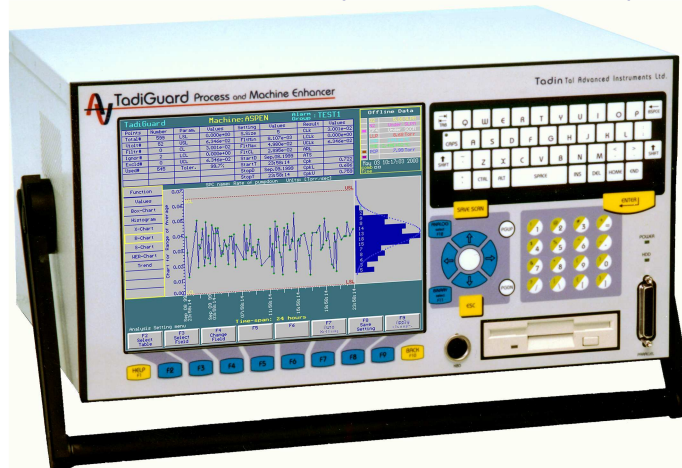


TadiGuard™ / TadUser™

Process and Machine Analyzer / Enhancer
Product Description Summary



The portable unit version is shown. Available also in 19" rack-mount format.

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What is the *TadiGuard* / *TadUser*?

TadiGuard is a Distributed Integrated Measurement and Analysis System used as Process and Machine Analyzer / Enhancer for semiconductor and flat-panel manufacturing facilities ('Fabs'). The *TadiGuard* is used also in numerous similar applications such as coatings, glass, biotech, metal treatment, etc.

***TadiGuard* helps to increase the Overall Equipment Efficiency (OEE) and to cut the Cost of Ownership (COO), thereby INCREASING THE OVERALL PROFITABILITY AND COMPETITIVENESS**

The *TadiGuard* helps to achieve this profitability increase by continuously monitoring the process and the machine operation, keeping it accurate and stable. The *TadiGuard* helps to maintain quality, yields, capacity and uptime at top performance. It connects directly to the machine's sensors and performs independently, yet in a distributed network, serving as an objective 'second opinion' tool, that will also detect control problems or incorrect operator settings.

The most common use of the *TadiGuard* is when connected permanently to one production machine. After learning the machine's normal process and behavior, the *TadiGuard* monitors the machine in real-time and alerts to any deviation from normal, while using its analytical capabilities. As all the collected data are being saved, the additional historical diagnostics features can be used to analyze the machine and the process performance, diagnose, measure capacity and efficiency, etc.. In addition, all data can be accessed and uploaded to a host computer via the network, making it available to all fab-level users and databases, analysis software and control systems.

Another use of the *TadiGuard* is as a portable maintenance and analysis tool. In this capacity, the *TadiGuard* can be connected to a variety of machines, whenever any of the machines require special attention. Among the *TadiGuard* capabilities are detecting intermittent malfunctions (that are very difficult and time consuming to detect otherwise), evaluating repairs and modifications, comparing performance with stored machine baseline and qualifying a machine for production.

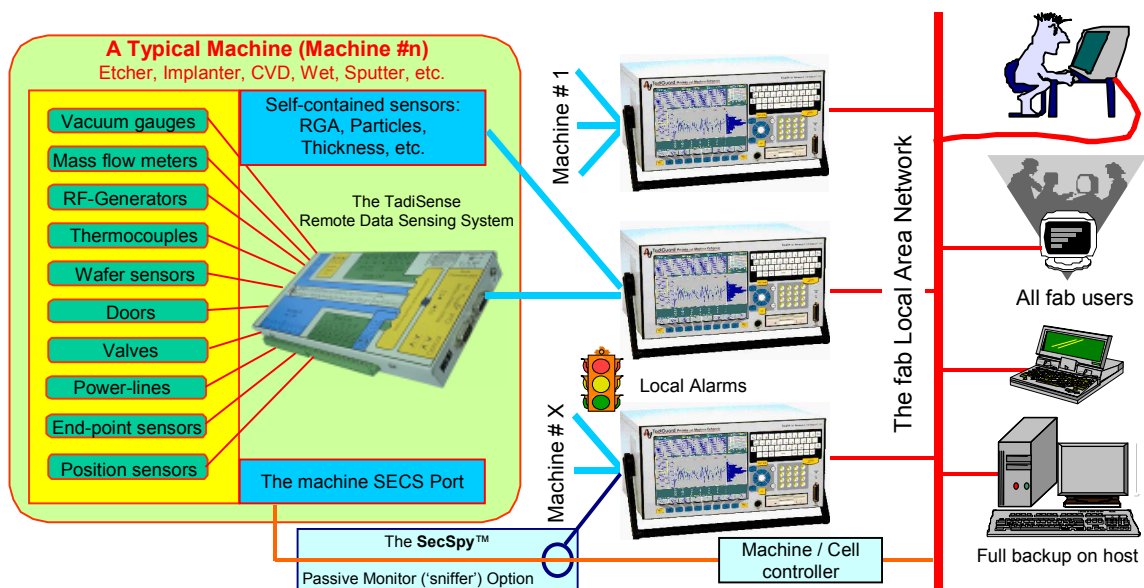
The direct and indirect saving in products, test wafers, machine time, engineering work etc. and the increased product quality and capacity that are all accomplished by the use of the *TadiGuard*, make the initial investment in this tool very easy to justify.

***TadiGuard* has remarkably fast Return-On-Investment.**

In the next pages you will find a description of a selection of the current *TadiGuard* features and screens. There are many additional functions that are not listed and many more to come, as this tool is always evolving, while Tadin works closely with its customers to keep the *TadiGuard* to be the best of its breed.

***TadUser* - The *TadiGuard* Remote Connection**

- * One of *TadiGuard*'s strengths is in its ability to perform independently, regardless of the machine controller or the network. Together with the sophisticated built-in monitoring, alarm and analysis capabilities, *TadiGuard* can help to identify and correct the majority of the process and equipment problems without the need to upload the data to the host that is overloaded anyhow. This is a unique advantage of the *TadiGuard*, and one of the arguments answering the question "Why *TadiGuard*?"
- * Another strength of the *TadiGuard* is that while performing as a standalone, independent tool, it can also be integrated into the overall fab data system, including the use of the optional built-in SECS Passive Monitor ('sniffer'). When networked, the *TadiGuard* can be operated remotely and continuously upload all data to the host in many standard data formats.
- * The *TadUser*, A remote *TadiGuard* tool is provided, that enables every user to access any *TadiGuard* on the network for immediate graphic display of the current machine status, under conditions very close to real-time. The *TadUser* enables also more advanced analytical and statistical functions to be performed remotely.

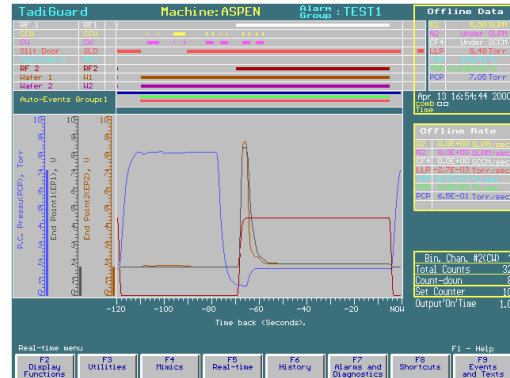


- * Both the *TadiGuard* and the *TadUser* are fully 'plug-and-play'. As soon as either is connected to the network, it can automatically search the network for *TadiGuard* applications and update all data files. This feature guaranties that whenever the *TadiGuard* network connection is resumed, the *TadiGuard* will update the host database.
- * The machine-data that is collected by the *TadiGuard* is used by the built-in *TadiGuard* analysis software or it can be integrated into an existing database for analysis and correlation with other machines, whether monitored by *TadiGuard* or by any other system.
- * For **multi-chamber and cluster tools**, a special distributed *TadiGuard* option is available, enabling up to 32 channels per chamber, all operated by one remote *TadUser*.

TadiGuard Functions Summary - Real-time functions

Real-time graphs display (default)

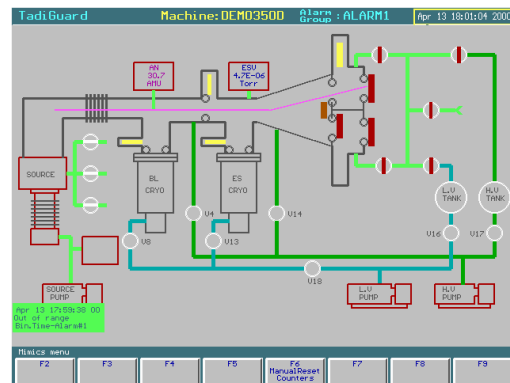
16 Binary channels, 16 Analog channels
 Analog bar-graphs
 Relative real-time scale
 Alarms with messages
 Alarms status
 Binary counters
 Current Lot#, recipe, wafer#, etc.
 Digital display of analog channels
 Rate-of-change of analog channels
 Communications status



Real-time mimics display

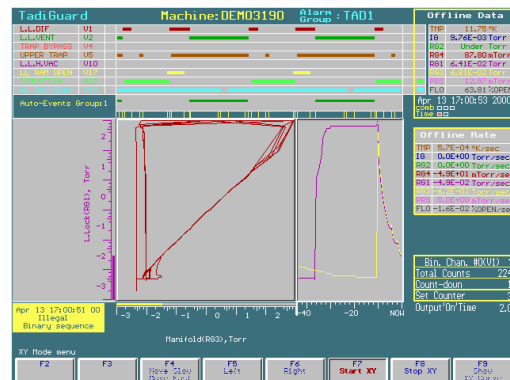
Real-time active analog objects
 Real-time graphic status of binary channels
 Alarms with messages
 Communications status (SECS)
 Active recipe name

Mimics screen uses the built-in Mimics editor to create and attach to channels.



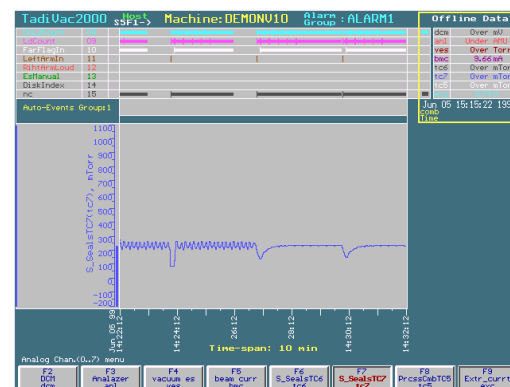
Real-time X-Y graph display

Real-time XY graph of any channel vs. any other channel.
 Useful to show dependence of pressure vs. flow, control valve vs. pressure, analyze heat control, check MFCs' etc.
 For repetitive patterns, this is an indispensable tool to show variations between patterns.
 This mode can also display data such as RGA, particle counters, etc.



Real-time analog channels' filter

Moving average filter on incoming analog signal.
 Set filter parameters while watching its affect on the signal in real-time.



History search functions

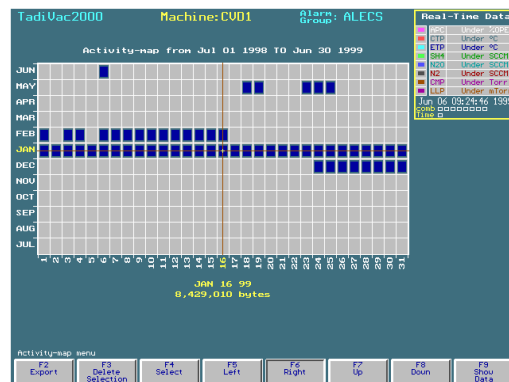
Search history by Activity-map

A one-year-back or one-month-back map with one-day or one hour resolution shows *TadiGuard* activity when connected to the selected machine.

Will show size of data file.

Used also to export and delete data.

While in any history screen, all alarms and some real-time information are displayed.

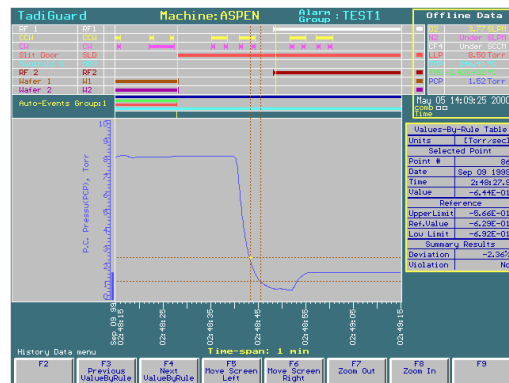


Search history by Pattern

Graphically select a data pattern and search history for additional occurrences of the pattern.

TadiGuard will identify all similar historical patterns, will calculate their values if required, will display each occurrence as a point on a time scale and enable to select and display the actual matching historical pattern.

Can also be used to test alarms on historical data.



Search history by Time

Search history by specific time (Down to 0.1-Sec resolution).

If the time of historical data is known, use the time-point in history and a time span forward or backward to display.

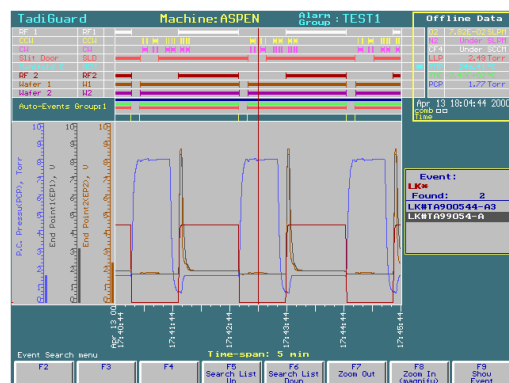
Then use browse and zoom to fine-tune to the exact data.



Search history by Event

Search history by events such as lot number, user-name, specific alarm or a group of alarms, user text, etc.

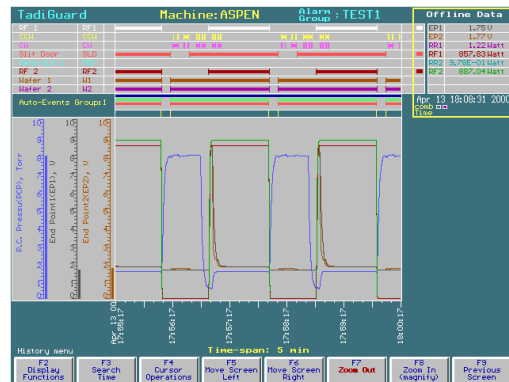
Use search-strings with wildcards to define single events or a group of events such as lot numbers.



History displays

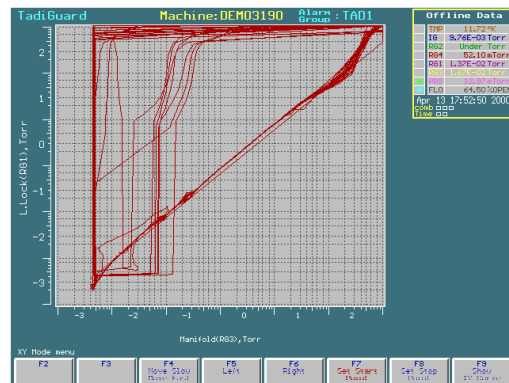
Main history display screen

- 16 Binary channels
- 16 Analog channels
- Analog bar-graphs
- Down to 0.1 Sec res. absolute time scale
- Zooming and browsing functions
- Time search by time, event, map
- Select channels, set scales
- Real-time alarms are always active.



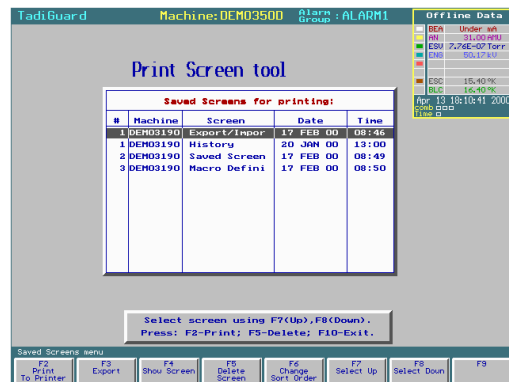
History X-Y display

- Display in XY mode historical data of any channel vs. any other one.
- This feature is an excellent analytical tool for control loops and other channels' interrelation analysis.



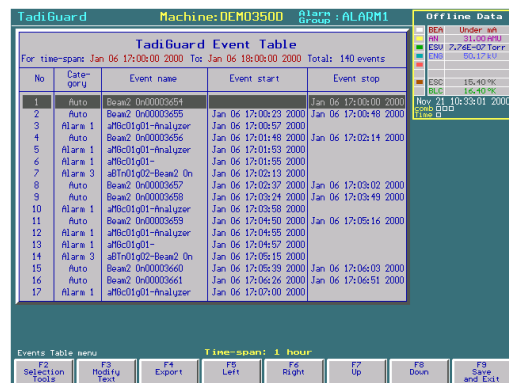
Saved screens

- All screen displays can be saved to a library from which they can be later displayed, printed or exported.
- Exported screen can be printed later using local or external printers.
- This quick screen-saver, with unlimited number of screens is an excellent tool that enables snapshots of various phenomenon for later in-depth checks, while current work can continue undisturbed.



Saved Events

- History data includes a large number of categorized events, including lot numbers, operator names, alarms, wafer counters, manually entered text messages and many more.
- History can be displayed and searched starting at the event table.



Cursors' operations

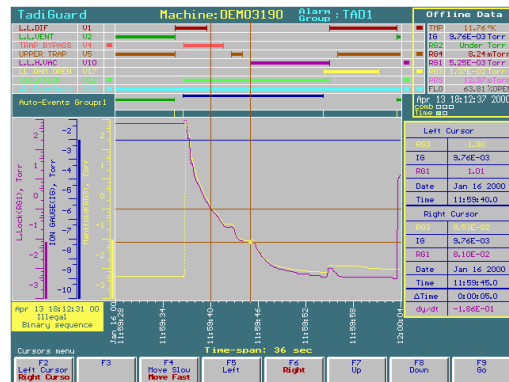
Analog cursors operation

4 line-cursors are available to perform various measurements, setups and calculations.

A cursors' table at the right displays the values pointed-to by the cursors and the measurements and calculations results thereof.

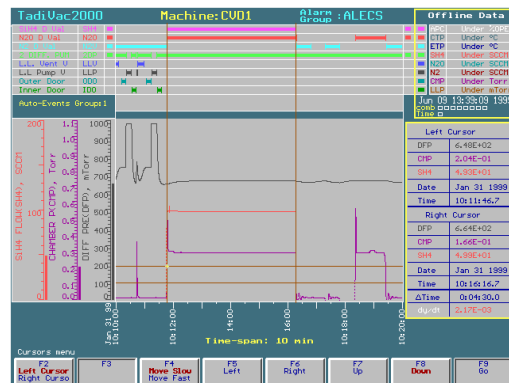
For the analog channels, the cursors are used to measure times (absolute and delta), levels, rate-of-change (derivative), etc.

Can show correlation between analog and binary, measure pump-down, rate-of-rise, etc.



Binary cursors operation

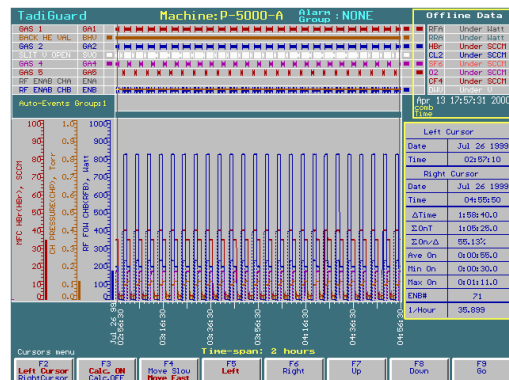
When used with binary channels, the cursors enable to measure exact timing and correlation. Machine states timing and delays can be measured and set. Correlation to analog channels is also available. Counting binary states (On – Off) enables to count, in history, number of wafers, machine cycles, etc.



Binary cursors calculations

The cursors can be used to measure and automatically calculate various machine parameters such as number of wafers per time, cycle-time per process or product, machine capacity, machine efficiency, rate of events, etc.

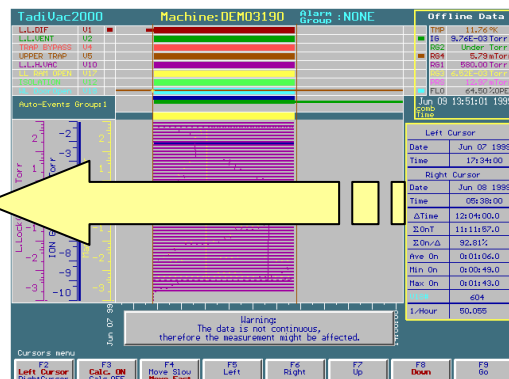
(Trend-graphs of the various measurements such as machine-capacity-over-time can be drawn using the *TadiGuard* Trend feature.)



Efficiency parameters

Machine capacity and intrinsic efficiency can be calculated and trends can be drawn. In this example, 604 wafers were run in 12 H 4 Min, resulting in 50 Wafers per Hour. The machine was running process 92.8% of the time. Exceptionally good non-stop operation!

Left Cursor	
Date	Jun 07 1999
Time	17:34:00
Right Cursor	
Date	Jun 08 1999
Time	05:38:00
ΔTime	12:04:00.0
ΣOnT	11:11:57.0
ΣOn/Δ	92.81%
Ave On	0:01:06.0
Min On	0:00:49.0
Max On	0:01:43.0
EN#	604
1/Hour	50.055



System setup and configuration

System initial setup

The initial system parameters-setup, including data acquisition parameters, units, voltages, calibration, etc. are all defined here.

The setup is an easy step-by-step procedure, where the options can easily be selected out of pre-defined tables.

Most standard units can be selected and converted using the built-in units conversion utility.

Most parameters can later be modified under real-time conditions.

machine : CUD1

Analog channels table :

#	Channel Name	Code	Unit	Unit Type	Dependence	Range	Bas	Umin [U]	Umax [U]	Y=(Umin)	Y=(Umax)	Range	Color	Shou
0	APC ANGLE	APC	E	Unit				0.000	10.000	-1.461	33.493	1	1	15 2
1	CONL TEMP	CTP	T					0.000	0.000	24.000	507.333	1	1	1 0 0
2	ELEC TEMP	ETP	T					0.000	5.000	0.000	200.000	1	1	2 5
3	SURF FLOW	SFT	F					0.000	5.000	-1.117	2168.555	1	1	3 2
4	N2 FLOW	N2F	F					0.000	5.000	-2.361	3028.689	1	1	4 7
5	CHAMBER P	CHP	P					0.000	10.000	4.3E-04	1.032	1	1	5 3
6	LEE Pressure	LEP	P					0.000	10.000	0.000	1.00E+04	1	1	6 0
7	DIFF PSE	DIFP	P					0.000	10.000	0.000	1000.000	1	1	8 0
8	OP Forward	OPF	E					0.000	10.000	0.000	2400.000	1	1	3 1
9	OP Rev	OPR	E					0.000	10.000	0.000	2400.000	1	1	3 1
10	OP Pos	OPP	E					0.000	10.000	0.000	10.000	1	1	1 1 2
11	HEATER U	HU	U					0.000	0.100	1.2E-05	274.262	1	1	1 2 0
12	OPC POSITION	OPCP	U					0.000	10.000	-23.859	3088.613	1	1	8 0
13	OPC SPEED	OPCS	U					0.000	1.000	0.000	1.000	1	1	1 4 0
14	SAFE TEMP	SFT	T	%	LNK	TKL	ANY	0.000	0.000	24.000	593.316	1	1	15 0

Enter Unit Type (1 character) of analog channel # 2 and press (Enter). To enter next table press (F3) (Save)

Config Menu: F2 Delete, F3 Change, F4 Left, F5 Right, F6 Up, F7 Down, F8 F-HELP, F9 F10-Back, F10 Save

Analog channels calibration

Analog channels can be calibrated using linear, log, pseudo-log dependencies or any non-linear calibration curve that is saved in the calibration-curves library.

New calibration curves can be generated using a special utility.

Here, a curve from the library is selected to be attached to an analog channel.

machine : DEM03190

Analog channels table :

#	Channel Name	Code	Unit	Unit Type	Dependence	Range	Bas	Umin [U]	Umax [U]	Y=(Umin)	Y=(Umax)	Range	Color	Shou
0	PUMP TEMP	PTP	T	%	LNK			0.0100	1.000	1.000	50.000	20	5	6 0
1	ION GAUGE	IG	P	Torr	LOG			1.0000	9.990	0.100	1.00E-10	1	5	1 2
2	Chamber	ES2	P	Torr	TRF	880	Dry	1.8900	9.990	5.000	2.00E-03	1	5	2 0
3	PLamp	ES4	P	Torr	TRF	880	Dry	1.8900	9.990	5000.000	2.000	1	5	4 0
4	LLock	ES1	P											
5	Manifold	ES3	P											

Select Curve, Units, Type

#	Code	Model	Manufact.	Bas	Date	Author
1	ES1	Varian 531	Varian	Uarian	HW 08 95	Tadin
2	ES2	Conv 275	SP	Uarian	HW 08 95	Tadin
3	880	varian 88005	Uarian	Dry air	HW 11 95	Tadin

Enter Model (up to 3 character) of analog channel # 3 and press (Enter). To enter next table press (F3) (Save)

Config Menu: F2 Delete, F3 Change, F4 Left, F5 Right, F6 Up, F7 Down, F8 F-HELP, F9 F10-Back, F10 Save

Configuration (Real-time)

Most system setup and configuration software parameters can be modified under real-time conditions, without interrupting data-collection. Channel name, code, color, polarity (binary), display-order, units, dependence, range, calibration numbers, filter, saving parameters, etc.

Machine: DEM03500 Alarm Group: ALARM1

Time interval for saving to disk: 5

Channel Table

#	Name	Code	Color	Shou	#	Name	Code	Color	Shou
0	IMPLANT #1	IM1	1	9	+	10	BEAM ES2	ES2	13
1	IMPLANT #2	IM2	4	6	+	11	BEAM ES3	ES3	15
2	BEAM ES#1	ES1	5	10	+	12	ES LIGHT	L	3
3	BEAM ES #2	ES2	6	7	+	13	PLATTEN #1	P1	1
4	BEAM PUMP	BP	9	8	+	14	PLATTEN #2	P2	4
5	ES#5	ES5	10	0	+	15	BEAM LINE	VL1	5
6	THICK LOCK2	TL2	12	5	+				

Analog Channels table

#	Name	Code	Unit	Unit Type	Dependence	Range	Bas	Umin [U]	Umax [U]	Y=(Umin)	Y=(Umax)	Range	Color	Shou
0	BEAM	BEA	E	mA	LNK	1	ANY	0.0200	8.000	2.00E-02	8.000	2	4	1
1	UNLOCKED	UNL	P	ANY	TRF	1	ANY	0.0000	0.000	0.000	0.000	5	5	2
2	VACUUM ES	ESU	P	Torr	LOG	1	842	ADR	2.0000	10.000	1.00E-04	1.00E-08	5	1
3	ENERGY	ENB	U	EV	LNK	1	any	0.0000	4.920	0.000	200.000	2	3	0
4														
5	ES CRV0	ESC	T	%	TRF	1	CRV	0.5371	1.489	10.000	320.000	2	8	0
6	BL CRV0	BLC	T	%	TRF	1	CRV	0.5371	1.489	10.000	320.000	2	2	0

Enter Interval for disk saving (1..30 min):

Configuration menu: F2 Undo Last, F3 Advanced Setup, F4 Change, F5 Left, F6 Right, F7 Up, F8 Down, F9 Save And Exit

Password user setup table

5 levels passwords utility is provided. Users level 4 and 5 can add users and set passwords.

The number of users is unlimited.

The utility protects from multiple passwords.

A detailed password table allows the setting of any password level to each menu key and each user.

Machine: DEM03500 Alarm Group: ALARM1

Password Table

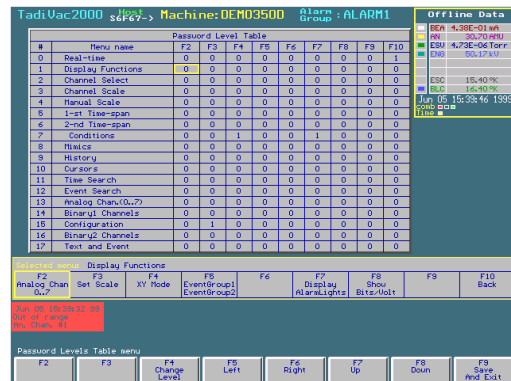
#	Level	Password	Full Name	Last Update
1	5	Ta	TADIN SERVICE SUPPORT	Aug 17 17:20:21 1998
2	4	TA	TADIN	Aug 17 17:20:21 1998
3	3	TA	GEORGE SERON	Jun 05 15:52:18 1999
4	2	UN	ELVIS PRESELY	Jun 05 15:34:07 1999
5	3	XU	MAHATHA GHANDI	Jun 05 15:36:17 1999

Password menu: F2 Add New User, F3 Level Table, F4 Change / Delete, F5 Left, F6 Right, F7 Up, F8 Down, F9 Save And Exit

Password-levels setup table

The password level table enables to assign each key in each menu one out of 5 protection levels.

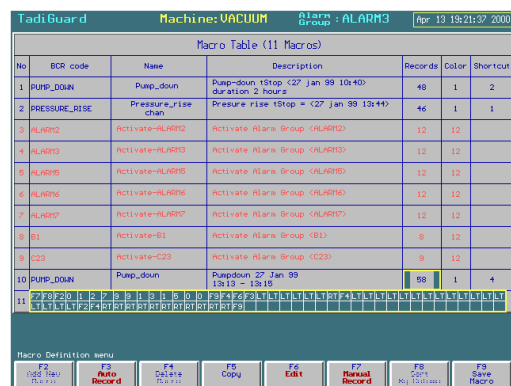
The *TadiGuard* comes with a default password assignment table, but users of levels 4 and 5 can modify the protection levels.



#	Menu name	F2	F3	F4	F5	F6	F7	F8	F9	F10
0	Real-time	0	0	0	0	0	0	0	0	0
1	Display Functions	0	0	0	0	0	0	0	0	0
2	Channel Select	0	0	0	0	0	0	0	0	0
3	Channel Scale	0	0	0	0	0	0	0	0	0
4	Manual Scale	0	0	0	0	0	0	0	0	0
5	1-st Time-span	0	0	0	0	0	0	0	0	0
6	2-nd Time-span	0	0	0	0	0	0	0	0	0
7	Conditions	0	0	1	0	0	1	0	0	0
8	Itmics	0	0	0	0	0	0	0	0	0
9	History	0	0	0	0	0	0	0	0	0
10	Course	0	0	0	0	0	0	0	0	0
11	Time Search	0	0	0	0	0	0	0	0	0
12	Event Search	0	0	0	0	0	0	0	0	0
13	Analog Chan(s)	0	0	0	0	0	0	0	0	0
14	Binary Channels	0	0	0	0	0	0	0	0	0
15	Configuration	0	1	0	0	0	0	0	0	0
16	Binary Channels	0	0	0	0	0	0	0	0	0
17	Text and Event	0	0	0	0	0	0	0	0	0

Macro setup table

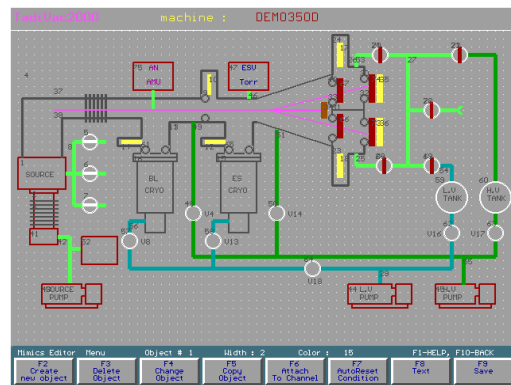
Each command and input sequence can be defined as a macro, enabling the use of macro-names to execute pre-defined sequences. Normally used by bar-code readers or host via SECS to perform command sequences. The barcode reader can also be used to enter lot numbers, operator's name, or pre-defined command sequences that make the use of the *TadiGuard* easy even for an untrained operator.



No	BCR code	Name	Description	Records	Color	Shortcut
1	PUMP_DOWN	Pump_down	Pump-down 15Stop <27 Jan 99 10:40>	48	1	2
2	PRESSURE_RISE	Pressure_rise_chan	Pressure rise 15Stop = <27 Jan 99 13:44>	46	1	1
3	ALARM0	Activate-ALARM0	Activate Alarm Group <ALARM0>	12	12	
4	ALARM1	Activate-ALARM1	Activate Alarm Group <ALARM1>	12	12	
5	ALARM2	Activate-ALARM2	Activate Alarm Group <ALARM2>	12	12	
6	ALARM3	Activate-ALARM3	Activate Alarm Group <ALARM3>	12	12	
7	ALARM4	Activate-ALARM4	Activate Alarm Group <ALARM4>	12	12	
8	01	Activate-01	Activate Alarm Group <01>	0	12	
9	02	Activate-02	Activate Alarm Group <02>	0	12	
10	PUMP_DOWN	Pump_down	Pump-down 27 Jan 99 18:19	98	1	4

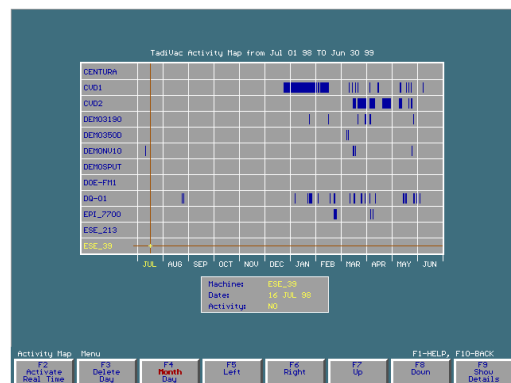
Mimics editor

The Mimics editor is an on-line feature that enables the user to generate a machine mimics and attach the mimics objects to analog and binary channels. This feature includes also counters that enable to illustrate repetitive and cyclic machine patterns.



Off-line activity map

The *TadiGuard* can accommodate a large number of independent machine configurations. An activity map lists all the machines' configurations available and the time the *TadiGuard* was connected to each machine. The map enables to display data of each machine for any selected time.



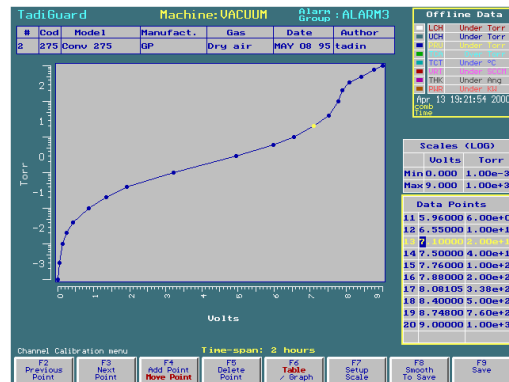
Calibration functions

Calibration-curves library

TadiGuard uses calibration curves for non-linear channels.

The curves can be imported to *TadiGuard* or they can be generated by the *TadiGuard* calibration curves utility.

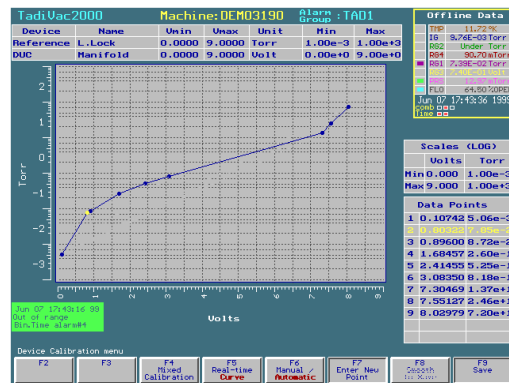
The basic curves are generated by entering points at the keyboard and by interpolation.



Device calibration

The Device Calibration makes the *TadiGuard* a full-featured calibration station. This feature enables to generate a calibration curve for a calibrated device using a known reference.

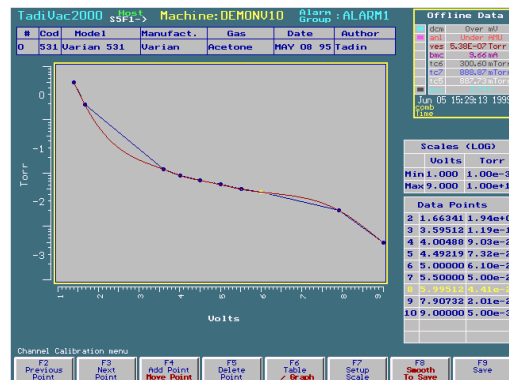
The reference can be either a known sensor or a keyboard entry ('mixed calibration'). All calibration curves are saved in the library and can be attached to a *TadiGuard* channel or they can be exported to be used by other instruments.



Calibration curves smoothing

Calibration curves for various sensors are often made out of a small number of originally measured points.

This utility enables to edit and to smoothen the curves to be more natural, as calibration curves normally are supposed to represent a smooth physical magnitude.

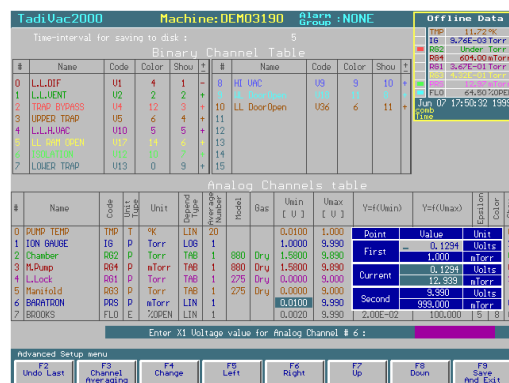


On-line channel calibration

Linear and log channels are calibrated using any two points on the line.

Fine-tuning of a channel calibration can be carried out while real information is read from the sensor. This feature is useful when it is necessary to match the *TadiGuard* reading to the machine reading, regardless of its absolute accuracy.

TadiVac saves all data in Volts. This way, an improved curve will improve data accuracy.



Tests and alarm system

Alarm displays

TadiGuard uses a unique state-dependent alarm system. The *TadiGuard* recognizes machine states and performs various tests based on pre-defined or pre-learned conditions.

Alarm tests, when fail, have several outputs:

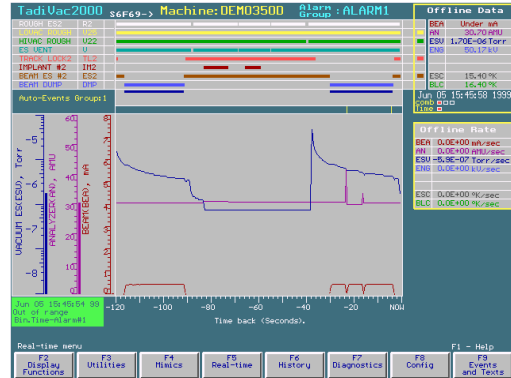
Audible

real-time moving and latching indicators

displayed message and saved message

saved event

hardware binary output



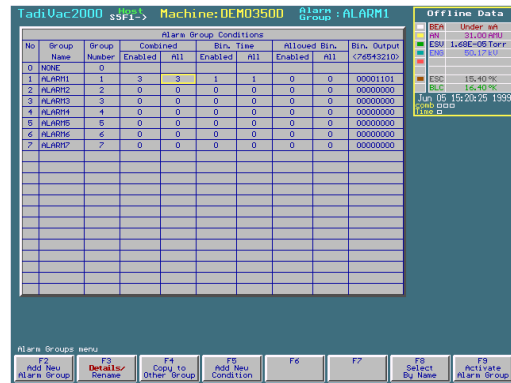
Alarm test table

Alarm tests are grouped into 'alarm groups', representing various machine processes.

Groups can be added, edited, deleted and copied.

An alarm group (process) can be selected manually at the keyboard, by a bar-code reader or by the host through the SECS port.

Alarms can be logically interconnected to each other and to timers and counters to affect selected outputs.



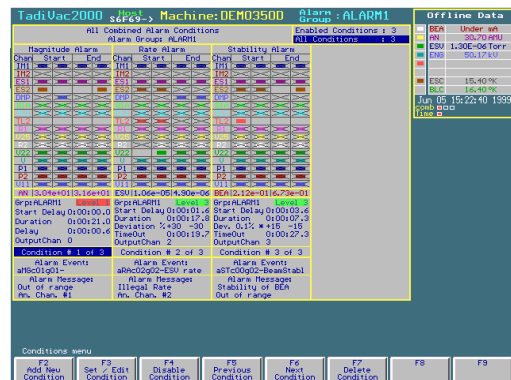
No.	Group Name	Group Number	Enabled	All	Bin. Time	Allowed Bin. Time	Bin. Output	Bin. Output
0	NONE	0						
1	ALARM1	1	3	3	1	1	0	00001101
2	ALARM2	2	0	0	0	0	0	00000000
3	ALARM3	3	0	0	0	0	0	00000000
4	ALARM4	4	0	0	0	0	0	00000000
5	ALARM5	5	0	0	0	0	0	00000000
6	ALARM6	6	0	0	0	0	0	00000000
7	ALARM7	7	0	0	0	0	0	00000000

Combined-alarms test setup

Each alarm test has a set of conditions that are saved and can be activated. Combined alarms use binary condition as triggers and analog values as test levels.

Combined alarms are of the rate-of-change, magnitude and stability types.

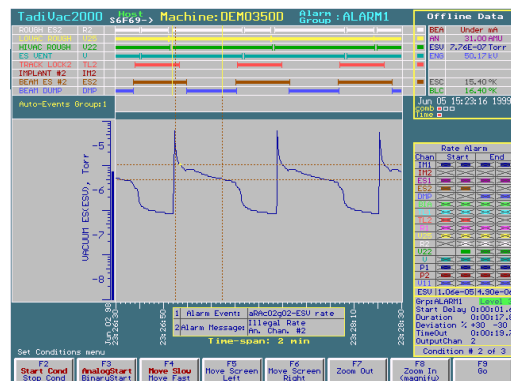
The Alarm Reset condition can be set automatically or manually.



Rate-alarm test setup

Rate alarm tests in real-time the rate-of-change of an analog, each time the start conditions are met. Useful for pump-down test, end-point signals, heat-up rate test, etc.

The test conditions include start condition, rate-of-change, end condition, allowed deviation, reset and timeout.



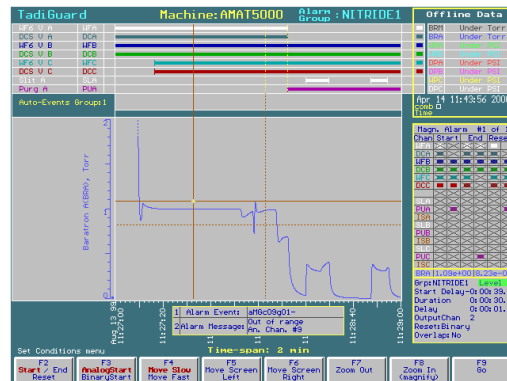
Magnitude-alarm test setup

Magnitude alarm tests in real-time the absolute value of an analog channel to be within defined boundaries for a predefined period of time after the start conditions have been detected.

Can ignore 'glitches'.

The magnitude alarm can be 'relative' one, where the reference level is changed dynamically based on another measured or calculated parameter.

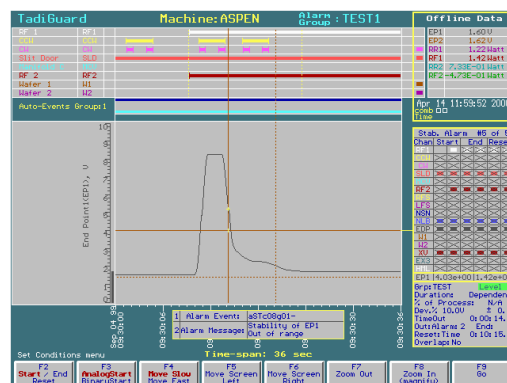
Magnitude alarm can also measure cumulative (time integral) magnitude such as dose, energy, etc.



Stability-alarm test setup

Stability alarm tests the stability of an analog channel after the start conditions have been met. If stable for a given period of time the test will pass. If stability is not sensed, an alarm will occur when the time-out condition has been met.

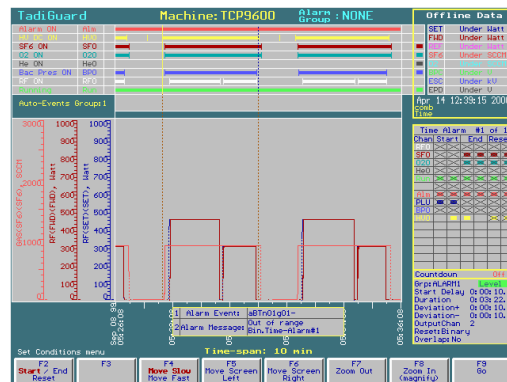
A number of special conditions enable the use of a stability test as a sophisticated end-point monitor for plasma and wet processes.



Binary time-alarm test setup

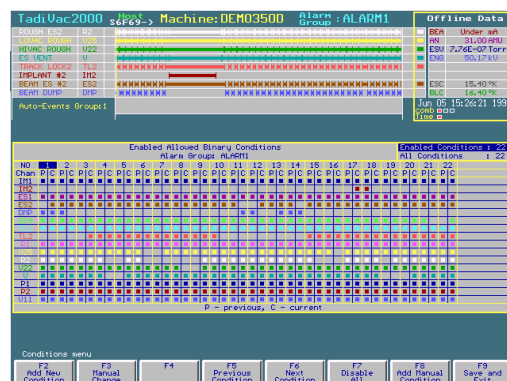
Binary time alarm test will test the time interval between any two pre-defined machine states. It will generate an alarm if the time differs from the preset allowed limits.

As the case is with other alarm-tests, a number of test conditions can be combined to form a group that will be simultaneously tested in real-time. Such an alarm-group can contain many different types of alarms.



Allowed-binary alarm test setup

All binary channels' combinations and sequences are automatically learned. When the machine is running process, all states are tested in real-time. Any unknown binary state that will be sensed under normal real-time machine operation generate an alarm. Conditions and states can be added manually or ignored.

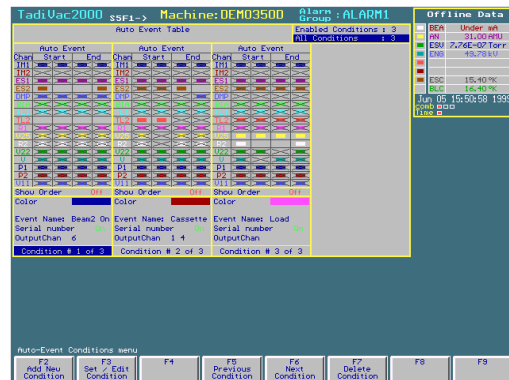


Events and Texts

Auto-event condition setup

Any machine state can be defined to generate an auto-event that is saved with a predefined message. Events can be found later by historical event search.

Useful to automatically mark wafers, lots, maintenance operations, personnel activity, or any other machine state.



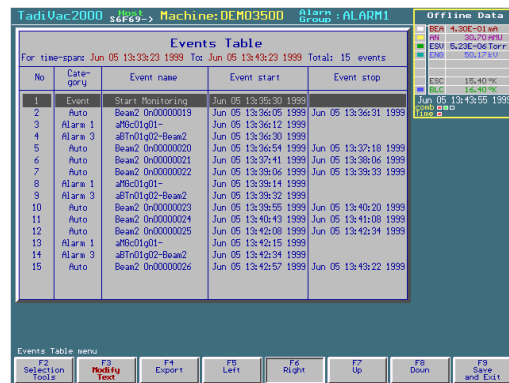
Events table

A chronological list of all system events and alarms. The events can be sorted by type or by time.

Event types are:

- Machine alarms
- TadiGuard* alarms
- Lot / Recipe / Wafer numbers
- Keyboard / barcode / SECS text
- Automatic events
- System status

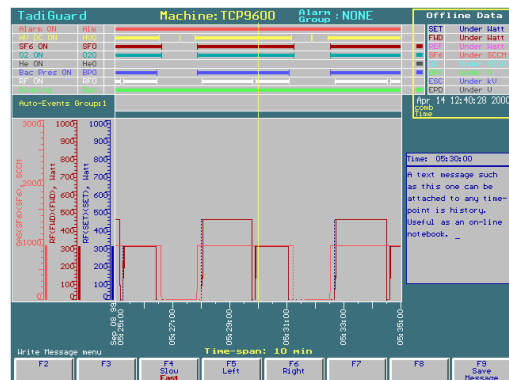
The list can be sorted, exported and printed.



Text messages

Manually entered text messages can be attached to any data as notes. The text can be saved under various text categories.

If saved as an event, the text can be searched in history using a search string.



Shortcuts

User programmed shortcuts convert complex command sequence into a single stroke operation. This feature makes any repetitive routine operation such as daily tests into simple operation that can be carried out by any user, without the need for special training. Enables also knowledgeable users to quickly repeat complex operations. The shortcuts can be entered manually at the keyboard, via the host or by a barcode reader.

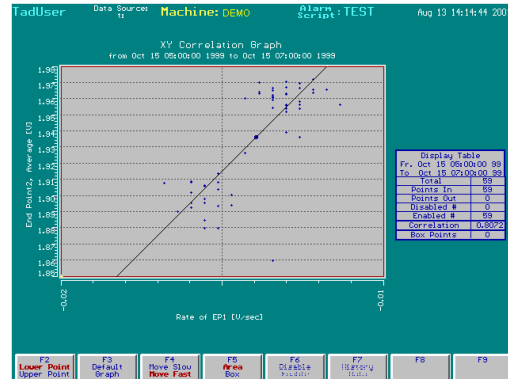


Diagnostic Mode – Trends and Predictions

X-Y Correlation graphs

Any parameter can be defined, and X-Y graphs can be drawn for extracted and calculated values for any parameter.

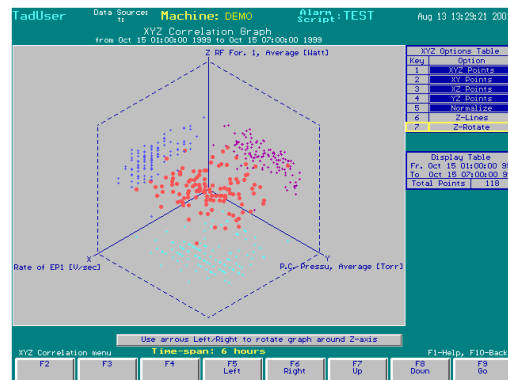
X-Y correlation is an excellent way to express dependence of parameters upon each other. In this example, the dependence of RF Load at the matching unit as function of the CHF3 flow show clear dependence.



X-Y-Z Correlation graphs

Any 3 parameters can be defined, and three-dimensional X-Y-Z graphs can be drawn for extracted and calculated values for any 3 parameters.

X-Y-Z dependence is an excellent way to analyze and express dependence of parameters upon each other.



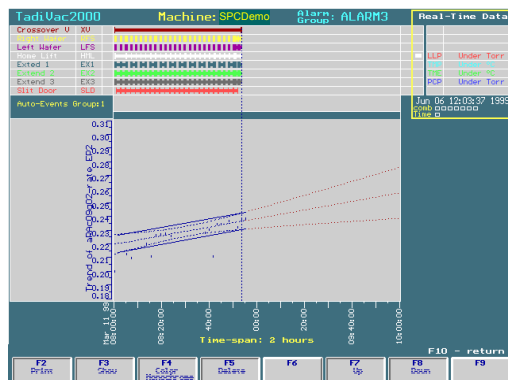
Trends and Predictions

Historical trends can be generated at any time. Trends are available for rate-of-change, magnitude, time, stability, etc.

Based on trends, a prediction of future parameter behavior can be calculated and a graph can be drawn.

This future trend enables to predict machine operation and plan work and predictive maintenance.

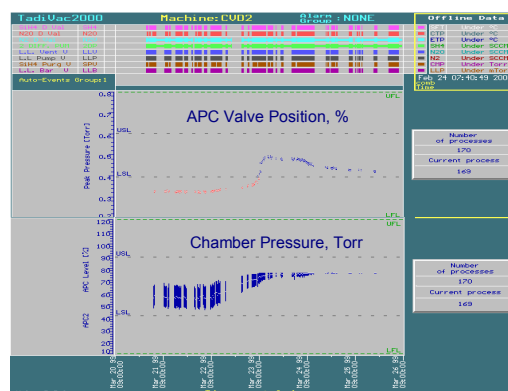
Time to limit, control and spec limits can be calculated.



Long-term trend of a pressure controller

An example: An APC (Automatic Pressure Control) valve position and pressure are checked over a long period of time. The long blue lines show pressure variation in each process. The rate of change is high.

Note at the end of the period, when the unstable pressure control condition was rectified, the valve variation is minimal, the pressure stabilizes fast and accurately



Diagnostic Mode – SPC Functions

SPC Functions

Full SPC functionality is available.

X-Chart, R-Chart, S-Chart, WER (Western-Electric Rules) Chart, Histogram, Box-charts, etc.

The SPC can be calculated for any historical time-period.

It can use any pre-defined machine or process parameter such as times, rate-of-change, magnitudes etc.

Here, a Western-Electric SPC graph is shown as an example.

Control limits are calculated and displayed.

SPC Functions - Histogram

SPC can be displayed in graph + Histogram format, Histogram and Box-Chart.

Histogram can be displayed for any extracted data such as process time per wafer or time, current, volts, temperature, power, flow, etc.

SPC Functions - Box Chart

Typical Box-Chart SPC display.

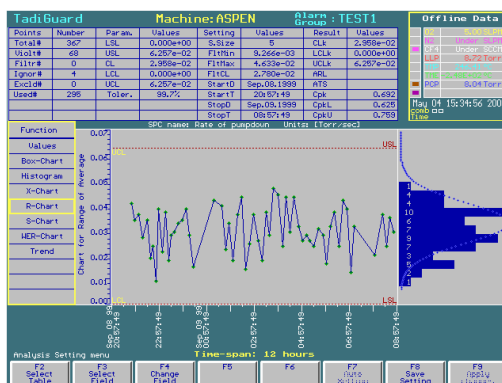
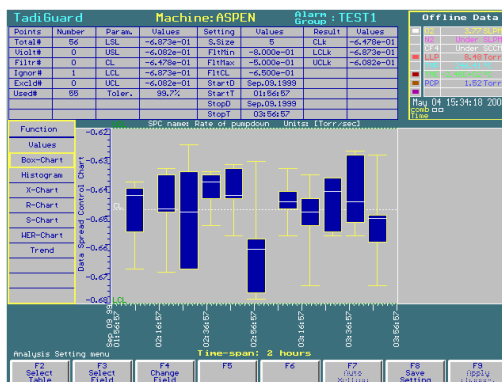
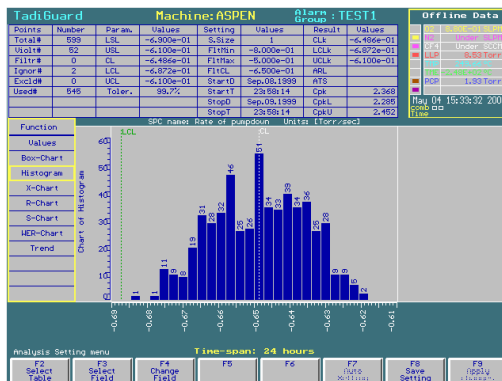
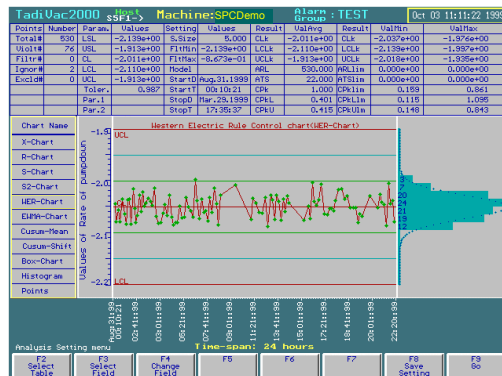
A very useful way to visually determine variations.

The box-chart can be displayed in the event (wafers) domain or in the time-domain.

SPC Functions – R Chart

A typical SPC screen example:

Here, SPC R-Chart (Range of Averages) shows 12-hours behavior of chamber Rate-of-Pumpdown. While the SPC function is calculated and drawn, all real-time functions are active in the background. Data collection is continued and the full alarm capabilities are active.

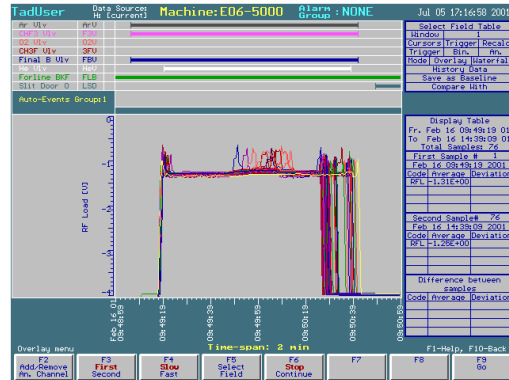


Diagnostic Mode – Overlay, Correlation and Tool Matching

Single-channel overlay

Define a process pattern and search history to extract all occurrences of the defined pattern in a selected timeframe.

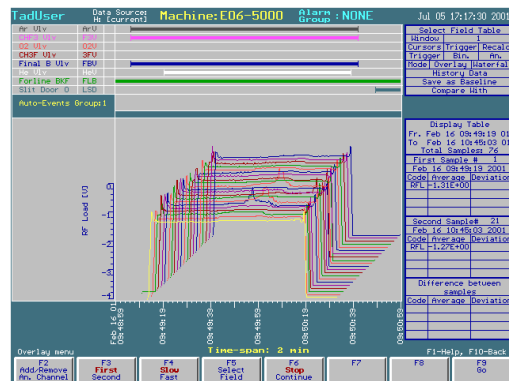
Display all extracted patterns upon each other, synchronized by either a binary trigger or by an adjustable analog level.



Single-channel overlay – Waterfall

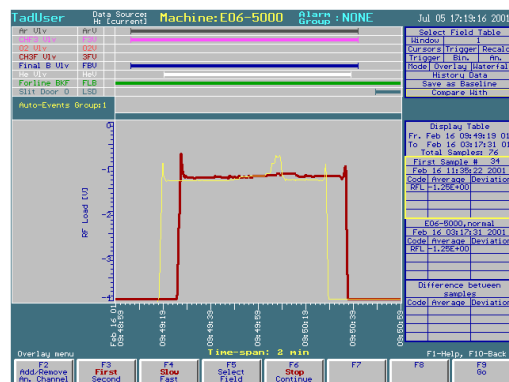
Waterfall display of single lot overlay shows wafer differences.

Best for in-lot difference checks.



Single-channel overlay – Comparison

Select as default and highlight any of the graphically displayed patterns. Compare any other pattern with the default one. Calculate pattern differences.

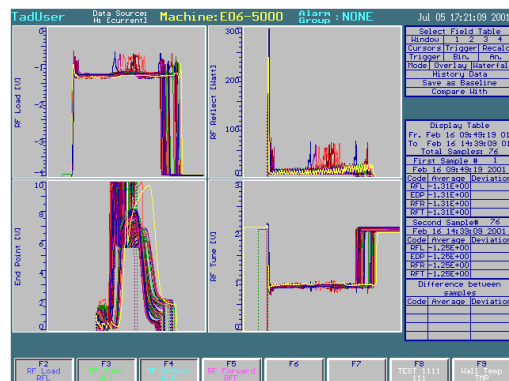


Multi-channel overlay

Define a process pattern and select up to 4 parameters (channels).

Display overlay of all selected channels for the same process step in up to 4 fully synchronized or matched windows.

Channels from different chambers or machines can be displayed and synchronized for tool matching.

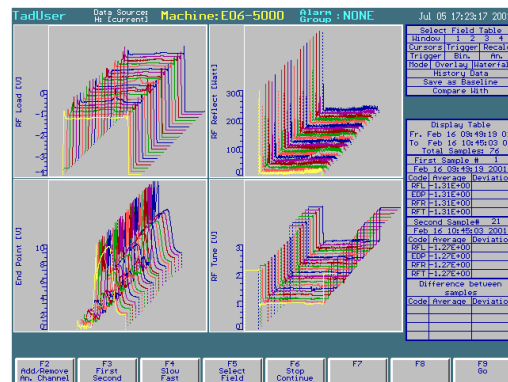


Multi-channel overlay – Waterfall

Display overlay of all selected channels for the same process step in up to 4 fully synchronized or matched windows in waterfall format.

Can clearly show in-lot differences

Channels from different chambers or machines can be displayed and synchronized for tool matching



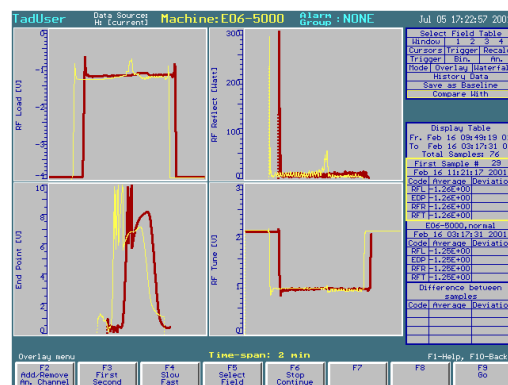
Multi-channel overlay – Compare

Select a channel as default and highlight any of the graphically displayed patterns.

Will automatically select the matching pattern in other displayed channel.

Compare any other pattern with the default one.

Calculate pattern differences.



Some additional TadiGuard features and options

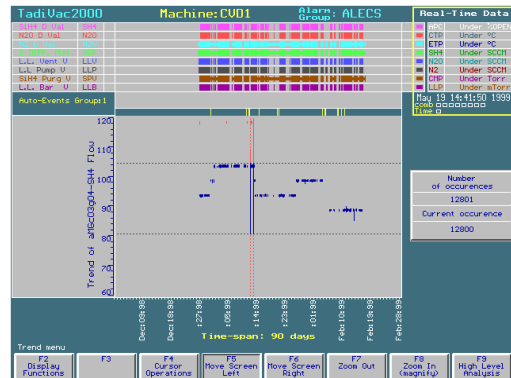
- ❖ **TadUser Remote Access:**
TadiGuard's multi-unit remote access tool. Enables to access any installed TadiGuard and run all features remotely.
- ❖ **Replay mode:**
Enables to replay historical data at normal or accelerated mode.
- ❖ **Analog outputs:**
4-channel Fully programmable wave-generator with real-time and history trace of analog input channels (Optional)
- ❖ **SECS option:**
TadiGuard can act as equipment, communicating with the host.
- ❖ **SECS monitor:**
The SECSpy™ enables to 'listen' to and log SECS transactions between the machine and the host (SECS-1 and HSMS), filter out relevant messages and act upon.
Can use lot number, recipe, event messages etc.
- ❖ **TadCenter:**
A TadiGuard host application that will automatically upload data from all installed TadiGuards and save as backup. Enables also data manipulation such as converting to standard database formats (Optional).
- ❖ **Ultra high-voltage isolation for use in high voltage areas such as Ion Implanters' 'red-box'.**

Analysis examples

Process long-term analysis

Silane flow variations over 3 months time graph is shown.

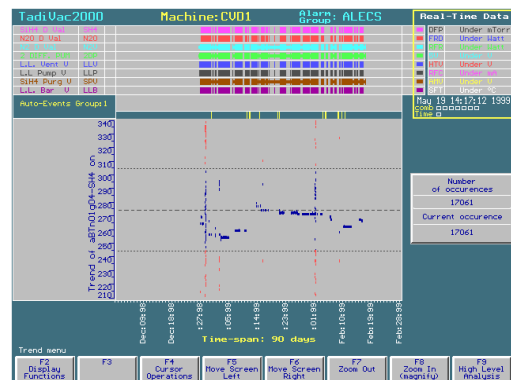
This typical graph can be correlated with other parameters to identify the source for various process and machine problems. Each calculated and extracted value point can be traced back to its origin (the actual data) for examination and analysis.



Process long-term analysis

Silane valve 'On' time variations over 3-month period.

This is another example of a long-time behavior of a machine parameter.



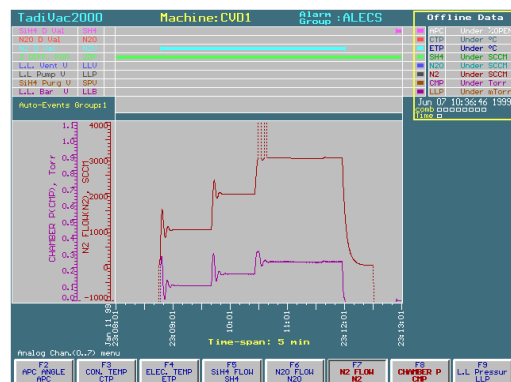
MFC analysis

MFC overshoot and chamber pressure.

This MFC causes machine instability and low efficiency and needs to be replaced.

By setting the MFC start command as an alarm test condition, each time the MFC will overshoot, an alarm will be set.

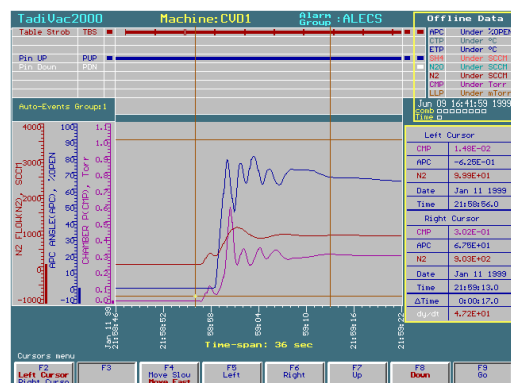
The alarm can be defined as low-level, warning that an MFC maintenance is necessary. It can also be set to halt the process.



Pressure control valve analysis

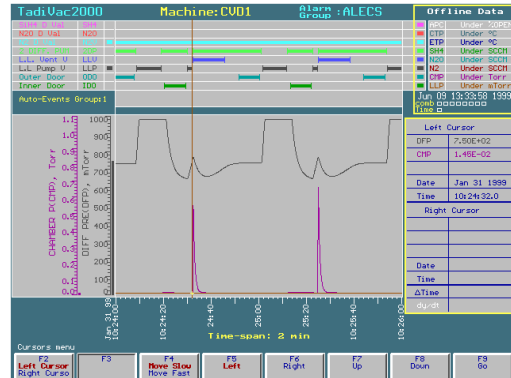
In this example, as a result of MFC overshoot (see previous example), the pressure control valve control loop is oscillating, causing unstable operation, possible particles and lost process time. Normally, the pressure stabilizes in 2-3 Sec. Here it takes about 17 Seconds for the pressure in the chamber to stabilize.

The yields, cycle-time and machine utilization are affected. If an alarm test had been performed, it would have generated a warning.



Load-lock inner door leak

Note poor differential pressure and chamber pressure burst when the load-lock vent valve opens. Due to poor differential pressure and leak in the inner door, this CVD process generates very high particle counts and unstable process.

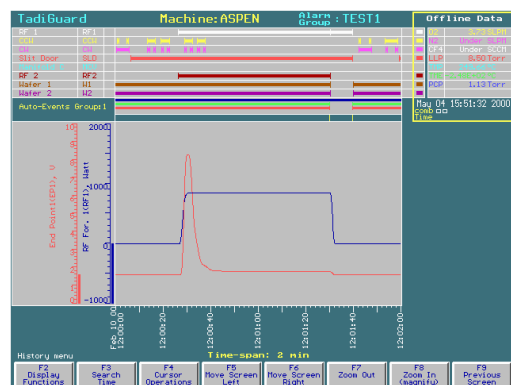


Etcher end-point analysis

As can be seen of the end-point detector signal, the process is complete after about 15 Sec, while the RF power stays on for additional unnecessary 40 seconds.

By using the TadiGuard to set the end-point and the over-etch time, the process time could be cut by 60%, increasing machine's capacity.

TadiGuard's 'Stability test' serves as an excellent end-point control signal and analyzer.

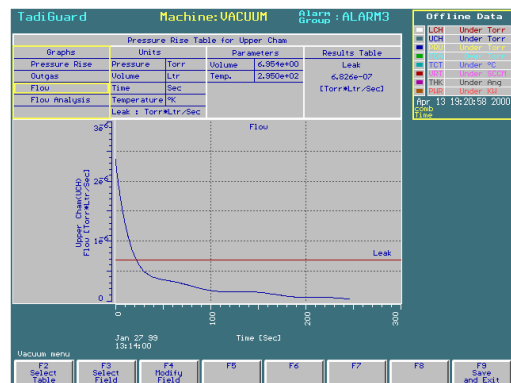


Vacuum analysis leak and outgas calculation

TadiGuard includes Tadin's unique vacuum analysis module.

It enables to breakdown pump-down and pressure-rise data and extract true leak rates, outgas rate and volume.

It is the only known tool that can use total pressure measurements to extract dominant outgas vapor-pressure, enabling to determine the main source for outgassing.

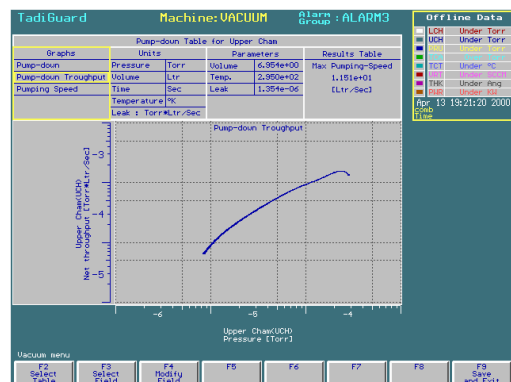


Vacuum analysis - pumping speed calculation

The vacuum analysis module enables also to calculate true net pumping-speed and pump throughput at the pump's-port.

This calculation can be done while the machine is running process.

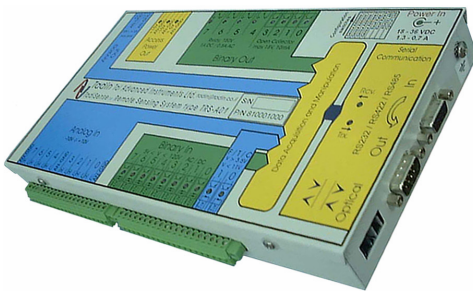
In this example, the net pumping speed (as function of pressure) for a small etch chamber was extracted by analyzing the pump-down and pressure-rise curves using advanced mathematical methods.



TadiSense™ Remote Data Acquisition System

The TadiSense™ is a packaged, self-contained data acquisition system, with basic front-end signal conditioning and signal processing. The TadiSense was originally developed for the *TadiGuard*, but it is also used as a product of its own.

This self-contained packaged unit communicates with the *TadiGuard* or any PC using a wired or optical serial link, that allows for installation in remote, unattended locations.



The TadiSense™, that was designed for industrial and commercial applications, can be used in large distributed systems or inside machines. It is especially efficient for very high-voltage or noisy environments, due to the optional optical link.

When used with Tadin's *TadiGuard* Process and Machine Enhancer / Analyzer, it makes a unique and superb complete monitoring and analysis system. Typical applications are monitoring, supervising and analyzing machines, processes, environmental and climate-control systems, oil, gas, power and water plants, etc.

Basic features – Inputs / Outputs

- ❖ Analog Inputs: Any combination from 8 differential to 16 single-ended, $\pm 10V$, 16-bit.
- ❖ Analog channels manual or automatic gain control ($\times 10$, $\times 100$, $\times 1000$).
- ❖ Over-voltage and ESD protection.
- ❖ Temperature and voltage reference sensors on-board.
- ❖ Binary Inputs: 8 fully isolated, TTL to 150 Volts AC/DC.
- ❖ Binary Outputs: 8 fully isolated (4 relays, 4 opto-isolators) expandable to 256.
- ❖ Frequency measurement inputs: 0.04Hz – 10MHz
- ❖ Time interval measurement inputs: 1 μ Sec. – 500Sec., R-R, F-F, TOn, TOff
- ❖ Counter inputs: Up to 2^{32} (ca. 4.3E8) counts @ up to 10MHz
- ❖ Analog Outputs: 2 independent programmable outputs, each $\pm 10V$, 16-bit.

Sampling method:

The channels are sampled at 1000 Samples per Second each. The data are then manipulated by the front-end processor and sent to the host at up to 20 Samples per Second per channel. The TadiSense™ built-in processor enables basic signal processing such as min, max, average.

Communications:

The TadiSense™ communicates with its host (*TadiGuard* or any PC) via RS232 or RS485 serial connection using either a wired link or an optical link. A number of TadiSense™ units can be chained to increase the total number of channels.

Software:

A basic self-contained data acquisition software driver is provided as standard.

When used with the *TadiGuard*, the overall system provides full data logging, alarms, analysis, trends, predictions, and all other sophisticated features available with the *TadiGuard*, making it a complete state-of-the-art system.