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# TransSECS OPCUA Guide for a GEM Host

Using TransSECS Servers to Create an  
OPCUA SECS/GEM Host Application



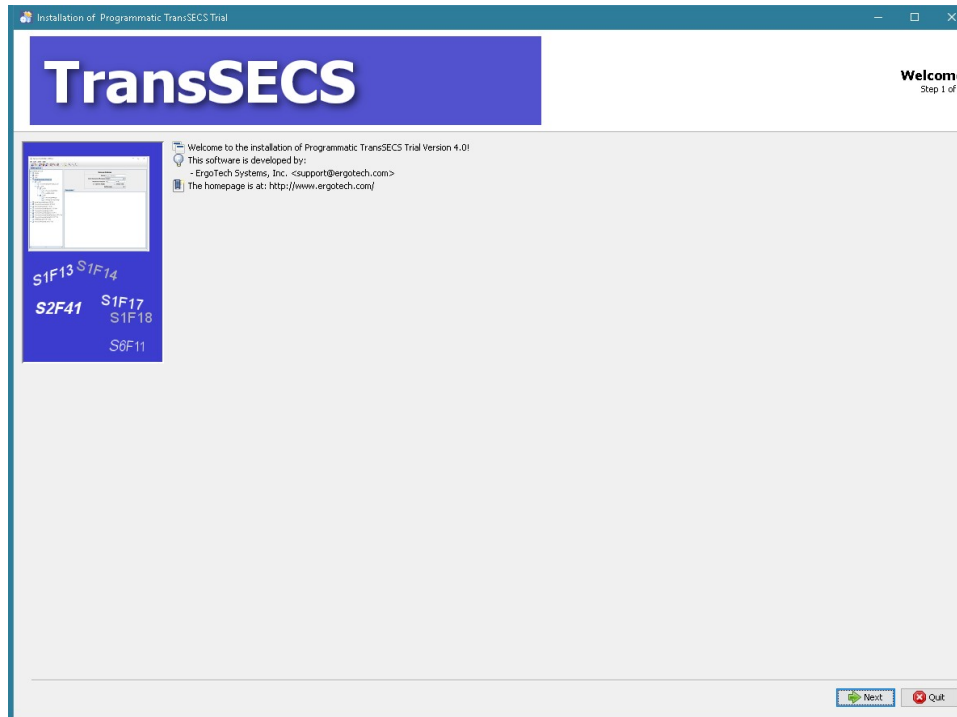
## TransSECS Guide Overview

This documentation will guide you through creating a GEM Host application in TransSECS. The host application will monitor and control your tool.

TransSECS will deploy the application as an OPCUA server. You can then use your OPCUA client to add logic to the interface – monitoring values, making decisions with those values and sending and receiving SECS messages.

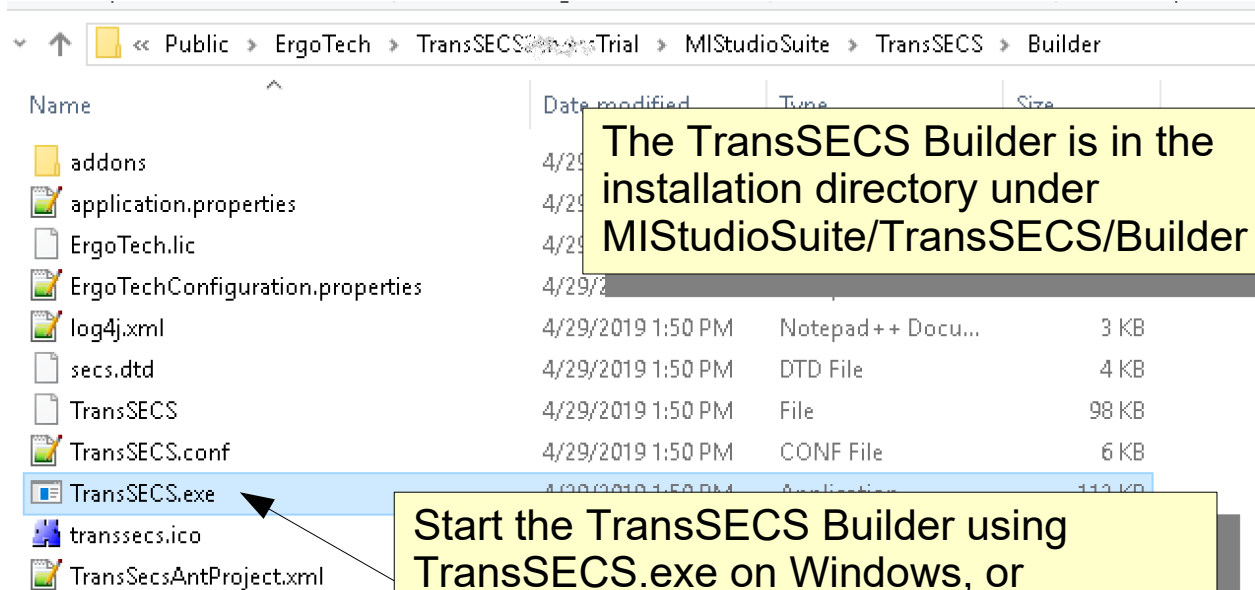
The example uses the *StandAloneGEMTool* provided with TransSECS as a tool simulator. The *StandAloneGEMTool* behaves just as a real GEM tool would behave and you can use it for testing before monitoring and controlling your real tool.

## Installing TransSECS



Double click on the installer and click **Next** when prompted. Once installed, start the TransSECS Builder application (MIStudioSuite/TransSECS/Builder/TransSECS.exe)

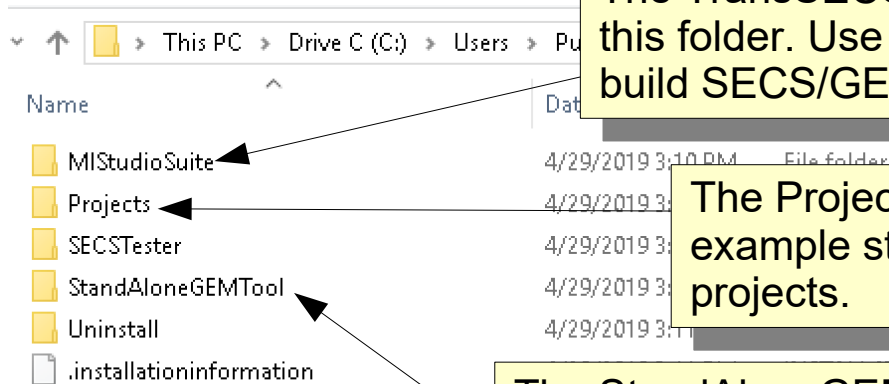
## Start the TransSECS Builder



The TransSECS Builder is in the installation directory under MISTudioSuite/TransSECS/Builder

Start the TransSECS Builder using TransSECS.exe on Windows, or TransSECS on Linux systems. For Windows systems there may be a shortcut you can use on your Desktop or Start Menu.

## TransSECS Installed



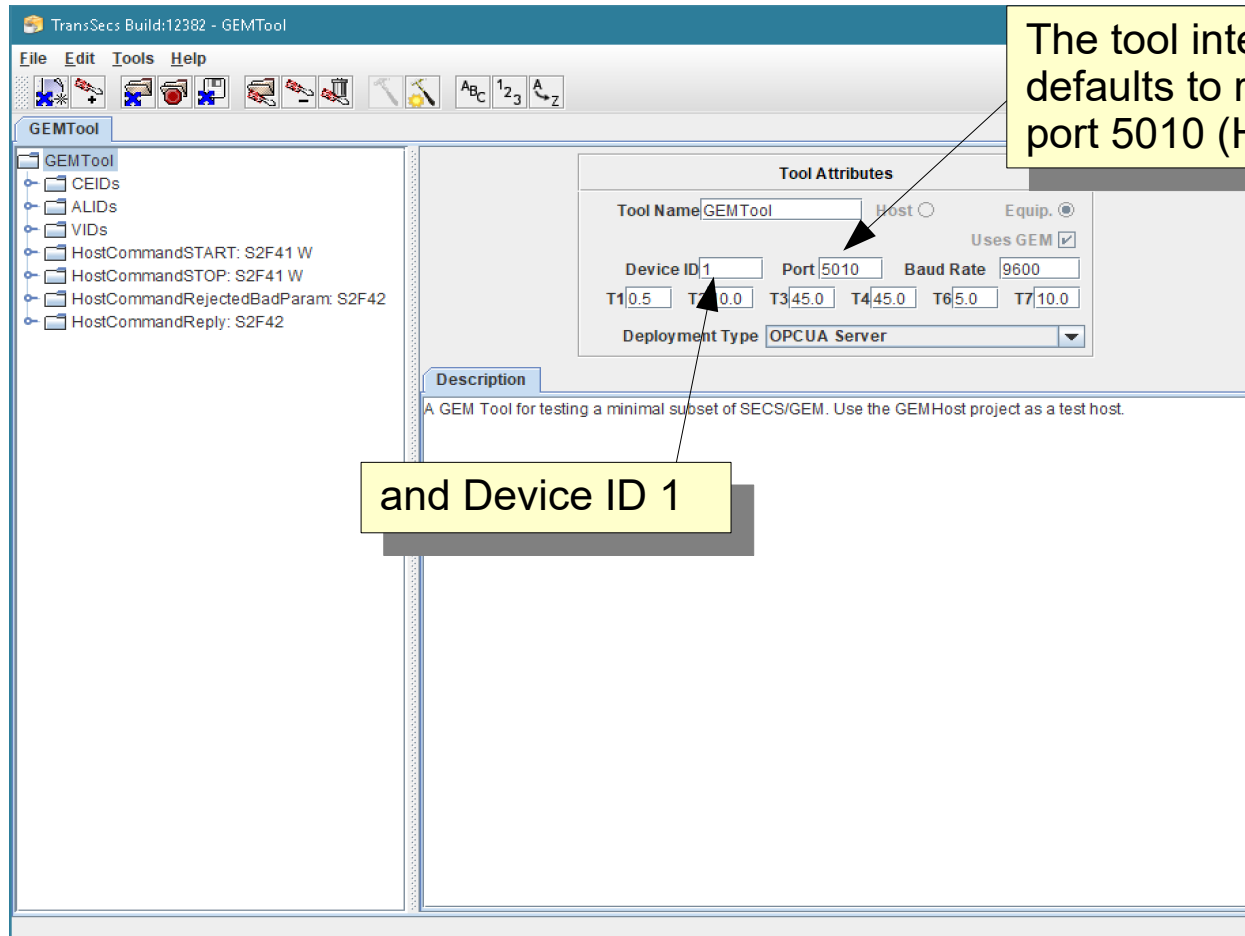
The TransSECS Editor is in this folder. Use the "Builder" to build SECS/GEM deployments.

The Projects directory contains example starting SECS/GEM projects.

The StandAloneGEMTool is a GEMTool simulator specifically for testing the example GEMHost project.

The installation directory contains the main MIStudioSuite directory, along with the Projects directory (where you will find GEMTool and GEMHost projects), and two helpful utilities, StandAloneGEMTool and the SECSTester, which is a simple GEM Host for basic tool characterization.

The GEMTool example project will be loaded when you start the TransSECS Builder for the first time



The tool interface defaults to running on port 5010 (HSMS)

and Device ID 1

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## Load the GEMHost Project

Use the File "Open Project" menu to open another project

TransSecs Build:12387 - GEMTool

File Edit Tools Help

- New Project Ctrl-N
- Add New Tool Ctrl-A
- Open Project Ctrl-O
- Close Project Ctrl-P
- Load Tool Ctrl-L
- Remove Tool Ctrl-F
- Delete Tool
- Save Project Ctrl-S
- Import SML
- Import Grapheq
- Import Using Script
- Exit

Opens an existing Project.

CT: S2F41 W  
2F41 W  
F41 W  
BadParam: S2F42  
F42

**Tool Attributes**

Tool Name: GEMTool Host  Equip.

Uses GEM

Device ID: 1 Port: 5010 Baud Rate: 9600

T1: 0.5 T2: 10.0 T3: 45.0 T4: 45.0 T6: 5.0 T7: 10.0

Deployment Type: OPCUA Server

**Description**

A GEM Tool for testing a minimal subset of SECS/GEM. Use the GEMHost project as a test host.

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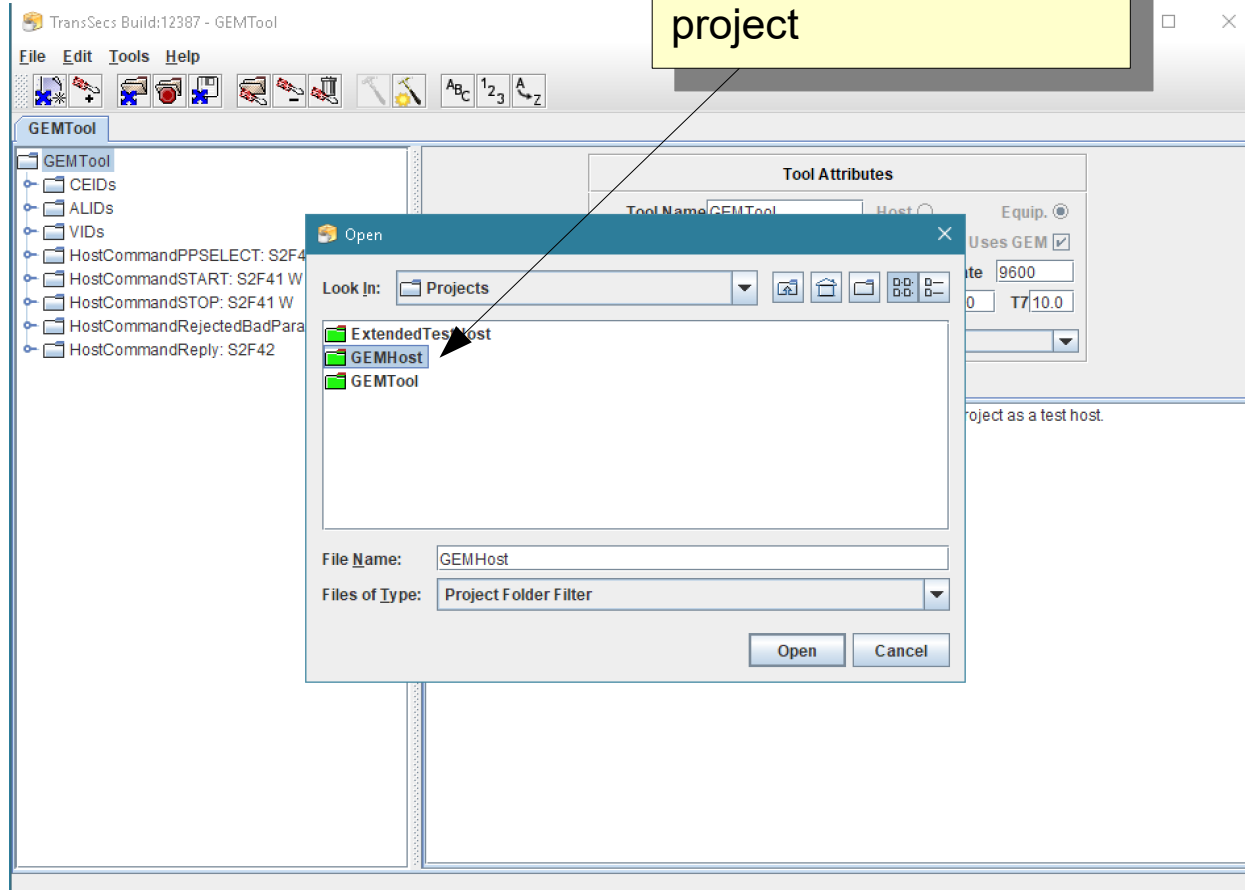


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## Load the GEMHost Project

Select the GEMHost project





## Modifying the GEMHost for Process Tool Data Collection

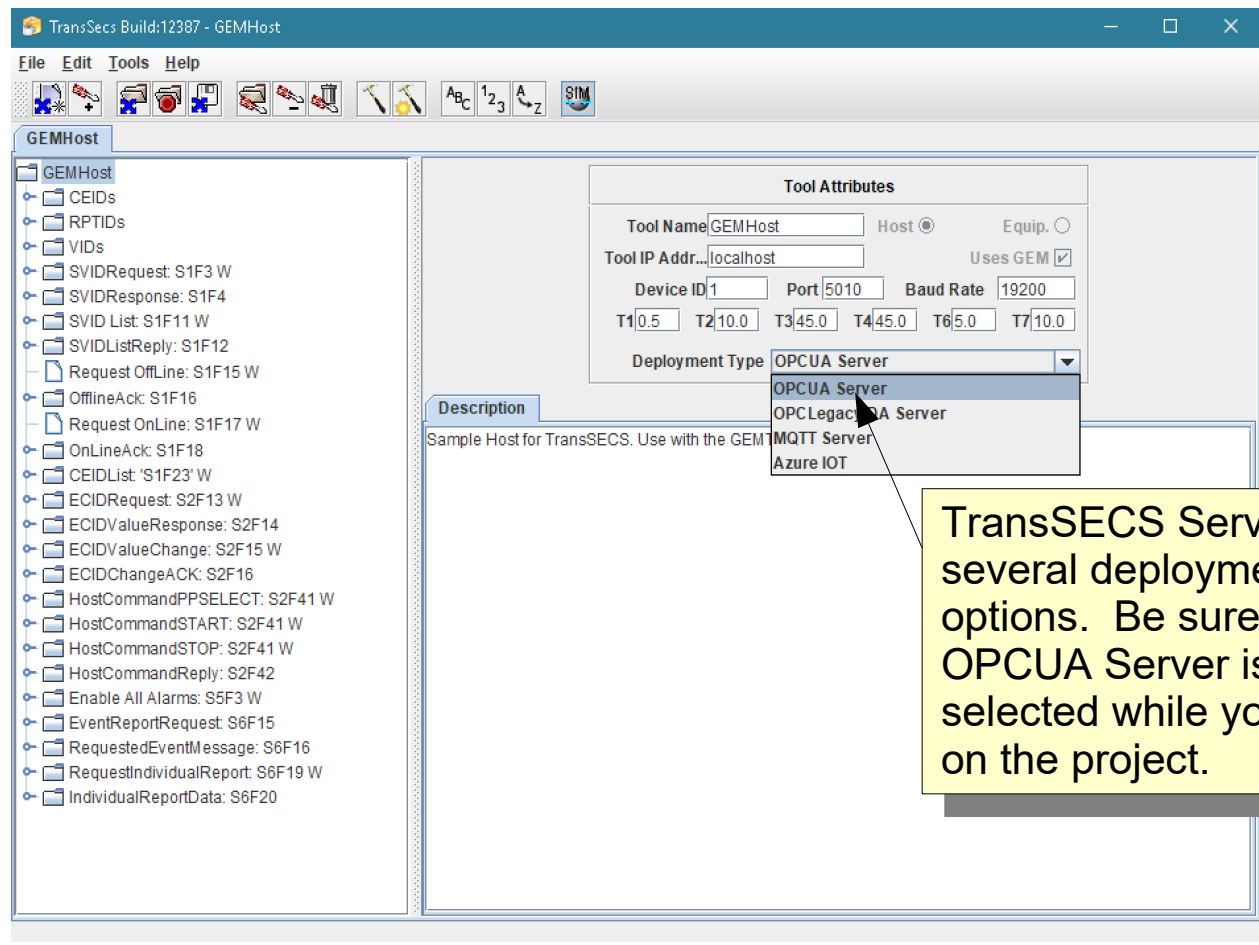
Once the GEMHost is loaded, you may customize it for data collection from your process tool. The **TransSECS GEM Host Tool Characterization Guide** goes into greater detail on easily importing the process tools VIDs and CEIDs from the tool and the procedure to set up reports (configuring RPTIDs).

<https://www.ergotech.com/files/guides/TransSECSGEMHostToolCharacterizationGuide.pdf>

Automatic data collection in TransSECS GEM Host applications is accomplished entirely from data in event reports (S6F11s). Each of the VIDs defined in the report through the report definition setup will automatically be updated in the OPCUA variables/vids node when a new event report is received by the host containing those VIDs, as well as the associated CEID and RPTID values.

Likewise, when an alarm (S5F1) is received by the host, the last alarm data in the OPCUA Server will be updated with this alarm data from the message.

## Select OPCUA Server for the Deployment Type



TransSECS Servers has several deployment options. Be sure OPCUA Server is selected while you work on the project.



## Data Collection

The primary data collection mechanism for SECS/GEM is to associate value with "Events". An Event is defined by the tool and indicates something of interest has happened, for example, loading, starting, complete, recipe changed, etc.

Values (VIDs) are grouped into "Reports", represented by Report IDs (PRTIDs) these reports are then associated with one or more Events. The following pages show you how to do this in TransSECS.

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## Defining RPTIDs

After the VIDs and CEIDs are obtained from the tool, you can add RPTIDs.

TransSecs Build:12387 - GEMHost

File Edit Tools Help

GEMHost

- GEMHost
  - CEIDs
    - RPT
      - Add RPTID
      - Online RPTIDs from Tool
      - Remove All RPTIDs
      - Sort By Name
      - Sort By Id
      - Sort By Name
      - Sort By Id
    - VIDs
    - CEID
    - ECID
    - ECID
    - ECID
    - ECID
    - Ena
    - EventReportRequest: S0F15
    - HostCommandPPSELECT: S2F41 W
    - HostCommandReply: S2F42
    - HostCommandSTART: S2F41 W
    - HostCommandSTOP: S2F41 W
    - IndividualReportData: S6F20
    - OfflineAck: S1F16
    - OnLineAck: S1F18
    - Request OffLine: S1F15 W
    - Request OnLine: S1F17 W
    - RequestedEventMessage: S6F16
    - RequestIndividualReport: S6F19 W
    - SVID List: S1F11 W
    - SVIDListReply: S1F12
    - SVIDRequest: S1F3 W
    - SVIDResponse: S1F4

Right-Click on the RPTID node to add a RPTID



## Defining RPTIDs

TransSecs Build:12387 - GEMHost

File Edit Tools Help

GEMHost

RPTID -1 RPT Name RPTID0

Available VIDs

AlarmsEnabled

AlarmsSet

CLOCK

VIDs

Report VIDs

A RPTID has been added with a default name "RPTID0"

LastControl State

LocalRemote State

MDLN

OnlineOffline State

PPID

ProcessTemperature

SOFTREV

SpeedCountActual

Description



## Defining RPTIDs

The RPTID has been renamed to "RPTID100" and assigned a RPTID of 100

These four highlighted VIDs have been selected for the report

The screenshot shows the TransSecs software interface. The top menu bar includes File, Edit, Tools, and Help. Below the menu is a toolbar with various icons. The main window is titled "GEMHost" and displays a tree view on the left with folders for RPTIDs, VIDs, and various alarm types. The "RPTID100" folder is selected. The right pane shows a list of VIDs, with four items highlighted: GasFlow, LOTID, LastControlState, and ProcessTemperature. Below this list is a "Description" field with a lightbulb icon. On the right side of the interface, there are two lists: "VIDs" and "Report VIDs". Between these lists are four buttons: ">", ">>", "<<", and "<". An arrow points from the ">>" button to a text box that says "Press this button to complete adding the selected VID items to the Report VIDs list". At the top of the right pane, there are input fields for "RPTID" (containing "100") and "RPT Name" (containing "RPTID100").

Press this button to complete adding the selected VID items to the Report VIDs list

You may choose any numeric id for the report (RPTID) unless the process tool manual documents a restriction, such as only an unsigned integer, but it's usually best to not choose one that is the same as a CEID or VID.



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## Defining RPTIDs

The screenshot shows the TransSecs software interface with the RPTID100 definition complete. The interface includes a menu bar (File, Edit, Tools, Help), a toolbar, and a tree view on the left. The RPTID100 definition is shown in the main area, with a list of available VID types and a list of report VID types. A yellow callout box states: "The RPTID100 definition is complete".

The RPT Name is RPTID100.

Available VIDs:

- AlarmsEnabled
- AlarmsSet
- CLOCK
- Communications State
- ControlState
- EventsEnabled
- LastControlState
- LocalRemote State
- MDLN
- OnlineOffline State
- SOFTREV
- SpoolCountActual
- SpoolCountTotal
- SpoolFullTime
- SpoolStartTime
- WaferCount

Report VIDs:

- GasFlow
- LOTID
- PPID
- ProcessTemperature

Next we will associate this report with the LOADED event



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## Defining RPTIDs

The screenshot shows the 'TransSecs Build:12387 - GEMHost' application window. The left sidebar contains a tree view with folders for 'GEMHost', 'CEIDs', 'RPTIDs', and 'VIDs'. Under 'CEIDs', there are sub-items 'COMPLETED', 'STARTED', and 'LOADED'. The 'LOADED' item is selected, and an arrow points to it from a yellow callout box. The main area shows the configuration for the selected CEID, with 'CEID Name' set to 'LOADED'. Below this, there are three panels: 'Available RPTIDs' containing 'RPTID100', 'RPTIDs' (empty), and 'Report IDs' (empty). A yellow callout box points to 'RPTID100' in the 'Available RPTIDs' list. At the bottom, there is a 'Description' field which is currently empty.

Select a CEID to be associated with one or more reports (RPTIDs)

We have one RPTID defined which is selected for this event





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## Build the Project using the Hammer/Star Button

The screenshot shows the 'TransSecs Build:12387 - GEMHost' application window. The menu bar includes 'File', 'Edit', 'Tools', and 'Help'. The toolbar contains various icons, with a yellow hammer and star icon highlighted by a black arrow. The main workspace is divided into a left-hand tree view and a right-hand configuration area.

**Tree View (Left):**

- GEMHost
  - CEIDs
  - RPTIDs
  - VIDs
  - SVIDRequest: S1F3 W
  - SVIDResponse: S1F4
  - SVID List: S1F11 W
  - SVIDListReply: S1F12
  - Request OffLine: S1F15 W
  - OfflineAck: S1F16
  - Request OnLine: S1F17 W
  - OnLineAck: S1F18
  - CEIDList: 'S1F23' W
  - ECIDRequest: S2F13 W
  - ECIDValueResponse: S2F14
  - ECIDValueChange: S2F15 W
  - ECIDChangeACK: S2F16
  - HostCommandPPSELECT: S2F41 W
  - HostCommandSTART: S2F41 W
  - HostCommandSTOP: S2F41 W
  - HostCommandReply: S2F42
  - Enable All Alarms: S5F3 W
  - EventReportRequest: S6F15
  - RequestedEventMessage: S6F16
  - RequestIndividualReport: S6F19 W
  - IndividualReportData: S6F20

**Tool Attributes Dialog (Right):**

- Tool Name: GEMHost
- Host  Equip.
- Tool IP Addr...: localhost
- Uses GEM
- Device ID: 1
- Port: 5010
- Baud Rate: 19200
- T1: 0.5, T2: 10.0, T3: 45.0, T4: 45.0, T6: 5.0, T7: 10.0
- Deployment Type: OPCUA Server

**Building All Files Dialog (Foreground):**

- Message: Building All Files
- Button: Cancel

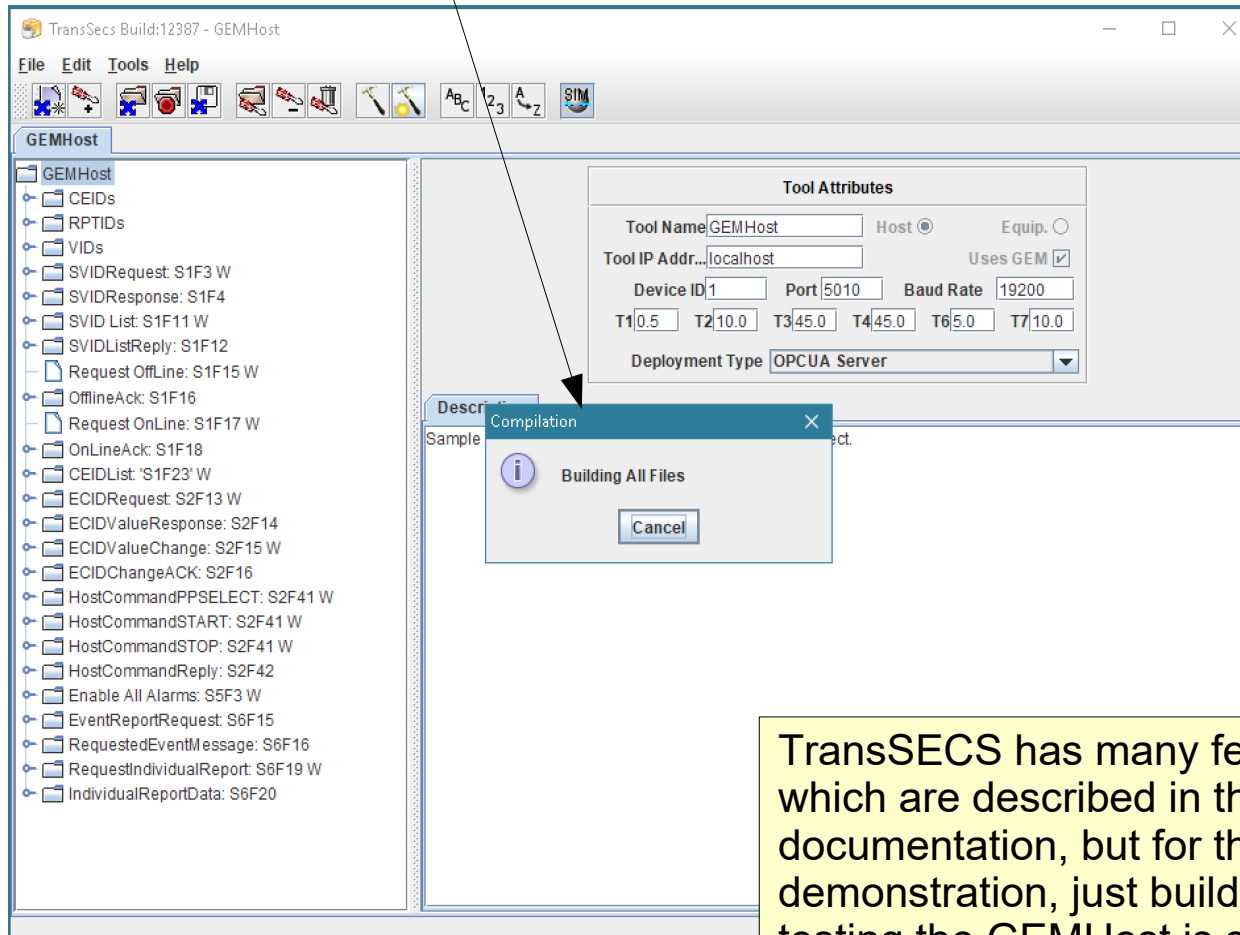
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When the "Compilation" popup closes the build is complete. This may take a minute or so.



TransSECS has many features which are described in the full documentation, but for this demonstration, just building and testing the GEMHost is sufficient.

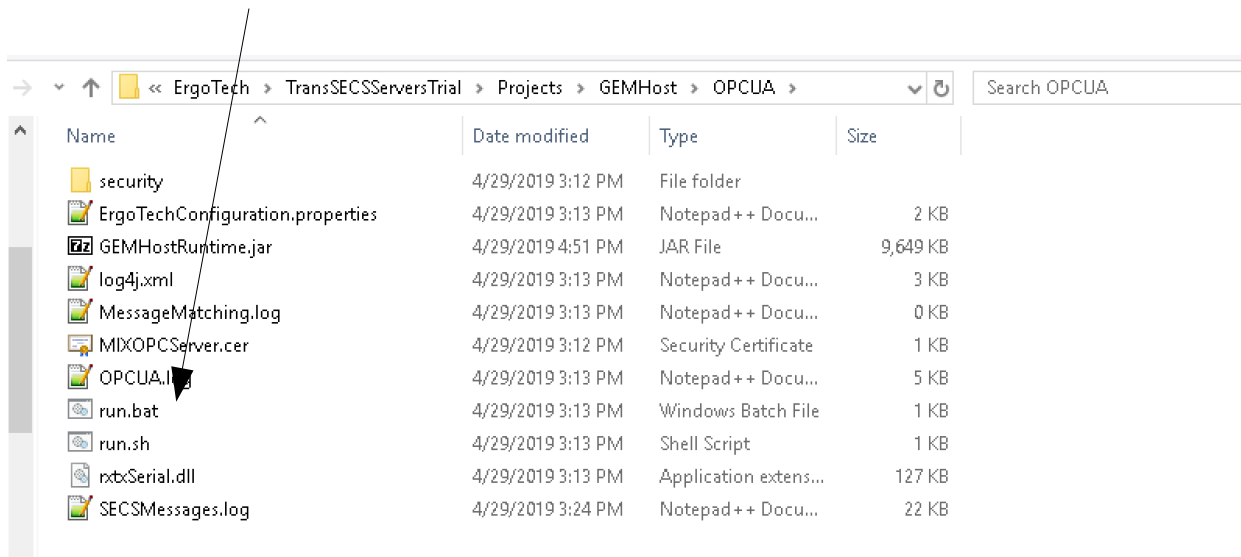
After the code is generated the OPCUA Server, with the Tags from TransSECS, will be in the Projects/GEMHost/OPCUA directory.

Name	Date modified	Type	Size
security	4/29/2019 3:12 PM	File folder	
ErgoTechConfiguration.properties	4/29/2019 3:13 PM	Notepad++ Docu...	2 KB
GEMHostRuntime.jar	4/29/2019 4:51 PM	JAR File	9,649 KB
log4j.xml	4/29/2019 3:13 PM	Notepad++ Docu...	3 KB
MessageMatching.log	4/29/2019 3:13 PM	Notepad++ Docu...	0 KB
MIXOPCServer.cer	4/29/2019 3:12 PM	Security Certificate	1 KB
OPCUA.log	4/29/2019 3:13 PM	Notepad++ Docu...	5 KB
run.bat	4/29/2019 3:13 PM	Windows Batch File	1 KB
run.sh	4/29/2019 3:13 PM	Shell Script	1 KB
rtxSerial.dll	4/29/2019 3:13 PM	Application extens...	127 KB
		Notepad++ Docu...	22 KB

Everything you need to run on Windows is in this directory. For Linux systems you will need install rtxSerial on the system and make appropriate changes to the run.sh file.

You may need to edit the path to the jre in run.bat if you move the deployment location.

Run the server with the run.bat file (or run.sh on Linux).





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# Run the SECS/GEM Interface as an OPCUA Server

```
C:\WINDOWS\system32\cmd.exe
Started GEMHost connecting to localhost on port 5010 with device id 1
at ip address localhost2019-05-01 17:52:29.149 [createFolderNode( gemhost:gemhost]2019-05-01 17:52:29.149
2019-05-01 17:52:29.149 [creatingNode( ecid:deploy.GEMHost.ECIDRequest periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:0 ) setValueObject="2000" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( responsestatus:deploy.GEMHost.ECIDRequest periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( errorstatus:deploy.GEMHost.ECIDRequest periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( goodstatus:deploy.GEMHost.ECIDRequest periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( sendmessage:deploy.GEMHost.ECIDRequest periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [createFolderNode( variables:gemhost/variables]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [createFolderNode( alarm:gemhost/variables/alarm]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( alarmset:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:0 ) setValueObject="0" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [createFolderNode( vid:gemhost/variables/vid]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( wafercount:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:1 ) setValueObject="0" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( alarm:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:2 ) setValueObject="" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( altx:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:3 ) setValueObject="" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [createFolderNode( ceid:gemhost/variables/ceid]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( started:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:4 ) setValueObject="" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 Unknown type a
2019-05-01 17:52:29.165 [creatingNode( enabledalarms:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:5 ) setValueObject="" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( localremotestate:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:6 ) se
2019-05-01 17:52:29.165 [createFolderNode( rptid:gemhost/variables/rptid]2019-05-
2019-05-01 17:52:29.165 [creatingNode( rptid103:com.ergotech.transsecs.secs.HostI
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:7 ) se
2019-05-01 17:52:29.180 [creatingNode( rptid100:com.ergotech.transsecs.secs.HostI
```

When you use the generated run.bat to start the OPCUA Server, the GEMHost application will make a connection to a tool running on Port 5010 and Device ID 1.



## Run the SECS/GEM Interface as an OPCUA Server

```
C:\WINDOWS\system32\cmd.exe
Started GEMHost connecting to localhost on port 5010 with device id 1
at ip address localhost2019-05-01 17:52:29.149 [createFolderNode( gemhost:gemhost]2019-05-01 17:52:29.149
2019-05-01 17:52:29.149 [creatingNode( ecid:deploy.GEMHost.ECIDRequest periodic false]2019-05-01 17:52:29.149
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:0 ) setValueObject="2000" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( responsestatus:deploy.GEMHost.ECIDRequest periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( errorstatus:deploy.GEMHost.ECIDRequest periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( goodstatus:deploy.GEMHost.ECIDRequest periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( sendmessage:deploy.GEMHost.ECIDRequest periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [createFolderNode( variables:gemhost/variables]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [createFolderNode( alarm:gemhost/variables/alarm]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( alarmset:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:0 ) setValueObject="0" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [createFolderNode( vid:gemhost/variables/vid]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( wafercount:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:1 ) setValueObject="0" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( alarm:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:2 ) setValueObject="" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( altx:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:3 ) setValueObject="" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [createFolderNode( ceid:gemhost/variables/ceid]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( started:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:4 ) setValueObject="" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 Unknown type a
2019-05-01 17:52:29.165 [creatingNode( enabledalarms:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:5 ) setValueObject="" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( localremotestate:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:6 ) setValueObject="0" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [createFolderNode( rptid:gemhost/variables/rptid]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [creatingNode( rptid103:com.ergotech.transsecs.secs.HostIDBean periodic false]2019-05-01 17:52:29.165
2019-05-01 17:52:29.165 [vib.utils.VIBOPC > setValueObject( PrimaryOutPort:7 ) setValueObject="" ]]2019-05-01 17:52:29.165
2019-05-01 17:52:29.180 [creatingNode( rptid100:com.ergot
```

The default SECS/GEM OPCUA Server endpoint URL is `opc.tcp://127.0.0.1:12686/MIXOPCServer`



## Review and Next Steps for Testing the OPCUA Host Server

The GEMHost project has been built as an OPCUA Server. When this GEMHost is running it will automatically attempt to find and connect to a process tool at ip address “localhost” using port 5010 and device id 1.

Now that the OPCUA server is running as a host application we can do two more things:

- 1) Allow the host to connect to a process tool simulator at “localhost” port 5010, device id 1 for testing

and












- 2) Connect an OPCUA Client to the OPCUA Server so we can send messages to the process tool from the host and also get data from the tool

The next part of this guide goes through both of these steps, first connecting a tool simulator (StandAloneGEMTool), then using an OPCUA client to test the OPCUA Server.

## Testing your OPCUA GEMHost with the StandAloneGEMTool

Browse to the installation directory and open the StandAloneGEMTool folder.

Use the tool simulator in the installation StandAloneGEMTool to test the GEMHost project. It is set up to use port 5010 and device id 1.

 ErgoTechConfiguration.properties	4/29/2019 1:50 PM	Notepad++ Docu...	2 KB
 ErgoTechStandAloneGEMToolLicense.txt	4/29/2019 1:50 PM	Notepad++ Docu...	12 KB
 GEMToolStandAlone.jar	4/29/2019 1:50 PM	JAR File	3,863 KB
 log4j.xml	4/29/2019 1:50 PM	Notepad++ Docu...	3 KB
 MessageMatching.log	4/29/2019 3:25 PM	Notepad++ Docu...	0 KB
 ProjectLog.log	4/29/2019 3:25 PM	Notepad++ Docu...	0 KB
 run.bat	4/29/2019 1:50 PM	Windows Batch File	1 KB
 run.sh			
 SECSMessages.log			
 sqlite3.dll			
 ToolParams.sqlite			

Use run.bat on Windows or run.sh on Linux to start the StandAloneGEMTool Simulator





## Testing your OPCUA GEMHost with the StandAloneGEMTool

Leave the StandAloneGEMTool running while you work on the GEMHost. The StandAloneGEMTool starts up in Remote/Online mode, ready for a host connection.

**GEM Tool**  
Use the GEMHost for testing

Remote Online

Control State 3  
Communications State 1

1 Wafer Count  
50.12 Temperature 50.00 Set Point ECID 2000  
36.69 Gas Flow 50-400 Allowed Range

PPID  
Lot ID

SELECT ALARM ACTION Select An Alarm Action  
Do Selected Alarm Action

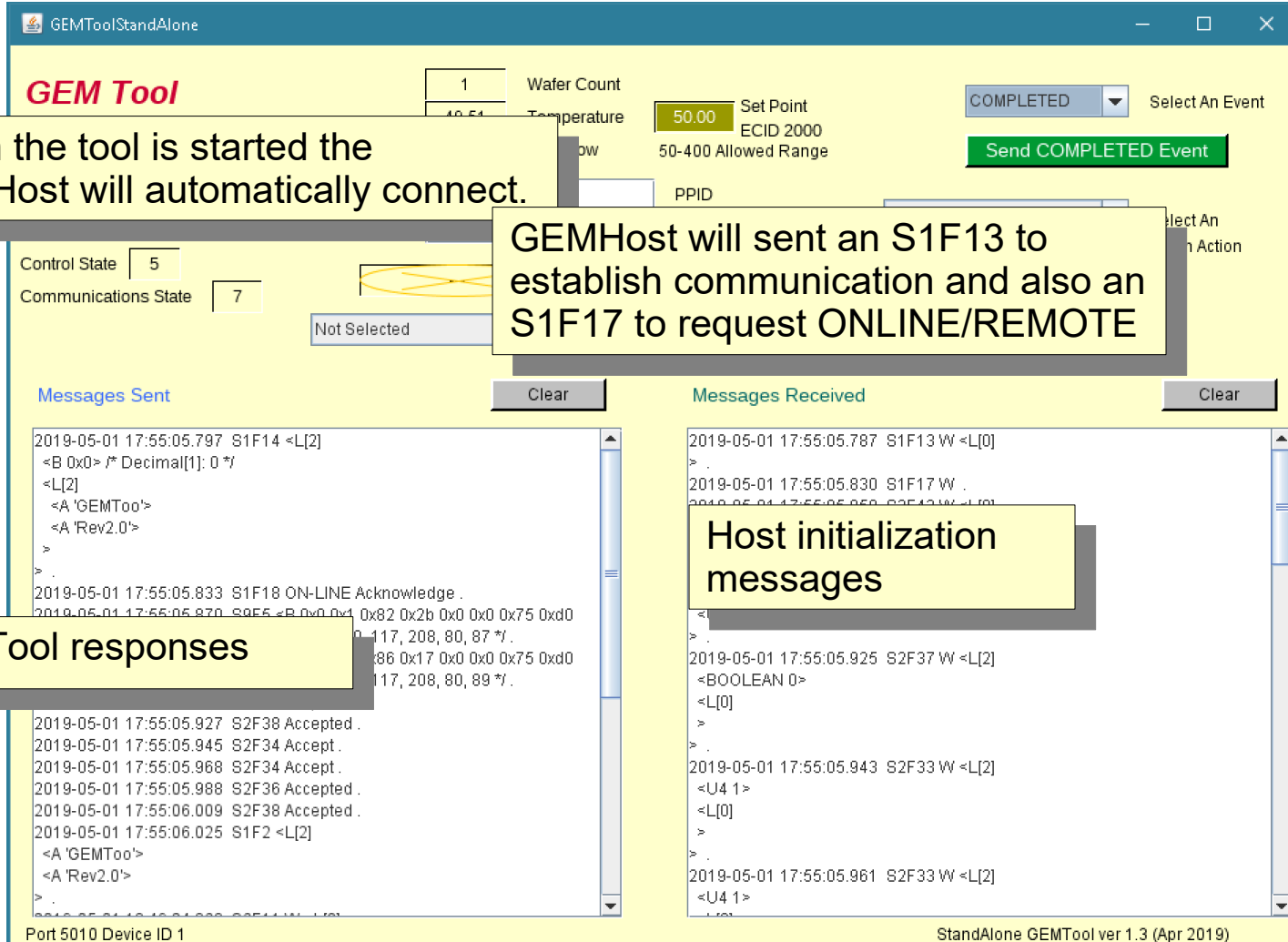
Not Selected Select Reply Code For Next Host Command Reply

Messages Sent Clear Messages Received Clear

Port 5010 Device ID 1 StandAlone GEMTool ver 1.3 (Apr 2019)

The GEMHost will automatically connect to the StandAloneGEMTool when the host is built and in run mode.

# Testing your OPCUA GEMHost with the StandAloneGEMTool



**GEM Tool**

1 Wafer Count  
40.54 Temperature  
50.00 Set Point  
ECID 2000  
50-400 Allowed Range  
PPID

COMPLETED Select An Event  
Send COMPLETED Event

Control State 5  
Communications State 7

Not Selected

Messages Sent

```

2019-05-01 17:55:05.797 S1F14 <L[2]
<B 0x0> /* Decimal[1]: 0 */
<L[2]
<A 'GEMTool'>
<A 'Rev2.0'>
>
>
2019-05-01 17:55:05.833 S1F18 ON-LINE Acknowledge .
2019-05-01 17:55:05.870 S1F5 <B 0x0 0x1 0x82 0x2b 0x0 0x0 0x75 0xd0
0 117, 208, 80, 87 */.
86 0x17 0x0 0x0 0x75 0xd0
117, 208, 80, 89 */.
2019-05-01 17:55:05.927 S2F38 Accepted .
2019-05-01 17:55:05.945 S2F34 Accept .
2019-05-01 17:55:05.968 S2F34 Accept .
2019-05-01 17:55:05.988 S2F36 Accepted .
2019-05-01 17:55:06.009 S2F38 Accepted .
2019-05-01 17:55:06.025 S1F2 <L[2]
<A 'GEMTool'>
<A 'Rev2.0'>
>

```

Messages Received

```

2019-05-01 17:55:05.787 S1F13 W <L[0]
> .
2019-05-01 17:55:05.830 S1F17 W .
2019-05-01 17:55:05.925 S2F37 W <L[2]
<BOOLEAN 0>
<L[0]
> .
2019-05-01 17:55:05.943 S2F33 W <L[2]
<U4 1>
<L[0]
> .
2019-05-01 17:55:05.961 S2F33 W <L[2]
<U4 1>

```

Port 5010 Device ID 1

StandAlone GEMTool ver 1.3 (Apr 2019)

When the tool is started the GEMHost will automatically connect.

GEMHost will sent an S1F13 to establish communication and also an S1F17 to request ONLINE/REMOTE

Tool responses

Host initialization messages



# Testing your OPCUA GEMHost with the StandAloneGEMTool

GEMHost will also set up reports which have been defined in the GEMHost project, and also link these reports to events. It also enables all alarms and events in the tool.

Tool responses

Host event and report set-up messages



# Testing your OPCUA GEMHost with the StandAloneGEMTool

The StandAloneGEMTool can simulate an event and send an S6F11 Event Report to the host

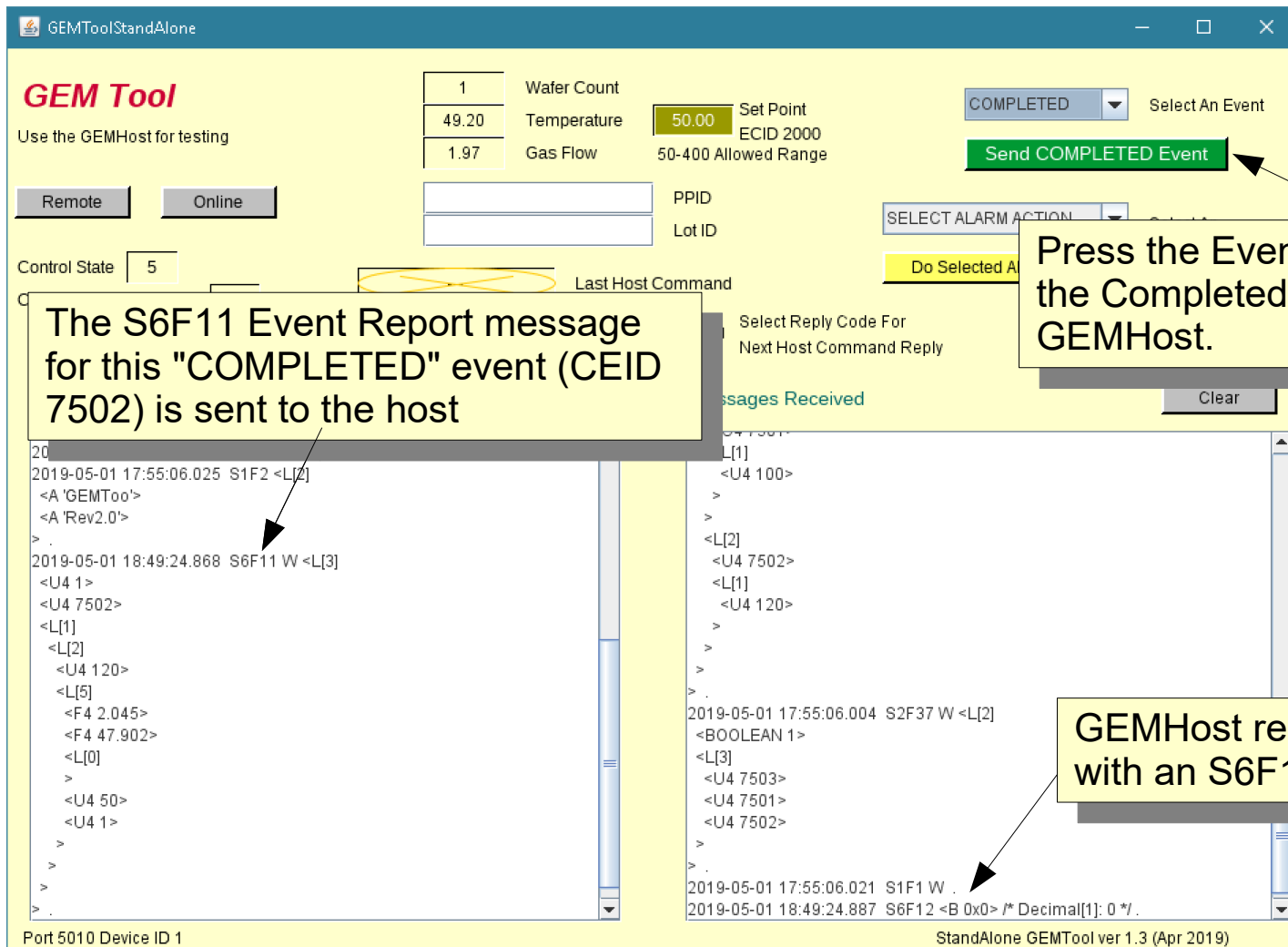
Select an event to trigger for testing, for example "COMPLETED"

The screenshot shows the GEMToolStandAlone application interface. At the top, there's a header with the title bar and window controls. Below that, the main area is divided into several sections:

- Wafers:** A table with columns for Wafer Count (1), Temperature (54.00), and Set Point (50.00).
- ECID 2000:** A section with a Set Point of 50.00 and an Allowed Range of 50-400.
- Event Selection:** A dropdown menu labeled "SELECT EVENT" with options: SELECT EVENT, LOADED, STARTED, and COMPLETED. A yellow box highlights the "COMPLETED" option.
- Do Selected Alarm Action:** A yellow button.
- Next Host Command Reply:** A dropdown menu currently set to "Not Selected".
- Messages Sent:** A scrollable list of outgoing messages, including S1F14, S1F18 ON-LINE Acknowledge, and S9F5.
- Messages Received:** A scrollable list of incoming messages, including S1F11, S2F37 W, and S1F1 W.

At the bottom, the status bar shows "Port 5010 Device ID 1" and "StandAlone GEMTool ver 1.3 (Apr 2019)".

# Testing your OPCUA GEMHost with the StandAloneGEMTool



**GEM Tool**  
Use the GEMHost for testing

Remote Online

Control State 5

Water Count: 1  
Temperature: 49.20  
Gas Flow: 1.97

Set Point: 50.00  
ECID 2000  
50-400 Allowed Range

PPID  
Lot ID

COMPLETED Select An Event  
Send COMPLETED Event

SELECT ALARM ACTION  
Do Selected A

Select Reply Code For Next Host Command Reply

Messages Received

Clear

Port 5010 Device ID 1

StandAlone GEMTool ver 1.3 (Apr 2019)

The S6F11 Event Report message for this "COMPLETED" event (CEID 7502) is sent to the host

Press the Event send button to send the Completed Event to the GEMHost.

GEMHost responds with an S6F12

```

2019-05-01 17:55:06.025 S1F2 <L[2]
<A 'GEMTool'>
<A 'Rev2.0'>
>
2019-05-01 18:49:24.868 S6F11 W <L[3]
<U4 1>
<U4 7502>
<L[1]
<L[2]
<U4 120>
<L[5]
<F4 2.045>
<F4 47.902>
<L[0]
>
<U4 50>
<U4 1>
>
>
>

```

```

2019-05-01 17:55:06.004 S2F37 W <L[2]
<BOOLEAN 1>
<L[3]
<U4 7503>
<U4 7501>
<U4 7502>
>
>
>
2019-05-01 17:55:06.021 S1F1 W .
2019-05-01 18:49:24.887 S6F12 <B 0x0> /* Decimal[1]: 0 */

```

# Set up an OPCUA Client Connection

The next step to testing the GEMHost is to use an OPCUA Client. Examples in this guide uses the UAExpert OPCUA Test Client which can be downloaded from:

<https://www.unified-automation.com/products/development-tools/uaexpert.html>

Please use the [TransSECS OPCUA Certificate Exchange Guide](#) for a detailed example of connecting an OPCUA Client to the running SECS/GEM OPCUA Server.



# OPCUA Client Test – Send a Host Message to a Tool (PP-Select)

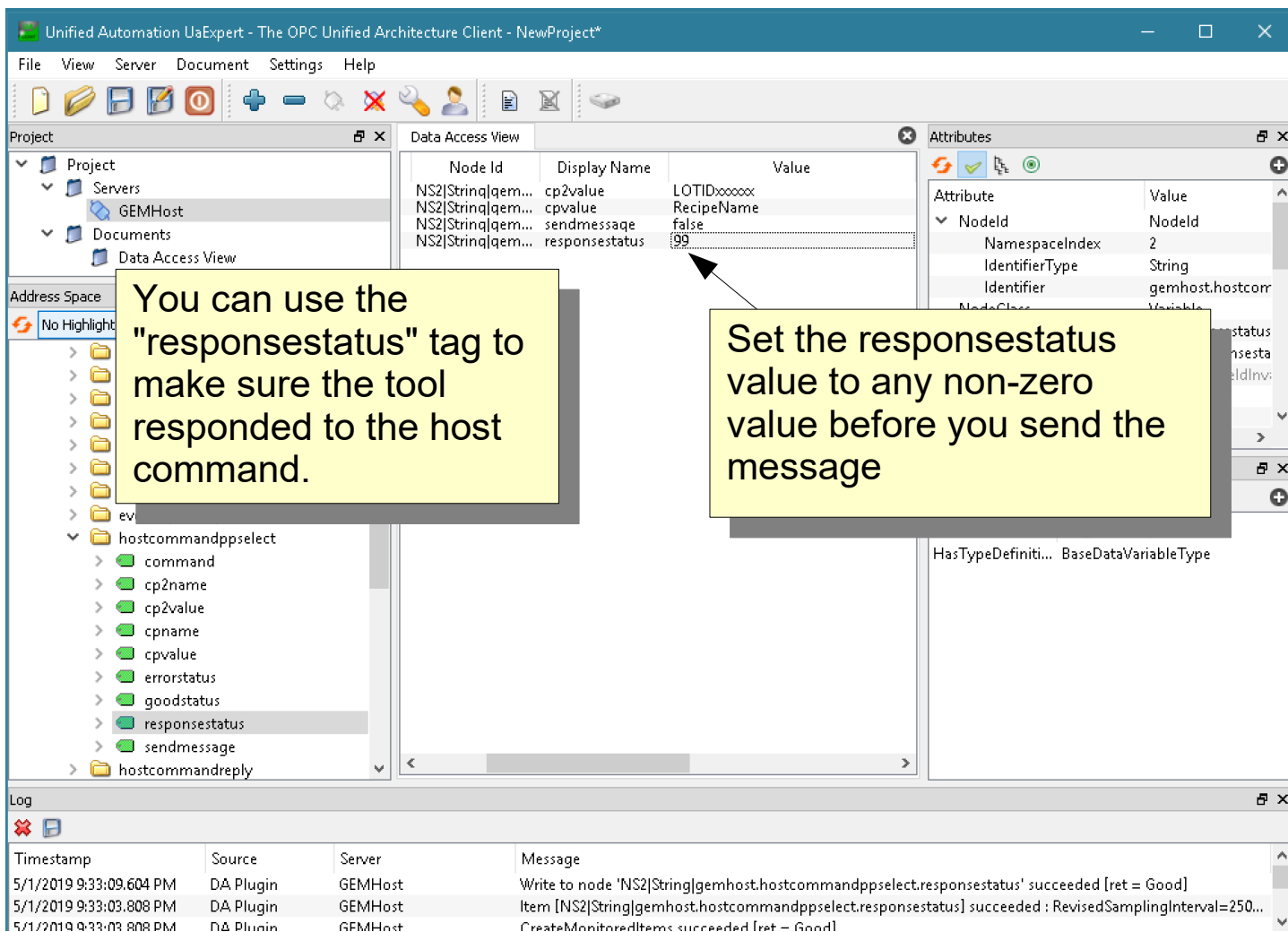
The screenshot shows the Unified Automation UaExpert software interface. The main window is titled "Unified Automation UaExpert - The OPC Unified Architecture Client - NewProject\*". The interface includes a menu bar (File, View, Server, Document, Settings, Help), a toolbar, and several panes:

- Project:** Shows a tree view with "Project", "Servers" (containing "GEMHost"), and "Documents" (containing "Data Access View").
- Address Space:** Shows a tree view with various nodes under "No Highlight". The "hostcommandppselect" folder is expanded, showing nodes like "command", "cp2name", "cp2value", "cpname", "cpvalue", "errorstatus", "goodstatus", "responsestatus", "sendMessage", and "hostcommandreply".
- Data Access View:** A table with columns "Node Id", "Display Name", and "Value". The "sendMessage" node is selected, and its value is "LOTIDxxxxxx RecipeName".
- Log:** A table with columns "Timestamp", "Source", "Server", and "Message".

Two yellow callout boxes provide instructions:

- The top callout box points to the "Value" column of the "sendMessage" node and contains the text: "Use your OPCUA Client to set variables in the message."
- The bottom callout box points to the "sendMessage" node and contains the text: "Use the 'sendMessage' tag to send the host message to the tool. Set this value in your OPCUA client to a non-false value to send the message."

# OPCUA Client Test – Send a Host Message to a Tool



The screenshot shows the Unified Automation UaExpert interface. The main window is titled "Unified Automation UaExpert - The OPC Unified Architecture Client - NewProject\*". The interface includes a menu bar (File, View, Server, Document, Settings, Help), a toolbar, and several panes:

- Project:** Shows a tree view with "Project", "Servers", "GEMHost", "Documents", and "Data Access View".
- Data Access View:** A table with columns "Node Id", "Display Name", and "Value".
 

Node Id	Display Name	Value
NS2 String qem...	cp2value	LOTID:xxxxx
NS2 String qem...	cpvalue	RecipeName
NS2 String qem...	sendmessage	false
NS2 String qem...	responsestatus	99
- Address Space:** Shows a tree view of nodes under "hostcommandppselect", including "command", "cp2name", "cp2value", "cpname", "cpvalue", "errorstatus", "goodstatus", "responsestatus", "sendmessage", and "hostcommandreply".
- Attributes:** Shows a table of attributes for the selected node.
 

Attribute	Value
NodeId	NodeId
NamespaceIndex	2
IdentifierType	String
Identifier	gemhost.hostcomm...
NodeClass	Variable
- Log:** Shows a table of log entries.
 

Timestamp	Source	Server	Message
5/1/2019 9:33:09.604 PM	DA Plugin	GEMHost	Write to node 'NS2 String gemhost.hostcommandppselect.responsestatus' succeeded [ret = Good]
5/1/2019 9:33:03.808 PM	DA Plugin	GEMHost	Item [NS2 String gemhost.hostcommandppselect.responsestatus] succeeded : RevisedSamplingInterval=250...
5/1/2019 9:33:03.808 PM	DA Plugin	GEMHost	CreateMonitoredItems succeeded [ret = Good]

Two yellow callout boxes provide instructions:

- Box 1:** "You can use the 'responsestatus' tag to make sure the tool responded to the host command." (An arrow points from this box to the 'responsestatus' row in the Data Access View table.)
- Box 2:** "Set the responsestatus value to any non-zero value before you send the message" (An arrow points from this box to the '99' value in the 'responsestatus' row.)





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# OPCUA Client Test – Send a Host Message to a Tool

Use the "sendMessage" tag to send the host message to the tool.

You can use the "responsestatus" tag to make sure the tool responded to the host command.

The responsestatus tag will revert to "0" after the response has been received.

Once the response has been received you can use your OPCUA Client to read values from the response message to check for errors from the tool.

The screenshot shows the Unified Automation UaExpert interface. The 'Data Access View' window displays a table with columns for Node Id, Display Name, and Value. The 'Address Space' window shows a tree view of nodes, with 'responsestatus' selected. The 'Log' window at the bottom shows a table of messages.

Node Id	Display Name	Value
NS2[String]gem...	cp2value	LOTIDxxxxx
NS2[String]gem...	cpvalue	Recip Name
NS2[String]gem...	sendMessage	false
NS2[String]gem...	responsestatus	0

Timestamp	Source	Server	Message
5/1/2019 9:34:15.907 PM	DA Plugin	GEMHost	Write to node 'NS2[String]gemhost.hostcommandppselect.sendMessage' succeeded [ret = Good]
5/1/2019 9:33:09.604 PM	DA Plugin	GEMHost	Write to node 'NS2[String]gemhost.hostcommandppselect.responsestatus' succeeded [ret = Good]
5/1/2019 9:33:03.808 PM	DA Plugin	GEMHost	Item [NS2[String]gemhost.hostcommandppselect.responsestatus] succeeded : RevisedSamplingInterval=250...



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## OPCUA Client Test – Send a Host Message to a Tool

The screenshot displays the StandAloneGEMTool interface with several key elements:

- Control Parameters:** Wafer Count, Temperature (50.00), Gas Flow (2.08), Set Point (50.00), ECID 2000, and Gas Flow range (50-400 Allowed Range).
- Buttons:** Remote, Online, Send LOADED Event, Do Selected Alarm Action, and Clear.
- Form Fields:** RecipeName (LOTIDxxxxx), PPID, and Lot ID.
- Host Command:** PP-SELECT, Last Host Command.
- Reply Selection:** A dropdown menu for "Select Reply Code for Next Host Command" with "0=OK Command Performed" selected.
- Message Logs:** "Messages Sent" and "Messages Received" sections.

Here are the two CPValues sent in the host command PP-Select

Select the host command reply code for testing (e.g., 0=OK) before sending the host command

The StandAloneGEMTool will display the command received

You can see the PPSELECT host command received by the StandAloneGEMTool, as well as the reply from the tool.



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## Test Sending an Event Message From the Tool

Trigger an event on the tool to send an event report to the host.

The LOADED event is selected

LOADED Select An Event

Send LOADED Event

Press the send event button to trigger the event

Wafer Count  
Temperature 50.00 Set Point ECID 2000  
Gas Flow 50-400 Allowed Range

Remote Online

Control State 5  
Communications State 7

LoadedRecipe1234 PPID  
LOTIDxxxxxx Lot ID

PP-SELECT Last Host Command

0=OK Command Performed Select Reply Code For Next Host Command Reply

Messages Sent Clear

```
2019-05-02 12:45:33.109 S2F42 <L[2]
<B 0x0> /* Decimal[1]: 0 */
<L[0]
>
> .
```

Messages Received Clear

```
2019-05-02 12:45:33.098 S2F41 W <L[2]
<A 'PP-SELECT'>
<L[2]
<L[2]
<A 'LOTID'>
<A 'LOTIDxxxxxx'>
>
<L[2]
<A 'PPID'>
<A 'RecipeName'>
>
>
> .
```



The report for this event was defined in the GEMHost configuration and was defined and linked to the event by the GEMHost during initialization (initial connection to the tool).

# Test Sending an Event Message From the Tool

GEMToolStandAlone
— □ ×

## GEM Tool

Use the GEMHost for testing

1	Wafer Count
53.55	Temperature
1.98	Gas Flow

Set Point: 50.00  
ECID 2000  
50-400 Allowed Range

LOADED ▼ Select An Event

Send LOADED Event

Remote Online

Control State: 5

Communications State: 7

LoadedRecipe1234 PPID

LOTIDxxxxxx Lot ID

PP-SELECT Last Host Command

SELECT ALARM ACTION ▼ Select An Alarm Action

Do Selected Alarm Action

Messages Sent

```

2019-05-02 12:45:33.098 <B 0x0> /* Decimal[1]: 0 */ .
<L[0]
>
> .
2019-05-02 13:39:57.634 S6F11 W <L[3]
<U4 1>
<U4 7503>
<L[1]
<L[2]
<U4 103>
<L[3]
<A 'LOTIDxxxxxx'>
<A 'LoadedRecipe1234'>
<U4 1>
>
>
>
> .
                
```

Messages Received

```

2019-05-02 12:45:33.098 S2F41 W <L[2]
<A 'PP-SELECT'>
<L[2]
<L[2]
<A 'LOTID'>
<A 'LOTIDxxxxxx'>
>
<L[2]
<A 'PPID'>
<A 'RecipeName'>
>
>
> .
2019-05-02 13:39:57.644 S6F12 <B 0x0> /* Decimal[1]: 0 */ .
                
```

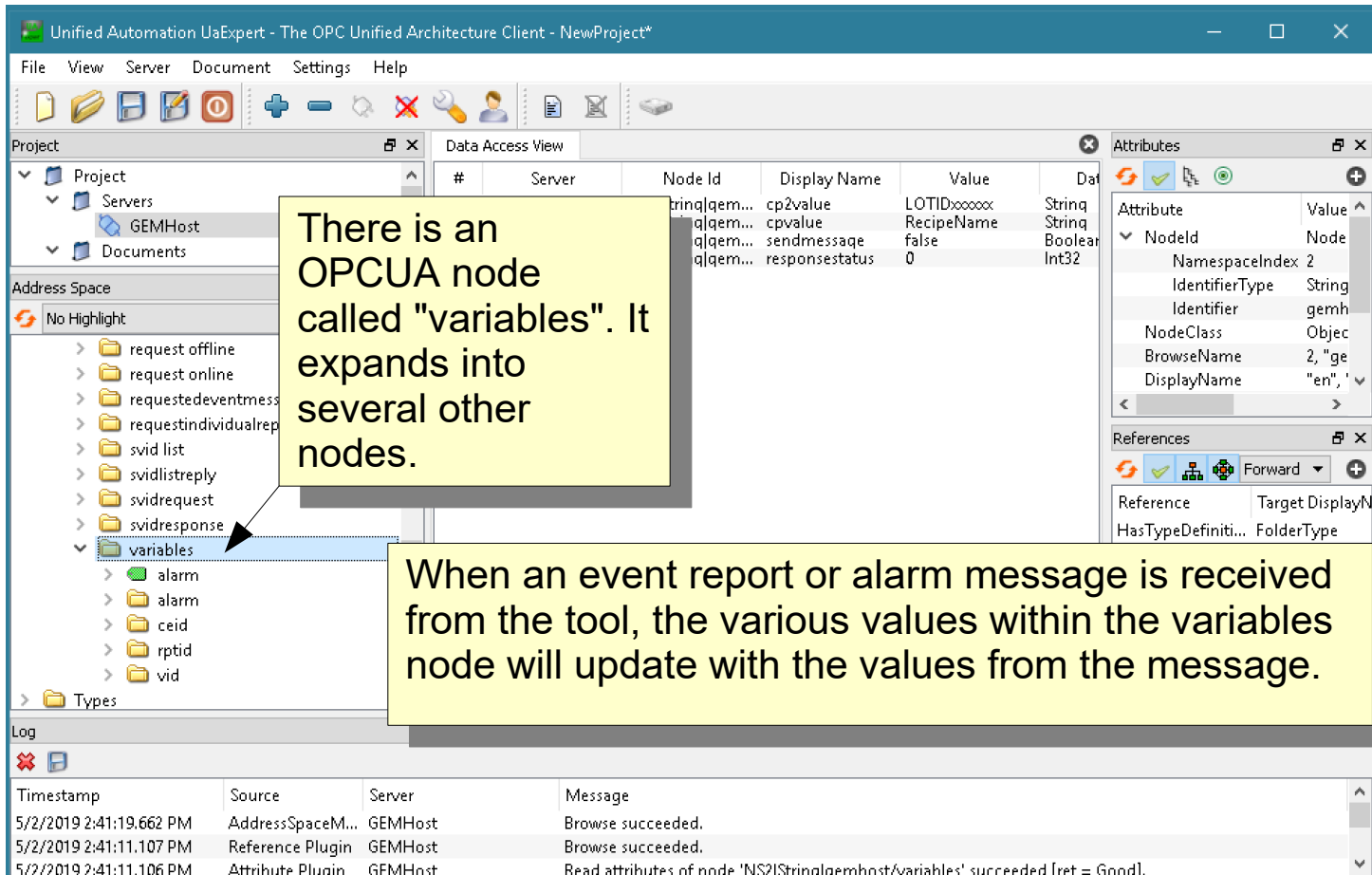
Port 5010 Device ID 1

StandAlone GEMTool ver 1.3 (Apr 2019)

The event report was sent to the host

The host replied with an S6F12 to acknowledge the report

## Test Sending an Event Message From the Tool

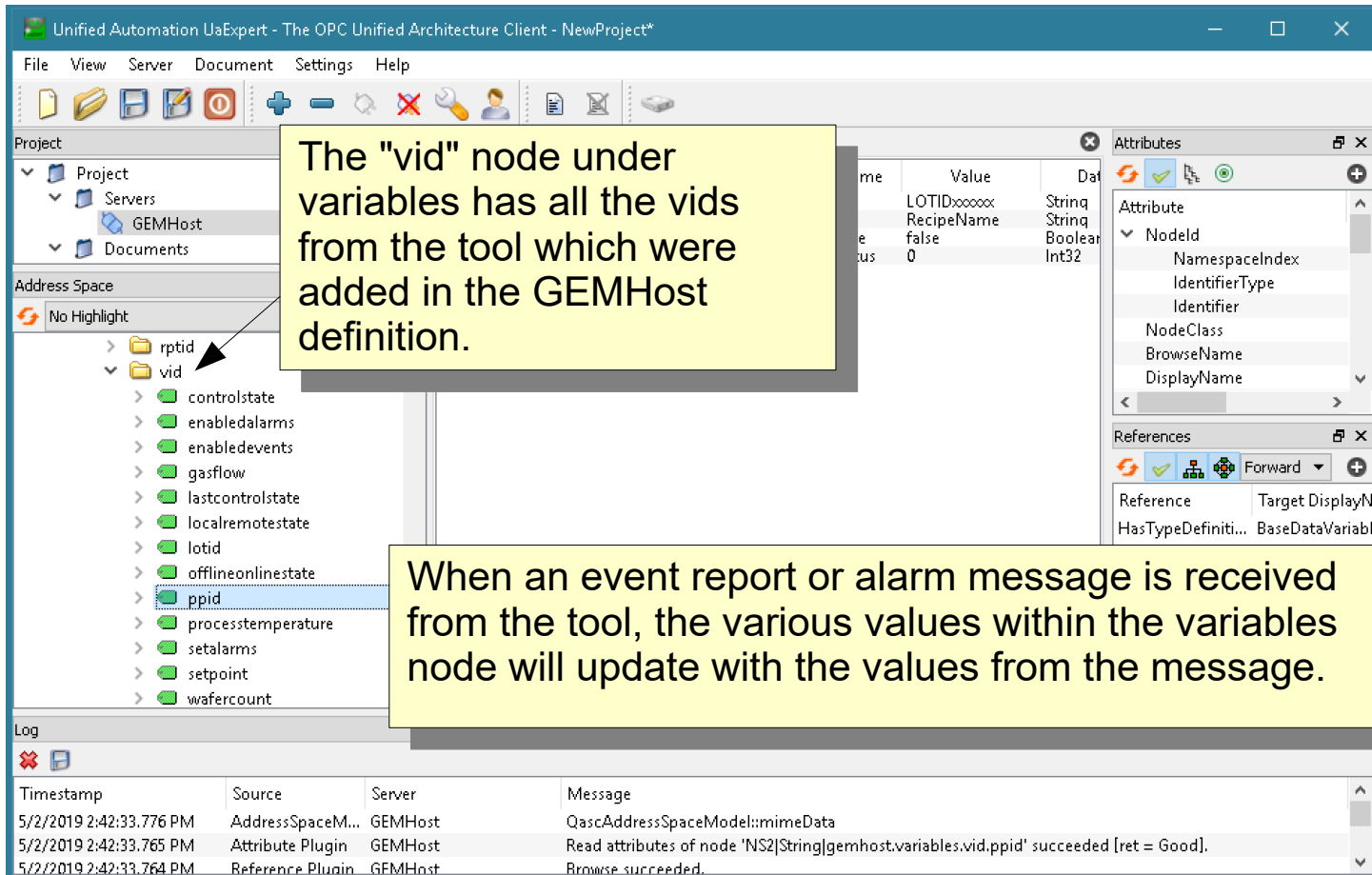


The screenshot shows the Unified Automation UaExpert interface. The 'Address Space' tree on the left is expanded to show the 'variables' node. A yellow callout box points to this node with the text: "There is an OPCUA node called 'variables'. It expands into several other nodes." Below this, another yellow callout box states: "When an event report or alarm message is received from the tool, the various values within the variables node will update with the values from the message." The 'Data Access View' table in the center shows several nodes with their values. The 'References' pane on the right shows the structure of the 'variables' node. The 'Log' pane at the bottom shows a sequence of events: a successful browse of the address space, a successful browse of the reference plugin, and a successful read of the attributes of the 'variables' node.

#	Server	Node Id	Display Name	Value	Data Type
1		brinqgem...	cp2value	LOTIDxxxxx	String
2		qlqgem...	cpvalue	RecipeName	String
3		qlqgem...	sendmessage	false	Boolean
4		qlqgem...	responsestatus	0	Int32

Timestamp	Source	Server	Message
5/2/2019 2:41:19.662 PM	AddressSpaceM...	GEMHost	Browse succeeded.
5/2/2019 2:41:11.107 PM	Reference Plugin	GEMHost	Browse succeeded.
5/2/2019 2:41:11.106 PM	Attribute Plugin	GEMHost	Read attributes of node 'NS2!Stringalgemhost/variables' succeeded [ret = Good].

## Test Sending an Event Message From the Tool



The "vid" node under variables has all the vids from the tool which were added in the GEMHost definition.

When an event report or alarm message is received from the tool, the various values within the variables node will update with the values from the message.

Timestamp	Source	Server	Message
5/2/2019 2:42:33.776 PM	AddressSpaceM...	GEMHost	QascAddressSpaceModel::mimeData
5/2/2019 2:42:33.765 PM	Attribute Plugin	GEMHost	Read attributes of node 'NS2[String]gemhost.variables.vid.ppid' succeeded [ret = Good].
5/2/2019 2:42:33.764 PM	Reference Plugin	GEMHost	Browse succeeded.

# Test Sending an Event Message From the Tool

The latest ppid and lotid values were updated from the LOADED event message data

#	Server	Node Id	Display Name	Value	Data Type
1	GEMHost	NS2[String]gem...	cp2value	LOTIDxxxxxx	String
2	GEMHost	NS2[String]gem...	cpvalue	RecipeName	String
3	GEMHost	NS2[String]gem...	sendmessage	false	Boolean
	GEMHost	NS2[String]gem...	responsestatus	0	Int32
	GEMHost	NS2[String]gem...	ppid	LoadedRecipe1...	String
	GEMHost	NS2[String]gem...	lotid	LOTIDxxxxxx	String

When an event report or alarm message is received from the tool, the various values within the variables node will update with the values from the message.

Timestamp	Source	Server	Message
5/2/2019 2:43:15.909 PM	TypeCache	GEMHost	Reading type info of NodeId NS2[String]gemhost.variables.vid.lotid succeeded
5/2/2019 2:43:15.898 PM	DA Plugin	GEMHost	Item [NS2[String]gemhost.variables.vid.lotid] succeeded : RevisedSamplingInterval=250, RevisedQueueSi...
5/2/2019 2:43:15.898 PM	DA Plugin	GEMHost	CreateMonitoredItems succeeded [ret = Good]



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## JSON Formatted Message Data

JSON formatted data for list items will be demonstrated for the data received in an S1F4 message from the tool.

Unified Automation UaExpert - The OPC Unified Architecture Client - NewProject\*

File View Server Document Settings Help

Project

- Project
  - Servers
    - GEMHost
  - Documents

Address Space

- No Highlight
  - offlineack
  - onlineack
  - request offline
  - request online
  - requestedeventmessage
  - requestindividualreport
  - svid list
  - svidlistreply
  - svidrequest
    - errorstatus
    - goodstatus
    - responsestatus
    - sendmessage
    - svid
  - svidresponse

#	Server	Node Id	Display Name	Value	Data Type
1	GEMHost	NS2[String]gem...	svid	1512	Int64
2	GEMHost	NS2[String]gem...	sendmessage	false	Boolean

Attributes

- Attribute
  - NodeId
    - NamespaceIndex
    - IdentifierType
    - Identifier
    - NodeClass
    - BrowseName
    - DisplayName

References

Reference	Target DisplayN
...sTypeDefiniti...	BaseDataVariabl

Log

Timestamp	Source	Server	Message
5/2/2019 3:15:25.173 PM	DA Plugin	GEMHost	Write to node 'NS2[String]gemhost.svidrequest.sendmessage' succeeded [ret = Good]
5/2/2019 3:15:13.317 PM	DA Plugin	GEMHost	Write to node 'NS2[String]gemhost.svidrequest.svid' succeeded [ret = Good]
5/2/2019 3:15:08.606 PM	TypeCache	GEMHost	Reading type info of NodeId NS2[String]gemhost.svidrequest.sendmessage succeeded

Use your OPCUA Client to send the S1F3 (SVID Request) with svid id value 1512 (process temperature).





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## JSON Formatted Message Data

JSON formatted data for list items will be demonstrated for the data received in an S1F4 message from the tool.

**Data Access View**

Node Id	Display Name	Value	Datatype	Source Time
NS2[String gem...	svid	1512	Int64	3:15:13.30
NS2[String gem...	sendmessage	false	Boolean	12:43:02.3
NS2[String gem...	svdlist	{ "values": [ "48...	String	3:15:25.19

**Log**

Timestamp	Source	Server	Message
5/2/2019 3:16:46.798 PM	TypeCache	GEMHost	
5/2/2019 3:16:46.790 PM	DA Plugin	GEMHost	Item [NS2[String gemhost.svidresponse.svidlist] succeeded : RevisedSamplingInterval=250, RevisedQueu...
5/2/2019 3:16:46.790 PM	DA Plugin	GEMHost	CreateMonitoredItems.succeeded [ret = Good]

Use your OPCUA Client to read the svidlist value from the svidresponse message data.

The value for svidlist is in JSON format, { "values": [ "50.422" ], "type":44 }

## Notes on OPCUA Servers: JSON List Formats

List elements are JSON formatted, such as `{ "values": [ ] }`

For example, the recipe list for an S7F20 might look like:

```
{ "values": [ "recipe1", "recipe2", "recipe3", "recipe4" ] }
```

There are more things you can do with the JSON format for the lists, including making lists of lists and specifying the SECS format for the data in the list.



# Notes on OPCUA Servers: JSON List Formats

If a specific type is required, it can be specified if needed. For example for the recipe list, the data is ASCII, type 20:

```
{ "values": [ "recipe1","recipe2", "recipe3", "recipe4"], type:20 }
```

**type** is defined by the SECS Standard:

00 - List

10 - Binary (can be an array)

11 - Boolean

20 - String

30 - 8 byte floating point

34 - 4 byte floating point

40, 41, 42, 44 - 8, 1,2,4 byte signed integers

50, 51, 52, 54 - 4 byte signed integer

# Notes on OPCUA Servers: JSON List Formats

Each element of the array can have a different type in this format (this might be useful in some message replies with different data types):

```
{"values":  
  {"value":"1.2", "type":"34"},  
  {"value":"Test", "type":"20"},  
  {"value":[5,6,7,8], "type":"10"},  
  {"value":1, "type":"10"}  
}]
```

## Notes on Tool OPCUA Servers: Triggering Events with DVVALS

Events can be triggered with a list of DVVALS, so if you need to do this you can define the list, then use this as the trigger input to the CEID. If you are using DVVALS in your project you would associate the DVVALS when you define your CEID.

DVVALS as a JSON String sent to the trigger of a CEID:

```
{ "values":[  
  { "dvid":WaferCount, dvval:15 },  
  { "dvid":23456, dvval:"Hello World" }  
]}
```

You can specify any VID with either its name (for example WaferCount), or its vid number (for example 23456) as the above example demonstrates.



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## Notes on OPCUA Servers: Host Commands

If you publish the whole host command, the structure is a list (with the host command), then the list elements for the parameters for the command.

It may look something like:

```
{ "values": [ { "value": "PP-SELECT", type: "20" } ] } { "values":  
[ { "values": [ LOTID ], type: "20" } { "values":  
[ { "value": "CHAMBER", type: "20" } ] } { "value": "1", type: "51" } ] }  
{ "values": [ PPID ], type: "20" } ] }
```



# Notes on OPCUA Runtime Configuration

The ErgoTechConfiguration.properties file has some settings which control some aspects of the OPCUA runtime. This file is located in the OPCUA deployment directory.

## **VIBOPC.NoMethodSupport**

This defaults to false. If set to true opcua methods are generated for operations such as sending messages. Some OPCUA clients do not support methods.

## **VIBOPC.UnderscoreCreatePaths**

This defaults to true. This allows you to define vid names with underscores which will generate a tree structure for the vids. For example a vid "robot\_xaxis" will generate a tag structure /toolname/vids/robot/xaxis".

## That's it.

Now you're ready to program your OPCUA Client application to complete integration of the SECS/GEM Host interface. Hopefully this guide is enough to get you started monitoring and controlling your tool. For the next steps, you'll need to make sure that the IDs in TransSECS match the documentation for your tool.

Use the characterization features of TransSECS for a GEM host to import the vids, etc. from your tool. For more information, see:  
TransSECS GEM Host Tool Characterization Guide

<https://www.ergotech.com/files/guides/TransSECSGEMHostToolCharacterizationGuide.pdf>

The host commands for your tool may be a little different, again, check the manual but the changes should be fairly straightforward.

Please let us know if you have any questions!