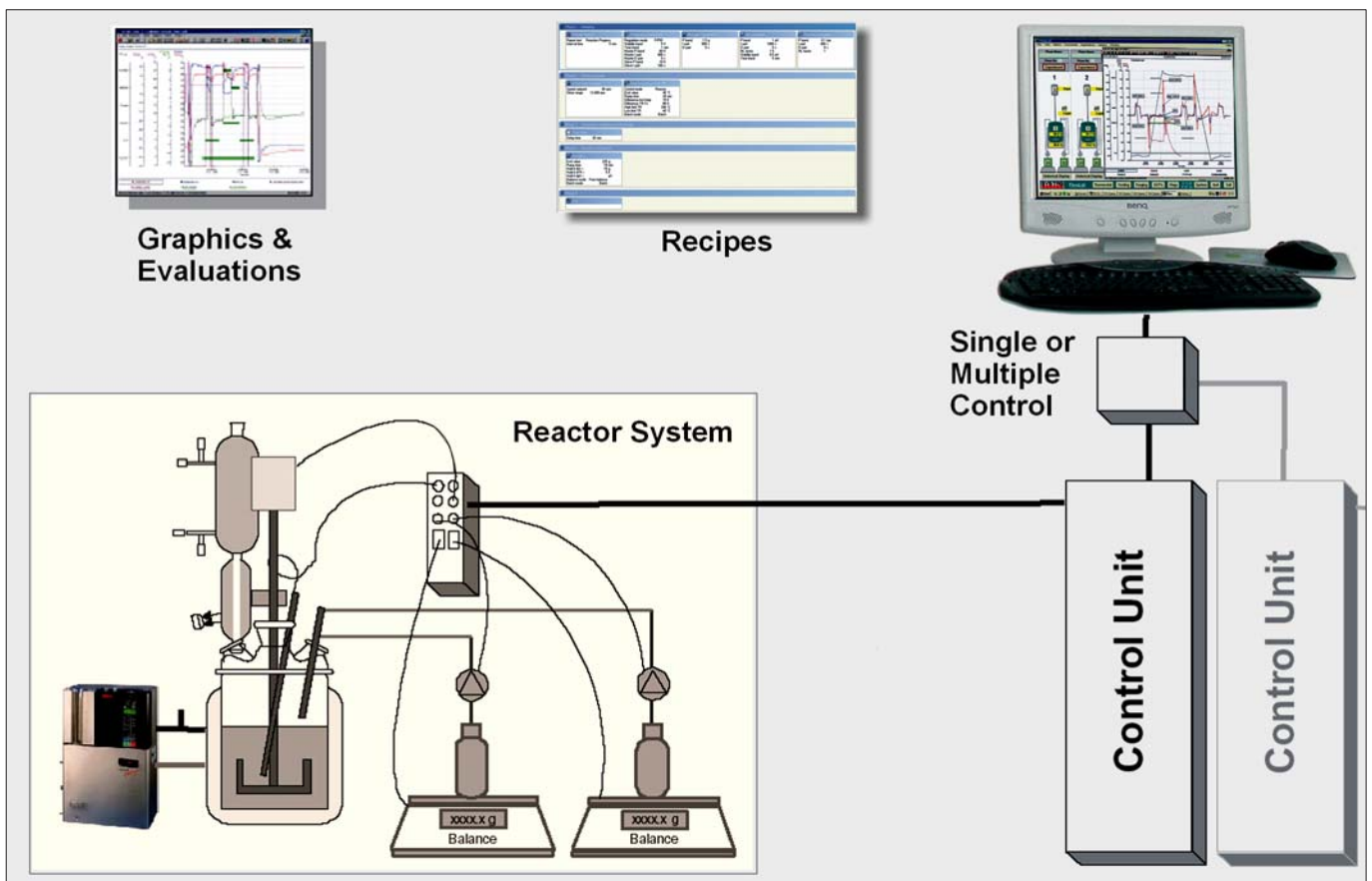




# FlexyALR

A single operating platform for your complete development process requirements



The major advantages of a standardised software programme for a complete chemical development process are:

- Minimum training effort, easily understood
- High degree of flexibility when selecting resources
- Existing and well proven principles are retained
- Operation identical to FlexyLab, FlexyScaleUp and Calorimetry instruments

## The FlexyConcept

### Aim

The FlexyConcept aims at applying a consistent operating philosophy throughout the process development process. Only a functionally flexible and highly refined software will cover applications from process research to pilot plant, as the most varied requirements must be met.

The FlexyALR is based on the Flexy-Concept, the same as FlexyLab, FlexyScaleUp, Reaction Calorimetry or Thermal Analyses.

### The FlexyALR

The most outstanding feature of the FlexyALR is its modularity down to its individual components. It is primarily suitable to develop systems, which can be built up with capacities from 0.1 l to 100 l.

If it is required to operate a number of reactors with a single PC, the concept will accommodate this, as well as cascading a number of reactors to simulate a complete process flow.

### FlexyALR Applications

Applications are most versatile due to its modular design and cover the following areas:

- Process Research
- Process Optimisation
- Scale-up
- Pilot-Plant

## Functions of FlexyALR

### Standard ALR System

A typical standard system comprises the following functions:

- Gravimetric dosing facilities
- Temperature control of jacket and reactor
- Stirring
- pH Measurement
- Refluxing
- Crystallisation
- Easy Inertisation
- Accurate data recording

### ALR Options

A large number of options are available to expand the basic functions:

- Distillation
- Reflux splitter
- pH Control
- Pressure and vacuum control
- Hydrogenation
- Efficient removal of reactants-purging
- pH Stabilisation
- Isothermal heatflow calorimetry

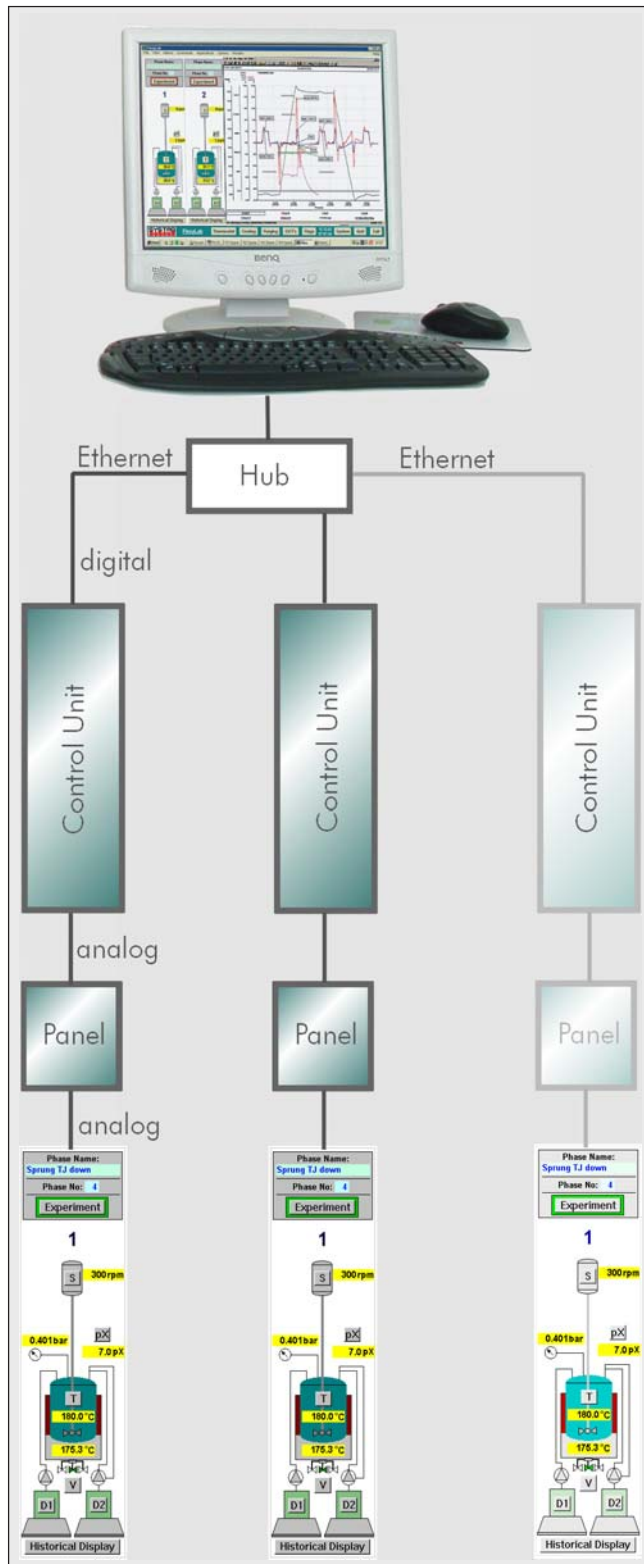
### Additional ALR instruments for:

- Turbidity measurement
- midIR or NIR measurement
- Incorporation of particle size analyses

### Customer Hardware Utilisation

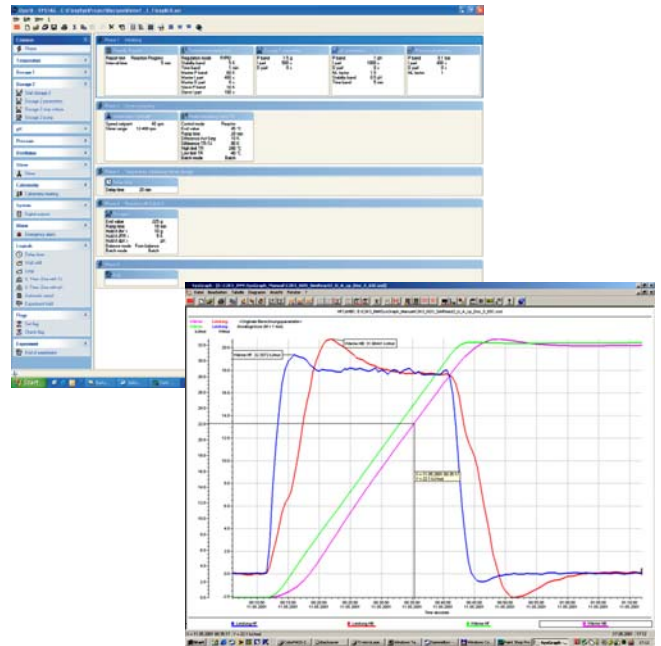
The FlexyALR Concept very often allows the use of already existing hardware. This will not only save costs, but will also speed up the automation process.

## FlexyALR means: 1 single PC, up to 6 independently operated reactors



### Recipe Editor

Familiar „drag and drop“ structure with a large function range and customer specific adaptations result in best possible flexibility.



### SysGraph

A powerful graphics package for graphics, mathematical calculations and evaluations.

### Expansion Capability

The state of the art process guidance system, which is based on Ethernet, allows an expansion of up to 6 independent FlexyALR's.

### Location

Because hardware is independently available on each reactor system, it can be located anywhere in a space near the reactor. Only a single Ethernet cable is required as a connection to the central PC.

### Remote Control

By means of remote control facilities, flexibility becomes „unlimited“. You are always „up to date“ whether in the office or away.

## Details: Equipment, Interfaces and Functions

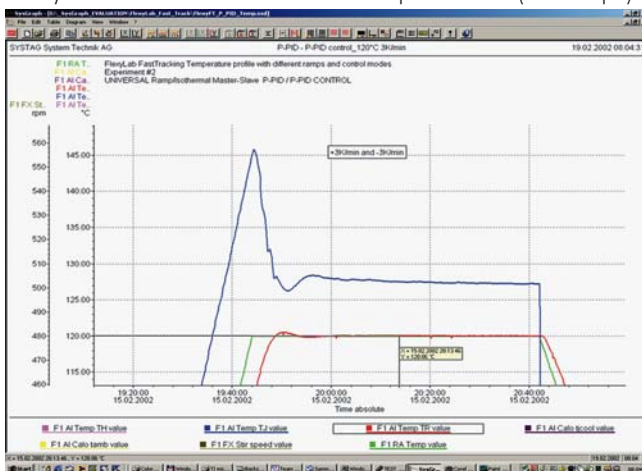
### Temperature Control

- Use of all popular thermostats (Huber, Julabo, Lauda..)
- Standard interface analog; RS-232 if required
- Alternative electrical heating; cooling with liquid cooling medium and valve (ideal when using autoclaves)
- Jacket and reactor control
- Only final temperature value and ramping time input required
- Individually selectable safety limits
- Control in emergency situations with preselected temperature values

### Stirring

- By means of regular stirrer drives such as IKA, Heidolph etc.
- Standard interface; RS-232 if required
- Alternative choice of multiphase motors with frequency converters
- Selection of stirrer types: Anchor, Propeller, Basket etc.
- Stirrers made from glass, steel, with PTFE type coatings
- Stirrer glands from PTFE, slip ring seals or magnetic couplings (stainless steel or Hastelloy)
- Stirrer speed and torque measurement
- Pre-programmable stirrer speed for emergencies

Presentation of control results using P-PID Mode in FlexyLab: only minimal variations of Reactor-Temperature TR (red Graph)



### Dosing

- Most commonly used membrane and peristaltic pumps and dosing valves can be integrated
- Dosing by balance or controlled by percentage
- Temperature controlled dosing
- Only final weight and dosing time input is required
- In temperature or pressure emergencies dosing will be immediately discontinued
- Two gravimetric dosing facilities available (standard version)

### pH

- Temperature compensation is automatically applied, depending on reactor temperature
- Semi-automatic calibration
- The concept allows a pH control from dosing unit No. 2 by either using an acid or alkali
- The pH can be controlled as a fixed or ramped value



Possible Configuration of a 2 l ALR with Double Jacketed Reactor

## Additional Options

A number of useful options can supplement the basic system. The following is a list of options, which is by no means complete.

### Reflux and Distillation

- Automatic recognition of boiling point, selectable from head or reactor temperature.
- Automatic compensation of the jacket temperature with a lead allowance in relation to the reactor temperature.
- Change-over from reflux to distillation, or reflux splitting respectively.
- Automatic termination of the distillation process based on a variety of termination criteria.

### Pressure and Vacuum

- Pressure measurement for selectable ranges: 0 -1.6 bar, 0 -10 bar and 0 -100 bar.
- Pressure, vacuum and venting can either be controlled as a percentage, a single or dual control.
- Different valves and pressure transmitters for each pressure range available.
- Only valves for the 0 -1.6 bar range can be equipped with PTFE or similar, valves for all other ranges can only be supplied in a stainless steel version.

### Turbidity Measurement

- For detection of turbidity and recipe progression, suitable measuring equipment can be supplied.

### midIR FTIR

- midIR FTIR is ideally suited for the on-line recognition of a reaction. We can implement such systems in your ALR complete with data transfer from FTIR to the ALR and vice-versa.

### On-line Particle Analysis

- Particle analysers are often used for the on-line measurement of a crystallisation process. We are able to install such systems complete with data transfer from the instrument to the ALR and conversely.

## Manual Operation

### Very Easy Handling

#### Manually via Screen

The manual operation via screen allows you to immediately start with first experiments! Starting from the main panel, you can get to the parameter window of every reactor just by a simple mouse-click. In the parameter window, you can enter the required values for temperature, dosing or stirrer speed and your experiment will be executed.

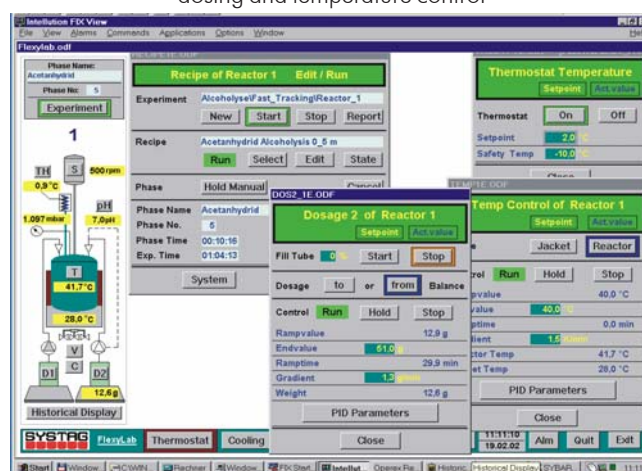
Of course, you can change at any time the various parameters defined or terminate the experiment by going through the same procedure.

In case you made an observation during your reaction or manually added a further reactant, logging of this event is advised. Just use the built-in logging function to enter a corresponding text and have the log date and time, as well as the most important data of the experiment added automatically. This option allows – besides the logging of data – to draw up a protocol to every single experiment! With FlexyALR, logging of your experiments is easy thing to do!

#### Manual Report Function

To record specific observations and comments, a manual report function is provided. In addition to comments by the operator up to 6 pre-defined variables can be recorded. For this the control is set to "Manual". A data file for recording is opened at the same time.

Synoptical screen with open sub-panel for recipe, dosing and temperature control



## Automated Programmable Run-Control

### Automated with Program

**FlexyALR** will be especially useful when operated with the easy-to-use programmable run-control! Each reactor unit is equipped with an individual run-control. You are free to choose whether you want to start several experiments at the same time or not.

Existing programs can easily be adjusted to suit new needs by change of parameters or insertion/deletion or basic operations. You will minimize the time requirement of each experiment by adapting existing programs.

Without much training you will program your individual experiment, based on an EXCEL table. With copy/paste you can insert the desired functions (basic operations) at the desired point of your program. Subsequently, the various parameters (temperature, time, dosing, etc.) are entered and the experiment can be started using the programmed run-control.

Basic operations for temperature-controlled dosing or emergency alert functions (emergency alert) allow unsupervised operation during nighttime. Even with automated run-control you can manually intervene at any time, change parameters or even interrupt stages of the experiment. Of course, you can alter or correct a running program at any time.

Thanks to a variety of basic operations you can program even complex tasks in an easy way. In addition to the actual control functions, such as

- temperature control
- dosing and
- stirrer control

you will find so-called “event basic operations”, such as

- wait until
- if...then...else
- loop
- hold
- timer.

If you want to wait at a certain stage of the experiment until, e.g., a given temperature or waiting time is reached, you can program this using the operation “wait until”. And/or relations increase the flexibility of this operation.

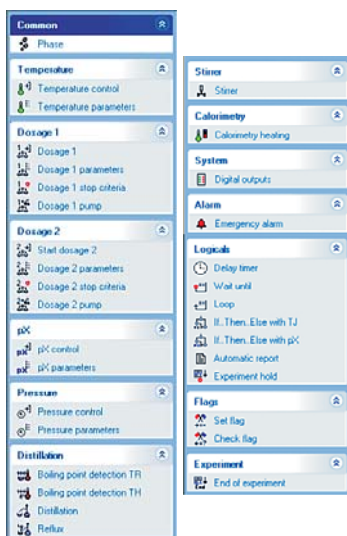
### If...Then...Else

The basic operation “if...then...else” allows you to exercise an influence on the course of a program depending on the value of a given parameter. You can insert this event operation whenever you have to make a “either...or” decision.

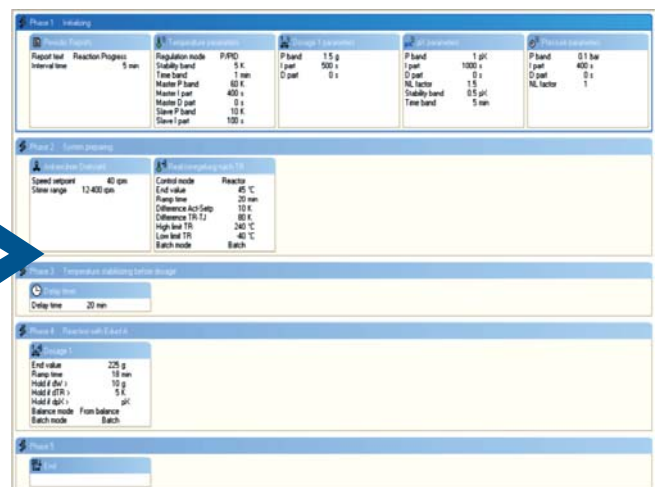
### Synchronisation

Synchronizing several recipes by means of “flags” makes it possible to cascade reactors. Intermediate reaction products can be fully automatically transferred into any other chosen reactor.

Detail of basic operations for programmed run-control



Detail of a program built from basic operations



## Excellent Data Logging and Analysis

### Hold

The "Hold" function is of vital importance if, during a particular stage of the experiment a manual intervention is expected to be performed. Especially if an analysis requires periodical sampling, or if a manual addition to the reactor is required, as, e.g., "add catalyst", the hold function is used.

By that means you are guaranteed, that a certain action at a defined time is not affected by external influences!

### Timer

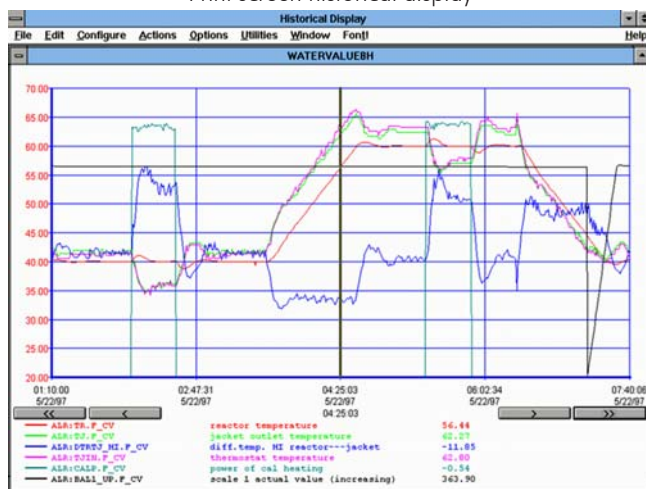
The timer function allows you to insert an absolutely reproducible waiting time at any stage of the experiment.

### Data Logging

All raw data are logged continuously during experiments. The historical display will give comprehensive informations about the course of an experiment at any time.

Individual, clearly arranged historical graphs can be produced for every reactor unit. Selected time ranges can be transferred to other Windows applications, such as **SysGraph** or Excel, for further modification just on mouseclick.

Print screen historical display



An efficient project management tool is included to allow unequivocal relation of logged data to corresponding experiments on a long-term basis. Backup of data on external media (network) is also possible.

### Automatic Report Writing

All critical activities such as the start of recipe phases and other inputs are presented in an automatically generated report. This report can be appended by the operator at a later stage.

### Data Analysis

The interpretation of a test series with various parameters becomes more difficult with increasing number of experiments. On demand, **FlexyALR** will support you on this task with the flexible graphic tool **SysGraph**.

Whether you want to display several experiments in one graph or compare different trends, **SysGraph** will assist you in an optimal way. Even statistical calculations become like mere child's play.

Further details on this optional tool can be found in the brochure «SysGraph, the powerful graphic tool for all SYSTAG applications».

Window with 2 charts in SysGraph, ideal for multiple graphs and mathematical analysis



## Technical Specifications

<b>FlexyALR Reactor- System</b>	<b>Reactor FlexyALR</b>	
	Capacity, materials of construction	100 ml to 5 l (typical), Borosilicate glass, stainless steel or Hastelloy
	Lid with connections	Glass lid with NS couplings, Steel lid, commonly with SwageLok couplings
	Temperature range	Standard -40°C to +200°C, extended approx. -80°C bis +280°C
	Heating/Cooling system	Standard Thermostats: Huber, Lauda, Julabo or similar, integrated with cooling unit. Alternatively with electric jacket heating (up to 400VAC and 4 kW) with water cooling, brine or from a central thermostat/cryostat. Cooling capacity depending on configuration up to 4 kW.
	Stirrer	Commonly Heidolph or IKA Stirrers with ranges from approx. 40 - 2000 rpm and torque of up to 200 Ncm. Alternatively 3 phase motor with frequency converter, any required output.
	Reflux Condenser	High performance cooler using mains water, approx. 20 l/h consumption
	<b>Dosing</b>	
	2 x simultaneously gravimetric Dosing Pumps	2 x Scales, typically 6000 g capacity, 0.1 g resolution. Ranges expandable up to 60kg
	Dosing Valves	Membrane pumps, e.g. Prominent, Peristaltic pumps e.g. Ismatec or Masterflex Optional: Parallel operated outlets with magnetic valves in place of pumps are available.
Dosing Capacity and Materials	Dependent on type of pump/valve and/or tube diameter. Novoprene (Standard), Silicon, Viton, PTFE (Masterflex).	
<b>Dimensions/Other Data</b>		
Operating range	10 - 35°C (ambient temperature)	
Mains	230/400 VAC, 10 - 25 A, 50 or 60 Hz, continuous (no interruptions)	
Power Consumption	Depending on thermostat or reactor heating unit	
Assembly	Normally inside the standard fume cupboard cover using the fastening elements provided. Optional: Free-standing frame can be supplied.	
Dimensions reactor unit	Typically for 1 - 3 l reactor: 1500 x 600 x 600 mm (Height x Length x Depth)	
<b>FlexyALR Control- Unit</b>	<b>General Data &amp; PC</b>	
	FlexyALR Control Unit	PC with Windows XP. Must be obtained from SYSTAG to ensure compatibility
	Operating range	1 Processor unit per reactor, 12/16-bit A/D inverter, Ethernet interface
	Mains	10 - 35°C (ambient temperature)
	Power consumption (PC incl.)	230 VAC, 10 A, 50 or 60 Hz, single phase continuous (no interruptions) Single phase approx. 400 WAC, PC included but without Scales, Pumps, Stirrer Motor, Thermostat and Electric Heating (if present)
	Dimensions (control unit)	220 x 520 x 350 mm (Height x Length x Depth), space requirements for plugs to be approx. 15 kg (added).
	Weight (control unit)	
	<b>Data Collection</b>	
	Online-Recording of	Temperature Set Value, Reactor and Jacket Temperature, Stirrer Speed and Torque, Balance 1, Balance 2. Optional: pH, Head Temperature, Vacuum, Pressure
	Continuous Logging	All manual and recipe interventions are continuously recorded
Temperature measuring range	-100°C to +300°C with Pt-100	
Resolution of temp. measuring	< 0.1K. Optional: High sensitivity < 0.01K is available	
Scan/Recording Intervals	<1/s scan control, every 10 s for logging file (standard)	
<b>Control &amp; Signals</b>		
Stirrer	Set value signal 0 - 10 VDC, respectively RS-232	
Temperature	PID controller PI-P for cascading respectively, with circuit changes P-P, P-PID, PID-PID	
Jacket/Reactor Control	Jacket or Reactor control (cascade) freely selectable, also in recipe	
Thermostat	Set value 4 - 20 mA, RS-232 and ON/OFF respectively (if present)	
Dosing 1 and 2	2 Independent dosing facilities with pumps (control each 0 - 10 VDC or 4 - 20 mA), PID. When using magnetic valves time proportional ON/OFF control 24 VDC.	
<b>OPTIONS</b>		
pH Control	Compensation using reactor temperature, calibration with manual temperature input. Single sided control (acid or alkali) using Balance 2	
Vacuum/Pressure Control	0-1600 mbar for glass reactors, 0 - 10 or 100 bar for pressure vessels. Control of vacuum, venting and pressure by means of magnetic valves (duty-cycle ON/OFF)	
Still Head Temp. Meas. for Distillation	Measuring range -100°C to +300°C with Pt-100	
Reflux Splitter Control	24 VDC solenoid, reflux and drainage time each programmable from 1 to 9999 secs.	