



# MAP 301

The session will begin at the scheduled time of 8:00am

As a courtesy to others on the session PLEASE be sure:

1. **Your audio is connected via phone or VoIP before the scheduled class time,**
2. **Your phone is on MUTE during the session.  
Please do NOT put your phone on HOLD**

If you would like to ask a question, please use the "chat" feature on your Go-To-Meeting dialog

**\*This session may be recorded for training or distribution**





**Paul**



**Mark**

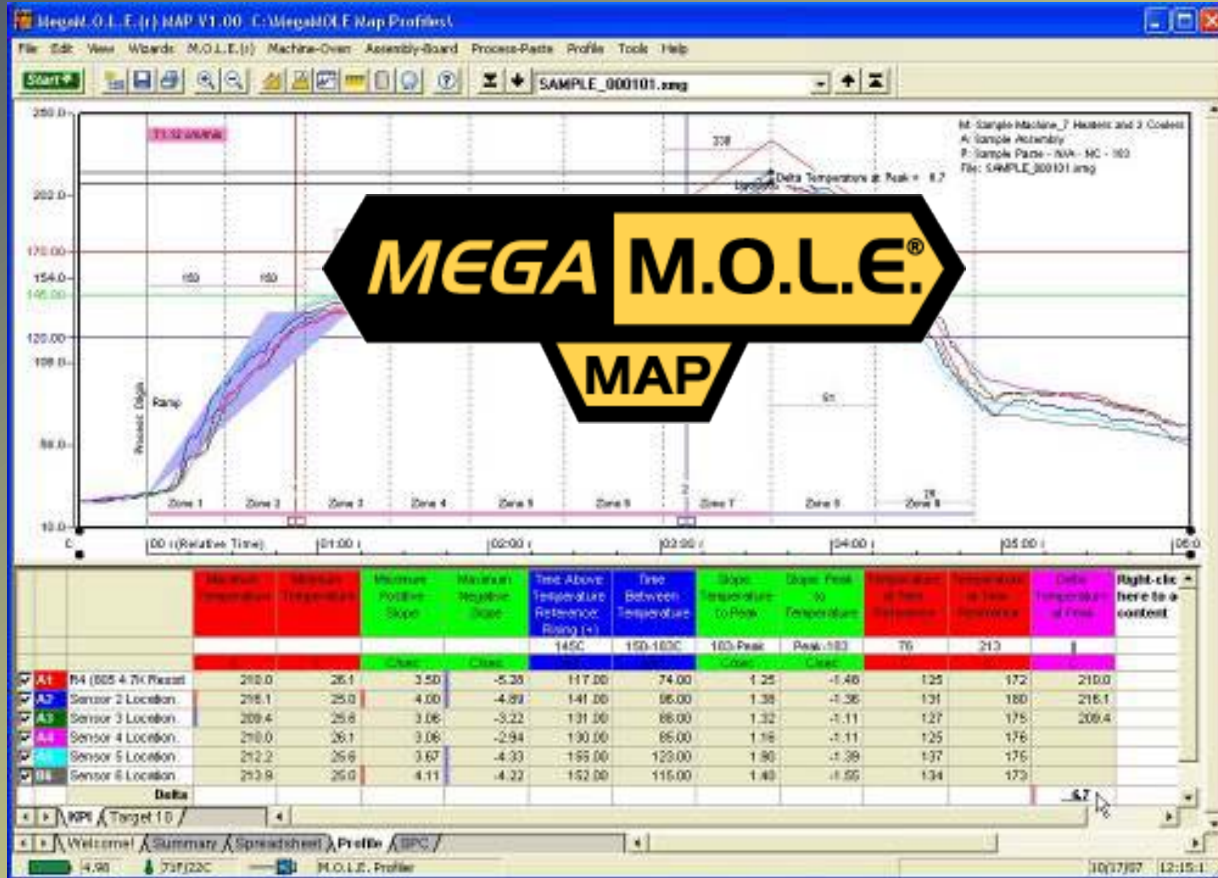


**Rex**



# MAP 301

Current version  
 MAP 2.20c  
 Free download @  
[www.ECD.com](http://www.ECD.com)





# Where ECD - University

Product Design  
& Development

New Product  
Introduction

Production

Machine  
Maintenance

**Requirements**

**Characterization**

**Verification**



Profile  
Specification

Recipe  
Creation

Product  
Verification

Oven  
Verification

**ThQM**

**Profiling A to Z**

**Profiling 201**

**Verification 101**

**Profiling 101**

**M.A.P. 201**

**OvenRIDER®**

**M.A.P. 101**

**WaveRIDER®**

**Profiling 301**

**M.A.P. 301**

**OvenCHECKER®**



# MAP 301

## Thermal Quality Management

Reduce Scrap and Increase Yields

### Requirements

### Characterization

### Verification

Stage 1 Define Requirements

***Why do we profile?***

- Identify heat sensitive components
- Choose soldering technology

Stage 2 Machine Recipe Development

***What is the oven recipe?***

- Develop machine settings required for production that meet the above requirements
- Assure all solder joints experience the required temperature profile
- Assure sensitive components do not experience long term damage

Stage 3 Collect Data

***How are we doing?***

- Assure the temperature profile developed during characterization is being repeated
- Proof your thermal process is in control





# MAP 301

## What is MAP?

MAP is an ECD acronym for “Machine, Assembly, Process.”



*Machine is the Reflow Oven.*



*Assembly is the Printed Circuit Board.*



*Process is the thermal “profile” specified by the Solder Paste manufacturer for proper reflow.*

*At ECD, our mission is to help the Process Engineer to “Optimize Machine, Assembly, and Process.”*



# **MAP 301**

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## ***Outline***

- **Data Extractions**
  - **Spreadsheet**
  - **Summary**
- **Preference File Directories**
  - **Templates**
  - **Database Files**
- **SPC**



# MAP 301

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- **Data Extractions**
  - **Spreadsheet**
    - **Same measure across many Profiles**
    - **Use SPC to track the measure over time**
      - **Enable SPC**
      - **Spec Limits (Cp and CpK)**
    - **The Process must be the same for SPC to be meaningful**
      - **Use the filter to group like Data Runs**
      - **Use separate Working Directories**
  - **Summary page**
    - **Customize to meet your reporting needs**



# MAP 301

Here is a single data extraction taken from multiple profile runs.

MegaM.O.L.E. (r) MAP V2.17c C:\ecd\MegaMoleMAP\Sample1

File Edit View Wizards M.O.L.E.(r) Machine-Oven Assembly-Board Process-Paste Profile Tools Help

Start Engineer

	A	B	C	D	E	F	G	H	I	J	K	L
SPC												
2	DataRun - File Name	Date	Time	User 1	User 2	User 3	User 4	User 5	Maximum Temperature	Right-click here to add content	Right-click here to add content	Right-click here to add content
3									Channel 1			
4									C			
Filter	All	All	All	All	All	All	All	All	All	All	All	All
Reset												
1	ECD_6ch_Sample1cropped.xmg	06/05/2009	13:50:38			Lead Free			226.1			
2	ECD_20ch_Sample1.xmg	06/05/2009	13:47:46			Lead Free			230.9			
3	ECD_3ch_Sample1.xmg	06/05/2009	13:47:46			Lead Free			230.9			
4	ECD_6ch_Sample1.xmg	06/05/2009	13:47:46			Lead Free			226.1			
5	ECD_6ch_Sample2.xmg	06/05/2009	13:47:46			Leaded			210.0			
6	ECD_6ch_Sample3.xmg	06/05/2009	13:47:46			Leaded			211.1			
7	MM_STHELENS_.xmg	05/28/2009	11:03:17			Leaded			217.0			
8	mY_SPECIAL_PROFILE.xmg	05/28/2009	11:02:34			Leaded			217.0			
9	Test.xmg	02/18/2009	11:45:46			Leaded			217.0			
10	Assb123 39390.xmg	02/04/2009	10:35:32			Leaded			217.0			
Sel=1	ECD_6ch_Sample1cropped.xmg	06/05/2009	13:50:38			Lead Free			226.1			
It:									10			
Min:									210.00			
Max:									230.90			
Avg:									220.310			
Std-De									7.6470			
USL												
LSL												
Template: C:\ecd\MegaMoleMAP\Template\SpreadsheetViewCalculations.tsh												

Welcome! Summary Spreadsheet Profile SPC /

No instrument attached

06/29/09 12:48:11



# MAP 301

Use the “Add Content” wizard to populate the columns.

Note: Upper and lower spec limits are entered at the end of the wizard, and are required for Cp and CpK capability measures.

MegaM.O.L.E.(r) MAP Y2.17df C:\ECD\MegaMoleMAP\Sample\

File Edit View Wizards M.O.L.E.(r) Machine-Oven Assembly-Board Process-Paste Profile Tools Help

Start Engineer

	A	B	C	D	E	F	G	H	I	J	K	L	M
SPC									<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	DataRun - Name	Date	Time	User 1	User 2	User 3	User 4	User 5		Right-click here to add content	Right-click here to add content	Right-click here to add content	Right-click here to add content
3													
4													
Filter Reset	All	All	All	All	All	All	Lead free	All	All	All	All	All	All
4	MM_MOLET	07/17/2009	11:21:18				Lead free						
5	ECD_20ch_S	07/17/2009	10:06:13				Lead free						
9	OCR_MM_MO	07/16/2009	13:26:04				Lead free						
70	ECD_6ch_Sa	01/07/2009	14:26:37	1	2	3	Lead free	5					
Sel=4	MM_MOLETE	07/17/2009	11:21:18				Lead free						
N:													
Min:													
Max:													
Avg:													
Std-De													
USL													
LSL													
	Template: C:\ECD\MegaMoleMAP\Template\SpreadsheetViewCalculationsBlank.tsh												

Right-click context menu options:

- Add Content
- Edit Content
- Delete Content
- Load Default Template
- Load Template
- Save Template
- Save Template As...
- Toggle Gridlines
- Toggle Headers
- Toggle Page Breaks

Bottom status bar: Welcome | Summary | Spreadsheet | Profile | SPC | N/A | 32F/OC | Done



# MAP 301

Use filtering to group like runs (i.e. Lead Free or same recipe)

OR

Use separate Working Directories to keep like data Runs together

MegaM.O.L.E. (r) MAP V2.17c C:\ecd\MegaMoleMAP\Sample1

File Edit View Wizards M.O.L.E.(r) Machine-Oven Assembly-Board Process-Paste Profile Tools Help

Start\* Engineer

	A	B	C	D	E	F	G	H	I	J	K	L
SPC												
2	DataRun - File Name	Date	Time	User 1	User 2	User 3	User 4	User 5	Maximum Temperature	Right-click here to add content	Right-click here to add content	Right-click here to add content
3						Leaded or Lead Free			Channel 1			
4									C			
Filter Reset	All	All	All	All	All	Lead Free	All	All	All	All	All	All
1	ECD_6ch_Sample1cropped.xmg	06/05/2009	13:50:38			Lead Free			226.1			
2	ECD_20ch_Sample1.xmg	06/05/2009	13:47:46			Lead Free			230.9			
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4	ECD_6ch_Sample1.xmg	06/05/2009	13:47:46			Lead Free			226.1			
Set=1	ECD_6ch_Sample1cropped.xmg	06/05/2009	13:50:38			Lead Free			226.1			
It:									4			
Min:									226.10			
Max:									230.90			
Avg:									228.500			
Std-De									2.7713			
USL												
LSL												
	Template: C:\ecd\MegaMoleMAP\Template\SpreadsheetViewCalculations.tsh											

Template: C:\ecd\MegaMoleMAP\Template\SpreadsheetViewCalculations.tsh

Welcome! Summary Spreadsheet Profile SPC /

No instrument attached

06/29/09 12:49:30



# MAP 301

Home of the M.O.L.E.® Profile

MegaM.O.L.E.(r) MAP V2.17df C:\ECD\MegaMoleMAP\Sample\  
File Edit View Wizards M.O.L.E.(r) Machine-Oven Assembly-Board Process-Paste Profile Tools Help

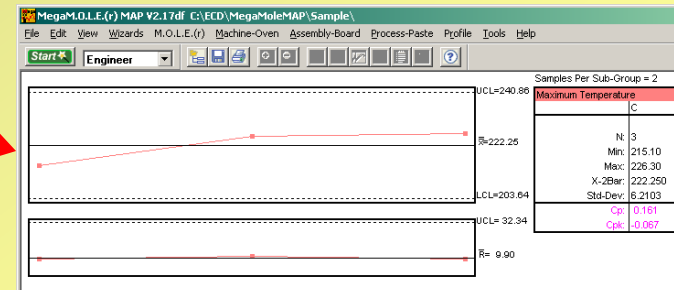
Start Engineer

	A	B	C	D	E	F	G	H	I	J	K	L	M
SPC										<input checked="" type="checkbox"/>			
2	DataRun - Name	Date	Time	User 1	User 2	User 3	User 4	User 5		Right-click here to add content	Right-click here to add content	Right-click here to add content	Right-click here to add content
3													
4													
Filter Reset	All	All	All	All	All	All	Lead free	All	All	All	All	All	All
4	MM_MOLET	07/17/2009	11:21:18				Lead free						
5	ECD_20ch_S	07/17/2009	10:06:13				Lead free						
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70	ECD_6ch_Sa	01/07/2009	14:26:37	1	2	3	Lead free	5					
Set-4	MM_MOLETE	07/17/2009	11:21:18				Lead free						
N:													
Min:													
Max:													
Avg:													
Std-De													
USL													
LSL													
Template:	C:\ECD\MegaMoleMAP\Template\SpreadsheetViewCalculationsBlank.tsh												

SPC

Check for X-Bar R charts to be added to the SPC tab

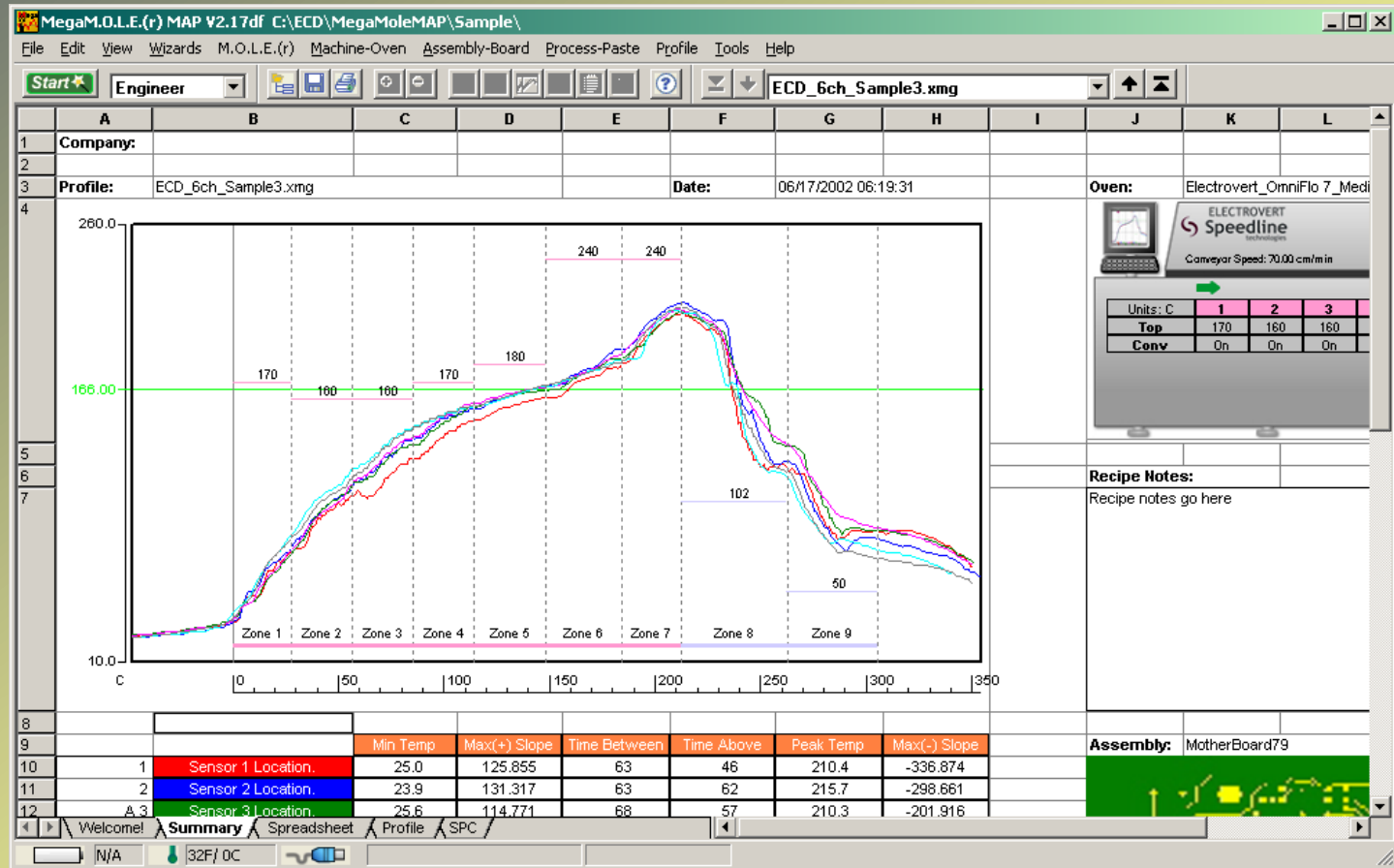
Up to 20 measures can be added to the Spreadsheet and any or all of those same measures can be added to the SPC tab





# MAP 301

- On the Summary tab rows and columns can be toggled on/off and sized
- Single or multiply cells can be selected and calculations, text, or special items like graphics and M.A.P information can be added.





# MAP 301

Use the “Add Content” wizard to populate the cells.

Soak - Time Between Temperatures	TAL - Time Above Liquidous	Peak - Temperature
150 - 160C	210C	250C
160 - 170C	210C	250C
170 - 180C	210C	250C
180 - 190C	210C	250C
190 - 200C	210C	250C
200 - 210C	210C	250C
210 - 220C	210C	250C
220 - 230C	210C	250C
230 - 240C	210C	250C
240 - 250C	210C	250C

### Add or Change a Calculation

Select your calculation category:  
**Y-Axis values are usually for a specific point or extremes.**  
**X-Axis values are typically times or times between events.**  
**Slopes are typically the rates things are changing.**

- Text
- Temperature Value (Y): Minimum, Peak, At Time Reference
- Time Value (X): Time To, Time Between, Time Above
- Slope (dy/dx): Maximum, Minimum, Between Time References
- Temperature (Y) Delta: Maximum Delta, Delta at Peak
- Speed (distance/time): Conveyor Speed
- Special Values

Channel Number  
 1-Type-K

Buttons: Help, << Previous, Next >>, Finish, Cancel







# MAP 301

Special values include information about the individual data run, the instrument, specific channel information, the machine, assembly, process, and any graphics you would like to insert.

**Add or Change a Calculation**

**Select Special Value**

-  Select Category
-  Select Special Value
-  Format Text
-  Format Cell Borders

Select Item ▼ DataRun

Select Item ▼ Instrument

Select Item ▼ Channel

Select Item ▼ Machine

Select Item ▼ Assembly

Select Item ▼ Process

Select Item ▼ Graphics

Help << Previous Next >> Finish Cancel



# MAP 301

## Preference File Directories

- **Profile\***
  - Default Template file for the Data Table
- Machine
  - Default Machine file
  - Default Recipe file
- Assembly
  - Default Assembly file
  - Default Image file
- Process
  - Default Process (Paste)
  - Default Target 10 Directory
- Summary
  - Default Template file
- Spreadsheet
  - Default Template file

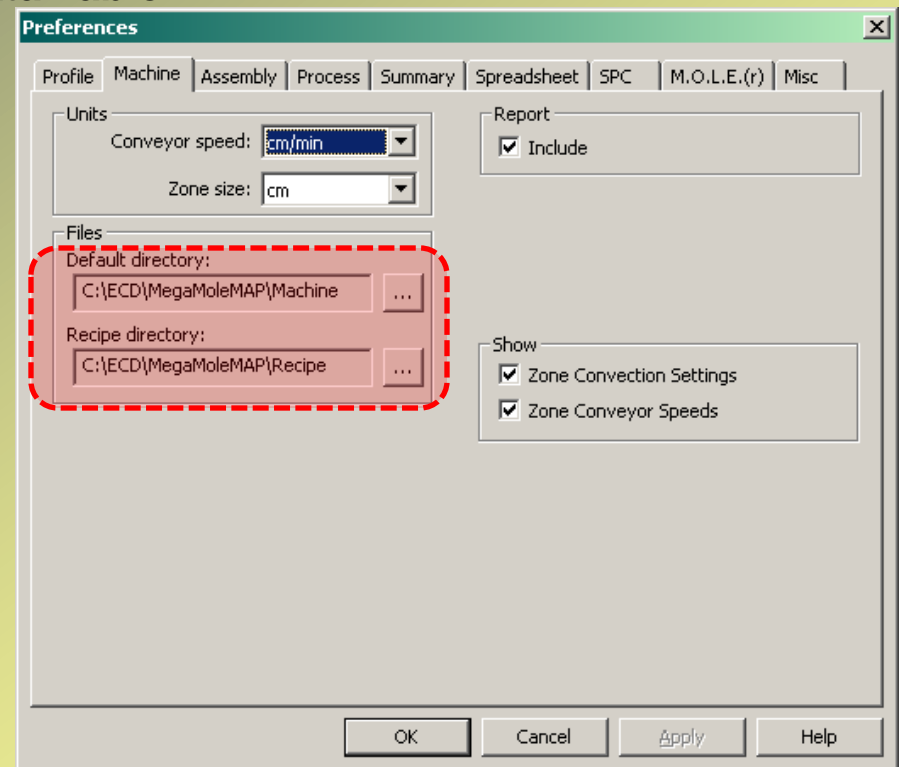
The screenshot shows the 'Preferences' dialog box with the 'Profile' tab selected. The 'Default template file' field is highlighted with a red dashed box. The field contains the path 'C:\ECD\MegaMoleMAP\Template\Mega...' and a file selection button. Other settings visible include 'Y-Axis Value Units' (Temperature: C, LW: mW/sqcm, AERO: m/min, Humidity: %), 'X-Axis Units' (Type: Points, Distance: cm), 'Files' (File name includes: Machine, Assembly, Process, Computer Name, Date-Time), 'Profile' (Autoscale Includes Recipe Values, Target10 Data Tab), 'Show' (# Y-Axis Grid Lines: 0, Profile Alignment Method: Align Profile Peaks), 'Colors' (Background: [empty]), 'Report' (Include), and 'Password' (Protect).



# MAP 301

## Preference File Directories

- Profile
  - Default Template file for the Data Table
- **Machine\***
  - Default Machine file
  - Default Recipe file
- Assembly
  - Default Assembly file
  - Default Image file
- Process
  - Default Process (Paste)
  - Default Target 10 Directory
- Summary
  - Default Template file
- Spreadsheet
  - Default Template file

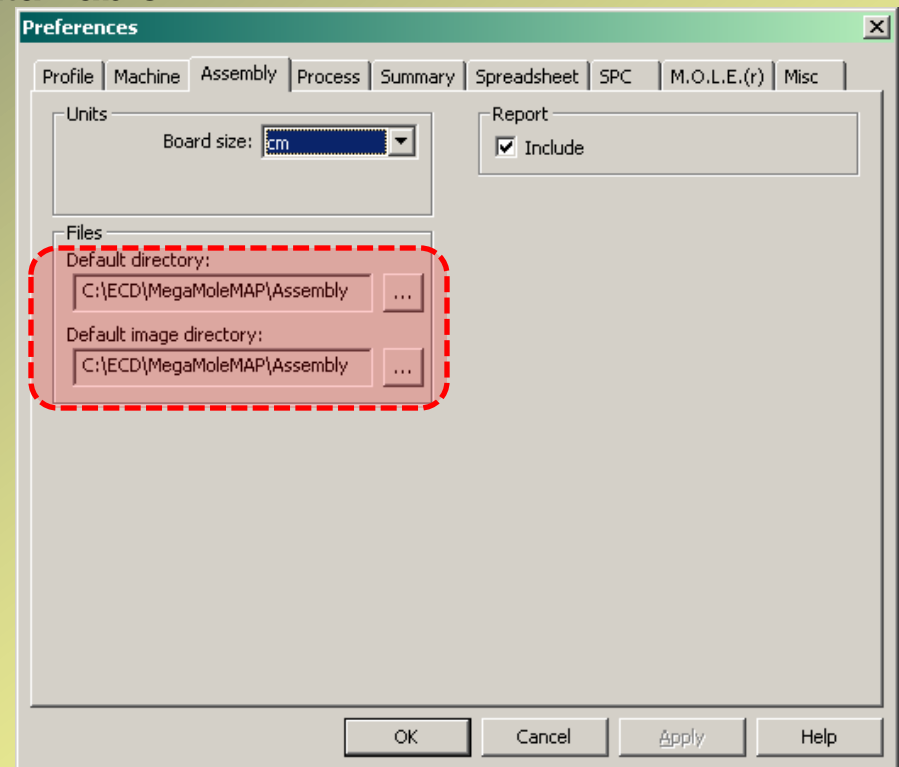




# MAP 301

## Preference File Directories

- Profile
  - Default Template file for the Data Table
- Machine
  - Default Machine file
  - Default Recipe file
- **Assembly\***
  - Default Assembly file
  - Default Image file
- Process
  - Default Process (Paste)
  - Default Target 10 Directory
- Summary
  - Default Template file
- Spreadsheet
  - Default Template file

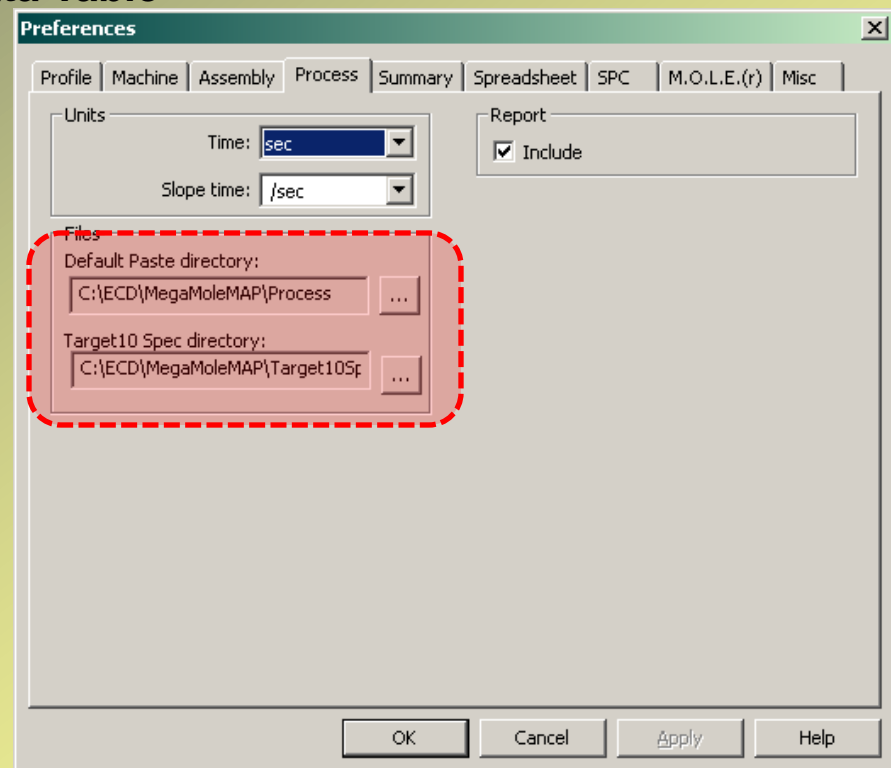




# MAP 301

## Preference File Directories

- Profile
  - Default Template file for the Data Table
- Machine
  - Default Machine file
  - Default Recipe file
- Assembly
  - Default Assembly file
  - Default Image file
- **Process\***
  - Default Process (Paste)
  - Default Target 10 Directory
- Summary
  - Default Template file
- Spreadsheet
  - Default Template file

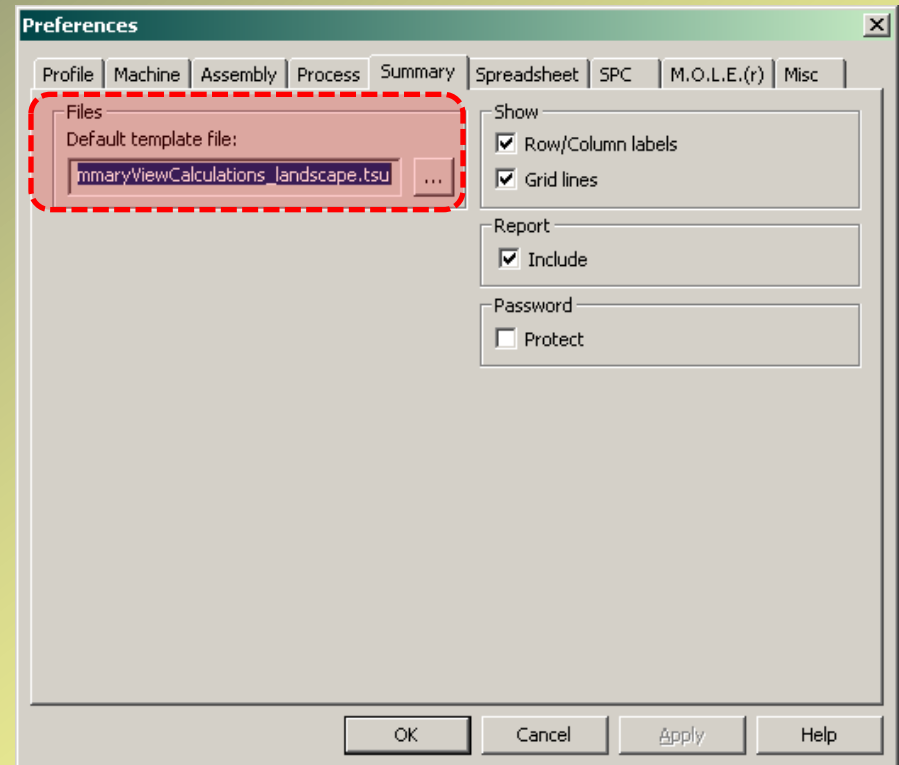




# MAP 301

## Preference File Directories

- Profile
  - Default Template file for the Data Table
- Machine
  - Default Machine file
  - Default Recipe file
- Assembly
  - Default Assembly file
  - Default Image file
- Process
  - Default Process (Paste)
  - Default Target 10 Directory
- **Summary\***
  - Default Template file
- Spreadsheet
  - Default Template file

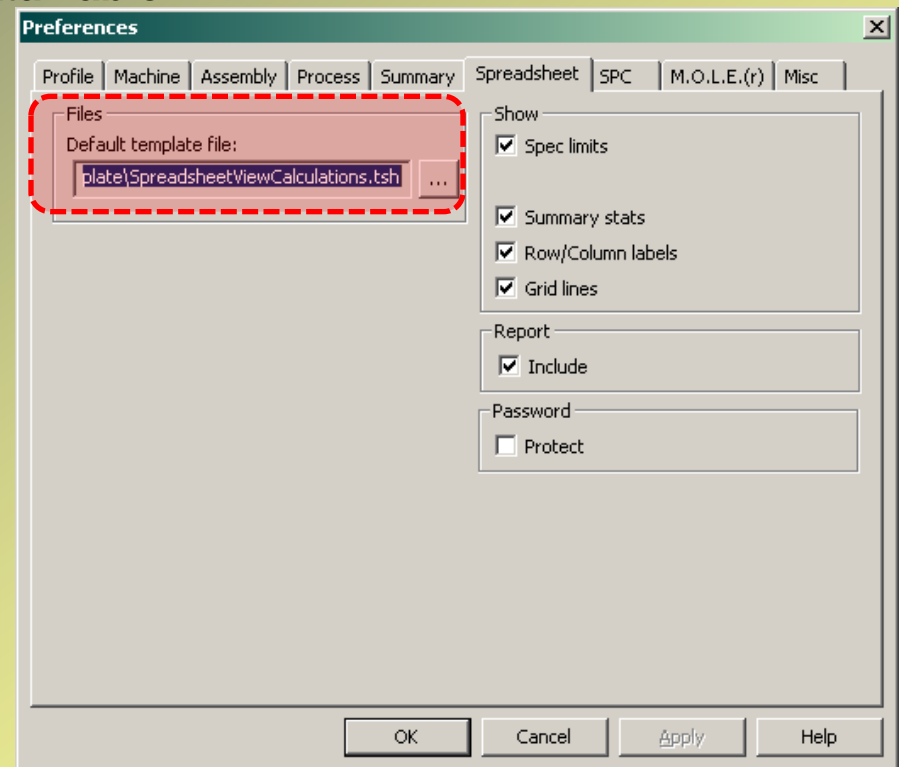




# MAP 301

## Preference File Directories

- Profile
  - Default Template file for the Data Table
- Machine
  - Default Machine file
  - Default Recipe file
- Assembly
  - Default Assembly file
  - Default Image file
- Process
  - Default Process (Paste)
  - Default Target 10 Directory
- Summary
  - Default Template file
- **Spreadsheet\***
  - Default Template file

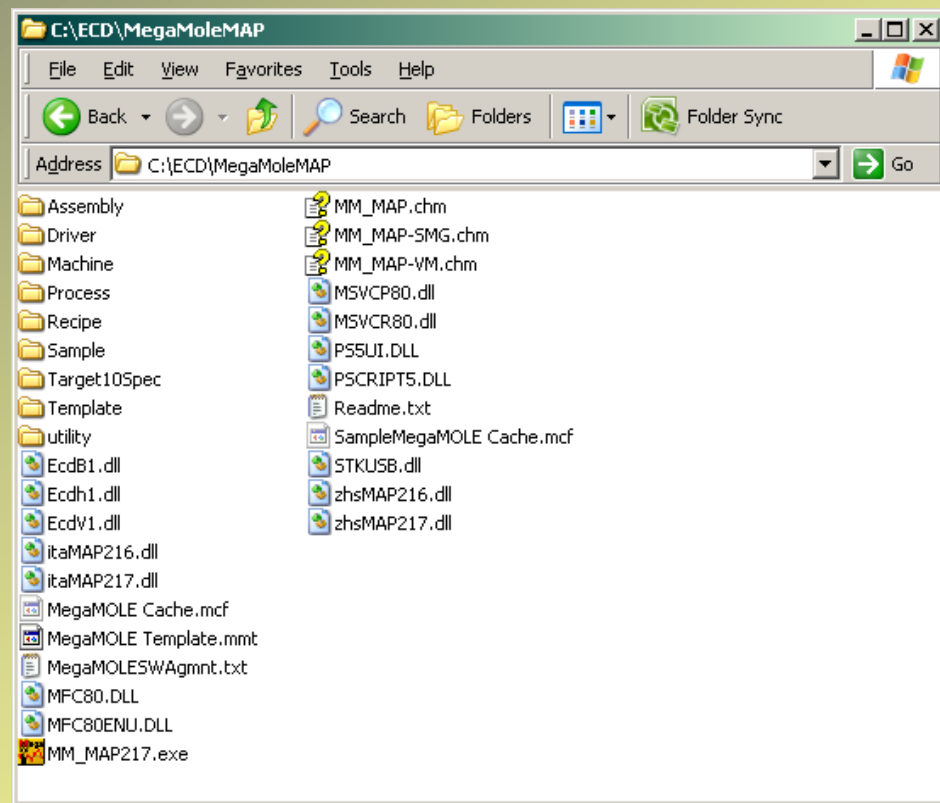




# MAP 301

## File Types

- **Templates**
  - Data Table (\*.tpf)
  - Summary (\*.tsu)
  - Spreadsheet (\*.tsh)
- **Machine (\*.ovs)**
- **Assembly (\*.xma)**
- **Process (\*.psp)**
- **Recipe (\*.xmr)**
- **Target10Spec (\*.t10)**
- **When is it saved**
  - When you Add or Delete
  - When you Save-As



**Note: All of these can be shared!**



# **MAP 301**

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## **SPC – *Statistical Process Control***

- **X-Bar R Charts**
- **Sub Group size**
- **Cp and CpK – (Spec Limits)**



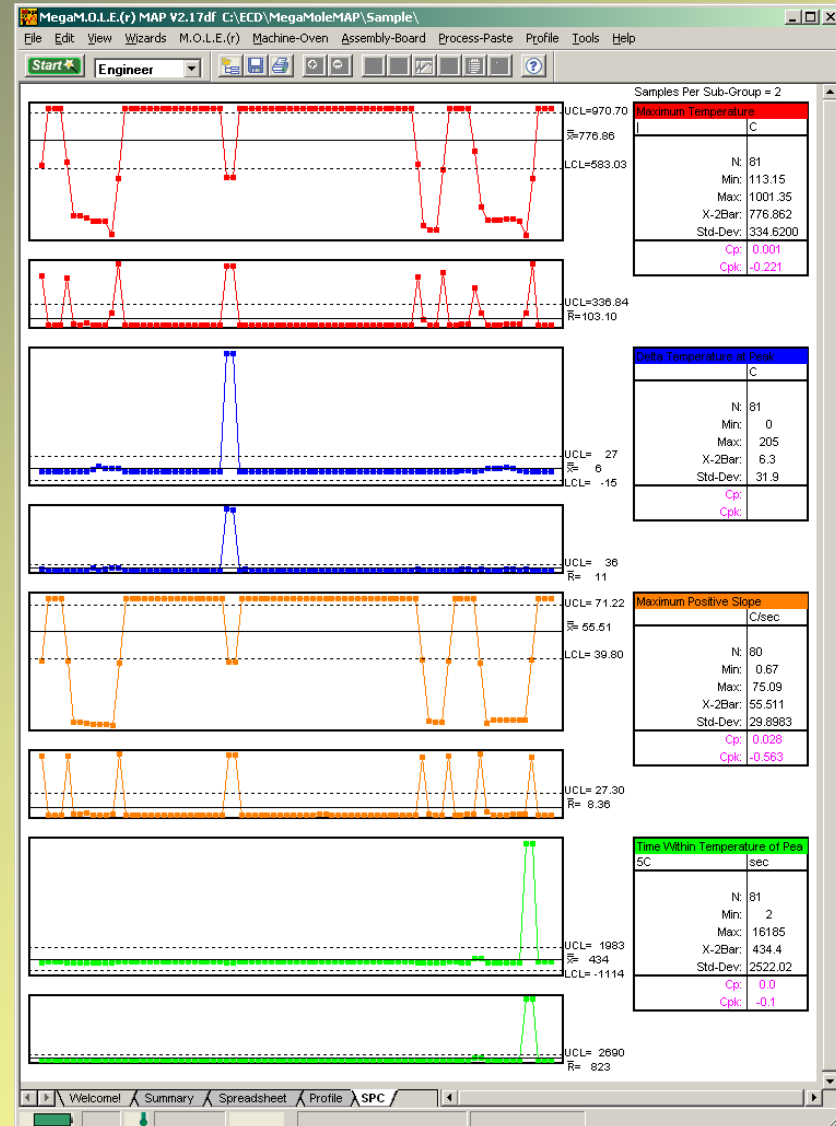
# MAP 301

## X-Bar R Charts

- **Automatically calculate Cp/CpK**  
(If upper and lower spec limits have been applied)

Note: Cp/CpK is mathematically valid only when Sub group size is 1 or what is called "individual measures"

- **Automatically calculate Upper and Lower control limits**
- **Displays only the data that is visible in the spreadsheet**
- **Generates Range charts and UCL automatically**

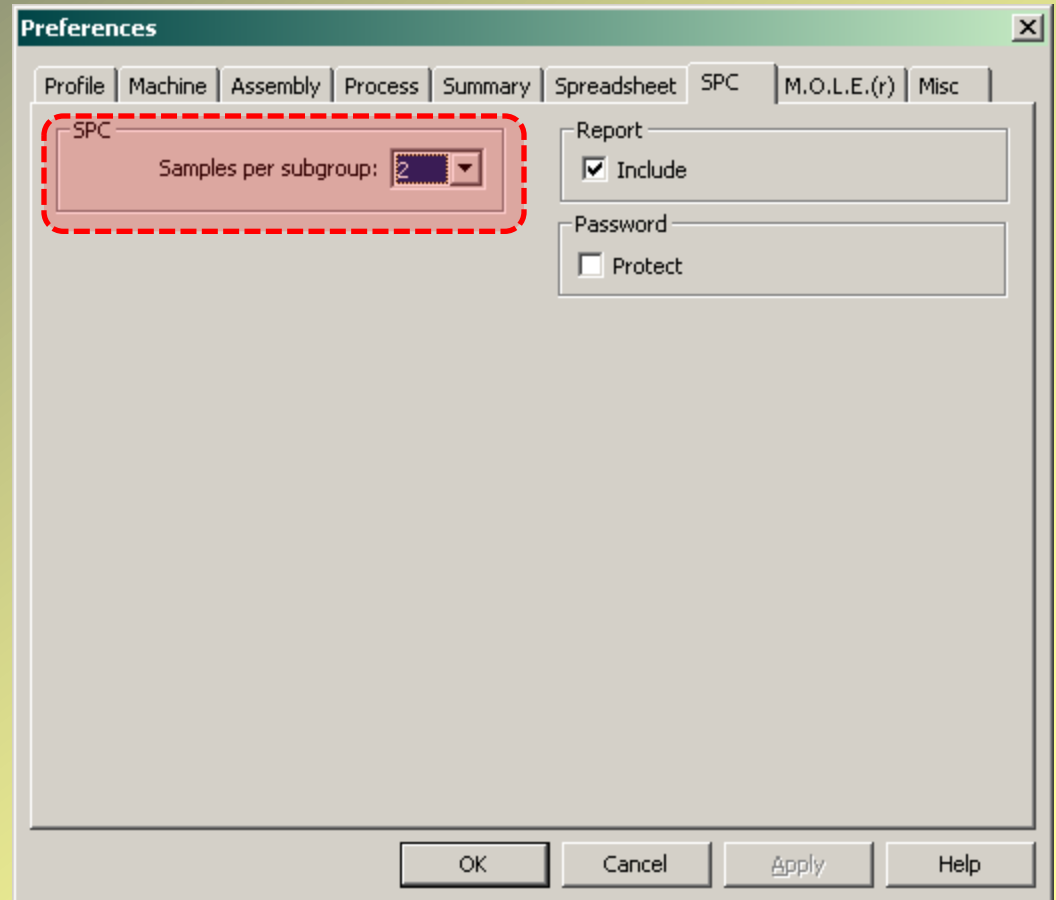




# MAP 301

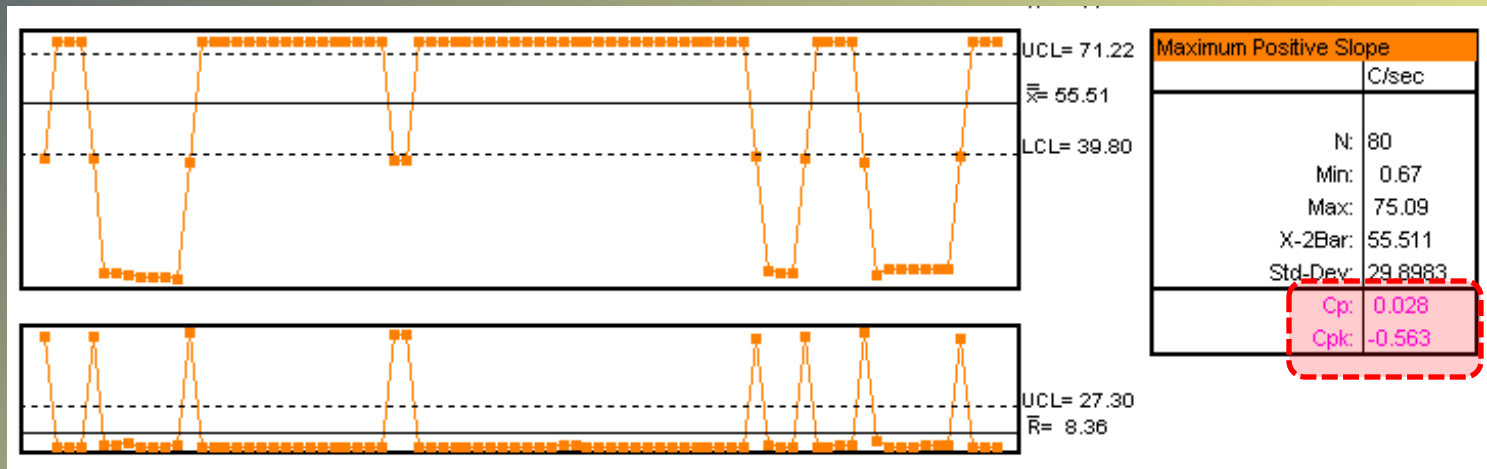
In the preferences dialog under SPC you can choose the subgroup size. When greater than one, each data point on the X-Bar R chart becomes an average of 2 or more points.

The center line on the X bar chart is the average of the averages, or X double bar.  $\bar{\bar{X}}$





# MAP 301



Cp & Cpk are automatically calculated.

Definitions:

$$C_p = \frac{USL - LSL}{6\sigma} \quad (\text{How consistent is the data})$$

$$C_{pk} = \min\left(\frac{USL - \mu}{3\sigma}; \frac{\mu - LSL}{3\sigma}\right) \quad (\text{How well centered is it between your spec limits})$$



# **MAP 301**

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## ***Summary***

- **Data Extractions**
  - **Spreadsheet**
  - **Summary**
- **Preference File Directories**
  - **Templates**
  - **Database Files**
- **SPC**



# MAP 301

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**Thank you for attending today's class**

Questions? Contact: [Support@ECD.com](mailto:Support@ECD.com)

ECD-U Class List: [www.ECD.com/ECDU](http://www.ECD.com/ECDU)

ECD Sales/Support: 503-659-6100



# MAP 301

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## Glossary of Mathematical Terms



# MAP 301

## Glossary of Mathematical Terms

- Measurement ( $X$ )
- Maximum
- Minimum
- Number ( $n$ )
- Average ( $\bar{X}$ )
- Mean ( $\mu$ )
- Standard Deviation

$$s = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{(n-1)}}$$



# MAP 301

## Glossary of Mathematical Terms

- **Sigma  $\sigma$**
- **Average of Average ( $\overline{\overline{X}}$ )**
- **USL**
- **LSL**
- **UCL =  $\overline{\overline{X}} + A_2^* \overline{\overline{R}}$**
- **LCL =  $\overline{\overline{X}} - A_2^* \overline{\overline{R}}$**
- **Range (R)**
- **Range UCL =  $D_4 \overline{\overline{R}}$**



# MAP 301

## Glossary of Mathematical Terms

### Capability Measures

$$C_p = \frac{USL - LSL}{6\sigma}$$

$$C_{pk} = \min\left(\frac{USL - \mu}{3\sigma}; \frac{\mu - LSL}{3\sigma}\right)$$

### Normal Distribution

$$\frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(X - \mu)^2}{2\sigma^2}}$$



# MAP 301

## Glossary of Mathematical Terms

### Constants for calculating Control Limits

Observations  
In Sample

Factors for Control  
Limits

$A_2$

$D_4$

2	.....	1.880	.....	3.267
3	.....	1.023	.....	2.574
4	.....	0.729	.....	2.282
5	.....	0.577	.....	2.114
6	.....	0.483	.....	2.004
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.