GETTING STARTED CRYSTAL XE

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This manual introduces Crystal XE software interface and its main features. It demonstrates the basics of using Crystal XE.

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I. INSTALLATION

1. Installation

If Crystal XE is preinstalled on your computer, the default directories are the following:

- Program directory: c:\riber\CrystalXE
- Project directory: d:\riber\<Project name>

To download the latest version of Crystal XE, you need to create your account on <u>http://www.crystalXE.com</u>. After receiving the activation confirmation, go in MY CRYSTAL XE and download the setup program.

Run the setup program and follow the installation instructions (select the demo files) in the dialog box to complete the installation.

In Crystal XE, a *project* corresponds to the directory name in which you can find the data files specifying your application (configuration file, synoptic, security files etc.).

A Crystal XE shortcut icon should be available on your desktop. If not, create the shortcut from the *'CrystalXE.exe'* file located in the directory c:\riber\CrystalXE.

2. License key

To benefit from all the features of the software, a license key will be required at the time of the execution of the application. You can skip this step for demo. In demo mode, only communications with devices are disabled, all other features remain available.

To receive your license key, note down your software information and send it to RIBER customer service to the indicated email address.

Welcome with CRYSTA	. XE 2.01 build 6	22
Welcome with CRYSTA	XE 2.01 build 6 Important information: this software in If you skip this step, XE will run in dem To enter a license key, please follow times the identifier and the veres of the veres of the identifier and the veres of the v	In the section of the
		Skip for demo



Click on the Setup menu to display the drop-down menu or click on the following icon in the

top right-hand corner of the interface 😧

3. Hardware configuration

Click on the Hardware configuration submenu.



You cannot modify the hardware configuration when a recipe is executing.

Crystal XE comes with a library of equipment and devices.

For each chamber (sub-system), click *Equipment* or *Devices* (*left*) to display the available items palette (*right*).





Add or modify equipment and devices

Drag and drop the equipment and devices from the palette directly to the equipment tree structure or to the devices graphical view.



Adding devices

To be operational, a sub equipment must be linked to a device and conversely, in order for Crystal to communicate with a device, the module must be linked to a sub equipment.

To link sub equipment to a device, click on the desired sub equipment name in the equipment tree structure and select the device and the channel to be linked with from the drop-down menu.

D-4 N_Plasma_	P7 C	olor used in charts	
	Device / Regulator Elflow1 Hidden in system view	Channel	

When a sub equipment is not linked to a device, it is displayed in italic gray.

Simulation mode

Switch from Online mode to Simulation mode, and conversely, by moving the following switch:



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RIBER ADDON VG SEMICON

i You must have a valid license to switch to the online mode.



4. Options

The Options dialog allows you to configure Crystal XE software.

You can configure the software even if a recipe is currently executing.

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ñ	2	General	۲	Startup	Chambers	Email	SMS	ሷ Cloud/ Mobile	1 4	Servers	Δ	Advanced	

i For more details, refer to the user manual.



5. Users

The Users submenu, allows you to manage the different users and their permissions.

You systematically need to enter a password to open the Users administration window.



The default password is 'admin'.

You can change the password by clicking on the *Change admin password* button, in the bottom left-hand corner of the window.

KE Users administration				_	008
Enable user restrictions					
Enable auto logOFF after a time (min)				
User	🕂 Add	User name	User		
Engineer	순 Up	Password	****		
	🕂 Down		Authorization group		
	🙆 Remove		Operator	-	as Edit groups
			Chambers		
			☐ Degas_chamber ✓ C21DZ		
			Parking		
Change admin password				ОК	Cancel

In this window, you can add new users, you can associate a user to a group of user and chambers. You can also create new group of users and change the rights of each group.

You can also open the Users administration window by right-clicking on the User icon located in the top left-hand corner of the main interface, and selecting Manage Users.





III. BACKUP

🐹 CRYSTAL XE 64 bits - DEMO_C21DZ - Version 2.01 build 6 ********** Not registred: communication disabled *********** 💿 🖻 🛞

To save the configuration of your current project and clone the software to another computer, click on the *File* menu and select *Backup*.



You can choose specific files to be saved by checking the corresponding boxes.

If you check the *Records* or *Black box* (if available) boxes, large files might be generated.



IV. INTERFACE OVERVIEW



1.1 User icon

Click on the following icon to display the list of users and log in (if user restrictions are enabled)

The following icon indicates that you are logged in or that user restrictions are disabled

You can open the Users administration window by right-clicking on the user icon and selecting Manage users.

Manage users



The following icon indicates that Crystal XE is operating in simulation mode.

In simulation mode, all communications with peripheral devices are disabled and some values are simulated.

You can switch from *Simulation* mode to *Connected* mode by checking the corresponding box in the *Project configuration* window, that can be accessed from the *Setup* menu > *Hardware configuration*.

1.3 Alarm icon

The alarm icon indicates that at least one alarm is <u>activated</u>. Click on the alarm icon to display all the alarms in a pop-up window.









2. Event history

The history area at the bottom of the interface displays all the recorded events.

All events Criticals and warnings Communication User events	
32019/07/08 16:42:33: (008) User:Closing hardware configuration	
🔍 2019/07/08 16:41:44: (008) User:Opening hardware configuration	
© 2019/07/08 15:09:06: (109) User:Alert window dosed	
²² 2019/07/08 15:08:50: (541) This version is up to date (server version=2.01build6)	-
2019/07/08 15:08:50: (800) User:C21DZ: As_VAC500_P1.Valve_AVP6504 Force Closure watchdog started	
112 M 1010/07/08 15:08:50: (800) Llear:(79107: Ar VAC500 01 Value AVD6504 Thermal evolution watchdon started	

• You can choose to display only a specific event type using the filter tabs:

All events	Criticals and warning	gs Communication	User events
	$\widehat{1}$	$\hat{\mathbf{L}}$	$\widehat{\Box}$
А	larms related events	Connection to device	s Actions of the users

• To **delete** the event history, right-click the history area and select *Clear all logs* (this does not delete the log file, this action only clears the display)

• Double-click on any of the events to **open** the *Log viewer* and display event details *Or right-click and select Open in a new window.*

Events are saved automatically as text files to the *Log folder*, in your project directory.

To open your project directory, click on the File menu and select Browse project directory.

3. Event notifications

These drop-down list boxes in the lower-right corner of the interface, allow you to define when you want to be notified by a pop-up window or an email alert (only available if email settings are defined in the options).



All events: Enable email alerts / pop-up windows for all events (all alarms, user events, etc.) Critical and warnings: Enable email alerts / pop-up windows for critical level or warning level alarms Critical only: Enable email alerts / pop-up windows for critical level alarms only Never: Disable all email alerts / pop-up windows

Use the corresponding drop-down list to select your choice.



The choice "Critical and warnings" is recommended.



The choice « Never » is not saved when exiting Crystal XE.





1. Automation

THE MAIN TAB

V.

The Automation tab allows you to create, edit and execute production batches.

A batch is used to organize each operation performed by the different parts of the epitaxy system, in parallel or in sequence. A "batch file" contains the description of the movements of the platens in the system.

 \rightarrow For more details, please refer to the chapter **Platens automation** in this manual.

2. User view

The user view interface is a visual representation of the MBE system that allows you to monitor and control the operation of equipment.





The User view interface depends on your configuration.

Example of equipment representation

Cell Ga2_ABI85_P11 and its three pieces of sub equipment (insert, base and shutter)



Click on the following button , from the desired sub equipment's item, to open the *Detail view* window.

→ For more details about the *Detail view*, please refer to the chapter **System view** in this manual.

Shutter



The interface allows you to perform the following actions:

- Opening / closing shutters
- following the measured value
- viewing the set point value
- following the output power bar graph
- opening the *Detail view* window



Interacting with the equipment

Opening / closing shutters



You can open/close a shutter by double-clicking on the desired shutter icon. Green icon indicates that the shutter is open while red icon

indicates that it is closed.

>> When you first click on the shutter icon, a progress bar appears over the icon

Double click before the time (yellow) is up.

Customizing the User view interface

Right-click on any part of the *User view* interface background and select "*Edit the form*" to open the *Tool palette (left)*.



Moving items

When the *Tool palette* is open, you can move any of the items directly from the interface. Click on the desired item, hold down the left mouse button and move it to another part of the interface.

Press the keyboard arrow keys to move the selected item pixel by pixel on the grid. You can change grid options by right-clicking on the interface and selecting *Grid options*.

Adding equipment or sub equipment



Select the basic tab and drag and drop equipment in the user view.

The equipment and sub equipment are listed in a tree view in the *Tool palette* in the basic tab. You can drag and drop the desired equipment and sub equipment directly to the *User view* interface.

• Not all types of equipment have a user view representation. You might need to expand an equipment list in the tree structure and add sub equipment only.

Example: to add a shutter, expand the cell item's list (click on the '+' sign), then drag and drop the shutter directly to the *User view* interface.



Deleting equipment or sub equipment

When the *Tool palette* is open, you can remove any equipment or sub equipment from the *User view* interface:

- select the desired item,
- right-click to display the drop-down menu,
- select Delete (or press Delete key on the keyboard).



3. Security

The Security tab allows you to enable or disable alarms for the system security agents.



For example, after selecting the *Memory Space* security agent, you can set a 500 MB low threshold value from the *Agent* tab. An alarm will be activated as soon as the amount of



memory available drops under 500 MB. The *Action* tab allows you to configure alarm notifications (sound, email, SMS, etc.).

VI. CHAMBER TABS

On the right side of the *Main* tab, chamber tabs allow you to display chamber features. The number of visible chambers depends on your configuration.

Click on the desired chamber tab to display the chamber's menu.

🌆 м	lain Loadi	ng 🖻	Degas_cha	mber	S C21DZ	🗊 Parki	ing				
4	Equipment		Security	¥	Recipe		Charts	Recorder	UL	Statistics	 Devices

1. System view

KE CRYSTAL XE 64 bits - DEMO_C21DZ - Version 2.01 build 6	**************** Not regis	stred: communication d	lisabled **********		
File View Tools Editors Setup Window Help					
C21 DZ SYSdemc					RIBER SOFT
👫 Main 🗟 Loading 🗟 Degas_chamber 🗟 C21DZ 🗟 F	Parking				
🧠 Equipment 🔔 Security 👗 Recipe 🖉	🖞 Charts 🔡 F	Recorder 🛄 Statis	tics 📴 Devices		
Cracker_Z2 Reservoir_Z1 Shutter Valve_AVP6504	As_VAC500_P1	Cracker_Z2	CSP 707.97 CSP 707.77 CSP 285.20 CSP 285.20	0ff TSP 0.00 Offs 0.00 Offs	0.00
CO - Controller settings		Valve_AVF0504	cted equipment		
77 787.97 0 1050 of int TSP Target SP Offset	🔔 Р_КРС250_Р2	Cracker_Z2 Reservoir Z1	MV 750.20 CSP 750.17	Off TSP 300.00 Offs	0.00
77 0.00 0 Slope		Shutter Valve NVC6000	Closed OK		
Detail view of selected	Si_ABN135D_P3	Temperature	MV 1012.70 CSP 1012.63	Off TSP 300.00 Offs	
sub equipment Auto	L Be_ABN135D_P4		MV 663.95 CSP 663.82	Off TSP 300 00 Offs	0.00
MANUAL - Power settings (%)	L C_C_cell_P5	List of eq	uipment and the	ir sub an offs	0.00
OP OP Max OP	AI_ABN60DF_P6		equipment	Off TSP 0.00 Offs	0.00
Current TOP Target OP			MV 307.63 CSP 0.00	Off TSP 0.00 Offs	0.00
Off Step Slope 0 %/min	L N_Plasma_P7	AIM	MV 3,600 V CSP 0.000 V	Off TSP 0.000 V	
Setup	Ga1_ABN60DF_P8	Tip Base	MV 787.70 CSP 787.50	Off TSP 0.00 Offs	0.00
		Shutter	Closed OK		
	L C_CBr4_LTI_P9	Temperature Shutter	MV 225.10 CSP 225.00	Off TSP 0.00 Offs	0.00
	In1_ABI85_P10	Insert Base	MV 682.77 CSP 682.70	Off TSP 0.00 Offs	0.00
Setup Inspect Tags list					
All events Criticals and warnings Communication User events					Popun window on alarm
 2019/07/09 09:33:23: (800) User:C21DZ: As_VAC500_P1.Valve_ 2019/07/09 09:33:23: (800) User:C21DZ: Sb_VCor300_P12.Valve 2019/07/09 109:33:23: (800) User:C21DZ: Sb_VCor300_P12.Valve 	AVP6504 Force Closure wate _AVP6504 Force Closure wate _AVP6504 Thermal expansion	chdog started atchdog started on watchdog started			Never

The *System view* interface displays all equipment in a **list view** (*right*) depending on your configuration.

You can directly interact with some of the equipment's from the list view (closing/opening shutters, modifying target set point values, etc.).

Click on the desired equipment from the list view to display its associated **Detail view** window (*left*).



1.1 Equipment list view

Each line displays an overview of the equipment and all its associated sub equipment.

Example: List view of the As VAC500 P1 equipment and its four pieces of sub equipment (Cracker, Reservoir, Shutter, Valve):

<u></u>	As_VAC500_P1	Cracker_Z2	[™] 788.03	CSP	787.77	Off	TSP	0.00	Offs	0.00	
		Reservoir_Z1	MV 285.23	CSP	285.20	Off	TSP	0.00	Offs	0.00	-##
		Shutter	Close	d	OK						
-		Valve_AVP6504									æ

Alarm icon

The alarm icon (bell), located on the left side of each piece of equipment, indicates the state of the equipment alarm:

Gray bell: the alarm is disabled Green bell: the alarm is enabled Red bell: the alarm is activated

Interact with the equipment

From the list view, you can directly modify some of the sub equipment parameters.

Example:

- opening/closing shutters
- modifying the values
- 20.1020.60 Open SP 1000.00 P 100.00 On Off

stopping a running linear ramp

The editable fields and available features depend on the type of equipment and sub equipment.

Customizing the list view

- To change the equipment order, drag and drop the equipment directly from the interface to move it up or down.
- To hide or display the equipment:

Click and hold down on the equipment item to display the trash icon To hide equipment, drag and drop the desired equipment item into the trash icon.





You can display all hidden equipment by right-clicking on any part of the interface and selecting *View all hidden equipment*.

To display only specific equipment, right-click on any part of the interface, move the cursor over *Show specific equipment* and select the equipment to be displayed.

The equipment reappears at its previous order.

1.2 Example of Detail view window (temperature)

The *Detail view* window displays all the configurable parameters of the sub equipment and allows you to follow and edit their values (when editable).

Each type of equipment displays a specific *Detail view* window.

Example: Detail view window of the *Ga1_ABN60DF_P8* equipment with its three associated pieces of sub equipment (broken into three tabs):

- Tip
- Base
- Shutter



Click on the desired sub equipment tab to display the configurable parameters.



Setting maximum and minimum values

Maximum and minimum value fields, such as maximum set point or maximum output power, are not directly editable.

To set maximum and minimum values:

- Select the desired chamber from the chamber tabs.
- On the *System view* tab, select the desired equipment in the list to display the associated *Detail view* window.
- Click on the Setup button Setup, located in the bottom left-hand corner of the window, to open the Setup pop-up window and modify the parameters.

Setup Ga1_ABN60DF_P8 [Base]	×
OP and SetPoint Limits Min SP Max SP 50 *C 975 *C Min OP Max OP 0 % 60 %	Max slope SP 1000 °C/min Max slope OP 100 %/min
Regulation parameters P I D 0 % 0 \$ 0 \$ CB low CB high 0 *C 0 *C	Auto tunning Limits Min OP Max OP 0 % 0 %
Ramp parameters Disable step in AUTO Disable step in MANUAL	Ramp refresh rate OP SP 1.0 s 1.0 s
Close	

A You will need suited user permissions to access this window.

Automatic mode and manual mode

The automatic mode consists of a regulation operated by the temperature controller which is associated with the equipment. In manual mode, the output power of the controller is directly used as the setpoint of the power supply. In manual mode, there is no regulation, the power is constant or follow a ramp.

As for some types of equipment, you can **switch the regulation mode** from *Automatic* to *Manual* by double-clicking on the *Regulation mode* button:

	Regulation mode	Manual		Regulation	mode	Auto
>> When you first click o	on the button, a	a progre	ess bar a	appears	Auto	-
Click again before the til	me (yellow) is	up.				

If a linear ramp is run	ning	On	you cannot switch the regulation mode.
Stop the linear ramp	Off	befo	re switching the regulation mode.



• The **Automatic mode** allows you to specify a target set point value (°C) to be reached. Click on the *Target SP* field to type the desired value.

AUTO - C	ontroller setti	ngs	
Setpoint 693.95 Current TSP 693.95 Off	Measure 694.02 Target SP 0.00 Step	Min SP 50	Max SP 975 Offset 0 Slope 10 °C/min
	Reg	ulation mode	Auto

• The **Manual mode** allows you to specify a constant power set point (%) to reach the required temperature. Click on the *Target OP* field to type desired value.

		Regulation mode	Manual
-#-	MANUAL - Power	settings (%)	
Cur	OP OP 0.00 rrent TOP Target % 0	% OP %	Max OP 100 %
			Slope
	Off Linear	*	2 %/min



Step and linear ramp

Step: select Step from the drop-down list to directly set a target set point value (in Automatic mode) or a target output power value (in Manual mode).



Linear ramp: select linear from the drop-down menu to modify the temperature by programming a rise using a linear ramp until reaching the target set point value (in Automatic mode) or the target output power value (in Manual mode):

%/mi

%



Set a target set point

The ramp activity button is turned on (green) when a linear ramp is running



To stop a running linear ramp, turn off the ramp activity button on by double-clicking on it.

> >> When you first click on the button, a progress bar appears on Click again before the time (yellow) is up).

Other ramps (custom profiles) can be defined using the Options menu.

Following in charts

Right-click on a parameter's value and select Follow in a chart to open the corresponding chart in a pop-up window.



To save this chart, right-click on any part of the chart window, select File > Save as and then select the desired file format.



2. Chamber security

👧 м	lain 🕄 Loadii	ng 🖻	Degas_char	nber	🗊 C21DZ	🗊 Parki	ing				
4	Equipment		Security	∡	Recipe		Charts	Recorder	<u>líh</u>	Statistics	 Devices

The alarms management interface allows you to:

- configure security agents for each type of equipment,
- set an alarm for each security agent,
- choose the action to be performed if the alarm is activated.
- If one of the chamber's alarms is activated, a red bell icon will appear over the chamber's tab and the *Security* tab alarm icon will turn red as follows:

N	1ain 🗊 LL1	🗊 Pr	ep 🙀 Grov	rth					
4	Equipment	8	Security	7	Recipe	Charts	Recorder	 Devices	

Bell icons indicate the state of the alarms as follows:

Gray bell: the alarm is disabled

Green bell: the alarm is enabled

Red bell: the alarm is activated

- The security interface is divided into three parts as follows:
- the equipment view (right),
- the tree view (center),
- the security agent management panel (left).

INNOVATIVE SOLUTIO	ONS FOR SEMICONDUCTO	R INDUSTRY	RIBER
RIBER ADDON VG SEMI	CON		
Main 🖾 Loading 🖾 Degas_chamber 🖾 C21D	Z S Parking		
🦉 Equipment 🐥 Security 👗 Recipe	: 🗟 Charts 남 Recorder 🖺 Statist	ics Devices	
🚊 Equipment 🔔 Temperature 💄 Shutter	🌲 Expand disabled only 🚊 Expand alarms only	â As_VAC500_P1	C_CBr4_LTI_P9
Temperature	Reservoir_Z1	^ e	
🗹 Shutter	Communication fault	P KPC250 P2	a In1 ABI85 P10
	A Shutter fault		
	D-4 Valve_AVP6504		
	Communication fault	🔔 Si_ABN 135D_P3	Ga2_ABI85_P11
	- Sout of range		•
	□ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □	Be_ABN135D_P4	Sb_VCor300_P12
	E Si_ABN135D_P3		
	□ □ - ■ Be_ABN135D_P4 □ □ - ▲ C_C_cell_P5		
	Al_ABN60DF_P6		Growth
	□ → N_Plasma_P7 □ → ▲ Ga1_ABN60DF_P8		•
	C_CBr4_LTI_P9	AL_ABN60DF_P6	🔔 Buffer
	Ga2_ABI85_P11		
	B→ Sb_VCor300_P12	N Plasma P7	
	⊕_≜ Buffer		
	⊕—≜ Load ————————————————————————————————————		•
	- Manipulator	Ga1_ABN60DF_P8	🔔 Growth_duster
	BakeOut System_control		•
	Cluster		
	Hand Hand Hand Hand Hand Hand Hand Hand		
Security agents panel	Tree view	Equipm	ent view

2.1 Equipment view

The equipment view displays all the functioning equipment, depending on your configuration.

Click on the desired equipment to highlight the equipment line in the tree view and display the associated security agents panel on the left side of the interface.



- The bell icon indicates the state of the <u>equipment</u>'s alarm (enabled, activated or disabled). The equipment alarm is activated if at least one of the equipment's security agents' alarms has occurred.
- The following circle icon 😉 indicates that the equipment alarm has occurred. The digit indicates the number of times the alarm of the equipment occurred.

For example, the following icon 4 indicates that the equipment's alarm occurred four times.

This icon will remain, even if there is no longer any activated alarm.

Click on this icon to acknowledge the activation of the alarms. Once all alarms have been acknowledged, the icon will turn green .

Nou cannot acknowledge an alarm as long as the alarm is activated.



2.2 Tree view

All the equipment and sub equipment alarms are visible in a tree view as follows:

equipment > sub equipment > security agents

Example: tree structure of the Si_ABN135D_P3 equipment



- Si_ABN135D_P3 equipment with two pieces of sub equipment:
- Temperature
- Shutter
- *Temperature* sub equipment with four security agents:
- Communication fault
- Minimum and maximum temperature
- Out of range
- Minimum and maximum power
- In the tree structure, double-click (or click on the + / icons) to expand / collapse a list.
- You can choose to expand only the security agents whose alarms are disabled by clicking on the *Expand disabled only* tab:



You can also choose to expand the equipment level alarms only to have a quick view on the alarms' state, by clicking on the *Expand alarms only* tab:





2.3 Security agents management panel



Each type of equipment displays a specific panel, located on the left side of the interface.



Example: Si_ABN135D_P3 equipment

The *Equipment* tab displays all sub equipment of the selected equipment. Click on one of the sub equipment tabs, to display the sub equipment's security agents.



In this example, the Temperature sub equipment has four security agents (Communication fault, Minimum and maximum temperature, Out of rang and Minimum and maximum power).

2.4 Enabling/disabling alarms

In the tree structure, right-click on the desired security agent and select *Enable* to enable the alarm (green icon) **a**.

Right-click and select *Disable* to disable the alarm (gray icon) (2).

Or check/uncheck the security agents' boxes in the Security agents panel to enable / disable the alarms as follows:





You can disable or enable alarms at the security agent level or at the sub equipment level in the tree structure.

Nou cannot disable alarm at the equipment level.



If one of the security agents' alarms is activated, the sub equipment alarm and the equipment alarm are activated.

If the alarm of the sub equipment is disabled, all alarms of the sub equipment's security agents are disabled as well.

The sub equipment level alarm must be enabled to allow you to enable its different security agents' alarms.

2.5 Configuring the security agents

You can configure the security agents using the security agents management panel, located on the left side of the *Security* interface:

🔔 Equipment 🔔 Temperature 🔔 Shutter								
Communication fault								
Min/Max Temperature								
Out of range (MV/SP)								
Min/Max power								
Agent Action Log								
Ouput power in %								
Min 0 Max 100								
Min 0 Max 100								
Min 0 Max 100 Filter type By allowed time (sec) Filter 2								



Click on the sub equipment tab and select desired security agent to display the settings

below. The available settings depend on the type of the selected security agent.

Agent

The Agent tab allows you to set threshold values and configure the activation of the alarm.

For example, using the *Temperature* security agent panel, you can specify minimum and maximum temperature values.

Agent	Action	Log	
	Te	mperature in degree C	
4	Min <mark>500</mark>	Max 1500	
-	Filter type	By allowed time (sec) 💌	
Å		Filter <mark>5</mark>	
	Current val	ue: 1012.800049	

In this example, if the temperature value drops below 500 °C or exceeds 1500 °C for <u>5 seconds</u> (filter), the alarm will be activated \triangleq .

The current value of the parameter is displayed bellow.



Action

On the Action tab, check the Enabled box to display the available actions tab bar.

Agent	Action	Log				0.55
🗹 Ena	bled				Test	
Recipe	/batch	Sound	Output	Email	5 4	Þ

You can define actions to be performed whenever the alarm is activated using these different tabs.

For example, if the alarm occurs, you can be notified by a sound, or receive an email alert with a customized message.

Log

The *Log* tab displays all alarm related events.



The events are saved automatically as '.txt' files to the Log folder, in your project directory.

To open your project directory, click on the File menu and select Browse project directory.



👧 м	1ain 🕄 Loadi	ng 🛐	Degas_cham	ber	C21DZ	🗊 Parki	ng				
4	Equipment		Security	¥	Recipe		Charts	Recorder	<u>lır</u>	Statistics	 Devices

The *Recipe* interface allows you to create, edit or execute your recipes.

In Crystal XE, the recipes are made of a succession of layers. All the actions defined in a layer are executed at the beginning of the layer's timer (temperature, opening the shutter, opening valve, etc.). The ramp duration can be defined over the layer's duration or can be customized.

3.1 Creating a new recipe

You can edit a new recipe using either:

- the recipe editor (graphical interface),
- or
 - the script editor (Pascal language).

The recipe files can be accessed from the Recipe folder, in your project directory.

To open your project directory, clicking on the File menu and select Browse project directory.

In the recipe tab, you can also browse the recipe directory and preview the contents of those recipes.





Graphical recipe editor

Click on New recipe and New recipe (basic mode) to open the Main recipe editor.



 Main recipe editor [GaAs deoxidation.rcp] File Edit View 									
La Evoand al El Collanse al	Dee	portion C		Chanta					
Main [GaAs deoxidation.rcp] Duration= 34 m		perces G	enerated script	Charts					
01:00:00:00.000- Start heating GaAs wafer- Layer dura	ion=6 m		tion 00:06:00.00	0		Show map	Show lines Substrate	on top	
🔲 🕮 Manipulator	V					SUC	STRATE		
Temperature.RampSP = 400 (inear while layer ti	ne)		ent Start heatin	g GaAs wafer					
02:00:06:00.000- increase T° under As flux at 25°C/min	Layer du	Backgroup	od color Sele	rt color 🗖		Start heat	ing GaAs wafer		
- Manipulator		backgrou							
Temperature.RampSP = 550 (linear while layer ti	ne)	Expand al	I [-] Collapse al						
121 Main_shutter.Control = OPEN	E	- C21D	Z		<u>_</u>				
Shutter Control = OPEN		E 2 A	S_VAC500_P1			crease T ^o unde	er As flux at 25°C/mi		
Valve AVP6504.RampOP = 24 (linear while layer	time)	🔲 🕺 s	ABN135D P3						
03:00: 12:00.000- go to degas T° under As flux-Layer d	ration=	😐 🝓 в	e_ABN135D_P4						
- Manipulator		🗉 🐗 C	_C_cell_P5						
As_VAC500_P1		🗏 🖳 🗎	LABN60DF_P6						
04:00:25:00.000- water degas at 615°C real 1°- Layer of	uration=	- H - N - N	Plasma_P7						
Anipulator		т 🕺 с	CBr4 LTI P9						
Temperature.RampSP = 640 (linear while layer ti	me)	🕀 🍓 In 1_ABI85_P 10				go to degas	T° under As flux		
		😟 🍕 G	a2_ABI85_P11						
		🗉 🍓 S	b_VCor300_P12						
		- E- 💁 🖁	lanipulator		-				
		E - 2 K	akeUut Vafer temperatur		÷				
	Va	lue or form	mula						
					Ĩ	un fan de see	ab CIECC and TO		
						water degas	at 015 C real 1		
						go to	growth T°		
						Total 00:24			
						10121-00.54	Notico and the fers		
Detach					2			1	
			1	Manipulator	5	4 A	s VAC500 P1		
			Rotation_basic	Temperature	Main_shutter	Shutter	Valve_AVP6504		
# Layer Description Dur.	tion Thicknes	Material	Rotation SP	RampSP	Control	Control	RampOP		
02 00:06:00.000 increase T° under As flux at 25°C/min 6	m	As	4	550 (linear while layer time)	OPEN	OPEN	24 (linear while laver time)		
03 00:12:00.000 go to degas T° under As flux 13	m	As		680 (linear while layer time)			76 (linear while layer time)		
		Ac.							
04 00:25:00.000 wafer degas at 615°C real T° 5	m	AS		640 finess while laves the sh			-		

The *Main recipe editor* is a graphical interface allowing you to easily create your recipe. The created recipe is saved as a '*.rcp*' file.

 Click on the Script tab to display the recipe's script. If you want to edit a recipe using the Script editor, use this tab to copy the script and paste it in the script editor (recommended):





Creating your layers



On the left side of the *Main recipe editor* window, you can create news layers, displayed in a tree structure.

- Use the button is to add a layer or region or to move the selected layer, or region to delete the selected layer.
- Right-click on any of the layers to display other available options.



For each layer, you can expand the list of equipment and associated parameters that have been defined:



Example of a layer

Defining the parameters

In the center of the *Main recipe editor* window, *the Properties* tab displays all equipment and sub equipment and their associated configurable properties, listed in a tree view.

For each layer, you can specify the layer duration, define a background color and then configure and add the desired parameters (properties) to the layer.

Expand the equipment list and select the desired property to configure / add the parameters using the pane below.

The configured parameters will be added to the layer in the tree structure on the left side of the editor window.

Conditional recipes

It is possible to execute a layer only if a condition is true or wait for a condition is true before to continue.

For more information, refer to the document *"CrystalXE_conditional_recipes.pdf"* available on <u>http://ww.crystalxe.com/manuals</u>

Uses variables in recipes

The values used as setpoint for the cells or manipulator and all other values that is used as parameters can be either a constant value or a property or a variable. Click on the following button to open the data explorer:

Value or formula		
		(E.

Graphical representation



On the right side of the editor window, a graphical representation of the recipe allows you to view the chronological sequences (layers) and their time duration.

By default, the substrate appears at the top and the layers are displayed from top to bottom, following a chronological order.

You can invert this representation and display the substrate at the bottom by unchecking the *Substrate on top* box as follows: Substrate on top

Script recipe editor



Click on "*New recipe*" and "*New script (advanced mode)*" located in the top left-hand corner of the recipe interface, to open the *Script editor*.



Use the *Script editor* to create a recipe using Pascal programming language.

The created recipe is saved as a *'.pas'* file.

3.2 Editing an existing recipe



and then

clicking on the pencil icon **recipe** to open the recipe editor.

You can edit either *'.pas'* files (edited with the script editor) or *'.rcp'* files (edited with the recipe editor).

Clicking on the following icon **X** clear the file name input field but <u>does not</u> delete the recipe file.

3.3 Executing a recipe

Click on the following icon in the *Recipe name* input field to select the desired recipe file.

Click on the *Run* button **I** . This will display a popup menu with two choices "Run

now..." and "Run at...". Clicking on "Run at..." allows you to start the recipe later.

Recipe nar

• If you choose to execute a batch at a predefined time you will have this window:

Will start	in: 23 h 59 m	54 s	1929 - 19
Date	10/07/2019	•	Start time preselection
Time	16:55:20	•	Cancel

As soon as you click on the *Start time preselection* button, the system starts counting down and executes the recipe at the fixed time.

• Supervise the execution of the recipe using the Recipe inspector:

Number: 2 Remaining time: 00:02:13 Layer time: 00:02:15 Pause time: Overall status Start time: 09/07/2019 15:50:12 Elapsed time : 00:00:37 Total pause time: Recipe remaining time: 00:02:37 Layer Date / Time Description 2019/07/09 15:50:12,357 Starting recipe "HEMT active layers.rcp" with provide the provided space in the provided space	1	100011100			
- Overall status Start time: 09/07/2019 15:50:12 Elapsed time: 00:00:37 Total pause time: Recipe remaining time: 00:02:37 Layer Date / Time Description 2019/07/09 15:50:12,357 Starting recipe "HEMT active layers.rcp" with y 0001 2019/07/09 15:50:12,361 AlGaAs spacer 0002 2019/07/09 15:50:47,359 AlGaAs:Si donor	Number : 2	Remaining time: 00	:02:13 Layer	time: 00:02:15	Pause time:
Start time: 09/07/2019 15:50:12 Elapsed time: 00:00:37 Total pause time: Recipe remaining time: 00:02:37 Layer Date / Time Description 2019/07/09 15:50:12,357 Starting recipe "HEMT active layers.rcp" with p 0001 2019/07/09 15:50:12,361 AlGaAs spacer 0002 2019/07/09 15:50:47,359 AlGaAs:Si donor	Overall status				
Recipe remaining time: 00:02:37 Layer Date / Time Description 2019/07/09 15:50:12,357 Starting recipe "HEMT active layers.rcp" with y 0001 2019/07/09 15:50:12,361 AlGaAs spacer 0002 2019/07/09 15:50:47,359 AlGaAs:Si donor	Start time: 09/0	07/2019 15:50:12	Elapsed time : 00:00:37	7 Total pause tim	e:
Layer Date / Time Description 2019/07/09 15:50:12,357 Starting recipe "HEMT active layers.rcp" with ; 0001 2019/07/09 15:50:12,361 AlGaAs spacer 0002 2019/07/09 15:50:47,359 AlGaAs:Si donor				Decine remaining tim	e: 00:02:37
2019/07/09 15:50:12,357 Starting recipe "HEMT active layers.rcp" with 0001 2019/07/09 15:50:12,361 AlGaAs spacer 0002 2019/07/09 15:50:47,359 AlGaAs:Si donor				Reuperenaining un	e. 00.02.37
0001 2019/07/09 15:50:12,361 AlGaAs spacer 0002 2019/07/09 15:50:47,359 AlGaAs:Si donor	Layer Date	e / Time	Description	1	e. 00.02.37
0002 2019/07/09 15:50:47,359 AlGaAs:Si donor	Layer Date 2019/	/ Time /07/09 15:50:12,	Description 357 Starting red	recuperentaining un 1 21pe "HEMT activ	e layers.rcp" with pr
	Layer Date 2019/ 0001 2019/	/ Time /07/09 15:50:12, /07/09 15:50:12,	Description 357 Starting red 361 AlGaAs space	reoperendaning din 2 ipe "HEMT activ 2 r	e layers.rcp" with pr
	Layer Date 2019/ 0001 2019/ 0002 2019/	/ Time /07/09 15:50:12, /07/09 15:50:12, /07/09 15:50:47,	Description 357 Starting red 361 AlGaAs space 359 AlGaAs:Si dd	redperential ing unit zipe "HEMT activ ar pnor	e layers.rcp" with pr
	Layer Date 2019/ 0001 2019/ 0002 2019/	/ Time /07/09 15:50:12, /07/09 15:50:12, /07/09 15:50:47,	Description 357 Starting red 361 AlGaAs space 359 AlGaAs:Si dd	redperennaming uni 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	e layers.rcp" with pr
	Layer Date 2019/ 0001 2019/ 0002 2019/	<pre>/ Time /07/09 15:50:12, /07/09 15:50:12, /07/09 15:50:47,</pre>	Description 357 Starting rec 361 AlGaAs space 359 AlGaAs:Si do	redperennaming uni sipe "HEMT activ er onor	e layers.rcp" with p

- The Skip layer button Skip layer allows you to abort the ongoing layer and starts the execution of the next one
- If the box 'Start / Stop system recorder with recipe' is checked, the data recorder will start recording as soon as the recipe starts executing and will stop when the recipe terminates.

Start / Stop system recorder with recipe



4. Charts

The *Charts* tab allows you to easily follow the data using a chart view. Charts are generated automatically depending on your system configuration.

Eile View Tools	4 bits - DEMO_C210Z Editor Satur Wordow Hale	•38
2		
Main 🛐 Load	ing 🕼 Degas_chamber 🗟 C2102 🕼 Parking	, <u>-</u>
Squipment	🌲 Security 👗 Recipe 🖄 Charitis 🔡 Recorder 🎼 Statistics 🐷 Devices	
Run Stop Temperature SP Output power Shutters Pressure Valve pos.	No. Temperature Sf (sch dus) 700- 2 - b - b - b - b - b - b - b - b - b -	A - 4 - 4 - 4 - 4 - 4 - 4 - 4 - 4 -
Others	% Temperature OP (Output Power)	Ga1_ABN50DE_P8.Tp./MV
Show dats Auto scale Auto scale Show Lagend Acquisition time: Curstion (min): O1:23:20 Mem size: 23 Mb 5000 pts/curve		Construction of the second secon
Clear all	Shutters	As_VAC500_P1.Shutter.State
	109633 80541 15950 <u>16469 16</u>	Carl 11 (19 South Carlson
		Tine
All events Criticals 2019/08/28 16:57 2019/08/28 16:57 2019/08/28 16:56 0019/08/28 16:56 0019/08/28 16:56	and warrings Communication User events 505. (pt) User-Class (LICIXA-Wardows Ha, Nuther [Control-0 507. (pt) User-CLIS (LICIXA-Wardows Ps, Shuther] Control-0 535. (pt) User-CLIS (LICIXA-Wardows Ps, Shuther] Control-0 535. (pt) User-CLIS (LICIXA-Wardows Ps, Shuther] Control-0 54. (pt) User-Shuther (LICIXA-USER) (pt) User (pt) (pt) (pt) (pt) (pt) (pt) (pt) (pt)	C Popo andor or alarm

Click on the *Run* button **Run**, in the top left-hand corner of the interface, to run the

• Right-click on a chart to display the available options.



 On the left side of the interface, the following box allows you to display or hide a chart by clicking on it.

The displayed charts are highlighted.



• The charts record the data over the configured time duration. You can **adjust the time duration** using the scroll bar from the settings pane, located on the left side of the interface.

You can increase the duration by increasing the acquisition time.

• Charts <u>are not</u> saved automatically onto your hard disk.

You can **save a chart** by right-clicking on the desired chart and Selecting *File > Save as* and then selecting the desired file format.

You can save a chart as a CHR, CSV or image file.



5. Recorder (data logger)

The recorder saves the main data onto the hard disk.

📄 New 📂 Open/Edit 🔅 Add	
Default recorder	
Record Stop Stopped	
General Column list	
Template : Default	Record number: 54 File number: 0
Output file name : Output file name : Neccord\2019-07-09_15-54-27_C21DZ.csv	
Start time: 09/07/2019 15:54:27 File size: 123 105 bytes	
Trigger mode Time 2 Sec Recipe layers	
The recorder win	ndow

Click on the *Record* button to start recording.

A grey *Record* button indicates that the system is currently recording.



To automatically start the recorder when opening Crystal XE, go to the Options and in the chambers tab, change the "Recorder status" of the relative chamber to "Started".

Record

 If the check box Start/Stop system recorder with recipe located in the Recipe interface, is checked, the recorder will start automatically as soon as a recipe starts executing and will stop when the recipe terminates.

5.1 Saving the data

The recorded data is saved as a '.*csv*' file (text format) that can be accessed from the *Record* folder, in your project directory.

To open your project directory, click on the File menu and select Browse project directory.



Click on the *CSV* icon 3, located in the top right-hand corner of the recorder window, to copy the file onto your hard disk. You can save the data during or after recording.

To open the recorded file, click on the spreadsheet icon 🛅. You can open the file even if the data is still being recorded.



5.2 Recorder templates

On the Template drop-down menu, you can select either:

default template,

or

custom template.



The **default template** records all the main data while a **custom template** allows you to choose only specific data to be recorded.

Lustom template is recommended in order to reduce the size of the generated file.

You can run four different recorders at the same time.

Creating a customized recorder template

The customized template must be created before recording.

Click on the *New* tab **New**, from the recorder tab bar, to open the *Record editor* pop-up window and create a new customized template.

The customized template is saved as a '.rec'.

Template files can be accessed from your project directory > *Record* > *Template*.

To open your project directory, click on the File menu and select Browse project directory.

Opening a customized record template

Click on the *Add* tab Add and select the desired customized template file.

Or, on the Template drop-down list, select Custom Template : Custom and click on the file icon icon icon below to open the desired customized template file.

Editing a customized record template

To edit an existing customized template file, click on the *Open/Edit* tab *open/Edit*, from the recorder tab bar. Select the desired template file to open the *Record editor* pop-up window.

Or click on the pencil icon *in the top left-hand corner of the recorder window.*





6. Devices



The *Devices* tab displays all the electronic devices that are able to communicate with Crystal XE and easily detect a communication or a connection problem.

If the connection has failed, the following alert icon will appear over the device icon as follows:



The absence of icon indicates that the connection has succeeded.

Right-click on a device to display the available options:

- analysing the connection to the device (select Analyser),
- configuring the device (select Setup),
- enabling / disabling the device (select *Disable*).

VII. PLATENS AUTOMATION

The *Automation* tab allows you to create, edit or run production batches. The *Automation* feature is available only with the MBE systems that are equipped with a transportation system like a cluster or a pick and place (MBE49,6000,8000)

In Crystal XE, a batch is used to organize the movements of one or more platens in the MBE system.

For each platen, you can define its path to follow by selecting:

- The first chamber,
- One or several process chambers and at least one recipe to be executed in,
- The last chamber.

For each of these steps, you can also define the position of the platen in the cassette.

1. Creating a new batch

Click on the *New* batch button New batch to open the batch editor.

Crystal XE asks you if the platen positions in the system must be loaded (unavailable in simulation mode). Select *Yes* (recommended) to open the *Batch editor* pop-up window.

The batch is saved as a *'.batch'* file that can be accessed in your project directory / *Batch*. To open the project directory, click on the *File* menu and select *Browse project directory*.

2. Batch editor overview

The platens are displayed in the following pane located on the left side of the Batch editor.



Platens are assigned a default order (in parenthesis).

You can change a platen order using the drop-down list in the Platen description box:



The platen numbers must match those defined with the touch panel of the cluster PLC (Programmable Logic Controller).

Select the desired platen (check the box) to define its path.

INNOVATIVE SOL	. U T I (DNS FOR SEM	ICONDU	CTOR INDUSTRY	RIBER	
RIBER ADDON VG	SEMI	CON				
MI 🛛	Bato	h properties Selected p	laten			
Batch properties		laten description				
🗹 🏐 Platen 1 (1)	Order 1 💌 Description					
Platen 2 (2)						
💚 Platen 3 (3)		Chamber	Position	Recipe	Post recipe	
Platen 4 (4)		Loading	1			
		Degas_chamber	1	Degas_chamber\test.rcp		
		C21DZ	1	C21DZ\HEMT growth.rcp		
		Loading	1			

Platen path

The path of the platen in the MBE system is composed of several configurable steps:

#	Chamber	Position	Recipe	Post recipe
1	Loading	1		
2	Degas_chamber	1	Degas_chamber\test.rcp	
3	C21DZ	1	C21DZ\HEMT growth.rcp	
4	Loading	1		

In the example just above, the platen will move from the load chamber at position 1 to the degas chamber and it will execute the recipe test.rcp located in the Degas_chamber sub directory.

When the recipe will be terminated, the platen will move to the growth chamber C21DZ and run the recipe HEMT growth.rcp. When the recipe will be terminated, the platen will move back to the load chamber at the same position.

To optimize platens processing time then when a recipe is running, Crystal can move another tray to another location and run another recipe.

For each step, select your choice from the corresponding drop-drop list:

• Chamber (required)

The platen will be dropped to this chamber. The list displays the chambers that are connected to the cluster only.

Position (required)

The position in the cassette, if several platens can be stored in the chamber

• **Recipe** (required for process chambers)

The recipe to be executed in the selected chamber

Post recipe (optional)

A second recipe will start as soon as the first recipe ends.

 If the batch contains an error, a message warns you and the platen icon turns red as follows:

All	Batc	n properties Selected	d platen			
Batch properties	PI PI	aten description				
✓ 🔮 Platen 1 (1)	Ord	ler 1 🔻 De	escription			
Platen 2 (2)	Line	#3 : Recipe is not	defined			
Platen 3 (3)	#	Chamber	Position	Recipe	Post recipe	
Platen 4 (4)	1	Loading	1			
Platen 5 (5)	2	C21DZ	1	C21DZ\test.rcp		
Platen 6 (6)	3	Degas_chamber	1			

Error examples:

- no recipe selected when required
- two platens start at the same position in the cassette



Batch properties

Click on the Batch properties tab to display the configurable options of the Batch editor.



Batch process options

Batch process options

- Limit the number of platens processed at the same time to 2
- Use a free position in a no process chamber (load,unload, etc...) for swaping
- Wait for a platen to be present at the starting position (do not stop the batch)
- Wait if a platen is present at the destination (do not stop the batch)

Limit the number of platens processed at the same time.	By default, a maximum of platens is processed simultaneously. You can limit the number of platens to be processed at the same time by checking the following box and selecting the desired number
Use a free position in a no process chamber (load, unload, etc) for swapping.	If two platens need to be dropped to the same chamber, you might need swapping the platens. Check this box to allow the cluster to swap platens to an auxiliary storage when needed.
Wait for a platen to be present at the starting position (do not stop the batch)	This option is useful when you want to perform continuous production. This allows the operator to unload the platen, reload another one and start the same path again.
Wait if a platen is present at the destination (do not stop the batch)	This option allows you to unload the platens always in the same place.

RIBER

RIBER ADDON VG SEMICON

Editor options

Editor options

- 🔲 Start a path anywhere (even a process chamber) 🔲 Terminate a path anywhere
- Recipe is not necessary when platen is moved into a process chamber
- Allow multiple path to start at the same position
- Allow multiple path to terminate at the same position

Start a path anywhere (even a process chamber) Terminate a path anywhere	By default, a platen may not start or terminate its path in a growth chamber. Check either one or both boxes to allow the platens to start or/and terminate their path in any of the chambers
Recipe is not necessary when platen is moved into a process chamber.	By default, some chambers require at least one recipe to be defined. You can allow the batch to be executed even if no recipe has been defined by checking this box.
Allow multiple path to start at the same position Allow multiple path to terminate at the same position	These options are useful when you want to perform continuous production.

3. Editing an existing batch

Click on the *Open/Edit* button *open/Edit* and select the desired file. The file will open in the batch editor.

Or you can click on the file icon prize to open the desired file and then click on the pencil icon real to open it in the Batch editor.



Clicking on the following icon **E** clears the *Batch name* file input field but <u>doest not</u> delete the batch file.

4. Executing a batch

On the *Batch name* file input field, click on the file icon **batch** to open the desired batch file.



Click on the *Run* button to start the batch.



This will display a popup menu with two choices "Run now..." and "Run at...". Clicking on "Run at..." allows you to start the recipe later.



During an ongoing movement, if you click either on *Pause* or *Stop* buttons, the platens will stop only once this movement has been completed. When paused, click on Resume to start the next movement.

• If you choose to execute a batch at a predefined time you will have this window:

Will start	in: 23 h 59 m	54 s	
Date	10/07/2019	-	Start time preselection
Time	16:55:20	-	Cancel

As soon as you click on the *Run* button, the system starts counting down and executes the batch at the fixed time:

- Overall status	
Start time: 09/07/2019 16:55:50	Elapsed time : 00:00:06

- You can execute the same batch over and over by checking the *Infinite batch* box <u>Infinite batch</u>. The batch will automatically start again when all the platen will be completely terminated. Click on the *Stop* button to end the loop.
- Select le choice Infinite path v to restart automatically each platen path independently when it is completed. This choice is different from the infinite batch because it does not wait until the other platens are finished.
- You can can monitor the execution of the recipe using the *Recipe inspector* window. On a process chamber column, click on desired platen and then click on the flask icon to open the *Recipe inspector* in a pop-up window.







• The chronogram displays in a table the different movements of the platens. Each column represents the movement of a platen from one position to another.

Detach Clear 🗾	Platens	Expo	rt Co	olumn widt	n 50 🥃	3
Step	1	2	3	4	5	6
Date	19/08/29	19/08/29	19/08/29	19/08/29	19/08/29	19/08/29
Time	14:14:05	14:14:14	14:14:18	14:15:17	14:15:21	14:15:41
Relative time	00:00:00	00:00:08	00:00:13	00:01:11	00:01:15	00:01:36
Duration	-	00:00:08	00:00:04	00:00:58	00:00:03	00:00:20
Loading			2 2	1 1 ³		1 2 ²
Degas_chamber	• 1		* ②		2	
C21DZ		• 1		1 1	• 2	12
Parking						
			10			- C.
Move time	3 sec	3 sec	3 sec	3 sec	3 sec	3 sec
	the second s	the second s			the second s	

Chronogram is saved automatically in a text file as '.csv' files to the Log folder, in your project directory.

To open your project directory, click on the File menu and select Browse project directory.

Click on the Info button I Platens to open the Platens information pop-up window.



For each selected platen, the *Platens information* windows gives you the date and exact time the platen was dropped into a chamber and allow you to control whether the path was correctly executed.