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Automation Design Document for the Agilent Seahorse XF Pro Analyzer

Notices

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1 Purpose

The purpose of this document is to define an interface between the XF Pro Controller software on a host XF Pro Controller (the computer connected to the XF Pro Analyzer) and your custom-built or third-party automation client software, for purposes of automating your XF data acquisition workflow. The host service will run on XF Pro Controller software on an XF Pro Analyzer, and the client is designed to be run separately.

The scheduling software is responsible for calling the server methods and coordinating robot actions for XF Pro cell plate and sensor cartridge handling. A valid XF Discovery software license is required to unlock the automation service for the XF Pro Analyzer. This automation service is designed for operation with one client at a time.

NOTE

Although this document references the term "XFE" throughout, the automation service is supported on XF Pro Analyzers and XF Pro Controllers only. No other Agilent Seahorse Analyzers feature an automation service as described in this document.

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2 Using the Automation Client to connect to the XF Pro Controller

Only an XF Pro Analyzer + Controller with a valid XF Discovery license can access the automation service. The XF Pro Controller software must be run in administration mode to run the automation service.

To enable automation mode:

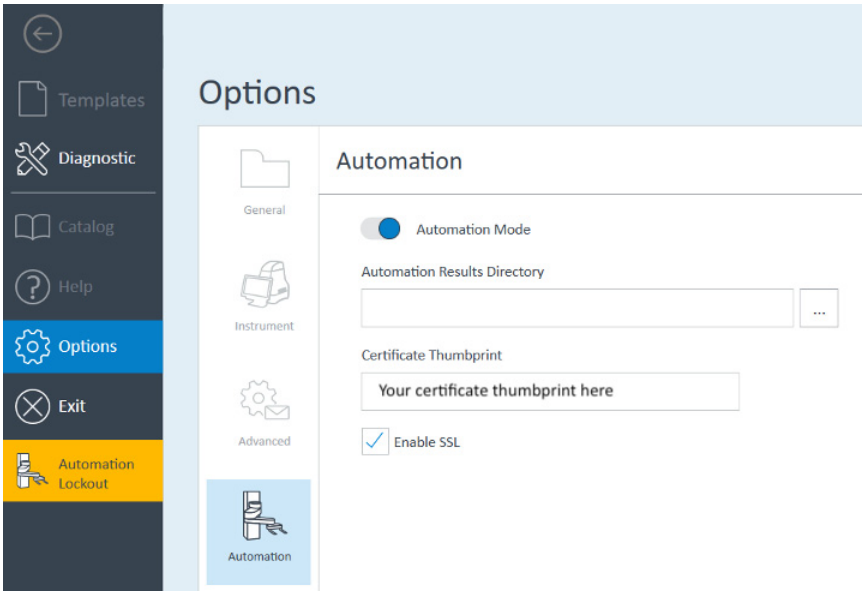
1 Open the XF Pro Controller software.

2 Select **Options** > **Automation**.

3 Enable **Automation Mode**.

4 Enter the **Certificate Thumbprint field** and **Enable SSL**.

5 To apply the changes, select **Save**. Onscreen buttons are now disabled and **Automation Lockout** is displayed.



After configuring the automation service in XF Pro Controller software, you may encounter a Windows Firewall warning when starting up the Automation service (see **Figure 1**). Ensure the check boxes for *Domain networks* and *Private networks* are selected and click **Allow access**. This will allow XF Pro Controller software to access port 8001 and Windows Firewall will automatically create a new rule for it to access the port.

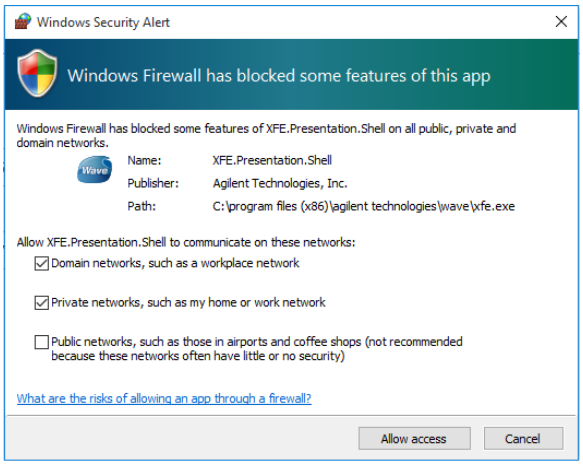


Figure 1. Windows Firewall warning.

To verify this worked successfully, open a web browser (IE recommended) and go to: **https://[CN]:8001/CellAnalysisServices/**

Example: **https://[server computer name].[sub domain].[domain]:8001/CellAnalysisServices/** where from the certificate, CN=[server computer name].[sub domain].[domain]

If successful, it should show up in the URL as shown in **Figure 2**.

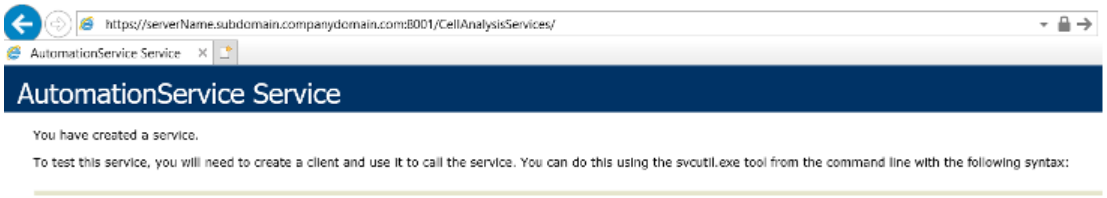


Figure 2. Successful Service.

NOTE

To test the connection, Internet Explorer is recommended. Chrome or Edge may display an erroneous warning that the connection is not private because the certificate uses a common name rather than a Subject Alternative Name (SAN) (see Figure 3).

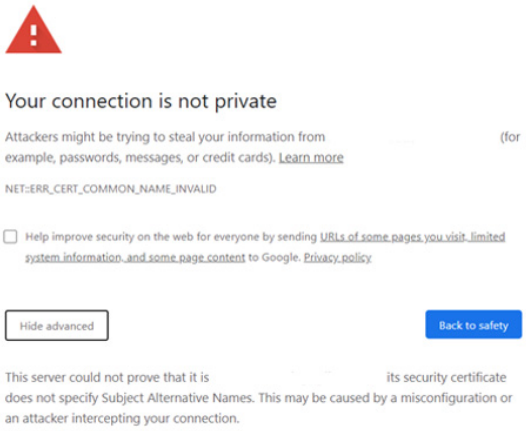


Figure 3. Browser connection warning.

Once automation mode is enabled, XF Pro Controller software is ready to begin receiving method calls from a client application interface. The client application running on a server or separate laptop or computer communicates with the XF Pro Controller through WsHTTP protocol.

On a local network, the IP address and port is needed of the XF Pro Controller in order for the client application to connect. To create an instance of the XFeAutomationClient class with the IP address and port as parameters:

```
AutomationClient client = new AutomationClient(“111.111.111.111”, 8000);
```

In the C# example, the IP address of the host controller is 111.111.111.111 and the port is 8000. If you are using SSL, use port 8001. The IP Address should be input as a string, following standard IP address formatting, and the port as an integer.

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3 Automation Service and XF Pro Controller software

The automation service serves as an interface to XF Pro Controller software. The interface to the automation service is composed of several methods that allow for automating data acquisition on the XF Pro Analyzer. The automation client application allows access to these methods which in turn control the XF Pro Analyzer and Controller software while the automation service is running. There are several properties of the automation service that represent basic statuses of the XF Pro Analyzer + Controller.

Automation Properties

XFeState

Parameter	Value
Type	String
Access	Read Only
Description	The current state of the XF Pro Analyzer
Example	"Ready"

Tray Status

Parameter	Value
Type	String
Access	Read Only
Description	The current state of the XF Pro Tray
Example	"In"

Automation Methods

GetStatus

The GetStatus method returns the current state of the instrument.

```
string GetStatus()
```

Return value: The instrument status

XFeState Enumeration	String Equivelant	Meaning
Ready	Ready	The instrument is ready to run an assay.
Running	Running	The instrument is running an assay.
RunningWaitingForReadyToLoadCartridgeAndCalibrantPlate	Ready to Load Cartridge and Plate	The instrument is ready for the user to open the tray for the cartridge and calibration plate to be loaded.
RunningWaitingForLoadCartridgeAndSupportingPlate	Waiting for Cartridge and Plate	The tray is open, and the instrument is ready for the user to place the cartridge and calibration plate on the tray.
RunningLoadCartridgeAndCalibrantPlate	Loading Cartridge and Plate	The user has loaded the cartridge and calibrant plate on the tray and has called LoadCartridge.
RunningCalibration	Calibrating	The instrument is running Calibration.
RunningCalibrationComplete	Finished Calibration	The instrument has finished Calibration.
RunningWaitingForReadyToLoadCellPlate	Ready to Load Cell Plate	The instrument is ready for the user to open the tray for the cell plate to be loaded.
RunningWaitingForLoadCellPlate	Waiting for Cell Plate	The tray is open, and the instrument is ready for the user to place cell plate on the tray.
RunningLoadCellPlate	Running	The instrument is running the Assay.
RunningComplete	Assay Finished	The Assay has completed successfully.
RunningWaitingForReadyToStripCartridge	Ready to Unload Cartridge	Assay has finished (or cancelled), ready to strip/unload cartridge message pops up.
RunningWaitingForStripCartridge	Waiting for Unload Cartridge	The instrument is waiting for the user to unload the cartridge.
RunningStripCartridge	Unloading Cartridge and Plate	Cartridge and Cell plate have been stripped and unloaded from tray, assay has completed.
ReadyRunComplete	Assay Completed!	The Assay has finished and is about to transition back to the Ready state.
AssayCancelled	Assay Cancelled!	The user has canceled the assay. The instrument will transition back to Ready state.

GetTrayStatus

The GetTrayStatus method returns the current state of the tray.

```
string GetTrayStatus()
```

Return value: The tray status

TrayStatus Enumeration	String Equivelant	Meaning
`In`	In	The tray is in.
`Out`	Out	The tray is out.

GetErrors

The GetErrors method returns the current list of errors.

```
string GetErrors()
```

Return value: Error text

OpenTray

The OpenTray method opens the tray in order to load/unload the cartridge or to load the cell plate.

```
bool OpenTray()
```

Return value: Boolean if client OpenTray method call succeeds

LoadCartridge

The LoadCartridge method loads the cartridge and utility plate after an assay has started and the tray has been opened.

```
bool LoadCartridge()
```

Return value: Boolean if client LoadCartridge method call succeeds

UnloadCartridge

The UnloadCartridge method unloads the cartridge and utility plate after an assay has completed and the tray has been opened.

```
bool UnloadCartridge()
```

Return value: Boolean if client UnloadCartridge method call succeeds

LoadCellPlate

The LoadCellPlate method loads the cell plate after calibration has finished and the utility plate has been removed with the tray open.

```
bool LoadCellPlate()
```

Return value: Boolean if client LoadCellPlate method call succeeds

LoadTemplate

The LoadTemplate method loads the given XF Pro template given the input name of the template file that is saved on the controller.

```
bool LoadTemplate(string name)
```

Return value: Boolean if client LoadTemplate method call succeeds

Run

The Run method starts and runs the assay given the loaded template.

```
void Run()
```

Return value: Void

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4 Error Codes

The following error codes can be displayed in the error text message returned by the GetErrors client method. Most errors result in the stoppage of Automation mode and will present user-facing dialogs in XF Pro Controller software that a user must physically address to resolve the issue. If you encounter error codes not described in this list, please contact Agilent Technologies Cell Analysis Support.

Code	Label	Meaning
1	`XFEStripCartridgeResultType.NoCommunicationError`	Communication error with instrument while stripping the cartridge.
2	`XFEStripCartridgeResultType.GripperReleaseError`	The grippers did not release while stripping the cartridge.
3	`XFEStripCartridgeResultType.StripAborted`	Strip cartridge failed going to the Home position.
4	`XFEStripCartridgeResultType.UnknownError`	Unknown error while attempting to strip the cartridge.
5	`ControllerBase Exception Caught in MProbes`	Error while moving probes.
7	`XFEApplicationExceptionType.InjectFailure`	Inject failure.
8	`ControllerBase.ExecuteSetAgitateStatus; Value of endoperation`	General error during mix operation.
10	`ControllerBase.Calibrate`	Error or abort called during calibration when moving tray to the measure position.
11	`ControllerBase.Calibrate`	Error or abort called during calibration when moving probes to the Z measure position.
12	`ControllerBase.Calibrate`	Autozero failure.
13	`ControllerBase.Calibrate`	Error while attempting to run Autozero.
14	`ControllerBase.Calibrate; AutoLED returned an error`	Coarse calibration failure.
15	`ControllerBase.Calibrate; AutoLED Error thrown`	Error while attempting to run Coarse Calibration.
16	`XFeControllerBase.Calibrate`	Error while attempting to run Fine Calibration or Measure.
27	`XFELoadCartridgeResultType.MovementError`	Load cartridge failure or load plate failure or moving probes operation was aborted.
40	`XFELoadCartridgeResultType.LoadAborted`	Load cartridge failed going to the Home position.
41	`ControllerXFe_96.MeasureMultiBoard`	Measure failure.
42	`XFeControllerBase.ReadCartridgeBarcode`	No barcode reader found when loading cartridge.

Code	Label	Meaning
43	`XFeControllerBase.ReadCartridgeBarcode`	No cartridge barcode error when loading cartridge, or cartridge type is not available or cartridge is not compatible with instrument.
44	`XFeControllerBase.ReadCartridgeBarcode`	Cartridge is not compatible with the Injections in the assay protocol.
45	`ControllerXFe_96.LoadCartridge`	Load cartridge failed going to the Measure position.
46	`XFELoadCartridgeResultType.GripperReleaseError`	The grippers did not release while loading the cartridge.
47	`ControllerXFe_96.LoadCartridge`	Load cartridge failure while going to the load/unload position (probe head).
48	`XFELoadCartridgeResultType.GripperEngageError`	The grippers did not engage while loading the cartridge.
49	`XFELoadCartridgeResultType.MovementError`	Error while moving to the Home Z position during load cartridge.
50	`XFELoadCartridgeResultType.NoCartridgeDetectedError`	No cartridge detected.
51	`XFELoadCartridgeResultType.LoadAborted`	Load cartridge failure while going to the load position.
52	`XFELoadCartridgeResultType.MonitoringError`	Unable to monitor tray movement while loading cartridge.
53	`ControllerXFe_96.LoadCartridge`	Load Cartridge Failure, or load failure while attempting move tray to barcode position to read the plate barcode or load aborted.
54	`XFELoadPlateResultType.NoBarcodeReaderError`	No barcode reader detected while attempting to read the plate barcode.
55	`XFELoadPlateResultType.NoBarcodeError`	No plate barcode detected while attempting to read the plate barcode.
56	`XFELoadPlateResultType.PlateCompatibilityError`	The plate is not compatible with the instrument.
57	`XFELoadPlateResultType.MonitoringError`	Unable to monitor tray movement while loading plate.
58	`ControllerBase.LoadPlate`	Communication error while loading plate.
60	`XFEStripCartridgeResultType.StripAborted`	Error moving tray to measure position while attempting to strip the cartridge.
61	`XFEStripCartridgeResultType.StripAborted`	Error moving probes to Z home position while attempting to strip the cartridge.
64	`XFEStripCartridgeResultType.StripAborted`	The strip procedure was aborted while attempting to strip the cartridge.
66	`ControllerBase.Measure`	Error or abort called during measure when moving tray to the measure position.
67	`ControllerBase.Measure`	Error or abort called during measure when moving probes to the Z measure position.
68	`ControllerBase.Inject`	Error while moving tray to measure position during an injection.

Code	Label	Meaning
69	`ControllerBase.Inject`	Error while moving probes to inject position during an injection.
70	`XFEApplicationExceptionType.MixFailure`	Mix was aborted or error while attempting to mix.
71	`XFEApplicationExceptionType.MixFailure`	Mix error or mix was aborted while attempting to move probes to Z mix position.
80	`ControllerBase.Wait`	Error or abort called during measure wait cycle when moving tray to the measure position.
81	`ControllerBase.Wait`	Error or abort called during measure wait cycle when moving probes to the Z wait position.
83	`XFELoadPlateResultType.CartridgeAlreadyLoaded`	Cartridge detected while attempting to load plate.
97	`Load Plate Failure`	Load plate error while doing load cartridge operation.
98	`XFELoadCartridgeResultType.NoBarcodeError`	Cartridge barcode read failure.
99	`XFEStripCartridgeResultType.CartridgeDetectedError`	A cartridge was still detected after attempting to strip the cartridge.
100	`XFEStripCartridgeResultType.StripOK`	Unload cartridge failure.
101	`ExecuteEjectPlate`	Abort called while ejecting plate during unload cartridge operation.
102	`ExecuteEjectPlate`	Abort called while moving tray to home position during eject plate operation.
197	`XFELoadCartridgeResultType.MovementError`	Load Plate Failure while loading the cartridge.
311	`XFELoadCartridgeResultType.CartridgeAlreadyLoaded`	Cartridge was already loaded.

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In This Guide

This guide provides automation design interface documentation for the Agilent Seahorse XF Pro Analyzer and XF Pro Controller software including:

- Using the Automation Client to connect to the XF Pro Controller
- Automation Service and XF Pro Controller software
- Error Codes

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