

SPC4[®] 720R Gateway



– Software Version 2.0 –

Revision 02

User Manual for Valley Forge 720R Gateway

VALLEY FORGE & BOLT MANUFACTURING COMPANY



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FCC ID: 2BN58-SPC4-720-DL

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference.
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- (1) L'appareil ne doit pas produire de brouillage;
- (2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

IC: 34541-SPC4720DL

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Changes or modifications not expressly approved by Valley Forge & Bolt could void the user's authority to operate the equipment.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

This device has been designed to operate with the antennas listed below, and having a maximum gain of 3 dB. Antennas not included in this list or having a gain greater than 3 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

INTRODUCTION TO VALLEY FORGE & BOLT LOAD INDICATING FASTENERS

Founded in 1974, by Ronald Clarke, Valley Forge & Bolt Mfg. Co. continues to maintain core values as a domestic manufacturer of the highest quality, state-of-the-art fasteners, and services in a timely and efficient manner. We began our legacy in controlled bolting supplying the mining industry with an improved design of forged liner bolts. Our capabilities expanded to forging and machining specialty fasteners and the innovation of our load indicating fasteners. Markets throughout the world, including, oil and gas, refining, chemical, power, heavy equipment, steel, and transportation have appreciated our efforts in continuous improvement.

Critical joints in any application require controlled bolting throughout their service life to maintain performance, enhance safety, simplify maintenance and inspections, and improve uptime. However, the term is more often applied to installation than to the service life of the bolted joint. Valley Forge & Bolt's family of load indicating fasteners makes it possible to monitor bolted joints after installation and to always know fastener tension, regardless of the service interval.

We are constantly developing new technology to optimize the integrity of the bolted joint. Our load indicating fasteners, Maxbolt™ and SPC4®, meet ASTM F-2482 standards to measure direct elongation or tension with an accuracy of +/-5% of minimum yield.

Maxbolt™ and SPC4® fasteners directly measure fastener tension by built-in gages with the Maxbolt™ or by local or remote meters with the SPC4® systems. Any tightening tool – hydraulic electric or a hand wrench may be used to install the fasteners to achieve even and optimal fastener load. These load indicating fasteners allow users to measure fastener load during installation, maintenance intervals or inspections and monitor load while fasteners are in service. Using the family of SPC4® Meters, fastener load data is directly visible locally with analog and digital hand-held meters or transmitted through wired or wirelessly meters to a local or remote monitoring system. Tightening tool "shut-off" control is also available.



SPC4® METERS

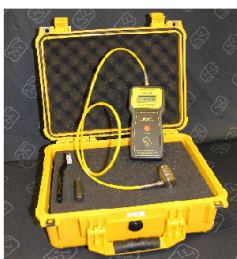
Each unit is shipped in a durable polymer carrying case, as shown, with a calibration gage.



SPC4® 500A

VF# SPC4-ASM-500A

SMALL, POCKET-SIZED MECHANICAL METER. This intrinsically safe unit consists of the handheld meter, calibration gage, calibration tool and meter lanyard. Easily snap this unit onto any SPC4® fastener to quickly view the load that the fastener is experiencing. Meter dial indicates SPC4® fastener load as a percentage of yield with the smallest visual increment ticks being 5% and largest labeled increments being 0%, 50%, and 100%. Meter calibration can be easily verified using the provided calibration gage. If need be, the reader can be easily adjusted with the provided calibration tool for offset drift that may occur over extended periods of use.



SPC4® 406A

VF# SPC4-ASM-406A

ELECTRONIC LOAD INDICATING METER. This unit consists of a handheld meter, (2) AA batteries, calibration gage and cleaning brush. This unit verifies the target load using a wired snap on probe to measure the load and digitally displays it on an LCD screen. The data is displayed as a percentage of minimum yield in 1% increments. The added Bluetooth 2.0 capability allows for remote clamp load monitoring to a smart device such as a cell phone or tablet. This unit uses a power supply of (2) AA batteries. *(cell phone or tablet not included)*



SPC4® 424A

VF# SPC4-ASM-424A

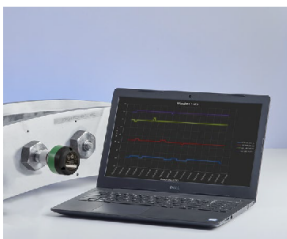
ELECTRONIC LOAD INDICATING METER WITH INSTALLATION TOOL CONTROL. This unit consists of a handheld meter, power switching unit, extension cable, calibration gage and cleaning brush. This unit is specifically designed for large fastener installations and to control the torque wrench. The power switching control box is set to the desired load value in percent of the fastener's yield, the wired probe clips onto the fastener, and the power is cut to the torque wrench when the desired load is reached. Available in 110V or 220V.



SPC4® 600A

VF# SPC4-ASM-600A

ELECTRONIC LOAD INDICATING METER, DATA RECORDING SYSTEM. This unit consists of a handheld meter with AA batteries, calibration gage, cleaning brush, software CD, and a PC connection cable. This unit verifies the target load using a wired snap on probe to measure the load and digitally displays as a percentage of yield in increments of 1%. The digital display shows load as a percentage of yield in increments of 1%. The unit's digital display can be set to report the current flange or location, number of bolts, bolt location, date, time, and SPC4® fastener load percentage. All data is recorded and may be downloaded to a PC using the software CD. This unit uses a power supply of six (6) AA batteries.



SPC4® 702-02

VF# SPC4-ASM-702-02

WIRELESS LOAD INDICATING SYSTEM AND LOAD DATA LOGGING SYSTEM. The SPC4® 702 series is a WiFi system that consists of SPC4® 702-02 and SPC4® 702-DL units to facilitate fastener load monitoring and data logging on both static and dynamic applications. The SPC4® 702-02 unit is connected onto a SPC4® fastener and remains in place to wirelessly transmit fastener load data, as a percentage of minimum yield, to the SPC4® 702-DL unit that has a built-in network. The data is then recorded with the software provided. The SPC4® 702 series operates at the radio frequency of 2.4 GHz. This system can also be configured with customer SCADA systems.

(laptop not included)

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1.0.0 Introduction

The SPC4® 720 Gateway is designed to collect, store, and display fastener load data collected by SPC4® 720R Remote Tension Monitors (RTM™) installed on SPC4® fasteners using wireless RF network. This SPC4® 720 System is to be used for continuous fastener monitoring after the initial installation of the SPC4® fasteners. This SPC4® System should not be used to facilitate fastener installation.

The SPC4® System contains precision electronic devices. Care must be taken in handling the wireless units and all its components. Abusive handling of these components or devices can render them inoperable and/or compromise the accuracy of the measured load readings.

All SPC4® load indicating fasteners have been shipped with protective caps installed over the datum discs for protection and to maintain surface cleanliness. These protective caps must remain on the datum disc, only to be removed during installation of the SPC4® 720R unit.

Valley Forge & Bolt Manufacturing Company assumes no responsibility for inaccurate loading or failure of SPC4® load indicating fasteners as a result of damage to the measuring instrument caused by improper handling or improper maintenance of datum disc surfaces. With proper care and use, this system can provide years of reliable operation.

This manual includes critical information on the components, operation, and maintenance of the SPC4® System. It is **imperative** to read this manual carefully and completely familiarize yourself with the operation of this system before use.

1.1.0 Inspection

When unpacking the SPC4® System, carefully check each item for damage that may have occurred during shipment. If anything is damaged or missing contact:

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1.2.0 Included Items

1	SPC4® Model 720R Gateway	Gateway
1	User's Manual (this manual)	UM
1	System Information Checklist	CG
1	PoE+ Switch	PoE Switch

1 **DEFAULT ANTENNA**

Every 720R Gateway is shipped with a default antenna either pre-attached or stowed away inside the enclosure depending on the wireless frequency of the system (915 MHz, 868 MHz, 433 MHz).

2 **N-TYPE CONNECTOR**

The 720R Gateway comes with an N-type external connector to add scalability to attach an external antenna routed away from the enclosure. Used with an N-type cable, an antenna can be placed in a optimum location for maximum wireless coverage.

Note: Valley Forge does not supply the external antenna, and only the default antenna will come with the system unless specified at the time of purchasing.

3 **GATEWAY ENCLOSURE**

The 720 Gateway has a default steel enclosure of 16 x 14 x 6 In. which can be customized to a larger size and alternate material such as plastic. Several things can be found on the enclosure such as the protective window, shielded power button, two NEMA 4X vents, a permanently attached antenna, and N-type connector.

4 **LCD WINDOW**

The LCD window allows users to glance at important information of the 720R Gateway's status. The window is designed to allow visual access and protect the inside from damage that may strike the exterior.

5 **POWER "ON/OFF" BUTTON**

The power "ON/OFF" button is protected by a steel cover. Lift the cover up to access the button. A quick momentary press will turn on the Gateway while in standby mode. While the gateway is on and running, holding the button down for a few seconds (2 to 3 seconds) will shut down the Gateway. The button comes with its own status LED. If the LED is not illuminated and not blinking, then the 720R Gateway has zero power. If the LED is blinking red, then the gateway is in standby mode.

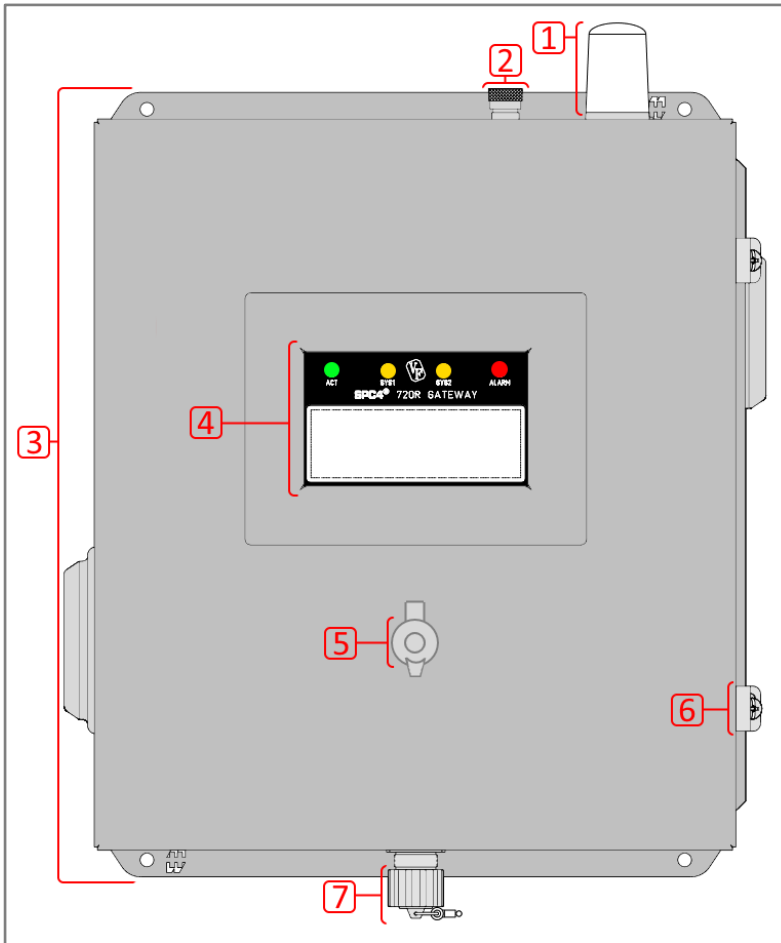
6 **ENCLOSURE LATCHES**

The enclosure latches hold the enclosure lid shut, creating a weathertight seal. The latches can be undone by loosening the latch screws found on each one. Unless modifying the enclosure for installation, there is little need to access the inside of the enclosure.

7 **ETHERNET PORT**

An exterior ethernet port can be found on the bottom of the enclosure. This port allows data to travel through the network and for the PoE+ Switch to power the 720R Gateway. Note that the 720R gateway must be connected to a network for the system to function, and the user must be connected to the same network to access the 720R Gateway Software. Internet access is optional but recommended as it allows local time to sync with the system and users to remotely log in.

1.2.1 SPC4® 720R Gateway



- 1** – DEFAULT ANTENNA
- 2** – N-TYPE CONNECTOR
- 3** – GATEWAY ENCLOSURE
- 4** – LCD WINDOW
- 5** – POWER "ON/OFF" BUTTON
- 6** – ENCLOSURE LATCHES
- 7** – ETHERNET PORT

Figure 1 – 720R Gateway - Front View

1.2.2 PoE+ Switch

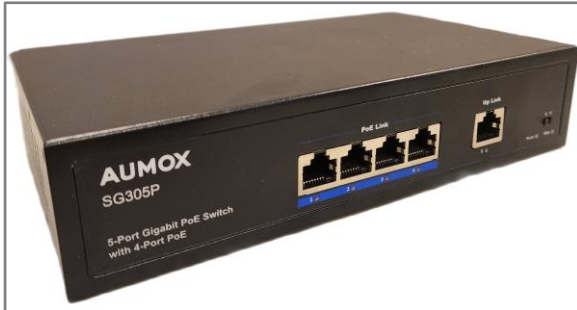


Figure 2 – PoE+ Switch

The supplied PoE+ Switch is used to power the 720R Gateway and act as a communication line to a network. The specific PoE+ version of the standard is required to meet the minimum wattage per port (30W).

A host router/gateway must be connected to the UP-Link port of the switch for the 720R Gateway to function. The 720R Gateway should be connected to the PoE switch in one of the PoE link ports with a Cat6(e) ethernet cable.

!! HIGHLY RECOMMENDED !!

The person or group (preferably the onsite IT department) in charge of the 720R Gateway network should set up a STATIC IP Address for the Gateway. This ensures that the address for the Gateway remains unchanged during its service life.

2.0.0 Software Operation

Outlined in this section is the operation of the 720R Gateway software. All software screens will be reviewed, and all functionality and symbolism will be explained. This user's manual will be based on the 915 MHz variation of the 720R Gateway but features and screens will remain identical for the other two wireless frequency options (433 MHz & 868 MHz). The terms "Probe" and "Node" will be used interchangeably in the user manual and software, so please understand that they are the same.

The 720R Gateway should already be installed and powered on prior to attempting any software functionality. It is recommended to read through the entirety of the "Software Operation" section before logging in, to fully understand what is available in the software.

2.1.0 Logging In

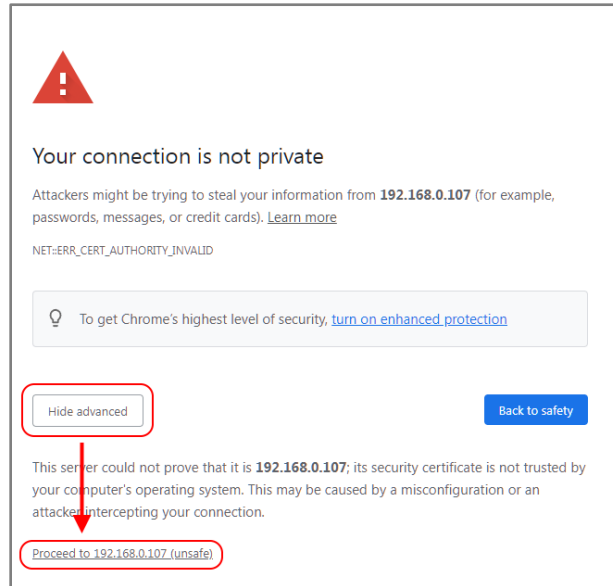
- [1]** Using a laptop, desktop, phone, or tablet connected to the same network that the 720R Gateway is on, open a web browser of your choice; This user manual will be using Google Chrome so please note there are minor differences in some browser specific functionality if using an alternate web browser.
- [2]** Go to the Gateway and note down the "IP" that is shown on the LCD.

If the LCD is not on, power on the Gateway via the power button.

If the displayed IP address does not look correct or is not what you were expecting, then the Gateway could have powered on while not connected to a network or is not connected to any network; verify that a proper network is connected to the PoE switch UP-Link and power cycle the 720R Gateway by turning it off and back on.

- [3] On the device with the web browser open, enter in the IP address (EX: "192.168.1.2") into the web search bar and press enter. Different browsers may require that two forwards slashes be entered before the IP (EX: "//192.168.1.2").
- [4] First time log ins will prompt a browser security warning saying something along the lines of "your connection is not private".

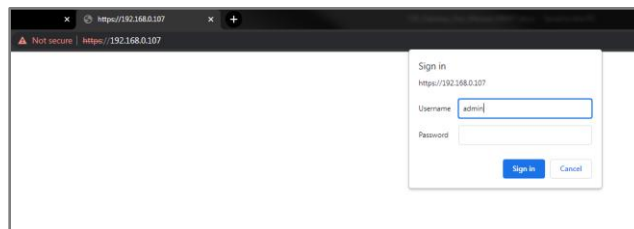
Note: This step only happens during the first-time logging into a specific IP address for the 720R Gateway and you may never see it again.



Click on the "Advanced" button to show more information, then click on the "Proceed to (IP Address) (unsafe)" text.

- [5] Once done, a log in prompt will be displayed. There are two login levels available with different privileges.

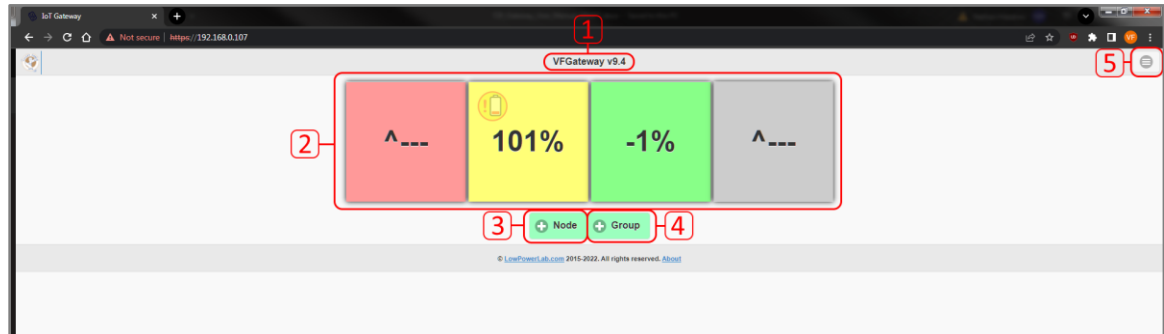
The default login with full access to the software functionality has the username of "admin" and a randomly assigned password that can be found in accompanying documentation with your system.



The other login is a display (read only) view of the main page with no other functionality and has a typical username of "Display" with a pre-assigned password also found in the system documentation.

2.2.0 Home Screen (Dashboard)

- [1] The home screen (or dashboard) is the first thing you see once you have logged in and is the place where you can quickly glance at the status of all installed wireless probes on the system. Brand new systems will have all wireless probes preconfigured and shown on the main page. This is done to ensure the system functions properly and that wireless probes are properly calibrated.



- [2] Using the image above as an example of a typical dashboard, several aspects are visible. Please note that this serves as an example of an already running system, whereas a new system's first logged in will have all grey probes.

Item [1] This is the name of the current VF Gateway. The default name is "VFGateway v9.4" and can be changed in the global settings (found in [5]). Changing the name of the Gateway can help differentiate between systems if you have several installed onsite.

Item [2] This is the list of SPC4[®] 720R RTM[™] (probes or nodes) tiles that have been or are currently active on this Gateway. In the image we see four different probes, all showing a different status and value. Clicking on a probe will enter the probe page which shows all the details of that particular probe, allow simple graphing of select metrics, and changing of probe behavior. More details of the probe page can be found in **2.3.0 Probe Details**.

Probe Tile Color

There are four possible colors that tiles can be based on the status of the probe.

Red: The Probe is outside the set min & max load measuring range (default -25% to 125%)

Yellow: The Probe battery level is below the set value (default 2.7 Volts)

Green: The Probe is within the set min & max load measuring range (default -25% to 125%)

Grey: The Probe has not communicated with this system after 5 attempts at the probe's current transmission rate or 24 hours.

Probe Measurement

Probes can measure any value between -25% and 125%, any value outside those boundaries will be displayed by the characters "^---" which represents a "no gage" or "no bolt" reading.

Item [3] This button labeled “Node” can be used to manually add probes before they connect to the system. This is typically unused as probes will automatically populate on the dashboard once they connect.

Item [4] This button labeled “Group” allows the user to create groups of nodes which is great for organizing probes and making large systems more manageable. More details about groups can be found in **2.4.0 Probe Groups**.

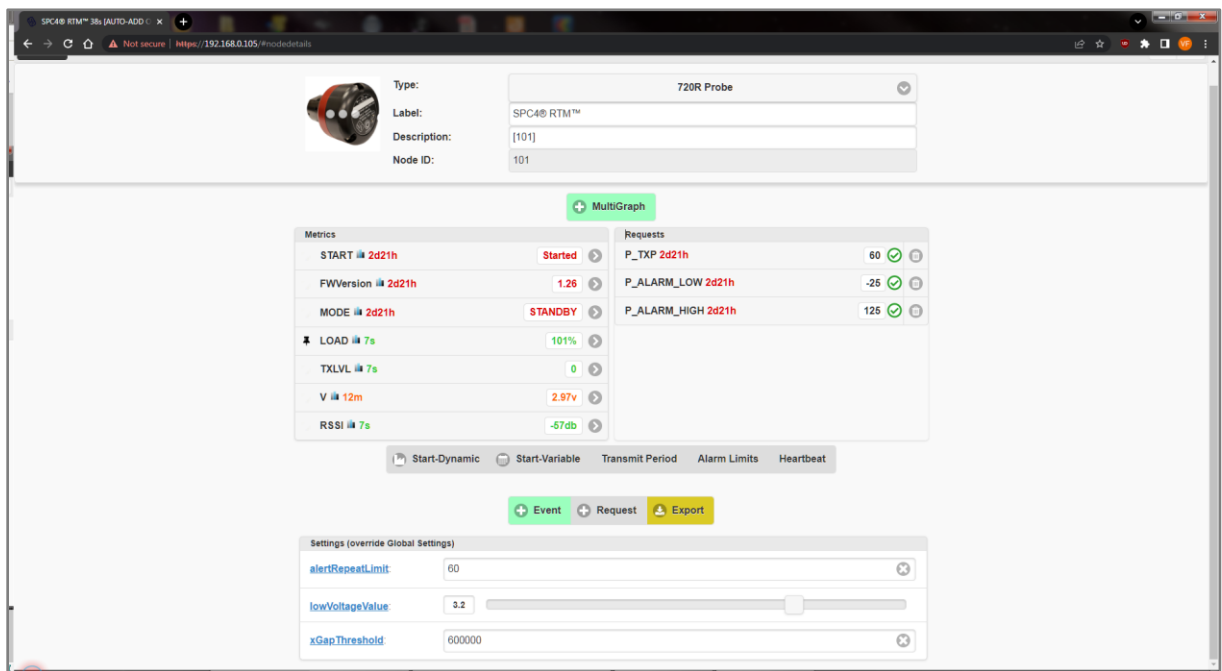
Item [5] This is the button that will show additional settings of the Gateway. This is where global settings can be found, Gateway wide data exporting, and simple Gateway information. More details about additional settings can be found in **2.5.0 Additional Settings**.

[3] The size of the probe icons on the dashboard can be adjusted by zooming in and out on the web page. This can be used to change the number rows and columns so that all or most probes fit on a single page.

[4] The order of probes and groups on the dashboard can be changed, given that there are at least two rows being displayed, by clicking and dragging the probe icons around.

2.3.0 Probe Details

[1] Probe details are the most important view of the Gateway software as it allows you to control probe behavior and manage information critical to you.



[2] On the top of the page you can find the unique probe identifier and description you can customize.

	Type:	720R Probe
	Label:	SPC4® RTM™ (101)
	Description:	Installed on bolt A8
	Node ID:	101

- ❖ **Type** determines how the probe profile looks and should not be changed from "720R Probe".
- ❖ **Label** acts as the name of the probe and will be displayed in larger text when hovered over on the dashboard.
- ❖ **Description** gives additional text space to indicate locations, install date, or other important information and is display as smaller text on the dashboard.
- ❖ **Node ID** is the unique identifier of the probe to distinguish it from the others on the system.

In addition to those, the icon of the probe can be changed to a preinstalled image, or a custom image can be taken and uploaded.

In the top right of the screen, you can choose to whether hide or delete the node. The eye button is used to hide, or unhide the probe on the dashboard. Hiding probes is useful for visually removing probes from the dashboard without the need to delete the probe.



The trashcan button will delete the probe from the gateway. Depending on what the settings are for the Gateway, the data for the probe can be deleted entirely or saved in the database even if the probe is deleted. If the data is saved and the probe ever reconnects to the gateway, all data will be available.

[3] Below the probe details are the "Metrics" and "Requests". More details of this section are explained in **2.3.1 Probe Metrics**.

Metrics			Requests		
START	2d21h	Started	P_TXP	2d21h	60
FWVersion	2d21h	1.26	P_ALARM_LOW	2d21h	-25
MODE	2d21h	STANDBY	P_ALARM_HIGH	2d21h	125
LOAD	7s	101%			
TXLVL	7s	0			
V	12m	2.97v			
RSSI	7s	-57db			

- [4] Below the probe “Metrics” and “Requests” are the global setting overrides that manage the probe.

Settings (override Global Settings)	
alertRepeatLimit:	60 ✕
lowVoltageValue:	3.2 Slider
xGapThreshold:	600000 ✕

- ❖ **alertRepeatLimit** is the time it takes (in minutes) between sending email or SMS alerts.
- ❖ **lowVoltageValue** determines the minimum voltage level that the battery must be before showing a low battery indication. Recommended default value for this setting is 2.7V.
- ❖ **xGapThreshold** is minimum time (in milliseconds) between two consecutive data points on the probe graph to be considered a missed transmission or absence of incoming data. If this time is lower than the time between two consecutive points, a graph gap will be determined and the area between the two points will be turned red.

2.3.1 Probe Metrics

Metrics are data that the Gateway receives from the wireless probe which can be graphed together. Some metrics are updated regularly based on probe transmission rate while others are updated once on start up.

Each metric has three components; a name, a time it was last updated, and an indicated/measured value. The color of the time and measured value is a visual representation of how much time has passed since it was last updated and has NO meaning regarding if it is good or bad.

START is a simple metric that keeps track of when the wireless probe was turned on.

FWVersion keeps track of the current firmware installed in the 720R probe.

MODE displays the current mode that the probe is operating in. “STANDBY” is the default operation.

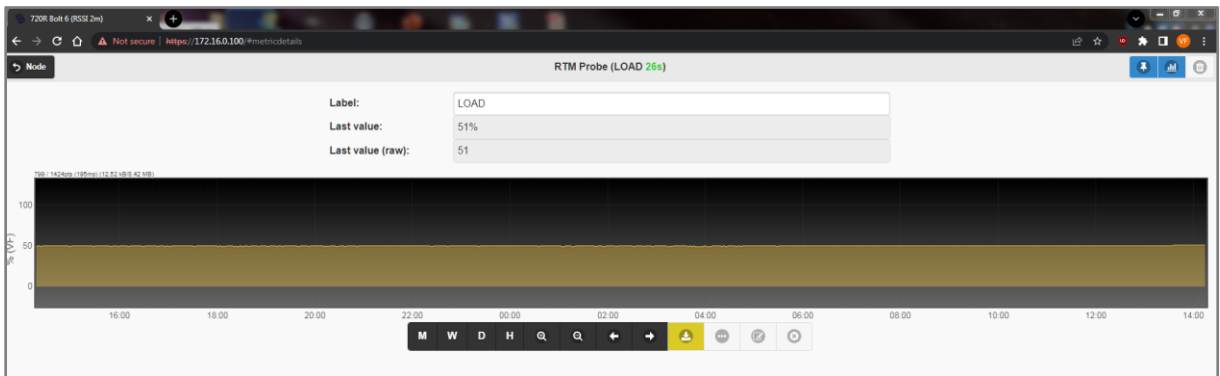
LOAD is the most important metric of the wireless probe as it indicates the measured load value of an SPC4® fastener. The measured LOAD value is a percentage (%) of the minimum yield load of the fastener. This metric can be any value between -25% and 125%. Any value beyond those two limits will be displayed as “^---” which can be seen when the probe is not attached to a fastener or calibration reference gage. Dirt or debris on the sensor face may also be displayed as “^---”

TXLVL is the power level of the transmitter radio inside the probe and is automatically increased and decreased based on the value of the RSSI. The Probe will attempt to maintain an RSSI value of -90 dB to save power as much as possible while maintaining a data connection to the Gateway. The TXLVL of 0 has the lowest power consumption while the TXLVL of 23 is the highest level of power consumption.

V is the measured value of the probe battery in Volts. Note that this metric is not updated as often as the others if the measure value does not change. Any changes in battery level will be sent to the gateway.

RSSI is the wireless signal strength measured in decibels (dB). The higher the number, the better the signal strength. Note that this is a negative number so higher numbers are closer to zero.

Clicking on a metric will bring up its individual page which displays additional features.



On the top middle of the screen, you can rename the metric which will change what it's called on the probe page.

A close-up of the 'Label:' field in the interface. The field is a text input box containing the word 'LOAD'. The label 'Label:' is positioned to the left of the input box.

In the top right of the screen, you can pin the metric which will show its current value on the homepage probe details if hovered over.



In the top right of the screen, you can graph and view the individual metric's data.

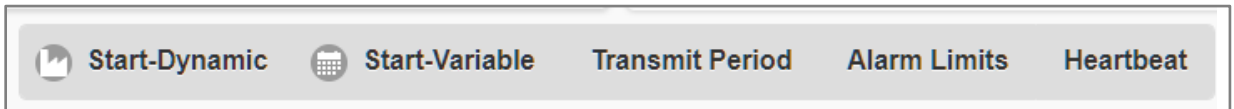


In the top right of the screen, you may also delete the metric. The data will be saved or deleted depending on the global settings enabled. Typically, there is zero need to delete a single metric, but the function has been added just in rare cases.

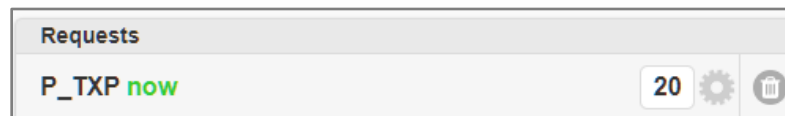


2.3.2 Probe Requests

Requests are parameters that are sent from the gateway to the 720R Probe which can be altered by the user to fit their needs. These requests can change the behavior of the probe as well as how the Gateway handles incoming data. There are several buttons below the metrics/request columns can be used to send various requests to the probe.

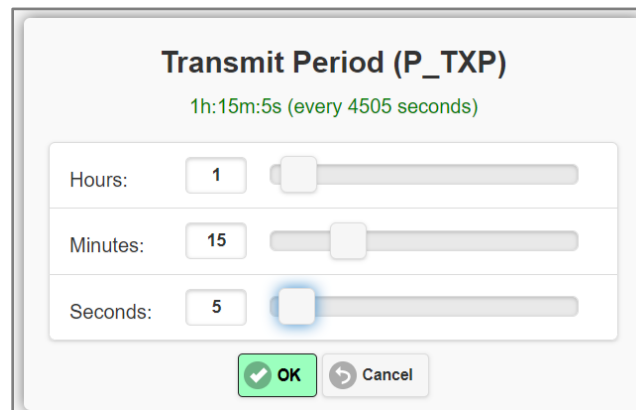


When a request is completed on the Gateway, it will be shown under the requests column as pending with a cog icon where it will wait until the probe communicates with the Gateway again.



It is possible for a request to fail if the communication between the probe and Gateway is poor, where sending the request again may be required.

Transmit Period is the standard method of data acquisition where data is acquired every 'X' amount of time at a constant rate. This is the default mode of operation and will be in use unless a different operating mode is active.



Alarm Limits sets the lower and maximum percentage values that is used to generate alerts when the LOAD percentage is outside the set range. In addition to alerts, this range is used to determine when the probe square on the dashboard is green or red. A green tile is when the load percentage is within the set range and a red tile is for when that measured load percentage is outside that range.

ALERT LIMITS
(P_ALARM_LOW & P_ALARM_HIGH)

Probe will generate ALERTS when LOAD(VF%)
is ABOVE or BELOW these limits:

60 80

OK Cancel

Heartbeat is a parameter similar to "Transmit Period" in functionality, but its purpose is to maintain radio contact with the Gateway in instances when the transmit period has been set to a very long period of time. In addition to contacting the Gateway earlier than the set transmit period, the heartbeat will only update the load metric if it is outside the set alarm limits, useful for catching problems sooner than later. For the heartbeat to function, it must be at least one minute less than the transmit period, otherwise the heartbeat will be disabled.

Heartbeat Period (P_HBT)

Probe will transmit heartbeats every:

15m

Minutes: 15

Seconds: 0

Note: Probe only transmits heartbeats if P_HBT (=900s) is less than P_TXP (=20s).

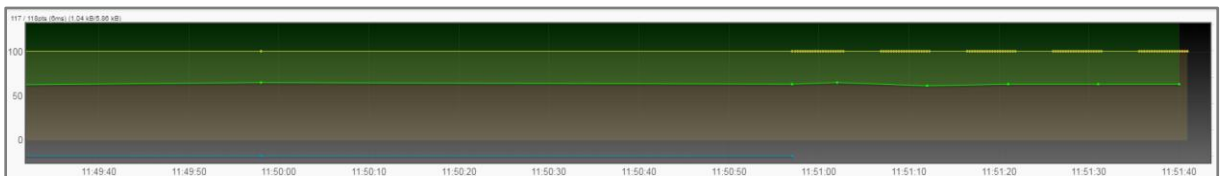
OK Cancel

Note: The battery life of the 720R will depend on how often the heartbeat is set to. This feature should only be used in areas of bad signal connectivity where getting data is imperative.

Start-Dynamic is a different mode of operation that the 720R Probe can function in temporarily before continuing its usual transmit period. This mode is useful for capturing instanced events in dynamic applications such as rotating hardware, that may affect fastener load in a very short amount of time.

The screenshot shows a dialog box titled "Dynamic Mode message". Inside, there is a "Parameters" section with three input fields: "Cycles:" set to 5, "Samples per cycle:" set to 20, and "Interval (optional):" set to 10. Below these fields, a green heading "Probe behavior in this mode:" is followed by a bulleted list: "takes 20 samples", "transmits them every 10 seconds", "for 5 cycles in total", and "resumes in STANDARD mode". At the bottom, there are two buttons: "Start DYNAMIC!" with a green checkmark icon and "Cancel" with a grey arrow icon.

This mode operates by taking a very quick number of samples all at once, and then sending that data as a group at a set interval. **Cycles** are the number of data groups to be taken, **Samples per cycle** which is the quantity of load percent samples to be taken per cycle, and then the **Interval** which is how long in-between cycles. If Interval is left empty, it will transmit at the standard set mode. Below is an example of what Dynamic mode looks like.



Five groups of data (yellow dots) can be seen at the end of the graph as a result of the Dynamic mode.

Start-Variable is another mode of operation that the 720R Probe can function in temporarily before continuing its usual transmit period. This mode is useful in applications that require a retorquing by increasing the wireless monitoring directly after an SPC4® fastener installation.

Variable Mode

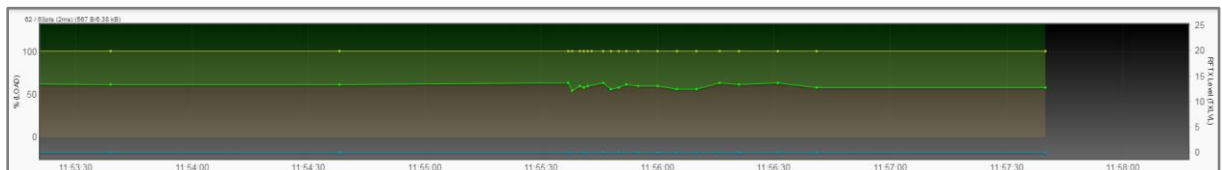
Sampling interval (s)	Repeat cycles	Step time (s)	Step time (m)
1	5	5	0.1
2	5	10	0.2
5	5	25	0.4
10	2	20	0.3

+ Add step

All OK

Start VARIABLE! Cancel

Variable mode can be configured with several different sampling intervals that must coincide with an ever increasing amount of time. This mode is required to have a minimum of two interval steps and more steps can be added and deleted as needed. The above example shows a Variable mode setup that starts off with 1 second intervals for five times, which totals five seconds. Then increases to 2 second intervals for five times, then 5 second intervals, and ending with 10 second intervals, before continuing with its standard mode. Below is an example of what Variable mode looks like.



Manual Requests may also be made using the request buttons or clicking on a request parameter. This method of making requests is less intuitive as the proper request names must be known and request syntax.

Request Parameter & Value:
(each limited to 15 characters)

P_TXP

60

Timeout in minutes (default=60):

120

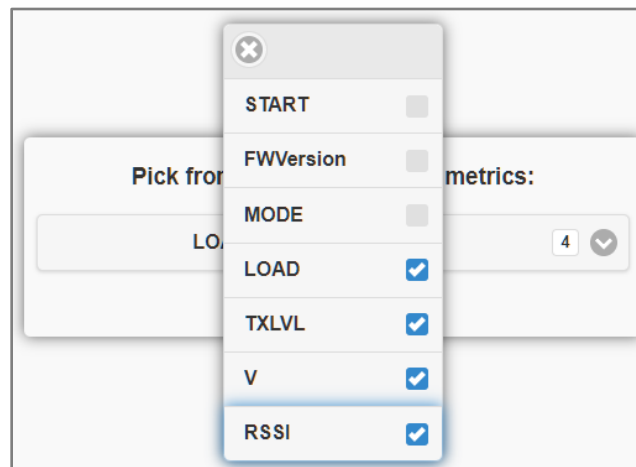
Submit Cancel

2.3.3 Probe Graph

All probe metrics can be graphed and displayed on the probe page. There may or may not be a graph the first time entering the probe page, so a multi graph may have to be created in order to view data. If there is no graph, click on the **MultiGraph** button found between the probe details and metrics.



A prompt page will appear asking for the user to select what metrics to graph. Recommended starting metrics are LOAD, TXLVL, V, and RSSI.



Once all the desired metrics are selected, click off of the pop up and then click on the "Add" button. A graph will appear with all of the selected metrics.



Below the graph is a bar of several buttons that can be used to navigate or alter the graph. The buttons **M**, **W**, **D**, **H**, stand for **Month**, **Week**, **Day**, **Hour** and can be used to instantly display a period of time matching that button on the graph. For example, pressing the **Week** button will display the last week of data on the graph.



There are two magnifying glass buttons labeled with a '+' and '-' which can be used to zoom in and out on the graph. Two more buttons labeled with '<<' and '>>' can be used to navigate the graph left and right respectively.



Clicking on the yellow button will download all the data points currently visible on the graph as a .csv file for manual spreadsheet graphing.

Clicking on the button with the three points will mark all data points on the graph to better visualize the data.

Clicking on the trashcan button will delete the current graph. Note that this does NOT delete data and only removes the graph. The graph can be remade again by pressing the **MultiGraph** button.

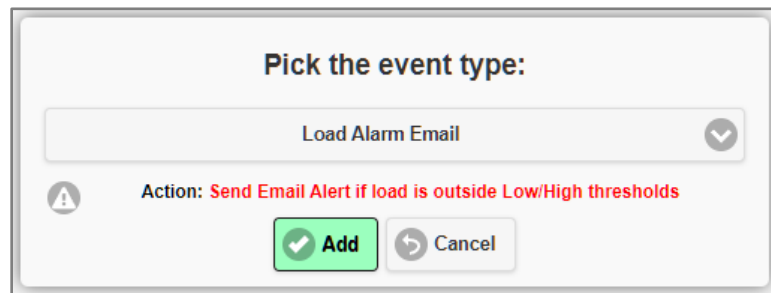
Note: In addition to the button, you may use the mouse scroll wheel to zoom in and out of the graph wherever the mouse pointer is. You can also click and drag the graph to pan sideways.

2.3.4 **Probe Alerts & Probe Data Export**

Probe Alerts (or Load Alerts) can be enabled by clicking on the Events button.

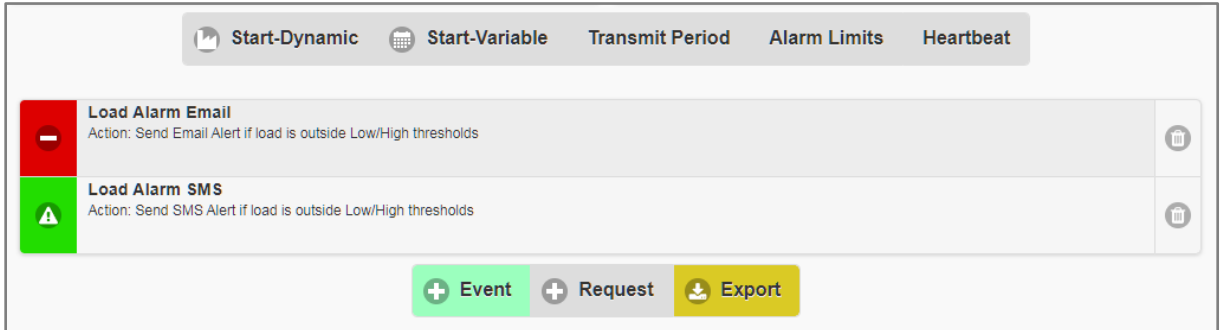


Clicking the button will bring you to a new page where you can select either an email alert or SMS alert. Both alerts may be active at the same time but must be enabled one at a time.



Once the alert is selected, just press add and it will show up on the probe page.

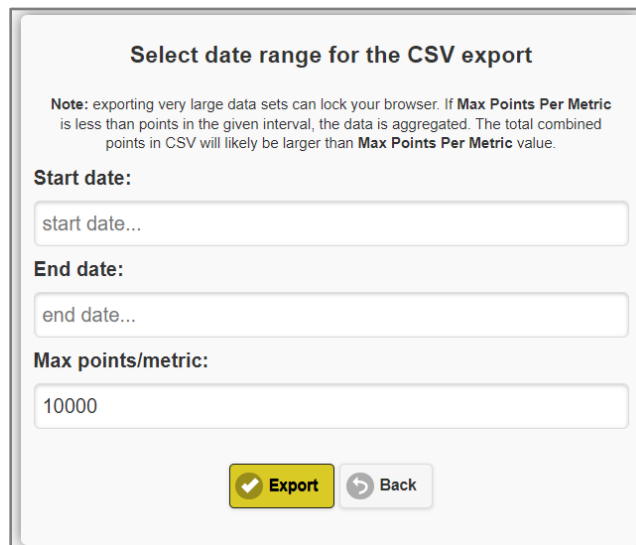
When the alert is shown as green, that means it is enabled. To disable an alert, simply click the green status of the alert and it will turn red showing it is disabled.



Probe Data can be exported to a csv file by clicking on the yellow Export button on the probe page.



This brings you to a new page, where you can select a period in which to export. There is a max points/metric option so that file size can be limited so it is easier to handle and download.

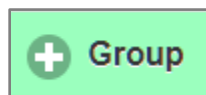


When finished setting up the export dates and max points, click on **Export** and a csv file will be downloaded to your device.

2.4.0 Probe Groups

Probe Groups are the perfect solution for organizing and managing probes connected to the Gateway. Similar to the functionality of individual probes, requests can be made within the group and the request will then be forwarded to ALL probes within the group. It's recommended to group probes up based on location, application, or flanges. In addition to requests, load alerts can be set to be group wide, instead of manually adding them to every probe.

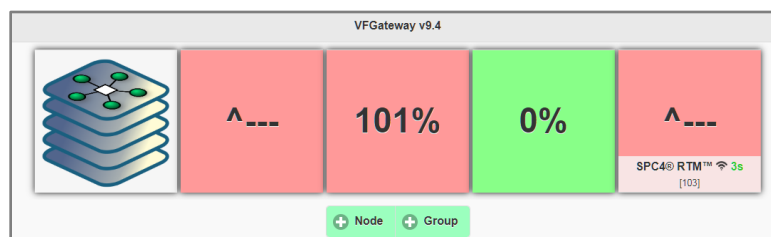
- [1] On the Gateway Dashboard, there is a button called **Group** that can be found in the bottom middle of the screen.



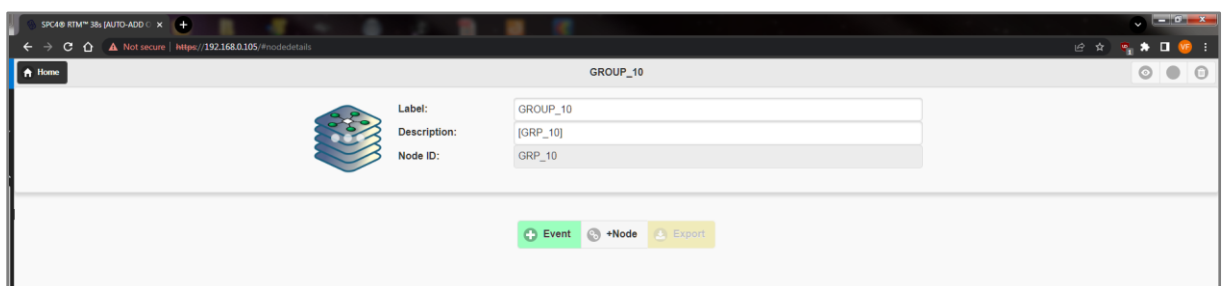
- [2] Clicking on the button will open a prompt to enter a Group number. This number can be anything within the specified limits and is only used as a unique identifier for that group.

Once a number has been entered, click on **Add**.

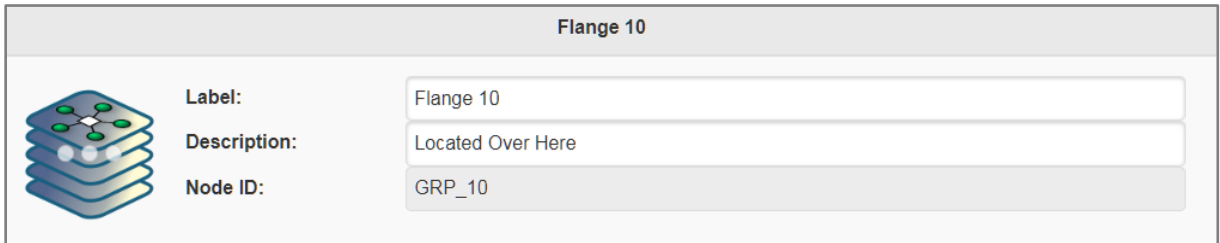
- [3] A new node will appear on the dashboard alongside the existing probes. This is the group that was just created.



- [4] Click on the group node to enter the group page. This page will be empty initially and probes will have to be manually added to the group.



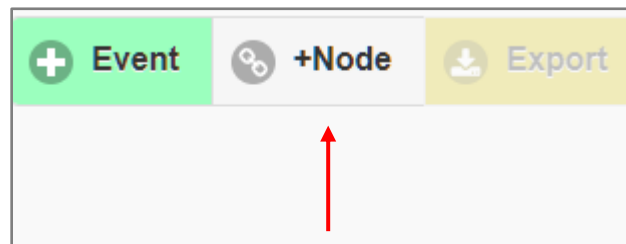
- [5] Like the probe, the top of the page has node details. Here group information can be customized to better differentiate it from other groups.



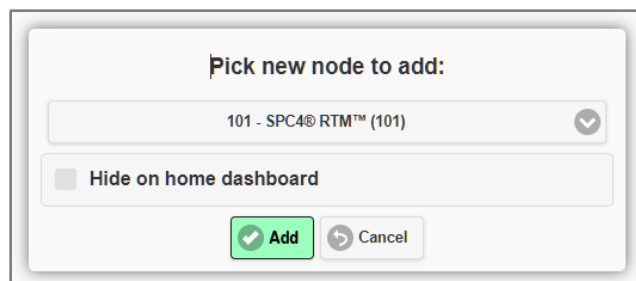
- ❖ **Label** acts as the name of the group and will be displayed in larger text when hovered over on the dashboard.
- ❖ **Description** gives additional text for more details or other important information and is displayed as smaller text on the dashboard.
- ❖ **Node ID** is the unique identifier of the node to distinguish it from the others on the system.

In addition to those, the icon of the group can be changed to a preinstalled image, or a custom image can be taken and uploaded to the gateway.

- [6] To add a node to the group, click on the **+Node** button. A new prompt will appear asking for what probe to add to the group. Note that adding probes to the group must be done one at a time.

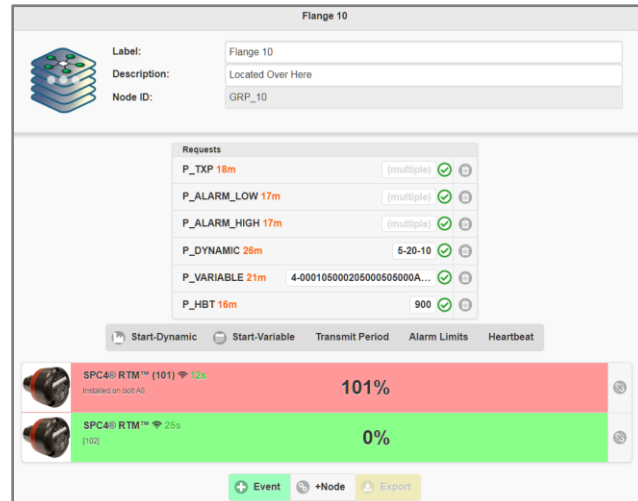


- [7] Determine which probe to be added to the group. Probes within the same group should be similar in location and operation.



Determine if you would like to hide the selected Probe on the Dashboard. This will turn it invisible so that it cannot be seen on the dashboard. To finalize adding the probe to the group, click on the **Add** button.

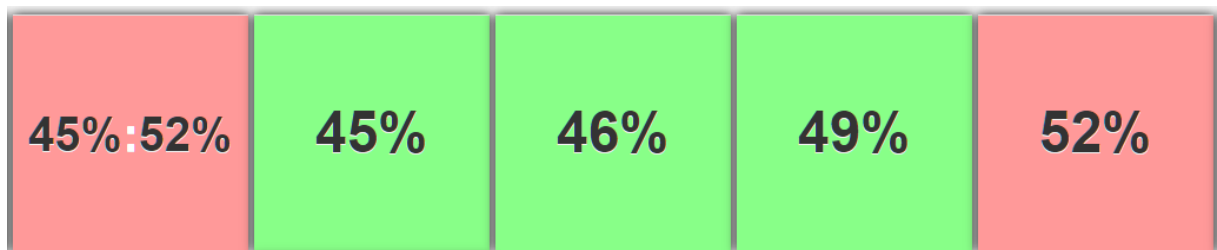
- [8] Below is an example of a group with two probes. When probes are added to the group, their metrics are posted above the list. If probes in the group have differing metrics, it will be displayed as “multiple” unless that metric is made the same for all probes in the group.



Below the metrics are the request buttons. These operate identically to how normal probe requests are made in **2.3.2 Probe Requests**.

In addition to requests, the events or load alerts operate the same as the probe page, see **2.3.4 Probe Alerts & Probe Data Export**.

- [9] Once two or more probes are added into a group, the tile on the dashboard will show the lowest and highest probe of the group. The color of the tile will be determined by if everything is okay (for green), or if there is an alert (for red). Group tile may also be grey if all probes in the group go offline.



- [10] Probes can be removed from the group by clicking the unlink button found to the right side of the probe.



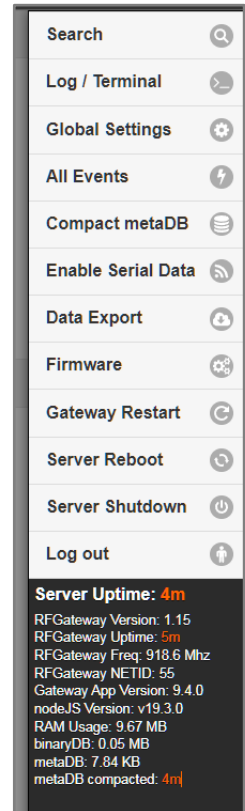
- [11] Similar to single probe pages, the group export will function the same, but for all probes within a group.
- [12] Similar to single probe pages, the group Alerts or Events will function the same, but for all probes within a group.

2.5.0 Additional Settings

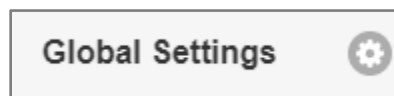
- [1] There are several additional settings that can be viewed by pressing the drop down found in the top right of the dashboard.



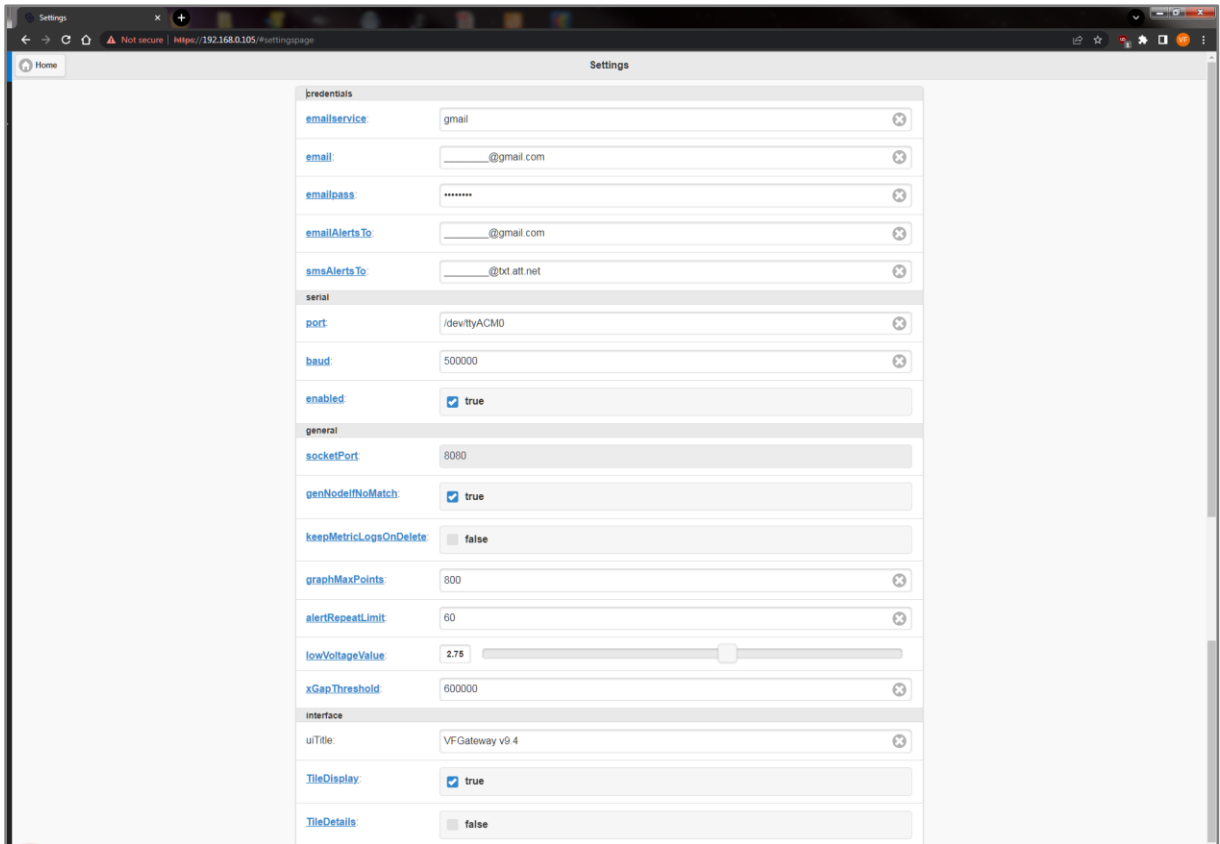
- [2] Among the additional settings, there are only three that will be discussed as they will be used regularly, **Global Settings**, **All Events**, and **Data Export**. All other listed items are to be used by a skilled technician or user following the advice of a technician during troubleshooting.



- [3] **Global Settings** contain some Gateway wide settings that affect the entire gateway or all probes configured to the Gateway.



Some of these settings should never be changed as they impact the functionality of the system but are there for technician availability should the system need troubleshooting.



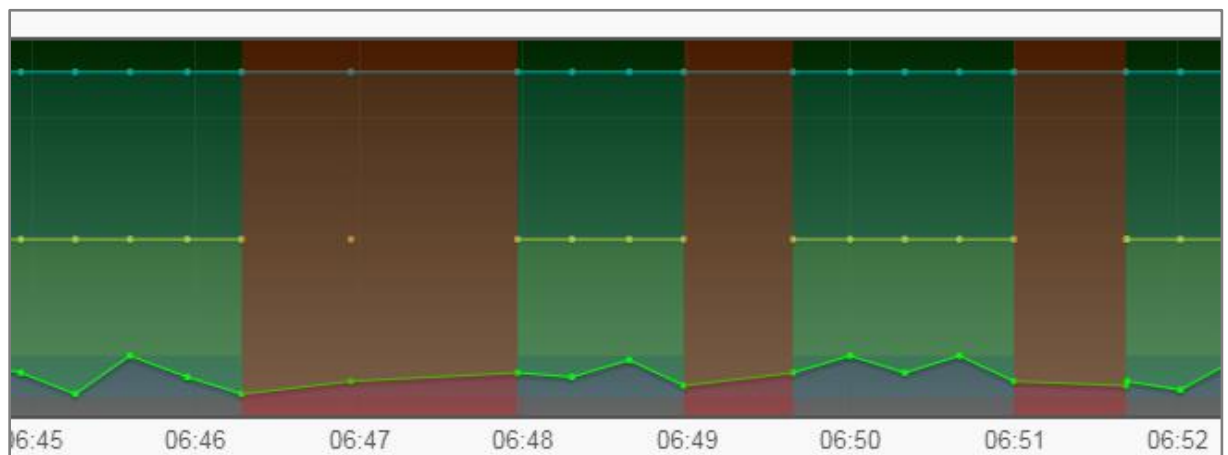
The **credentials** section handles how load alerts are sent out and whom receives these alerts.

- ❖ **emailservice** is the email provider that will handle sending emails out to devices receiving alerts.
- ❖ **email** is the email address that the gateway will use as a proxy to send out the Load Alerts. It is recommended to create a dedicated gmail account for the Gateway if Load Alerts are used. Note that the Gateway requires an internet connection in order to send out alerts.
- ❖ **emailpass** is the password of the email address entered or the app access code created by that email. The gateway needs this in order to sign into the email to create alerts.
- ❖ **emailAlertsTo** is the list of email addresses that will receive load alerts. Multiple email address can be entered but must be separated with a comma ','.
- ❖ **smsAlertsTo** is the list of phone numbers that will receive load alerts. Multiple phone numbers can be entered but must be separated with a comma ','. In addition to the phone number, a domain address must be appended to the number. The domain address differs by carrier.
Verizon: @vtext.com
AT&T: @txt.att.net
T-Mobile: @tmomail.net

The **serial** section handles how the gateway communicates with the wireless probes and can be ignored for general use. These settings should never be changed unless done by a skill technician familiar with this system.

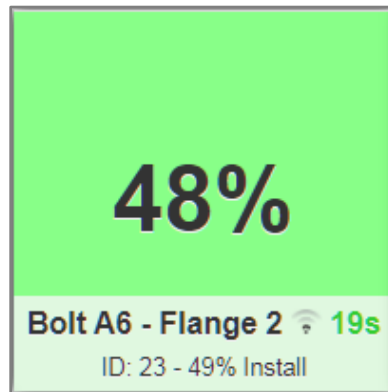
The **general** section includes some global probe settings that will dictate how probes handle some information, unless they are overridden at the probe level.

- ❖ **socketPort** is used in wireless communication with the probes. this setting should never be changed unless done by a skill technician familiar with this system.
- ❖ **genNodeIfNoMatch** handles how unexpected nodes are assigned if they connect to the 720R Gateway. Leave this setting as true and it can be ignored for general use.
- ❖ **keepMetricLogsOnDelete** determines if the data of a probe is saved or deleted when a probe is removed from the Gateway. Saved data will reappear when the probe reconnects to Gateway.
- ❖ **graphMaxPoints** is the maximum amount of visible data points displayed on the graph at once. If the amount of visible points exceeds this limit, they will be aggregated into fewer points so that it is equal to this set value.
- ❖ **alertRepeatLimit** is how often load alerts will be sent out if they are enabled (in minutes). As long as an alert is preset, a load alert will repeatedly be sent out at this time interval.
- ❖ **lowVoltageValue** determines the minimum voltage level that the battery must be before showing a low battery indication and turning the node tile yellow on the dashboard. Recommended default value for this setting is 2.7V.
- ❖ **xGapThreshold** is minimum time (in milliseconds) between two consecutive data points on the probe graph to be considered a missed transmission or absence of incoming data. If this time is lower than the time between two consecutive points, a graph gap will be determined and the area between the two points will be turned red.

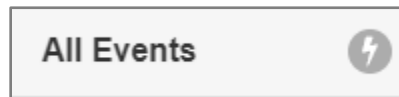


The **interface** has a few settings that affect how the dashboard looks.

- ❖ **uiTitle** is what is shown at the top of the page on the dashboard and should be changed to a title that reflects its use or location.
- ❖ **TileDisplay** determines if the dashboard displays tiles or a list of probes. By default, the tile view is enabled.
- ❖ **TileDetails** determines if the Probe label and description are shown on the dashboard for each probe.



[4] **All Events** is useful for viewing every enabled and disable alert event at a glance.



This page makes it easier to manage alerts in instances that one should be enabled/disable or remove alerts if they are no longer needed.

All Events		
	[20] Load Alarm SMS Action: Send SMS Alert if load is outside Low/High thresholds	
	[20] Load Alarm Email Action: Send Email Alert if load is outside Low/High thresholds	
	[21] Load Alarm Email Action: Send Email Alert if load is outside Low/High thresholds	
	[21] Load Alarm SMS Action: Send SMS Alert if load is outside Low/High thresholds	
	[23] Load Alarm Email Action: Send Email Alert if load is outside Low/High thresholds	
	[23] Load Alarm SMS Action: Send SMS Alert if load is outside Low/High thresholds	

- [5] **Data Export** is a Gateway wide option for downloading all of the data available. Note that downloading a large amount of data will tie up the Gateway and may prevent new data from being received.

The screenshot shows the 'Data Export' interface. At the top, there's a section for 'Completed data exports' with a table listing four CSV files: '2022-06-30_19-21-37.csv (12.87 MB)', '2022-06-30_19-23-44.csv (42.64 MB)', '2023-01-18_18-46-46.csv (170 B)', and '2023-02-09_19-34-23.csv (2.54 MB)'. Each file has a 'Delete' button. Below this is a dropdown menu set to 'Export ALL NODES' and a checkbox for 'Exclude Hidden Nodes'. There are three buttons for time ranges: 'Last 7 days', 'Last 30 days', and 'Last 90 days', along with a close button. Below these are input fields for 'Start date:' and 'End date:'. A list of metrics to include is shown with checkboxes: 'Include START metric', 'Include FWVersion metric', 'Include MODE metric', 'Include VF(%) metric', 'Include TXLVL metric', 'Include V(v) metric', and 'Include RSSI(db) metric'. All are checked. Below the list, it says 'Export includes 17 nodes' and there is a yellow 'Export' button.

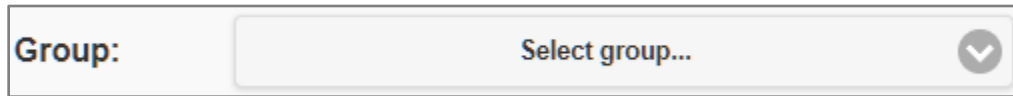
The top of the page has **Completed data exports** which are compiled data logs in csv format available for download. Click on the file name to start downloading the file to your device. Below that is the option to select what Nodes/Probes to export data for

The screenshot shows a dropdown menu with the title 'Export ALL NODES'. The menu is open, showing three options: 'Export ALL NODES' (highlighted in blue), 'Export a RANGE of Nodes', and 'Export a GROUP'.

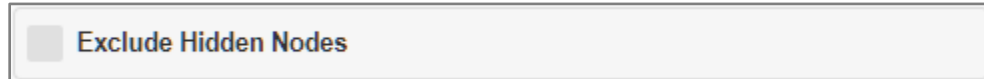
- ❖ **Export ALL NODES** will create a single data log file for every probe on the gateway.
- ❖ **Export a RANGE of Nodes** will create a single data log file for a range of probes. This option allows the user to select a starting probe and an ending probe thus creating a range with every probe in between. New options will pop up asking **From ID** and **To ID**.

The screenshot shows two input fields. The first is labeled 'From ID:' and has a dropdown menu showing '11 - SPC4® RTM™'. The second is labeled 'To ID:' and has a dropdown menu showing '14 - SPC4® RTM™'.

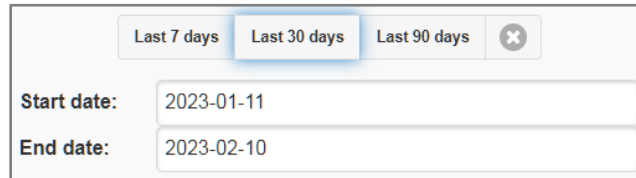
- ❖ **Export a GROUP** will create a single data file for every probe within a selected group. Selecting this option will pop up a new prompt asking for what group to export.

A form element for selecting a group. It consists of a label "Group:" followed by a dropdown menu. The dropdown menu has a light gray background and contains the text "Select group..." in a medium gray font. To the right of the text is a small downward-pointing arrow icon inside a circle.

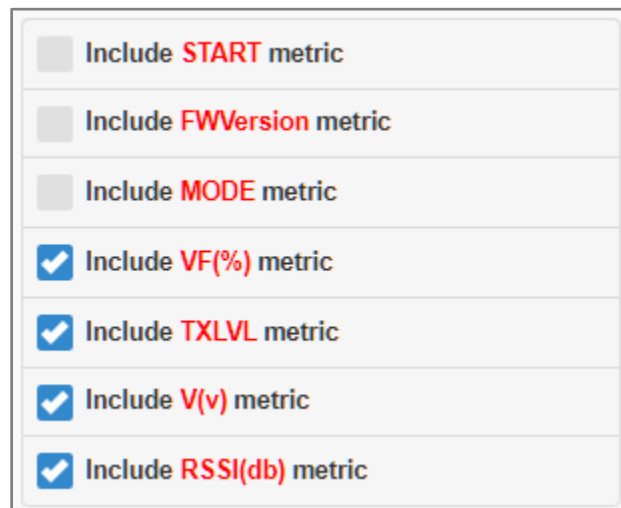
In addition to selecting all the nodes, a range, or group, there is an additional option to exclude hidden nodes from the data download.

A form element for the "Exclude Hidden Nodes" option. It features a square checkbox on the left, which is currently unchecked and has a light gray background. To the right of the checkbox is the text "Exclude Hidden Nodes" in a medium gray font.

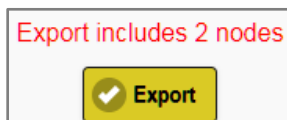
Next is to select a time frame in which the downloaded data will reflect. There are three buttons to quickly select the last 7 days, 30 days and 90 days. Custom dates can be selected using the start and end date options below those button. Leaving the start and end date empty will download all data since a probe has been on the gateway.

A form element for selecting a time frame. At the top, there are three buttons: "Last 7 days", "Last 30 days", and "Last 90 days". The "Last 30 days" button is highlighted with a blue border. To the right of these buttons is a small "X" icon. Below the buttons are two input fields. The first is labeled "Start date:" and contains the text "2023-01-11". The second is labeled "End date:" and contains the text "2023-02-10".

After a time period of data has been selected, choosing what data to export can be customized below using checkboxes. Only the metrics with a blue checkbox will be logged.

A form element for selecting metrics to include in the export. It consists of a list of six items, each with a checkbox on the left and a label on the right. The labels are: "Include START metric", "Include FWVersion metric", "Include MODE metric", "Include VF(%) metric", "Include TXLVL metric", and "Include V(v) metric". The first three items have unchecked checkboxes with light gray backgrounds. The last three items have checked checkboxes with blue backgrounds. The labels for the last three items are in a red font.

Finally, you can begin exporting your data to a csv file by pressing the yellow **Export** button at the bottom of the page. Just above it will tell you how many nodes you have selected to give a sense of how large the file will be.

A form element for the export button. It consists of a text label "Export includes 2 nodes" in a red font, positioned above a yellow button. The button has a green checkmark icon on the left and the text "Export" in a bold black font.

3.0.0 SPC4® Model 720R Gateway Specifications

3.1.0 Electrical Specifications

Power Supply.....PoE+ (IEEE 802.3at) 30W per Port Switch
Internal Supply Voltage.....12 V_{DC}
RTC Batteries (Quantity 3 Rechargeable NiCd).....4.32 V_{DC} (1.44 V_{DC} /Cell) 500 mAh
Power Consumption (±5%).....Pending Testing Results

3.2.0 Wireless Specifications

915MHz Signal Radius.....Typically Less than 304.8 m / 1000 ft. (LoS)
.....MAX 20 dBm (100mW) Transmit Power
915MHz (902MHz – 928MHz) band consists of 84 usable frequency channels.
Wireless communication is proprietary and does NOT work with LoRa Systems.

868MHz Signal Radius.....Typically Less than 304.8 m / 1000 ft. (LoS)
.....MAX 20 dBm (100mW) Transmit Power
868MHz (865.1MHz – 869.5MHz) band consists of 15 usable frequency channels.
Wireless communication is proprietary and does NOT work with LoRa Systems.

433MHz Signal Radius.....Typically Less than 304.8 m / 1000 ft. (LoS)
.....MAX 20 dBm (100mW) Transmit Power
433MHz (433.05MHz – 434.79MHz) band consists of 6 usable frequency channels.
Wireless communication is proprietary and does NOT work with LoRa Systems.

3.3.0 Environmental Specifications

Operating

Temperature.....-20°C to 65°C / -4°F to 149°F
Humidity.....80% Maximum (Non-condensing)

Storage

Temperature.....-30°C to 75°C / -22°F to 167°F
Humidity.....95% Maximum (Non-condensing)

Enclosure Protection.....NEMA 4X / IP-56

3.4.0 Physical Characteristics

Steel Enclosure

Dimensions (W x L x D)368 x 431 x 171 mm / 14.5 x 17 x 6.75 in.
Weight11.11 kg / 24.5 lbs.

4.0.0 Troubleshooting

The SPC4® System is designed to be accurate, reliable, and easy to use. However, if a problem does occur during operation, follow the steps listed below as an attempt to correct the problem.

- ❖ If the Gateway fails to boot up properly, meaning that power button is blinking green, the LCD backlight is active, but there is no text being displayed on the LCD after three or more minutes.
 - Turn off the Gateway via the power button found on the enclosure. Remember to hold it down for 2 seconds and then release for it to start the shutdown. Turn the gateway back on and wait to see if the problem is resolved. Try this twice if it doesn't work on the first attempt.
- ❖ If there are any software related problems.
 - Go to the additional settings for the Gateway and there are options to perform a **Gateway Restart** and a **Server Reboot**. Perform a server reboot first and then check if the problem persists. If it does, then attempt a gateway restart.
- ❖ The Gateway fails to receive a proper IP Address
 - The Gateway must be connected to a proper network that includes a router so that the Gateway may receive an IP Address. It is up to the user and their IT team to configure the network properly so that the Gateway may function.

If the issues persist after trying the above methods, contact Valley Forge for further assistance.

VALLEY FORGE & BOLT MANUFACTURING COMPANY

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