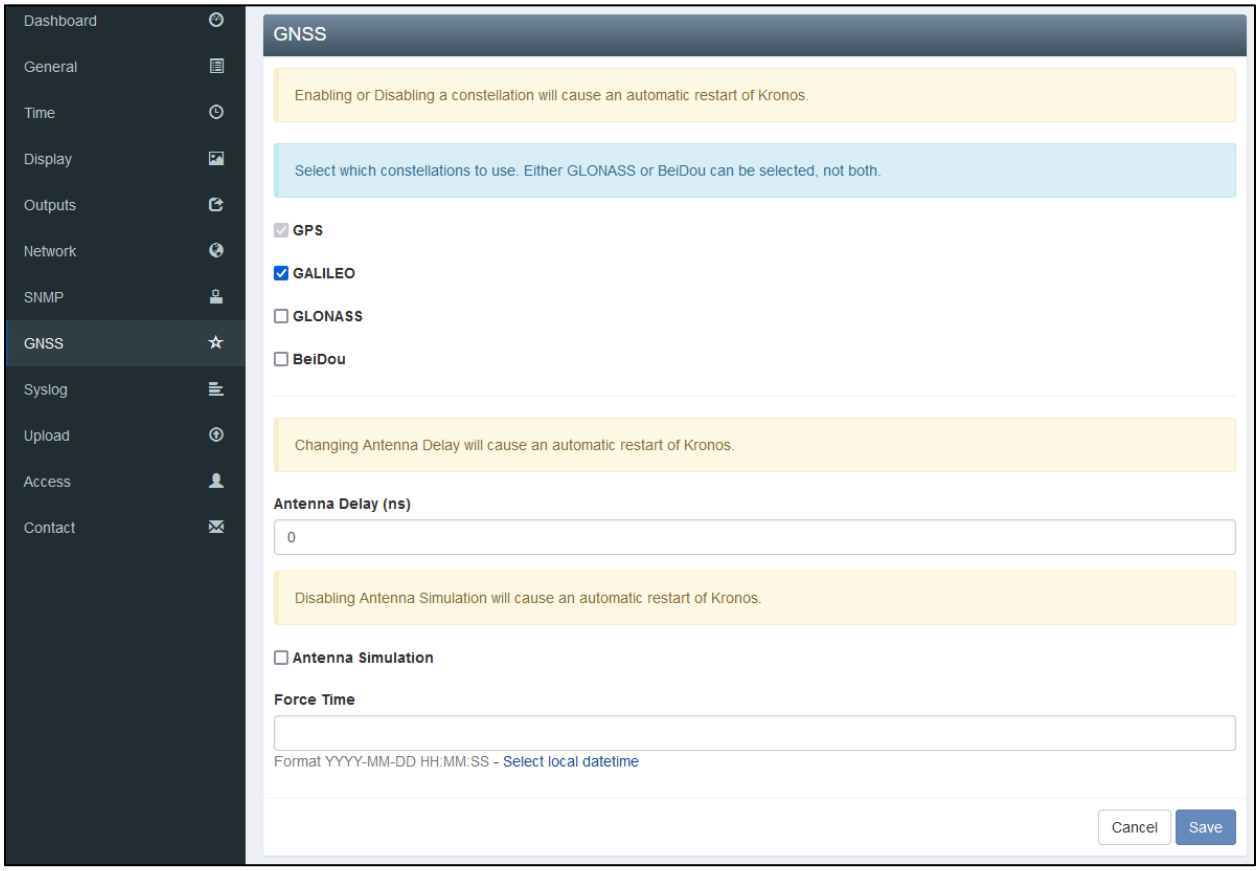


Figure 23: GNSS and out-of-bound limits settings

Item	Description
GPS	GPS is always enabled and cannot be disabled.
GALILEO	Galileo can be enabled or disabled as desired.
GLONASS BeiDou	Either Glonass or BeiDou can be enabled, but not both at the same time.

Item	Description
`Antenna Delay (ns)`	Enter the delay introduced by the antenna cable in nanoseconds to compensate for the delay. The delay is as follows: **Cable Type** / **Per foot** / **Per meter** RG58 / ~1.5ns / ~4.9ns LMR400 / ~1.2ns / ~3.9ns
`Antenna Simulation` `Force Time`	To run the clock without a connected antenna, or for specific testing purposes, check `Antenna Simulation` and enter the start time in `Force Time` which the clock will use for this simulation. Click `Select local datetime` to set the clock to the time of the PC.

Table 12: GNSS settings

Note: Users should be aware that switching between GNSS (and especially away from GPS) may affect the long term accuracy of the receiver until the next cold start. In normal operation the receiver selects the best models and corrections from the transmitted auxiliary data (e.g. UTC and ionospheric parameters), basing this selection on the configured GNSS. Disabling a major GNSS prevents auxiliary data from that GNSS being refreshed and so it will become stale, resulting in progressively degraded performance. For this reason, NovaTech recommends that the satellite clock be cold started after any change that disables an active GNSS, within a few weeks, but preferably immediately. This will ensure that the GNSS receiver then uses only regularly refreshed information from the newly configured constellations

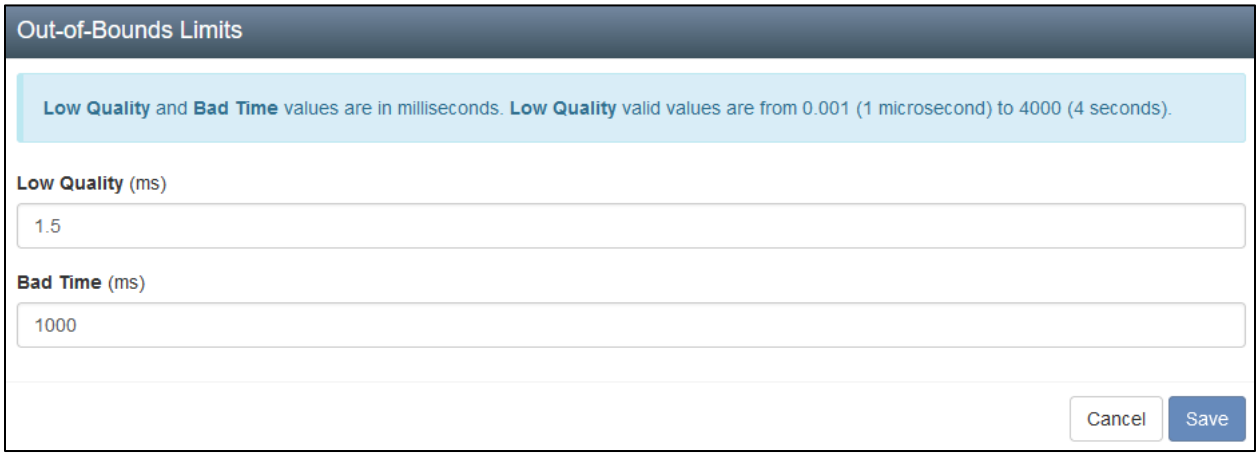


Figure 24: Out-of-Bounds Limits

Item	Description
`Low Quality`	When the time becomes inaccurate by more than the time specified value, the LOWQUALITY alarm is set. The range is 0.001 to 4000ms. Default: 0.5ms
`Bad Time`	When the time becomes inaccurate by more than the time specified value, the BADTIME alarm is set. The range is 0.001 to 4000ms. Default: 1000ms

Table 13: Out-of-bounds limits settings

See section Clock States for an explanation of how the limits in Table 13 affect clock operation.

4.8 Syslog (Online)

Configure the syslog as follows. The same settings can be made offline as described in Syslog (Offline). To disable syslog, leave the fields `Target_A` and `Target_B` empty.

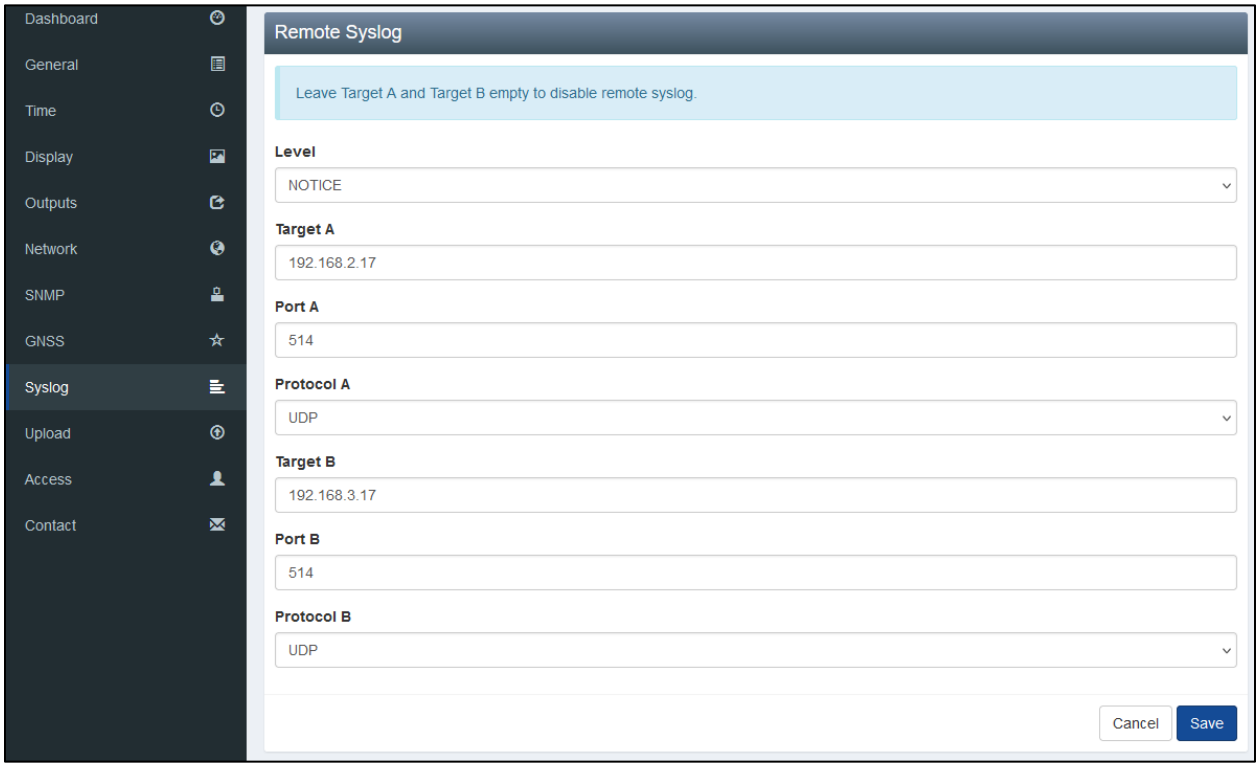


Figure 25: Syslog settings

Parameter	Description
[SYSLOG]	Section name for syslog settings.
LEVEL	Select the desired priority (see Table 15) for sending syslog messages. The set priority includes all higher priorities. The highest priority that can be set in Series 3R is Error which automatically includes Critical, Alarm, and Emergency.
TARGET_A	IP address of the primary syslog server.
PORT_A	Port used by the primary syslog server.
PROTOCOL_A	Protocol used by the primary syslog server. Select TCP or UDP.
TARGET_B	IP address of the secondary syslog server.
PORT_B	Port used by the secondary syslog server.
PROTOCOL_B	Protocol used by the secondary syslog server. Select TCP or UDP.

Table 14: Syslog settings

Level	Text	Series 3R Operational Events
0	Emergency	None
1	Alert	None
2	Critical	None
3	Error	None
4	Warning	▪ Antenna open ▪ Antenna short ▪ Bad time limit exceeded ▪ Power supply status goes from Good to Bad
5	Notice	▪ Configuration changes ▪ GNSS receiver state changes (locked, holdover)
6	Informational	▪ SSH access ▪ SFTP access
7	Debug	None

Table 15: Syslog priority levels

4.9 Upload (Online)

Upload the following files to the clock by clicking `Select file to upload` or drag & drop the respective file to this page.

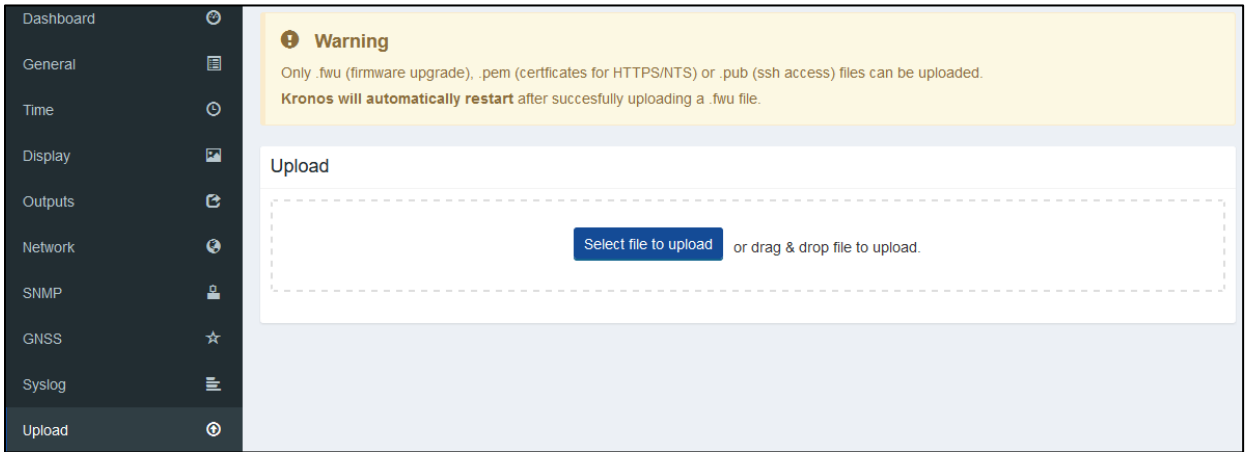


Figure 26: Upload files

File Type	Purpose	Alternative Upload
.fwu	Firmware file	See section Appendix F – Firmware Upgrade Procedure
.pem	Certificate for HTTPS	See section Keys (Offline)
.pub	SSH access	See section Keys (Offline)

Table 16: Upload Files

Note: After the uploading a new .fwu firmware to the clock, the clock will restart automatically and run the updated firmware.

This page does not support file types other than those listed above.

The latest .fwu file is available on the NovaTech Support Site at https://support.novatechautomation.com/kronos/?model=series_2p_2r. If you need login credentials, contact support@novatechautomation.com.

4.10 Access Passwords (Online)

The access passwords are configured on the following webpage tab. They can be configured only online.

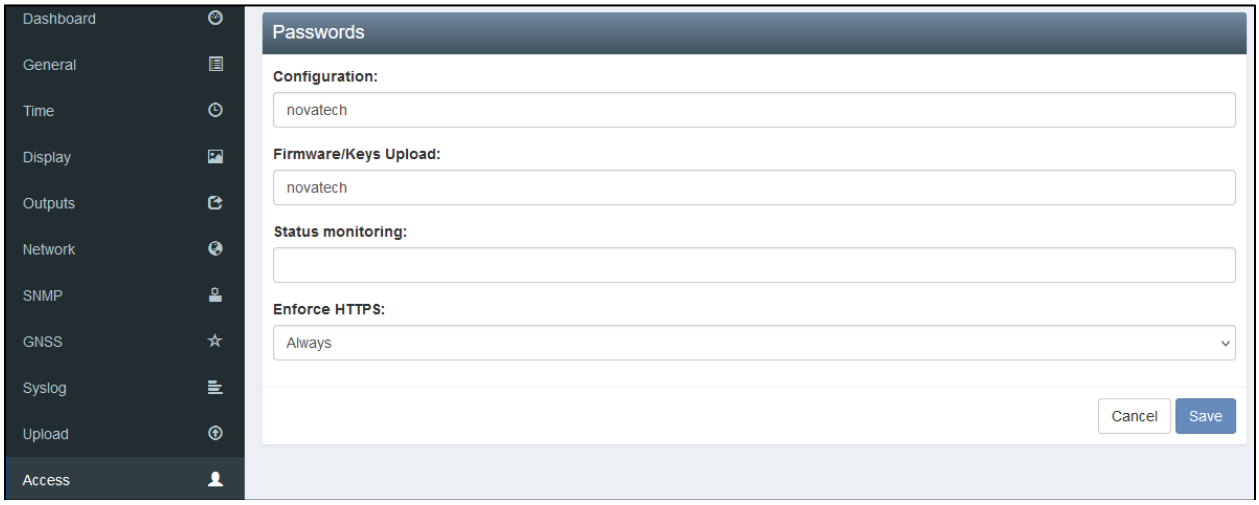


Figure 27: Access settings

Item	Description
`Configuration`	Enter a secure password for accessing the clock configuration with web page (Figure 12) and SFTP client (SFTP Access). If left blank, no password is required for accessing the clock configuration. Default password: `novatech`
`Firmware Update`	Enter a secure password for updating the firmware (Appendix F – Firmware Upgrade Procedure). If left blank, no password is required for updating the firmware. Default password: `novatech`
`Status Monitoring`	Enter a secure password for accessing the main page (Figure 11). If left blank, no password is required for accessing the main page. The default password is empty.
`Enforce HTTPS`	`NEVER` HTTPS is never enforced `CFG_ONLY` HTTPS enforced only for configuration page (default) `ALWAYS` Enforce HTTPS always.

Table 17: Access settings

5 Offline Clock Configuration with Configuration File

This section describes the offline configuration of the clock by editing the configuration file on a PC. This requires using an SFTP client on the PC to download the configuration file from the clock and then upload the edited configuration file to the clock again. The SFTP access is described in section SFTP Access.

5.1 Configuration File Structure

The configuration file is a single text file (ASCII file) which is segmented into sections. In each section there are one or more variables. Values are assigned to variables using the equal sign ('=').

The structure is very similar to the INI files used in Microsoft Windows. See Appendix G – Sample Configuration File for a complete sample configuration file.

The configuration file is named kronos2.cfg. It can be downloaded/uploaded using the SFTP protocol (user `cfg`, see section SFTP Access). Some SFTP clients also allow online editing of the configuration file. If editing offline, use only ASCII text editors (like Windows Notepad).

Note: Do NOT use a word processor (like Microsoft Word or WordPad) to edit the configuration file. Word processors insert hidden formatting characters that are not correctly interpreted by the clock.

Sections and variables are case insensitive. Any combination of uppercase and lowercase letters can be used. Most values are also case insensitive, except for passwords which are case sensitive. Blank characters (ASCII 32) and tabs (ASCII 08) can be freely used to improve the legibility of the configuration file.

5.1.1 Sections

The configuration file is segmented into Sections. A section name is enclosed in square brackets and must be the only text on a line. Section names are case insensitive. Example:

```
[SectionName]
```

Note: Section names should be kept on a line of their own. Comments (see below) are NOT allowed on lines with section names.

5.1.2 Variables and Values

In any section there are one or more variables, declared with the following syntax:

```
Variable = value
```

Variable names are case insensitive. The value is any character on the right side of the equal sign. Quotes can be used to enclose the values, but they are not required. If no quotes are present, the value is understood as containing all characters between the first and the last non-blank characters before the comment. If quotes are present, the value is understood as containing all characters between the quotes, with the quotes themselves not being considered to be part of the value.

The following declarations are identical:

```
Hello = "this is a long string value"
Hello = this is a long string value
```

5.1.3 Comments

Lines starting with a hash sign (#) are considered to contain comments and discarded by the clock:

```
# This is a comment, notice the hash sign
```

Comments can also be given on value lines using a semicolon. Everything after the semicolon up to the end of the line is ignored by the clock:

```
SomeVariable = some_value ; this is also a comment
```

5.1.4 Blank Lines

Blank lines (i.e. lines containing only blanks or tabs) can be used to visually separate the sections of the configuration file and increase readability.

5.2 Keys (Offline)

The files in this section can also be uploaded as described in section Upload (Online).

```
# certificates and keys for SSH and HTTPS/websockets
[KEYS]
SSH = novatech
HTTPS = kronos2
```

Use WinSCP or SFTP to upload the .pem files described in the following table to the respective directory in the clock. See section SFTP Access for details.

Parameter	File Type	Directory	Description
SSH =	.pub	/kronos/keys	Enter the name of the .pub file to use for SSH without the .pub extension. Default: novatech
HTTPS =	.pem	/kronos/keys	Enter the name of the .pem file to use for HTTPS without the .pem extension. Default: kronos2

Table 18: Key file locations

5.3 General Settings (Offline)

The parameters in this section of the configuration file allow the definition of identifier, location, and contact strings for the unit. These strings are shown on the web-based dashboard and reported as sysName, sysLocation, and sysContact over SNMP. They are also included in all log files. The same settings can be made in the webpage as described in General Settings (Online).

```
# IDENTIFIER, LOCATION and CONTACT are shown on the dashboard web page and
# reported as sysName, sysLocation and sysContact when using SNMP
# Replace with values meaningful to the installation
[GENERAL]
IDENTIFIER = Kronos Series 2
LOCATION = Lenexa
CONTACT = ""
```

Parameter	Description
[GENERAL]	General parameters are defined in section [GENERAL].
IDENTIFIER	User-defined identifier for the clock, up to 30 characters long. Default: Kronos Series 2
LOCATION	User-defined string for the clock location, up to 30 characters long.
CONTACT	User-defined contact string (email or telephone) for the clock, up to 30 characters long.

Table 19: General settings

5.4 Time Zone Settings (Offline)

The parameters in this section allow the clock to derive local time from UTC. If a daylight saving time (DST) rule is specified, daylight savings time changes will be performed automatically. The same settings can be made in the webpage as described in Time Zone Settings (Online).

```
# Timezone and daylight saving time rules
# In order to disable DST, specify DST_RULE = NONE
[TIMEZONE]
OFFSET = +06:00
STD_NAME = CST
DST_NAME = CDT
DST_RULE = US
DST_BEGIN = M3.2.0/2:00
DST_END = M11.1.0/2:00
```

Parameter	Description
[TIMEZONE]	Time zone parameters are defined in section [TIMEZONE].
OFFSET	OFFSET is the time value that has to be added to the local time to get UTC during standard (not daylight saving) time. OFFSET is positive if the local time zone is west of the Prime Meridian and negative if it is east.
STD_NAME	Time zone abbreviation during standard time. Should not be shorter than three letters. Only the first four letters are used. Default: UTC
DST_NAME	Time zone abbreviation during daylight saving time. Only the first four characters are used. Default: blank

Parameter	Description
DST_RULE	During daylight saving time, local time is one hour ahead of standard time. DST_RULE should be one of NONE, US, EUROPE (or EUROPE_C), EUROPE_W, EUROPE_E, BRAZIL, or CUSTOM. See Appendix D – Daylight Saving Time Rules for details about each of the daylight saving time rules above. Default: NONE.
DST_BEGIN	Only used if DST_RULE = CUSTOM. See section User-Defined DST Rule for syntax.
DST_END	Only used if DST_RULE = CUSTOM. See section User-Defined DST Rule for syntax.

Table 20: Time settings

Example: Configuration for a clock in Central Europe

```
[TIMEZONE]
OFFSET = -01:00 ; one hour east of Greenwich
STD_NAME = CET ; central European time
DST_NAME = CEST ; central European summer time
DST_RULE = Europe
```

5.5 GNSS Settings (Offline)

The parameters GALILEO, GLONASS, and BEIDOU for controlling these constellations can also be set in the webpage as described in GNSS Settings (Online).

The parameter ANT_DELAY compensates the propagation delay in the antenna cable.

It is possible to force the clock to operate in a time simulation mode, where reception of satellite signal and antenna connection are simulated. This can be useful during commissioning work, where the clock is required to operate before antenna installation has been completed.

```
# GNSS related settings
# ANT_DELAY is the antenna cable delay compensation in nanoseconds (~4 ns for
# each meter of coax cable)
# GALILEO, GLONASS and BEIDOU can be set to TRUE/FALSE in order to
# enable/disable the usage of additional constellations
# FORCEGNSS and FORCETIME can be used to simulate antenna connection and GNSS
# signal reception
# (use for commissioning work only, set to FALSE before normal operation !)
[GNSS]
ANT_DELAY = 60
GALILEO = TRUE
GLONASS = TRUE
BEIDOU = FALSE
FORCEGNSS = FALSE
FORCETIME = 2023-01-01 12:00
```

Note: Switching between GNSS may affect the long term accuracy of the receiver until the next cold start. In normal operation the receiver selects the best models and corrections from the transmitted auxiliary data (e.g. UTC and ionospheric parameters), basing this selection on the configured GNSS. Disabling a GNSS prevents auxiliary data from that GNSS being refreshed and so it will become stale, resulting in progressively degraded performance. For this reason, NovaTech recommends that the satellite clock be cold started after any change that disables an active GNSS, within a few weeks, but preferably immediately. This will ensure that the GNSS receiver then uses only regularly refreshed information from the newly configured constellations

Parameter	Description
`[GNSS]`	GPS related parameters are defined in section `[GPS]`.
`ANT_DELAY`	Value (in nanoseconds) that corresponds to the delay introduced by the antenna cable, typically 1.2ns/ft (4ns/m). The exact delay can be computed by: $$t = \frac{1}{c \times K_v} \times l$$ where $c = 3 \times 10^8$ *m/s* is the light speed K_v is the velocity factor of the cable being used *l* is the cable length in meters. Default: 60ns (equivalent to 50ft (15m) antenna cable)

`GALILEO`
`GLONASS`
`BEIDOU`
	Use of these satellite systems can be enabled if desired by setting the respective value to `TRUE`. Glonass and BeiDou cannot be enabled at the same time. Note that GPS is always enabled. The default value for each is `FALSE`.

`FORCEGNSS`	If TRUE, antenna connection and reception of satellite signals is simulated by the unit. Note: The time reported by the clock will not be correct if FORCEGNSS is TRUE. Make sure to set FORCEGNSS to FALSE before normal operation. Alternatively, delete or comment out the line from the configuration file.
`FORCETIME`	If a date and time are entered, the clock uses and displays the entered date and time and counts up time from there instead of using the satellite signal. This is useful for testing. Example: `2023-01-01 12:00` **Note: The time reported by the clock will not be correct if date and time are entered for `FORCETIME`. Make sure to remove date and time for normal operation. Alternatively, delete or comment out the line from the configuration file**.

Table 21: GPS receiver settings

5.6 Out-of-bound Limits (Offline)

The parameters in this section configure the user defined out-of-bounds limits. All values are in milliseconds. Valid values are from 0.001ms (1 microsecond) to 4000ms (4 seconds). See section Clock States for an explanation of how these limits affect clock operation. The same settings can be made in the webpage as described in GNSS Settings (Online).

```
# User defined out-of-bounds limits (in miliseconds)
# Valid values are from 0.001 (1 microsecond) to 4000 (4 seconds)
[LIMITS]
LOWQUALITY = 2
BADTIME = 500
```

Parameter	Description
[LIMITS]	Out-of-bounds limits are defined in section [LIMITS].
LOWQUALITY	When the time becomes inaccurate by more than the time specified value, the LOWQUALITY alarm is set. The range is 0.001 to 4000ms. Default: 0.5ms
BADTIME	When the time becomes inaccurate by more than the time specified value, the BADTIME alarm is set. The range is 0.001 to 4000ms. Default: 1000ms

Table 22: Out-of-bound limit settings

5.7 Display Settings (Offline)

This section configures the information presented on the dot matrix display. The same settings can be made in the webpage as described in Display Settings (Online).

```
# Selects what is shown on the unit's dot matrix display. MODE can be:
# 1: day-of-year (001 to 356) + HH:MM:SS
# 2: HH:MM:SS + STD_NAME/DST_NAME of TIMEZONE
# 3: HH:MM:SS + TIMEZONE OFFSET
# 4: dd mmm  HH:MM:SS
# 5: HH:MM:SS + number of satellites used in solution
[DISPLAY]
MODE = 3
```

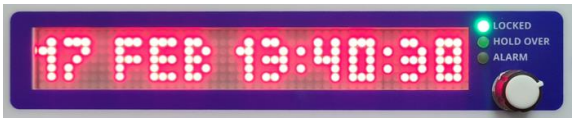
Parameter	Description
[DISPLAY]	The settings are in section [DISPLAY].
MODE	Selects the information that is shown on the dot matrix display during normal operation. Default: 1 (Day-of-year + HH:MM:SS).
MODE = 1	Displays day-of-year (001 to 366) and local time: 
MODE = 2	Displays local time and the appropriate time zone abbreviation (STD_NAME during standard time, DST_NAME during daylight saving time): 
MODE = 3	Displays local time and the current time zone offset (OFFSET during standard time, OFFSET plus one hour during daylight saving time: 
MODE = 4	Displays day-of-month, month, and local time. This is the default setting. 
MODE = 5	Displays local time and the number of satellites used for time calculation: 

Table 23: Display settings

5.8 Network Settings (Offline)

This section describes the configuration of network parameters for Ethernet ports A and B (if Series 2R has a second Ethernet port, option -P). The same settings can be made in the webpage as described in Network Settings (Online).

If the clock is equipped with a second Ethernet port, it can be configured as an independent port or both ports can be configured to operate in bonding. In this case they appear as single port with one IP address and provide link redundancy.

```
# Network parameters
# MODE can be one of DHCP, SINGLE, DUAL, BALANCE-RR, ACTIVE-BACKUP or BROADCAST
# IPADDRB and NETMASKB are only used if MODE=DUAL
# MODE = SELECT prompts the user to select DHCP or single fixed IP address
# (see reference manual for further details)
[NETWORK]
MODE = DHCP
IPADDR = 192.168.0.1
IPMASK = 255.255.255.0
GATEWAY = 192.168.0.254
IPADDRB = 10.0.0.181
IPMASKB = 255.255.255.0
```

Parameter	Description
`[NETWORK]`	Network parameters are defined in the section `[NETWORK]`.
`MODE`	MODE can be one of DHCP, SINGLE, DUAL, BALANCE-RR, ACTIVE-BACKUP or BROADCAST.
`MODE = DHCP`	Obtain network parameters from a DHCP server. Use only if DHCP server is available and leases renew to same IP address.
`MODE = SINGLE`	Use only Ethernet port A.
`MODE = DUAL`	Use Ethernet ports A and B as independent network ports.
`MODE = ACTIVE-BACKUP`	Combine network ports A and B as slaves in a bonding interface. Only one slave in the bond is active at a time. The other slave becomes active if, and only if, the active slave fails. The bond's MAC address is externally visible on only one port to avoid confusing the switch. This mode provides fault tolerance.
`MODE = BALANCE-RR`	Combine network ports A and B as slaves in a bonding interface using a round-robin policy (alternate sending packets over both slaves). This mode provides load balancing and fault tolerance.
`MODE = BROADCAST`	Combine network ports A and B as slaves in a bonding interface. Transmits everything on all slave interfaces. This mode provides fault tolerance but increases the required bandwidth.
`IPADDR`	IPv4 address of Ethernet port A in the form a.b.c.d
`NETMASK`	Network mask for Ethernet port A in the form a.b.c.d
`GATEWAY`	IPv4 address of gateway in the form a.b.c.d
`IPADDRB`	IPv4 address of Ethernet port B in the form a.b.c.d. This parameter is only valid if `MODE = DUAL`.
`NETMASKB`	Network mask for Ethernet port B in the form a.b.c.d. This parameter is only valid if `MODE = DUAL`.

Table 24: Network settings

Example: To force the clock to use IP address 192.168.0.50 in a class C private network with a gateway located at 192.168.0.1, place the following in the configuration file:

```
[NETWORK]
MODE = SINGLE
IPADDR = 192.168.0.50
NETMASK = 255.255.0.0
GATEWAY = 192.168.0.1
```

5.9 Virtual LAN Settings (Offline)

This section allows the definition of Virtual LANs (VLANs), a broadcast domain that is partitioned and isolated at the data link layer. These settings can only be made in the configuration file.

Note: VLAN is supported only if the mode is `SINGLE` in sections Network Settings (Online) or Network Settings (Offline).

```
# VLAN configuration (only supported if MODE=SINGLE in [NETWORK])
#[VLAN10]
#IPADDR  = 172.16.10.100
#IPMASK  = 255.255.255.0
#GATEWAY = 172.16.10.1

#[VLAN20]
#IPADDR  = 192.168.20.99
#IPMASK  = 255.255.255.0
#GATEWAY = 192.168.20.1
```

Parameter	Description
`[VLAN`*id*`]`	VLANs are specified using sections in the form `[VLAN`*id*`]`, with id being any number from 1 to 4094. As many as 4094 VLANs can be defined. VLANs cannot use DHCP.
`IPADDR`	IPv4 address in the form a.b.c.d
`NETMASK`	Network mask in the form a.b.c.d
`GATEWAY`	IPv4 address of gateway in the form a.b.c.d

Table 25: Virtual LAN settings

Example: To define a VLAN with id 100 and to assign the IP address 192.168.2.10 in a class C private network with a gateway located at 192.168.2.1, place the following in the configuration file.

```
[VLAN100]
IPADDR = 192.168.2.10
NETMASK = 255.255.0.0
GATEWAY = 192.168.2.1
```

5.10 SNMP Settings (Offline)

This section allows configuration of the built-in SNMP agent. The same settings can be made in the webpage as described in SNMP Settings (Online).

There are separate configurations for SNMPv1, SNMPv2c, and SNMPv3 protocol versions.

The associated MIB (SNMP Management Information Base) file can be downloaded using a web browser from the device's HTTP dashboard.

```
# SNMP parameters: there are separate sections for versions 1, 2c and 3.
Uncomment to enable.
[SNMPv1]
RO_COMMUNITY = PRIVATE

[SNMPv2c]
RO_COMMUNITY = PRIVATE
TRAP_COMMUNITY = secret.trap.community
TRAP_HOST1 = 172.16.0.10
TRAP_HOST2 = 172.16.0.20

[SNMPv3]
AUTH_NAME = whatever.you.want
AUTH_KEY = very.secret.password
AUTH_PROTOCOL = SHA
```

Parameter	Description
[SNMPv1]	Section name for SNMPv1 parameters.
RO_COMMUNITY	Read-only community string for SNMPv1. Default: blank (access is disabled)
[SNMPv2c]	Section name for SNMPv2c parameters.
RO_COMMUNITY	Read-only community string for SNMPv2c. Default: blank (access is disabled)
TRAP_COMMUNITY	Trap community name for SNMPv2c traps.
TRAP_HOST1 TRAP_HOST2	IPv4 trap destination address (or addresses), specified in the form a.b.c.d.
[SNMPv3]	Section name for SNMPv3 parameters.

Table 26: SNMP settings

Parameter	Description
AUTH_NAME	User name for read-only access using SNMPv3. Default: (disabled)
AUTH_KEY	Password for read-only access using SNMPv3.
AUTH_PROTOCOL	Authentication protocol to use when validating AUTH_NAME and AUTH_KEY. Possible values are MD5 or SHA. Default: MD5

Table 27: SNMP settings

5.11 Serial Port (Offline)

This section configures the optional serial port -S.SRL for time output.

```
# Settings for datagram contents and speed over serial port
# TIMESTRING can be NONE, SELB1, SELB5, SELB6, SELB8, GPZDA, MEINBERG,
# TRUETIME or SAT
# BITRATE can be 1200, 2400, 4800, 9600, 19200 or 38400 BPS
# TIMEBASE specifies the timebase to use (UTC or LOCAL)
# PPS selects if the time reported refers to the CURRENT or NEXT PPS pulse
[SERIAL]
TIMESTRING = GPZDA
BITRATE = 9600
FORMAT = 8N1
TIMEBASE = LOCAL
PPS = NEXT
```

Parameter	Description
`[SERIAL]`	Serial port parameters are defined in section `[SERIAL]`
`TIMESTRING`	Selects contents of time string sent over the serial port. Possible values are `NONE` (serial port is disabled), `GPZDA`, `MEINBERG`, `SAT`, `SELB1`, `SELB5`, `SELB6`, `SELB8`, or `TRUETIME`. See Appendix E – Time Strings for a detailed description of each timestring. Default: `NONE`
`BITRATE`	The speed at which the time string will be transmitted. Valid values are `1200`, `2400`, `4800`, `9600`, `19200`, or `38400` bits per second (bps). Default: `9600`
`FORMAT`	The number of data bits, parity and stop bits to use for the messages transmitted. Specified using a three-character shortcut in the form dps, where d number of data bits: `7` or `8` p parity: `N` (none), `E` (even), `O` (odd) s number of stop bits: `1` or `2` Default: `8N1`
`TIMEBASE`	Specifies whether the time reported in the time string is local time (`LOCAL`) or UTC time (`UTC`), If `LOCAL` is selected, it will be subject to the daylight saving time rules. `UTC` time ignores daylight saving time rules. Default: `LOCAL`.
`PPS`	This parameter selects which PPS pulse refers to the time reported in the time string. Possible values are `CURRENT` or `NEXT`. If `CURRENT` is selected, the time string will contain the time stamp of the "current" PPS pulse (see Figure 28). This is probably the right configuration if the time string is not being latched by the PPS signal on the receiving device. If `NEXT` is selected, the time string will contain the time stamp of the next PPS pulse (see Figure 29). This configuration allows the use of the PPS signal to latch the reported time in the receiving device. Default: `CURRENT`

Parameter	Description
POLARITY	Configures the polarity of the PPS signal (NORMAL or INVERTED, see Figure 30). The pulse width is fixed at 200 ms. Default: NORMAL

Table 28: Serial time settings

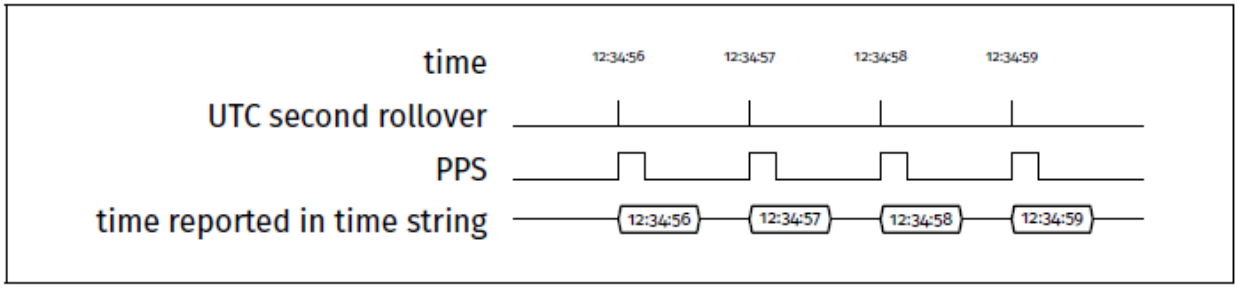


Figure 28: Reported time with option PPS = CURRENT

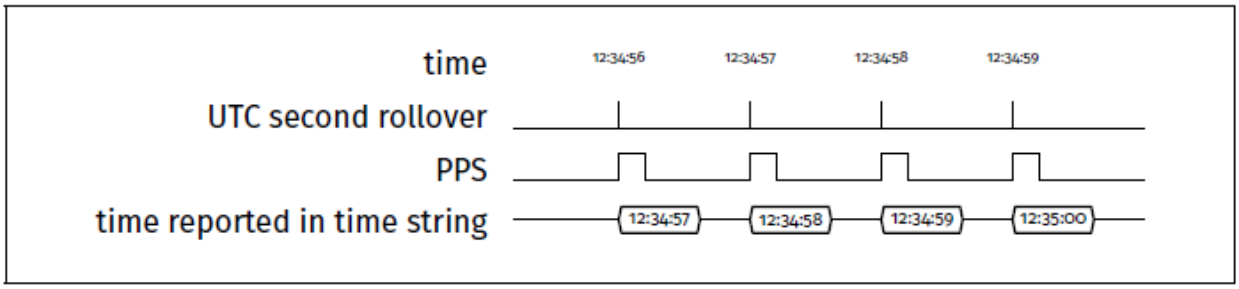


Figure 29: Reported time with option PPS = NEXT

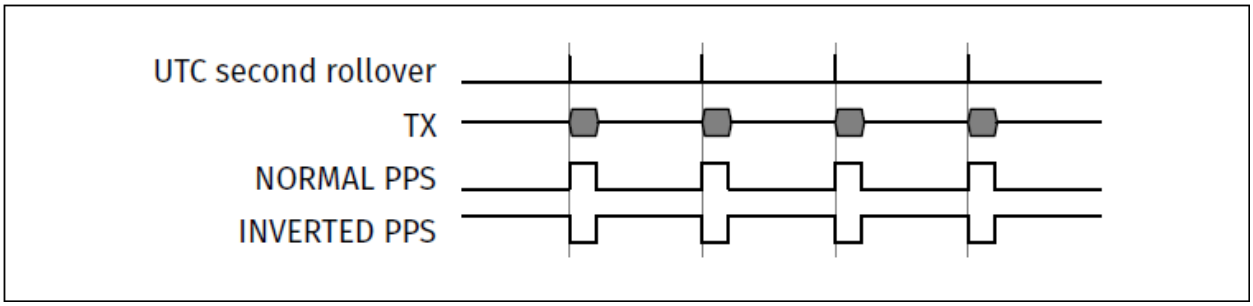


Figure 30: NORMAL and INVERTED PPS signals

Example: Configuration for a revenue meter, where the time zone and daylight saving time rules are defined in the revenue meter. No PPS signal is used.

```
[SERIAL]
TIMESTRING = TRUETIME
BITRATE = 9600 ; default, could be omitted
FORMAT = 8N1 ; default, could be omitted
TIMEBASE = UTC
```

5.12 Syslog (Offline)

This section configures the syslog. The same settings can be made in the webpage as described in Syslog (Online).

```
# Settings for remote syslog
# Leave TARGET_A or TARGET_B empty if only one remote syslog server is used
[SYSLOG]
LEVEL = NOTICE
TARGET_A =
PORT_A = 514
PROTOCOL_A = UDP
TARGET_B =
PORT_B =
PROTOCOL_B = UDP
```

Parameter	Description
[SYSLOG]	Section name for syslog settings.
LEVEL	Select the desired priority (see Table 15) for sending syslog messages. The set priority includes all higher priorities. The highest priority that can be set in Series 3R is Error which automatically includes Critical, Alarm, and Emergency.
TARGET_A	IP address of the primary syslog server.
PORT_A	Port used by the primary syslog server.
PROTOCOL_A	Protocol used by the primary syslog server. Select TCP or UDP.
TARGET_B	IP address of the secondary syslog server.
PORT_B	Port used by the secondary syslog server.
PROTOCOL_B	Protocol used by the secondary syslog server. Select TCP or UDP.

Table 29: Syslog settings

5.13 Output Settings (Offline)

This section allows the configuration of the timing signals that will be generated for the outputs 1 through 6 of the clock. The same settings can be made in the webpage as described in Output Settings (Online).

The number of outputs depends on the model (Kronos 2P has up to two outputs, Kronos 2R up to six) and the part number of the clock.

Note that the POLARITY can only be set in the configuration file and not in the webpage.

See Appendix A – Options for information about how to interpret the SKU and determine the number and type of outputs available in your unit.

```
# Signal generation on OUTPUT1 .. OUTPUT6
[OUTPUT1]
# OPTIONS = OFF, IRIG-B000, IRIG-B002, IRIG-B004, IRIG-B006, PPS, PPM
SIGNAL = IRIG-B004
```

```
TIME = LOCAL
POLARITY = NORMAL

[OUTPUT2]
# OPTIONS = OFF, IRIG-B000, IRIG-B002, IRIG-B004, IRIG-B006, PPS, PPM
SIGNAL = IRIG-B004
TIME = UTC
POLARITY = NORMAL

[OUTPUT3]
# OPTIONS = OFF, IRIG-B120, IRIG-B122, IRIG-B124, IRIG-B126
SIGNAL = IRIG-B124
TIME = LOCAL
POLARITY = NORMAL

[OUTPUT4]
# OPTIONS = OFF, IRIG-B120, IRIG-B122, IRIG-B124, IRIG-B126
SIGNAL = IRIG-B124
TIME = LOCAL
POLARITY = NORMAL

[OUTPUT5]
# OPTIONS = OFF, IRIG-B000, IRIG-B002, IRIG-B004, IRIG-B006, PPS, PPM
SIGNAL = IRIG-B000
TIME = LOCAL
POLARITY = NORMAL
```

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>[OUTPUTn]</td><td>Outputs are defined in sections [OUTPUT1] through [OUTPUT6].</td></tr>
<tr><td>SIGNAL</td><td>Configures the type of signal that will be generated on OUTPUTn. Valid values are:
<table>
<tr><th>Card Name</th><th>Card Type</th><th>Signals</th></tr>
<tr><td>-1
-2
-4
-F</td><td>Single unmodulated output
Dual unmodulated outputs
Quad unmodulated outputs
Dual fiber outputs</td><td>OFF
PPM
PPS
IRIG-B000
IRIG-B002
IRIG-B004
IRIG-B006</td></tr>
<tr><td>-A</td><td>Dual modulated outputs</td><td>OFF
IRIG-B120
IRIG-B122
IRIG-B124
IRIG-B126</td></tr>
</table>
Default: OFF</td></tr>
</table>

Parameter	Description

`Time`
`UTC`
`Local`
	The output can be set to send either UTC time or local time.

`POLARITY`	Configures the polarity of the signal at OUTPUTn. Valid values are `NORMAL` and `INVERTED`. Default: `NORMAL`

Table 30: Output signals

6 SFTP Access

The clocks supports SFTP (Secure File Transfer Protocol) for accessing the configuration and log files, and for performing firmware upgrades.

The SFTP server runs on port 22 (the default port for SFTP).

The following usernames are predefined:

Username	Default Password	Files	Description
`cfg`	`novatech`	`kronos2.cfg` (read/write) `kronos2.default` (read only)	Active configuration file Default configuration file. When the reset button on the back of the clock is pressed, then this file is copied to `kronos2.cfg`.
`upl`	`novatech`	`.fwu`	See Appendix F – Firmware Upgrade Procedure

Table 31: Default SFTP usernames and passwords

Note: It is recommended to change the default passwords at commissioning as described in section Access Passwords (Online).

This requires installing an SFTP client on the engineering PC. A SFTP client such as FileZilla (www.filezilla.org) or WinSCP (www.winscp.net) can be downloaded from the respective website. You can download an installation package or use the "portable" executable if available. The latter is just a .exe file that can be copied and run without needing to install anything. The following screens show the use of WinSCP.

When the program is started, you will be prompted for a hostname, username, and password (Figure 31).

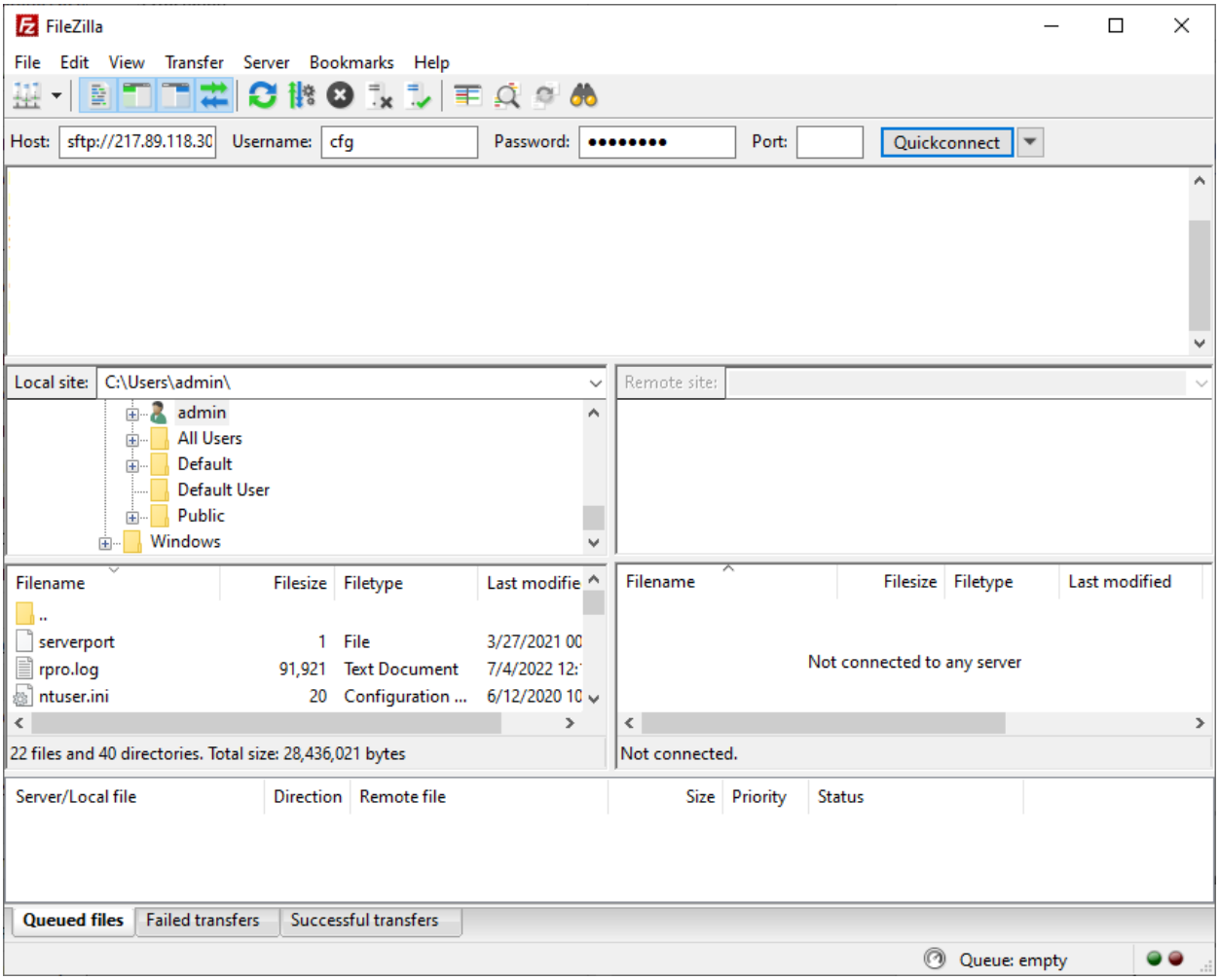


Figure 31: FileZilla

Field	Description
`Host`	Enter the IP address of the clock. The IP address is displayed briefly at the end of the boot sequence.
`Username`	Enter the appropriate user name. See also Table 31.
`Password`	Enter the appropriate password. See also Table 31.
`Port`	For SFTP, enter 22.

Table 32: FileZilla parameters

After entering hostname, username, and password, click the `Login` button.

If this is the first time that the SFTP client is connecting to this particular clock, you will see a warning about this being an “unknown server”.

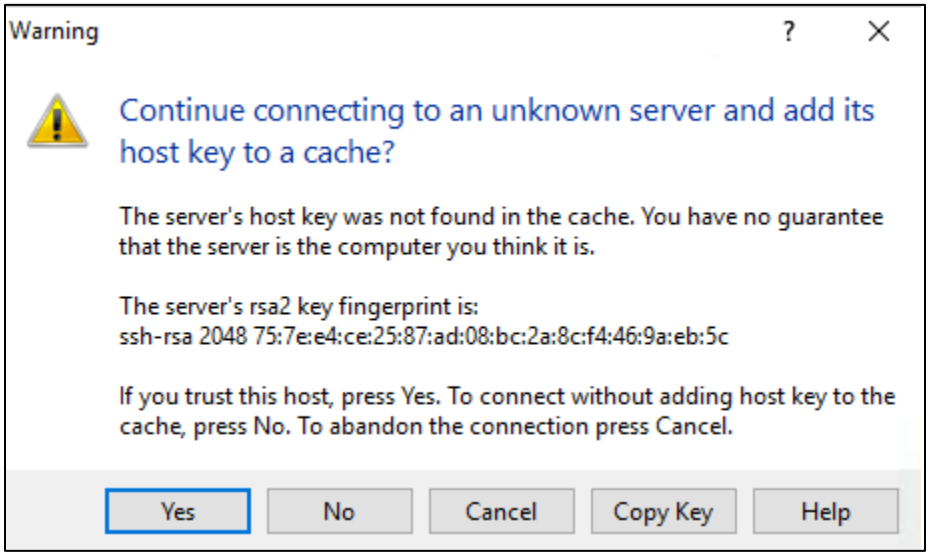


Figure 32: Unknown server warning message

Click `Yes` to add the host key to the cache of known keys.

After accepting the clock's fingerprint you will see a screen similar to Windows Explorer. On the left side are the files stored locally on your computer and on the right are the files on the clock.

You can click and drag from either window to copy files between your computer and the clock.

You can also use the built-in editor to edit the configuration file on-line. Changes in the configuration file become active as soon as the file is saved or closed.

You can also user other SFTP clients based on your preferences and computer's operating system. Other SFTP clients operate similarly to the description in this section.

7 Log Files

There are two log files in the clock.

Log File	Description
`kronos2.log`	This file registers major events in the clock, like power-up, first lock, transitions to and from HOLDOVER, LOWQUALITY, and BADTIME, configuration file changes, and firmware upgrades.
`cfg.log`	This file logs the configuration history of the clock.

Table 33: Kronos log files

Log files are "rotated" after reaching a size of 1MB: `kronos2.log` is renamed into `kronos2.log.1`, after `kronos2.log.1` is renamed into `kronos2.log.2`, and so on. The tenth file (`kronos2.log.10`) is effectively erased.

The `cfg.log` file is rotated in the same way.

All log files can be downloaded to a PC using an SFTP client (see section SFTP Access).

8 Troubleshooting and Maintenance

8.1 Troubleshooting

The following table shows troubleshooting steps for various scenarios.

Scenarios	Possible causes
`ant. open` displayed Alarm LED is on	▪ No antenna connected ▪ Antenna cable defective ▪ Surge arrester defective ▪ Wrong antenna connected
`ant. short` displayed Alarm LED is on	▪ Short-circuit in antenna cable or connector ▪ Antenna cable defective ▪ Surge arrester defective ▪ Wrong antenna connected
`bad time` displayed Alarm LED is on	▪ Poor antenna location

Table 34: Troubleshooting scenarios

8.2 Cleaning

If it necessary to clean the exterior of the clock, use only a dry cloth.

Before cleaning the clock, make sure that the primary voltage has been disconnected.

To avoid damages to the electrostatically sensitive electronic parts, no cleaning of internal parts should be performed.

Appendix A – Options

For the available options, see respective model builder at:

Series 2P	https://quotes.novatechautomation.com/pg/satellite-clocks/kronos-series-2p
Series 2R	https://quotes.novatechautomation.com/pg/satellite-clocks/kronos-series-2r

Table 35: Links to Model Number Builder

Note: If the P card is used, it must always be in the first expansion slot. If different cards are used, all A cards must be configured before any 1, 2, 4, or F cards. An A card cannot be installed after 1, 2, 4, and F cards.

Note: It is not possible to use the A card and the present P card version in the same clock.

Appendix B – Technical Specifications

The datasheets and drawings for the clock and the antenna accessories are available in the following locations.

Series 2P	https://www.novatechautomation.com/community/products/kronos-series-2p
Series 2R	https://www.novatechautomation.com/community/products/kronos-series-2r

Table 36: Links to Datasheets

The Series 2 offered with NovaTech antenna mount, cables, and surge arrester.

If another antenna is used, it must meet the following specifications:

- Constellation: GPS; Glonass, Galileo, Beidou if desired
- TNC female
- 50Ω
- 3.3V dc operating voltage
- Less than 100mA operating current
- Operating temperature range: -40°C to +85°C
- IP 67 enclosure

If another surge arrester is used, it must meet the following specifications:

- Bi-directional coaxial surge
- High energy gas discharge tube which can be replaced in the field
- TNC female
- Frequency range: DC to 3.5GHz
- Insertion loss: < 0.2dB
- Return loss: ≥ 20dB
- Nominal discharge current: 5kA
- Temperature range -50°C to 85°C
- IP 67
- UL 497E

Appendix C – Enclosure Dimensions and Panel Cutouts

Kronos Series 2P

The drawings are available at https://www.novatechautomation.com/community/products/kronos-series-2p.

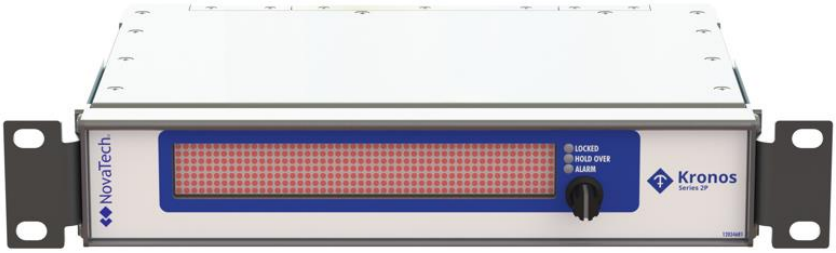


Figure 33: Series 2P front view

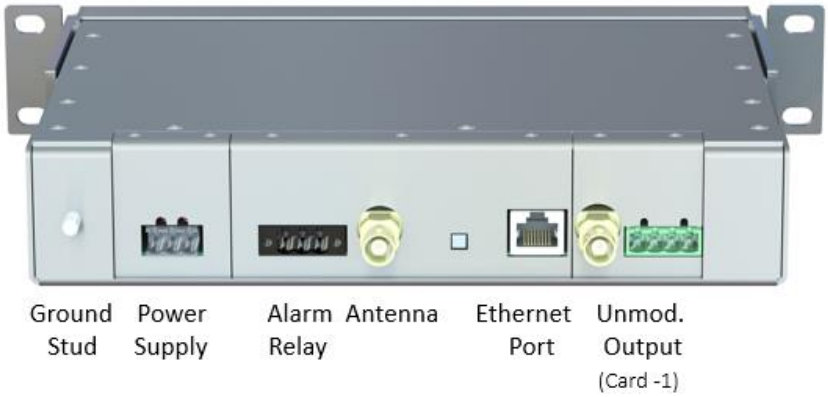


Figure 34: Series 2R rear view

Kronos Series 2R

The drawings are available at https://www.novatechautomation.com/community/products/kronos-series-2r.

Figure 35: Series 2R front view

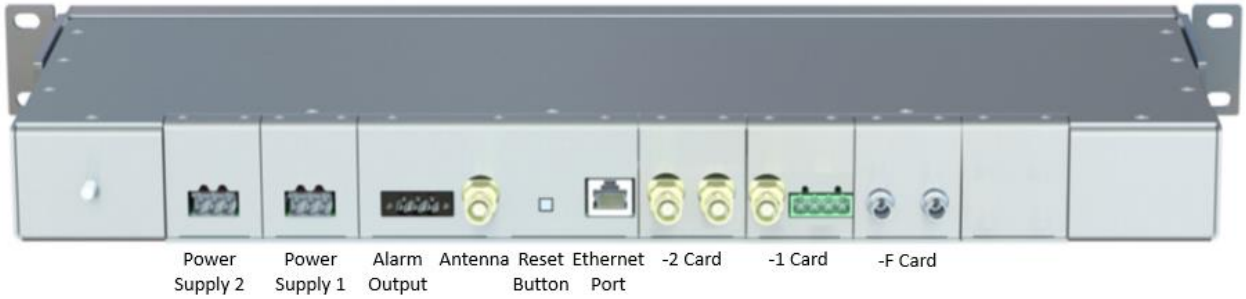


Figure 36: Series 2R rear view

Appendix D – Daylight Saving Time Rules

Western European Summer Time

Known as British Summer Time (BST) in the United Kingdom. Daylight saving time starts at 01:00 local time on the last Sunday in March and ends at 02:00 local time on the last Sunday in October.

Selected by using

```
DST_RULE = EUROPE_W
```

in the configuration file.

Central European Summer Time

Daylight saving time starts at 02:00 local time on the last Sunday in March and ends at 03:00 local time on the last Sunday in October.

Selected by using

```
DST_RULE = EUROPE
```

or

```
DST_RULE = EUROPE_C
```

in the configuration file.

Eastern European Summer Time

Daylight saving time starts at 03:00 local time on the last Sunday in March and ends at 04:00 local time on the last Sunday in October.

Selected by using

```
DST_RULE = EUROPE_E
```

in the configuration file.

North American DST Rule

Daylight saving time starts at 02:00 local time on the second Sunday in March and ends at 02:00 local time on the first Sunday in November.

Selected by using

```
DST_RULE = US
```

in the configuration file.

Brazilian DST Rule

Daylight saving time starts at 00:00 local time on the third Sunday in October and ends at 00:00 local time on the third Sunday in February.

Selected by using

```
DST_RULE = BRAZIL
```

in the configuration file.

Brazilian DST rule provides an exception should DST end during Carnival, stating that “details will be decided in time”. For this type of exception, use a custom DST rule, see section User-Defined DST Rule for details.

User-Defined DST Rule

To use a custom DST rule, place the following in the configuration file:

```
DST_RULE = CUSTOM
```

Additionally, values for DST_BEGIN and DST_END also have to be defined. These values can be specified using relative dates (“3rd Sunday in October”) or fixed dates (“the 3rd of March”).

For the specific syntax, see the following sections.

Begin / End Using Relative Dates

Use a value in the form

```
m.w.d/hh:mm
```

to specify day d of week w of month m. Day d must be between 0 (Sunday) and 6 (Saturday). Week w must be between 1 and 5; week 1 is the first week in which day d occurs, and week 5 specifies the last d day in the month. The month m should be between 1 (January) and 12 (December). Time hh:mm should be specified as local time. DST should begin at 02:00

Example: on the second Sunday in March and end at 02:00 on the last Friday in October:

```
DST_RULE = CUSTOM
DST_BEGIN = M3.2.0/02:00 ; second Sunday in March
DST_END = M10.5.5/02:00  ; last Friday in October
```

Begin / End on Fixed Dates

Use a value in the form

```
Jnnn/hh:mm
```

to specify the ordinal day-of-year (also referred to as Julian day) and the local time at which the change to/from DST should occur. nnn should be in the range 001 to 365. February 29 is never counted, even in leap years.

Example: DST should begin at 02:00 on the 1st of March and end at 00:30 on the 30th of October:

```
DST_RULE = CUSTOM
DST_BEGIN = J060/02:00 ; 1st Mar is ordinal day 60
DST_END = J304/00:30 ; 30rd Oct is ordinal day 304
```

Appendix E – Time Strings

NMEA GPZDA

$GPZDA,hhmmss.00,DD,MM,YYYY,SZZ,zz*CC<CR><LF>

When `TIME = UTC` is selected in the `[SERIAL]` section of the configuration file, the contents are:

`hh`	UTC hours	00–23
`mm`	UTC minutes	00–59
`ss`	UTC seconds	00–59
`DD`	UTC day-of-the-month	01–31
`MM`	UTC month	01–12
`YYYY`	UTC year	2000–2099
`SZZ`	local zone hours	+00 to ±13
`zz`	local zone minutes	00 to 59
`CC`	checksum	two hexadecimal digits representing the result of the XOR of all characters between `$` and `*` (`$` and `*` not included in the computation)
`<CR>`	carriage return	ASCII 13d
`<LF>`	line feed	ASCII 10d

Local time zone is the magnitude of hours plus the magnitude of minutes added, with the sign of local zone hours, to local time to obtain UTC. Local zone is generally negative for East longitudes with local exceptions near the International Date Line.

When `TIME = LOCAL` is selected in the `[SERIAL]` section of the configuration file, the contents are:

`hh`	local hours	00–23
`mm`	local minutes	00–59
`ss`	local seconds	00–59
`DD`	local day-of-the-month	01–31
`MM`	local month	01–12
`YYYY`	local year	2000–2099
`SZZ`	local zone hours	fixed at +00
`zz`	local zone minutes	fixed at 00
`CC`	checksum	two hexadecimal digits representing the result of the XOR of all characters between `$` and `*` (`$` and `*` not included in the computation)
`<CR>`	carriage return	ASCII 13d
`<LF>`	line feed	ASCII 10d

In this case, local time zone is set to +00:00.

Meinberg Standard

```
<STX>D:DD.MM.YY;T:w;U:hh.mm.ss;uvxy<ETX>
```

where

<STX>	start-of-text	ASCII 02d
DD	day-of-the-month	01–31
MM	month	01–12
YY	year	00–99
w	day-of-week	1–7 (1 means Monday)
hh	hours	00–23
mm	minutes	00–59
ss	seconds	00–59
u	clock status	␣ : locked to satellites # : low quality time signal
v	equipment status	␣ : all well * : alarm
x	time zone indicator	␣ : local standard time S : local daylight saving time U : UTC
y	discontinuity announcement (lasts one hour)	␣ : nothing to announce ! : start or end of DST A : leap second insertion
<ETX>	end-of-text	ASCII 03d

SAT

```
<STX>DD.MM.YY/w/hh:mm:sszzzzuy<CR><LF><ETX>
```

where

<STX>	start-of-text	ASCII 02d
DD	day-of-the-month	01–31
MM	month	01–12
YY	year	00–99
w	day-of-week	1–7 (1 means Monday)
hh	hours	00–23
mm	minutes	00–59
ss	seconds	00–59
zzzz	time zone abbreviation	up to 4 characters long (UTC, CET, CEST, …)
u	clock status	␣ : locked to satellites # : low quality time signal
y	discontinuity announcement (lasts one hour)	␣ : nothing to announce ! : start or end of DST
<CR>	carriage-return	ASCII 13d
<LF>	line-feed	ASCII 10d
<ETX>	end-of-text	ASCII 03d

SEL B1

```
ddd:hh:mm:ss<CR><LF>
```

where

ddd	day of the year	001–366
hh	hours	00–23
mm	minutes	00–59
ss	seconds	00–59
<CR>	carriage return	ASCII 13d
<LF>	line feed	ASCII 10d

SEL B5

```
l␣YY␣ddd:hh:mm:ss.000<CR><LF>
```

where

l	satellite locked status	␣ : locked to satellite ? : low quality time signal
YY	last two digits of year	00–99
ddd	day of the year	001–366
hh	hours	00–23
mm	minutes	00–59
ss	seconds	00–59
<CR>	carriage return	ASCII 13d
<LF>	line feed	ASCII 10d

SEL B6

```
ddd:hh:mm:ss␣q<CR><LF>
```

where

ddd	day of the year	001–366
hh	hours	00–23
mm	minutes	00–59
ss	seconds	00–59
q	time quality	␣ : locked to satellite . : better than 1 microsecond * : better than 10 microseconds # : better than 100 microseconds ? : worse than 100 microseconds
<CR>	carriage return	ASCII 13d
<LF>	line feed	ASCII 10d

SEL B8

`YYYY:ddd:hh:mm:ss␣q<CR><LF>`

where

`YYYY`	year	2000–2099
`ddd`	day of the year	001–366
`hh`	hours	00–23
`mm`	minutes	00–59
`ss`	seconds	00–59
`q`	time quality	`␣` : locked to satellite `.` : better than 1 microsecond `*` : better than 10 microseconds `#` : better than 100 microseconds `?` : worse than 100 microseconds
`<CR>`	carriage return	ASCII 13d
`<LF>`	line feed	ASCII 10d

Truetime/Kinemetrics

`<SOH>DDD:hh:mm:ssq<CR><LF>`

where

`<SOH>`	start-of-header	ASCII 01d
`DDD`	day-of-year	001–366
`hh`	hours	00–23
`mm`	minutes	00–59
`ss`	seconds	00–59
`q`	clock status	`␣` : normal `?` : low quality time signal
`<CR>`	carriage return	ASCII 13d
`<LF>`	line feed	ASCII 10d

Appendix F – Firmware Upgrade Procedure

The Kronos firmware can be updated in the field. NovaTech's Support Site provides the firmware to download for performing the update.

Login credentials are required for access to the Support Site (https://support.novatechautomation.com) and are available from a support@novatechautomation.com or a NovaTech Sales Representative.

Do not power-cycle or restart the clock during the update process. Such action will interrupt the update process and usually requires returning the clock to the factory. The update process completes with either a "Success" or "Failure" message as described in this manual. If the update process takes longer than expected, contact NovaTech Technical Support at (913) 451-1880.

The current Kronos firmware version is displayed as `Firmware Version` under `General` on the left side of the Kronos dashboard. Access the dashboard by entering the IP address of the clock in the web browser (Figure 39).

If necessary, the IP address can be determined by pressing the knob on the front of the clock. Then the IP address will be displayed for a few seconds (Figure 37).

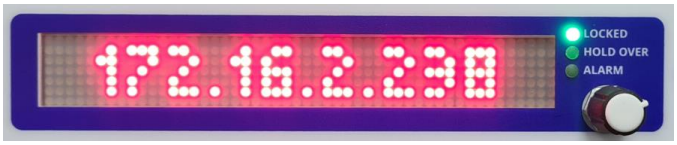


Figure 37: Determine IP address

If the dashboard is password-protected, first the following window (Figure 38) is displayed for entering the password. Enter your custom password. In case the password has not been changed from the factory setting, the default password is `novatech`. Then the dashboard is displayed.

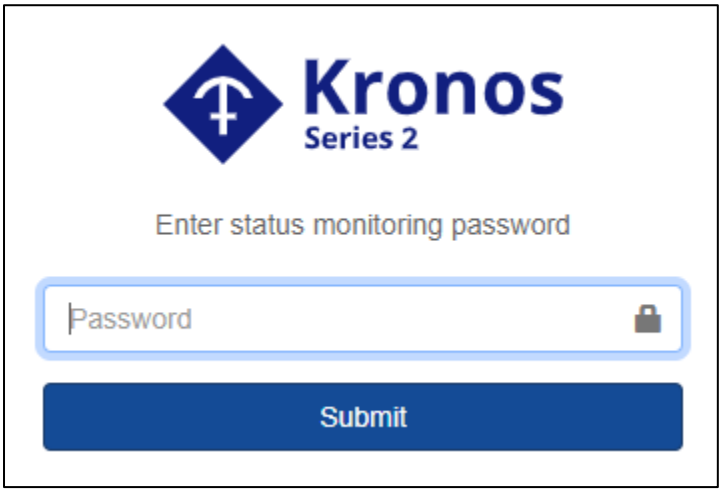


Figure 38: Enter dashboard password

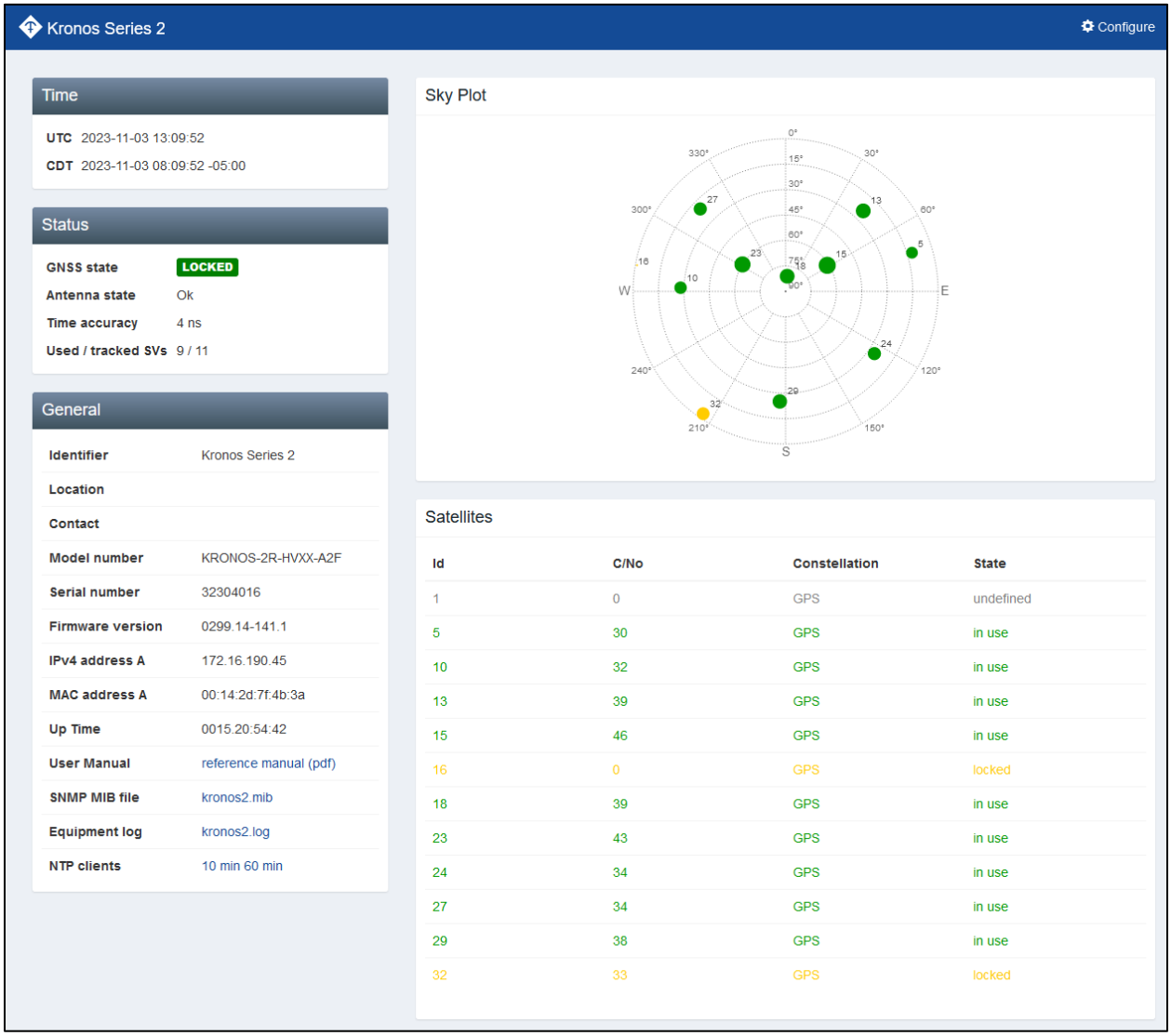


Figure 39: Kronos firmware version on dashboard

In this example, the firmware version is 0299.14-141.1.

If the support site has a newer firmware version available than is running in the Kronos clock, check the release notes for applicability to your issue and download the new firmware.

Use a SFTP client such as FileZilla to upload the new firmware to the Kronos clock. After a power cycle, the firmware procedure installation is automatically started.

1. Using the SFTP client, log in to the clock as user `upl` using your firmware update password. The default password is `novatech`. Make sure to prefix the clock's IP address with `sftp://` or manually set the port number to `22`.

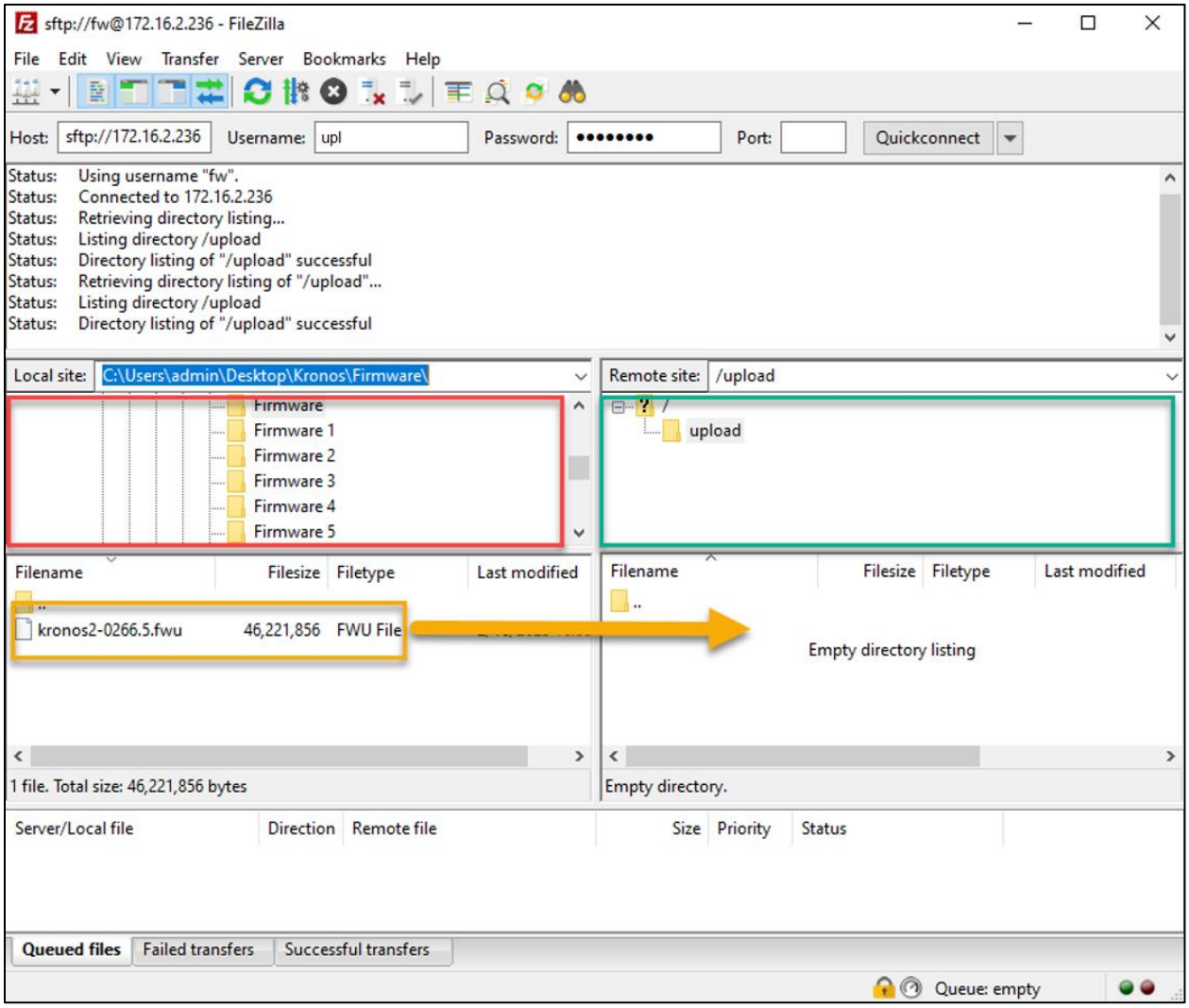


Figure 40: Upload the new firmware

3. After you connect to the clock, the SFTP client displays the above or a similar window. The green frame points to the correct directory in the clock. In the red frame, navigate to the directory on your PC where the new firmware is located. This file will be displayed in the orange window. Then drag-and-drop the file to the pane that the orange arrow points to. Then the new firmware will be uploaded to the clock.

4. Once the upload is complete, turn off the clock.

5. Wait 10 seconds.

6. Turn the clock on again. The clock will show the firmware version and the progress bar, as usual.

7. At the end of the startup sequence, the dot matrix display will show the following messages in order:

```
FW UPGRADE

Unpack

Verify

Install

Done
```

Figure 41: Firmware upgrade completed

8. Turn the clock off again.
9. Wait 10 seconds.
10. Turn the clock on again. The clock should show the new firmware version on the dot matrix display and start as usual.

Possible Error Messages

Error Message	Description
ERROR 01	Checksum invalid, file corrupted. Download the file from https://support.novatechautomation.com again.
ERROR 02	Digital signature invalid. Only digitally signed firmware upgrade files can be installed.
ERROR 03	Wrong firmware version. Upgrade not possible. Contact NovaTech at support@novatechautomation.com.
ERROR 99	Unexpected error. Contact NovaTech at support@novatechautomation.com.

Table 37: Error messages

Appendix G – Sample Configuration File

```
# kronos series 2 configuration file

# FIRMWARE version
VERSION = 04.02

# certificates and keys for SSH and HTTPS/websockets
[KEYS]
SSH = novatech
HTTPS = kronos2

# IDENTIFIER, LOCATION and CONTACT are shown on the dashboard web page and
# reported as sysName, sysLocation and sysContact when using SNMP
# Replace with values meaningful to the installation
[GENERAL]
IDENTIFIER = Kronos Series 2
LOCATION =
CONTACT =

# Timezone and daylight saving time rules
# In order to disable DST, specify DST_RULE = NONE
[TIMEZONE]
OFFSET = 00:00
STD_NAME = UTC
DST_NAME = UTC
DST_RULE = NONE
DST_BEGIN = M3.5.0/02:00
DST_END = M10.5.0/03:00

# GNSS related settings
# ANT_DELAY is the antenna cable delay compensation in nanoseconds (~4 ns for
each meter of coax cable)
# GALILEO, GLONASS and BEIDOU can be set to TRUE/FALSE in order to
enable/disable the usage of additional constellations
# FORCEGNSS and FORCETIME can be used to simulate antenna connection and GNSS
signal reception
# (use for commissioning work only, set to FALSE before normal operation !)
[GNSS]
ANT_DELAY = 60
GALILEO   = FALSE
GLONASS   = FALSE
BEIDOU    = FALSE
FORCEGNSS = FALSE
FORCETIME = 2024-10-01 12:00

# User defined out-of-bounds limits (in miliseconds)
# Valid values are from 0.001 (1 microsecond) to 4000 (4 seconds)
[LIMITS]
LOWQUALITY = 0.5
BADTIME = 1000

# Selects what is shown on the unit's dot matrix display
# MODE can be:
# 1: day-of-year (001 to 366) + HH:MM:SS
```

```
# 2: HH:MM:SS + STD_NAME/DST_NAME of TIMEZONE
# 3: HH:MM:SS + TIMEZONE OFFSET
# 4: dd mmm  HH:MM:SS
# 5: HH:MM:SS + number of satellites used in solution
[DISPLAY]
MODE = 4

# Network parameters
# MODE can be one of DHCP, SINGLE, DUAL, BALANCE-RR, ACTIVE-BACKUP or
# BROADCAST
# IPADDRB and NETMASKB are only used if MODE=DUAL
# MODE = SELECT prompts the user to select DHCP or single fixed IP address
# CHANGEIP enables/disables changing the IP address of eth0 using the rotary
knob on the front panel
# (see user manual for further details)
[NETWORK]
CHANGEIP = TRUE
MODE     = SELECT
IPADDR   = 192.168.0.1
IPMASK   = 255.255.255.0
GATEWAY  = 192.168.0.254
IPADDRB  = 10.0.0.181
IPMASKB  = 255.255.255.0

# VLAN configuration (only supported if MODE=SINGLE in [NETWORK])
# (repeat as often as needed)
#[VLAN10]
#IPADDR  = 172.16.10.100
#IPMASK  = 255.255.255.0
#GATEWAY = 172.16.10.1

#[VLAN20]
#IPADDR  = 192.168.20.99
#IPMASK  = 255.255.255.0
#GATEWAY = 192.168.20.1

# SNMP parameters: there are separate sections for versions 1, 2c and 3.
Uncomment to enable.
[SNMPv1]
RO_COMMUNITY = PRIVATE

[SNMPv2c]
RO_COMMUNITY = PRIVATE
TRAP_COMMUNITY = secret.trap.community
TRAP_HOST1 = 172.16.0.10
TRAP_HOST2 = 172.16.0.20

[SNMPv3]
AUTH_NAME = whatever.you.want
AUTH_KEY = very.secret.password
AUTH_PROTOCOL = SHA

# Settings for datagram contents and speed over serial port
# TIMESTRING can be NONE, SELB1, SELB5, SELB6, SELB8, GPZDA, MEINBERG,
# TRUETIME or SAT
# BITRATE can be 1200, 2400, 4800, 9600, 19200 or 38400 BPS
# TIMEBASE specifies the timebase to use (UTC or LOCAL)
```

```
# PPS selects if the time reported refers to the CURRENT or NEXT PPS pulse
[SERIAL]
TIMESTRING = GPZDA
BITRATE = 9600
FORMAT = 8N1
TIMEBASE = LOCAL
PPS = NEXT

# Settings for remote syslog
# Leave TARGET_A and TARGET_B empty to disable remote syslog
[SYSLOG]
LEVEL = NOTICE
TARGET_A =
PORT_A = 514
PROTOCOL_A = UDP
TARGET_B =
PORT_B = 514
PROTOCOL_B = UDP

# Signal generation on OUTPUT1 .. OUTPUT6
[OUTPUT1]
# OPTIONS = OFF, IRIG-B120, IRIG-B122, IRIG-B124, IRIG-B126
SIGNAL = IRIG-B124
TIME = LOCAL
POLARITY = NORMAL

[OUTPUT2]
# OPTIONS = OFF, IRIG-B120, IRIG-B122, IRIG-B124, IRIG-B126
SIGNAL = IRIG-B124
TIME = LOCAL
POLARITY = NORMAL

[OUTPUT3]
# OPTIONS = OFF, IRIG-B000, IRIG-B002, IRIG-B004, IRIG-B006, PPS, PPM
SIGNAL = IRIG-B004
TIME = LOCAL
POLARITY = NORMAL

[OUTPUT4]
# OPTIONS = OFF, IRIG-B000, IRIG-B002, IRIG-B004, IRIG-B006, PPS, PPM
SIGNAL = IRIG-B004
TIME = LOCAL
POLARITY = NORMAL

[OUTPUT5]
# OPTIONS = OFF, IRIG-B000, IRIG-B002, IRIG-B004, IRIG-B006, PPS, PPM
SIGNAL = IRIG-B004
TIME = LOCAL
POLARITY = NORMAL

[OUTPUT6]
# OPTIONS = OFF, IRIG-B000, IRIG-B002, IRIG-B004, IRIG-B006, PPS, PPM
SIGNAL = IRIG-B004
TIME = LOCAL
POLARITY = NORMAL
```

Revision	Date	Changes
A	03/03/2023	Initial release. BM
B	03/23/2023	Updated firmware update procedure, options information, alarm relay information. BM
C	04/11/2023	Removed serial. BM
D	05/04/2023	Added B000, B002, B006, B120, B122, B126. Dashboard update. Firmware version 273.5. BM
E	07/14/2023	Upgrade to form C alarm output and universal antenna. New antenna mount. FileZilla screenshot. IRIG-B cabling. Options AA and AM. Support site. BM
F	12/06/2023	Updated screenshots, channels, accessories. Added quad output card. Firmware 0307. Mounting length. BM
G	02/14/2025	Firmware version 04.02.02. Firmware and release notes are available on the Support Site. Updated GNSS information. Updated antenna power information. Added Pctel antenna. BM
H	05/27/2025	Added offline serial configuration. Moved specs and drawings to Community.