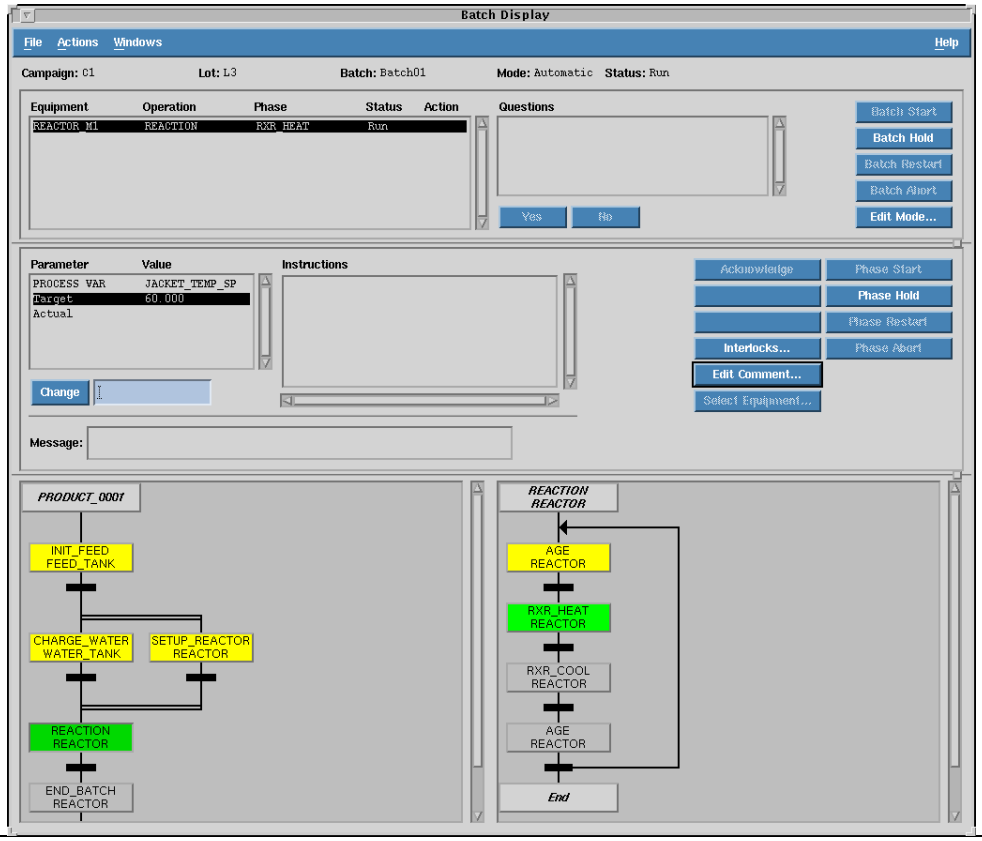
I/A Series® Software
FoxBatch



FoxBatch provides comprehensive batch control solutions to process industries, such as food, beverage, pharmaceuticals, and fine chemicals.

The I/A Series FoxBatch package automates plant batch production control activities and provides an integrated environment for recipe management, materials tracking, process management, and production information management.

It is a fully-configurable graphical software package serving as an equipment-independent interface to batch production processes. FoxBatch follows the ISA Batch Control Standard: S88, Part 1 and NAMUR NE33. It also supports IEC 1131-3 compliance-based graphical recipe configuration and monitoring. FoxBatch features enhanced security in accordance with FDA guidelines.

FoxBatch offers significant advantages:

- Reduces the life-cycle engineering effort and facilitates recipe development and updating.
- Reduces dependence on system experts (Recipe configuration can be done by process engineers or chemists.)
- Speeds batch processing for greater production capability.
- Produces more consistent batches that meet tighter tolerances.
- Provides flexibility for manufacturing different products and grades of products and quick switch over between products.
- Offers extensive data collection and batch production reports that help in production tuning and in meeting FDA requirements.
- Provides expandability from entry-level system to large installations while maintaining full functionality.

OVERVIEW

FoxBatch is an easy-to-use graphical control package that requires no programming. A model of the process is created interactively on workstation display screens with icons and selections from pull-down menus. Recipes are configured by specifying unit and phase data interactively. The recipes are represented graphically in IEC 1131-3 based sequential function charts.

FoxBatch provides recipe management, production information management functions, and an appropriate environment for hierarchical structuring of batch process control.

BENEFITS

FoxBatch is a graphically configurable package that allows a process engineer to use it without having to learn a programming language. It makes the addition and modification of recipes very easy and cost-effective. Operators can create batches, assign equipment, and run batches in automatic, semi-automatic, or manual mode allowing maximum flexibility.

The FoxBatch hierarchical management and control structure allows plant engineers to maintain the system easily. By splitting the logic into real-time process control (the phases running in sequence blocks) and into supervisory control (FoxBatch), a top-down/bottom-up approach allows a structured and efficient implementation of batch projects. All configuration data, recipes, and batch records in FoxBatch are kept in relational databases that interface with other applications and business information systems.

FEATURES

The major batch development and execution features in the FoxBatch package include:

- Various process modeling options for creating a plant/process model.
- Tracking and reporting on process materials, from raw ingredients through finished products.
- Master recipe configuration and maintenance functions with provisions for keeping revision records.
- A pre-production approval mechanism for master recipes.
- Control recipe configuration when new batches are specified, and ingredient quantity scaling for specific batch sizes.
- Downloading of formula variables and specification of orderly phase execution during a batch production cycle.
- A set of intuitive and graphical human interface screens for batch execution, along with the capabilities of adding additional application-dependent interfaces.
- Batch execution in simulation mode where each recipe phase remains active for a predetermined amount of time, allowing for recipe verification and validation without process interaction.
- Priority-based execution of batches, where priorities can be specified or modified manually.
- Batch tracking and reporting functions.
- A security system that supports FDA guidelines.

MATERIALS TRACKING MANAGEMENT

Materials tracking management defines materials as ingredients, intermediates, finished goods, byproducts and others, along with the characteristics of each material. The FoxBatch materials database is used to automatically track the location of materials stored in different units.

The batch management function uses the ingredients location data to get ingredients during the manufacture of a batch. This capability allows ingredient locations to be independent of recipes and control programs and permits ingredients to change location with no effect on recipe execution providing that a comprehensive process model is used.

The unit location can be entered in the materials database by plant personnel, when new ingredients are received. A lot identification can also be assigned to a material, and multiple lots of the same ingredient can be stored in the same vessel. The batch management system updates the database when ingredients are used and when intermediates and finished goods are produced.

The materials database provides for easy access to Work in Process (WIP) information and can be used to update higher level management and Material Resource Planning (MRP) systems with ingredient usage, work-in-process, and finished goods production information. Materials tracking management can be used to complement an existing inventory system.

PROCESS MODELING

A batch processing plant is made up of units, unit classes, various connections, transfer classes, process phases, and transfer phases.

- A unit is a group of processing equipment that processes materials such as reactors, mixers, blenders, and retorts. A unit can also simply hold materials. Examples are manual add stations, hold tanks, bulk storage vessels, and filling stations.
- Process classes are groups of units. Each unit in the class has the same processing capabilities and/or performs the same function.
- A train is a group of associated units that represent the natural processing lines in terms of material flow through a plant.
- Connections define a group of equipment that transfer material from a source unit to a destination unit. All connections between units must be defined when configuring the process model.
- Transfer classes define a group of connections where all source units are in the same process class and all destination units are in the same process class.
- Process phases with their parameters define the capability of process classes.
- Transfer phases with their parameters define the transfer capabilities of the transfer classes.

FoxBatch supports two approaches to structure the batch process plant into the process model:

- The Comprehensive Model approach
- The Connectionless approach

The Comprehensive Model approach uses all the available configuration tools of FoxBatch using process classes as well as transfer classes, while the Connectionless approach only deals with the definition of process classes. In this case, the movement of material between units is accom-plished using complementary transfer phases that get assigned to a process class rather than to a connection class.

The process model also specifies the relationship between the tags used in workstations and controllers. Initially, FoxBatch generates default relationships which can be modified during the modeling process.

Process modeling consists of the following steps:

1. Identify each unit and its attributes.
2. Group units into process classes.
3. Identify connections between units.
4. Group connections into transfer classes.
5. Define the processing capabilities of each process class by specifying process phases and parameters.
6. Define the transferring capabilities of each transfer class by specifying transfer phases and parameters.

An integral part of process modeling involves defining specific data points, called tags, for units, processes, connections, and transfers. Tags allow the mapping of data between workstations and the controllers.

PROCESS MANAGEMENT

Batch Scheduling

A batch is scheduled by entering the campaign, lot, batch, and recipe name. Also, the train needs to be selected along with the batch size and the mode. The mode could be automatic, semi-automatic, or manual.

AUTO: In automatic mode, the default mode, the unit operations and phases are activated automatically as specified in the recipe.

SEMI-AUTO: In semi-automatic mode, the operator must start each phase manually. The order of phases is specified in the recipe.

MANUAL: In manual mode, the operator can select any available phase in the recipe to be performed next. For example, manual mode would allow an operator to retry a failed phase or to choose DISCHARGE and dump a batch immediately.

The batch scheduling function maintains a list of batches to be produced and allows priority based execution of batches, where the priorities can be manually specified or modified.

Batch Validation

Once selected, a batch must be validated before it can execute. Validation of a batch consists of:

- Verification for recipe existence in the database.
- Verification of process model references made from the recipe.
- Verification of materials database references made from the recipe.
- Verification of train existence.
- Verification of the batch size against the allowed boundaries.

Batch Management

When a batch executes, the Batch Manager directs and supervises the run. Based on the recipe procedure, phases are executed in sequential and parallel fashions after checking that the appropriate transition conditions are satisfied.

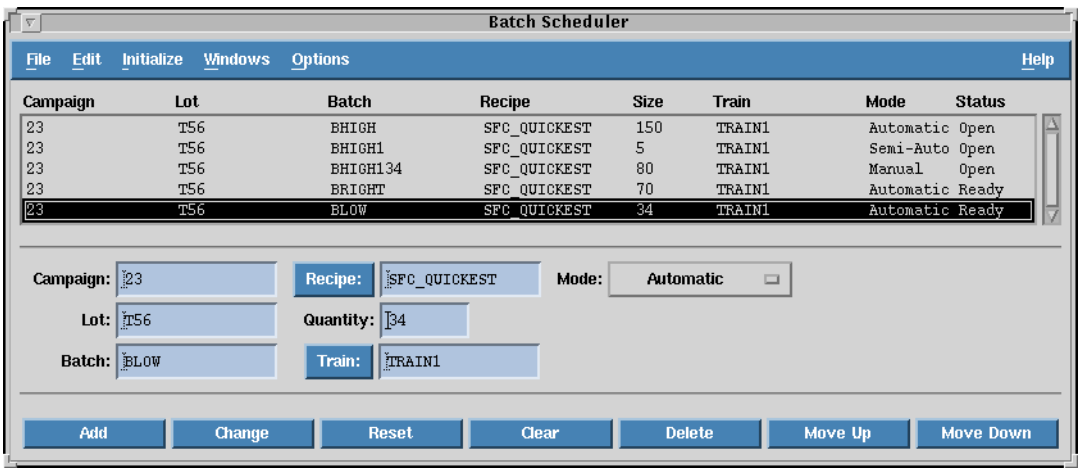
The batch manager also interfaces with batch display modules and provides operators with information on the batches running in the system. The Batch Manager coordinates the usage of process units for each batch and allocates units as they are available, within the specified train. Unit selection can also be done manually. The Batch Manager captures all batch execution events and operator activities during the execution of a batch and sends this information to the historical database.

Restart Capability

The batch management system is designed with warm restart functionality. This capability allows automatic recovery and normal execution after system shutdowns due to hardware or other problems. During the execution of batches, all pertinent information such as batch names, operation and phase pointers and equipment allocation are saved automatically. In the event of a system restart, all this information is retrieved to restore the batches that were running.

Simulating Batches

FoxBatch allows batches to be run in a simulation mode, where batches are created and run without actually starting the phases in a control processor. The user specifies a global phase duration time to permit operator interaction during the simulated execution.



FoxBatch Schedule Display

RECIPE MANAGEMENT

The recipe management function provides the environment to configure, copy, and modify master recipes in an IEC 1131-3 graphical environment. The recipe structures follow the ISA Batch Control Standard: S88, Part 1.

FoxBatch provides the environment for maintaining version history of a master recipe with date and time stamp, author name, and optional comments. Up to five levels of recipe approvals can be implemented.

A master recipe is scalable to the batch size specified manually or by production schedule. All formula quantities for ingredients, intermediates, by-products, and finished goods are scalable and can be entered either as actual quantities or as a percent of the total batch size.

PRODUCTION INFORMATION MANAGEMENT

The production information management can be divided into the following functions.

- Historian
- Historian Archive Manager
- Process Logger
- Report System

Historian

The function of the FoxBatch Historian is to store all information related to the production of a batch. This includes events, process data, production information, material usage, operator comments, operator actions and equipment usage.

Historian Archive Manager

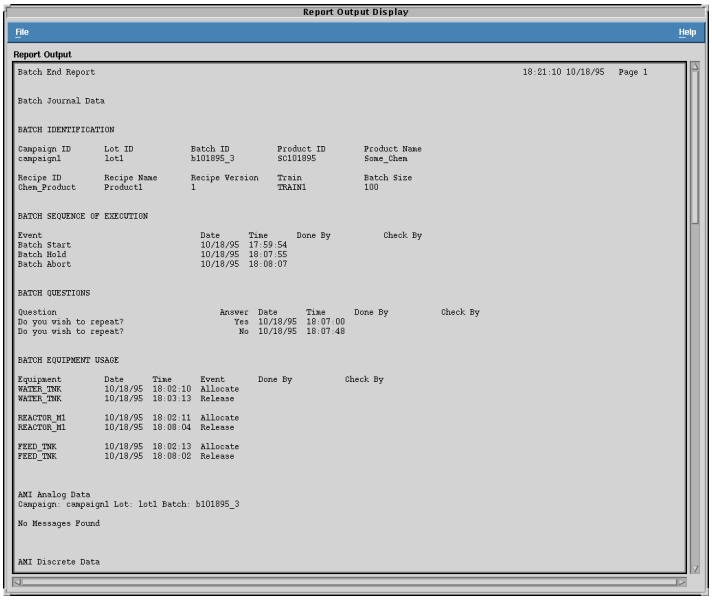
The Archive Manager is responsible for purging old records from the Historian and optionally can create ASCII export files of the deleted records. The export files can be archived to removable media using standard UNIX commands. Should historical reporting be required on archived history, the Historical Import Utility can be used to import exported files back into the Historian database for data retrieval and report generation.

Process Logger

The Process Logger retrieves data and passes it to the printer or to the FoxBatch Historian for storage. The Process Logger Editor window creates data collection configurations, which consist of one or more groups of tags with each group having its own data collection configuration. The runtime Process Logger uses the logging configuration to determine how each group of tags and its respective values should be collected and logged. Data collection may be periodically scheduled or event driven.

Report System

The Historical Reporting System is an on-line data retrieval and report generation utility. Using standard SQL (Structured Query Language) queries, data is retrieved from the Historian and either displayed or sent to a printer.



FoxBatch Report Display

Batch End Report 18:08:23 10/18/95 Page 1

Batch Journal Data

BATCH IDENTIFICATION

Campaign ID	Lot ID	Batch ID	Product ID	Product Name
campaign1	lot1	b101895_3	SC101895	Some_Chem

Recipe ID	Recipe Name	Recipe Version	Train	Batch Size
Chem_Product	Product1	1	TRAIN1	100

BATCH SEQUENCE OF EXECUTION

Event	Date	Time	Done By	Check By
Batch Start	10/18/95	17:59:54		
Batch Hold	10/18/95	18:07:55		
Batch Abort	10/18/95	18:08:07		

BATCH QUESTIONS

Question	Answer	Date	Time	Done By	Check By
Do you wish to repeat?	Yes	10/18/95	18:07:00		
Do you wish to repeat?	No	10/18/95	18:07:48		

BATCH EQUIPMENT USAGE

Equipment	Date	Time	Event	Done By	Check By
WATER_TNK	10/18/95	18:02:10	Allocate		
WATER_TNK	10/18/95	18:03:13	Release		
REACTOR_M1	10/18/95	18:02:11	Allocate		
REACTOR_M1	10/18/95	18:08:04	Release		
FEED_TNK	10/18/95	18:02:13	Allocate		
FEED_TNK	10/18/95	18:08:02	Release		

AMI Analog Data
Campaign: campaign1 Lot: lot1 Batch: b101895_3

1995-10-18 18:03:11 CP1001 WATER_TNK:FIC_01 ANALOG HHABS ALM ACK WATER FLOW CTRLR
100.000000 115.447449 LPM

1995-10-18 18:02:33 CP1001 WATER_TNK:FIQ_01.WATER TOTALIZ ANALOG PTARG RTN ACK WATER FLOW BATCHER
500.000000 0.000000 WATER TARGET REACHED LTRS

1995-10-18 18:02:31 CP1001 FEED_TNK:PIC_01 ANALOG LOABS ALM ACK PURGE CONTROL
4.000000 3.982657 PSIG

AMI Discrete Data
Campaign: campaign1 Lot: lot1 Batch: b101895_3

Sample FoxBatch Printed Report

ENHANCED SECURITY OPTION

FoxBatch provides a security system which may be used to control the access and manipulation capability of users. A security level is assigned to users based on their job function such as operators, supervisors, engineers, etc. Only one security level can be assigned to a given user. New security levels can be added to the security system at any time, and there is no limit to the number of levels that can be defined.

FoxBatch applications and their associated functions can be assigned security levels defining which groups of users can access an application and which groups can execute and verify the various functions available within that application. FoxBatch applications include Archive Manager, Batch Display, Batch Scheduler, Recipe Editor, etc. Each application can be assigned one or more security access levels permitting groups of users to access the application. Applications can be added to the security system at any time.

FoxBatch supports security for execution and verification of the functions available within an application. As an example, the Batch Display application includes functions such as Abort Batch, Allocate Equipment, Start Batch, Unit Hold, etc. Each function can be assigned one or more Done By and Check By security levels. More than one level of user can be permitted to perform or verify a function, e.g., both operators and supervisors could be permitted to perform a function, but only supervisors could verify the function. Functions can be added to the security system at any time.

Recipe and Operator Station security assignments are made on a per user basis. Recipe assignments protect against operators working on products for which they have not been trained. None, one, many, or all Recipes can be assigned to a user. Operator Station assignments protect against operators working at operator stations to which they should not have access. None, one, many, or all Operator Stations can be assigned to a user.

Each user has an account consisting of a user name containing a maximum of 30 characters and a user identification containing a maximum of 12 characters. When a security clearance is required, the security system prompts the user for their ID and password. The number of requests that a user is permitted to attempt to obtain a security clearance can be limited and access denied if the number of retries is exceeded. The system supports password time-out (the number of days a password is valid) and password reuse (the number of day which must pass before a password can be re-used). All passwords in the security system are stored and transmitted in an encrypted format.

FoxBatch DEVELOPER'S TOOLKIT

The FoxBatch system is designed to be open and completely configurable. External applications can easily be interfaced. Additional application-specific interfaces, graphic or otherwise, can be built using standard I/A Series tools and FoxBatch Developer's Toolkit which is available as an option.

FoxBatch SYSTEM CONFIGURATION

The FoxBatch package runs on an AW51/AP51. The graphical user interface requires WP/AW51 with I/A Series Versions 4.2 and 5.0 software.

The FoxBatch server is scalable and available in three sizes: large, medium, and small. The maximum number of running phases determines the size of FoxBatch. A unit assumes an average of three concurrent phases. The number of operator and configuration stations is selectable.

FoxBatch Size	Host Processor Memory Requirements	Number of Units	Total Phases*
Large	96 MB	21 to 100	300
Medium	64 MB	11 to 20	60
Small	32 MB	1 to 10	30

*Total number of concurrent phases active should not exceed the listed value

FUNCTIONAL SPECIFICATIONS

Process Model
There are no absolute limits on the number of process units or connections. The only limitation is hard disk space in the host processor.

Maximum Number of Formula Variables per Phase when Downloading to a Sequence Block
24 Booleans, 8 integers, 15 reals and 10 strings. {Note: These limitations do not apply when downloading to multiple blocks.}

Maximum Number of Recipes
Unlimited. The only limitation is hard disk space in the host processor.

Maximum Number of Serial Steps (Operations) in a Recipe
510.

Maximum Number of Serial Steps (Phases) in an Operation
510.

Maximum Number of Phases for Operator Selection of Parallel Execution.
20.

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