	Standard	**Technology**

Title: **SEL-2488 GPS TIME SYNCHRONISING UNIT CONFIGURATION GUIDE**

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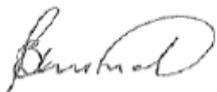
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1. Introduction

This document outlines the necessary steps required to adequately configure the SEL-2488 GPS clock.

2. Supporting clauses

2.1 Scope

This document serves to aid users tasked with configuring the SEL-2488 GPS Time Synchronizing Unit for application in Eskom Transmission substations.

2.1.1 Purpose

This document serves to aid users tasked with configuring the SEL-2488 GPS Time Synchronizing Unit. Due to the technical nature of this document, large extracts have been taken out of the SEL-2488 user manuals and associated documentation from Schweitzer Engineering Laboratories, Inc [2].

2.1.2 Applicability

This document shall apply throughout Eskom Holdings SOC Limited's Transmission Division.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1]	ISO 9001	Quality Management Systems
[2]	SEL-2488	Satellite-Synchronized Network Clock, Instruction Manual
[3]	240-64100247	Standard for Earthing of Secondary Plant in Substations
[4]	474-283	Technical Specification for GPS Time Synchronising Unit
[5]	6AGW-7101-M1	Main 1 Gateway Panel Design
[6]	6AGW-7101-M2	Main 2 Gateway Panel Design

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

Definition	Description
DB-9	D-sub 9 Connector.
ETH F	Front Ethernet Interface.
Form A	A Form A contact is one that is normally open (NO) when the contact is in a de-energized state.
Form C	A Form C contact contains both normally open (NO) and normally closed (NC) contacts. NO and NC refer to the state of the contact when it is in a de-energized state.

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2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
ASCII	American Standard Code for Information Interchange
BNC	Bayonet Neill–Concelman
CIDR	Classless Inter-Domain Routing
COM	Communications
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
FID	Firmware Identification Number
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HTTPS	Hyper Text Transfer Protocol Secure
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IRIG	Inter-range instrumentation group
ISO	International Organization for Standardization.
kPPS	Kilo Pulse per Second
LCD	Liquid-crystal Display
MIB	Management Information Base
NTP	Network Time Protocol
OID	Object Identifier
PPH	Pulse per Hour
PPM	Pulse per Minute
PPS	Pulse per Second
SEL	Schweitzer Engineering Laboratories
SNMP	Simple Network Management Protocol
URL	Uniform Resource Locator
UTC	Coordinated Universal Time

2.5 Roles and responsibilities

Not Applicable

2.6 Process for monitoring

Not Applicable

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2.7 Related/supporting documents

Not Applicable

3. SEL-2488 GPS Time Synchronising Unit Configuration Procedure

3.1 Connecting to the SEL-2488

The SEL-2488 is equipped with a front management port (ETH F) which can be utilised for configuration.

The front management port is a captive port which combines a subset of Dynamic Host Configuration Protocol (DHCP) and Domain Name System (DNS) applications to assist with the automatic network configuration of devices connected to the port. The Captive Port on the SEL-2488 is intended to supply a single IP address to a device directly connected to it and is not meant to supply a multitude of IP addresses to a network of devices.

In the event a configuration error disables this interface and renders the clock inaccessible, one can depress the pin-hole reset button located next to the alarm output contact for 5 seconds. This resets the interface and re-enables the Captive port.

To be able to connect with the SEL-2488 from an engineering workstation, configure the workstations network interface adaptor for automatic configuration through Dynamic Host Configuration Protocol (DHCP). Navigate to the network interface adaptor configuration settings and select "Obtain an IP address automatically" and "Obtain DNS server address automatically".
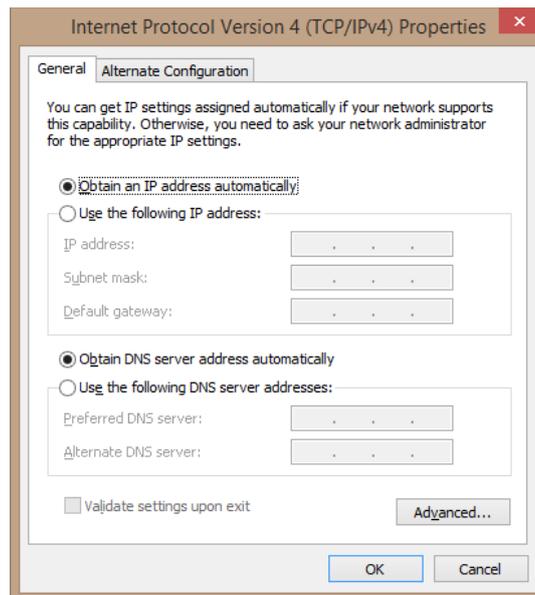
Figure 1: Local Area Connection Properties

Connection to the front management port is achieved using a standard RJ45 copper Ethernet cable illustrated below. Once connected, the Captive port DHCP server assigns the workstation an IP address adjacent to the IP address of the SEL-2488, so the computer will be on the same subnet and capable of communicating with it. It also sets the DNS server for the computer to the IP address of your SEL-2488. Once this occurs, any DNS requests from the computer will resolve to the SEL-2488, so that browsing to any host, such as www.selinc.com, results in opening the web management interface of your SEL-2488.

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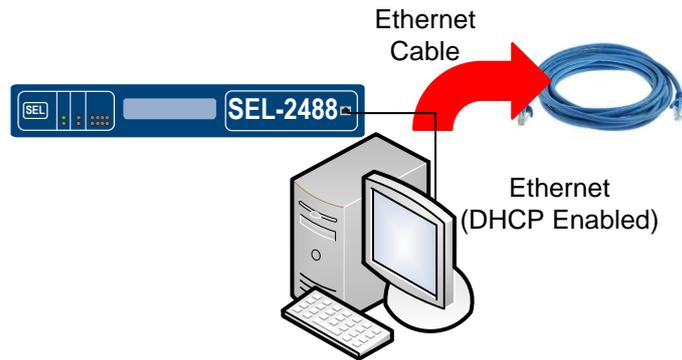
Figure 2: Commissioning Network

Configuration and management of the SEL-2488 is done through the device management webpage which is securely accessible from any Internet browser client (e.g. Internet Explorer, Chrome, Mozilla Firefox etc.) using HTTPS. The recommended browser to be used is Microsoft® Internet Explorer® 9 or higher. The default URL for the web server via the ETH F port is https://192.168.1.2. Upon initial use, the management interface can only be reached through the front management port, however through this connection, additional management interfaces can be configured.

Figure 3: SEL-2488 Device Webpage with Dashboard Display

The web management interface can allow multiple concurrent user sessions and is equipped with a session timeout which logs a user out if left to idle for the timeout period. These settings are configurable and can be accessed by navigating to System > Global Settings.
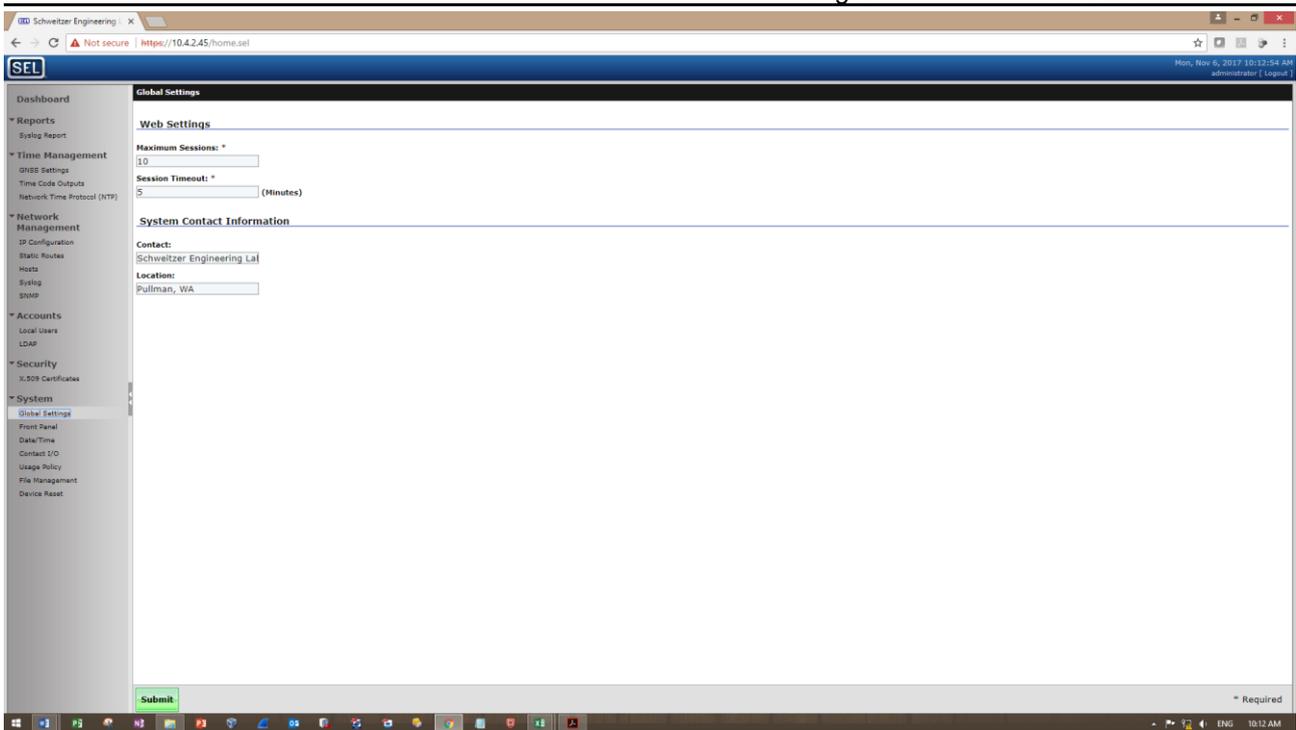
Figure 4: Web Settings

The applicable settings are detailed below:

Table 1: Web Settings

Setting	Values	Default	Description
Maximum Sessions	1-20	5	Maximum number of concurrent web user sessions.
Session Timeout	1-60 minutes	5	Time a user session is inactive before the device terminates the session.

3.2 User Management

Upon connection to the SEL-2488, a user will see the device usage policy and a login prompt. The login prompt includes fields for entering a username and the password associated with that username. To log in, the user must enter a valid username and the appropriate password. Usernames are case insensitive and unique to each individual granted authority to access the device. Users who enter valid usernames and matching passwords will have access to the device based the privileges assigned to them.

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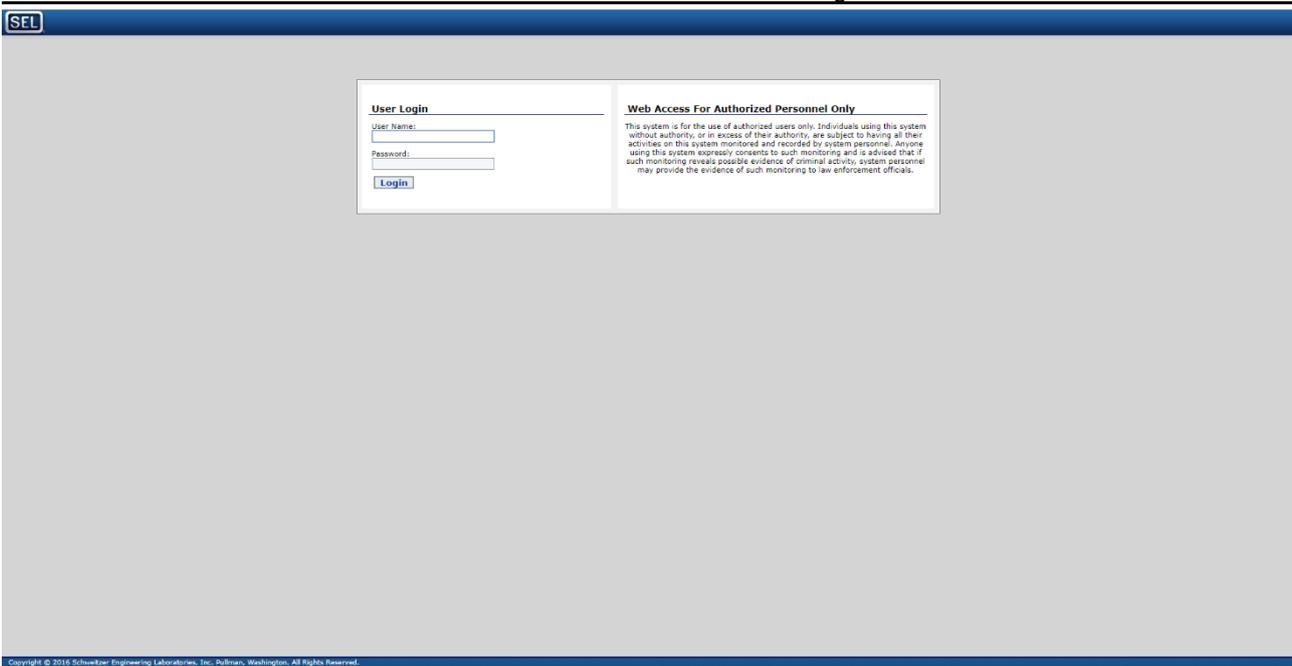
Figure 5: Web Login Prompt and Usage Policy

Each user account is associated with a user-role which has predefined device permissions. An overview of each role is briefly tabulated below. The SEL-2488 requires that at least one Administrator level account be available and enabled always.

Table 2: User Roles

Role	Permission
Administrator	Users have full access to the device.
Engineer	Users have access to most device settings and information, but cannot access user account management.
User Manager	Users have access to user account management. Access to other settings is restricted.
Monitor	Users have read-only access to device settings.

As a user with Administrator or User Manager role assignment, one can add, delete and edit user accounts. Configure user accounts by navigating to the Accounts > Local Users menu option.

The User Management section contains three pages: List Users, Add New User, and Change Your Password. The List Users Page provides a list of users that have been created on the device and the status regarding each user accounts. Each existing account record has an associated edit and delete button with the exception being the user account currently being logged into.

By clicking the edit button, one navigates to the Edit User page. The Edit User page provides options which allows settings of an existing user account to be changed.
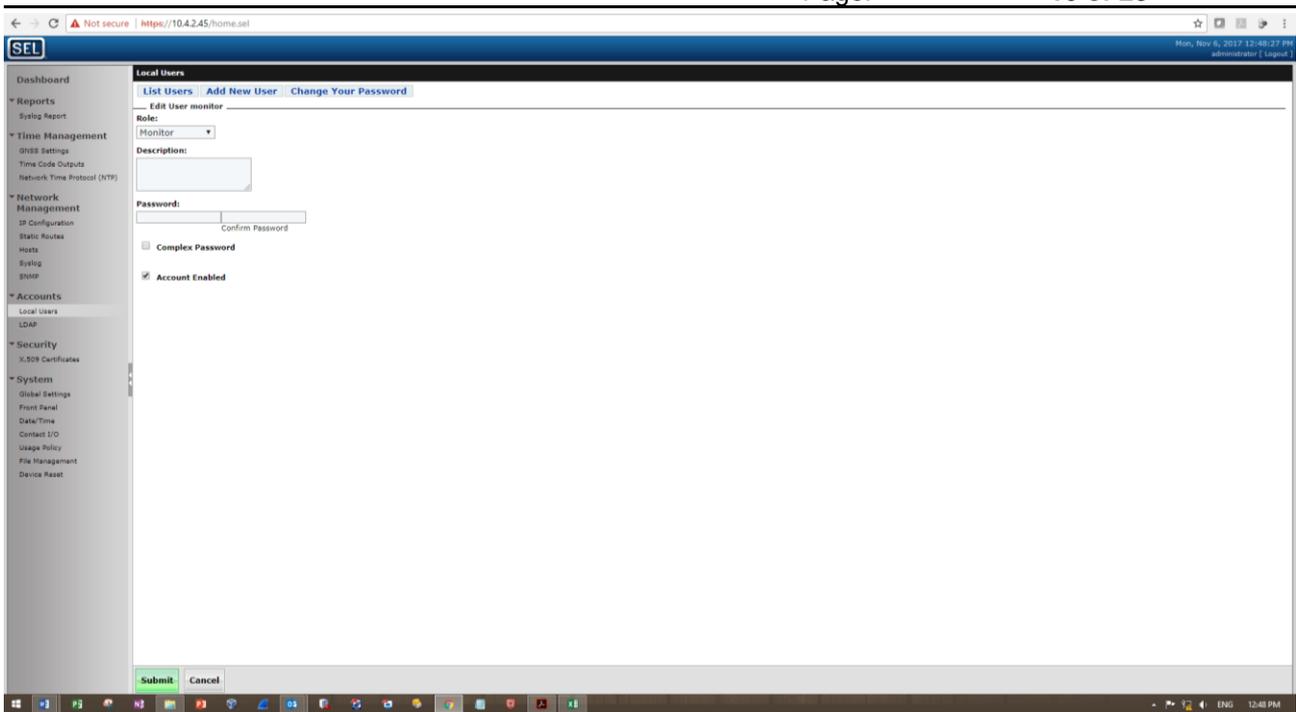
Figure 6: Edit User Page

Clicking the Delete button associated with a user account results in the display of a dialog box which confirms the deletion of the user.
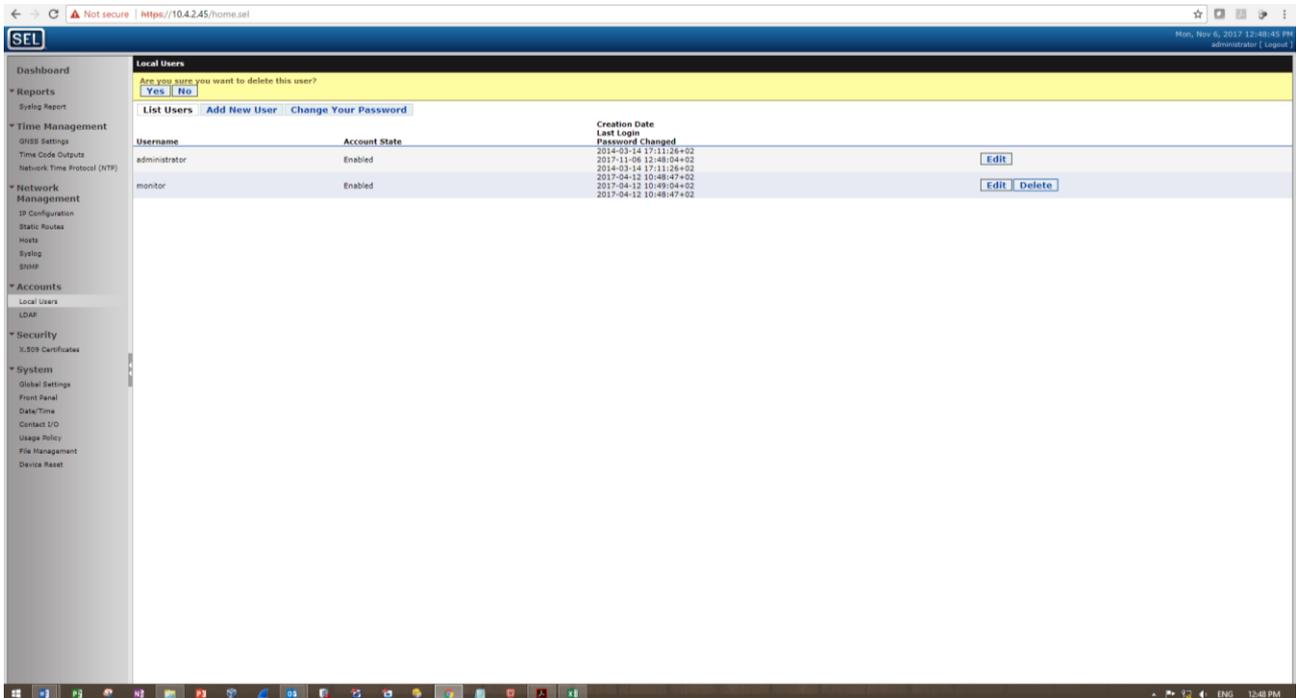
Figure 7: Delete User Dialog

The Add New User page provides settings fields which allow for the creation of a user account. These fields are detailed below.

Table 3: User Management Settings

Settings Field	Description
Username	Name that user will use to access device. Name is not case sensitive and will be displayed as lowercase (as many as 63 ASCII characters).
Role	Permission that will be granted to user (Administrator, Engineer etc.).
Description	Optional description of account (as many as 4096 characters)
Password/Confirm Password	Password for user account. Must be entered in both Password and Confirm Password fields (as many as 72 characters)
Complex Password	Enforces use of complex password rules.
Account Enabled	Enables or disables the user account.
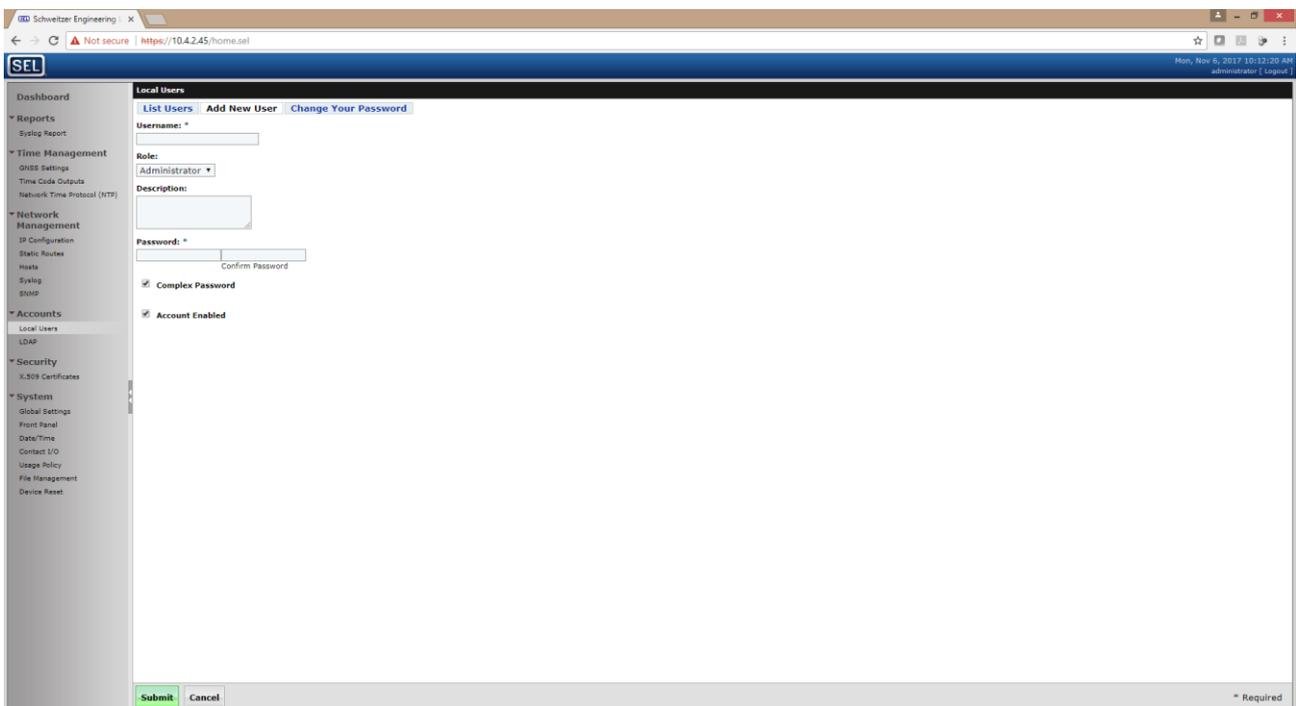
Figure 8: Add New User Tab

The Change Your Password page allows each user (irrespective of the user's role assignment) to change the password of the local user account that is logged into and currently accessing the SEL-2488.
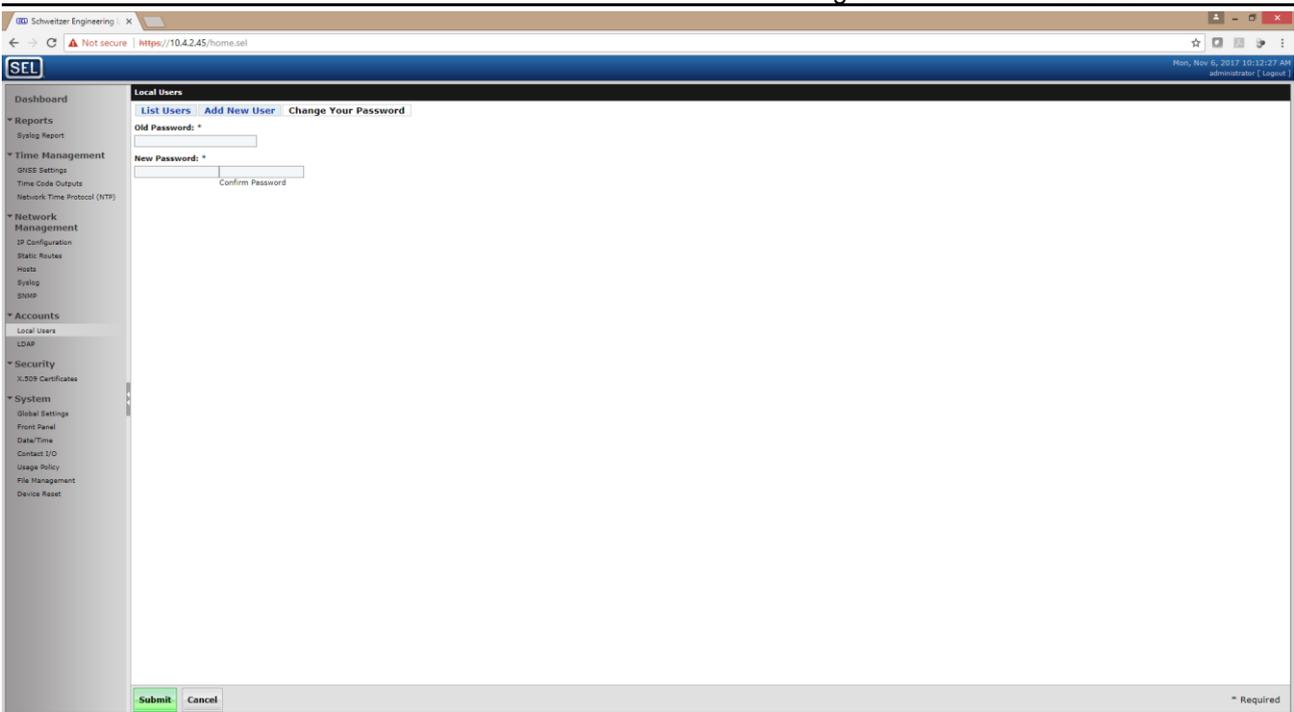
Figure 9: Change Your Password Tab

3.3 Firmware Upgrade

The SEL-2488 firmware revision number (FID) provides the current firmware version/patch level. The FID can be found on the Dashboard page of the web management interface or on the front-panel LCD.

Figure 10: Firmware Revision Number (FID)
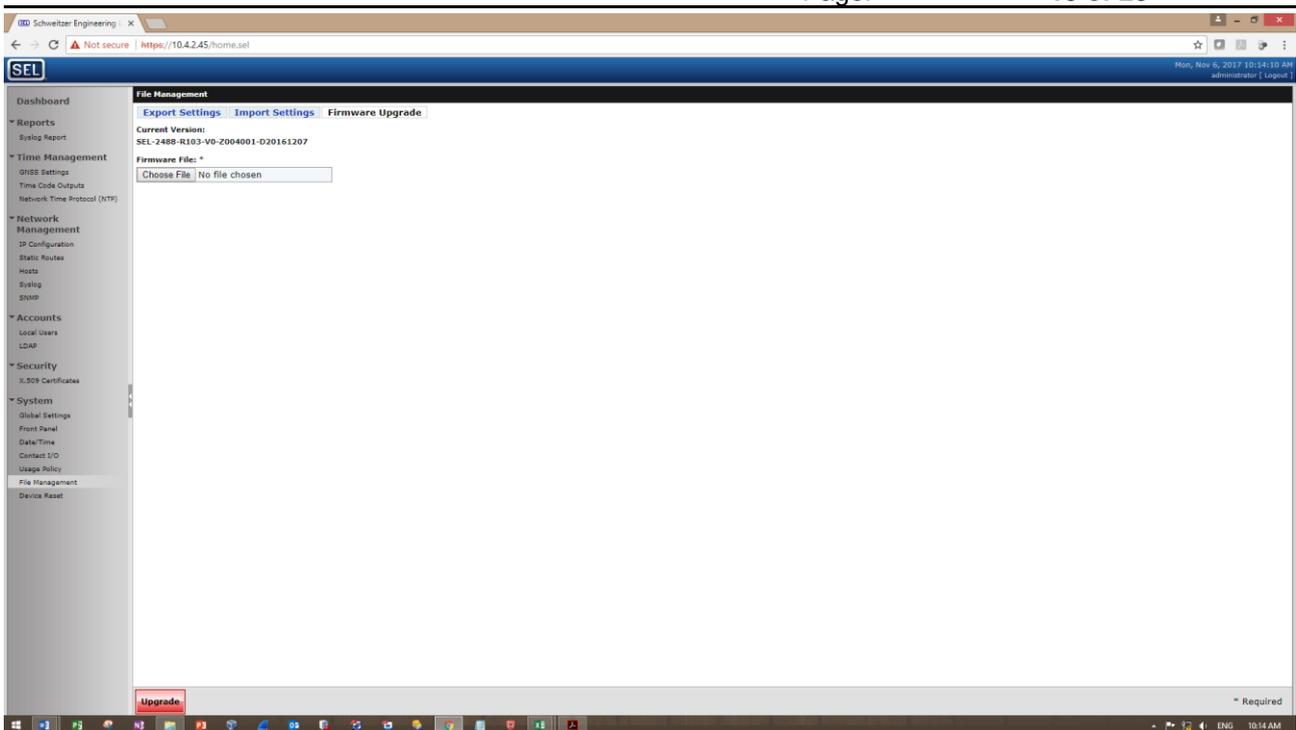
Figure 11: Firmware Management/Firmware Upgrade

Clicking the Upgrade button at the bottom of the page begins the new firmware upload and installation process. The device displays Upgrading Firmware and periodically updates the progress of the upgrade operation. Completion of a firmware upgrade takes about 10 minutes.

3.4   IRIG-B

The SEL-2488 comes standard with eight Bayonet Neill–Concelman (BNC) outputs (labelled TO1 to TO8) and a single DB-9 output (labelled COM1). Each of these ports can independently output demodulated IRIG-B, kilo pulses per second (kPPS), and pulses per second (PPS). Ports TO1 through TO4 can output modulated IRIG-B signals. Refer to section 3.7 Timer contact for the Pulse per minute (PPM) configuration parameters.
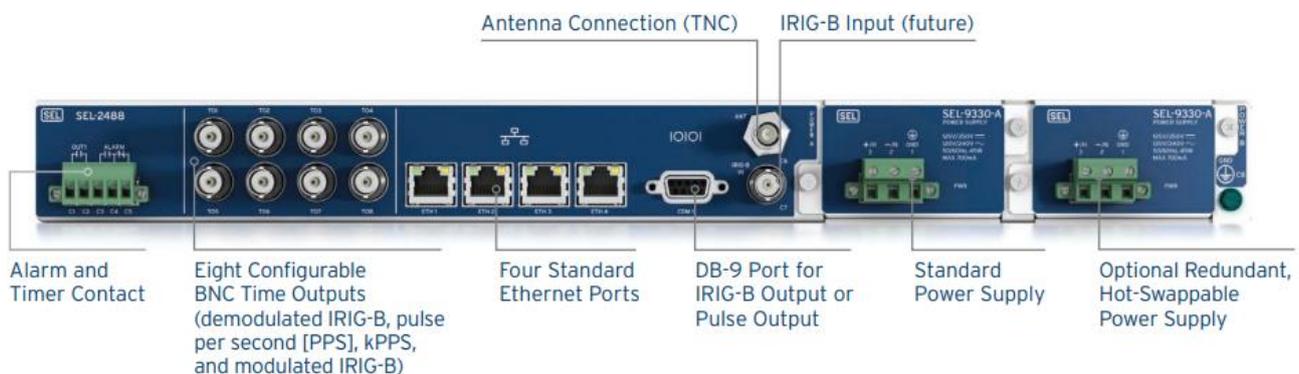
Figure 12: SEL-2488 Rear View illustrating the time outputs [2]

The SEL-2488 outputs IRIG-BXX4 with C37.118-2011 control bit extensions. For slave devices, which cannot decode this format, IRIG-BXX2 is an available signalling option. IRIG-BXX4 as opposed to IRIG-BXX2, includes the year and is recommended to be used for synchronizing the substation gateway. Below is a description of the supported signalling options.

Table 4: Signal Output Formats

Signal Format	Description
IRIG-B002	Transmit demodulated IRIG-B002 in local time or Coordinated Universal Time (UTC). Format does not send year or control bits.
IRIG-B004 (Recommended Setting)	Transmit demodulated IRIG-B004 format in local time or UTC. Control bits comply with the IEEE C37.118.1-2011 standard (reverse compatible with IRIG-B000 and IEEE C37.118-2005).
IRIG-B122	Transmit modulated IRIG-B122 in local time or UTC. Format does not send year or control bits.
IRIG-B124	Transmit modulated IRIG-B124 format in local time or UTC. Control bits comply with the IEEE C37.118.1-2011 standard (reverse compatible with IRIG-B120 and IEEE C37.118-2005).
kPPS	Transmit 1,000 pulses per second.
PPS	Transmit 1 pulse per second.
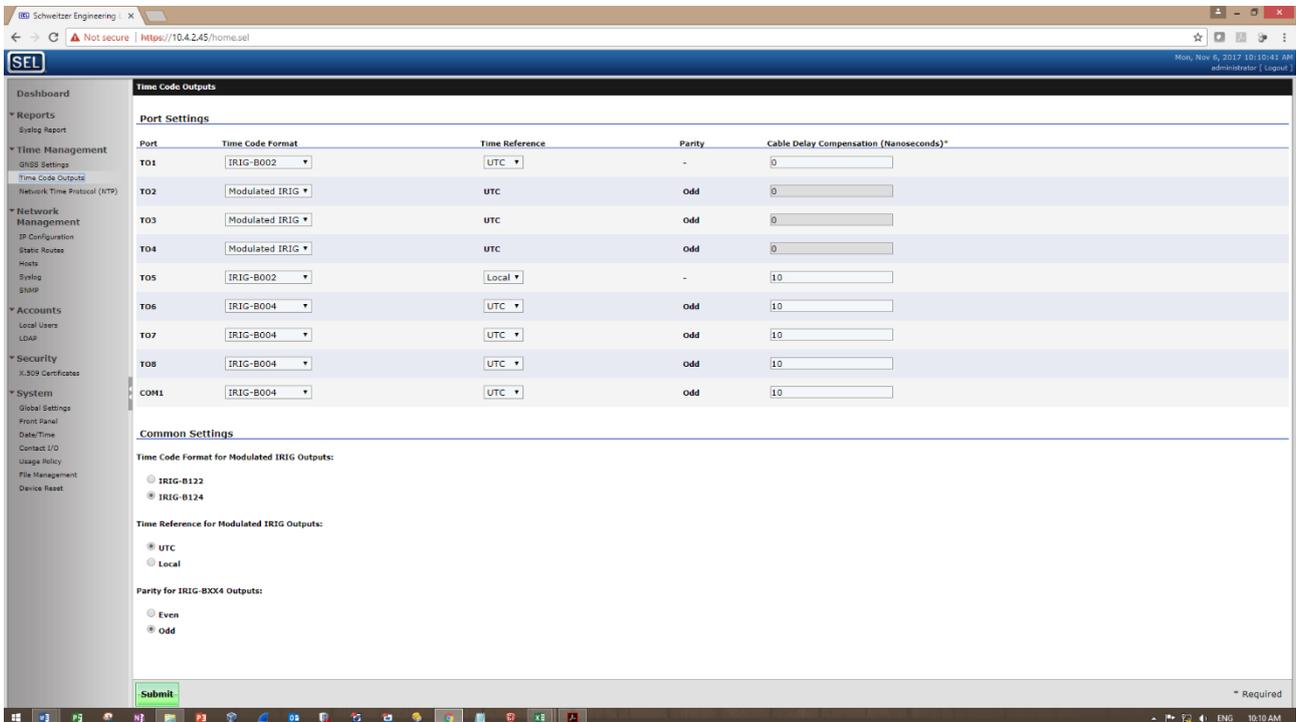
Figure 13: Time-Code Outputs Settings Web Interface

Configuration of IRIG-B begins by selecting the Time Code Outputs menu option. The Time Code Outputs page allows settings for each of the individual output ports, TO1 to TO8, and COM1.

The applicable time-code output settings are described below. All time outputs allow configuration of the ports as IRIG-B002, IRIG-B004, kPPS, and PPS. Ports TO1 through TO4 can individually be configured for modulated IRIG-B output. Common settings control the modulated time configuration. One can only choose one time-code format and time reference for all ports configured for modulated time.

Table 5: Time-Code Output Common Settings

Setting	Values	Default	Description
Time Code Format for Modulated IRIG-B Outputs	IRIG-B122 IRIG-B124	IRIG-B124	Selects the format of the modulated IRIG-B signal for the ports using modulated IRIG-B output.
Time Reference for Modulated IRIG-B Outputs	UTC, Local	UTC	Selects Local or UTC time for the modulated IRIG-B messages.
Parity for IRIG-BXX4 Outputs	Even, Odd	Odd	Sets the parity of the IRIG-B frame.

Table 6: Time-Code Output Port Settings

Setting	Values	Default	Description
Time Code Format (Ports TO1–TO4)	IRIG-B002, IRIG-B004, Modulated IRIG-B(122,124), PPS, KPPS	IRIG-B004	Sets TO1–TO4 to the specified signal format.
Time Code Format (Ports TO5–TO8, COM1)	IRIG-B002, IRIG-B004, PPS, KPPS	IRIG-B004	Sets TO5–TO8 and COM1 to the specified signal format.
Time Reference	Local, UTC	UTC	Selects local time or UTC for the IRIG-B message. When Modulated IRIG Output is selected, tracks Common Settings Time reference. This setting has no effect on PPS or kPPS signals.
Parity	Even, Odd	Odd	Not directly settable on port, tracks to common Parity for IRIG-BXX4 Outputs setting when IRIG-B004 or Modulated with IRIG-B124 format selected. Otherwise, set to "-".
Cable Delay Compensation	0–2500 ns	10	Compensates for signal delays introduced by cable type and length, adjustable for demodulated, kPPS, or PPS formats. When modulated time format is selected for a port, this setting for that port is forced to 0 and is not adjustable. This setting is entered in nanoseconds of delay: RG-58: 5 ns/meter (1.52 ns/foot) RG-8X: 3.87 ns/meter (1.18 ns/foot)

3.4.1   Recommended Settings

The SEL-2488 within the context of its application in the solution design [5,6], utilises COM 1 as an IRIG-B output to synchronise the substation gateway. The recommended settings to be configured for are tabulated below.

Table 7: COM 1 IRIG-B Recommended Time Code Output Settings for D400 gateway

Setting	Values
Time Code Format (T01-T04)	IRIG-B122
Time Reference	UTC
Parity	Odd
Cable Delay Compensation	10 ns

Table 8: COM 1 IRIG-B Recommended Time Code Output Settings for SEL 3555 gateway

Setting	Values
Time Code Format (COM1)	IRIG-B004
Time Reference	UTC
Parity	Odd
Cable Delay Compensation	10 ns

3.5 Ethernet Interfaces

The SEL-2488 has four network interfaces for normal network connections and one interface on the front designed for local management of the device. All the interfaces are independent of each other and do not pass (bridge or route) network traffic among the interfaces.

The Network Interface Settings are accessible by navigating to the Network Management > IP Configuration menu option. The applicable settings are described in the tables below.
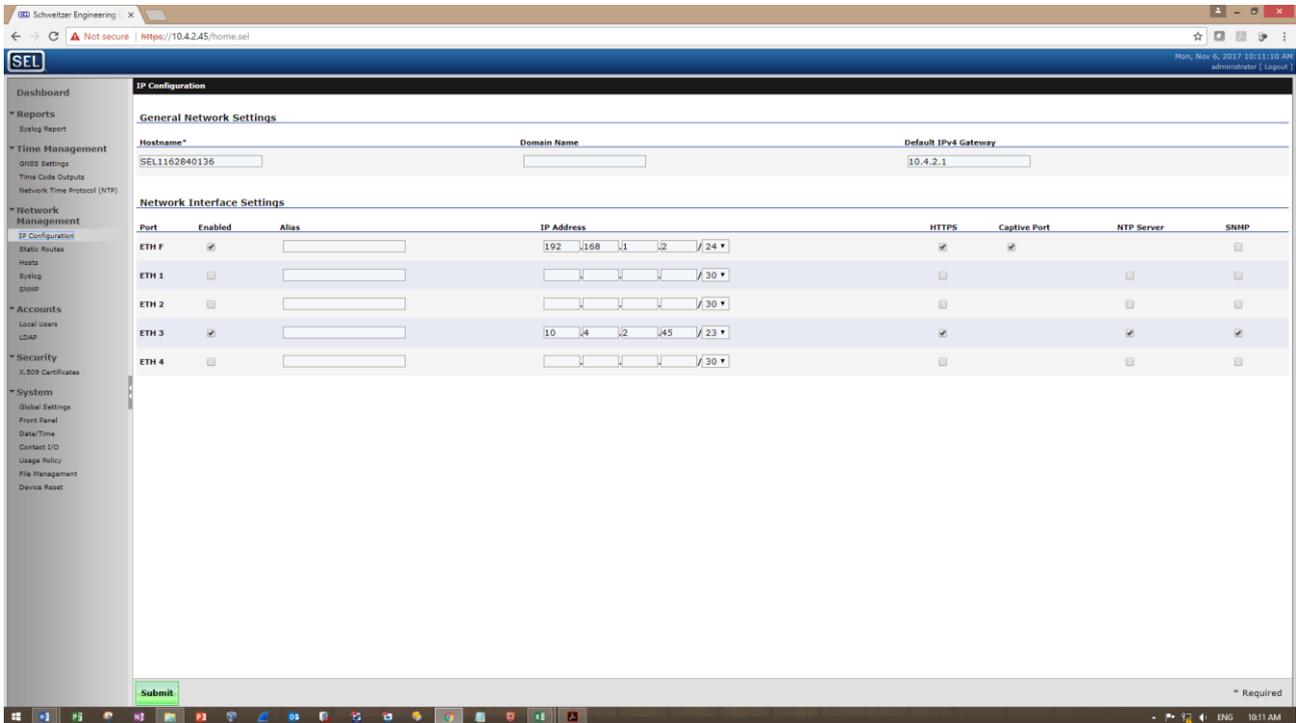
Figure 14: IP Configuration Web Interface

Table 9: General Network Settings

Setting	Values	Default	Description
Hostname	1-63 Characters	-	The unique name identifying the device on the network.
Domain Name	0-253 Characters	-	The domain name of which the device is a member.
Default IPv4 Gateway	Unicast IP Address	-	The IP address of the device used to transfer packets to another network.

Table 10: ETH F Network Interface Settings

Setting	Values	Default	Description
Enabled	Checked, Unchecked	Checked	Enables or disables the interface.
Alias	1-32 Characters	Default F	Associates a name with the network interface.
IP Address	Unicast IP Address	192.168.1.2/24	Establishes the IP address of the interface. The device uses classless inter-domain routing (CIDR) notation to assign the subnet mask.
HTTPS	Checked, Unchecked	Checked	Enables or disables HTTPS on the interface.
Captive Port	Checked, Unchecked	Checked	Enables or disables captive port on the interface.
SNMP	Checked, Unchecked	Unchecked	Enables or disables SNMP read through the interface.

Table 11: ETH 1–4 Network Interface Settings

Setting	Values	Default	Description
Enabled	Checked, Unchecked	Checked	Enables or disables the interface.
Alias	1-32 Characters	Default F	Associates a name with the network interface.
IP Address	Unicast IP Address	192.168.1.2/24	Establishes the IP address of the interface. The device uses classless inter-domain routing (CIDR) notation to assign the subnet mask.
HTTPS	Checked, Unchecked	Checked	Enables or disables HTTPS on the interface.
NTP Server	Checked, Unchecked	Checked	Enables or disables NTP Server on the interface.
SNMP	Checked, Unchecked	Unchecked	Enables or disables SNMP read through the interface.

3.5.1   Recommended Settings

The SEL-2488 network interface ETH 3 is utilised in drawings [5] and [6] as the interface which connects to the substation ethernet network. The recommended settings for ETH 3 are tabulated below.

Table 12: Recommended ETH3 Ethernet Settings

Setting	Values
Enabled	Checked
Alias	Determined on a per application basis
IP Address	Determined on a per application basis
HTTPS	Checked
NTP Server	Checked
SNMP	Checked

3.6   Network Time Protocol (NTP)

The SEL-2488 provides Stratum 1 NTP server functionality. There are three modes supported by the device which includes NTP client-server mode, NTP Broadcast mode and NTP Multicast mode. NTP is supported on each of the four rear ports.

To enable the NTP service on an Ethernet interface, one needs to select NTP Server for the appropriate Ethernet interface as described in Section 3.5, Ethernet Interfaces above.

The NTP Server settings is accessible by navigating to the Network Management > IP Configuration and Time Management > NTP Settings menu option.
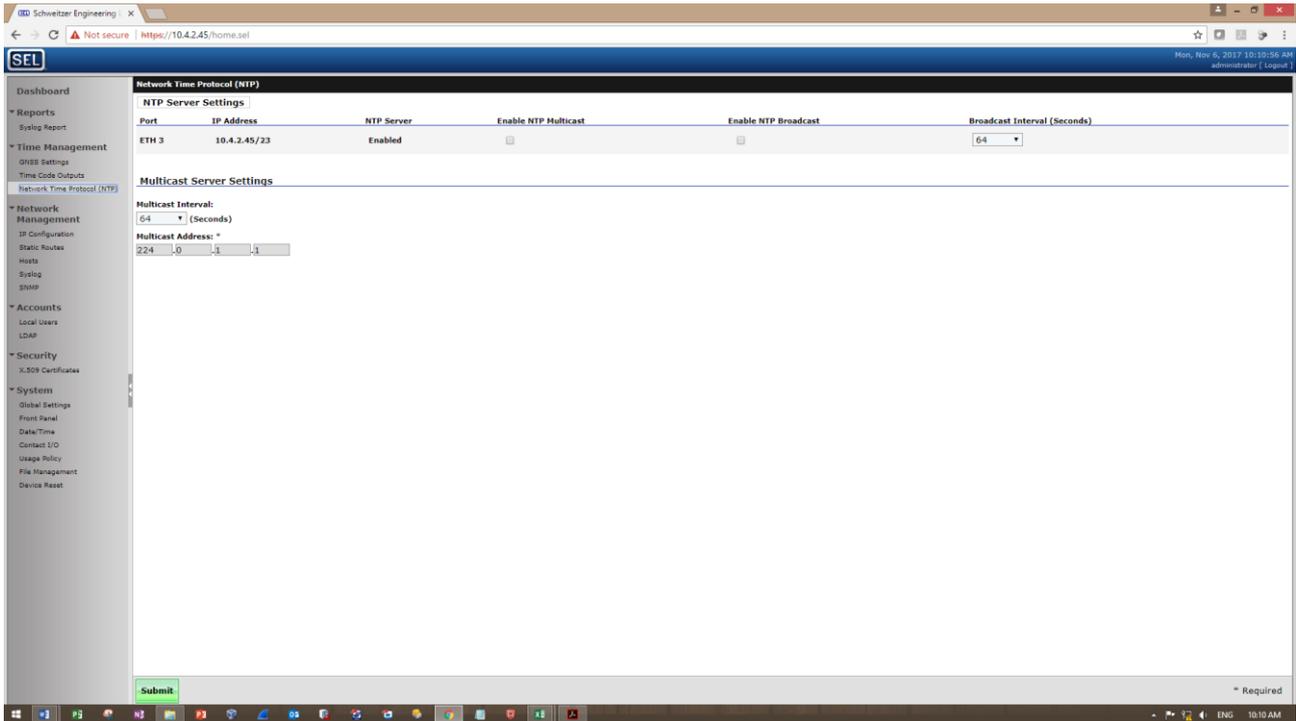
Figure 15: NTP Web Settings Interface

The applicable settings are described in the Tables below.

Table 13: NTP Multicast/Broadcast Settings

Setting	Values	Default	Description
Enable NTP Multicast	Checked, Unchecked	Unchecked	Enables the use of NTP as a time server sending multicast time messages through interface.
Enable NTP Broadcast	Checked, Unchecked	Unchecked	Enables the use of NTP as a time server broadcasting time packets to a local network subnet, defined by an interface IP address.
Broadcast Interval	16–131072 seconds	64	Sets the interval between the broadcast messages on the interface.

Table 14: Multicast Server Settings

Setting	Values	Default	Description
Multicast Interval	16–131072 seconds	64	Sets the interval when the NTP server sends time to the corresponding multicast address.
Multicast Address	Multicast IP addresses	224.0.1.1	Sets the NTP server multicast IP address.

For instances where both the Enable NTP Multicast and Enable NTP Broadcast modes remain unchecked, the SEL-2488 will default to the NTP Client-server mode.

3.6.1   Recommended Settings

The SEL-2488 Network Interface ETH 3 as prescribed in Section 3.5.1, Recommended Settings has the NTP server enabled on its interface. The recommended NTP mode to be used is the default NTP client-server mode. Consequently, the settings prescribed in Table 12 and Table 13 can remain as default.

3.7   Timer contact

The Timer contact is a clock controlled, Form A, high-speed, solid state contact output. The timer contact requires an external power source which can range between 12 and 250 VDC to be able to generate output pulses to an end device.

The Timer contact supports both single and repeating pulse modes. The repeat pulse mode provides a mechanism to generate custom repeating pulse sequences e.g. 1 PPM (Pulse Per Minute), or 1 PPH (Pulse Per Hour).

The Timer Contact settings page has several configuration options which control the contact operation. There is a master enable control (Enable Timer Contact) which allows one to enable and configure the timer contact operation.

The Timer contact settings are accessible by navigating to the System > Contact I/O settings menu option and thereafter selecting the Timer Contact tab.
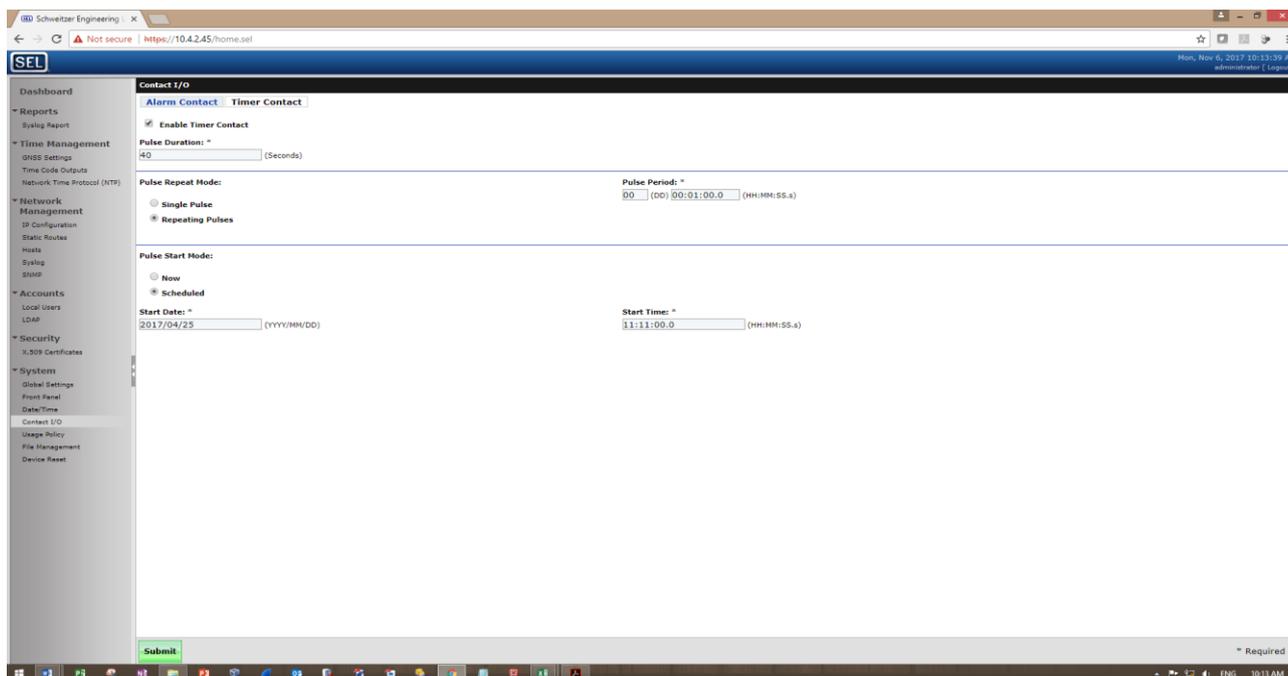
Figure 16: Timer Contact Settings Tab

The applicable settings are described in the Table below:

Table 15: Timer Contact Settings

Setting	Values	Default	Description
Enable Timer Contact	Checked, Unchecked	Unchecked	Enables the timer contact for use.
Pulse Duration	0.01-3600	0.5 seconds	Sets the time during which the contact remains closed when activated.
Pulse Repeat Mode	Single Pulse, Repeating Pulse	Single Pulse	Sets whether the contact keeps repeating the operation or occurs only once.
Pulse Period	(DD) (HH:MM:SS.s)	(00) (00:00:00:0)	Sets the interval between pulses.
Pulse Start Mode	Now, Scheduled	Now	Sets the time when the contact will start to pulse.
Start Date	01/01/2000 – 12/31/23035	01/01/2000	Sets the start date to start the pulse operation.
Start Time	00:00:00.0 – 23:59:59.9	00:00:00.0	Sets the start time to start the pulse operation.

3.7.1   Recommended Settings for Pulse Per Minute (PPM)

A Pulse per Minute (PPM) signal may be required to synchronise the substation disturbance recorder. The settings to achieve this is described below.

Table 16: Timer Output Contact settings for PPM

Setting	Values
Enable Timer Contact	Checked
Pulse Duration	Determined by the Disturbance Recorder
Pulse Repeat Mode	Repeating Pulse
Pulse Period	(00)(00:01:00:0)
Pulse Start Mode	Scheduled
Start Date	Pulse Start Date
Start Time	Pulse Start Time (selected to start on the minute)

3.8   Alarm contact

The Form C alarm output contact notifies users of an event by means of its operation. The alarm contact operates for two categories of alarms, classified as either major or minor alarms. By default, the output contact operates for all major alarms. Its operation for minor alarms is however configurable. Major alarms as opposed to minor alarms are those which indicate that the device has a failed component such as a Global Navigation Satellite System (GNSS) receiver, or that the device experienced a significant change in status, such as a part number change.

The operation of the alarm output contact differs for both major and minor alarms. For major alarms, the alarm output contact latches until such time the alarm is acknowledged. A minor alarm however will only pulse the alarm output contact for one second and does not require any acknowledgement.

Minor alarms are grouped into alarm classes which can be selected to operate the alarm output contact. A list of all alarms, their respective categories and alarm classes are detailed below.

The alarm output contact settings are accessible by navigating to the System > Contact I/O menu option.
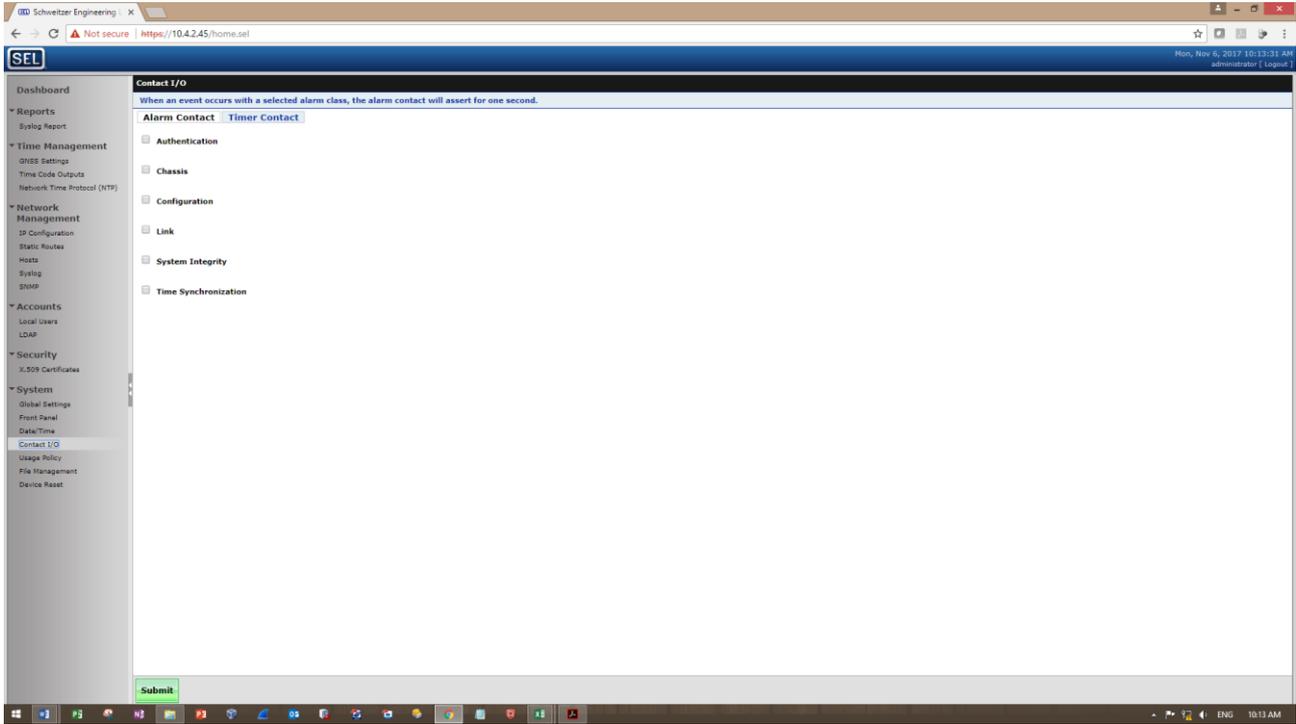
Figure 17: Alarm Contact Settings Tab

The applicable settings are described in the Table below:

Table 17: General Alarm Settings

Setting	Values	Default	Description
Authentication	Checked, Unchecked	Checked	Enables or disables notification of minor authentication events on the alarm contact.
Chassis	Checked, Unchecked	Checked	Enables or disables notification of minor chassis events on the alarm contact.
Configuration	Checked, Unchecked	Unchecked	Enables or disables notification of minor configuration events on the alarm contact.
Link	Checked, Unchecked	Unchecked	Enables or disables notification of minor link events on the alarm contact.
System Integrity	Checked, Unchecked	Unchecked	Enables or disables notification of minor system integrity events on the alarm contact.
Time Synchronization	Checked, Unchecked	Unchecked	Enables or disables notification of minor time synchronization events on the alarm contact.

Table 18: Event Log Classification

Message	Severity	Facility	Alarm Category	Alarm Class
Failure: Antenna open/absent	Alert	SYSTEM	Major	–
Failure: Antenna short	Alert	SYSTEM	Major	–
Failure: Flash	Alert	SYSTEM	Major	–

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Message	Severity	Facility	Alarm Category	Alarm Class
Failure: FPGA	Alert	SYSTEM	Major	–
Failure: GNSS Receiver A	Alert	SYSTEM	Major	–
Failure: GNSS Receiver B	Alert	SYSTEM	Major	–
Failure: Holdover Clock	Alert	SYSTEM	Major	–
Failure: Power Supply A	Alert	SYSTEM	Major	–
Failure: Power Supply B	Alert	SYSTEM	Major	–
Failure: RAM	Alert	SYSTEM	Major	–
Failure: Internal Clock	Critical	SYSTEM	Major	–
The firmware update from {0} to new version failed with an error of "{1}".	Critical	SYSTEM	Major	Configuration
The Part Number for the device has changed from {0} to {1}.	Critical	SYSTEM	Major	Chassis
Imported from another device, please reset SNMP v3 profile passwords.	Critical	USER	Major	Configuration
Holdover Alert.	Critical	CLOCK	Major	Time
Alarm Contact: configuration changed by {username} at {user_ip}	Notice	USER	Minor	Configuration
Captive Port: disabled by {username} at {user_ip}	Notice	USER	Minor	Configuration
Captive Port: enabled by {username} at {user_ip}	Notice	USER	Minor	Configuration
System Contact Information: changed by {username} at {user_ip}	Notice	USER	Minor	Configuration
Usage Policy: changed by {username} at {user_ip}	Notice	SECURITY	Minor	Configuration
Local Time Settings: Changed by {username} at {user_ip}.	Notice	USER	Minor	Configuration
Failure: LCD	Error	SYSTEM	Minor	–
OK: Antenna connection	Error	SYSTEM	Minor	–
OK: Power Supply A	Error	SYSTEM	Minor	–
OK: Power Supply B	Error	SYSTEM	Minor	–
Failure: Internal Clock Battery	Warning	SYSTEM	Minor	–
Failure: Internal Clock Battery absent	Warning	SYSTEM	Minor	–
OK: Internal Clock Battery	Warning	SYSTEM	Minor	–
The firmware version downgrade is not compatible with the current firmware	Error	SYSTEM	Minor	Configuration

Message	Severity	Facility	Alarm Category	Alarm Class
Uploaded firmware update package is corrupted; unable to either decrypt the firmware update package or validate the signature on the firmware update package	Error	SYSTEM	Minor	Configuration
Firmware update to new version initiated by {username} at {user_ip}	Notice	USER	Minor	Configuration
Firmware update from {0} to {1} succeeded	Warning	SYSTEM	Minor	Configuration
Front Panel Contrast: Changed by user at Front Panel.	Notice	USER	Minor	Configuration
Front Panel Settings: Changed by {username} at {user_ip}.	Notice	USER	Minor	Configuration
GNSS Notification Settings: Changed by {username} at {user_ip}.	Notice	USER	Minor	Configuration
GNSS Settings: Changed by {username} at {user_ip}.	Notice	USER	Minor	Configuration
Port {0} changed link state to down.	Notice	SYSTEM	Minor	Link
Port {0} changed link state to up.	Notice	SYSTEM	Minor	Link
Login to {interface}: failed from {user_ip}	Notice	SECURITY	Minor	Authentication
Login to {interface}: successful by {username} at {user_ip}	Notice	SECURITY	Minor	Authentication
Logout {interface}: {username} at {user_ip}	Notice	SECURITY	Minor	Authentication
User account {0} locked out due to consecutive failed login attempts	Warning	SECURITY	Minor	Authentication
User account {0} timeout	Warning	SECURITY	Minor	Authentication
Network Interface {0}: changed by {username} at {user_ip}	Notice	USER	Minor	Configuration
Network Settings: changed by {username} at {user_ip}	Notice	USER	Minor	Configuration
Static Route Settings: changed by {username} at {user_ip}	Notice	USER	Minor	Configuration
NTP Server Settings: Changed by {username} at {user_ip}.	Notice	USER	Minor	Configuration
NTP Server: Disabled on port {0}, {1} by {username} at {user_ip}.	Notice	USER	Minor	Configuration
NTP Server: Enabled on port {0}, {1} by {username} at {user_ip}.	Notice	USER	Minor	Configuration
Device reset because of hardware watchdog	Critical	SYSTEM	Minor	Chassis
Device rebooted by {username} at {user_ip}	Error	USER	Minor	Chassis

| Message	Severity	Facility	Alarm Category	Alarm Class
Device initialization completed	Notice	SYSTEM	Minor	Chassis
SNMP v2c profile {0} added by {username} at {user_ip}.	Notice	USER	Minor	Configuration
SNMP v2c profile {0} modified by {username} at {user_ip}.	Notice	USER	Minor	Configuration
SNMP v2c profile {0} removed by {username} at {user_ip}.	Notice	USER	Minor	Configuration
SNMP v3 profile {0} added by {username} at {user_ip}.	Notice	USER	Minor	Configuration
SNMP v3 profile {0} modified by {username} at {user_ip}.	Notice	USER	Minor	Configuration
SNMP v3 profile {0} removed by {username} at {user_ip}.	Notice	USER	Minor	Configuration
GNSS signal verification failed.	Error	CLOCK	Minor	System Integrity
GNSS signal verification successful.	Error	CLOCK	Minor	System Integrity
GNSS signal verification is not operational.	Warning	CLOCK	Minor	System Integrity
GNSS signal verification is operational.	Warning	CLOCK	Minor	System Integrity
Time Code Output Settings: Changed by {username} at {user_ip}.	Notice	USER	Minor	Configuration
Timer Contact Settings: Changed by {username} at {user_ip}.	Notice	USER	Minor	Configuration
1µs $\leq$ Time Quality < 1ms.	Notice	CLOCK	Minor	Time Synchronization
Time Quality < 1µs.	Notice	CLOCK	Minor	Time Synchronization
Time Quality $\geq$ 1ms.	Notice	CLOCK	Minor	Time Synchronization
Time set manually by {username} at {user_ip}.	Notice	USER	Minor	Time Synchronization
Time source has changed to {0}.	Warning	CLOCK	Minor	Time Synchronization
User {0}: attributes changed by {username} at {user_ip}	Notice	SECURITY	Minor	Configuration
User {0}: disabled by {username} at {user_ip}	Notice	SECURITY	Minor	Configuration
User {0}: enabled by {username} at {user_ip}	Notice	SECURITY	Minor	Configuration
User {0}: created by {username} at {user_ip}	Notice	SECURITY	Minor	Configuration
User {0}: deleted by {username} at {user_ip}	Notice	SECURITY	Minor	Configuration

Message	Severity	Facility	Alarm Category	Alarm Class
User {0}: password set by {username} at {user_ip}	Notice	SECURITY	Minor	Configuration
Device commissioned by {0} at {user_ip}	Notice	SECURITY	None	–
Device factory reset initiated by {username} at {user_ip}	Notice	SECURITY	None	–
Daylight Saving Time began.	Informational	CLOCK	None	–
Daylight Saving Time ended.	Informational	CLOCK	None	–
Leap Second deleted.	Informational	CLOCK	None	–
Leap Second inserted.	Informational	CLOCK	None	–
Daylight Saving Time adjustment pending.	Notice	CLOCK	None	–
Leap Second adjustment pending.	Notice	CLOCK	None	–
The {0} event queue overflowed	Error	SYSTEM	None	–
The {0} event queue left the overflow condition. Approximately {1} events were lost.	Notice	SYSTEM	None	–

3.9   SNMP

The SEL-2488 provides Simple Network Management Protocol (SNMP) read request support. Through SNMP read requests, one can access SEL-2488 diagnostic and status information using an SNMP client or Network Management System (NMS).

The SEL-2488 allows SNMPGET, SNMPGETNEXT, and SNMPWALK requests using SNMP v2c and v3 protocols. The status information is presented as value responses to OIDs (identifiers used for SNMP operations). Most of the information is grouped using the same grouping found on the SEL-2488 web dashboard.

The SEL-2488 provides customized Management Information Base (MIB) modules which can be imported into an SNMP client to assist with finding the information and decoding the SNMP responses. These MIBs are available for download directly from the SEL-2488.
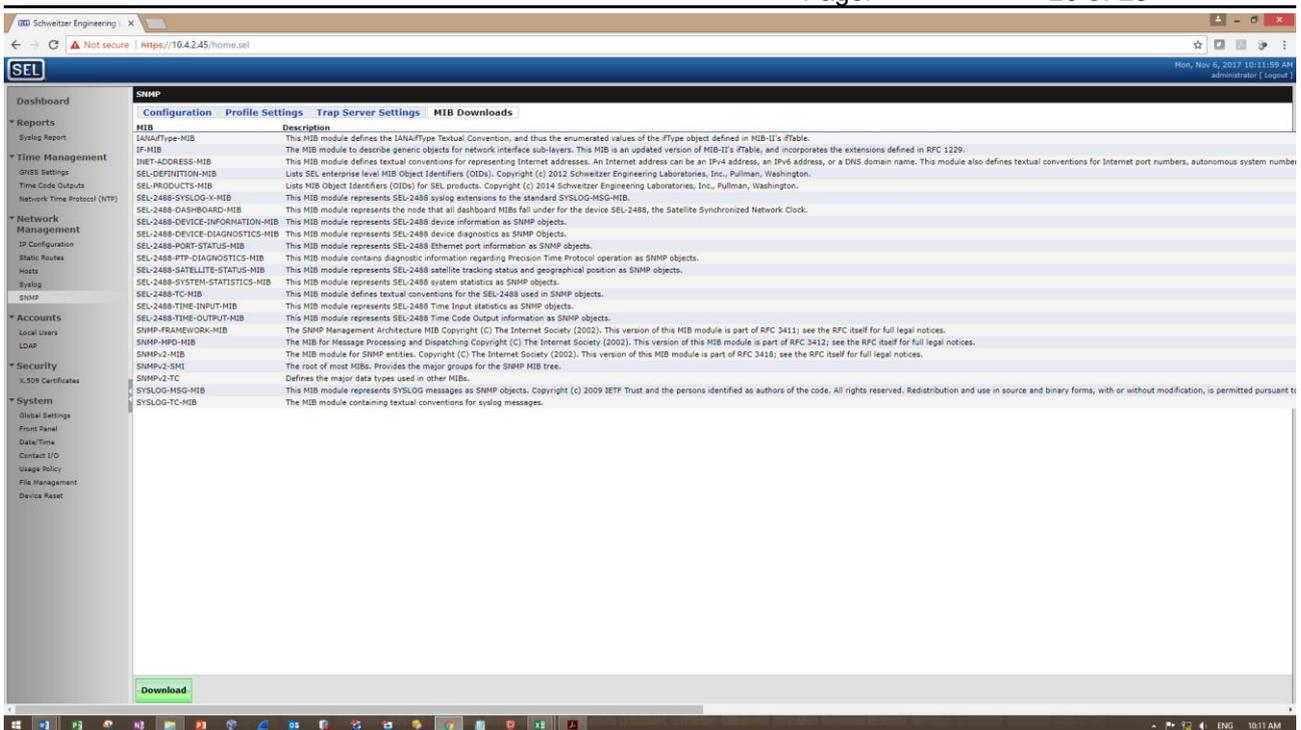
Figure 18: SNMP MIB Downloads

The SNMP configuration settings are accessible by navigating to the Network Management > SNMP menu option and selecting the Profile Settings Tab.

The Profile Settings tab allows one to configure either a v2c or v3 profile. Depending on the profile selected, one will be required to enter an Alias or Username and optionally mark the profile to allow read access. The Alias is a unique user-defined name for the v2c profile. When configuring a v2c profile, one is also required to enter a Community String which serves as a user ID or password, allowing or denying SNMP clients from accessing the devices' diagnostics and status information.

When configuring a v3 profile, one needs to select the authentication and encryption modes and provide passwords for those selections.

Either a v2c or v3 profile is required for read access to be used to access the SEL-2488. SNMP v2c profiles use a non-secure common community string to allow access, whereas v3 profiles use specific usernames and have the option for secure message authentication and encryption. The use of v3 profiles with authentication and encryption enabled, where possible, is highly recommended to preserve the security of the communications with the device.
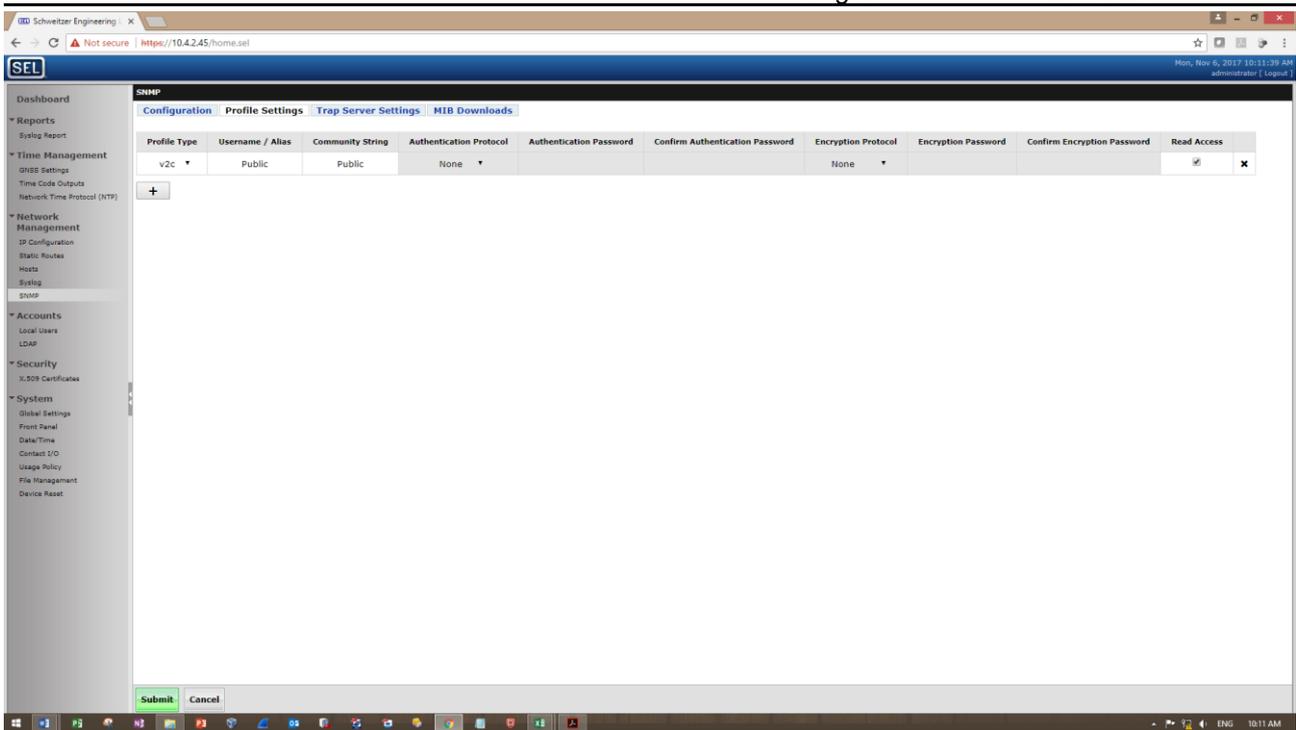
Figure 19: SNMP Profile Settings Tab

The SEL-2488 supports as many as eight user defined SNMP profiles. By clicking the plus (+) button, one can add additional SNMP profiles to the SEL-2488.

The applicable SNMP Profile settings are listed below:

Table 19: SNMP Profile Settings

Setting	Values	Default	Description
Profile Type	v2c, v3	v2c	Selects the type of profile that will be added. Enables appropriate additional settings for the profile.
Username/Alias	1–32 characters	N/A	SNMP v2c alias or v3 username. The number of characters in a v3 username may be limited because of character selection.
Community String	1–128 characters	N/A	The community string used to authenticate SNMP v2c sessions.
Authentication Protocol	None, SHA-1, MD5	None	The v3 authentication protocol used to authenticate SNMP v3 sessions.
Authentication Password/Confirm Authentication Password	8–128 ASCII characters	N/A	The v3 authentication password must include at least one uppercase and one lowercase letter, one number, and one special character.
Encryption Protocol	None, DES, AES-128	N/A	The v3 encryption protocol to be used to encrypt the message traffic. An authentication protocol must be selected to allow selection of an encryption protocol.

Setting	Values	Default	Description
Encryption Password/ Encryption Confirm Password	8–128 ASCII characters	N/A	The v3 encryption password must include at least one uppercase and one lowercase character, one number, and one special character. The encryption password must be different than the authentication password.
SNMP Read Enable	Checked, Unchecked	Unchecked	Allows the profile to be used for SNMP read access to the SEL-2488.

4. Authorisation

This document has been seen and accepted by:

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5. Revisions

Date	Rev	Compiler	Remarks
Sept 2020	1	Phetheni Khumalo	First issue

6. Development team

The following people were involved in the development of this document:

- Ian Naicker
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