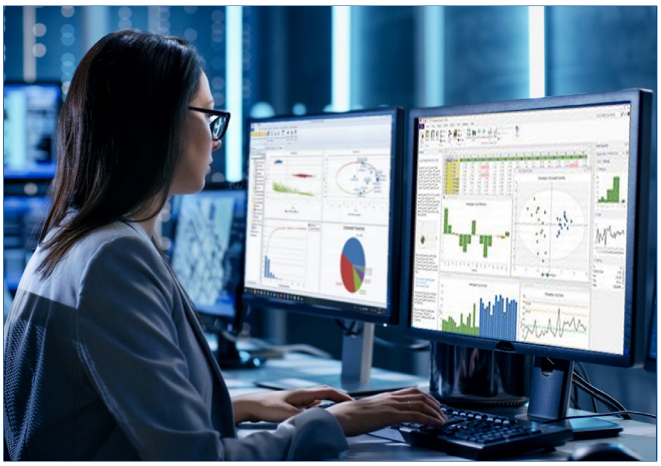
DeltaV™ Spectral PAT

- Improves product quality by reducing variability
- Increases reliability and robustness
- Lowers cost to implement, maintain, and validate



Introduction

DeltaV's Embedded Spectral Process Analytic Technology (PAT) helps you to increase production and improve quality and reliability. Using spectral analyzers to measure reflected light frequencies from on-line product samples, PAT's modern machine learning algorithms and chemometric modeling techniques can accurately predict product quality for use as on-line quality soft sensors. Traditional implementation of PAT using spectroscopy can be difficult to implement and maintain; especially when critical quality measurements are used in closed loop control strategies. DeltaV's Embedded Spectral PAT provides a more robust and secure solution which is easier to implement and maintain.

DeltaV™ Embedded Spectral PAT embeds an industry leading chemometric model engine in a standard DeltaV function block which runs on a DeltaV Application Station. This new PAT function block is easily configured using DeltaV Control Studio and can be easily incorporated into control strategies including closed loop advanced control. Communications with spectral analyzers is supported using standard DeltaV OPC UA client on the Application Station.

Benefits

Improves product quality by reducing variability. On-line measurements and quality calculations provide continuous information for tighter control and less variability.

As an embedded DeltaV function block, critical quality attributes can be easily incorporated into quality control strategies for closed loop control and optimization.

Increases reliability and robustness. Traditional PAT solutions involve layered solutions with multiple servers and communications dependencies. Embedded DeltaV PAT increases reliability with a robust architecture designed for uninterrupted communications and closed loop control.

Lowers cost to implement, maintain, and validate. Embedded DeltaV PAT is easier to implement and maintain by leveraging standard DeltaV configuration, database, and support infrastructure used by your other control applications. And process validation is simplified because applications are all part of an integrated DeltaV platform.

Product Description

DeltaV Spectral PAT provides quality predictions based on spectroscopic analyzer measurements and chemometric models executing in a modeling engine embedded into a standard DeltaV function block. This integrated solution collapses the traditional PAT architecture by bringing spectral signals directly into the control system and performing chemometric model calculations within real-time control module execution. Spectral array signals are read by DeltaV's OPC UA client and accessed directly by the PAT model function block running in DeltaV control modules. This robust architecture is ideal for critical quality attribute calculations used for real-time monitoring and closed loop control within the DeltaV control system.

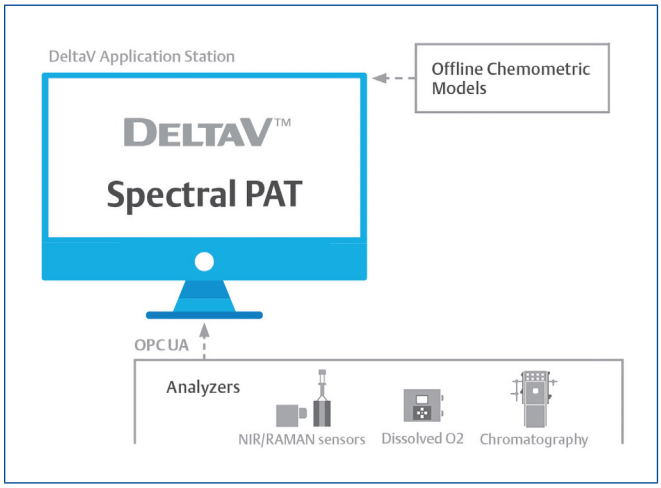


Figure 1. *DeltaV Spectral PAT.*

DeltaV Spectral PAT Function Blocks

DeltaV Spectral PAT uses industry leading chemometric modeling engines which are implemented in function blocks. There are 2 function blocks available in DeltaV Spectral PAT in order to choose the suitable modeling engine for the application.

Unscrambler MVA

The Unscrambler MVA Function Block is used to predict quality attributes using models developed in Aspen Unscrambler™. The MVA models are developed from spectral analyzer measurements using PLS, PCR and SVR regression algorithms. Options for auto-pretreatment of the spectral data include baseline offset correction, detrending, smoothing, various types of derivates, standard normal variate (SNV) and multiplicative scatter correction (MSC).

The Aspen MVA Function Block can append up to 8 additional non-array analog input values into the model. Aspen Unscrambler model files are transferred to DeltaV where they are accessed by the DeltaV Aspen MVA function block. Refer to Aspen Unscrambler™ product documentation for detail information on model calculations.

Each function block calculates one Y prediction. Input and output parameters from the Aspen MVA Function Block are shown in Table 1.

Input Parameters	Output Parameters
Spectra Array (up to 4000 elements)	Output Prediction - One prediction output per function block
Project Model File	Output Deviation
Spectra Acquisition Time Stamp	Predicted Scores and Limit Values
Analog Inputs (up to 8 values)	Hoteling's T2 and Limit Values
	Q-Residuals and Limit Values

Table 1. *Unscrambler MVA Function Block Inputs / Outputs.*

SIMCAQ

The SIMCA®-Q Function Block is used to predict quality attributes using models developed in Sartorius' offline SIMCA® model builder. The SIMCA® models are developed from spectral analyzer measurements using various filtering algorithms (e.g., SNV, 1st and 2nd Derivative) and PLS and OPLS regression algorithms. SIMCA® off-line model files are transferred to DeltaV where they are accessed by the DeltaV Spectral PAT SIMCA®-Q function block. Refer to SIMCA® product documentation for detail information on model calculations.

Each function block calculates one Y prediction. Input and output parameters from the SIMCAQ function block are shown in Table 2.

Input Parameters	Output Parameters
Spectra Array (up to 4000 elements)	Output Prediction - One prediction output per function block
Project Model File	Predicted Component Residuals
Spectra Acquisition Time Stamp	Predicted Scores and Limit Values
	Hoteling's T2 and Limit Values

Table 2. *SIMCAQ Function Block Inputs / Outputs.*

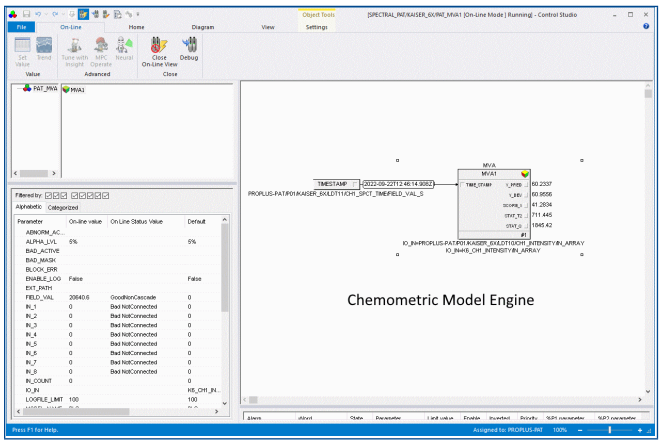


Figure 2. *DeltaV Spectral PAT Function Block.*

Data Logging

The DeltaV Spectral PAT function blocks support logging of spectral data array with timestamp and corresponding output prediction and statistic results. The log file may be used to view PAT calculation results or to collect training spectral data for building PAT models. The log files are CSV format so training quality information can be easily inserted.

Spectral Analyzer OPC UA Data Access

DeltaV Spectral PAT supports spectral analyzer data acquisition using DeltaV's OPC UA client on the Application Station. Data communicated between DeltaV and the spectral analyzer varies by vendor but typically includes spectral measurement array (double or single floating-point), acquisition set-up parameters like exposure time, commands to start / stop / trigger acquisitions, and diagnostic information. Including the spectral analyzer interface in DeltaV provides a single operating window to operate the analyzer and automatically records all analyzer changes in DeltaV as part of the production record.

Figure 3 shows I/O configuration of a typical spectral analyzer using OPC UA. Figure 4 illustrates an example operator display to operate the analyzer using DeltaV Live.

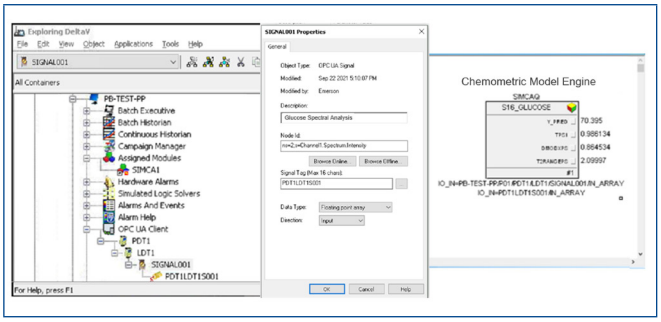


Figure 3. *Configuration of OPC UA Spectral Data Access.*

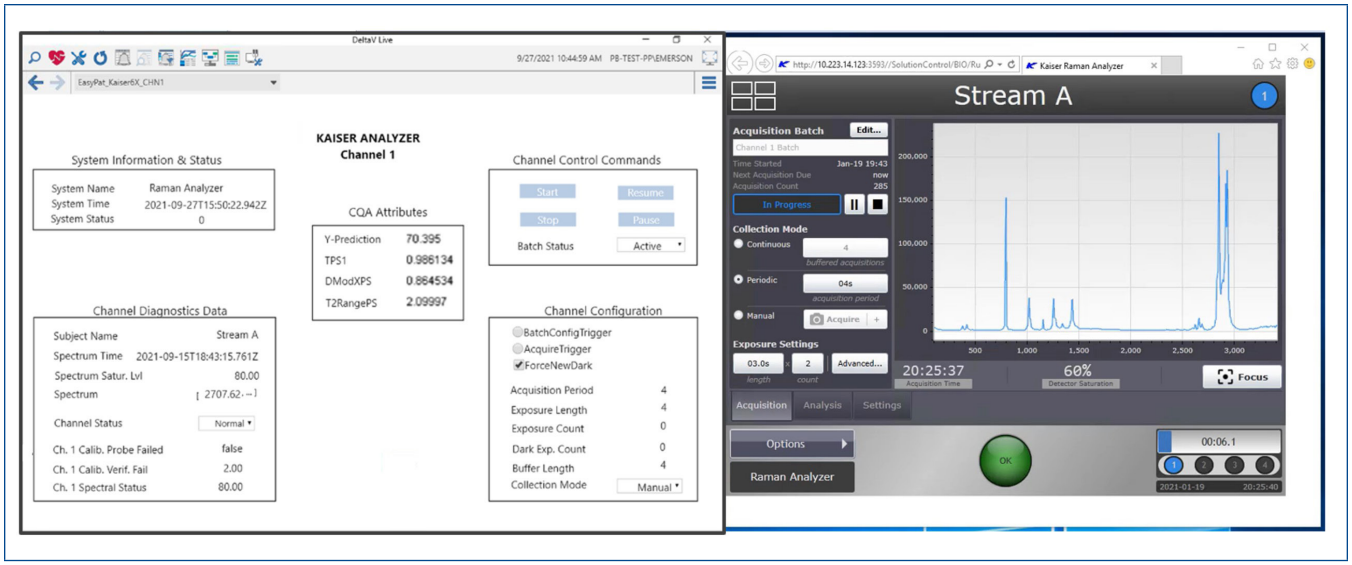


Figure 4. *Example Spectral Analyzer Interface using DeltaV Live Display.*

DeltaV Spectral PAT Specifications

- A single module is limited to 4 Spectral PAT function blocks.
- Modules containing Spectral PAT function blocks must be assigned to the Application Station or ProfessionalPLUS.
- The total number of OPC UA parameters is limited to 30,000. This is calculated by multiplying the spectral array size by the number of Spectral PAT function blocks added to the number of non-Spectral PAT OPC UA parameters on that workstation.
- The fastest update from a spectral analyzer OPC UA server is 3 seconds.
- The fastest module execution for a module containing a Spectral PAT function block is 1 second.

Licensing

DeltaV Spectral PAT is licensed by the function block where each function block provides one quality prediction. A base DeltaV chemometric model license is required for each system and includes one function block. Additional function blocks may be added with scale-up licenses available in bundles of 1, 5, 10, and 20. Multiple Spectral PAT function blocks may be executed in the same Application Station or Professional Plus station simultaneously using the same or different spectra. While you can use different modeling engines on the same system or workstation, the models are uniquely licensed per chemometric modeling engine. In order to use a SIMCA model, you must purchase the corresponding quantity of SIMCA function blocks. In order to use an Unscrambler MVA model, you must purchase the corresponding quantity of MVA function blocks. The base license must be purchased for each type of model. For example, you cannot add a MVA scale-up to a SIMCA-Q base license. In addition, a SIMCA license cannot be used for an MVA function block and vice versa.

In addition to the Spectral PAT licenses, the system must have a system-wide OPC UA Activation license and a workstation based OPC UA Client Signal License for the total number of OPC UA signals. For Spectral PAT, each spectral array (regardless of number of parameters) counts as a single OPC UA signal.

DeltaV licenses are required for either a production DeltaV system ID or DeltaV Simulate Multinode system ID or DeltaV Discovery system ID. Please refer to the DeltaV Discovery Product Datasheet for ordering information.

Information on product options is described in the Ordering Information section below.

Ordering Information

DeltaV Spectral PAT SIMCA®-Q Function Block.

Description	Model Number
DeltaV Spectral PAT SIMCA®-Q Function Block - Embedded SIMCA®-Q Engine in DeltaV function block. One model prediction per block. Licensed by number of function blocks per system.	
Perpetual Licenses	
DeltaV Spectral PAT SIMCA®-Q Perpetual Base License – Includes one SIMCA®-Q Function Block license and is required to apply additional scale-up licenses for more blocks[1]	VE3156PR17
DeltaV Spectral PAT SIMCA®-Q Perpetual Scale-up; 1 Function Block	VE3156PR17UPS01
DeltaV Spectral PAT SIMCA®-Q Perpetual Scale-up; 5 Function Blocks	VE3156PR17UPS05
DeltaV Spectral PAT SIMCA®-Q Perpetual Scale-up; 10 Function Blocks	VE3156PR17UPS10
DeltaV Spectral PAT SIMCA®-Q Perpetual Scale-up; 20 Function Blocks	VE3156PR17UPS20
Subscription Licenses	
DeltaV Spectral PAT SIMCA®-Q Subscription Base License – Includes one SIMCA®-Q one-year Function Block license and is required to apply additional subscription scale-up licenses[1]	VE3156SR17
DeltaV Spectral PAT SIMCA®-Q Scale-up; 1 Function Block – 1 Year Subscription	VE3156SR17UPS01
DeltaV Spectral PAT SIMCA®-Q Scale-up; 5 Function Blocks – 1 Year Subscription	VE3156SR17UPS05
DeltaV Spectral PAT SIMCA®-Q Scale-up; 10 Function Blocks – 1 Year Subscription	VE3156SR17UPS10
DeltaV Spectral PAT SIMCA®-Q Scale-up; 20 Function Blocks – 1 Year Subscription	VE3156SR17UPS20
DeltaV Spectral PAT SIMCA®-Q Base License 1 Year Subscription Renewal; includes 1 Function Block	VE3156SR17-R
DeltaV Spectral PAT SIMCA®-Q Function Block Scaleup 1 Year Subscription Renewal; 1 Block	VE3156SR17UPS01-R
DeltaV Spectral PAT SIMCA®-Q Function Block Scaleup 1 Year Subscription Renewal; 5 Blocks	VE3156SR17UPS05-R
DeltaV Spectral PAT SIMCA®-Q Function Block Scaleup 1 Year Subscription Renewal; 10 Blocks	VE3156SR17UPS10-R
DeltaV Spectral PAT SIMCA®-Q Function Block Scaleup 1 Year Subscription Renewal; 20 Blocks	VE3156SR17UPS20-R

1 – DeltaV Spectral PAT SIMCA®-Q Perpetual Base License can be used with either Perpetual Scale-up Licenses or Subscription Scale-up Licenses. DeltaV Spectral PAT SIMCA®-Q Subscription Base License can only be used to scale-up Subscription Scale-up Licenses.

DeltaV Spectral PAT Unscrambler MVA Function Block.

Description	Model Number
DeltaV Spectral PAT Unscrambler MVA Function Block - Embedded UNSCRAMBLER MVA Engine in DeltaV function block. One model prediction per block. Licensed by number of function blocks per system	
Subscription Licenses	
DeltaV Spectral PAT Unscrambler MVA Subscription Base License – Includes one Unscrambler MVA one-year Function Block license and is required to apply additional subscription scale-up licenses	VE3157SR12
DeltaV Spectral PAT Unscrambler MVA Scale-up; 1 Function Block – 1 Year Subscription	VE3157SR12UPS01
DeltaV Spectral PAT Unscrambler MVA Base License 1 Year Subscription Renewal; includes 1 Function Block	VE3157SR12-R
DeltaV Spectral PAT Unscrambler MVA Function Block Scaleup 1 Year Subscription Renewal; 1 Block	VE3157SR12UPS01-R

Ordering Information for DeltaV Simulate Multi-node Systems

DeltaV Simulate Multi-Node Spectral PAT SIMCA®-Q Function Block.

Description	Model Number
Subscription Licenses	
DeltaV Spectral PAT SIMCA®-Q Subscription Base License for DeltaV Simulate Multi-node – Includes one SIMCA®-Q one-year Function Block license and is required to apply additional subscription scale-up licenses	VX3156SR17
DeltaV Spectral PAT SIMCA®-Q Scale-up for DeltaV Simulate Multi-node; 1 Function Block – 1 Year Subscription	VX3156SR17UPS01
DeltaV Spectral PAT SIMCA®-Q Scale-up for DeltaV Simulate Multi-node; 5 Function Blocks – 1 Year Subscription	VX3156SR17UPS05
DeltaV Spectral PAT SIMCA®-Q Scale-up for DeltaV Simulate Multi-node; 10 Function Blocks – 1 Year Subscription	VX3156SR17UPS10
DeltaV Spectral PAT SIMCA®-Q Scale-up for DeltaV Simulate Multi-node; 20 Function Blocks – 1 Year Subscription	VX3156SR17UPS20
DeltaV Simulate Multi-Node Spectral PAT SIMCA®-Q Base License 1 Year Subscription Renewal; includes 1 Function Block	VX3156SR17-R
DeltaV Simulate Multi-Node Spectral PAT SIMCA®-Q Function Block Scaleup 1 Year Subscription Renewal; 1 Block	VX3156SR17UPS01-R
DeltaV Simulate Multi-Node Spectral PAT SIMCA®-Q Function Block Scaleup 1 Year Subscription Renewal; 5 Blocks	VX3156SR17UPS05-R
DeltaV Simulate Multi-Node Spectral PAT SIMCA®-Q Function Block Scaleup 1 Year Subscription Renewal; 10 Blocks	VX3156SR17UPS10-R
DeltaV Simulate Multi-Node Spectral PAT SIMCA®-Q Function Block Scaleup 1 Year Subscription Renewal; 20 Blocks	VX3156SR17UPS20-R

DeltaV Simulate Multi-Node Spectral PAT Unscrambler MVA Function Block.

Description	Model Number
Subscription Licenses	
DeltaV Simulate Multi-Node Spectral PAT Unscrambler MVA Subscription Base License for DeltaV Simulate Multi-node – Includes one Unscrambler MVA one-year Function Block license and is required to apply additional subscription scale-up licenses	VX3157SR12
DeltaV Simulate Multi-Node Spectral PAT Unscrambler MVA Scale-up for DeltaV Simulate Multi-node; 1 Function Block – 1 Year Subscription	VX3157SR12UPS01
DeltaV Simulate Multi-Node Spectral PAT Unscrambler MVA Base License 1 Year Subscription Renewal; includes 1 Function Block	VX3157SR12-R
DeltaV Simulate Multi-Node Spectral PAT Unscrambler MVA Function Block Scaleup 1 Year Subscription Renewal; 1 Block	VX3157SR12UPS01-R

Prerequisites

- The DeltaV Spectral PAT SIMCA function block is available in DeltaV v14.FP3 and later only. The DeltaV Spectral PAT Unscrambler MVA function block is available in DeltaV 15.LTS and later only. Using both DeltaV Spectral PAT Unscrambler MVA and SIMCA function blocks in the same system requires a v15.LTS DeltaV Spectral PAT installation.
- DeltaV Spectral PAT executes in your DeltaV Application Station or Professional Plus Station.
- For testing, validation and training, the DeltaV Spectral PAT function block may also be executed in a DeltaV Simulate Multi-Node or DeltaV Discovery system.
- The DeltaV SIMCAQ function block uses SIMCA®-Q 17 from Sartorius. SIMCA-Q 17 is also compatible with SIMCA 13, SIMCA 14, SIMCA 14.1, SIMCA 15 and SIMCA 16 projects.
- A system-wide OPC-UA Activation license is required along with a workstation based OPC UA Client Signal License for the total number of OPC UA signals.
- Some very old DeltaV licensing dongle types will not work with Spectral PAT. Users must check their DeltaV system licensing dongle to ensure that it will work. The “hardlock” dongles sold up to 2014 will not work with Spectral PAT. These can be physically identified by the end of the USB looking like a fish tail. The USB dongles shipped since 2014 that are compatible have either a solid, rounded end or a rounded end with an open oval.

Related Products

- **OPC UA.** The different OPC UA servers and clients in the DeltaV system allow data reads and writes to and from 3rd party application in an easy, reliable and secure way.
- **Monitor and Control Software.** Provides a single user interface with industry standard control languages and functions for graphical control strategy development, testing, and deployment.
- **DeltaV Workstation Software Suite.** ProfessionalPlus, Professional, Base, Application, and Operator Workstation software suites are available. See the DeltaV workstation product data sheets for additional information.
- **DeltaV Neural.** Easily create virtual sensors using neural networks.
- **DeltaV Predict and DeltaV PredictPro.** Obtain greater throughput, reduced variability, and increased profitability with easy to design, implement, operate, and maintain Model Predictive Control (MPC)
- **DeltaV Simulate.** Use all DeltaV software for training and development without system hardware.
- **DeltaV Discovery.** Provides control and monitoring of Life Science laboratory applications in a single DeltaV workstation.

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