SIMATIC Route Control
Configuration, Control and Diagnostics of Material Transports

Product Brief · February 2004

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PCS 7

SIEMENS

# Application Area, Configuration

Application Area

SIMATIC Route Control adds a tool for the configuration, control, monitoring and diagnostics of material transports in pipeline networks. It is not specialized on any particular industry.

With SIMATIC Route Control, which can also be combined with SIMATIC BATCH, users of SIMATIC PCS 7 are capable of automating not only their production processes and associated warehouses but also the material transports linking both areas.

SIMATIC Route Control can handle complex networks as well as simple transport routes. In particular SIMATIC Route Control is predestined for plants with a multitude of complex route combinations or extensive tank farms such as are found above all in the chemical, petrochemical and food and drinks industries.

Preferred Applications

■ Plants in the medium and high capacity range with an extensive route/pipeline network

■ Frequent conversions and extensions of the transport network incl. actuators and sensors

■ Transport routes with high flexibility:
  – regularly changing materials
  – dynamic selection of the source and destination of the material transport (incl. reversing of direction on bidirectional transport routes)

■ Numerous simultaneous material transports

■ Plant projects in combination with SIMATIC BATCH
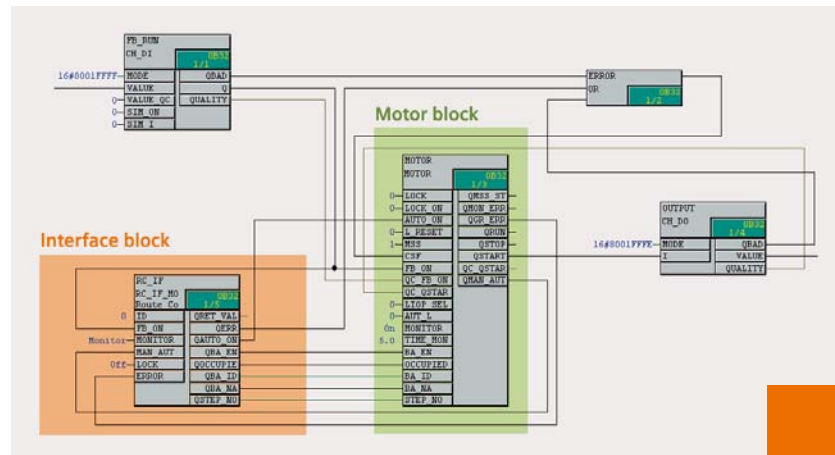
Interconnection of an interface block for a motor

Configuration

SIMATIC Route Control is integrated in the SIMATIC PCS 7 user administration with SIMATIC Logon and provides graded user authorizations for engineering, operating and maintenance personnel.

The configuration of Route Control builds on the basic configuration of the SIMATIC PCS 7 process control system using blocks from the PCS 7 Standard Library. Technological elements of relevance for Route Control (RC elements) are adapted in the CFC Editor using uniform interface blocks from the Route Control Library. This means that existing plants are also easy to upgrade with SIMATIC Route Control.

Following configuration components are available in addition to the basic tools of the SIMATIC PCS 7 Engineering System for configuring Route Control applications:

Route Control Library

The Route Control Library contains blocks for RC configuration, blocks for creating transport routes, and interface blocks for RC-elements: control (actuator) elements, sensor elements, parameter (RC setpoint) elements and connection elements (material data related to a partial route). It is made available in the catalog of the CFC Editor.

Route Control Wizard

The Route Control Wizard is the interface between the RC configuration and the SIMATIC PCS 7 basic configuration. The wizard, which can be called up from the SIMATIC Manager menu, receives the RC-specific configuration data of the SIMATIC PCS 7 project for importing into the Route Control Engineering. In doing so it carries out a plausibility check, defines the AS-OS and AS-AS communication connections and configures the RC server signals.

Configuration

Route Control Engineering Tool

Once the RC-relevant basic data of a PCS 7 project have been adopted in a Route Control project, the next step is to configure the RC-specific objects with the Route Control Engineering Tool:

- Partial Routes
  Dividing the transport routes into partial routes helps to increase flexibility and to minimize the amount of configuration work through grouping. Relevant partial route parameters: "bidirectional" and "priority" (when searching for a route, the lowest total of partial route priorities is decisive for the overall route)

- Locations
  The beginning and end of each partial route - and hence the source and destination of a material transport - are marked by locations. The locations are also parameters for requesting a material transport (source, destination, intermediate locations/via).

- Interconnections
  The RC elements are incorporated in a partial route and thus "interconnected" with it. As a result, the RC elements acquire additional properties depending on their type (e.g. "close valve" in base position). These properties can be edited in configuration windows.

- Mode tables
  The partial routes can be assigned to certain mode tables, e.g. "Cleaning" or "Product Transport", according to technological and product-specific aspects. When searching for routes, mode tables allow you to limit the results to the type of material transport.

- Function Steps/
  Sequence Functions (Modes)
  Each mode table includes as many as 32 configurable technological sequence functions (modes), e.g. base position of the control elements, open transport valves, open source valve, switch on pump. Together with the RC elements interconnected in the
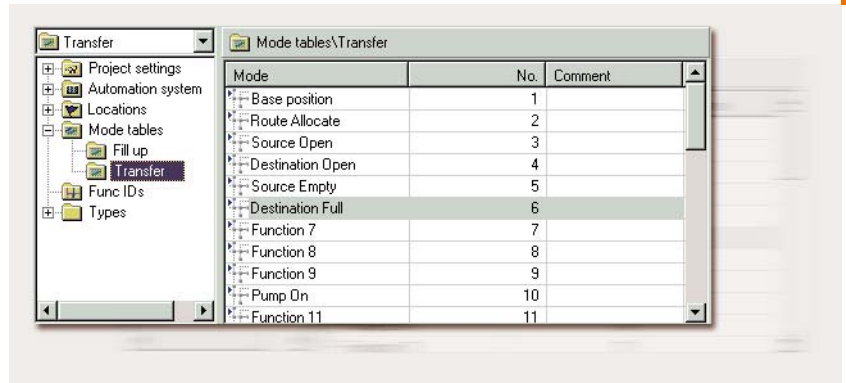
Mode table with sequence functions (modes)

partial routes, the sequence functions determine the sequence of the material transport.

Fundamental Procedure During Configuration

- Create the RC-specific objects in the CFC chart (based on blocks from the RC Library):
  - interface blocks for RC-elements
  - configuration blocks, e.g. AS-OS and AS-AS communication for each of as many as 32 automation systems
  - route block for each material transport that can be performed simultaneously

- Automatically adopting the RC-relevant configuration data of the SIMATIC PCS 7 project using the Route Control Wizard (RC elements, transport routes and technological hierarchy) and importing them into the Route Control Engineering Tool

- RC configuration using the Route Control Engineering Tool This involves structuring the plants and their sections from the Route Control View in:
  - as many as 64,000 partial routes
  - as many as 64,000 mode tables, each with up to 32 sequence functions:
    Using the sequence functions of Route Control, the material transports can be started and performed by user program

(AWL, SFC-block, SIMATIC BATCH) as well as manually.

- Testing the variants of a material transport using the Route Test integrated in the Route Control Engineering Tool, thus ruling out inconsistencies and undesirable combinations.

- Transferring the RC configuration data to the Route Control Server, where they can then be activated at a suitable time.

- Creating a SIMATIC PCS 7 user program (AWL, SFC, SIMATIC BATCH) for the material transport sequence. An SFC-sample block (SFC type) is supplied with SIMATIC Route Control.

Configuration Details
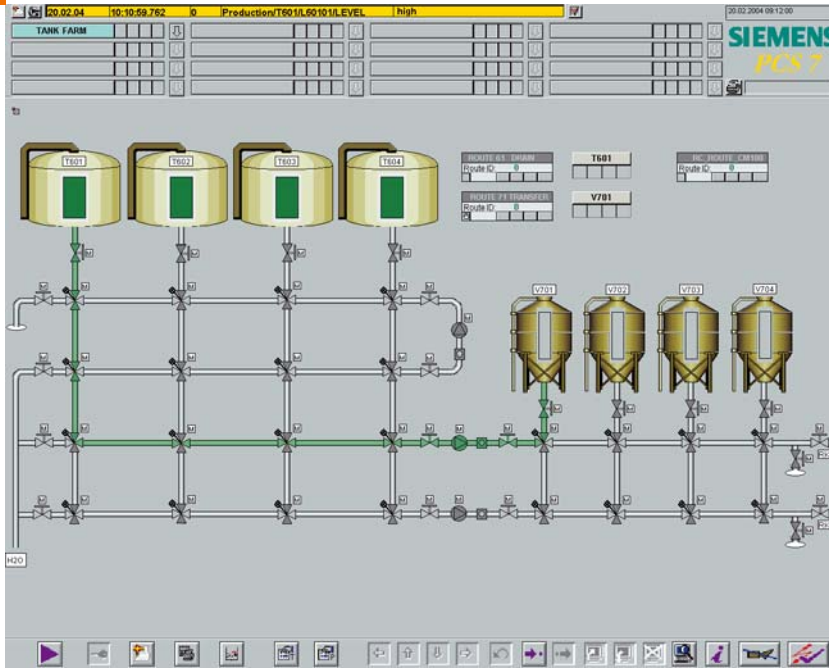
SIMATIC PCS 7 process display: Route network overview

Exporting/Importing CSV files

The Route Control Engineering Tool offers the possibility to export configuration data in the form of CSV files, e.g. into Microsoft Excel. There the data can be easily and quickly copied and edited, and finally reimported. This relieves the Route Control configurator of routine tasks and reduces the amount of configuration work.

Joint Partial Routes

The joint use of partial routes by several material transports can be controlled by means of function IDs. Each of the up to 300 material transports that can be performed simultaneously has a configurable function ID.

After a transport route request is issued, all active RC elements - including their partial routes - are loaded with the function ID of the material transport.

These RC elements are thus interlocked and can only be used by material transports with an identical function ID.

Allowance for Material Compatibilities

The mixing of different materials (e.g. lye and beer) is often unwanted in practice. SIMATIC Route Control supports its prevention by the interlocking of partial routes in incompatible material sequences. Route Control checks the material compatibility in the transport route request by comparing the material ID currently saved in the connection element of the partial route with the previously configured material sequences.

Dynamic (External) Setpoint Values

SIMATIC Route Control knows dynamic setpoint values as well as the static setpoint values (RC-setpoint values), which are selected by means of parameter elements during RC Engineering and are already known during configuration. Dynamic setpoint values come from the process in runtime and are connected to the route block from the outside (e.g. weighed quantity).

Parallel transport from one source to several destinations
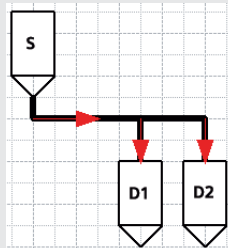
Simultaneous transport from two sources to two destination tanks (mix)
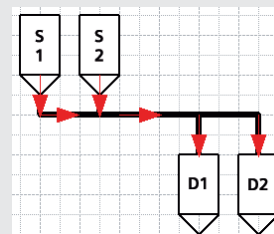
Runtime Mode and Diagnostics

When a material transport with source and destination parameters and 1 to 10 optional locations (intermediate locations) is requested, the statically defined partial routes are dynamically compiled to form one transport route. Route Control performs the triggering and monitoring of all the RC elements involved on this transport route. If errors occur, detailed diagnostics information tells you why the search for a suitable transport route failed.

The following runtime components are available for the operation, visualization and diagnosis of material transports:

RC Block Symbol

of the route block in the process display of the SIMATIC PCS 7 Operator System

- Transport route status display (route not active, request active, material transport stopped, running, faulty)
- Group display for PCS 7 messages

RC Faceplate

of the route block in the process display of the SIMATIC PCS 7 Operator System; select by double-clicking on the RC block symbol:

- Transport route status display (route not active, request active/material transport stopped, material transport running, faulty)
- Diagnostics data (locations, active sequence functions, feedback signals from the sequence functions)
- Operating elements for simple operations: manual/automatic mode selection, in manual mode: request, start, stop, continue and end material transport
- Buttons for selecting other dialog boxes (in relation to the route block of the faceplate): Route Control Center, Batch Control Center and SFC Visualization
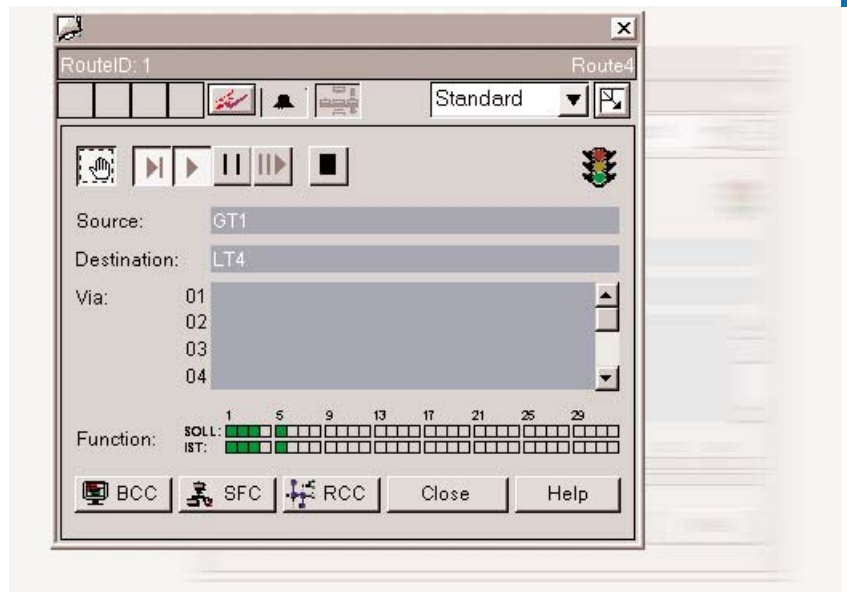
Faceplate of a route block

Route Control Center (RCC)

Route Control Client selectable through RC Faceplate (interconnected route block) or Start Menu (all routes)

- Display of all of a material transport's relevant route data and error information in several coordinated views
- Overview of all RC elements and request details
- Operation of the selected material transport:
  - selection of operating mode: manual / automatic
  - request, start, stop, continue and end material transport
  - set/change request parameters (locations: source, destination, intermediate locations) and general properties (mode table, function ID, material ID and "ignore error") in manual mode
  - activate/deactivate sequence functions in manual mode

- Diagnostics of material transport request errors caused by locked RC elements, locked partial routes, inconsistent actuations or prohibited sequential material
- Diagnostics of currently running material transports: color and text display of transport route status in the route view of the RCC; detailed analyses by evaluation of feedback signals from RC elements
- Server functions: Select RC Server, display RC Server status, update view (read in data again from the RC Server)
- Display of the operator who has logged on

Architecture

Route Control Center (RCC)

Route Control Server

The Route Control Server supplies the RC Clients (RCC) with the necessary data and transfers their operations to the automation systems.

When a material transport is requested through the RCC, it is job of the RC-Server to dynamically compile a suitable transport route from the partial routes which were configured using a map of the automation systems on the basis of the selected parameters (source, destination and intermediate locations) and with due account taken of other parameters (e.g. mode tables, function IDs or material IDs).

Configuration changes can be taken immediately into account in the determination of a suitable transport route after transfer from the Route Control Engineering Tool to the Route Control Server and subsequent activation through the Route Control Center (online loading).

SIMATIC Route Control is integrated in SIMATIC PCS 7 and, thanks to the modular architecture and 3-step scalability (up to 30 / up to 100 / up to 300 simultaneous material trans-

ports), can be flexibly adapted to different sizes of plant.

SIMATIC Route Control uses the basic hardware of the SIMATIC PCS 7 process control system. Where small plants are concerned, the SIMATIC PCS 7 Operator System and SIMATIC Route Control can be combined on a single-station system.
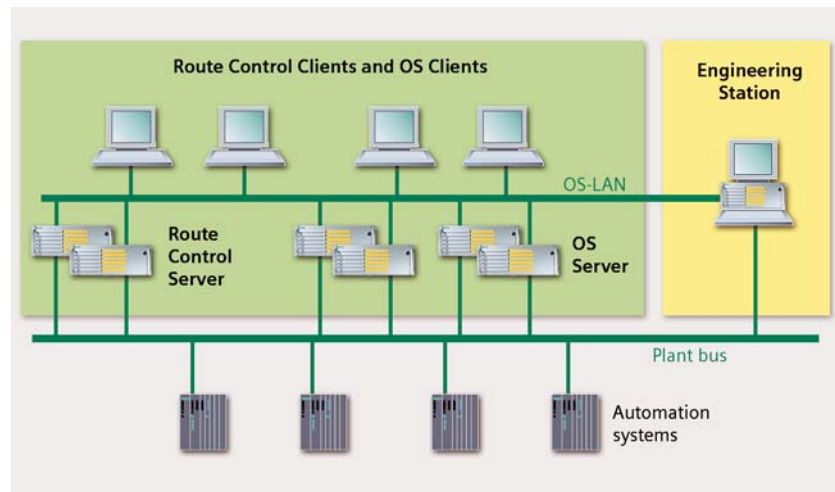
Typically, SIMATIC Route Control uses Client-Server configurations that can be expanded with up to 32 RC-Clients per Server. Basically it is possible to operate an RC Server, Batch Server and OS Server on shared basic hardware. However, availability will be higher and performance better if each component has its own server hardware. The availability of the RC Serve can be further increased through redundant configuration of the server hardware.

The Route Control Center can be installed on an OS Client or a Batch Client, but it is also configurable as a separate Route Control Client.

Route Control Engineering is integrated in the Engineering Tool Set of the central SIMATIC PCS 7 Engineering System.

It is always recommendable to enlarge the working area by means of multiple-channel operation with 2 process monitors. This greatly improves user-friendliness for engineering and operation.

Highlights

- **Extensive range of application**
Preferred for plants in the medium and high capacity range with an extensive route/pipeline network, for transport routes with high flexibility and for frequent conversions or planned extensions of the route network
- **Complete integration in** SIMATIC PCS 7
- **Integratable in** existing SIMATIC PCS 7 projects
- **Combinable with SIMATIC BATCH**
- **Flexible, modular architecture** with scalable hardware and software components for single and multiple station systems
- **Plant transparency**
  - One-to-one mapping of the plant's route network on the Route Control route network in the form of partial routes
  - Easy partial route assignment of the RC elements using plant plans
- **Fast response to plant changes** during configuration, commissioning or in runtime (e.g. installation of additional valves); configuration changes in the Route Control Engineering are taken into account with the very next transport route request after "online loading"
- **RC Wizard** for relieving the configurator of complex, repetitive tasks, e.g. adopting RC-specific configuration data from the PCS 7 project in the RC configuration, incl. carrying out plausibility checks and configuring messages and communication connections

- **Reduction of the amount of configuration work and shortening of commissioning times through the encapsulation of functionality**
From the point of view of a user program, the material transport is actuated as an entity. SIMATIC Route Control performs the actuation and monitoring of the RC elements as well as the evaluation of the feedback signals, and it does so in a way that is fully transparent for the higher levels (user program, technical function).
- **Offline test during configuration** to check for completeness and to detect inconsistencies and undesirable combinations; display of the RC elements involved and their actuation
- **Import/export interface** for configuration data (CSV files)
- **Exclusive assignment of RC-elements/partial routes**
Automatic assignment of RC-elements and partial routes involved in the material transport so that they are locked for other material transports (standard)

- **Material transports using joint partial routes** (several sources, several destinations) with the possibility of switching surge-free from one tank or silo to another
- **Account taken of material compatibilities** in order to prevent undesirable mixing or sequences of materials
- **Automatic calculation of discharge quantities** for the pipelines involved in the material transport
- **Detailed diagnostics** of material transport request errors and currently running material transports
- **Recording of route protocols** with filter functions for screen and printer output, e.g. with data on the source and destination, operating mode and operator name (in manual mode), start and end time of the material transport, material designation, partial routes used and their status

Technical Data

Quantity framework for SIMATIC Route Control (maximum values)	
Configuration	
Number of SIMATIC PCS 7 automation systems that can be integrated in an RC project	32
Number of material transports that can be performed simultaneously per RC project	300
Number of locations	64.000
Number of partial routes per RC project	64.000
Number of RC elements per partial route	64.000
Number of interconnected RC elements within a material transport (transport route) • per automation system (AS) • over all the automation systems involved in the material transport	 450 number of AS x 450
RC elements per automation system • Control elements (actuators), e.g. motors, valves, pumps • Sensor elements (sensors), e.g. for scanning flow rates • Parameter elements for setpoint selection, e.g. transport quantities • Connection elements for saving material data related to the partial route	 1.024 1.024 1.024 1.024
Number of mode tables, e.g. cleaning, product transport	64.000
Number of function steps/sequence functions (modes) per mode table, e.g. base position of the control elements, open transport valves, open source valve, switch on pump	32
Material definitions and sequential relationships between materials • Material groups • Materials • Materials per material group • Sequential relationships between materials	 1.024 1.024 1.024 64.000
Architecture	
Single-station systems (optionally together with PCS 7 Operator Systems)	
Multiple-station systems (Client-Server architecture), optionally together with PCS 7 Operator Systems or SIMATIC BATCH, also with redundant RC Servers • Number of Route Control Clients (Route Control Center) per RC Server/ Server pair • Number of Servers/Server pairs incl. RC Servers/Server pairs	 32 12

More information

Information on all aspects of automation engineering is listed on our order and download form in the Internet:

www.siemens.com/simatic/ printmaterial