General Specifications

Exasmoc System Overview

GS 36J06D10-01E

■ GENERAL

Multivariable Control Technology is gaining in popularity in the process industry. It is now a unanimous conclusion that APC (Advanced Process Control) delivers sustainable measurable benefits by simply stabilizing the plant to produce more with more stable product quality. The foundation for this conclusion is that control strategies should be developed from an understanding of the process and its nuances, a grasp of control systems over which APC will sit, the need for integrating it with wider plant objectives and a knowledge of base layer control loops.

Exasmoc, a product of Yokogawa-Shell alliance, marries these demanding necessities of the industry. It is a Multivariable Control package, which is built with the end user in mind. It is designed for use by a process engineer working in a process plant with minimal advanced control theory knowledge.

Key Characteristic of Exasmoc:
- Highest Uptimes in industry (i.e. Highest in industry)
- Use of unmeasured disturbance models and grey box models to include apriori process know how resulting in high robustness.
- Easy to use design and simulation kit (offline)
- Embedding in DCS
- Easy integration with other plant information networking

Exasmoc off-line operates in familiar Windows 2000/XP while Exasmoc on-line operates in Windows environment.

■ FUNCTION SPECIFICATION

A multivariable controller

Exasmoc periodically adjusts the level of several manipulated variables, so as to bring/keep the controlled variables at or within given targets, taking into account all the steady-state and dynamic interactions between variables.

Set point and/or minimum/maximum objective
The objective of each controlled variable can be specified either as a set-point, or as lying between minimum and maximum constraint. The controller takes no action if the controlled variable lies within the limits.

Selectable constraints on the control actions
Limits can be set on each manipulated variable, specifying absolute minimum, absolute maximum and maximum move size over one control step.

The limits on control valve position are recognized to avoid the controller “winding-up” beyond what process can achieve.

Controller can be made to respect valve gains.

Controller can continue to run in “crippled mode” after some manipulated variables cease to be available for control.

Adjustable gain matrix.

Robust
The controller has an ability to learn by distinguishing between process noise and process movement. It uses the Kalman filter.

Process optimization
It is possible to minimize/maximize either any single variable (manipulated or controlled), or an economic function defined as a linear combination of any process variables. This optimization task has a lower priority than process control, and is performed under the condition that more degrees of freedom are available after all control objective are met.

Main-controller and Sub-controller concept
When Multi-Variable Control is applied to a large process unit, a single large controller would be divided into several sub controllers to improve controller’s flexibility in operation and maintenance.

The Exasmoc R3 enables control engineer to define sub-controllers.

A sub-controller will perform observation and control functions for a sub-set of manipulated and controlled variables. It will be possible to define different control period for different sub-controllers. Between 2 sub-controllers, there will be only intermediate variables (Intermediate variable links a process variable to another one.).

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GS 36J06D10-01E

3rd Edition Nov.01, 2004

A main-controller will perform coordination between the sub-controllers. It will execute the feasibility check and optimization functions for the overall controller at steady state. The steady state functions will download manipulated variable horizon limits to the sub-controllers that will enforce consistent and optimized control strategy.

Blending control
An in-line blender requires a sub-controller with the following special features.

1. All manipulated variables shall be ratios.
2. The only valid disturbance variables are non-manipulated blended components.
3. The sum of the ratios automatically should be kept to 1 (One).
4. The optimized control is performed at steady state only.

The Exasmoc R3 is capable of blending control.

Non-linear optimization function
The Exasmoc R3 has a unique optimization function at steady state. It will be possible to define a non-linear (Bilinear form) optimization function. The Exasmoc R3 will handle classical margin maximization function. An example of non-linear function could be:

Maximize (Feed * sum of (Yield * Product Price))

Where:

Feed and Yields are process variables and Product Prices are parameters

The control engineer will have the possibility to define multiple economic functions by off-line and to select the one that is active by on-line. All economic function parameters are tunable by on-line.

On-line model gain update
The on-line tuning function is enhanced to include controller's model gain update. The update will not cause MV's bump.

It will be possible to update the gains remotely. For instance, the robust quality estimator can download new gains and trigger the gains update.

The on-line gain update is an essential feature of the "Green Gasoil" control scheme.

Specified execution order of application program
If special calculations for SMOC input and output variables are performed by application programs, the application programs should be executed in the specific order.

For example:

(Step 1) To execute SMOC input calculations
(Step 2) To execute SMOC control calculations
(Step 3) To execute SMOC output calculations

The Exasmoc R3 enable control engineer to specify the execution order of application programs.

■ GENERAL CONFIGURATION

● Features

It handles feed-forward
For process variables which can be measured but not adjusted, and which are known to affect the controlled variables, anticipatory action can be taken upon a change in the "disturbance" variable.

Time delay compensation
In case of a delayed process (which has no response to an adjustment until a certain time has passed), a predictive technique is used which recognizes the presence of the delay and avoids over-reaction.

Speed tuner for manipulated variable adjustment
Manipulated variable control moves are always as small as possible, and the relative use of manipulated variable against each other and against the control objectives can be defined.

Defining weight of each control objective
If the problem becomes over constrained, not all the control objectives (setpoints or constraints) can be achieved. Then the objectives, which are first abandoned, or the relative offset on each objective, can be defined.

On-line tuning via filters
Tuning filters are used to specify the desired speed of responding to set-point changes, compensating for disturbances in the controlled variables (or responding to inaccuracies in the controller's process model) as well as anticipating the effect of the measured disturbance variables.

Providing "Graceful degradation" of abnormal events
In case of loss of a manipulated variable (saturation, actuator failure, etc) optionally control can continue with the remaining manipulated variables (as best as possible). In case of the loss of measurement of a controlled variable, control of the other variables can optionally continue. "Open loop" control of the variable with missing measurement is then performed. Automatic checks are provided on the validity of on-line analyzer signals that the controller may be using.

● Connected Systems

System	Connection Method	Connection Method	Support
CENTUM CS 3000	Directly connected to VF701 Control Bus Interface Card	VHF	X
CENTUM CS 1000			X
CENTUM CS			X
CENTUM-XL	Via ECGW3 gateway	Ethernet	X (*1)
		GP-IB	–
		BSC	–
		TTY Protocol	–
μXL	Via MOPS/MOPL getaway	Ethernet	X (*1)
		GP-IB	–
		BSC	–
		TTY Protocol	–
DCS from other vendors	Depends on each specification	Ethernet/OPC	X (*2)

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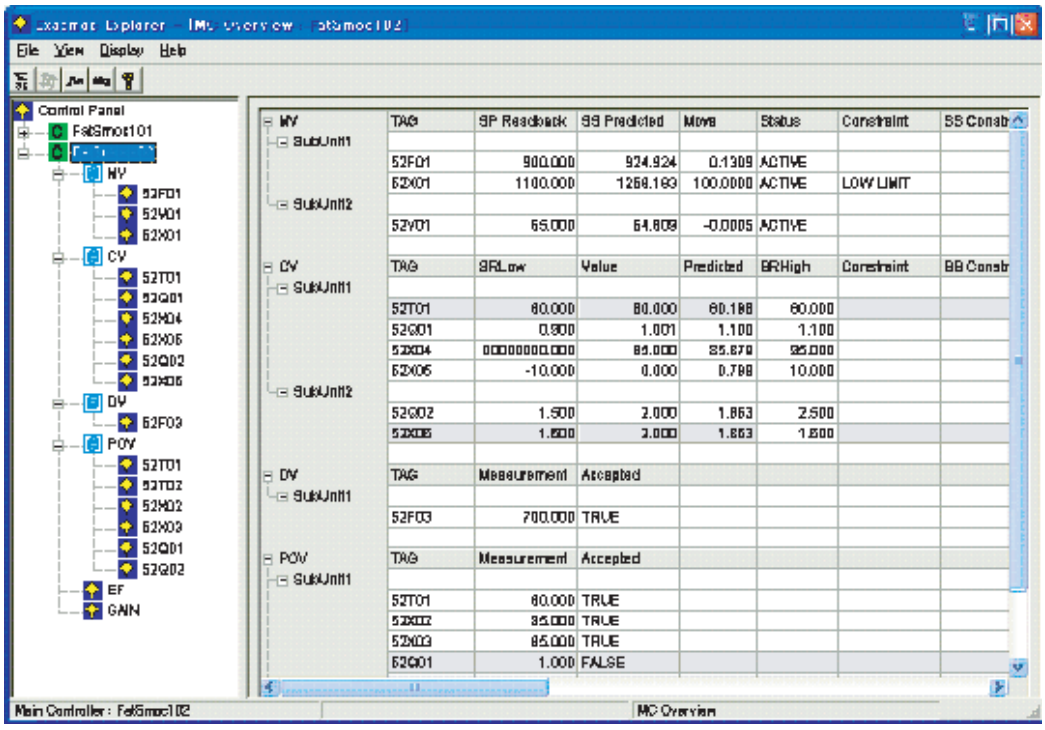
*1: Contact APC Center for support
*2: TOKUCHU

■ HMI CONFIGURAION

- Overview
- MV/DV/POV/CV/GAIN/EFpanel
- Trend
- Historical message



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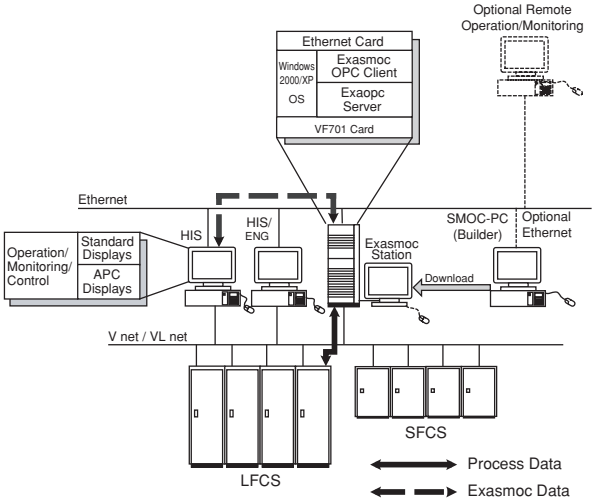
System Configuration

CENTUM CS 3000/1000 System Configuration

Exasmoc station is connected to control stations via the VF701 Control Bus Interface Card, and it reads/writes tag data and receives process messages.

Exasmoc station as well as HIS equalizing engineering data from the ENG engineering station of the CENTUM system.



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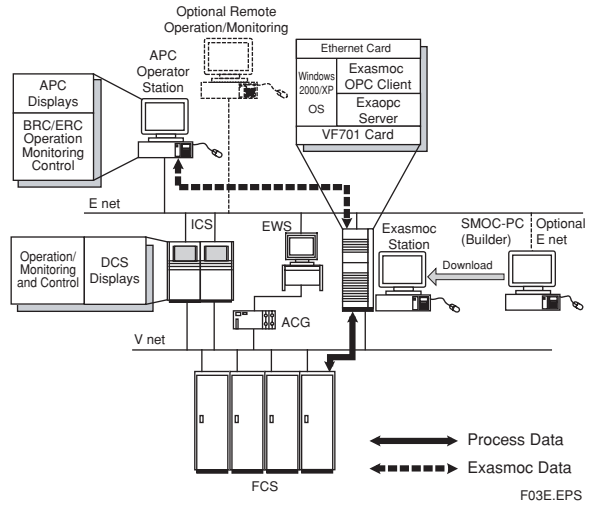
CENTUM CS Configuration

Exasmoc station is connected to control station via the VF701 Control Bus Interface Card as well, and it also reads and writes tag data and receive process messages.

It also equalizes engineering data from the ENG/EWS engineering station of the CENTUM System.



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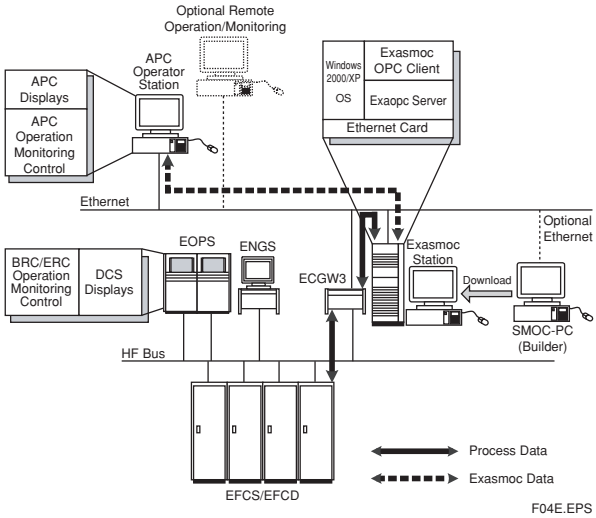
CENTUM XL System Configuration

The Exasmoc station is connected to control station via ECGW3 gateway. It reads/writes tag data and receives process messages.

The gateway equalizes engineering function data.

After equalizing, process data is sent to APC operator station.



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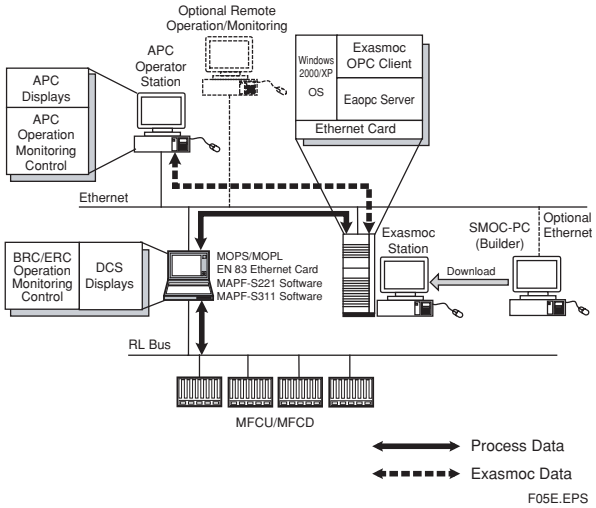
µXL System Configuration

The Exasmoc station is connected to control station via MOPS/ MOPL gateway, which also reads and writes tag data and receives process messages.

The gateway also equalizes engineering function data.

APC operator station will receive process data after equalization.



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■ APPLICATION CAPACITY

Max. no of Exasmoc main controller:
*20 controllers/station
Max. no of Exasmoc subcontroller:
20 controllers/station
Control period: Min. 10 seconds.
Number of MV: 100/subcontroller.
Number of CV: 200/subcontroller.
Number of DV: 50/subcontroller.
Number of POV: 200/subcontroller.
Number of EF: 100/subcontroller.
Number of input compaction point: 100/controller.
Number of output compaction point: 100/controller.
The name of Exasmoc controller: Up to 10 characters

*: Actual number of controllers are depending on the size of the controllers, memory size and CPU performance.

■ OPERATING ENVIRONMENT

Hardware

Machine: IBM PC/AT (DOS/V)-compatible
(where Windows 2000/XP runs)
CPU: Pentium 500 MHz or faster
Main memory: 256 MB or greater
Disk capacity: 10 GB or greater.
Communication device:
Ethernet-ready network card
VF701 Control Bus Interface Card (YOKOGAWA)
required when connecting to CENTUM CS 3000/1000, CENTUM CS.

Software

OS: Windows 2000/XP Professional/2003 Server
The Exasmoc package and Windows must use the same language.
Other:
CENTUM CS 3000: R2.06.00 or later versions
CENTUM CS 1000: R2.06.00 or later versions
CENTUM CS: R2.09.00 or later versions
Optional software: To connect to the μXL system, the following optional software are required:
MAPF-S221 Ethernet Communication Package for EN83.
MAPF-S311 Ethernet Computer Communication Package for EN83.

Interface Package

Exaopc R2.01 or later is required.
When Exaopc is installed on the same pc as Exasmoc, Exaopc R3.10 is required.

Note: The current version does not support DualCPU or Hypert Thread mode. Please use on the Single CPU and Hypert Thread = OFF.

OPC Interface

OPC interface connected to Exasmoc should support the following specification. Connection test in advance is recommended.

- OPC revision: Compliant to OPC Foundation specification.
- OPC DA 1.0 a or later .
- OPC function: Synchronous read/write
- OPC performance : 100 data read and write per every second

■ MODEL AND SUFFIX CODES

[Release: R1]

		Description
Model	NTPS410	Exasmoc Multi-variable Model Predictive Control Package
Suffix Codes	-S0	Software License for Small Units (with Media) (*1)
	-S1	Basic Software License (with Media) (*2)
	-S5	Site License for Small Site (with Media) (*3)
	-S6	Site License for Medium Site (with Media)
	-S7	Site License for Large Site (with Media)
	0	Without Exasmoc online package (*4)
	1	With Exasmoc online package
	1	Always 1
	1	English version
Option Code	/□-ADU	Software License for Additional Unit (1 to 7 units) (*5) □: 1 to 3 □: 4 to 7

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*1: The size of controller for the small unit is less than 5 ins and 5 outs.

*2: Basic software license includes 1 copy of SMOC PC and AIDA.

*3: Site license includes 3 copies of SMOC PC and AIDA.
Suffix Code "-S5": Small Site; Less than 100,000 BPD
Suffix Code "-S6": Medium Site; 100,000 BPD to 199,999 BPD
Suffix Code "-S7": Large Site; 200,000 BPD or larger

*4: At least one Exasmoc online package has to be quoted per PC.
Exaopc package is required for Exasmoc to interface with CENTUM CS 3000.

*5: The number of additional unit(s) has to be entered in □ (i.e., enter "1" for the second unit).

■ TRADEMARKS

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