

**SAP Manufacturing Execution
How-To Guide**



How To Set Up and Use the SAP ME SPC with Statit[®] Feature

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SAP ME How-To-Guide for SPC - using Statit

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Document History

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1.0	Initial version	Chet Moutrie
1.1	Minor correction to SPC chart in section 3..2.1	Chet Moutrie
1.2	Modified section 5.1.3 for Statit version 5.4.3	Chet Moutrie

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1 Introduction

1.1 Purpose

The SAP ME How-To-Guide for Statistical Process Control (SPC) - using Statit, is intended to provide sufficient information to enable the feature to be easily configured and readily utilized to meet business needs, making use of available best practices.

1.2 Scope

This information covers all aspects of SPC – using Statit and how to set it up. It also covers the SPC specific integration with the SAP ME Data Collection feature.

1.3 Glossary

Centerline	The average of the entire set of measured data values
Characteristic	A numerically measurable aspect of the production process, the production environment or a product feature
CL	Centerline
CS	Center Spec – centerline of specification (Target or Nominal value)
LCL	Lower control limit
Lower control limit	Three sigma below the centerline
Lower spec	Lower specification limit - the minimum acceptable value
LSL	Lower specification limit
ME	Manufacturing Execution
Mean	Average value for a set of values
Median	In a set of values, the median value has the same number of values that are larger than it as values that are smaller than it
Mv. Average	Moving Average – the average value for the set of chart points that includes the current point and the (subgroup size -1) preceding points
Mv. Range	Moving Range – the range for the set of chart points that includes the current point and the (subgroup size -1) preceding points

Range	The largest value in a set of values minus the smallest value in the set
SPC	Statistical Process Control
Sigma	One standard deviation
UCL	Upper control limit
Upper control limit	Three sigma above the centerline
Upper spec	Upper specification limit - the maximum acceptable value
USL	Upper specification limit
Zone A	Between two sigma and three sigma from the centerline
Zone B	Between one sigma and two sigma from the centerline
Zone C	Between the centerline and one sigma from the centerline

2 SPC Feature Overview

This overview provides a high level description of SAP ME Statistical Process Control (SPC) – using Statit. Statit is a software product from ACS – Midas+ Statit Solutions Group, a Xerox company.

2.1 Description and Applicability

The SPC feature enables the monitoring of production processes and product quality and the display of graphical information which indicates whether or not the production process is in statistical control. Variation in a manufacturing process is one of the primary causes of poor product quality. Variation can be due to common cause variation or special cause variation.

Common cause variation is the usual, historical, quantifiable variation in a process or system. It is the to-be-expected “noise” within the process or system. A manufacturing process with only common cause variation is considered to be in statistical control.

Special cause variation is the unusual, not previously observed, non-quantifiable variation in a process or system. It is the unexpected variation in the process or system. It indicates that the process is not in statistical control and either has produced, or is likely to produce, defective items.

By monitoring the variation in the manufacturing process by means of one or more SPC control charts, the occurrence of special cause variation can be detected and the production of defective items can be prevented or reduced in number.

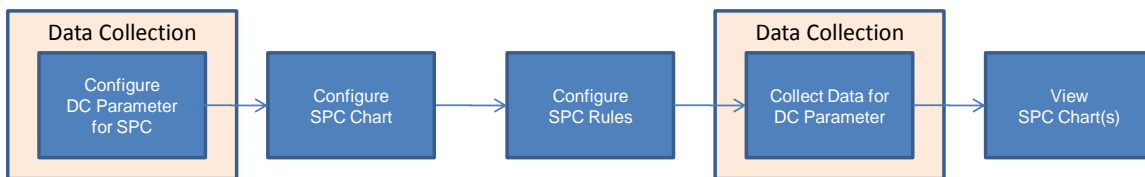
The SAP ME SPC feature is applicable to any production process where characteristic data from the process or product features can be measured and used to control or limit variability in the production process.

2.2 Business Purposes / Functions

The primary purpose of the SPC feature is to apply statistical calculations to collected characteristic data and to check the resultant data against established trend rules to determine if the production process is out of statistical control. If the data meets the conditions established by an SPC trend rule, the user can be alerted to the situation, so that action can be taken to prevent the production process from producing defective product.

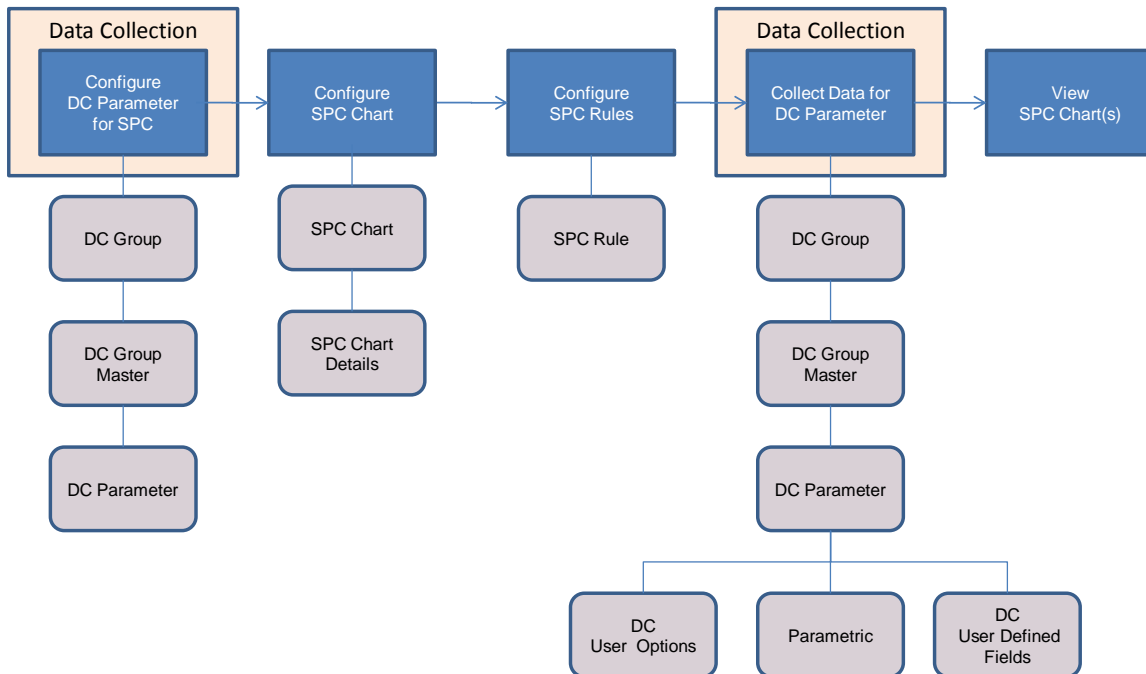
2.3 High-Level Process Flows

This figure illustrates the primary flow of user actions when setting up and utilizing the SPC feature.



2.4 High Level Data Model

The following figure shows the relationship between some of the SPC functions and ME database tables.



2.5 Best Practices

3 SPC Functions

3.1 View SPC Chart

3.1.1 Description and Applicability

SPC charts can be viewed on-demand and as a result of data collection. Viewing of SPC charts enables the user to determine whether or not the associated manufacturing process is in statistical control.

The types of SPC charts supported and their descriptions are shown in the following table.

Chart Type	Description
Individual	Displays each observation (value) of the characteristic being measured.
Median	Calculates and displays the median of each subgroup. This type of

	chart is used when it is desirable to give little weight to occasional "wild shot" values. The median chart should be used only when subgroup sizes are very small, since the efficiency of the median in estimating the true universe mean decreases with increasing subgroup size.
Moving Average	Calculates and displays the moving averages of subgroups.
Moving Range	Calculates and displays the moving range of subgroups.
Process Capability	Displays a normal curve superimposed over a histogram of data and several statistics which provide a measure of the capability of the process.
X-Bar and R	Displays the means and ranges of the subgroups. X-bar chart calculates and displays subgroup averages. R chart calculates and displays subgroup ranges.
X-Bar and S	Calculates and displays the means and standard deviations of the subgroups. X-bar chart calculates and displays subgroup averages. S chart calculates and displays subgroup standard deviations.

The user can interact with the SPC chart to view additional information by holding the cursor over one of the following chart elements:

- Data point
- Rule letter
- Chart labels (displayed in green on the right side of the chart)

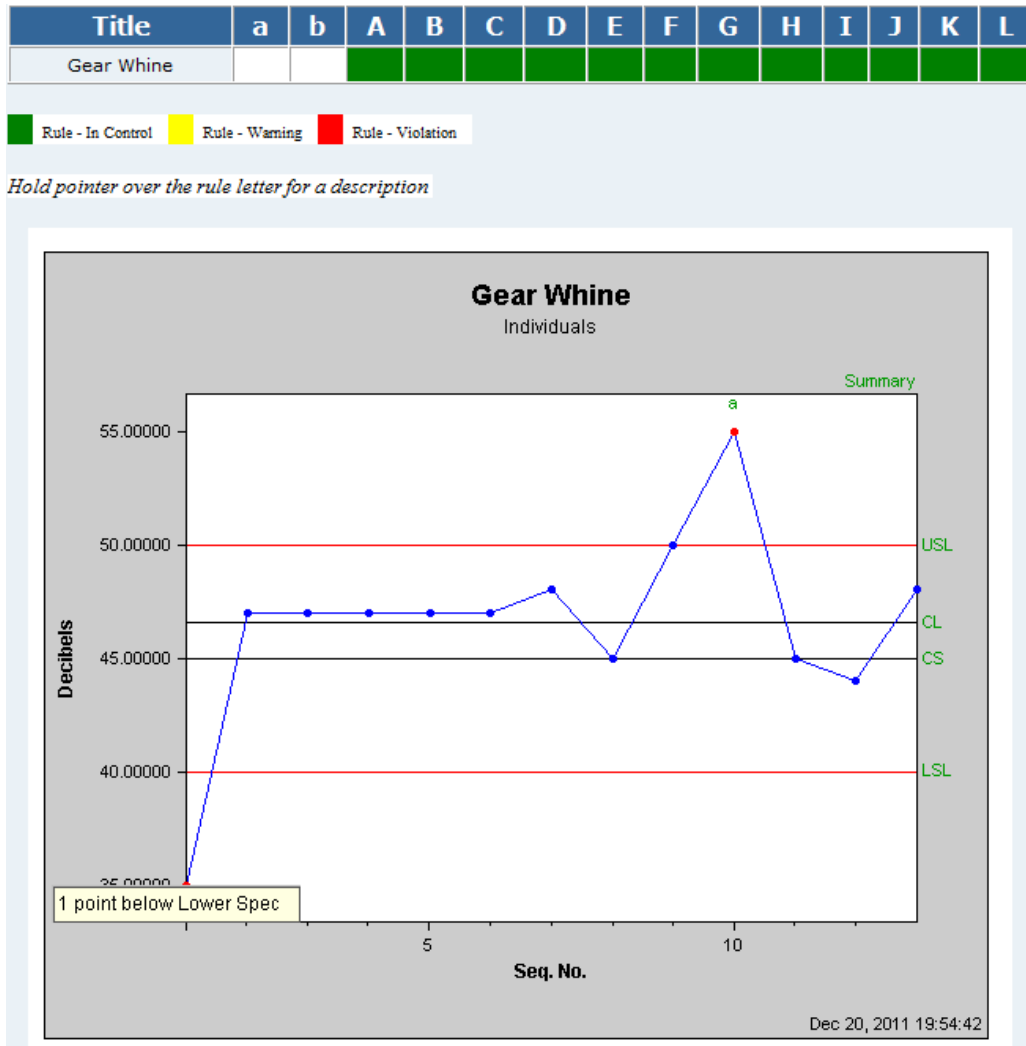
3.1.2 Purpose / Effects

3.1.2.1 View SPC Charts On-Demand

The SPC Display activity (SPC500) enables the user to view the SPC chart(s) for any data collection parameter that is configured for SPC. This is accomplished by:

- a) Selecting the SPC Display activity, typically in the Real Time SPC activity group, under the Quality Management activity group
- b) Select the DC group and DC parameter whose chart(s) are to be viewed
- c) Specify the time range for the data to that is to be included in the chart(s)
- d) Specify other filter parameters (such as material, operation and resource) as needed
- e) Select the Search button to view the chart

SAP ME will retrieve the collected data that corresponds to the user specified filters and will pass the data to Statit for processing and display. Statit will use the data to generate and display the specified chart.



Statit will also check the data against the SPC trend rules that have been specified for the chart and will display a visual indicator on the chart for any SPC trend rule whose conditions are met. See [SPC Trend Rule Processing](#) for more information.

3.1.2.2 View SPC Charts During Data Collection

When a user collects data for a DC group where one or more DC parameters has an associated SPC chart, an SPC pop-up window may be displayed to enable the user to view the SPC chart(s). Whether or not the pop-up window is displayed depends upon the Display Chart setting for the DC parameters:

- If the setting for any of the parameters is Always, the pop-up window will be displayed
- Otherwise, if the setting for any of the parameters is Only Alarm, the pop-up window will be displayed if the associated chart has a new trend rule alarm

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- If the setting for all of the parameters is Never, the pop-up window will not be displayed

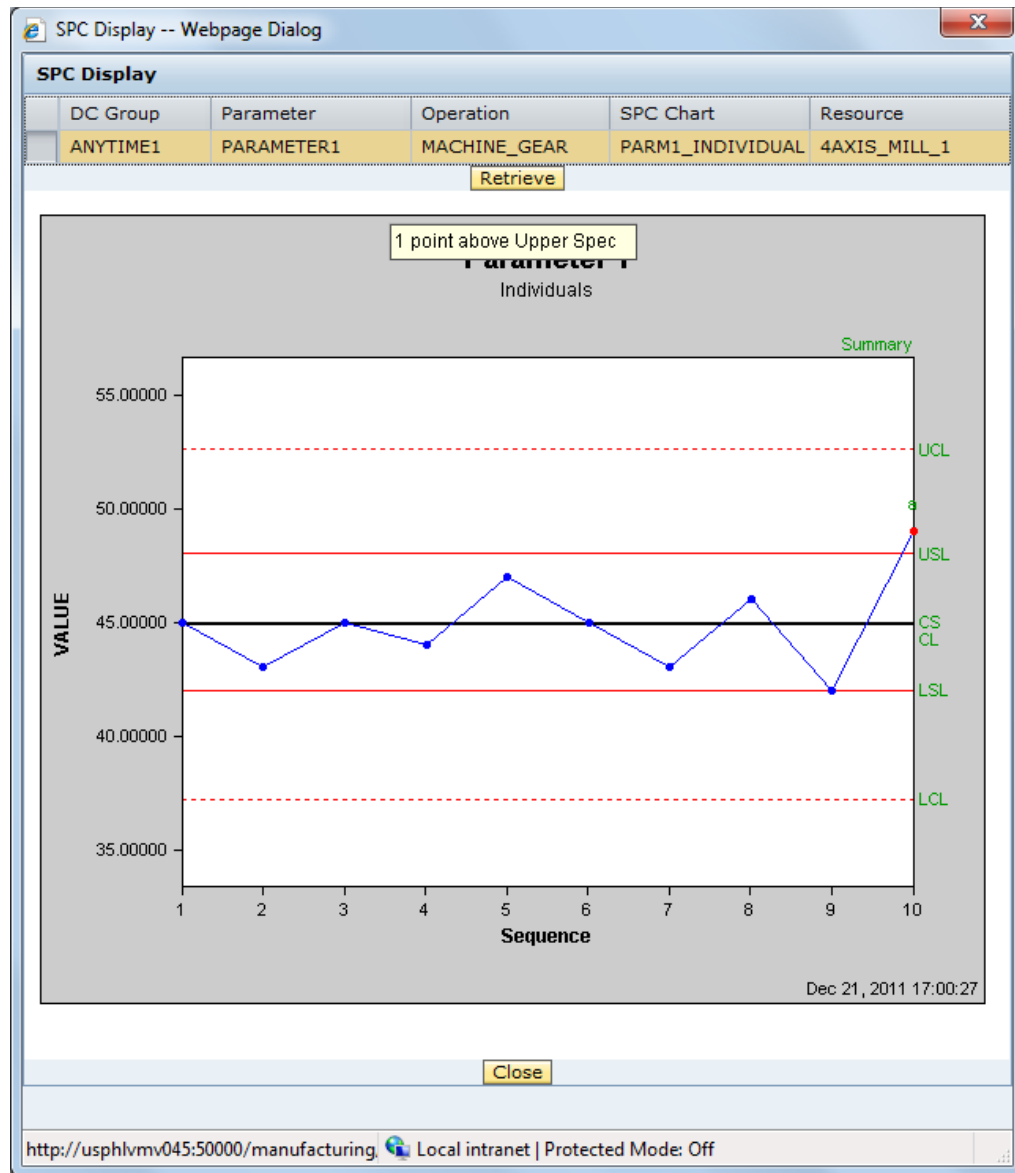
If more than one parameter has an associated SPC chart, a list of the SPC charts, available for viewing for the DC group, will be displayed. After the user selects an SPC chart from the list and selects to retrieve the data for that chart, or if there is only one chart in the list, the SPC chart will be displayed.

A chart will not be displayed until enough data has been collected to complete at least one subgroup. Currently, not having enough data to complete at least one subgroup is treated as an alarm condition for the chart.

Statit will also check the data against the SPC trend rules that have been specified for the chart and will display a visual indicator on the chart for any SPC trend rule whose conditions are met. See [SPC Trend Rule Processing](#) for more information.

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The following screenshot shows an example of the pop-up window for an SPC chart.



3.1.3 Best Practices

3.2 SPC Trend Rule Processing

3.2.1 Description and Applicability

The SPC trend rules provide the capability to determine if the process has data out of specification or if the process is out of statistical control.

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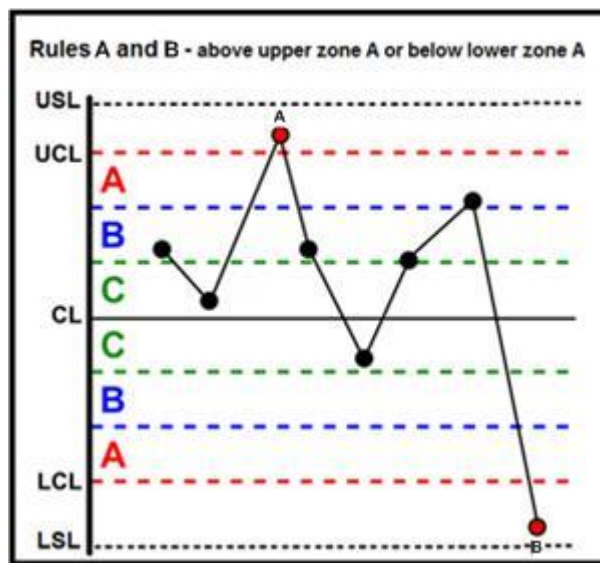
There are seven sets of SPC Trend rules:

Rule Set	Description
<i>AT&T Rules</i>	Used for <i>X-bar</i> , <i>Individual</i> , and <i>Median</i> charts, and for <i>R</i> charts when the minimum subgroup is at least four
<i>AT&T R Rules</i>	Used for <i>R</i> charts when the minimum subgroup is less than four
<i>AT&T A Rules</i>	Used for <i>P</i> , <i>NP</i> , <i>C</i> , and <i>U</i> charts
<i>Ford I X Rules</i>	Used for <i>X-bar</i> charts
<i>Ford I R Rules</i>	Used for <i>R</i> charts
<i>Sigma Rules</i>	Used for <i>S</i> , <i>Moving Average</i> , and <i>Moving Range</i> charts
<i>Nelson Rules</i>	Used for <i>X-bar</i> and <i>S</i> charts

The specific rules for the AT&T Trend Rules are shown in the table below.

Rule	Description
a	1 point above upper spec
b	1 point below lower spec
A	1 point above upper zone A
B	1 point below lower zone A
C	2 of 3 successive points in or above upper zone A
D	2 of 3 successive points in or below lower zone A
E	4 of 5 successive points in or above upper zone B
F	4 of 5 successive points in or below lower zone B
G	8 successive points above center line
H	8 successive points below center line
I	15 successive points in zone C
J	8 successive points on both sides of center line
K	14 successive points alternating up and down
L	6 successive points increasing or decreasing

The diagram below graphically illustrates the terms used in the above descriptions.



Each trend rule can be configured so that if the conditions for that rule are met, one of the following actions will be taken:

- Send a Violation message
- Send a Warning message
- Do not send a message

For more details, see [SPC Alarm Severity Maintenance](#).

3.2.2 Best Practices

4 Integration

4.1 Statit e-Server™ Integration

The SAP ME SPC feature requires Statit e-Server 5.4. Statit is a third party product that must be licensed separately from SAP ME. The Statit e-Server should be installed on a computer on the network (see [Statit e-Server Installation](#)). It also requires installation of the SPC server (see [SPC Server Setup](#)).

4.2 SAP ME Data Collection Integration

The SPC feature is directly and indirectly integrated to the SAP ME Data Collection feature. It is directly integrated in that the SPC chart display pop-up window can be invoked when data is collected by a user. It is indirectly integrated via the parametric data that is stored in the SAP ME database.

4.3 SAP ME Test Plan Integration

The SPC feature is indirectly integrated to the SAP ME Test Plan feature via the test plan measurement data that is stored in the SAP ME database. This data can be viewed in an SPC chart through the SPC Display (SP500) activity.

5 SPC Feature Setup

5.1 External Configuration

5.1.1 Statit e-Server Installation

To install the Statit e-Server and SDK:

1. Obtain the e-Server541.exe setup file and copy it to the Statit host computer.
2. Execute the e-Server541.exe file
3. Select Yes in the User Account Control pop-up window, if one appears
4. In the Statit Not Found dialog, select No
5. Select Next in the Welcome dialog
6. Select Next in the Statit Software, LLC e-Server dialog
7. Modify the path in the Destination Folder field as needed and select Next

8. In the Results Folder dialog, adjust the path to the Results Folder, as needed, and select Next
9. Select Next on the Backup File Destination Directory dialog
10. In the License Options dialog, select the radio button for Enter the License Information and select Next
11. In the License Information dialog, enter the license information and select Next
12. In the Statit Software, LLC License Agreement dialog, select the radio button for I Agree and select Next
13. In the Ready to Install Statit dialog, select Next
14. In the Statit e-Server has been successfully installed dialog, select Finish

5.1.2 SPC Server Setup

To set up the SPC Server:

1. Obtain the SPC_51.exe setup file from the local directory that holds the installation files.
2. Execute the SPC_51.exe file on the SPC host computer
3. Select Yes in the User Account Control pop-up window, if one appears
4. Select Yes to All in the Overwrite Protection dialog, if one appears
5. In the Welcome dialog, select Next
6. Modify the path in the Destination Folder field as needed and select Next
7. In the Select Program Folder dialog, select Next
8. In the SPC Server Installation has finished selecting Components dialog, select Next
9. In the Setup Complete dialog, select Finish
10. Copy the StatitRMIServer.jar and StatitServerCom.dll files to the installation directory to overwrite the existing files there.

5.1.3 External Program Setup

License - The number of simultaneous clients allowed to run *Statit* charts is determined by the SPC Server. To change this value, edit the `statit.server.licenses` setting in the `system.properties` file found in the *SPC Server installation* directory. This value is set to 5 by default. If this is increased, the system must be tested to ensure that it performs adequately under the additional load.

The SPC installation creates a 30-day evaluation license for the Statit E-Server. Once you have received a full license, the Windows registry must be edited on the Statit server.

1. Launch the registry editor on the SPC server machine by choosing *Start > Run*, then entering **regedit** and selecting OK.
2. Select the following folder:
HKEY_LOCAL_MACHINE\SOFTWARE\Statware\Statit Server\5.3\License.
3. Modify the registry keys based on the values provided with your license:
 - Site Name SiteName *SAP Demo*
 - Site ID SiteID *9999* Note that your input must be in decimal mode
 - Password SiteCode *01ABC-ABC12-12345-ABCDE-O1XYZ-VWXYZ*
4. After entering the license information, reboot the computer and restart the SPC server.

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Results URL - In order for Statit e-Server 5.4.3 to generate an HTML report correctly, the Windows registry must be edited on the Statit server as follows:

1. Launch the registry editor on the SPC server machine by choosing ► Start → Run ◀ and then entering regedit.
2. Navigate to the following folder:
 - HKEY_LOCAL_MACHINE\SOFTWARE\Statit Software, LLC\Statit e-Server\ResultsTopURL for Windows Server 2008 32-bit.
 - HKEY_LOCAL_MACHINE\SOFTWARE\WOW6432Node\Statit Software, LLC\Statit e-Server\ResultsTopURL for Windows Server 2008 64-bit.
3. Modify the registry key value as follows:
ResultsTopURL=http://<serverName.dnsSuffix>:7994/ For example:
http://server1.xyz.sap.corp:7994/

5.2 Maintenance Activities

5.2.1 System Rules

5.2.1.1 Statit Server Host Computer Name

The Statit Server Host Computer Name system rule specifies the name of the server where the Statit e-Server software is installed (e.g. SPCServer).

5.2.2 Product Configuration

5.2.2.1 Data Collection Maintenance

In order to apply the SPC feature to data collected through the SAP ME Data Collection feature, the DC parameter must be set up for SPC in the Data Collection Maintenance (DC100) activity.

To have SAP ME pass the data collected for a DC parameter to Statit for processing, the fields in the following table must be configured on the SPC tab in the Data Collection Maintenance activity.

Field	Description
<i>Perform SPC Analysis</i>	If selected, the SPC analysis is performed to generate the SPC chart
<i>SPC Chart</i>	The name of the SPC chart to generate. The chart must be defined in SPC Chart Maintenance .
<i>Short Run</i>	If selected, the data is applied in short run mode. In short run mode, data from multiple materials and characteristics can be used in the same chart. Instead of using the actual measurement value, the deviation of the value from the nominal (or target) value for each characteristic is used.
<i>Display Chart</i>	<i>Never:</i> SPC charts never appear during data collection. <i>Always:</i> SPC charts always appear during data collection. <i>Only Alarm:</i> SPC charts appear only when an SPC trend rule warning or violation occurs.
<i>Expression Builder</i>	Enables calculating the values to be passed to the SPC chart. For example, <i>Log (@X)</i> , where the logarithm of the entered value is used for the chart.
<i>Check Syntax</i>	Executes Statit to test the syntax of the expression entered in the <i>Expression Builder</i> field.

5.2.3 System Configuration

5.2.3.1 Message Type Maintenance

In Message Type Maintenance, the following message types must not be deleted or disabled, if SPC alarm messages are to be propagated.


- SPC_ALARM_VIOLATION
- SPC_ALARM_WARNING

5.2.4 Other Maintenance Activities

5.2.4.1 SPC Chart Maintenance

This maintenance activity is used to create an SPC chart that can be viewed during data collection, for the associated DC parameter, or viewed using the SPC Display activity. The following tables describe the fields that can be set in SPC Chart Maintenance.

5.2.4.1.1 Main Tab Page

Field	Description
Chart Type	<p>The type of control chart you are adding or modifying. All control chart types are for variable data.</p> <p><i>Individual</i>: Displays each collected value separately</p> <p><i>Median</i>: Calculates and displays the median of each subgroup. This chart type is used when it is desirable to give little weight to occasional wild shot values. The median chart should be used only when subgroup sizes are small, since the efficiency of the median in estimating the true universe mean decreases with increasing subgroup size.</p> <p><i>Moving Average</i>: Calculates and displays the moving average of each subgroup</p> <p><i>Moving Range</i>: Calculates and displays the moving range of each subgroup</p> <p><i>Process Capability</i>: Displays a normal curve superimposed over a histogram of data, along with calculated values associated with the process capability</p> <p> CAUTION</p> <p>For a <i>Process Capability</i> chart, you must fill in the <i>Upper Spec Limit</i>, <i>Target</i>, and <i>Lower Spec Limit</i> fields.</p> <p><i>X-Bar and R</i>: Displays the mean and range of each subgroup, using two charts. The <i>X-Bar</i> chart calculates and displays the mean of each subgroup. The <i>R</i> chart calculates and displays the range of each subgroup.</p> <p><i>X-Bar and S</i>: Calculates and displays the mean and standard deviation of each subgroup, using two charts. <i>X-Bar</i> chart calculates and displays mean of each subgroup. <i>S</i> chart calculates and displays the standard deviation of each subgroup.</p> <p>Note that if you select the <i>X-Bar and R</i> or <i>X-Bar and S</i> chart type, the system enables all the fields on the <i>Secondary Chart</i> tab page.</p>
Subgroup Size	<p>The number of data points to be used per plot point for this control chart. For <i>Median</i> charts, the entered number must be at least 2 and no more than 25. For all other charts, the entered number must be at least 2 and no more than 30.</p>

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<i>Max Plot Points</i>	The maximum number of plot points displayed on this control chart. A number between 2 and 100 is recommended.
<i>Max Data Age (days)</i>	The maximum age (in days) of the data points to be used in the analysis and the chart display
<i>Propagate Alarms</i>	If selected, allows the system to generate an alarm message if an associated SPC Trend Rule is met (see SPC Alarm Severity Maintenance).

5.2.4.1.2 Chart Labels Tab Page

Field	Description
<i>X Tick Label</i>	Defines the type of labeling for each subgroup along the X Axis. <i>Sequential (1 to N)</i> : Displays a number starting at 1, and incremented by 1 for each subgroup <i>Time</i> : Displays the time the data was entered <i>Date</i> : Displays the date the data was entered <i>Date/Time</i> : Displays the date and time the data was entered <i>SFC</i> : Displays the SFC number for which the data was collected
<i>X Axis Label</i>	The label displayed along the X-axis of the control chart
<i>Y Axis Label</i>	The label displayed beside the Y-axis of the control chart
<i>Y Axis Min</i>	The minimum value to be plotted on the control chart
<i>Y Axis Max</i>	The maximum value to be plotted on the control chart
<i>Scale</i>	Determines whether the chart's Y-axis scale is linear or logarithmic (based on powers of 10)

5.2.4.1.1 Primary Chart Details Tab Page

Field	Description
<i>Control Limit Options</i>	<i>None</i> : Control limits are not used. <i>Fixed</i> : Control limits are fixed as specified by the user. <i>Calculated</i> : Control limits are calculated from the process data and the sigma coefficient. Note that the upper and lower control limits specify the threshold values at which the process output is considered to be statistically “out of control”.
<i>Upper Control Limit</i>	The maximum value above which the process is considered to be statistically “out of control”. It is typically set at three standard deviations above the center line.
<i>Center Line</i>	The mean of the values plotted on the chart.
<i>Lower Control Limit</i>	The minimum value below which the process is considered to be statistically “out of control”. It is typically set at three standard deviations below the center line.
<i>Sigma Coefficient</i>	The number of sigma, or standard deviations, used to calculate the upper and lower control limits
<i>Upper Spec Limit</i>	The maximum value above which the plotted value is considered to be “out of specification”.
<i>Target</i>	The specified (nominal) value for the characteristic being plotted.
<i>Lower Spec Limit</i>	The minimum value below which the plotted value is considered to be “out of specification”.
<i>Trend Rules</i>	The identifier of the group of rules used to determine if a manufacturing process is in a state of statistical control. These rules are used during the SPC analysis. See SPC Alarm Severity Maintenance for more details.

5.2.4.1.1 Secondary Chart Details Tab Page

The fields on this tab page have the same description as fields on the Primary Chart Details tab page.

5.2.4.2 SPC Alarm Severity Maintenance

This maintenance activity is used to specify the type of message to be sent when the conditions for an SPC trend rule are met. The type of message is set individually for each trend rule in each trend rule set.

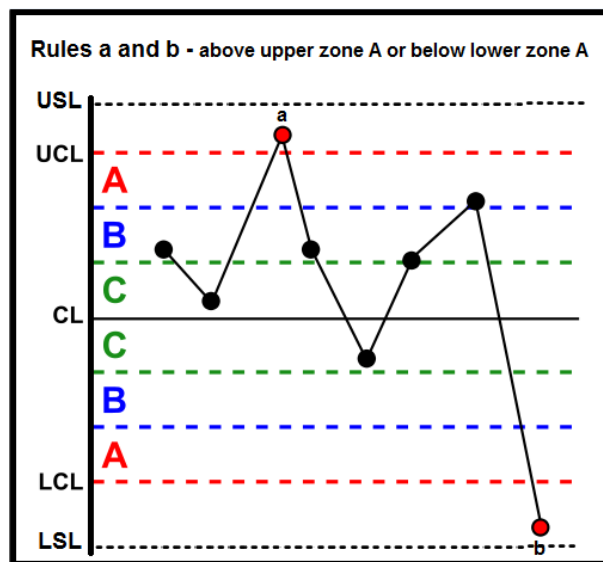
The following table describes the action taken for each type of message.

Type of Message	Description
SPC Violation	The SPC_ALARM_VIOLATION message is sent if the conditions for the rule are met.
SPC Warning	The SPC_ALARM_WARNING message is sent if the conditions for the rule are met.
Ignore	No message is sent when the conditions for the rule are met.

There are seven sets of SPC Trend rules:

Rule Set	Description
<i>AT&T Rules</i>	Used for <i>X-bar</i> , <i>Individual</i> , and <i>Median</i> charts, and for <i>R</i> charts when the subgroup size is at least four
<i>AT&T R Rules</i>	Used for <i>R</i> charts when the subgroup size is less than four
<i>AT&T A Rules</i>	Used for <i>P</i> , <i>NP</i> , <i>C</i> , and <i>U</i> charts – Attribute charts for countable data
<i>Ford I X Rules</i>	Used for <i>X-bar</i> charts
<i>Ford I R Rules</i>	Used for <i>R</i> charts
<i>Sigma Rules</i>	Used for <i>S</i> , <i>Moving Average</i> , and <i>Moving Range</i> charts
<i>Nelson Rules</i>	Used for <i>X-bar</i> and <i>S</i> charts

The diagram below graphically illustrates some of the terms used in the SPC Trend Rule descriptions.



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The specific rules for each Trend Rule Set are shown in the tables below.

AT&T Rules

Rule	Description
a	1 point above upper spec
b	1 point below lower spec
A	1 point above upper zone A
B	1 point below lower zone A
C	2 of 3 successive points in or above upper zone A
D	2 of 3 successive points in or below lower zone A
E	4 of 5 successive points in or above upper zone B
F	4 of 5 successive points in or below lower zone B
G	8 successive points above center line
H	8 successive points below center line
I	15 successive points in zone C
J	8 successive points on both sides of center line
K	14 successive points alternating up and down
L	6 successive points increasing or decreasing

AT&T R Rules

Rule	Description
a	1 point above upper spec
b	1 point below lower spec
A	1 point above upper zone A
B	2 successive points in or above upper zone A
C	3 successive points in or above upper zone B
D	7 successive points in or above upper zone C
E	10 successive points in or below lower zone C
F	6 successive points in or below lower zone B
G	4 successive points in lower zone A

AT&T A Rules

Rule	Description
a	1 point above upper spec
b	1 point below lower spec
A	1 point above upper zone A
B	1 point below lower zone A
C	9 points in a row above center line
D	9 points in a row below center line
E	6 points in a row steadily increasing or decreasing
F	14 points in a row alternating up and down

Ford1 X Rules

Rule	Description
a	1 point above upper spec
b	1 point below lower spec
A	1 point above upper zone A
B	1 point below lower zone A
C	7 points in a row above center line
D	7 points in a row below center line
E	7 points steadily increasing or decreasing
F	14 points in a row alternating up and down
G	2 of 3 successive points in upper zone A or beyond
H	2 of 3 successive points in lower zone A or beyond

Ford1 R Rules

Rule	Description
a	1 point above upper spec
b	1 point below lower spec
A	1 point above upper zone A
B	1 point below lower zone A
C	14 points in a row alternating up and down

Sigma Rules

Rule	Description
a	1 point above upper spec
b	1 point below lower spec
A	1 point above upper zone A
B	1 point below lower zone A

Nelson Rules

Rule	Description
a	1 point above upper spec
b	1 point below lower spec
A	1 point above upper zone A
B	1 point below lower zone A
C	9 points in a row in upper zone C or beyond
D	9 points in a row in lower zone C or beyond
E	6 points in a row increasing or decreasing
F	14 points in a row alternating up and down
G	2 out of 3 points in a row in zone A or beyond
H	4 out of 5 points in a row in zone B or beyond
I	15 points in a row in zone C (above and below the center line)
J	8 points on both sides of the center line with none in zone C

6 Usage Scenario Examples

No usage scenario provided.

7 Links to Additional Information

SAP ME 6.0 Help Topics

[Statistical Process Control](#)

[Setting up Statistical Process Control](#)

[SPC Chart Maintenance](#)

[SPC Alarm Severity Maintenance](#)

[SPC Display](#)

Statit Web Site - <http://www.statit.com/>

8 Other Reference Material

“Understanding Statistical Process Control” by David S. Chambers and Donald J. Wheeler, published by SPC Press (Statistical Process Control)

“Introduction to Statistical Quality Control” by Douglas C. Montgomery, published by John Wiley & Sons Inc

9 Overview of Changes

Not applicable