Automation & Control Solutions

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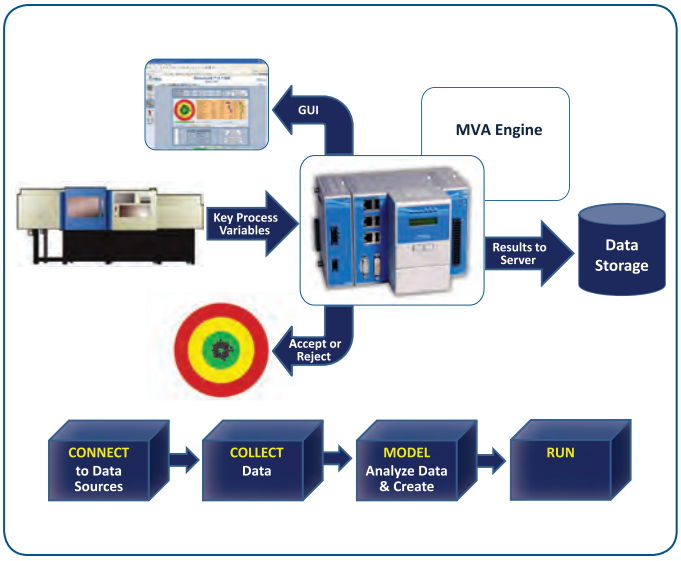


SenseLink™ QM

REAL-TIME MULTIVARIATE FAULT DETECTION

SenseLink™ QM data monitoring system provides an entire solution for process monitoring, fault detection, and part quality prediction utilizing multivariate analysis (MVA) technology. Adding MVA to your process will provide the highest level of process monitoring and fault detection attainable. All necessary data acquisition, multivariate processing, electrical and control functions come from a self contained, compact unit. The multivariate libraries and automated modeling functions were developed by MKS, the market leader for MVA software. Adding SenseLink QM to your industrial manufacturing processes will provide in-process fault detection along with contribution details which provide an understanding of your process not attainable from traditional SCADA and SPC approaches.

Only SenseLink QM integrates the entire multivariate process, from data collection to modeling to run-time control, into a single, compact package. The SenseLink QM hardware is designed as a highly integrated industrial computing platform, which can be mounted near almost any process. Process data can be acquired from analog, digital, and/or networked sources, and can be downloaded in chart, text, or CSV formats. All configuration and model creation are accomplished via a web browser user interface, requiring no software installation. Out-of-spec parts are diverted automatically, based upon alarm thresholds setup with the MVA results, eliminating the downstream costs associated with the acceptance of poor quality parts.

Features & Benefits

- Identify the quality of parts in-process
- Excellent multivariate prediction capabilities with existing machine sensors; does not require additional sensors
- Compact; easy to mount and integrate
- Easy web browser configuration and data analysis; no additional software required
- Automatic part containment
- Production reporting
- More efficient preventative maintenance scheduling
- Real-time process control
- Setup using automated modeling process, does not require MVA training
- Data acquisition up to 100 Hz (Future 1000 Hz)

The SenseLink QM is a data acquisition system with a multivariate data analysis engine that was developed for any industrial manufacturing process, including primary or secondary operations to provide significant ROI benefits through improved process understanding, shortened process debug times, reduced scrap, and improved quality control.

Applications

- Casting
- Molding – (Injection, Blow, Insert, Thermoset, LSR)
- Coatings Applications
- Ultrasonic and RF Welding
- Painting and other Secondary Operations
- Form, Fill, and Seal Operations
- Thermoforming
- Extrusion – Tube, Sheet, Film, etc.
- Tablet Compression, Compounding
- Spectral Analysis
- Assembly Operations

SenseLink™ QM Fault Detection

Detecting faults in any process is only possible when the variables with the highest correlation to the final part quality are monitored. The SenseLink QM determines and calculates the most important features of all the process signals to accurately detect out of spec product and part quality defects.

A multivariate analysis is performed on all process variables, in real-time, and on each process cycle. The analysis may reject a part based on a variables value or, more importantly, on a change in correlation structure between a few variables or between multiple variables. The detection of variable relationship changes provides a tremendous improvement over typical univariate SPC methods used in manufacturing processes.

The SenseLink QM has been proven to detect faults based on out-of-spec critical part dimensions in industrial applications. Physical part quality defects include the following:

- flash
- short shots
- sink marks
- voids
- burning
- contamination
- weight
- bubbles
- surface appearance
- weld integrity
- poor seal bond
- imperfect granulation
- tablet density
- preform pearlescence

Multivariate Approach to Fault Detection

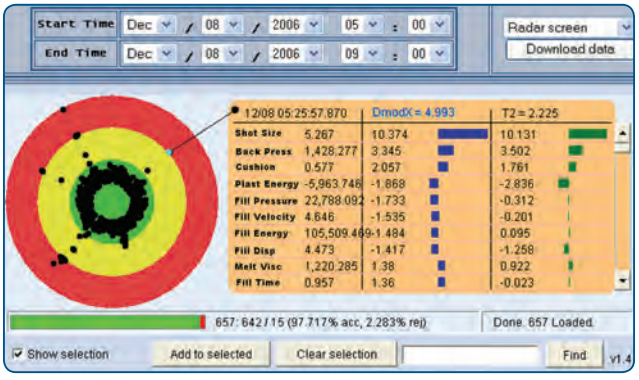
This approach consists of creating a multivariate model that accurately predicts when a part is acceptable or out-of-spec, based on key process data. The value of the multivariate detection system is highly dependent on the multivariate model that is used to perform the analysis.

The recommended method and most common approach to creating a multivariate model is to run a short design of experiments (DOE). A well designed DOE can be run to establish a good process window and also to create structured variation in the data.

Run	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
1	-1	-1	1	1	-1	-1	1
2	1	1	-1	1	-1	-1	-1
3	-1	1	1	-1	-1	1	-1
4	1	-1	-1	-1	-1	1	1
5	0	0	0	0	0	0	0
6	-1	1	-1	-1	1	-1	1
7	1	-1	1	-1	1	-1	-1
8	-1	-1	-1	1	1	1	-1
9	1	1	1	1	1	1	1

Example Design of Experiment (DOE) –
Fractional Factorial Res III DOE 7 factors & 9 runs

Once the DOE has been run, the SenseLink QM creates the model from the DOE data. All new data is then compared in real-time to the multivariate alarm limits established in the model, providing digital feedback to any auxiliary systems. Contribution charts are then shown in real-time which detail the variable or interaction of variables that were responsible for the deviation from the multivariate model. The results are available for web browser review and sent to local servers for storage. For slowly shifting or drifting processes, adaptive techniques can be included to allow the model to adjust to process changes. As a result false alarms are minimized.



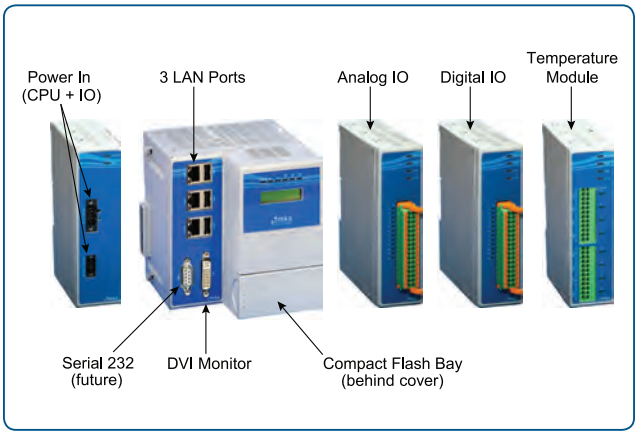
SenseLink™ QM Multivariate Contribution Plot –
Contribution plots are shown in real-time to provide quick and easy process troubleshooting

- Summarizes multiple signals into easily understandable plots
- Process variables contributing to poor quality are easily identified
- Models can adapt to acceptable process changes resulting from material variation, equipment wear, environment, time, etc
- Reduced false alarms over typical univariate methods
- Ability to analyze multiple variables simultaneously
- Filters out process noise
- Correlation structure between all process variables is determined

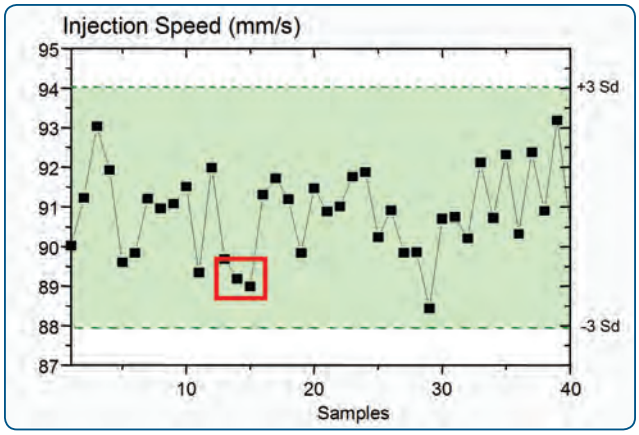
System Components

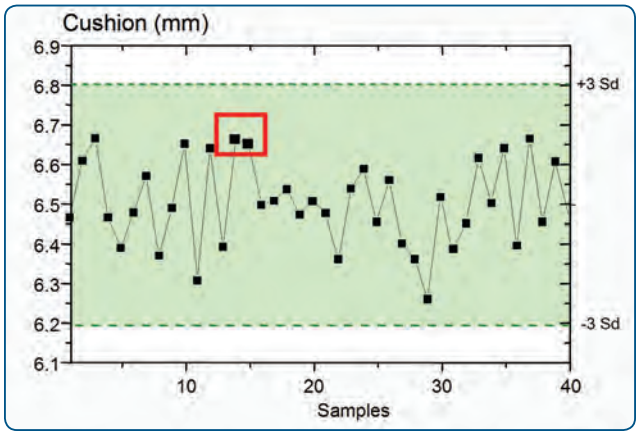
Each SenseLink QM system is contained within a single, compact data acquisition and computing module. The module consists of the MKS PAC hardware platform with the SenseLink QM multivariate analysis software. The SenseLink QM system can run up to 8 simultaneous MVA models.

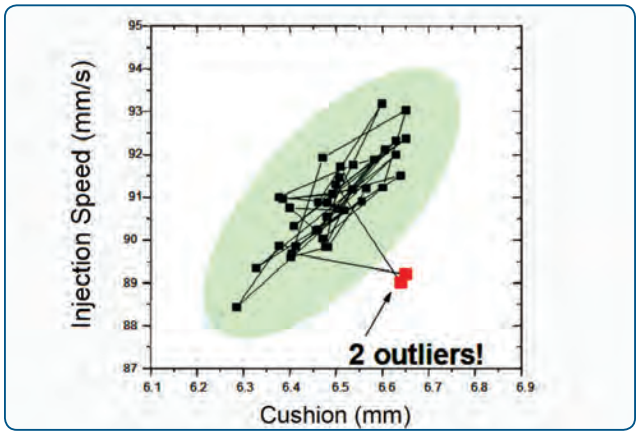
The PAC platform CPU module, which runs the SenseLink QM, can interface directly with your own PLC over Ethernet and comes with a minimum size of 130 x 125 x 140 mm (W x H x D), with expandable common IO modules (analog, digital, temperature input) of 35 mm x 125 mm x 92.3 mm (W x H x D). The number of process variables which can be collected is potentially unlimited.



Hardware Features —
Connectivity to any data source







Correlation Structure Example –
The three MVA charts above illustrate changes detected in the relationships between variables

Specifications and Ordering Information

Communications	
Ethernet Port	3 ports, 100 BaseT, RJ45 connector with EMI filter, LED indicators
Serial Port	1 port standard, RS232 (TXD, RXD), DB9 connector (future development)
USB	3 Ports USB V1.1 Compliant, (mouse and keyboard supports Linux console)
Electrical	
Power Supply	24VDC, ±10%
Power Consumption	15W – 25W, depending on configuration
Digital Inputs/Outputs	
Number I/O	12 IN / 12 OUT per Digital module
Voltage Range	Active high or active low, factory selectable
Input Current	2.2 to 4.7 mA
Output Current	Max 200 mA
Analog Inputs	
Number of Analog Inputs	8 Differential IN, 4 OUT, per Analog module
Resolution	14 bit
Input Voltage Type	0-5V, 0-10V, ±5V, ±10V, user selectable
Input Current Type	4-20mA
Temperature Inputs	
Number of Inputs	8
Resolution	16 bit
Input Voltage Type	2-wire, Thermocouples (J, K, or N - software configurable) 3-wire resistance temperature detectors (RTDs, factory configured) PT100 (-200°C to 715°C) PT1000 (-200°C to 850°C)
Mechanical	
Dimensions CPU (W x H x D)	130 mm x 125 mm x 140 mm
Dimensions PWR (W x H x D)	35 mm x 125 mm x 92.3 mm
Dimensions AIO (W x H x D)	35 mm x 125 mm x 92.3 mm
Dimensions DIO (W x H x D)	35 mm x 125 mm x 92.3 mm
Dimensions Temperature Module (W x H x D)	35 mm x 125 mm x 92.3 mm
Environmental	
Operating Temperature	0°C to 40°C
Storage Temperature	-40°C to 85°C
Humidity	5-95% (non-condensing)
Compliance	CE

Base unit comes with PAC CPU unit, display, GB compact flash card based on number of MVA models ordered, and MVA software.

Ordering Code for Base Unit

AS11850G-5x	PAC SLQM CPU module, where x = number of simultaneous MVA models, up to 8
AS11840G-02	PAC power module, required for PAC SLQM CPU (AS11850G-5x)
AS11880G-12	PAC analog module, optional
AS11893G-02	PAC digital module, optional
AS11860G-40	PAC temperature module, optional

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