



# Instruction Manual

## Plus-X VSWR

*Rev B (Firmware v.1.0.24)*

If you encounter problems during installation or need additional assistance getting started, contact Burk Technical Support.

Telephone 1 (978) 486-3711

If any parts are not present when you unpack the box(es), please contact Burk Technology sales department.

Telephone 1 (978) 486-8600 x700, or

Email [sales@burk.com](mailto:sales@burk.com)

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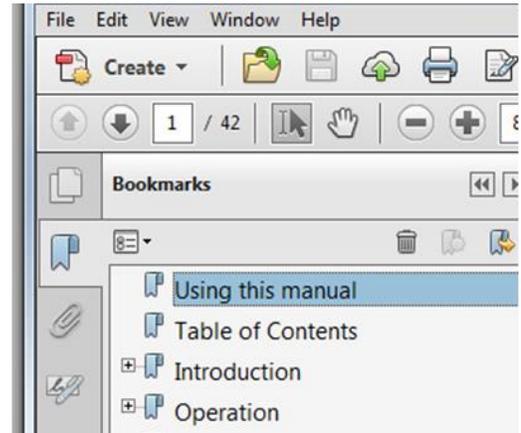
## USING THIS MANUAL

This manual is best viewed as a .pdf on a computer or tablet. The manual has many hypertext links to help you get to the section you need. Most of the initial setup requires a web browser. Keeping a copy of the manual in .pdf form on the same machine is very helpful.

The .pdf file has bookmarks to assist with navigation. You should have a current copy of Adobe Reader on your computer and have the Bookmarks enabled. The most recent version of Adobe Reader can be downloaded at <http://get.adobe.com/reader/>.

To enable bookmarks, press  and expand the desired section by pressing .

You can also jump directly to a section in the **TABLE OF CONTENTS**. Just click on the section or page number to go directly there.



Take a few minutes to familiarize yourself with the organization of this manual, as it will likely save time later when you need to find a specific piece of information quickly. Throughout the manual, you will find hypertext links like this: **INSTALLATION**. Ctrl-click on the link to go directly to the named section.

Here is a quick set of links to the major sections of the manual:

<b>TABLE OF CONTENTS</b>	Fully expanded table of contents useable in .pdf or printed form
<b>INTRODUCTION</b>	Brief overview of Plus-X VSWR
<b>INSTALLATION</b>	Hardware installation and input/output connections
<b>OPERATION</b>	A web browser is used to operate the unit

The manual contains several instances of user input. Text between < > symbols are user input fields. You should put your input data between the < > symbols but do not include the < > symbols.

## BEFORE YOU BEGIN

To make getting started simpler, it is recommended that you read the **INTRODUCTION** and become familiar with Plus-X VSWR controls, indicators, and terminology before proceeding to **INSTALLATION**.

## INTRODUCTION

The Plus-X VSWR is a fully autonomous system that reduces risk to your investment in RF combiners, transmission lines and antenna systems by fast interrupt of transmitter interlocks that prohibit RF power output. This system simultaneously monitors forward and reflected power on up to four transmission lines and continuously updates Voltage Standing Wave Ratio (VSWR) calculations. The Plus-X VSWR takes immediate action to interrupt transmitter RF output if a user-defined threshold is exceeded for either reflected power or VSWR depending on which parameter the user prioritizes for setting a fault.

Plus-X VSWR can be integrated with Arcturus or ARC Plus as well as combined with other Plus-X devices in your system for comprehensive monitoring and remote control of your entire operation.

Even without a connection to Arcturus or ARC Plus, the Plus-X VSWR continues to provide full interrupt service. Redundant relay outputs eliminate single point relay failures and “Three strike” logic provides quick recovery from transient events maximizing uptime while reducing risk from actual system faults.

## OPERATION OVERVIEW

### CONTROL RELAYS AND INTERLOCK CIRCUITS

The Plus-X VSWR is equipped with meter inputs, a status input, and control relays that either open or close external transmitter interlock circuits. The meter inputs are used to monitor forward and reflected power on each transmission line (up to four lines per Plus-X VSWR). These signals are converted to power measurements via a user calibration factor stored for each power sensor. The power measurements are used to calculate VSWR for each transmission line.

The Plus-X VSWR can be set to monitor either reflected power or VSWR for each transmission line. If the measured value exceeds a user defined threshold, the control relay pair assigned to that transmission line will interrupt the interlock. The control relays can operate in normally closed or normally open configuration depending on how the user wants to control the transmitter interlock circuit. By appropriately opening or closing the Control Relay, the Plus-X VSWR can interrupt the RF signal flow for the affected transmission line reducing the risk of damage to the line, antenna or other components.

### CASCADED OPERATION

By enabling Cascaded Interlock Operation on one or more Plus-X VSWR units and tying together all Pin 16 Status Inputs, for all the Plus-X VSWR units, an operator can set up the system to shut down the RF signal to all transmission lines simultaneously if there is a single fault detected. Cascaded operation is useful in situations where multiple transmitters feed a combiner and a single fault downstream of the combiner output would require removal of RF power from all the combiner inputs.

### INTERLOCK CONTROL PRIORITY

Priorities have been established for control of transmitter interlocks. The parameters that control interlock operation and the resulting actions are listed in the table below in priority order. If an action is in effect based on current system conditions, the occurrence of a higher priority event will take precedence, potentially changing the

state of the interlock. For example, during maintenance mode (priority 3) interlocks are normally held in the closed state. However, an active cascade input signal (priority 2) indicates that a connected Plus-X VSWR unit, not in maintenance mode, has detected a fault requiring all interlocks to be opened. This higher priority action will be implemented. The terminology in the table below is based on normally-closed interlock operation such that an open interlock results in the interruption of transmitter power.

Priority	Action	Description
1	Force off – Open interlocks	<b>Force Off</b> has been selected as the Interlock Control Mode for this transmission line on the Interlock Configuration page of the web interface.
2	Cascade input – Open interlocks	The cascade input signal, status input 16, to the Plus-X VSWR has been asserted (pulled low).
3	Maintenance mode – Close interlocks	The Plus-X VSWR is in maintenance mode due to activation of the front panel <b>Maint</b> button. When maintenance mode is activated, the front panel <b>Link</b> LED flashes Red/Green if linked to an ARC Plus or Arcturus system or Red/Off in stand-alone operation.
4	Force on – Close interlocks	<b>Force On</b> has been selected as the Interlock Control Mode for this transmission line on the Interlock Configuration page of the web interface.
5	Control together – Open interlocks	<b>Control Together</b> has been selected for Relay Control for this transmission line on the Interlock Configuration page of the web interface, and another transmission line on the same Plus-X VSWR unit has detected a fault, calling for all interlocks to open.
6	VSWR or reflected power fault – Open interlocks	A VSWR or reflected power fault has been detected on this transmission line.

**FRONT PANEL**

The front panel of the Plus-X VSWR is shown in Figure 1.



*Figure 1. Front panel of the Plus-X VSWR*

**POWER INDICATOR**

Table 1 describes the possible states of the power indicator.

<b>Indicator</b>	<b>State</b>	<b>Description</b>
<b>Power LED</b>	Unlit	Power is off
<b>Power LED</b>	Green	Power is on
<b>Power LED</b>	Amber	No firmware loaded (If still on 5 seconds after power up, contact Technical Support at Burk Technology)
<b>Power LED</b>	Flashing Green	Resetting to factory default settings

*Table 1. Front panel power indicator states.*

---

## LINK INDICATOR

Table 2 describes the possible states of the link indicator.

<b>Indicator</b>	<b>State</b>	<b>Description</b>
<b>Link LED</b>	Green	Connected to Arcturus or ARC Plus
<b>Link LED</b>	Amber	No firmware loaded (If still on 5 seconds after power up, contact Technical Support at Burk Technology)
<b>Link LED</b>	Unlit	No Connection to Arcturus or ARC Plus
<b>Link LED</b>	Flashing Red/Green	Connected to Arcturus or ARC Plus but unit is in Maintenance Mode
<b>Link LED</b>	Flashing Red/Unlit	No Connection to Arcturus or ARC Plus but unit is in Maintenance Mode

*Table 2. Link indicator states*

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## MAINT BUTTON

Plus-X VSWR can be placed in Maintenance mode by pressing the front panel Maint button. When the Plus-X VSWR is in maintenance mode, remote control commands are disabled. VSWR and Reflected Power faults are detected and reported while maintenance mode is enabled, but interlocks are not interrupted unless the “Cascade Interlock Input” is enabled and status pin 16 is pulled low.

The cascade output function is disabled during Maintenance Mode, regardless of the setting for “Cascade Interlock Output” on the Interlock Configuration web page. The cascade relays will be placed in their inactive, released state whenever Maintenance Mode is activated. When Maintenance Mode is disengaged, the cascade relays will return to normal operation and will open or close as appropriate based on the system configuration and current conditions.

Maintenance mode must be toggled from the front panel and the front panel control must be enabled in the Interlock Configuration page of the website interface. For safety reasons, Maintenance mode cannot be enabled or disabled by any remote means.

## REAR PANEL

The rear panel of the Plus-X VSWR is shown in the photograph below in Figure 2.

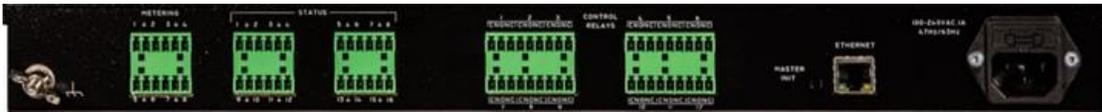
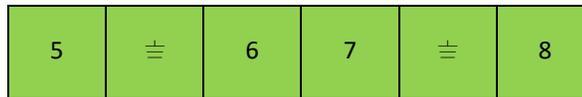
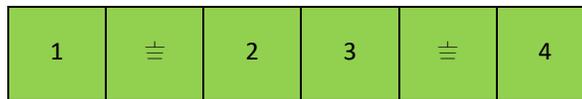


Figure 2. Rear panel of Plus-X VSWR

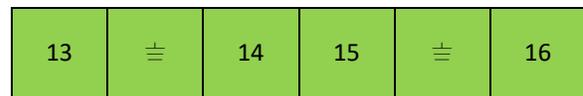
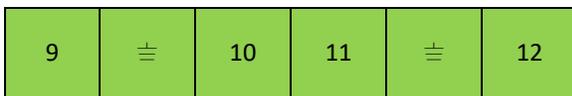
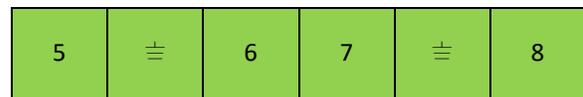
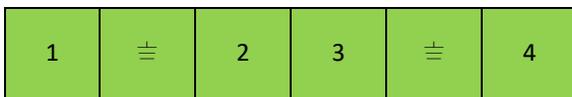
### METERING CONNECTIONS

Metering inputs are available on a 2x6 “Phoenix”-type header (two mating 6-pin plugs are included). Pins for each channel and ground are labeled. The forward and reflected power signals from the calibrated power sensors provide the inputs used by the Plus-X VSWR to calculate VSWR for each transmission line. Pin assignments are detailed in Table 5 and are pre-assigned.



### STATUS CONNECTIONS

The Plus-X VSWR Status Inputs are organized into two 2x6 “Phoenix”-type headers (four mating 6-pin plugs are included). Pins for each channel and ground are labeled. Status inputs are normally not used except for Pin 16 which is the input for cascaded operation.



### CONTROL RELAY CONNECTIONS

The Plus-X VSWR contains twelve Control Relays that are grouped in redundant pairs. Relays are organized into two 2x9 “Phoenix”-type headers (four mating 9-pin plugs are included). Pins for common, normally open and normally closed are indicated for each relay. The redundant pairs are organized and assigned to transmission lines as shown in Table 3.

<b>1</b>			<b>2</b>			<b>3</b>			<b>4</b>			<b>5</b>			<b>6</b>					
C	NO	NC	C	NO	NC	C	NO	NC	C	NO	NC	C	NO	NC	C	NO	NC	C	NO	NC
<b>7</b>			<b>8</b>			<b>9</b>			<b>10</b>			<b>11</b>			<b>12</b>					
C	NO	NC	C	NO	NC	C	NO	NC	C	NO	NC	C	NO	NC	C	NO	NC	C	NO	NC

<i>Relays</i>	<i>Assignment in Plus-X VSWR</i>
<b>Relays 1 &amp; 7</b>	Transmission Line 1 Interlocks
<b>Relays 2 &amp; 8</b>	Transmission Line 2 Interlocks
<b>Relays 3 &amp; 9</b>	Transmission Line 3 Interlocks
<b>Relays 4 &amp; 10</b>	Transmission Line 4 Interlocks
<b>Relays 5 &amp; 6</b>	Control of Cascade Operation
<b>Relays 11 &amp; 12</b>	Spare

*Table 3. Relay pairs in the Plus-X VSWR*

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## MASTER INIT

The MASTER INIT button on the rear panel of the Plus-X VSWR is used to reset the Plus-X VSWR to factory default settings. Press and hold this button for approximately three seconds. The LED above the Maint button on the front panel will flash for a few seconds and go solid again. Unplug the unit and plug it back in. The unit will now be reset to factory default settings.

Note: Initializing the unit in this manner will reset all network connection data in the unit to factory default status.

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## ETHERNET CONNECTION

The ETHERNET connection is the Plus-X VSWR connection to a network and/or an Arcturus or ARC Plus system.

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## AC POWER

The AC POWER connector is the Plus-X VSWR connection to 110VAC power for the unit.

## MONITORING AND CONTROL

Once configured correctly the Plus-X VSWR provides automatic interrupt of interlock(s) based on either reflected power or VSWR (depending on user configuration) if higher than a threshold limit.

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## WEBSITE INTERFACE

The website interface is accessed through your web browser by entering the IP address of the unit into the address bar of the browser. From the website interface, you can monitor channel values, view and change network settings, configure interlocks and view operational parameters.

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## ARCTURUS AND ARC PLUS

The Plus-X VSWR can be integrated with the Burk Arcturus or ARC Plus remote-control system. Once integrated with Arcturus or ARC Plus, the Plus-X VSWR channels become just like any other channel in the Burk system and can be used to create virtual channels, set alarms, activate interlocks beyond those directly controlled by the Plus-X VSWR and provide integrated status with the rest of the site.

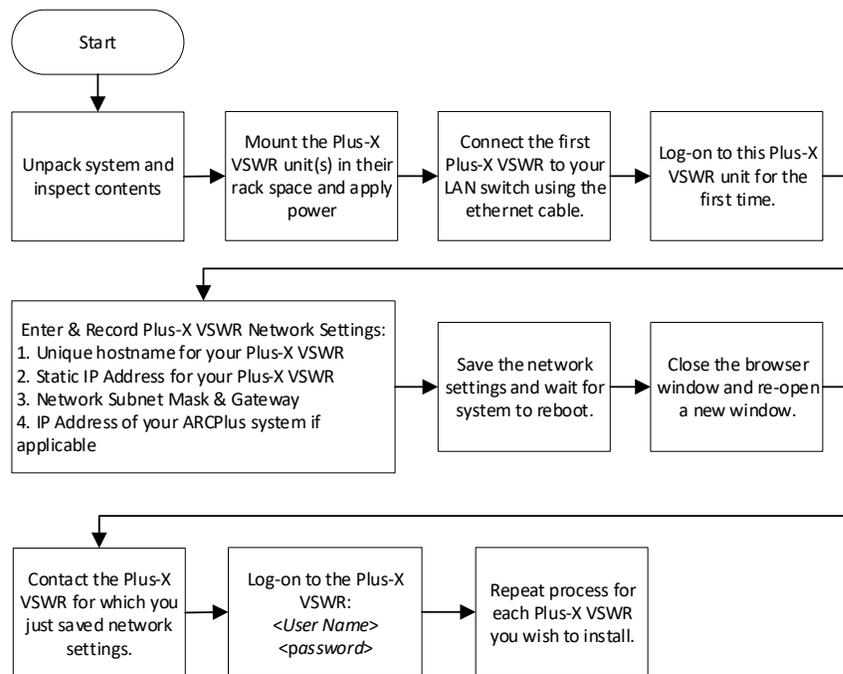
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## FIRMWARE UPDATES

Plus-X VSWR firmware is subject to updates on a periodic basis. To update the firmware, refer to the *Burk Firmware Loader Manual* and Application at: <https://www.burk.com/support/downloads>.

## INSTALLATION

The flowchart in Figure 3 shows the top-level installation steps for a single Plus-X VSWR. Step-by-step instructions follow. This flow chart is intended to orient the user to the complete process. If you plan to install more than one Plus-X VSWR system, perform this installation process separately for each Plus-X VSWR. To prevent a possible network collision, do not plug a new Plus-X VSWR into your network until you have entered the unique network settings for the last Plus-X VSWR system installed.



*Figure 3. Overview of Plus-X VSWR installation procedure*

## UNPACKING

The Plus-X VSWR ships with the following:

- Plus-X VSWR unit
- Power cord
- 10' shielded CAT5 cable
- Six (6) 6-pin "Phoenix"-type plugs
- Four (4) 9-pin "Phoenix"-type plugs

These parts will be needed for each Plus-X VSWR you plan to install. If any parts are not present when you unpack the box(es), please contact Burk Technology Sales Department.

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## COMPATIBILITY

If you plan to use your Plus-X VSWR unit(s) with an Arcturus or ARC Plus System, make sure the system firmware and AutoLoad Plus software versions are updated to the minimum release versions provided in Table 4. If you plan to use AutoPilot software with your Plus-X VSWR unit(s), make sure your AutoPilot software is updated to the minimum release version provided in Table 4.

<b>System</b>	<b>Software or Firmware Version</b>
Arcturus	5.0.15.1
ARC Plus V5	5.0.14.1
ARC Plus V4	4.1.32
ARC Plus V3	3.0.2.12
AutoLoad Plus	3.1.124
AutoPilot	4.1.32

*Table 4. Firmware compatibility*

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## NETWORK CONNECTIVITY

Before installing the Plus-X VSWR, have the following information ready to enter in the Plus-X VSWR network settings window when you get to that step in the process:

- A unique static IP address for the Plus-X VSWR you are installing
- The subnet mask and gateway address for your LAN
- The IP address of your Arcturus or ARC Plus system, if applicable

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## LOG ON FOR THE FIRST TIME

The process to establish communication with the Plus-X VSWR for the very first time depends on whether you have a Dynamic Host Configuration Protocol (DHCP) enabled network.

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### USING A DHCP ENABLED NETWORK

If your network has DHCP, follow the steps below or else proceed to [IF DHCP IS NOT ENABLED](#)

1. Plug one Plus-X VSWR into your network switch.
2. Open a web browser and type in the following address in the browser address bar: plusxvswr/
3. A window will appear asking to enter in a password for the Plus-X VSWR.

**BURK**  
TECHNOLOGY

Set the administrator password.

Username:

Enter Password:

Confirm Password:

- After you **Save** the new password for the Plus-X VSWR, a new login screen will appear.

**BURK**  
TECHNOLOGY

Username:

Password:

- Enter in the default username <admin> and the password you just defined in step 3.
- After you log on, the next screen to appear will request that you enter a static IP address for your Plus-X VSWR. This is the IP address you will use to launch a website interface session with the Plus-X VSWR and that an Arcturus or ARC Plus system can use to communicate with the Plus-X VSWR.

**BURK**  
TECHNOLOGY Plus-X VSWR

Channel Values Settings

Network

Interlock Status

Interlock Configuration

Advanced

Update Firmware

Network

A static IP address must be assigned to the Plus-X VSWR. (Do not assign within the DHCP range.)

Current DHCP IP address: 192.168.0.179

IP Address:

7. After you enter in and **Save** a new Static IP address for the Plus-X VSWR, a new log-on screen will pop up asking you to log on again. Enter the username and password you have set for the Plus-X VSWR just as you did in step 4.
8. After your login is complete, the Plus-X VSWR will open to the Network screen of the website interface.

**BURK TECHNOLOGY** Plus-X VSWR

Channel Values Settings

**Network**

Interlock Status

Interlock Configuration

Advanced

Update Firmware

**Network**

NetBIOS/Hostname: PLUSXVSWR

IP Address: 192.168.0.97

Subnet Mask: 255.255.255.0

Gateway: 192.168.0.1

ARC Plus IP Address: 192.168.0.96 Connected

Reinitialize if ARC Plus is not connected:

HTTP Port: 80

Plus-X Port: 45000

MAC: 70 : B5 : D5 : BD : 2C : 2D

Change Password?

Password: \_\_\_\_\_

Confirm: \_\_\_\_\_

Save

In this window you should enter in the following information:

- Unique Net/BIOS Hostname (especially if you have more than one Plus-X VSWR)
  - Subnet Mask
  - Gateway
  - Arcturus or ARC Plus IP Address (if applicable)
9. The Plus-X VSWR is now ready for operation in your system as either a stand-alone device or as part of an Arcturus or ARC Plus system. Repeat this process for each Plus-X VSWR one at a time.

## IF DHCP IS NOT ENABLED

If you are not working in a DHCP enabled network, follow the steps below.

1. Temporarily set up your computer to have an IP address as follows:

192.168.0.xxx

You can use any unused number you like for the xxx except 1 or 100. Make sure the temporary IP address you choose for your computer doesn't conflict with other equipment on your network.

2. Open a web browser and type in the following address into the address bar:

192.168.0.100

3. A window will appear asking you to enter in a password for the Plus-X VSWR.



The screenshot shows a web interface for Burk Technology. At the top is the Burk Technology logo. Below it, the text reads "Set the administrator password." There are three input fields: "Username:" with the value "admin", "Enter Password:" with a masked password of seven dots, and "Confirm Password:" with a masked password of seven dots. A "Save" button is located below the input fields. At the bottom of the screen, it says "Firmware Version 1.0.7" and "© 2018 Burk Technology, Inc. All rights reserved."

4. After you **Save** the new password for the Plus-X VSWR, a new log on screen will appear.



The screenshot shows a web interface for Burk Technology. At the top is the Burk Technology logo. Below it, there are two input fields: "Username:" and "Password:". A "Log On" button is located below the input fields. At the bottom of the screen, it says "Firmware Version 1.0.7" and "© 2018 Burk Technology, Inc. All rights reserved."

5. Enter in the default username <admin> and the password you just defined in step 3.
6. After you log on, the next screen to appear will request that you enter a static IP address for your Plus-X VSWR. This is the IP address you will use to launch a website interface session with the Plus-X VSWR and that an Arcturus or ARC Plus system can use to communicate with the Plus-X VSWR.

Network

Interlock Status

Interlock  
Configuration

Advanced

Update Firmware

**Network**

A static IP address must be assigned to the Plus-X VSWR. (Do not assign within the DHCP range.)

Current DHCP IP address: 192.168.0.179

IP Address:

7. Once the new IP address for the Plus-X VSWR is saved, reset your computer back to its original IP address so that you can communicate with your network again (including the new Plus-X VSWR).
8. Open a browser window and type in the IP address you have assigned to the Plus-X VSWR in Step 5.
9. The Plus-X VSWR is now ready for operation in your system as either a stand-alone device or as part of an Arcturus or ARC Plus comprehensive monitoring and control system. Repeat this process for each Plus-X VSWR you install in your monitoring and remote-control system.

## METER INPUT WIRING

The Plus-X VSWR can provide forward and reflected power measurements and VSWR calculation on up to four transmission lines simultaneously. For each transmission line, two RF power sensors provide analog voltage signals to the inputs of the Plus-X VSWR. The metering inputs on the Plus-X VSWR only accept inputs between 0 VDC and +10 VDC. An appropriate calibration factor is required for each input. Metering input pins are pre-assigned to transmission line inputs and cannot be changed. See Table 5.

Pin	Transmission Line	Input
1	1	forward power
2	ground	
3	1	reflected power
4	2	forward power
5	ground	
6	2	reflected power
7	3	forward power
8	ground	
9	3	reflected power
10	4	forward power
11	ground	
12	4	reflected power

*Table 5. Metering input pins for Plus-X VSWR*

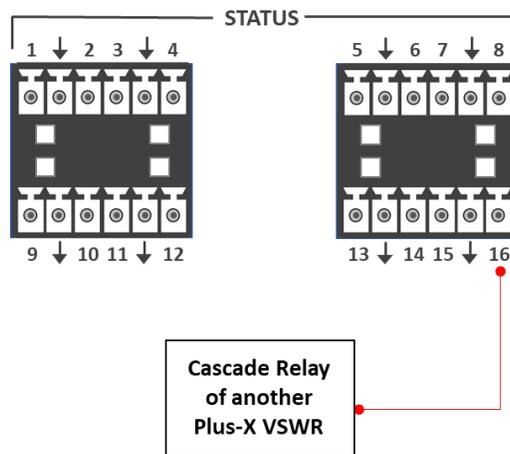
The Burk PRF-1, Precision RF Sensor, is powered by a DC power supply providing between 9 V and 24 V. The DC output signal is linear with respect to the RF sample input power. Pin-outs for the PRF-1 are shown in Table 6.

Pin	Signal
1	(V+) DC power supply in
2	ground
3	(V+) DC signal out
4	ground

*Table 6. Pin identification for Burk PRF-1  
Precision RF Sensor*

## STATUS INPUT WIRING

The status inputs on the Plus-X VSWR are not used except for one possible exception. Pin 16 can be used to accept



Cascade input from another Plus-X VSWR system. Cascade operation refers to the built-in option for the VSWR to open all relay outputs on a single input fault from any of the transmission lines directly tied to the Plus-X VSWR, or from grounding of status input pin 16 by another Plus-X VSWR Cascade output signal.

## CONTROL RELAY WIRING

The Plus-X VSWR relays are factory assigned to the transmission lines per Table 3 in **CONTROL RELAY CONNECTIONS**. Each relay opens and closes together with its paired partner. The relays can be operated in Normally Closed or Normally Opened configuration. A setting in the Interlock Configuration window of the website interface allows the user to identify whether the interlocks are used in normally open or closed configuration. See **STATUS CONNECTIONS** for an example installation of control relays for the Cascade operation function of the Plus-X VSWR.

## SOFTWARE CONFIGURATION

Unlike other Plus-X devices, the Plus-X VSWR does not need an additional Arcturus or ARC Plus system to function. Once communications with the Plus-X VSWR are established from your Personal Computer (see **LOG ON FOR THE FIRST TIME**), you can configure the device through the website interface via the **Settings Menu** and the Interlock Configuration page (see **MONITORING AND CONTROL**).

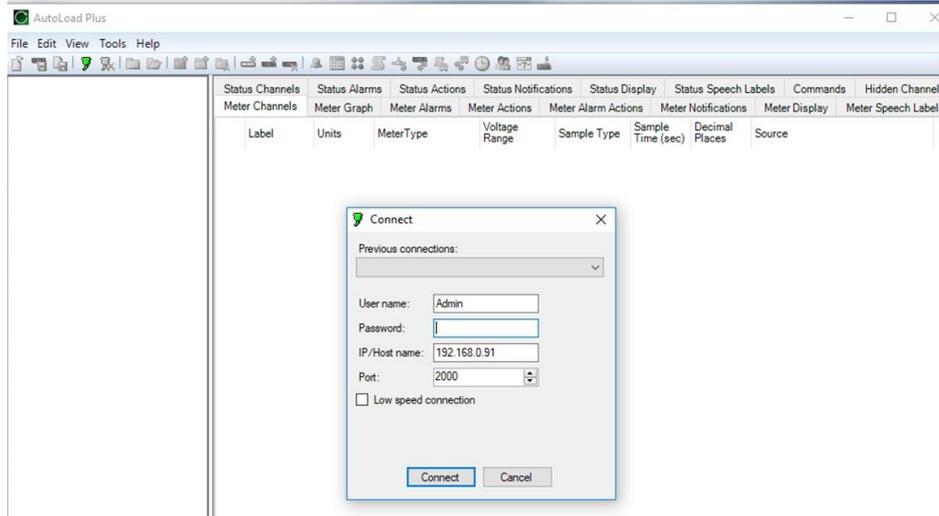
## ADDING THE PLUS-X VSWR TO THE ARCTURUS OR ARC PLUS

**Installation Note:** Even though you may operate the Arcturus or ARC Plus system and Plus-X VSWR on different subnets, Burk Technology strongly recommends installing the Plus-X VSWR on the same LAN as the Arcturus or ARC Plus. If communications between separate networks fail, an Arcturus or ARC Plus can only continue to monitor and control a Plus-X device on the same LAN. If the network link between the units is not available, Arcturus or ARC Plus macros and alarm monitoring will be unavailable for the Plus-X VSWR.

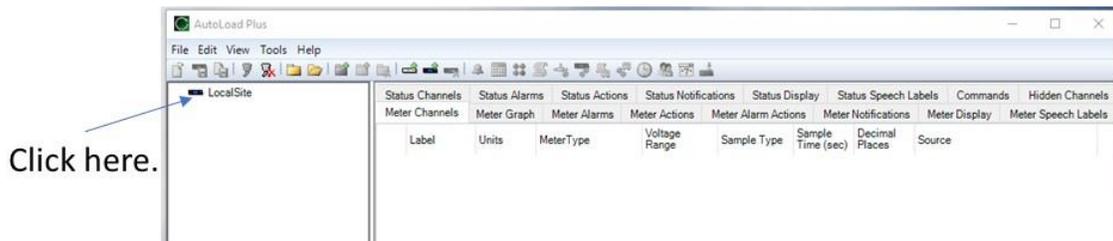
To use the Plus-X VSWR as part of an Arcturus or ARC Plus remote monitoring and control system, you will need to add the Plus-X VSWR to the system using Autoload Plus software.

1. Complete steps in **LOG ON FOR THE FIRST TIME** to establish PC communications with your Plus-X VSWR Unit(s).

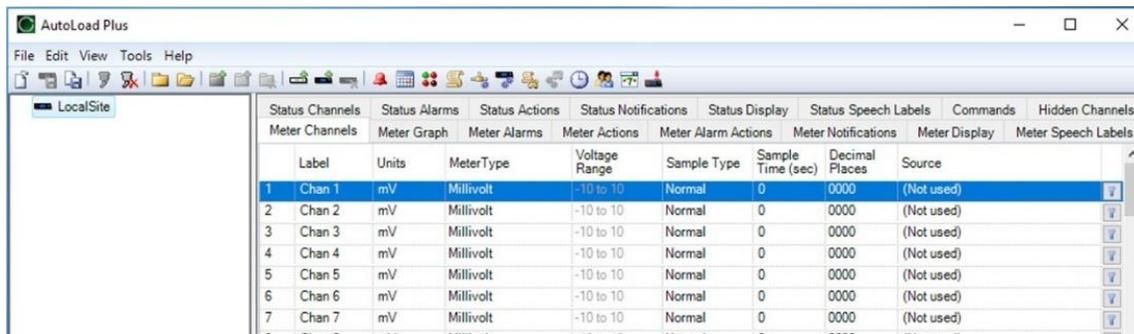
2. Download the latest AutoLoad Plus software from the Burk Website.
3. Open the AutoLoad Plus software. You will see a screen like the one below.



4. Enter in the Username, Password and IP/Host name for your Arcturus or ARC Plus system. The default screen will look the screen shown below. Click **Local Site** in the top left of the window.



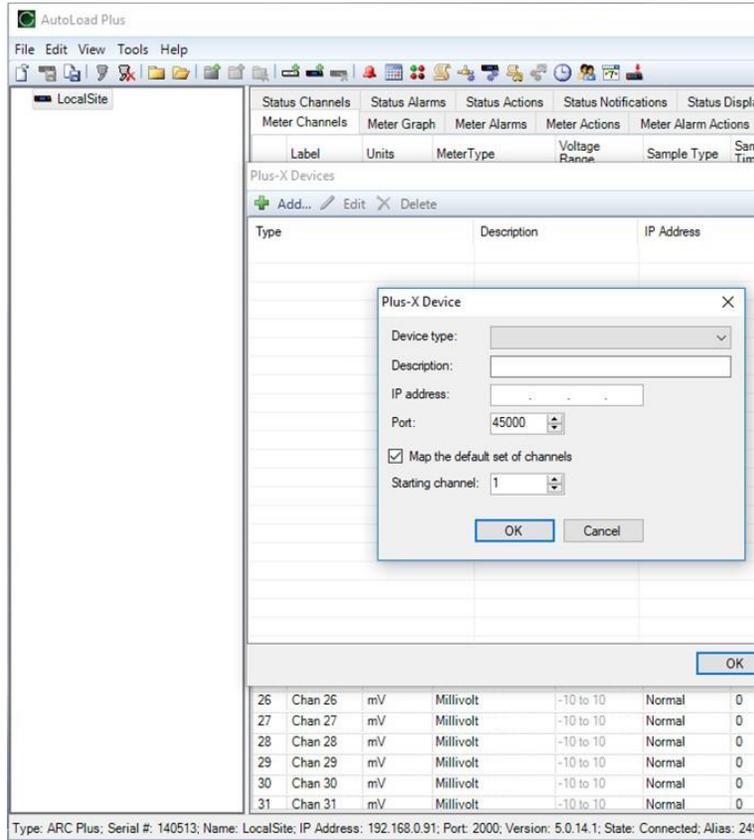
5. After you click **LocalSite**, you will see the existing channels that are already configured on the Arcturus or ARC Plus appear in the AutoLoad Plus window.



In the screen shot above, the ARC Plus system has no meter channels configured. This may or may not be the case with your system.

Note: If you have meter channels already configured in your Arcturus or ARC Plus, note the channel number of the first available meter channel.

- To add a Plus-X VSWR unit to the Arcturus or ARC Plus, select **Edit Menu**, click **Add Plus-X Device** under the **Edit Menu** and click on **+ Add** on the screen that pops up. You will see a second pop-up screen for you to enter in the relevant data for the Plus-X VSWR unit.



<b>Device Type</b>	Choose Plus-X VSWR from the pull-down list of choices.
<b>Description</b>	Provide a unique descriptor like "PlusXVSWR104".
<b>IP Address</b>	Enter in the static IP address you selected when you first setup communications with the Plus-X VSWR.
<b>Port</b>	Leave this at Port 45000.
<b>Check Box</b>	Map the default set of channels. Make sure this box is checked.
<b>Starting Channel</b>	Enter channel 1 or the channel number you noted in step 5.

Table 7. Pop-up window for Plus-X VSWR information needed to add the unit to an ARC Plus system.

7. Click **OK**.
8. After you click **OK** in Step 6, you will see the following screen.

Label	Units	Meter Type	Voltage Range	Sample Type	Sample Time (sec)	Decimal Places	Source
1 FwdPwr 1	Millivolt	Millivolt	-10 to 10	Normal	0	00.00	FwdPwr 1 on Plus-X VSWR_104
2 RefPwr 1	Millivolt	Millivolt	-10 to 10	Normal	0	00.00	RefPwr 1 on Plus-X VSWR_104
3 VSwrR 1	Millivolt	Millivolt	-10 to 10	Normal	0	0.000	VSwrR 1 on Plus-X VSWR_104
4 FwdPwr 2	Millivolt	Millivolt	-10 to 10	Normal	0	00.00	FwdPwr 2 on Plus-X VSWR_104
5 RefPwr 2	Millivolt	Millivolt	-10 to 10	Normal	0	00.000	RefPwr 2 on Plus-X VSWR_104
6 VSwrR 2	Millivolt	Millivolt	-10 to 10	Normal	0	0.000	VSwrR 2 on Plus-X VSWR_104
7 FwdPwr 3	Millivolt	Millivolt	-10 to 10	Normal	0	00.00	FwdPwr 3 on Plus-X VSWR_104
8 RefPwr 3	Millivolt	Millivolt	-10 to 10	Normal	0	00.000	RefPwr 3 on Plus-X VSWR_104
9 VSwrR 3	Millivolt	Millivolt	-10 to 10	Normal	0	0.000	VSwrR 3 on Plus-X VSWR_104
10 FwdPwr 4	Millivolt	Millivolt	-10 to 10	Normal	0	00.00	FwdPwr 4 on Plus-X VSWR_104
11 RefPwr 4	Millivolt	Millivolt	-10 to 10	Normal	0	00.000	RefPwr 4 on Plus-X VSWR_104
12 VSwrR 4	Millivolt	Millivolt	-10 to 10	Normal	0	0.000	VSwrR 4 on Plus-X VSWR_104
13 Chan 13	mV	Millivolt	-10 to 10	Normal	0	0000	(Not used)
14 Chan 14	mV	Millivolt	-10 to 10	Normal	0	0000	(Not used)
15 Chan 15	mV	Millivolt	-10 to 10	Normal	0	0000	(Not used)
16 Chan 16	mV	Millivolt	-10 to 10	Normal	0	0000	(Not used)

Save to ARC Plus button

Label	Units	Meter Type	Voltage Range	Sample Type	Sample Time (sec)	Decimal Places	Source
1 FwdPwr 1	Millivolt	Millivolt	-10 to 10	Normal	0	00.00	FwdPwr 1 on Plus-X VSWR_104
2 RefPwr 1	Millivolt	Millivolt	-10 to 10	Normal	0	00.000	RefPwr 1 on Plus-X VSWR_104
3 VSwrR 1	Millivolt	Millivolt	-10 to 10	Normal	0	0.000	VSwrR 1 on Plus-X VSWR_104
4 FwdPwr 2	Millivolt	Millivolt	-10 to 10	Normal	0	00.00	FwdPwr 2 on Plus-X VSWR_104
5 RefPwr 2	Millivolt	Millivolt	-10 to 10	Normal	0	00.000	RefPwr 2 on Plus-X VSWR_104
6 VSwrR 2	Millivolt	Millivolt	-10 to 10	Normal	0	0.000	VSwrR 2 on Plus-X VSWR_104
7 FwdPwr 3	Millivolt	Millivolt	-10 to 10	Normal	0	00.00	FwdPwr 3 on Plus-X VSWR_104
8 RefPwr 3	Millivolt	Millivolt	-10 to 10	Normal	0	00.000	RefPwr 3 on Plus-X VSWR_104
9 VSwrR 3	Millivolt	Millivolt	-10 to 10	Normal	0	0.000	VSwrR 3 on Plus-X VSWR_104
10 FwdPwr 4	Millivolt	Millivolt	-10 to 10	Normal	0	00.00	FwdPwr 4 on Plus-X VSWR_104
11 RefPwr 4	Millivolt	Millivolt	-10 to 10	Normal	0	00.000	RefPwr 4 on Plus-X VSWR_104
12 VSwrR 4	Millivolt	Millivolt	-10 to 10	Normal	0	0.000	VSwrR 4 on Plus-X VSWR_104

The last step is to save the configuration of the Arcturus or ARC Plus channels for your Plus-X VSWR by clicking **Save To** (this example shows saving to an ARC Plus system).

Your first Plus-X VSWR is now connected to the Arcturus or ARC Plus system. Channels may be calibrated and configured via the Plus-X VSWR website interface using the **Interlock Configuration** tab under the **Settings Menu**.

**Important note:** Once configured, the Plus-X VSWR provides filtering and calibrated meter readings that get delivered to the Arcturus or ARC Plus system. The Plus-X VSWR meter type should be left at **millivolt** and sample type should be left at **normal**. Calibration of meter channels should only be done through the Plus-X VSWR website interface. Changing any of these settings in AutoLoad Plus will result in inaccurate values displayed on the Arcturus or ARC Plus system.

## OPERATION

The Plus-X VSWR is an automatic interlock interrupt system and, once configured, requires no operator input or attention. The main screen of the website interface has two menu items: **Channel Values** and **Settings**.

## SETTINGS

Under the **Settings Menu**, the operator can examine and change network connection information (including change the password to the system), configure the system's operational parameters and check and reset the status of each channel interlock.

### VERIFYING/SETTING NETWORK CONNECTIONS

Click **Network**, under the **Settings Menu**, and your browser will display a screen like the one below. This screen appears when you first set up the Plus-X VSWR for operation on your network (see **LOG ON FOR THE FIRST TIME**). From this screen enter the IP address of your Arcturus or ARC Plus system or change the password to your Plus-X VSWR system.

The screenshot shows the web interface for the Plus-X VSWR system. At the top left is the BURK TECHNOLOGY logo. To its right is the text 'Plus-X VSWR'. Below the logo is a navigation bar with 'Channel Values' and 'Settings' tabs. A blue sidebar on the left contains menu items: 'Network', 'Interlock Status', 'Interlock Configuration', 'Advanced', and 'Update Firmware'. The main content area is titled 'Network' and contains the following fields and controls:

NetBIOS/Hostname:	<input type="text" value="PLUSXVSWR"/>	
IP Address:	<input type="text" value="192.168.0.97"/>	
Subnet Mask:	<input type="text" value="255.255.255.0"/>	
Gateway:	<input type="text" value="192.168.0.1"/>	
ARC Plus IP Address:	<input type="text" value="192.168.0.96"/>	Connected
Reinitialize if ARC Plus is not connected:	<input checked="" type="checkbox"/>	
HTTP Port:	<input type="text" value="80"/>	
Plus-X Port:	<input type="text" value="45000"/>	
MAC:	<input type="text" value="70 : B5 : D5 : BD : 2C : 2D"/>	
Change Password?	<input type="checkbox"/>	
Password:	<input type="password"/>	
Confirm:	<input type="password"/>	

At the bottom right of the form is a 'Save' button.

## CONFIGURATION

The first two columns of the Interlock Configuration page on the website interface are shown in Figure 4. This page is used to configure parameters for all transmission lines monitored by the Plus-X VSWR. Click the **Save** button at the top or bottom of the page after entering changes to save them to the Plus-X VSWR unit. The **Save** button will be disabled (grayed out) if invalid entries are detected on this page and the invalid entries will be highlighted with a red outline.

The screenshot shows the 'Interlock Configuration' page for 'Transmission Line 1'. The page is part of the 'BURK TECHNOLOGY Plus-X VSWR' interface, with a navigation menu on the left containing 'Network', 'Interlock Status', 'Interlock Configuration', 'Advanced', and 'Update Firmware'. The main configuration area includes a 'Save' button at the top left. The configuration parameters are as follows:

Name:	Transmission Line 1
Forward Power Value:	15.3 kW Calibrate
Forward Power Units:	<input type="radio"/> W <input checked="" type="radio"/> kW
Reflected Power Value:	90 W Calibrate
Reflected Power Units:	<input checked="" type="radio"/> W <input type="radio"/> kW
Minimum Forward Power for VSWR:	1 W Wizard
VSWR:	1.165 : 1
Interlock Control Mode:	<input type="radio"/> Force On <input type="radio"/> Force Off <input checked="" type="radio"/> VSWR <input type="radio"/> Reflected Power <input type="radio"/> Hybrid
VSWR Threshold:	1.4 : 1
Reflected Power Threshold:	100 W
Hybrid Threshold:	0 kW
Interlock Open Delay:	0 seconds
Interlock Open Duration:	10 seconds
Interlock Open Retry:	3
Lockout Window:	5 minutes
Lockout Timeout:	<input checked="" type="radio"/> Infinite <input type="radio"/> 1 minutes
Interlock Relay Polarity:	<input checked="" type="radio"/> Relay energized on fault (use normally closed for series interlock) <input type="radio"/> Relay de-energized on fault (use normally open for series interlock)
Relay Control:	<input checked="" type="radio"/> Control each interlock separately <input type="radio"/> Control the interlocks together
Cascade Interlock Output:	<input type="radio"/> Enable the Cascade Relay to turn off other panels. <input checked="" type="radio"/> Disable the Cascade Relays.
Cascade Interlock Input:	<input checked="" type="radio"/> Enable the Cascade Status Input to turn off this panel. <input type="radio"/> Disable the Cascade Status Input.
Maintenance Mode:	<input checked="" type="checkbox"/> Enable Front Panel Button

A 'Save' button is located at the bottom left of the configuration area.

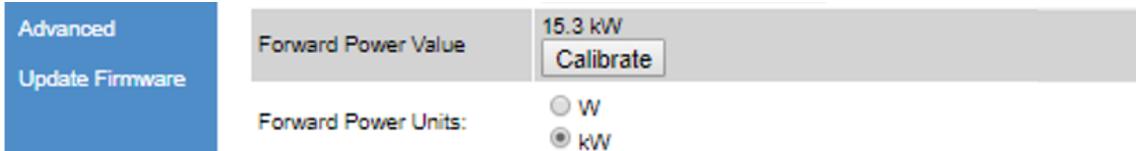
Figure 4. Interlock Configuration page (partial)

## CHANNEL COLUMN:

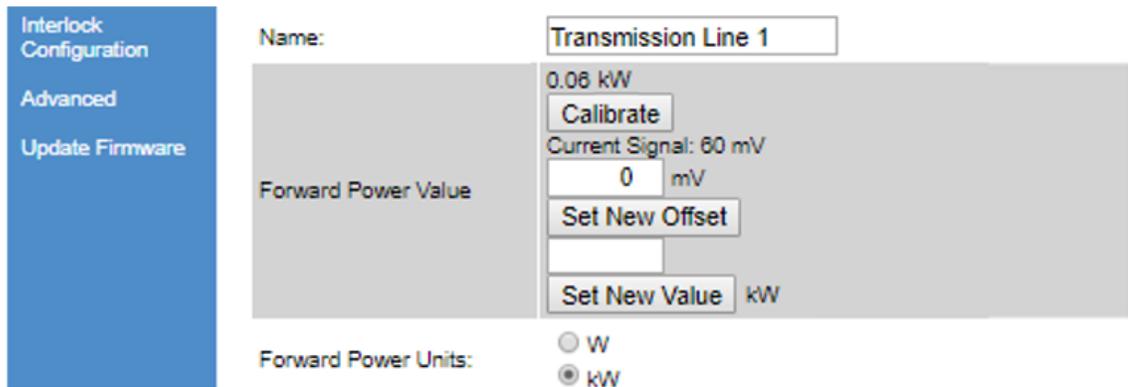


Enter a name to identify the channel.

## FORWARD POWER VALUE AND FORWARD POWER UNITS



1. Set the units for your forward power value as either Watts (W) or Kilowatts (kW) by choosing the appropriate radio button.
2. Prepare for calibration of the forward power channel by removing RF power from the forward power sensor. Then click **Calibrate**. The forward power region of the screen will expand as shown below:



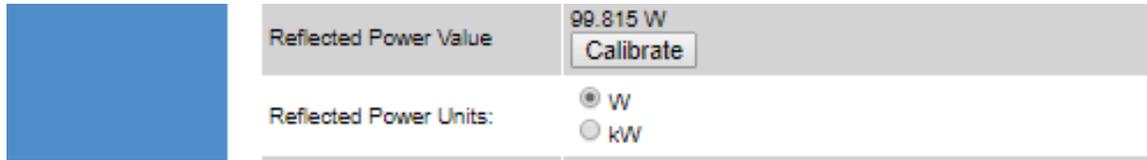
3. The value displayed for Current Signal, 60mV in the example shown above, represents the DC measurement offset. Enter this value in the box labeled mV and click **Set New Offset**.
4. Now apply RF power to the sensor and Independently measure the forward power at the point of monitoring. Enter this power value into the open window and click **Set New Value**. (Make sure to use the same units that you initially set for forward power units).

## QUALIFICATION OF RF SENSOR INPUT SAMPLES

The nominal output voltage range of the PRF-1 Precision RF sensor, after removal of DC offset is 0 to 5 Volts DC. All meter inputs on the Plus-X VSWR are tested against these limits during each measurement cycle. If after removal of DC offset a sample greater than 5.5 Volts DC is detected, the RF power value displayed on the Interlock Status page of the web interface is replaced with the words "Too High". If the detected value after removal of offset is lower than -0.1 Volts DC, the value displayed on the Interlock Status page is replaced with the words "Too Low". If either the high or low limit is exceeded, a connected Arcturus or ARC Plus system will report the channel as "Offline" and any active AutoPilot® custom views will display the words "No Data" for that channel. VSWR calculation and VSWR fault detection are disabled

for any transmission line during the time that either the forward or reflected power sample for that transmission line exceeds one of the measurement limits.

### REFLECTED POWER VALUE AND REFLECTED POWER UNITS



The screenshot shows a configuration panel for Reflected Power. On the left is a blue square. The main panel has a header 'Reflected Power Value' with a text input field containing '99.815 W' and a 'Calibrate' button below it. Below this is the 'Reflected Power Units:' section with two radio buttons: 'W' (selected) and 'kW'.

Repeat steps 1-4 from above for the two Reflected Power rows.

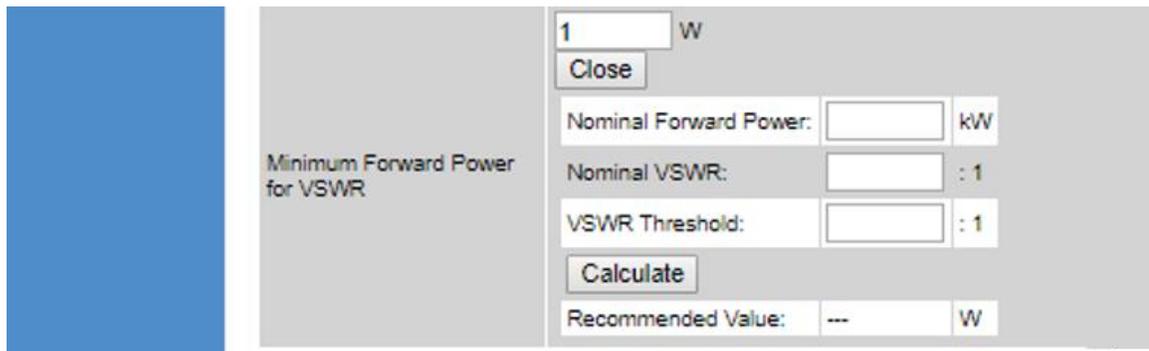
### MINIMUM FORWARD POWER FOR VSWR



The screenshot shows a configuration panel for Minimum Forward Power for VSWR. On the left is a blue square. The main panel has a header 'Minimum Forward Power for VSWR' with a text input field containing '1' and 'W' to its right, and a 'Wizard' button below it.

This parameter sets a lower limit on the measured forward power level before a VSWR calculation is made ensuring that there is adequate forward power for a valid VSWR calculation. This parameter is expressed in Watts. A wizard is provided to calculate a recommended value for the parameter as follows:

1. Click **Wizard**. This region of the screen will expand as shown below.



The screenshot shows the expanded wizard dialog box for Minimum Forward Power for VSWR. On the left is a blue square. The dialog has a header 'Minimum Forward Power for VSWR' with a text input field containing '1' and 'W' to its right, and a 'Close' button below it. Below this are three input fields: 'Nominal Forward Power:' with a text input field and 'kW' to its right; 'Nominal VSWR:' with a text input field and ': 1' to its right; and 'VSWR Threshold:' with a text input field and ': 1' to its right. Below these is a 'Calculate' button. At the bottom is a 'Recommended Value:' field with a text input field containing '---' and 'W' to its right.

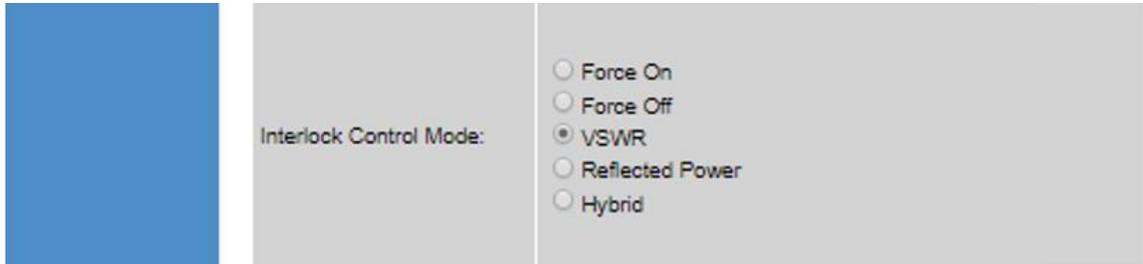
2. Enter values for Nominal Forward Power and Nominal VSWR. Also enter the VSWR Threshold you plan to use for VSWR fault detection. Then click **Calculate**. A recommended value for the parameter is calculated and displayed. This value can be accepted by entering it in the box at the top of the gray area above.

## VSWR

This indicator provides the value of VSWR calculated from the measurements of forward and reflected power. No user input is required or permitted in this field.

 VSWR 1.223 : 1

## INTERLOCK CONTROL MODE



Interlock Control Mode:

- Force On
- Force Off
- VSWR
- Reflected Power
- Hybrid

The Interlock Control Mode field allows you to enter the condition used for controlling the interlock activation for this transmission line. There are five possible choices:

- **Force On** – this test mode forces the OK interlock condition
- **Force Off** – this test mode forces the fault interlock condition
- **VSWR** – this normal mode sets the interlock to the fault condition if the VSWR threshold is exceeded.
- **Reflected Power** – this mode sets the interlock to the fault condition if the reflected power threshold is exceeded
- **Hybrid** – In hybrid mode, forward power is tested against a user configured Hybrid Threshold value. If forward power is above the threshold, interlock activation will be triggered by VSWR exceeding the VSWR threshold. If forward power is at or below the Hybrid Threshold, interlock activation will be triggered by reflected power exceeding the reflected power threshold.

## VSWR THRESHOLD

 VSWR Threshold  : 1

Set the VSWR Threshold to the maximum value allowed before the fault interlock loop condition is set. This threshold applies if the Interlock Control Mode is set to VSWR or Hybrid.

## REFLECTED POWER THRESHOLD

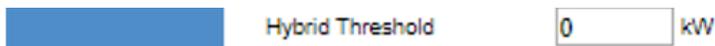
Set the reflected power Threshold to the maximum value allowed before the fault interlock loop condition



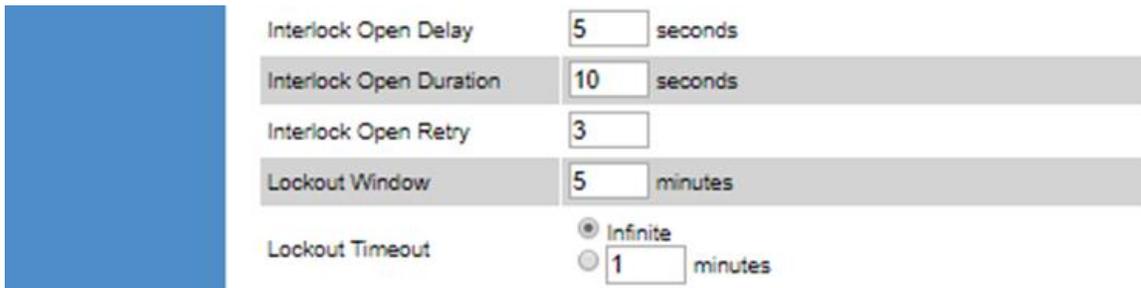
is set. This threshold applies if the Interlock Control Mode is set to Reflected Power or Hybrid.

## HYBRID THRESHOLD

In Hybrid mode, this threshold sets the forward power value above which interlock activation will be based on VSWR, and below which interlock activation will be based on Reflected Power.



## INTERLOCK AND LOCKOUT SETTINGS



Plus-X VSWR employs strike counting to minimize off-air time due to transient events while at the same time reducing risk of damage from a sustained fault. A strike is defined as the interruption of transmitter output power in response to a VSWR or reflected power fault condition. A strike is declared by the Plus-X VSWR when reflected power or VSWR exceeds a preset threshold for a duration longer than a specified wait time defined by the Interlock Open Delay setting. If the operator defines the wait time to be zero seconds, then a strike occurs immediately on detection of a fault.

The Plus-X VSWR uses the interlock circuit to keep the transmitter off until the Interlock Open Duration time expires. At the end of this delay, transmitter power is restored. If the previous strike was the result of a transient fault, then the fault will have cleared and power will remain on. If the fault is still active when the transmitter is turned back on, the process above will repeat and another strike will occur.

If a preset number of strikes happens within a specified time window the system will enter lockout mode. The Plus-X VSWR will not exit lockout and allow the transmitter to turn on again until one of the two following conditions are met:

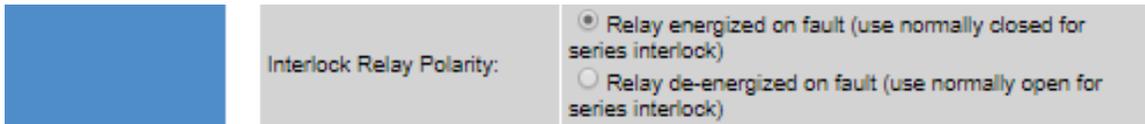
- The Plus-X VSWR will automatically exit lockout after a specified Lockout Timeout if the user allows this action.
- The user can manually reset the lockout condition from the Interlock Status page of the Plus-X VSWR user interface or via a mapped command in the Arcturus or ARC Plus system.

Strike counting requires user assigned values in each of the following numeric fields in the Configuration Page of the website interface. These numeric fields are defined below.

- **Interlock Open Delay** The number of seconds a fault condition must be sustained before the transmitter output power is interrupted via the interlock and a strike is logged by the Plus-X VSWR. The Interlock Open Delay can be set to a value from 0 to 25.4 seconds in 0.1 second increments.
- **Interlock Open Duration** After a strike is incurred, the number of seconds transmitter output power is interrupted before the Plus-X VSWR automatically restores transmitter power and starts to monitor for the next strike.
- **Interlock Open Retry** The number of strikes that may be incurred before a lockout is initiated (maximum = 3).
- **Lockout Window** The amount of time during which the selected number of strikes must occur to initiate lockout. If the maximum number of strikes does not occur by the end of the lockout window, the strike counter is reset to zero.
- **Lockout Timeout** The number of minutes that a lockout shall be enforced before it is automatically cleared. If set to Infinite, the lockout must be manually cleared by the user and will never be automatically cleared.

The names Interlock Open Delay, Interlock Open Duration and Interlock Open Retry are all indicative of interlock circuits wired in series. If the interlocks are wired in parallel, then these names would more appropriately be Interlock Closed Delay, Interlock Closed Duration and Interlock Closed Retry.

#### INTERLOCK RELAY POLARITY



Determines if relays are used in normally open or normally closed mode.

#### RELAY CONTROL



Determines if relays for all transmission lines are toggled together or separately. If interlocks are controlled together, a single fault on any one transmission line will activate interlock interrupts for all transmission lines on the Plus-X VSWR unit.

#### CASCADE INTERLOCK OUTPUT



Enables or disables the Cascade relay pair to activate interlocks on other Plus-X VSWR units. If the Enable button is active, relay pair 5 & 6 are enabled to provide Cascade outputs to other Plus-X VSWR units as shown and discussed in **STATUS CONNECTIONS** and **CONTROL RELAY CONNECTIONS**.

## CASCADE INTERLOCK INPUT



Cascade Interlock Input:

- Enable the Cascade Status Input to turn off this panel.
- Disable the Cascade Status Input.

Enables or disables the Cascade input (status pin 16). If enabled, this Plus-X VSWR can accept the Cascade outputs from other Plus-X VSWR units, as discussed in **STATUS CONNECTIONS** and **CONTROL RELAY CONNECTIONS**.

## MAINTENANCE MODE



Maintenance Mode

Enable Front Panel Button

If this box is checked the front panel Maint button is enabled.

## INTERLOCK STATUS

Name:	Transmission Line 1	Transmission Line 2	Transmission Line 3	Transmission Line 4
Forward Power	9.953 kW	0.28 kW	0.033 kW	0.281 kW
Reflected Power	99.815 W	0.109 W	0.019 W	0.082 W
VSWR	1.223 : 1	0 : 1	0 : 1	0 : 1
Strike 1	-	-	-	-
Strike 2	-	-	-	-
Strike 3	-	-	-	-
	Interlock Closed	Interlock Closed	Interlock Closed	Interlock Closed

The Interlock Status page is dynamic. Its appearance and function depend on the status of the interlocks. A larger view of the first two columns is shown below. This partial screen shot shows an Interlock Status page with no faults detected and with only one active channel (Transmission Line 1).

Name:	Transmission Line 1
Forward Power	9.953 kW
Reflected Power	99.815 W
VSWR	1.223 : 1
Strike 1	-
Strike 2	-
Strike 3	-
	Interlock Closed

For this situation, Transmission Line 1 is identified in the Name row. Forward power is 9.953 kW (units for forward and reflected power were set in the Interlock Configuration page of the website interface), reflected power = 99.815 W, VSWR = 1.223:1, no strikes are recorded, and the Interlock status is shown as Closed.

In the next screen shot, below, the VSWR Limit = 1.224:1 In this case, a fault condition is detected (VSWR > threshold limit), three strike timing is recorded, the interlock is open and Lockout condition exists. The time

indications show that 21 minutes and 8 seconds have elapsed since the first strike, and that the three strikes were 10 seconds apart.

Since the Lockout Timeout is set to infinite on the Interlock Configuration page, the only way to clear the lockout is to click on the Reset Lockout button.

If a condition exists in which 2 strikes have been recorded but the time since the first strike exceeds the configured Lockout Window duration, then the first strike will be retired, and Strike 2 will be shifted up to the Strike 1 position. This ensures that Lockout only occurs if all three strikes happen within the specified Lockout Window.

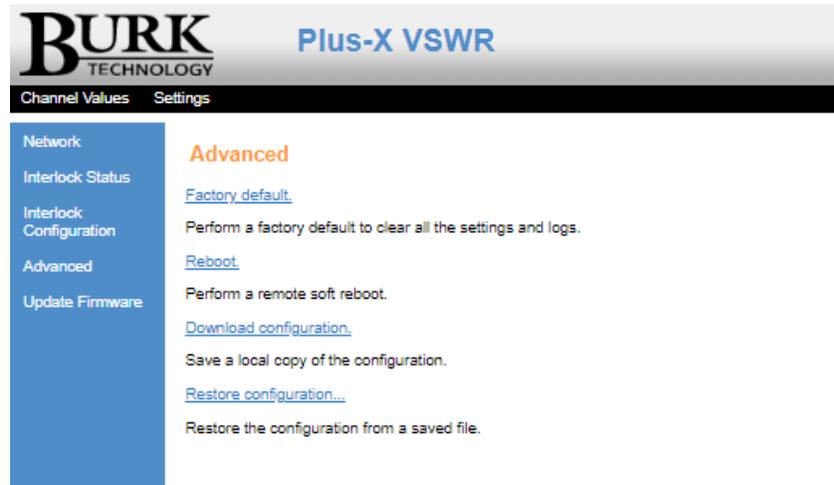
The screenshot shows the BURK Plus-X VSWR web interface. The top navigation bar includes 'Channel Values' and 'Settings'. A left sidebar contains menu items: 'Network', 'Interlock Status', 'Interlock Configuration', 'Advanced', and 'Update Firmware'. The main content area is titled 'Interlock Status' and displays the following data for 'Transmission Line 1':

Name:	Transmission Line 1
Forward Power	9.978 kW
Reflected Power	100.818 W
VSWR	1.224 : 1
Strike 1	21:08
Strike 2	20:58
Strike 3	20:48
	Interlock Open
	Locked Out
	<input type="button" value="Reset Lockout"/>

---

## ADVANCED FUNCTIONS

The Advanced menu provides a variety of administrative functions. It is recommended to download and save the Plus-X VSWR configuration whenever it is modified. The saved configuration file includes all current settings and calibration values for the Plus-X VSWR.



## CHANNEL VALUES

An example snapshot of the Channel Values page is shown below:



Meter Values		Status Values	
Meter Channel	Voltage	Status Channel	State
Meter 1	4.988	Status 1	Open
Meter 2	1.151	Status 2	Open
Meter 3	0.363	Status 3	Open
Meter 4	0.107	Status 4	Open
Meter 5	0.031	Status 5	Open
Meter 6	0.019	Status 6	Open
Meter 7	0.278	Status 7	Open
Meter 8	0.082	Status 8	Open
		Status 9	Open
		Status 10	Open
		Status 11	Open
		Status 12	Open
		Status 13	Open
		Status 14	Open
		Status 15	Open
		Status 16	Open

[\[ Refresh for current values \]](#)

Raw meter values shown in volts for diagnostic purposes only.  
Status closed is  $\pm 0V$ .

There are two types of channel values reported on this page:

- Meter Values
- Status Values.

There are no Plus-X VSWR controls available from this page. It is only used to view raw voltage inputs to each of the meter channels and logic values associated with status channels.

If a status channel is pulled to ground by an external circuit, it will show Closed. Otherwise the status channel value will always be Open. The values displayed are latched at the time the Channel Values page is opened. Refreshing the browser window will display the Network page for Settings. Channel values can be refreshed by pressing the blue [Refresh for current values](#) link.

## TECHNICAL SUPPORT

For technical support, please email [support@burk.com](mailto:support@burk.com) or call our direct technical support line at 978-486-3711. We will be glad to assist you. The technical support office is open Monday – Friday, 9AM to 5PM Eastern time.