Tempress System Controller_II
Reference Manual

Tempress® Systems, Inc.
TSC-II manual
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PREFACE

This reference manual is a guide for the operation of the Tempress System Controller (TSC-II). The TSC-II user interface is Microsoft Windows XP® based and provides centralized control over furnaces used in the production of silicon wafers. The user interface is easy to manage and reduces learning times. It interfaces to the Digital Process Controller (DPC) to enable control of up to 16 process tubes per server. Other interfaces allow the connection of several terminals.
Additionally the TSC-II has the possibility for a client/server network. Up to 16 servers can work in the same network, with up to 8 clients per server. For more than 4 clients per server it is recommended to operate TSC-II network in a separate segment.

This manual is part of a series of manuals dealing with the use of Amtech/Tempress Systems furnace control products. It is assumed that the operator is fully conversant with the procedures of furnace control. It is further assumed that the user has a basic knowledge of the use of a personal computer (see Operator manual).

Chapter 1 is an introduction to the TSC-II. Chapter 2 includes the installation procedures.

WARNING

Never Install additional hardware and software, *other then TSC-II* related components or programs on the TSC-server(s). This may cause serious control problems.

Chapter 3 describes the basic operations, including such topics as menu selection and screen layout. Each function of TSC-II will be described in the remaining chapters. Each chapter starts with some background information on the screens described in that chapter. A more experienced user can go directly to the required screen to see the possible inputs for any parameter.
Chapter 11 describes Secs/Gem and contains the information to connect TSC-II to your local network (if available).

All warranty will be expired in case anyone modifies the TSC-II software, installs any other software on the TSC-server(s) or alters the original TSC-server(s) hardware. In this case support by Tempress Systems Inc. will be supplied based on Tempress standard service chart.

Tempress Systems Inc. is not responsible for any serial damage as a result of software deficiency.

RELATED DOCUMENTATION

- Flat Panel Display - Reference Manual
- Digital Process Controller - Reference Manual
- Digital Temperature Controller - Reference Manual

1 INTRODUCTION

1.1 INTRODUCTION

The Tempress System Controller II (TSC-II) is designed to provide centralized control of Tempress furnaces used for the production of silicon wafers. The user interface is based on Microsoft Windows® NT. The TSC-II has the possibility for a client/server network. Each server is protected by a parallel license key containing the customer name, nr. of tubes, nr. of TSC-II clients, and number of SECS/GEM modules.

The TSC-II can interface via the communication ports to the Digital Process Controller (DPC) and gain access to the Digital Temperature Controller (DTC) and the Flat Panel Display (FPD) to provide accurate control of all parts of a furnace. A maximum of 16 DPCs can be connected to a communication extension card giving control to 16 tubes from one central computer.

1.2 FEATURES

- Easy to operate
- Possibility of direct navigation between functional screens
- Software is built up like the "Microsoft XP Internet Explorer"
- User oriented structure instead of machine oriented
- Short learning time
- Based on the Sematech Userinterface Style Guide 1.0
- Functional and non distracting design
- Direct visible result on operating input
- Easy to enter and modify input data
- Operation by mouse or track ball
- Expandable TSC-II system, using a client/server network (TCP/IP, up to 16 server).

1.3 MINIMUM REQUIREMENTS

Personal computer	: Pentium IV 500 Mhz PC, 128 MB internal memory, 256 Mb for more than 8 tubes.
Operating System	: Microsoft Windows New Technology (NT 4.0 English version + service packs 6)
Keyboard	: Windows 95/NT
Operating components	: Mouse or Track Ball
Monitor diameter	: 17" or more
Resolution	: 1024 x 768 pixels
Video Card	: 65536 colors
Communication + Interface	: RS422 compatible moxa card (for 3 or more tubes)

1.4 FURNACE CONTROL DESCRIPTION

The configuration of the furnace control system comprises:

- Digital Process Controller (DPC) - one for each tube.
- Digital Temperature Controller (DTC) - one for each tube.
- Flat Panel Display (FPD) - one for each tube, (optional).
- Tempress System Control II - one for up to 16 tubes.

1.5 HARDWARE ARCHITECTURE

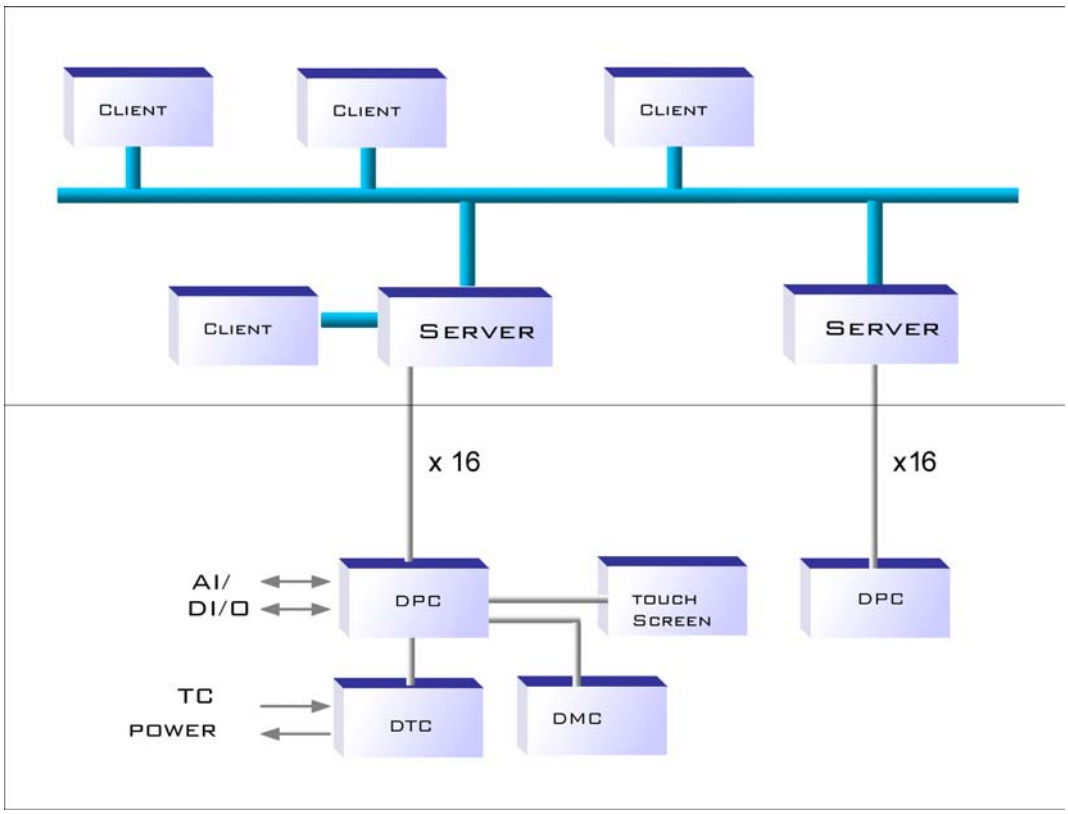


FIGURE 1-1: OVERVIEW OF THE HARDWARE ARCHITECTURE

The process, temperature and motion controllers are all microprocessor based, driven by operator commands, recipes, tables and internal routines. They operate fully independent, and are also fully independent from the Flat Panel Display, the TSC-II host computer system and the network.

1.5.1 DIGITAL PROCESS CONTROLLER (DPC)

Each tube has a dedicated DPC providing accurate control over process parameters, such as timing, boat loading, gas flows and temperature setpoints. (See the DPC Reference manual)

1.5.2 DIGITAL TEMPERATURE CONTROLLER (DTC)

The Digital Temperature Controller controls the process temperature inside the tube. The DTC provides precise control over the spike and paddle thermocouples. (See the DTC Reference Manual)

1.5.3 FLAT PANEL DISPLAY (FPD)

The Flat Panel Display provides an easy-to-use alternative user interface to the DTC and DPC at tube level. It allows for real time process monitoring, but lacks the TSC-II capability of logging and backups. (See the Flat Panel Display Reference manual).

1.6 SYMBOLS


Save


Next item


Print


New item

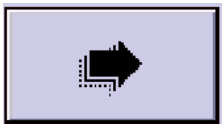

Import


Delete item

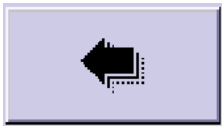

Export

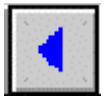

Selected item


To first item


Next screen tube overview


To last item


Previous screen tube overview


Previous item

2 TSC-II SOFTWARE INSTALLATION

This section describes the TSC-II software installation procedures. For a new installation, see section 2.1, for upgrading an existing version, see section 2.4.1.

NOTE

Make a backup of existing user files before upgrading an existing version.

2.1 INSTALLING NEW TSC-II SOFTWARE

Note: To install the TSC-II software administrator privileges are required.

1. Insert CD-Rom in CD-Rom driver.
2. Select **Setup.exe**
3. Select **Next,** after reading the text in the 'Welcome' screen
4. Select **Yes**, after reading the 'Software License Agreement'
5. Choose destination location by replacing **C** into **D**:\Program files\Tempress Systems, Inc\Tempress System Controllers
6. Select **Ok**
7. Select **Yes**, to create a new folder
8. Select **Next**
9. Select the type of installation: **Diffusion / Conveyer**
10. Select **Next**
11. Choose setup Type: **Client/server, client, server**
12. Select **Next,** the system asks to copy database files
13. Select **Yes,** I want to copy the Database files
14. Select **Next**. Files will be copied to the hard disk.
15. Select **Yes**, I want to restart my computer now.
16. Select **Finish**
17. Press **Ctrl + Alt + Del** to login on the computer
18. Fill in username: login as **Administrator**
    Password:
    Hmi Post Install screen will open automatically
19. Type unzip folder **C:\Temp** (*attention*: under XP it is no default folder)
20. Select **Unzip**
21. Select **Ok** after successfully unzipping
22. Select **Close** (ignore *Windows-XP* error message "Mdac-typ.V2.5.exe").
23. Accept the license agreements
24. Press **Next** (2x)

25. Press **Finish** when setup is completed
26. Select **Ok** in the HMI PostInstall window to finish the installation
27. Press **X**-button in the upper right corner to close the window

2.1.1 TSC REGISTRY SETUP FOR WINDOWS NT/2000

1. Double click on **My Computer**
2. Double click on:
   . D:\
   . Program Files
   . Tempress System, Inc.
   . Tempress System Controller
3. Select **Sharing**, by clicking with the right mouse-button on **Db** directory
4. Select **Shared as**
5. Fill in Sharename: **TSC**
6. Select **Permissions**
7. Select **Everyone** for Access Through Share Permission
8. Select **Remove**
9. Select **Add**
10. Select **Add users and groups**
11. Select **Show users**
12. Select **TSC user**
13. Press **Add**
14. Select **Full control**
15. Press **Ok** (2x)
16. Click **X-button** in the upper right corner to close window
17. Press Windows **Start → Run**
18. Type **tscsvr /service** (Do not forget the space after *tscsvr*)
19. Press **Ok**
20. Press Windows **Start → Run**
21. Type **tscgemsvr /service** (Only in case of Gem communication. Do not forget the space after *tscgemsvr*)
22. Press **Ok**
23. Plug in hardware license key (dongle) into the computer

NOTE

Before using the TSC-II it is important to adjust the 'Eventlog' of MS Windows NT, otherwise the eventlog will get filled with data.

24. Press Windows **Start → Control panel → Administrative Tools → Event Viewer**.
25. Start **Event viewer**
26. Select 'Log', 'Log Settings'

27. Change Log Settings for: *System, Security and Application*. Select **Overwrite events as needed**. Change these log settings for all three settings separately.

2.1.2 TSC REGISTRY SETUP FOR WINDOWS XP

TSC-2 writes settings to the MS Windows registry, therefore it is important to grant TSC-2 users access to the registry on the server and client pc. Follow the next steps:

1) Make a **User Group** called **TSC users**
2) Go to **start, Settings, Control Panel, Administrative Tools, Computer Management**
3) Select **Local users and groups** in Computer Management,
4) Select **Groups**
5) Select **Action**, **New Group…** to make a new group named: ***Tsc users***, or right mouse button in the right screen, see Figure 2-1.

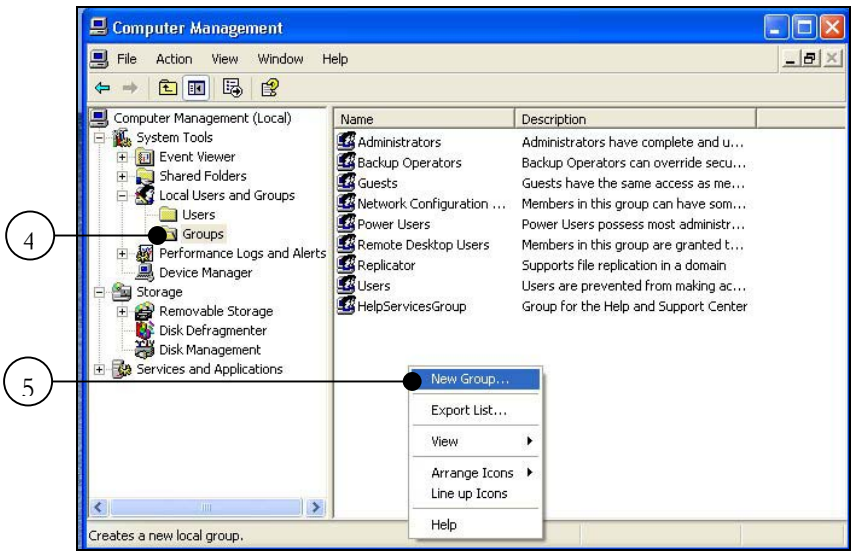


FIGURE 2-1

6) Click on **Add** to select the users for this group, (Figure 2-2)

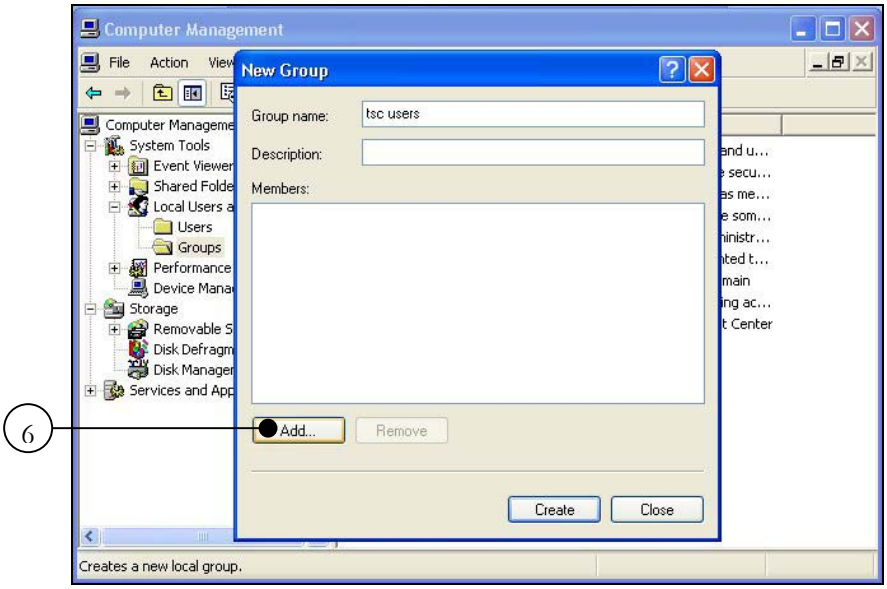


FIGURE 2-2

7) Click on **Advanced** (Figure 2-3) to search for existing users.

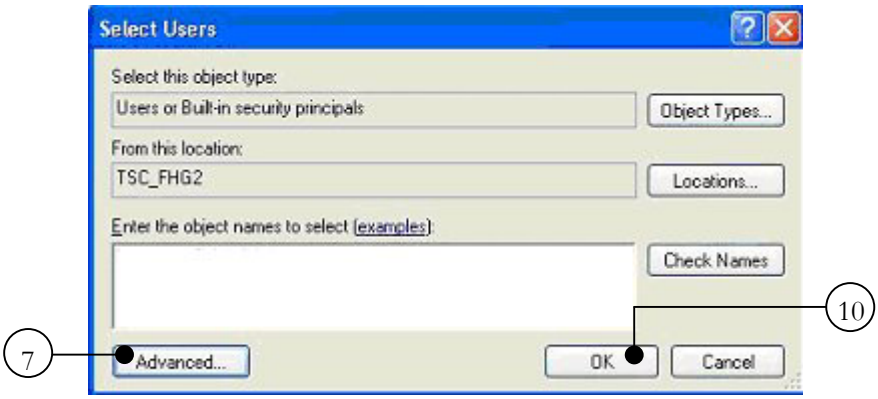


FIGURE 2-3

8) Click on **Find Now** (Figure 2-4) in the enlarged window.

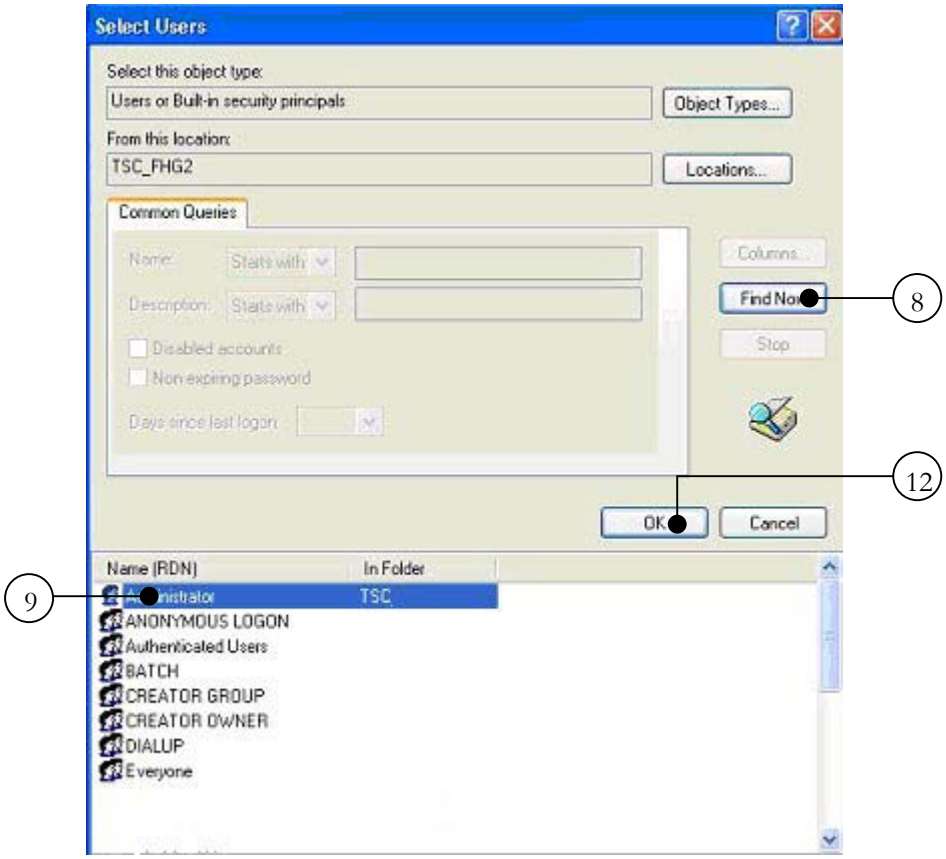


FIGURE 2-4

9) Select the users to add, ***Administrator***, ***TSC***. To select them at once, hold the CTRL key while selecting the users.
10) Click on **OK**, Figure 2-3 is shown again. 2 users have been selected for the TSC Users group.
11) Click on **OK**, and close **Computer Management**
12) Go to **START** and click on **run**
13) Type **Regedit**, and click on **OK** (Figure 2-5)

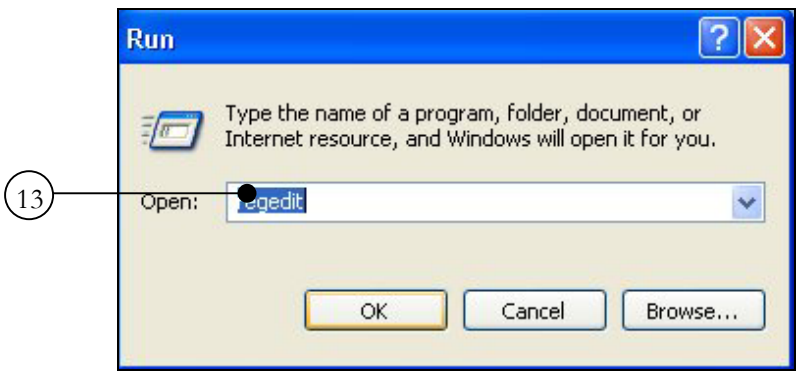


FIGURE 2-5

14) Select the handle key, **HKEY_LOCAL_MACHINE** (Figure 2-6) in Registry editor
15) Click on the right mouse button and select **Permissions** (Figure 2-6)

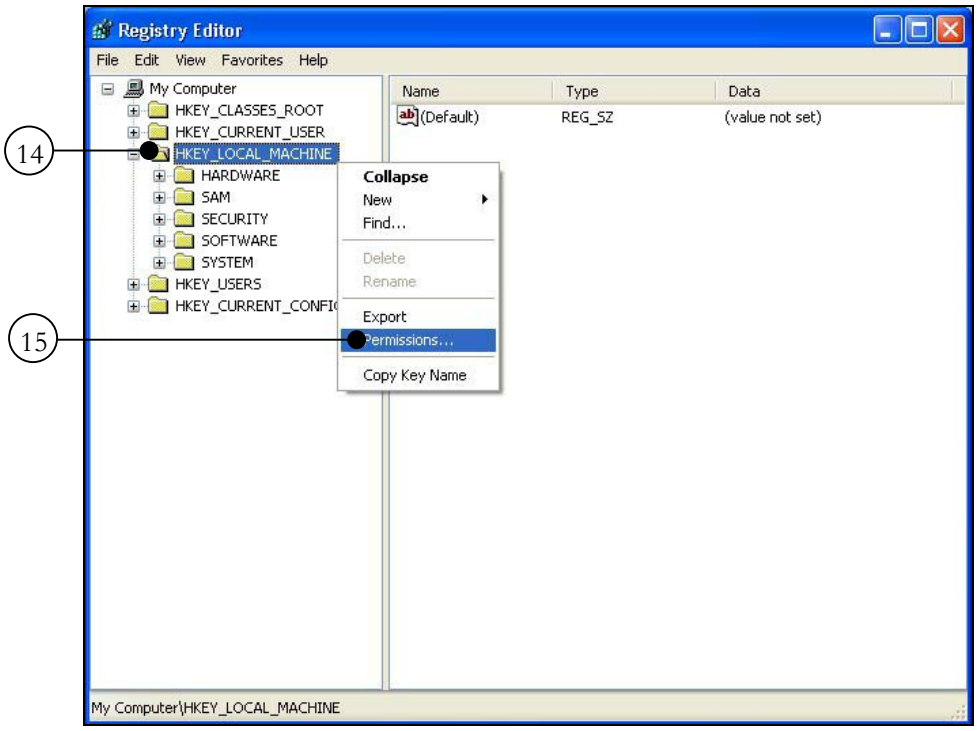


FIGURE 2-6

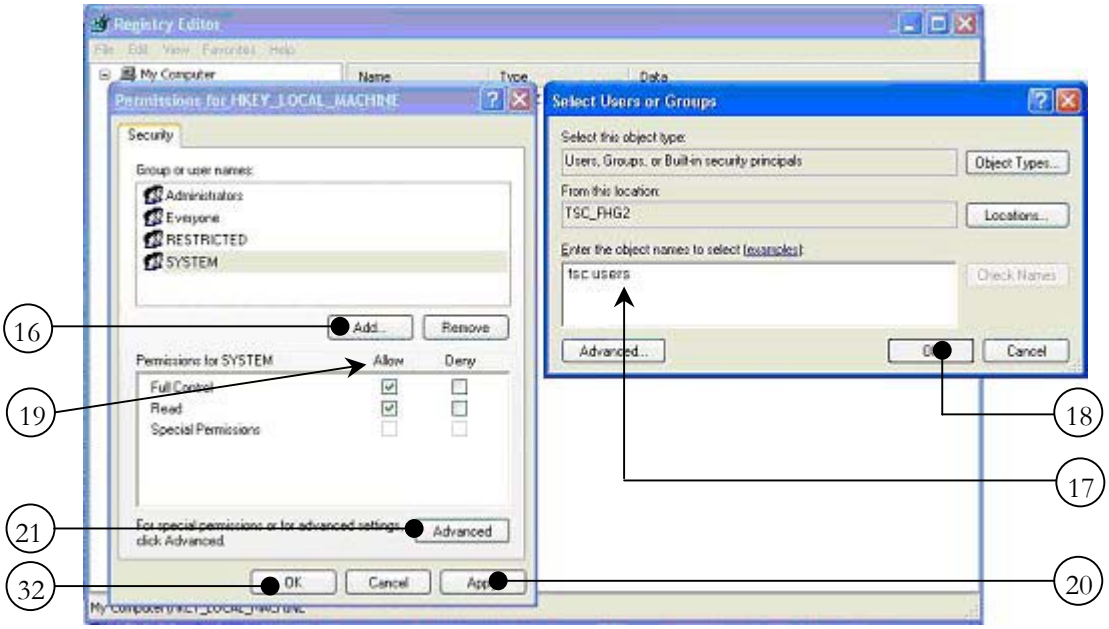


FIGURE 2-7

16) Add the user group **Tsc Users** by clicking on **Add** (Figure 2-7)
17) Select **Tsc users**
18) Click on **OK** (Figure 2-7)
19) Select the User Group **Tsc Users** and Allow the Group Full Control by activate the Allow box. (Figure 2-7)
20) Click on **Apply** (Figure 2-7)

21) Click on **Advanced** the following screen appears (Figure 2-8)

FIGURE 2-8

22) Select **Tsc users**
23) Activate **Replace permissions entries on all child objects….**
24) Click on **Apply**
25) Click on **Yes** in the next window (Figure 2-9)

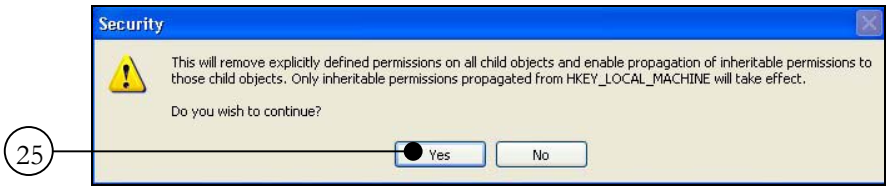


FIGURE 2-9

26) Click on **OK** in the next window (Figure 2-10)

FIGURE 2-10

27) Click on **OK**, see Figure 2-8
28) Click on **OK**, see Figure 2-7
29) Close **Regedit**

2.2 FINISH INSTALLATION

28. Restart	the computer
29. Logon	Username: **TSC**
.	Password: **TSC**
30. Press	**OK**
	TSC Debug Dialog will start automatically.
31. Start	TSC. Windows **Start → Programs → TSC Diffusion → TSC Diffusion 2.** Wait until main overview screen appears
32. Click	with the right mouse-button on **System** in the navigation bar in the bottom field.
33. Select	**Update**

The server shows the server name and 1 stack with 1 tube.

2.3 CONFIGURATION OF THE TSC-II

Configuration of TSC-II is only required for a fresh installation

1. To start up TSC-II press: **Start→ Programs → TSC Diffusion → TSC Diffusion 2**.
2. The communication program will be started. The TSC-II will start up in 'Overview'. The main field will be empty. Click with the right mouse button on 'System'. Select 'Update'. After a few minutes in the Tube selection field the name of the computer will appear, for example TSC-server. Select this name: **Server: '**TSC-server'.
3. Select **System**
4. Login with User Name: **sysmaster** and Password: **sm**.
5. Select 'General System Setup'

6. Add a tube by pressing  y.
7. Fill in the tube name, stack nr, position.
8. Select a value for logging size. Divide the available disk size by the number of tubes. Select the nearest lowest value. For example: If the value of tube is 55 Mb, select 50 Mb.
9. Select update time, 10 minutes. This forces a logging every 10 minutes
10. Select **COM3** for COM port (=first port of the moxa card)
11. Save data
    Repeat this procedure for the other tubes. When the system asks to use the tube as base, press 'OK'.

NOTE

- **Make sure the correct Communication port is selected.**
- **Press Save to store the new or modified settings**

After adding all the tubes, click with the right mouse button on 'System' and select 'Update' to activate modifications.

For 4 tubes in stack 1, the tubes has to be defined as follows:

Tube 1	Tube 2	Tube 3	Tube 4
Stack 1	Stack 1	Stack 1	Stack 1
Position 1	Position 2	Position 3	Position 4
Com 3	Com 4	Com 5	Com 6

1. Log in as '**sysmaster**', '**sm**'
2. The 'Overview' screen will appear again and the added tubes should be visible.
3. Close TSC-II by selecting '**System**', '**Close**', '**Yes**'.
4. After shutting down the program, the communication program must also be closed by using CTRL-C

5. Press: **Start → Program files → TSC Diffusion → TSC Diffusion 2**.
6. The server program will be automatically started. This will take a while, because the first time the system will create the logging files for each tube.
7. In the screen 'Overview' all tubes must be visible with a green marking, indicating communication is enabled. Click with the right mouse button on tube 1 and select '**Enabled**'. The first time the system will ask to log in. Repeat this step for all tubes.
8. Select a tube.
9. Select '**System**'.
10. Read all the DPC and DTC data.
11. Press save to store the newly read configuration.
12. After this press **'Reinit DB'**. Repeat this step for all tubes.
13. Select Recipes. Read the recipes and normal temp table for each tube.

The configuration is finished.

2.4 UPGRADING AN EXISTING TSC-II VERSION

Existing TSC-II version can be upgraded using this procedure.

NOTE

Make a backup of the user files before proceeding. Failure to do so will result in loss of data!

2.4.1 BACKUP USER FILES

Before uninstalling a previous version of TSC-II make a backup of the user files **TSC.mdb** and **TscSvr.mdb.** Use a file manager to copy those files to a backup location, for example D:\Backup.
The configuration file Tsc.mdb **and the server file** TscSvr.mdb **are located in the folder "DB". Go to,** D:\program files\TEMPRESS SYSTEMS, INC\Tempress System Controller\DB**.**

Close the **TSC debug dialog** by selecting the window and type CTRL-C. Acknowledge error messages from the tscgemsvr program, so this program will stop as well.

2.4.2 UN-INSTALL CURRENT TSC-II VERSION

Note: To un-install the current TSC-II software version, administrator privileges are required.

1) Press **Start → Settings → Control Panel**
2) Select '**Software**'. The screen 'Properties for software' will appear.
3) Select **Add/Remove**, select Tempress system Controller and press **'Add/Remove'**.
4) The following question appears: 'Are you sure you want to completely remove 'Tempress System Controller' and all of its components?' select '**Yes**'. The program will be removed.
5) When asked to 'Remove Shared File', select **'Yes to all'**.
6) When asked again 'Remove Shared File', select **'Yes'**
7) Press '**Ok**' to close: 'Remove Programs From Your Computer'
8) Close all windows
9) Reboot computer.

2.4.3 TSC-II VERSION 4.XX TO 6.XX

The procedure of upgrading an existing TSC-2 version 4.xx to version 6.xx requires the following preparation step:

- Make a share for the DB folder in the installation directory D:\program files\TEMPRESS SYSTEMS INC\Tempress System Controller\DB with the following properties (see also steps 28 – 43 of the installation procedure, section 2.1):
- Share name 'TSC'
- Maximum number of users
- Grant the user 'TSC' full access
- Continue with the upgrade described for version 5.xx and higher

2.4.4 TSC-II VERSION 5.XX OR 6.XX TO 6.XX

The procedure of upgrading an existing TSC-2 version 5.xx or higher to version 6.xx requires the following steps.

- Backup existing data
- Install the latest version of the TSC-2 software

NOTE

Press Yes**, to copy database files. Failure to do so will result in a lot of extra work.**

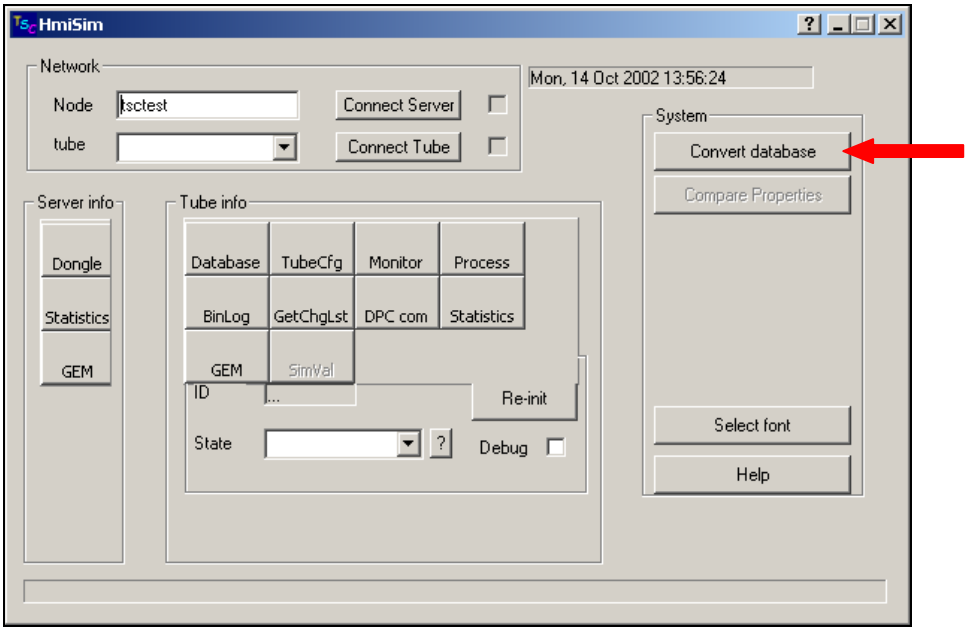
- Convert old database to new format

2.4.4.1 Installing the new TSC-II version 6.0

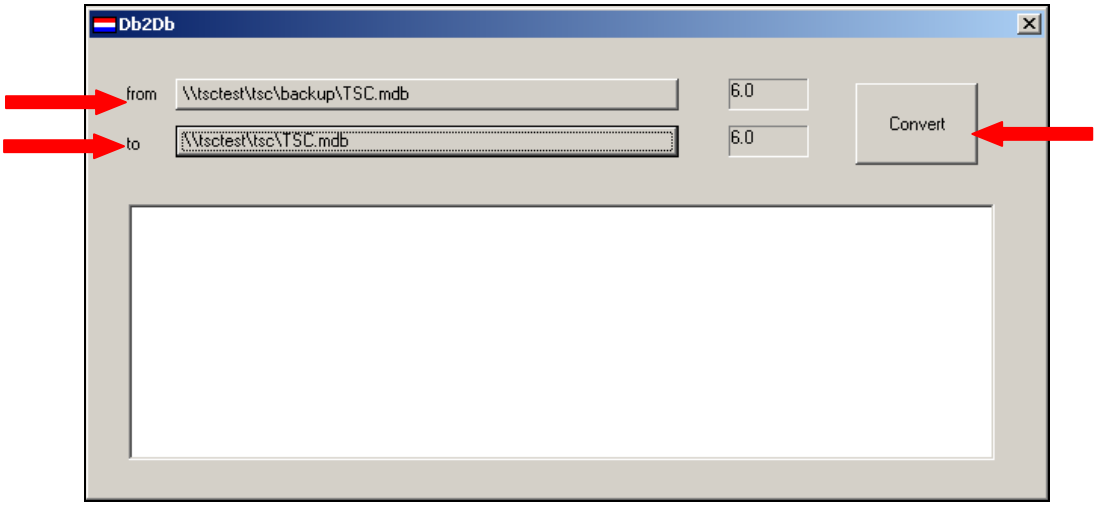
1. Start the program **setup.exe** on the installation CD and follow the procedure as described in section 2.1 (steps 1-27).
   Make sure to have a backup of existing user files as described in section 2.4.1
2. Check if DB-directory sharing properties are configured, if not then follow steps 29-43 of the installation procedure.
3. Finish the installation procedure as described in the steps 44-60.

2.4.4.2 Converting existing database to new format

To keep all the existing data, the old database has to be converted to the new modified format.
From the startmenu, select: **Programs → TSC Diffusion → HmiSim**.

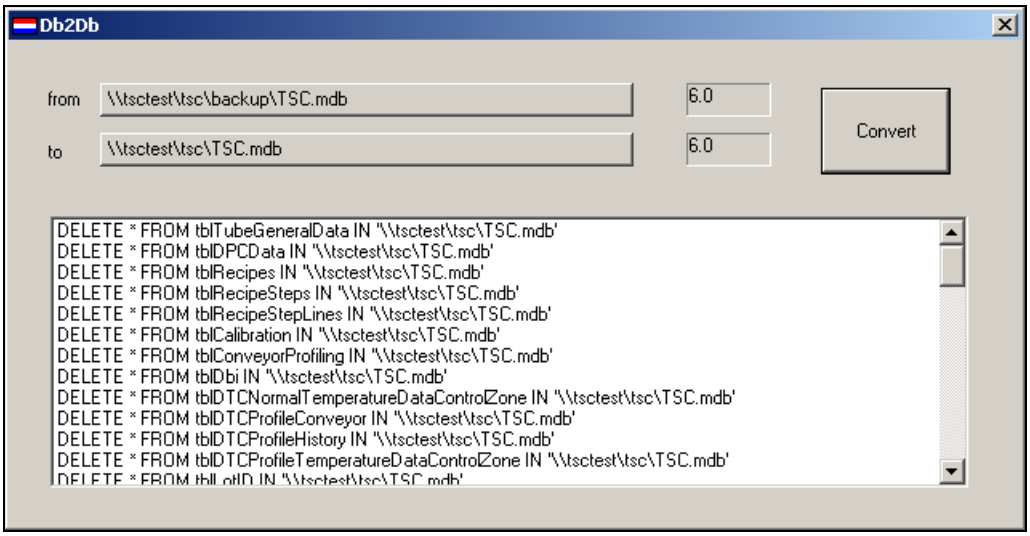


1. Press the button 'Convert database'.

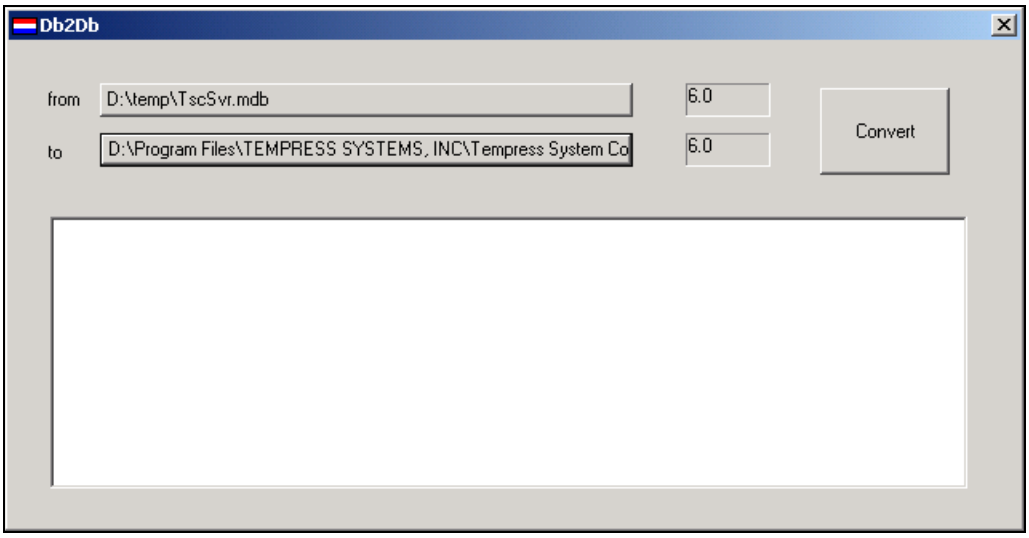


2. Select the configuration file **Tsc.mdb** from the backup folder in the 'from' button by:
    1. click 'from' button
    2. select TSC.mdb from the *backup folder*.
3. Select the Tsc.mdb from the *Db folder* in the 'to' button.
4. Then press the Convert button.

After a while the following screen will appear.

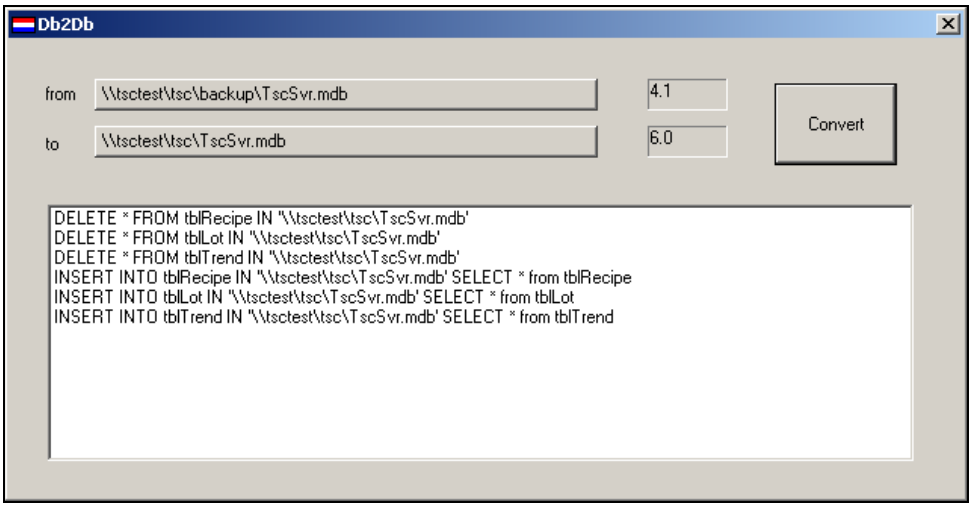


5. Close the window by pressing the 'X' in the right top corner.
6. Press the 'Convert Database' button again.



7. Select 'from' button
8. Change file type to TSC server file
9. Select **TscSvr.mdb** from the source directory
10. Select 'to' button
11. Change file type again to server file
12. Select **TscSvr.mdb** at the target folder
13. Then press the 'Convert' button

When ready the following screen will appear



14. Close the window by pressing the 'X' in the right top corner.

Now both databases are converted to the new format.

3 BASIC OPERATION

3.1 GETTING STARTED

1) Turn on the computer.
2) Login as TSC with password TSC.
3) The TSC-II server will automatically start.
4) Press 'Start', 'Programs', 'TSC Diffusion', 'TSC Diffusion 2'. The TSC-II client program will start and the main screen 'Overview' will be displayed.

3.2 BASIC SCREEN LAYOUT

The screen Overview is a diagram of the 'floorplan' of the equipment, which is controlled by TSC-II.

The design of the user interface is based on:

- The split-up of main screens in taskgroups (general, operations, processing and system engineering).
- The ability to navigate directly from one main screen to another. (Horizontal navigation)
- The possibility to switch Tubes within each main screen. (Vertical navigation)

The main screens

The main screens consist of 3 fields. The top field (title bar), which contains general information, about time, tube selection and login user ID. The bottom field (navigation bar) with control push buttons to navigate between the main screens. The center field (main field) consists of 2 information fields on the left and the operating field with push buttons on the right.

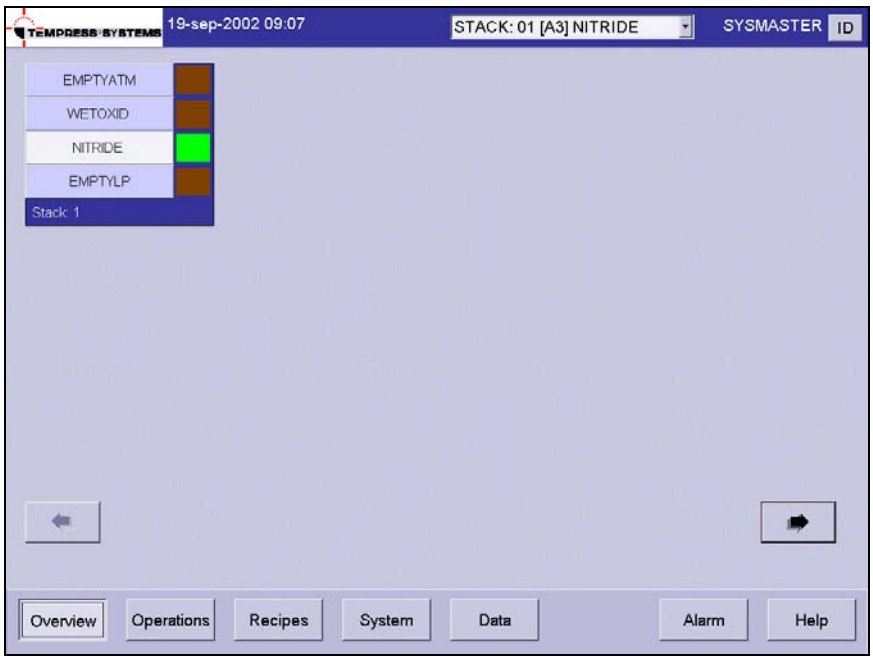


FIGURE 3-1: START-UP SCREEN OF THE TSC-II

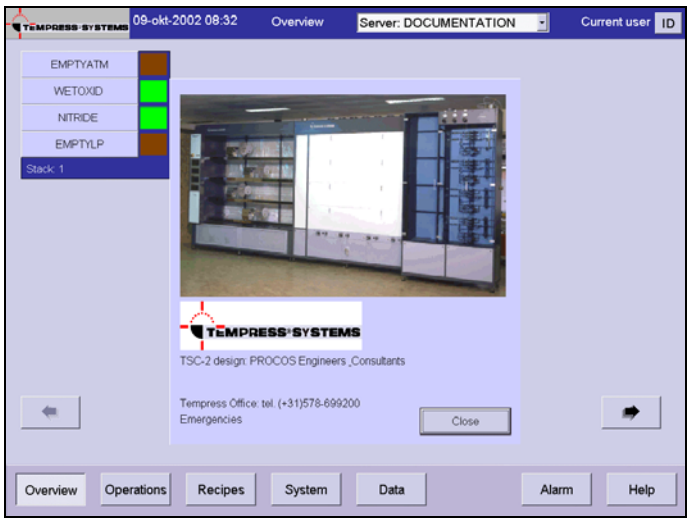
The TSC-II contains 7 main screens:

- Overview
- Operations
- Recipes
- System
- Data
- Alarms
- Help

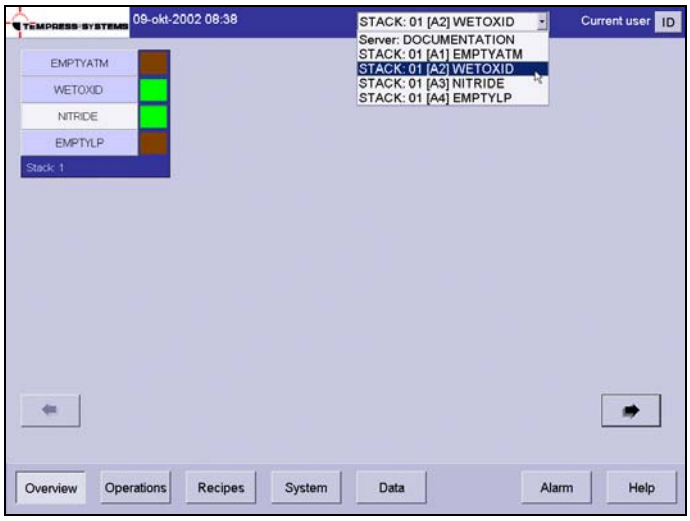
3.2.1 TITLE BAR

The title bar has a basic layout, which is the same for all screens and always available.
The left part of the title bar contains the Logo of Tempress Systems Inc. By clicking the logo a screen will appear with general information about Tempress Systems Inc.
The center part of the title bar shows the Date and Time and the title of the Main Screen. A drop-down menu with Tube selection and the logged in User ID can be found on the right. In the top field quick navigation to another tube or login as a different user is possible.

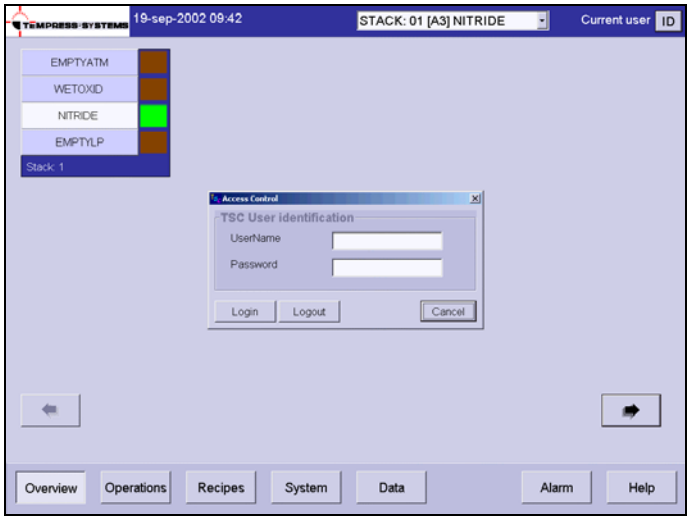
- ID (login/logout)
  - A login screen automatically pops up when a user requests particular functions
  - A user is automatically logged out after 5 minutes of no activity



General Information



Server or Tube selection



ID (Login)

3.2.2 NAVIGATION BAR

The navigation bar in the bottom field is always visible, like the title bar. Clicking a push button on the requested main screen automatically closes the previous one.

3.2.3 MAIN FIELD

The contents of the center field changes according to the selection made either in the title (tube or server selection) or in the navigation bar. The right side of the center screen contains context sensitive control buttons, whereas the left side shows the related information.

3.2.4 TSC-II SOFTWARE OVERVIEW

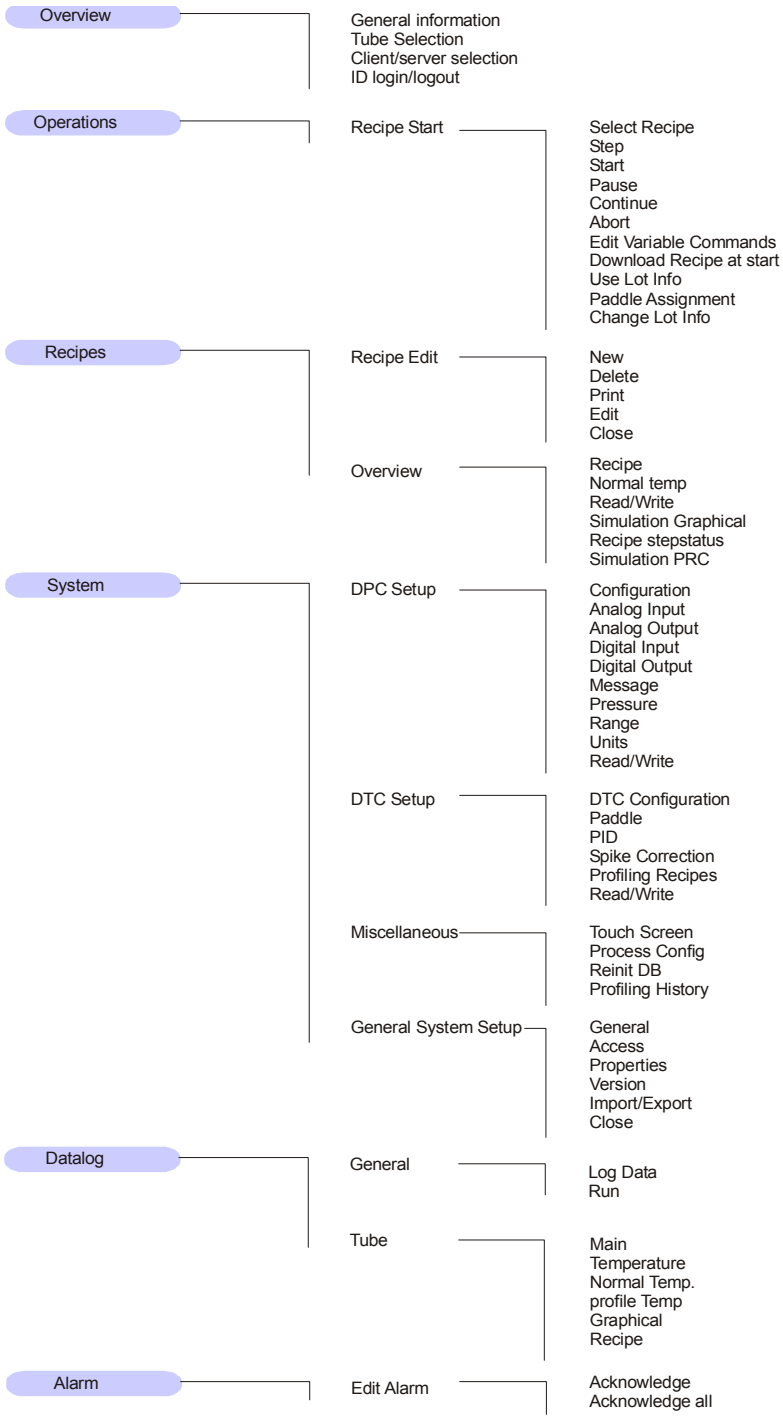


FIGURE 3-2: TSC SOFTWARE OVERVIEW

3.3 EXIT THE TSC-II

To close TSC-II the server must be selected in the title bar. The System menu activates the context sensitive functions. In the bottom right corner of the center field select 'Close' and confirm to exit TSC-II.

4 OVERVIEW

4.1 INTRODUCTION

The TSC-II will starts in Overview modus. In this screen an overview of all connected tubes per stack is presented (maximum of 4 tubes per stack). If more than 32 tubes are connected, the black arrows in the main field can be used to make the remaining tubes visible. A maximum of 4 screens is available per TSC-II client.

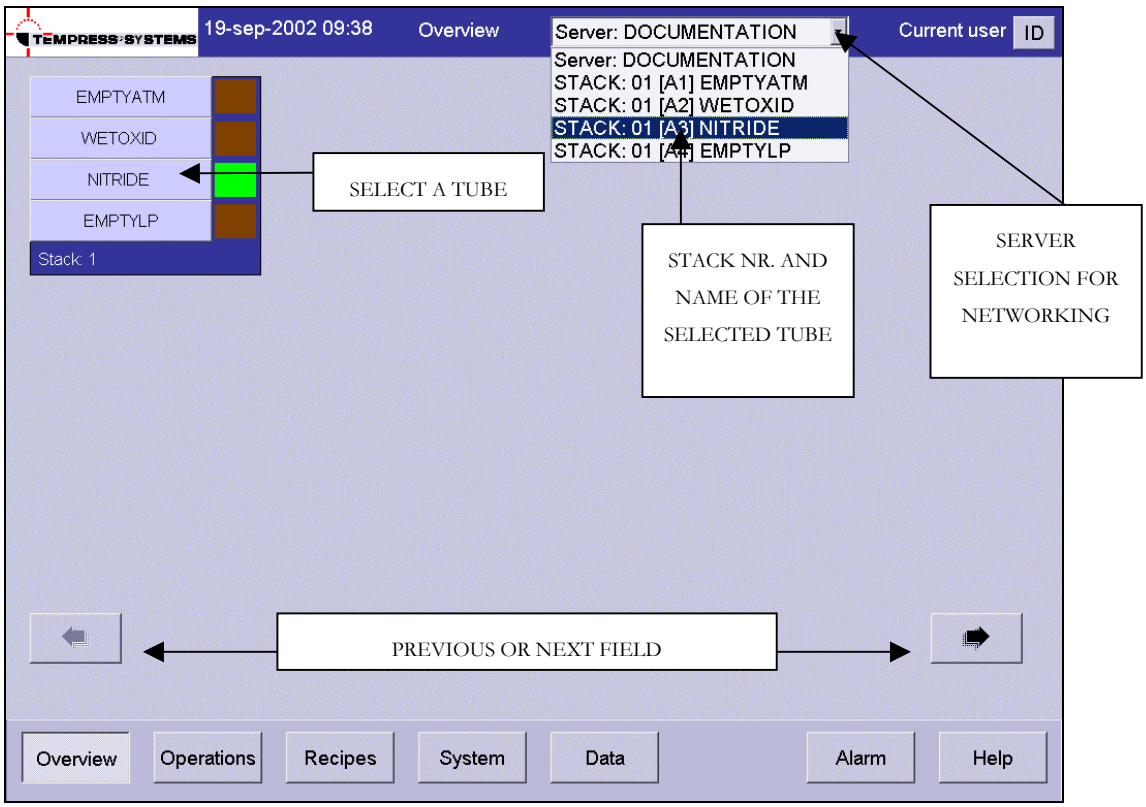


FIGURE 4-1: OVERVIEW

Tube selection is possible by directly clicking on the name of the desired tube in the desired stack. Upon selection the stack number and tube name will appear in the drop down menu of the title bar to confirm the selection.
Alternatively, the tube can be selected from the dropdown menu directly.

4.2 TUBE COMMUNICATION PROPERTIES

Select the tube in the drop-down menu or click with the left mouse button in the field of the tube. To enable communication with the tube, click the right mouse button on the tube name in the desired stack. The tube properties will appear (see Figure 4-2) with the following options (see Figure 4-2):

- **Enabled** — Enables communication to the tube
  The status indicator will turn green
- **Disabled** — Disables communication to the tube
  The status indicator will turn brown
- **In Service** — Maintenance status of the tube
  Disables logging, communication still enabled
  The status indicator will turn brown
- **Demo mode** — The status indicator will turn brown.

NOTE

The default colors mentioned can be modified in the System Properties of the server. See section 7.3.6.

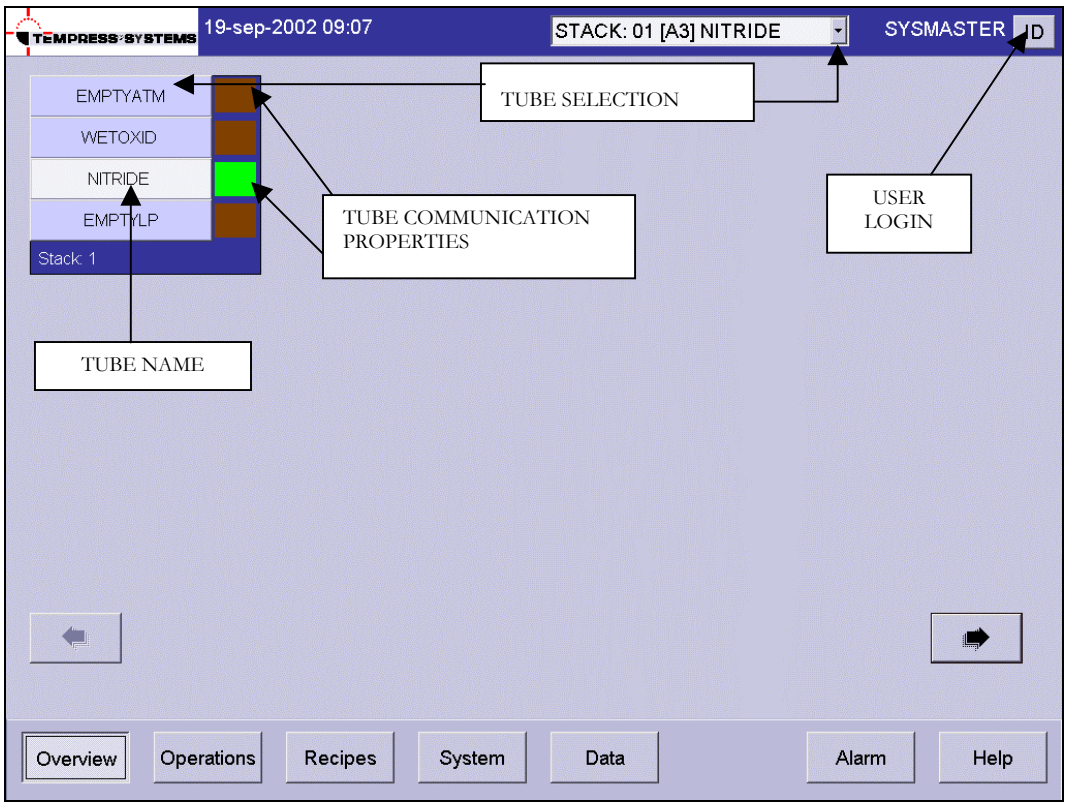


FIGURE 4-2: TUBE SELECTION AND PROPERTIES

5 OPERATIONS

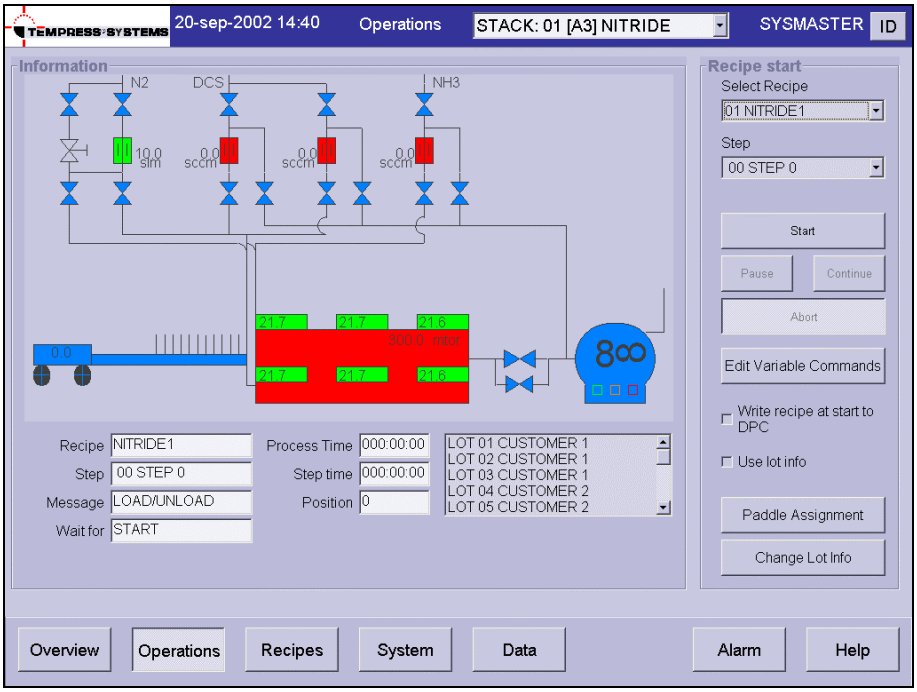


FIGURE 5-1: THE TSC OPERATIONS SCREEN

5.1 INTRODUCTION

The 'Operations' screen is the control center for the process recipes. There process recipes can be selected, started, paused, continued or aborted. In addition variable commands can be edited (if available). Lot info can be entered and the paddle thermocouple can be assigned.
The main center screen shows a graphical view of the tube configuration including its current gas flows, spike and paddle thermocouples readings and boat position information on process message, remaining (total process and step) time and wait condition Figure 5-2.

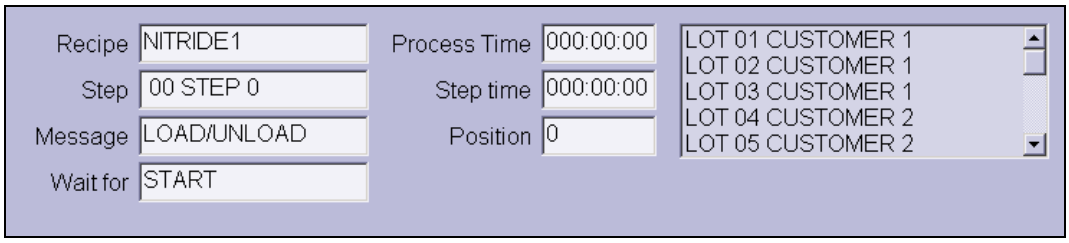


FIGURE 5-2: RECIPE STATUS

Recipe	The name of the selected recipe;
Step	Current step number and name;
Message	Process message of current step;
Wait for	Waits for a displayed condition to be fulfilled;
Process time	Remaining process time;
Step time	Remaining step time;
Position	Position of the boat;
Lot	Active Lot ID.

5.2 SELECT A PROCESS RECIPE

Select the desired process recipe from the drop down list 'Select Recipes'. This can only be accomplished if the current recipe is in step '0'.

5.3 SELECT A PROCESS RECIPE STEP

Select the process step number from the dropdown list 'Step'. To prevent a step being jumped to accidentally, the user is asked to confirm selection. All commands in the newly selected step will be executed except for the time function. The time function (if present) can be started by pressing 'Start'.

DANGER

Use this function only after verifying that the required action can only be accomplished by jumping directly.

Use this function only after verifying that the newly selected steps contains all the desired commands.

Selecting a wrong process step can cause life threatening danger

NOTE

Commands in a process recipe step are active until changed.

5.4 START, PAUSE AND CONTINUE A RECIPE

To start the process recipe press 'Start'. Starting a recipe from 'step 0' causes previous abort and branch alarms to be cleared. In the center field a graphical layout of the process will be shown real time.
If a process recipe is selected it needs to be started to run. No auto-run facility is available, a manual start command must be issued.
Once the process recipe is selected all commands in 'step 0' will be executed. To continue with the process recipe it must be started.
The process recipe can be paused by selecting the appropriate button. This action will only stop the timer in that particular process step, all other commands will remain active (z.g. the boat continues to move to its setpoint, the temperature will increase or decrease to its setpoint and/or MFC's will reach their programmed values).
Two situations require the 'Continue' button to be pressed:

1. A 'Pause' command has been issued before and continuation of the timer (and the rest of the process recipe) is desired;
2. The process recipe is 'waiting for start', which is activated by the 'Wait for Operator' instruction in the process recipe.

5.5 EDIT VARIABLE COMMANDS

Variable commands are instructions in the process recipe that can be quickly modified, without the use of the recipe editor.
This is convenient when fine-tuning a process during process qualifications or if minor adjustments to the process settings are required. Currently only Analog outputs (such as MFC setpoints), boat position and Digital outputs are supported as Variable commands.

5.6 ABORT PROCESS RECIPE

The running recipe can be aborted by selecting 'Abort'. To avoid accidental abortion of the process recipe the user will be asked to confirm this selection.

A recipe cannot be aborted if the normal recipe is in 'step 0'.
If a recipe is aborted the process returns to 'step 0' in the current recipe and an abort alarm appears.
If in the process recipe an abort recipe is enabled, this abort recipe will be executed first and then the process returns to 'step 0'.

If a process recipe is aborted 2 commands are executed. An abort alarm is generated and the actual process recipe is returned directly to 'step 0' if no abort recipe has been set active in this process recipe. If an abort recipe is activated this will be executed. When the abort recipe reaches its 'END' command then the system returns to 'step 0' of the process recipe that was aborted.

5.7 PADDLE ASSIGNMENT

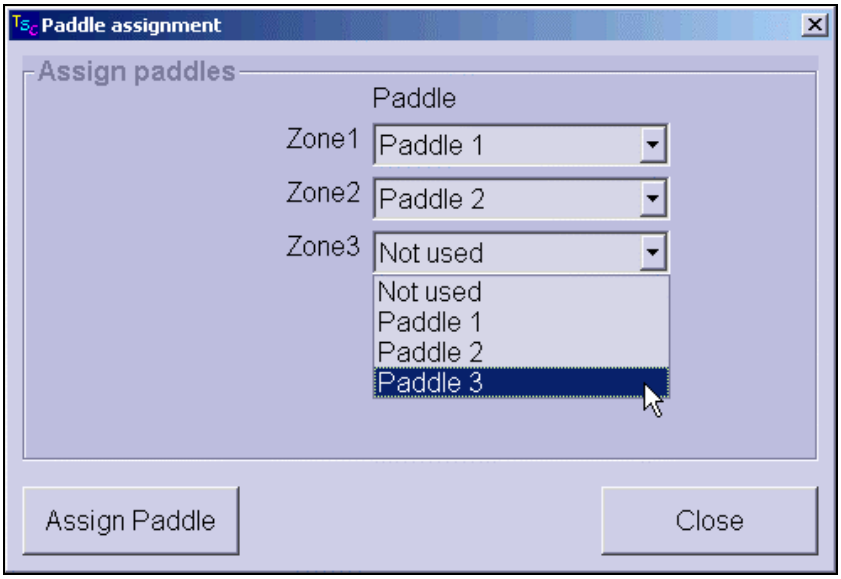


FIGURE 5-3: PADDLE ASSIGNMENT

The paddle assignment allows the paddle thermocouple input signals to be used for temperature control.
Select the desired paddle from the pull down menu and 'Assign Paddle'. Enter name and password and 'Close' to return to the 'Operations' main screen.

DANGER

Assigning the wrong paddle thermocouple input to a control zone may cause serious system damage.

5.8 CHANGE LOT ID

When a batch of wafers needs to be processed it often comes with Lot ID. This Lot ID allows history tracing if process problems should occurs.
A maximum of 16 (Nr) lot ID's can be entered when 'Change Lot Info' is selected. The following sub screen will appear:

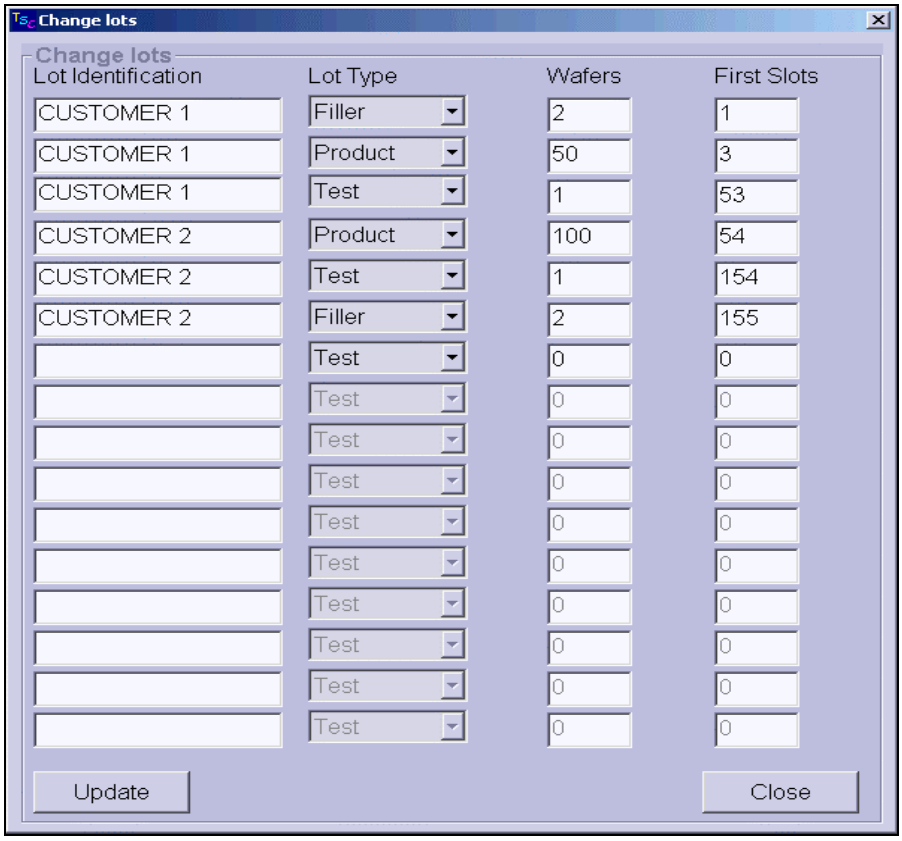


FIGURE 5-4: CHANGE LOT INFO

Lot Identification Enter a name with a maximum of 16 characters.

Lot Type Enter the wafer type. Filler wafers are dummy wafers. Product wafers are the actual process wafers. Test wafers are process monitor wafers.

Wafers Enter the number of wafers, of each type

First Slots Enter the first slot number for this lot. Empty slots between different certification are also full positions and have to be counted.

NOTE

Lot ID will only be used if the 'Use Lot ID' selection box is checked.

6 RECIPES

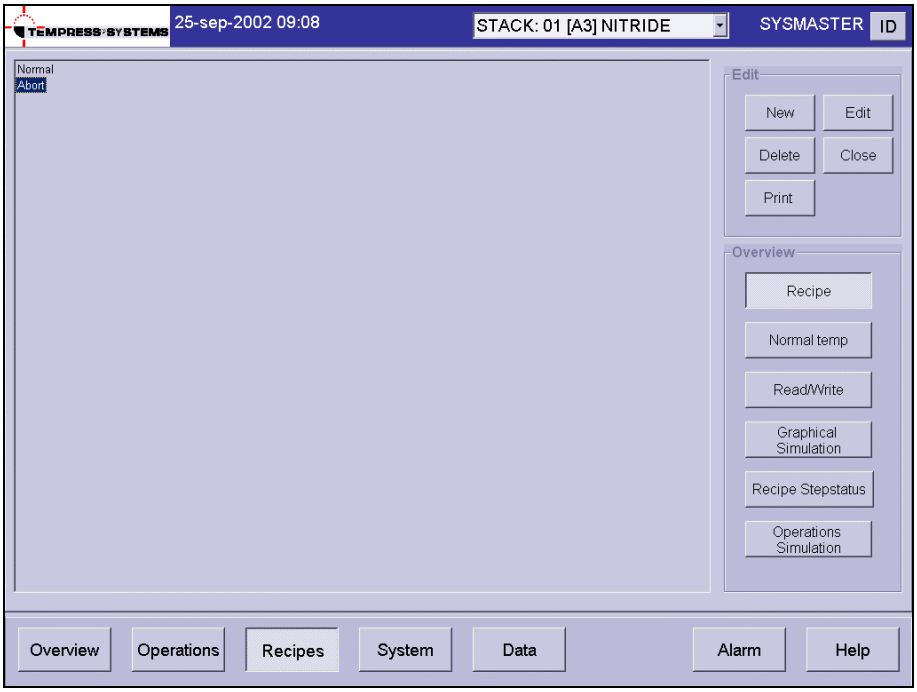


FIGURE 6-1: THE TSC-II RECIPE SCREEN

6.1 INTRODUCTION

This chapter describes the Recipe Explorer, which contains the screens used to create, edit, print, delete and write a recipe to or read a recipe from the DPC. Additionally, the normal (process) temperature table must be defined here. There are two types of recipes: NORMAL and ABORT. Double clicking on the Normal list shows the current recipes stored on the local hard disk of the TSC server pc. During daily process operation a normal recipe is used to run a process. In the normal process recipe the command ABORT recipe can used to enable an Abort recipe. If an abort instruction is issued after this command, the enabled Abort recipe will be executed instead of going to step 0. The Abort command cannot be used in step 0 of the normal recipe and can also not be used in an abort recipe (no nesting allowed).

A recipe can be created and/or modified at the tube level (on the Touchscreen), at each server and all client PCs.

The recipes can be 'read from DPC' or 'written to DPC' in the network.

At every 'Write to DPC' the recipe is verified against the certifications inside the DPC to ensure the proper instructions are used.

Information of 'date and user ID of the last modification to a recipe' and also date of the last read/write is logged in the system.

With the Recipe storage on the server/client PCs there is no limitation to the number of Recipes (both temperature and process recipes) in this configuration.

Recipe Editing:
The Tube controller recipe structure is based on programming changes only in the 'next step' This gives a compact recipe that is easy to read and understand.

The TSC-II software provides the Actual I/O Status in every step (like used in some furnace controllers). Only the changes from one step to the other need to be programmed with full details of all parameters in each step are available.
At every 'Write to DPC' a safety check is performed by verifying the targeted tube and if the same certifications are used in the recipe and in the DPC. Relevant information about user ID, time, recipe and tube ID is logged at any Read or Write. The Recipe editor has the following context sensitive buttons available. Many of those can also be accessed with the right mouse button.
Context sensitivity lies in the selected item, for example if the Normal (process) recipe list is highlighted the 'New' button allows a new process recipe to be made. If 'Recipe' is highlighted the same 'New' button allows new process recipe step to be added.

- **New**
  Create a new process recipe, step or command

- **Edit**
  Edit a recipe, step or command

- **Delete**
  Delete a process recipe, step or command

- **Close**
  Close a process recipe, step or command

- **Print**
  Print a recipe overview

- **Normal Temp**
  Enter or change the normal (process) temperature and limits

- **Graphical Simulation**
  Perform graphical simulation

- **Recipe Stepstatus**
  Show recipe step status

- **Operations simulation**
  Perform process simulation

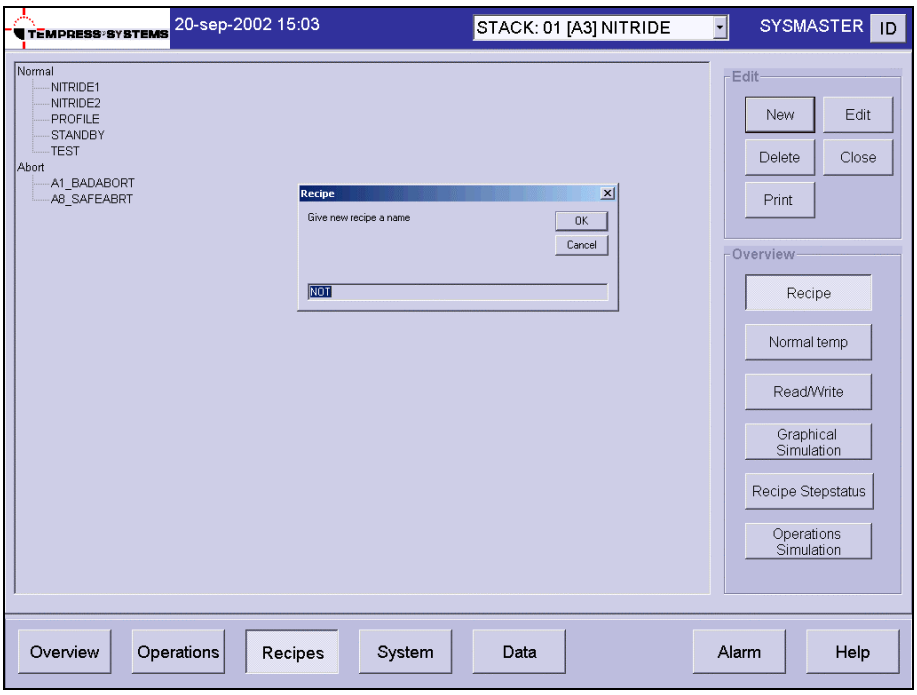


FIGURE 6-2: CREATING A NEW RECIPE

6.2 NORMAL AND ABORT RECIPES

Double clicking on the Normal list shows the names of the recipes that are stored on the harddisk of the server PC.
Double clicking on the Abort list shows the names of the abort recipes that are stored on the hard disk of the sever PC.
Pressing the 'New' button or using the right mouse button and selecting 'New Recipe' allows the user to create a new (process) recipe. The editor asks for configuration or the creation of a new recipe and by continuing the new name can be entered.

NOTE

Existing names will not be accepted

Subsequently new recipe can be based on an existing recipe by selecting the appropriate recipe from the drop down list that occurs next. Default selection is empty, this will result in a completely new recipe.

6.2.1 CREATE A NEW RECIPE

1) To create a new recipe select the desired tube and click with the left mouse button on Normal (or abort) in the Recipe Explorer, or use the right mouse button on Normal in the main field and select 'New Recipe'.
2) Select 'New' in the Recipe Edit field. The system will ask to add a new recipe. Press OK.
3) A submenu will appear for entering the new recipe name see Figure 6-2. Enter the new recipe name and press OK.
4) Another submenu appears giving the opportunity to copy from an existing recipe.

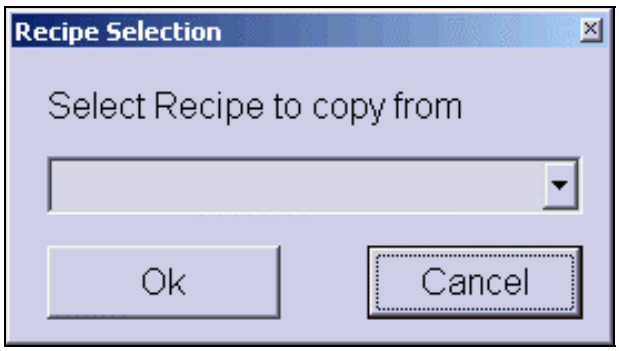


FIGURE 6-3: COPYING AN EXISTING RECIPE

5) Press OK without using the dropdown menu to create an empty new recipe. Use the dropdown menu to select the desired recipe to copy from and press OK. This copies the selected existing recipe into the new recipe.
   If an existing recipe has been selected accidentally and an empty new recipe is intended press 'Cancel'. This will create the new empty recipe instead of copying the selected one.

6.2.2 IMPORT A RECIPE

Using the right mouse button on the Normal (recipe) list in the Recipe Explorer allows a recipe to be imported. A browse menu appears and the desired recipe can be selected (*.rec):

FIGURE 6-4: IMPORT A RECIPE

Select the desired recipe and press 'Open'. The desired recipe will be imported to the recipe explorer and can be modified and handled like any other recipe.

6.2.3 EDIT RECIPE PROPERTIES

The recipe name can be altered by changing the recipe properties. These can be accessed by clicking once on the recipe to be modified and menu 'Edit'.

1) Select with the left mouse button the recipe name in the recipe explorer.
2) Select 'Edit' in the recipe edit menu. The following screen will appear with the recipe properties.

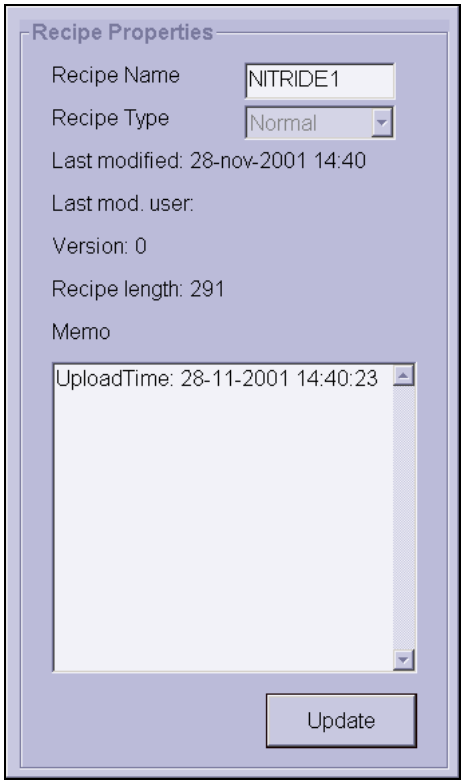


FIGURE 6-5: RECIPE PROPERTIES

- Recipe name
- Recipe type (Normal or Abort)
- Last modified
- Last modified user
- Version
- Recipe length
- Memo
- Update recipe

Only the Recipe name can be modified. Press 'Update' to store the changes. Selecting another recipe without pressing Update will cancel the modification.

6.3 EDIT PROCESS RECIPES

The name of the process recipe can be modified by pressing 'Edit', as described in section 6.2.3. The contents of the recipe consists of recipe steps, which can be appended or inserted above existing recipe steps. Each step contains commands, which are described in section 6.4.

6.3.1 NEW RECIPE STEP

1) To append a new recipe step click with the left mouse button on the Recipe Name in the Recipe Explorer in the left part of the main field and click 'New' in the recipe Edit field. Alternatively use the right mouse button to click once on the recipe name and select 'New Step' to add a new step to the end of the recipe.
2) The following screen will appear:

FIGURE 6-6: INSERT NEW RECIPE STEP

3) Give the new step a name to increase recipe readability and press 'OK'. Pressing 'Cancel' will create a new step without a step name.

The new step will be automatically numbered.
If a new recipe step is created and existing recipe steps are present the user can copy an existing step into the new step. See Figure 6-7.

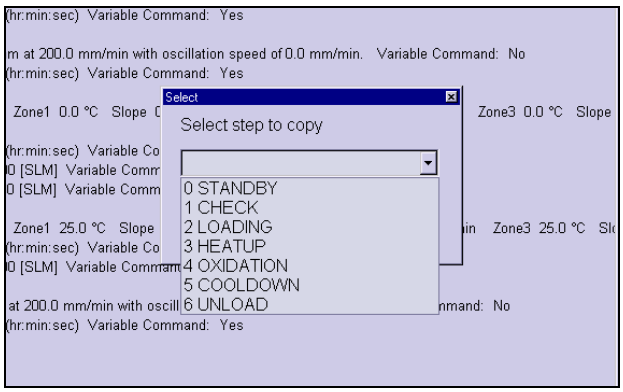


FIGURE 6-7: COPY RECIPE STEP

4) Select from the pull-down menu the desired recipe step and press OK. The selected recipe step will be copied to the new step.

6.3.2 INSERTING A NEW RECIPE STEP IN RECIPE EXPLORER

A new recipe step can be inserted above an existing step by using the right mouse button once on the step above which the new step must be inserted.

1) Click with the right mouse button on the recipe step name where the recipe step has to be inserted above. The next screen will be shown:

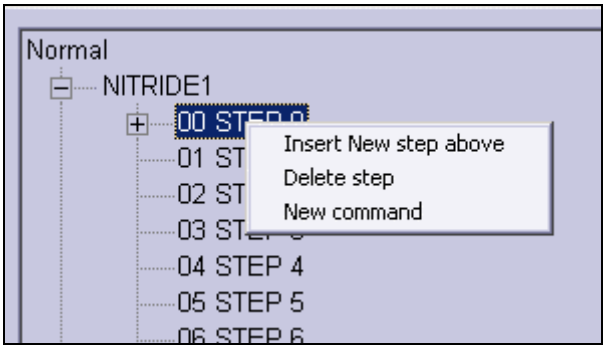


FIGURE 6-8: INSERTING A NEW RECIPE STEP

2) Select the option 'Insert New Step Above'.
3) Enter the new step name and press OK.
4) To copy an existing step into the new inserted step select from the desired recipe step and press OK.

6.3.3 EDIT RECIPE STEP

The name of the recipe step can be modified by selecting the step and pressing 'Edit'. A screen appears with recipe step properties.

The modified step name is stored by pressing 'Update line'

6.4 RECIPE COMMANDS

A process recipe consists of recipe steps, which in turn contains recipe commands. All commands in a particular recipe step are executed simultaneously. The sequence of commands is therefore not important except for alarm branch and abort commands. It is recommended to use a similar sequence for all recipes to improve readability.

6.4.1 CREATE A NEW RECIPE COMMAND

1) To insert a new command click with the left mouse button on the Recipe Step and select 'New' in the recipe edit field. Alternatively use the right mouse button on the recipe name once and select 'New command'.

2) A list of all available commands appears. Append the desired command by double clicking the name or clicking it once and pressing OK. If more than one sub command is available the command list will expand to show the possible sub commands. Double click or click once and press OK to append the new command. The contents of the newly added command are set when 'Update' is pressed.

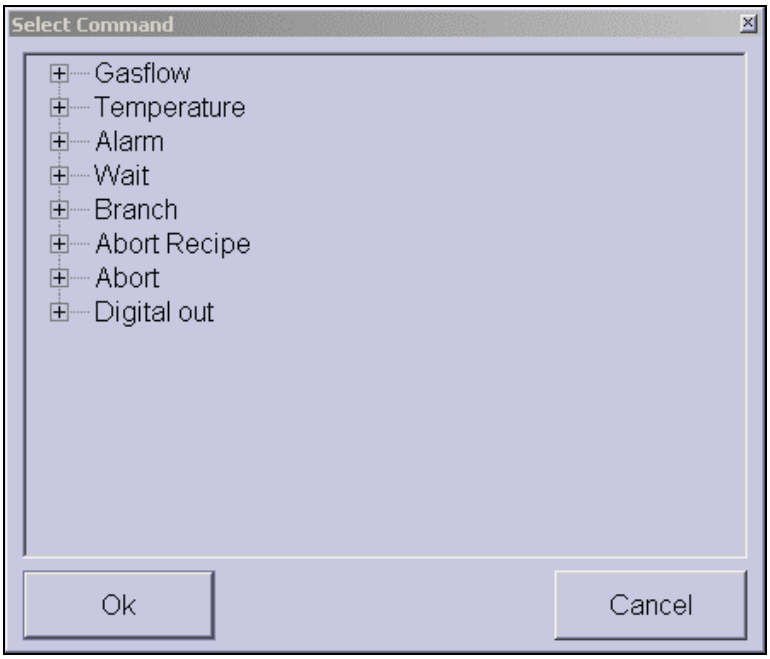


FIGURE 6-9: INSERT NEW COMMAND

6.4.2 INSERT A NEW COMMAND

To insert a new command above an existing command click with the right mouse button on the recipe command where the new command has to be inserted above. The next screen will be shown.

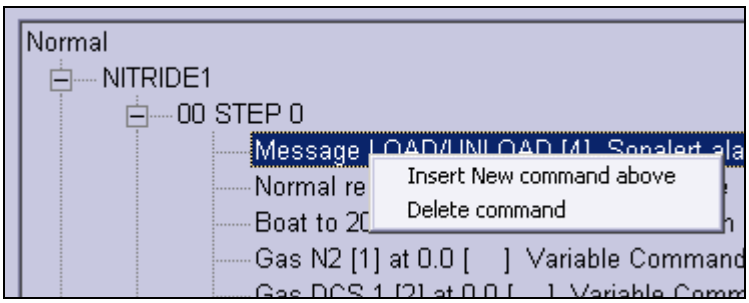


FIGURE 6-10: CREATE A NEW COMMAND IN THE RECIPE EXPLORER

Select 'Insert New Command Above' and the list of available commands appear.

6.4.3 RECIPE COMMAND PROPERTIES

Each time a recipe command is selected its properties are shown and can be modified from pulldown menu's. Changes are stored only when 'Update' is pressed.

6.5 EXPORT A RECIPE

A process recipe may be exported for use in other tubes or as a backup.

1) To export a recipe, click with the right mouse button on the recipe name. The next screen will be shown:

FIGURE 6-11: EXPORT, DELETE OR CHECK RECIPE

2) Select the option 'Export'. A browser will appear (Figure 6-12):
3) Browse to the desired location and press 'Save'.

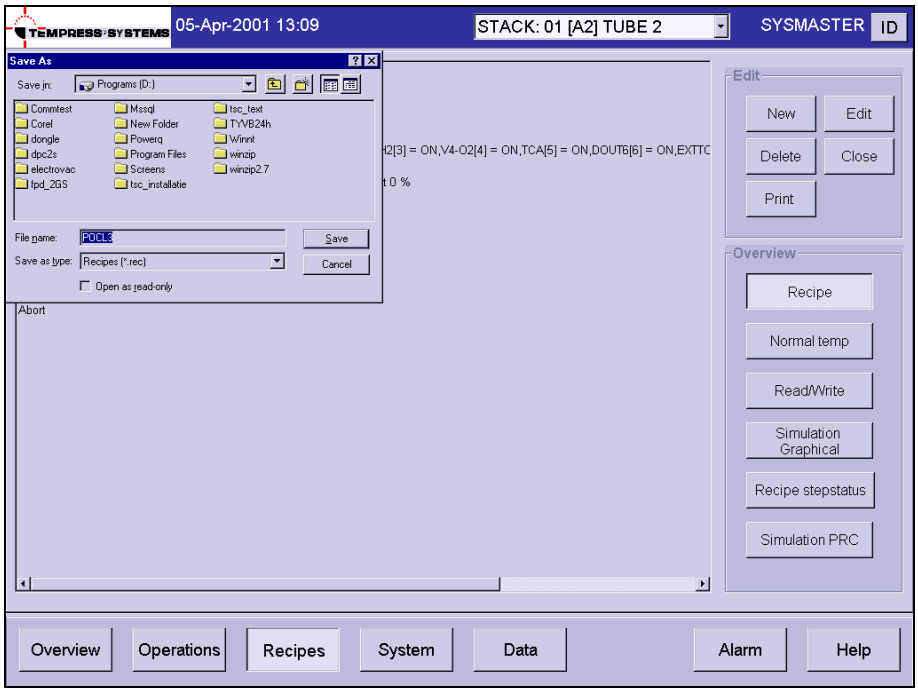


FIGURE 6-12: EXPORT RECIPE

6.6 DELETE A RECIPE

A process recipe may be deleted by selecting the recipe and press 'Delete' in the recipe edit menu.
A confirmation screen appears, press 'Yes' to delete or 'No' to cancel. Alternatively sue the right mouse button on the recipe once and select 'Delete'. Confirm by pressing 'Yes' to delete.
Alternatively use the right mouse button on the recipe step once and select 'Delete'.

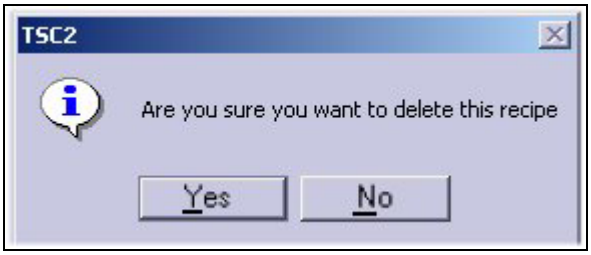


FIGURE 6-13: DELETE A RECIPE

6.7 DELETE A RECIPE STEP

A recipe step can be deleted by clicking with the left mouse button on the recipe step name select 'Delete' in the Recipe Edit menu. The confirmation screen will appear:

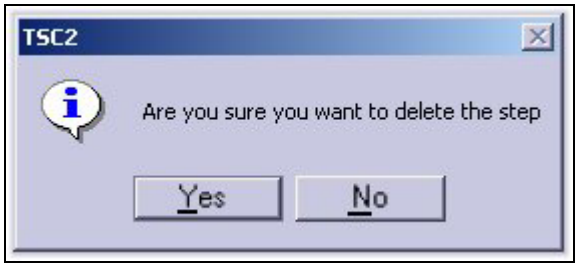


FIGURE 6-14: DELETE A RECIPE STEP

Press 'Yes' to delete or 'No' to return to the recipe explorer.
Alternatively use the right mouse button on the recipe step once and select 'Delete'.

6.8 DELETE A COMMAND

A recipe command can be deleted by clicking with the left mouse button on the command and select 'Delete' in the Recipe Edit menu.
Alternatively use the right mouse button on the command once and select 'Delete'. The confirmation screen appears. Press 'Yes' to delete or 'No' to return to the recipe explorer.

FIGURE 6-15: DELETE A RECIPE COMMAND

6.9 PRINT A RECIPE

A recipe can be printed by selecting the desired recipe and press 'Print'. A print preview will be generated. This may take several minutes.

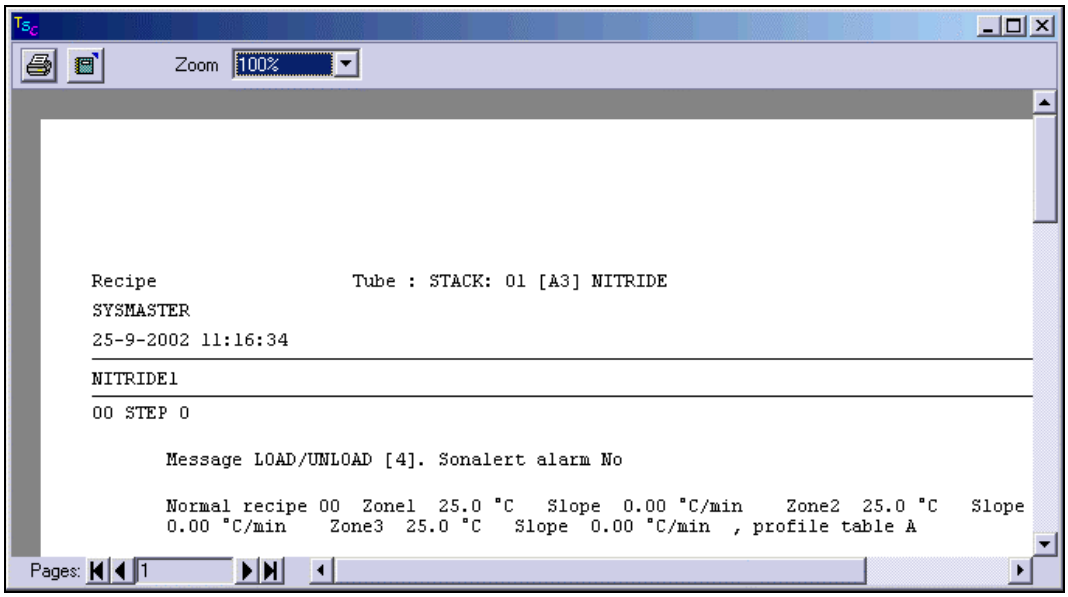


FIGURE 6-16: PRINT A RECIPE

The print preview screen contains two buttons and a pull down menu. The  button is used to give the Print command; the  button is used to export the printed recipe to a file. The pull down menu Zoom is used to Zoom in on the print preview.

Print recipe preview:

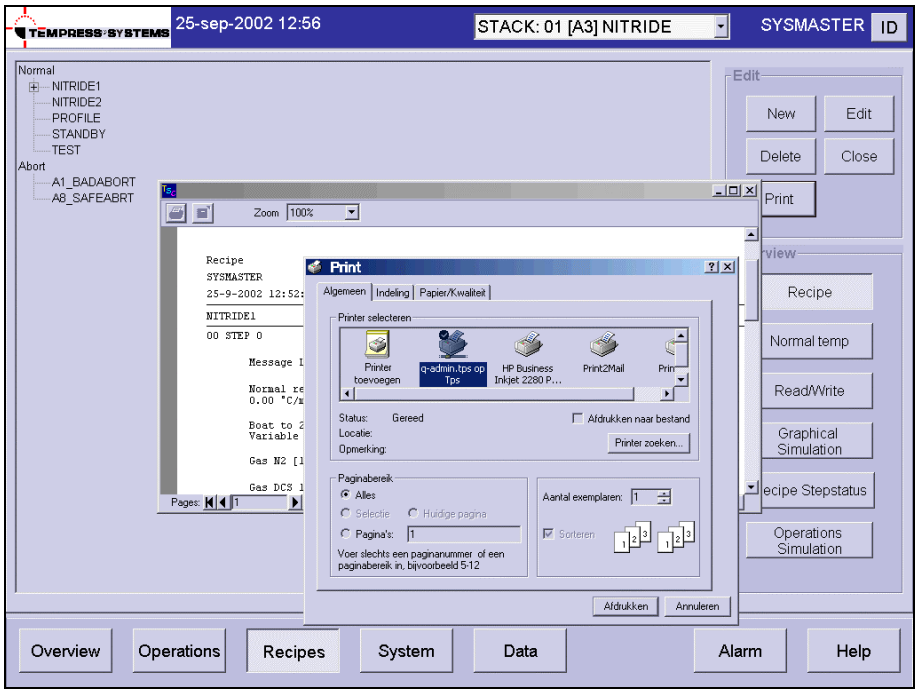


FIGURE 6-17: PRINT PREVIEW

This prints a hard copy to the system printer

1) Export recipe

This feature exports the recipe to a selected location as '.txt' or '.html'.

2) Zoom in or out the recipe overview

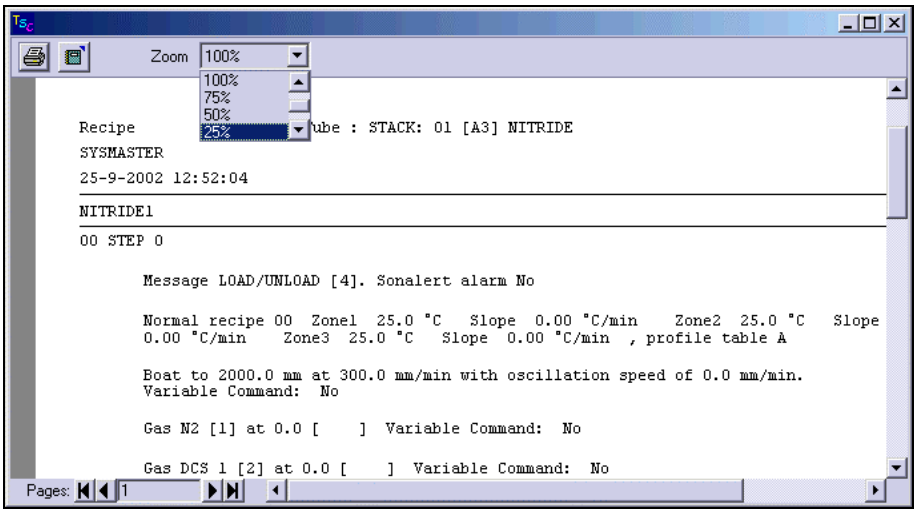


FIGURE 6-18: ZOOM PRINT PREVIEW

With this feature the recipe overview can be zoomed in or out in a range from 10 % to 200%

6.10 NORMAL TEMPERATURE TABLE

The normal temperature table can be modified and printed with the 'Normal temp' button.

FIGURE 6-19: NORMAL TEMPERATURE TABLE

This screen allows the temperatures and limits used in all zones of a tube during the normal operation of the furnace to be entered or changed. The input fields are:

Recipe number — As of DTC version 2.I an unlimited amount of temperature recipes can be stored. Older DTC's can store a maximum of 16 recipes.

Control — This selects the thermocouple type on which the control is to be exercised (spike or paddle).

Control — This selects the type of control (independent or master/slave)

Temperature setpoint — Enter the temperature setpoint for each zone. Each entry must be in the range set in the tube configuration screen (System, DTC Configuration)

Slope — Enter the rate of increase in temperature for each zone. Each entry must be in the range 0.0 to 99.0°C.

High/low limits The first column in this field is the high alarm limit. Enter the allowed maximum deviation above the temperature setpoint before an alarm is to be generated. The second column in this field is the low alarm limit. Enter the allowed maximum deviation below the temperature setpoint before an alarm is to be generated. Both parameters must be in the range 0.0 to 25.5 °C.

Gain Enter the gain setpoint for each zone. This must be in the range 0 to 255%.

Press 'save' to store the entered data or 'print' to print the normal temperature table.

6.11 READ/WRITE

To read normal and abort recipes or the normal temperature table from DPC or DTC, or to write the recipes or normal temperature table to DPC or DTC the 'Read/Write button opens the appropriate menu.

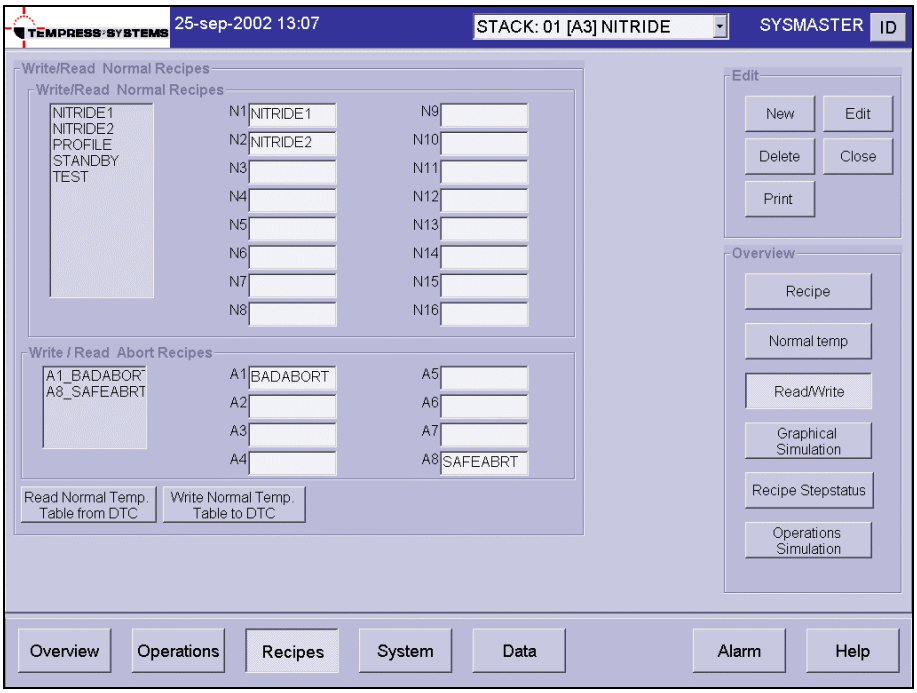


FIGURE 6-20: READ/WRITE RECIPES OR NORMAL TEMPERATURE TABLE

Drag and drop from right to left the desired Normal Recipe number or Abort Recipe Number to read from DPC. Select 'Read Normal Temp Table' to read from DTC.
Drag and drop from left to right the desired Normal Recipe or Abort Recipe on the desired DPC position to write. Select 'Write Normal Temp Table' to write to DTC.

6.12 PROCESS SIMULATION

When a recipe is completed a Simulation can be performed. With this screen a Graphical, step of operation, simulation of the selected parameters (for example temperatures, gasflows, pressure) are shown step by step where the 'X' axis shows the steps+time and the 'Y' axis the simulated actual values of the selected data.
The TSC-II software provides the Actual I/O Status in every step (like used in some furnace controllers). Only the changes from one step to the other need to be programmed with full details of all parameters in each step are available.

6.12.1 GRAPHICAL SIMULATION

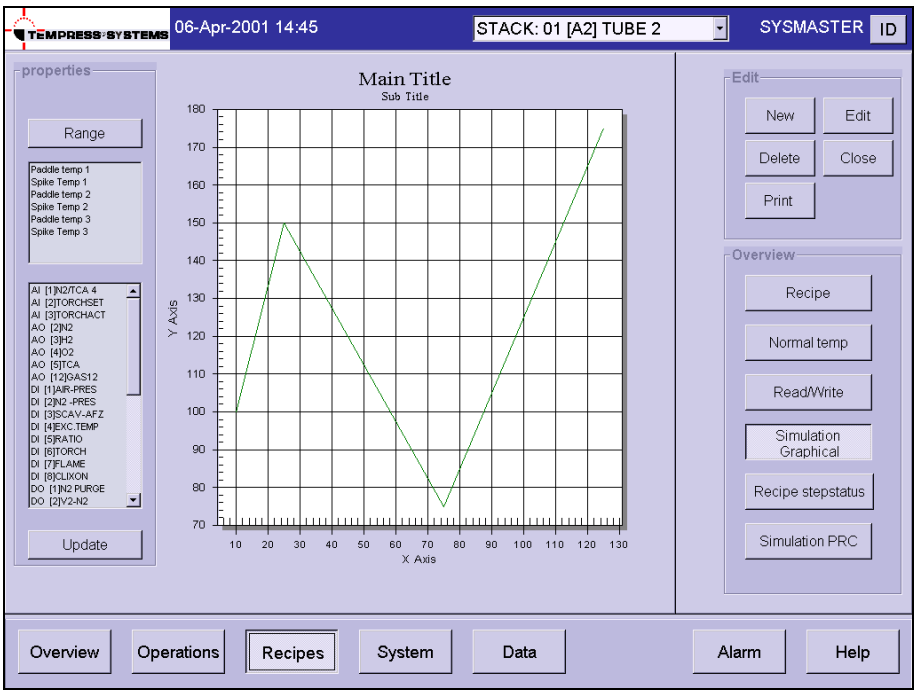


FIGURE 6-21: GRAPHICAL SIMULATION OF THE RECIPE

To verify a process recipe three simulations are available. When a recipe is completed a graphical simulation can be performed. Select 'Simulation Graphical'. The following screen will appear Figure 6-21.
The selected parameters (for example temperatures, gas flows, pressure) are shown step by step where the 'X' axis shows the steps+time and the 'Y' axis the simulated actual values of the selected data.
To select more then one parameter, hold the CTRL key or Shift key and select the desired parameters.

6.12.2 RECIPE STEP STATUS

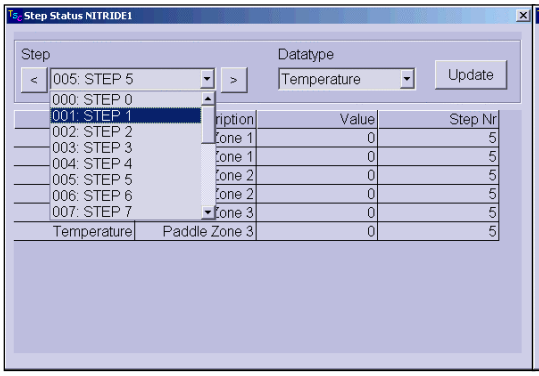


FIGURE 6-22: RECIPE STEPSTATUS

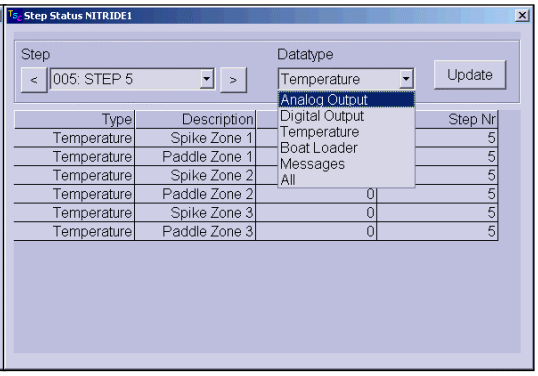


FIGURE 6-23

The recipe step status can be used to verify a process recipe step by step. It can be accessed by pressing 'Recipe step status'.
In this menu the recipe steps can be selected with their different types of data: Analog output, Digital Output, Temperature, Boat loader and All. In the table the selected Data Type will be shown with a Description, the Value and the Recipe Step number.
It allows modification of the parameters to be reviewed before the process recipe is used in the table.

6.12.3 OPERATIONS SIMULATION

A process recipe can also be simulated on the Operations Screen.

NOTE

The operation screen must be defined in system, process configuration.

An example of an operation screen is given below:

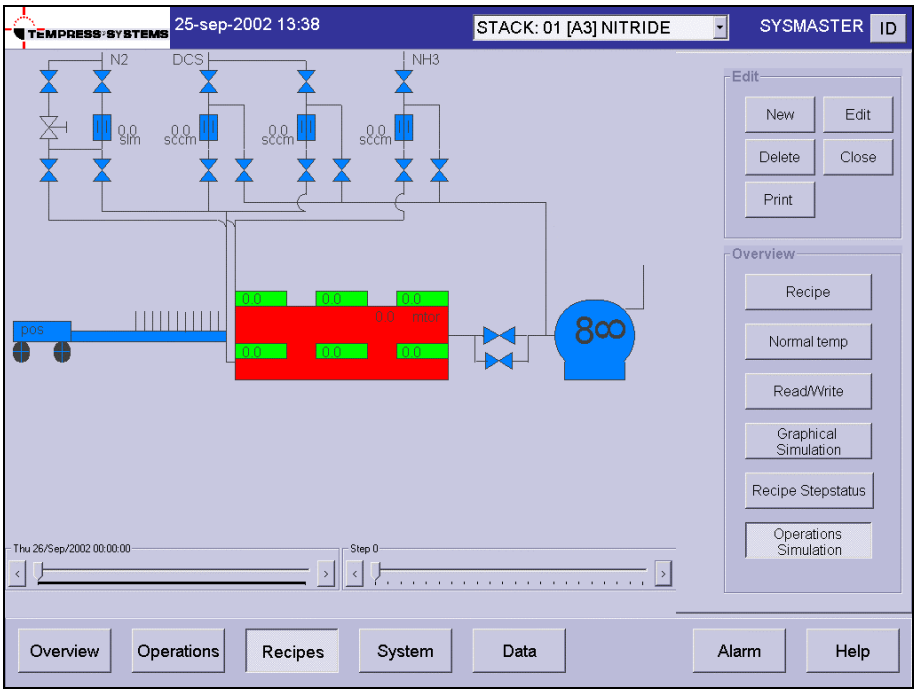


FIGURE 6-24: SIMULATION PROCESS RECIPE

In this screen a graphical overview of the tube and its parameters is shown. There are two slide-bars visible in the main field. With the left slide bar the process time can be selected to see the graphical simulation at the selected time. The right slide-bar will skip to the step, corresponding to the selected time. With the right-slide bar the process recipe step number can be selected to see the graphical simulation during the selected step. The time slide-bar will jump to the time corresponding to the selected step.

7 SYSTEM

7.1 INTRODUCTION

The System Menu is the configuration menu for TSC-2. It allows the setup of TSC-2, how many tubes (up to the license) are connected, the tube IDs and names can be modified, allocated disk space for logging can be changed. In addition, access rights can be granted per user, language properties can be selected, version numbers can be viewed and tube setups can be stored and restored for backup purposes.

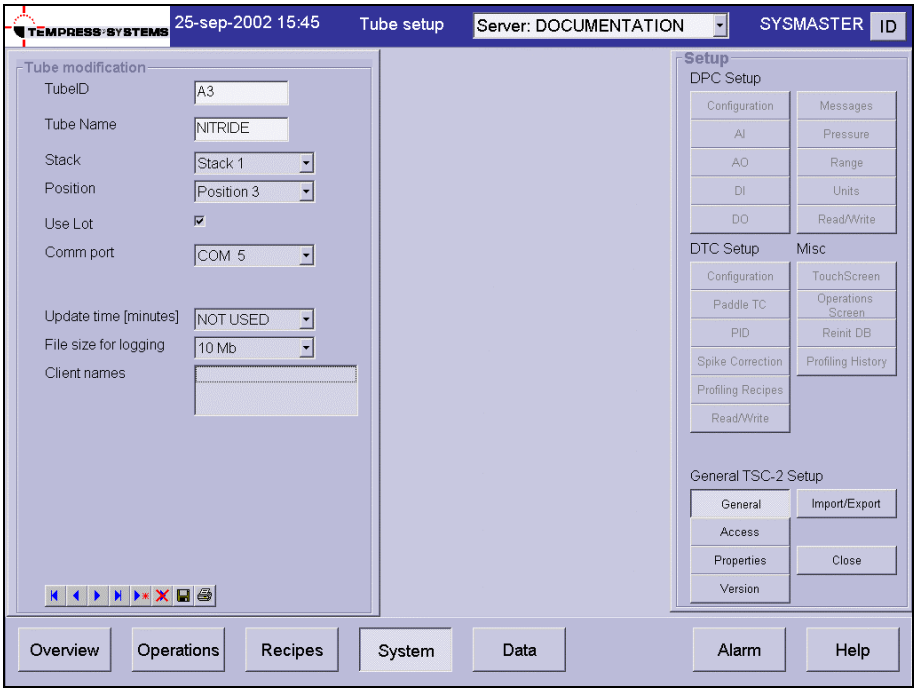


FIGURE 7-1: THE SYSTEM SETUP MENU

At tube level the setup **MUST** match the actual hardware to be able to safely and reliably operate a tube using TSC-2.

When a tube is selected from the pull-down menu or via the overview screen and the System Menu is accessed a screen as presented in Figure 7-1 appears.
On the right three submenus can be used, DPC Setup, DTC Setup and Miscellaneous. Each submenu will be described in this section.
The greyed out General TSC-2 Setup can be accessed similarly by using the pull-down menu and select the server name.

7.2 TUBE SETUP

A tube can only be safely controlled with TSC-2 if it is configured correctly. Therefore TSC-2 **MUST** match the actual tube hardware. Failure to do so may result in permanent damage to the furnace or cause serious if not deadly health risks.

WARNING

TSC-2 setup must match the actual tube hardware.

Each tube is controlled by one DPC and one DTC. The TSC-2 Setup submenu (formerly known as certifications) is used to correctly set up these controllers. This Tube Setup screen is divided into three sections, one for the DPC Setup, one for the DTC Setup and one for Miscellaneous Setup.
The Tube Setup is activated by selecting the appropriate tube from the pull-down menu. Alternatively, the tube can be selected in the Overview Menu and the Tube Setup is then activated by selecting the System Menu.

The DPC Setup consists of the following items

- DPC configuration
- Analog Inputs
- Analog Outputs
- Digital Inputs
- Digital Outputs
- Messages
- Pressure (LPCVD only)
- Range
- Units
- Read/Write

The DTC Setup consists of the following items

- DTC configuration
- Paddle thermocouple
- PID settings
- Spike correction table
- Profiling (Temperature) Recipes
- Read/write

The Miscellaneous Setup consists of the following items

- Touch Screen backup
- Operations Screen
- Reinit DB
- Profiling History

7.2.1 DPC SETUP

The DPC configuration will be automatically selected when the System Menu is accessed with a tube preselected. The DPC Configuration allows the setup of the tube to include a DTC, determine the maximum number of process recipes, define the type and length of the boat loader (if present), define the Analog and Digital Inputs/Outputs, set the Alarm Input/Output configuration and allow Step names to be used in the process recipes. The last 2 options are only available for DPC version 2.I or higher.
The DPC Setup Configuration screen has the following details:

DTC
Select this option if a DTC is installed. Default is yes for a diffusion furnace, but must match the DPC processor board jumper settings (See TECHNICAL MANUAL DPC).

Number Recipes
Enter the number of Process Recipes contained in the DPC. This is either 8 (8 x 1500 bytes) or 16 (16 x 750 bytes). Default value is 16 x 750 bytes.

Internal Press/Atm. Controller
Select this option if the Tempress Internal Pressure Controller is present (LPCVD tubes only). The pressure range and associated PID settings can be edited once the internal pressure controller is selected here.
Do not select this option if an external pressure controller is present or no pressure controller at all (atmospheric tubes). PID settings for the external pressure controller must be set remotely.

Boat loader
When an automatic boat loader is installed select this option. A High Speed Loader is a special loader with a maximum speed of 1 m/sec.
For manually loaded tubes the boatloader option must be deselected.

Boat Minimum
Enter the minimum value for the boat position. Default is 10 mm and is equivalent to *boat out*.

Boat Maximum
Enter the maximum value for the boat position. The range is 10 to 3000 mm. The boat maximum position is equivalent to *boat in* and should match the actual travel distance to allow accurate speed control.

Pulses per mm
This option is only applicable to older tubes with step motors. Current tubes use servomotors and this option is therefore ignored regardless of its value.

Number of I/O used

Analog Out: Select the maximum number of Analog Outputs (8 or 16). This number must match the DPC processor board jumper settings (See REFERENCE MANUAL DPC).

Analog In: Select the maximum number of Analog Outputs (8 or 16). This must be the same as the number of Analog Outputs.

Digital Out: Select the maximum number of Digital Outputs (8, 16, 24 or 32). This number must match the DPC processor board jumper settings (See REFERENCE MANUAL DPC).

Digital In: Select the maximum number of Digital Inputs (8, 16, 24 or 32). This number must match the DPC processor board jumper settings (See REFERENCE MANUAL DPC).

Alarm IO config

For tubes without a Touchscreen a Digital Output Port Number can be assigned to activate an alarm buzzer (an alarm buzzer is default connected to a Touchscreen).
Similarly a Digital Input Port Number can be assigned to silence the alarm buzzer (comparable to touching the Touchscreen).
This option is only available for DPC version 2.I or higher.

Download Stepnames

When a process recipe is programmed each process step can be given a name to improve the readability. The stepnames will be written to the DPC if this option is selected.
This option is only available for DPC version 2.I or higher.

NOTE

Press  to save the entered data or confirm the question Save Data, or all data will be lost!

7.2.1.1 Analog Inputs

The Analog Inputs (AI) are analog signals that are not controlled by the DPC. The DPC uses Analog Inputs to verify safety conditions and present their settings to the user. Up to 16 separate Analog Inputs are available.
The following screen will appear (depending on the actual hardware different names and numbers may be used):

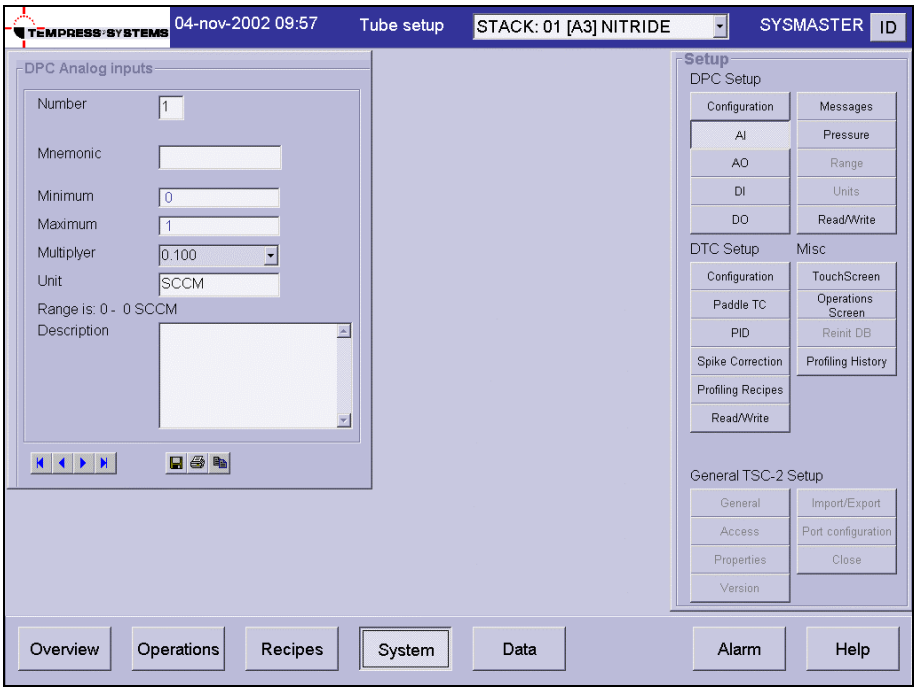


FIGURE 7-2: ANALOG INPUT CONFIGURATION

The Analog Inputs that must be defined here can be found in the electrical drawings of the furnace. For a safe and reliable operation of the tube using TSC-2 the Analog Inputs described here **MUST** match the actual tube hardware.

Number Enter the number of the Analog Input

Mnemonic Enter the name for the Analog Input

Minimum Enter the lowest value

Maximum Enter the value matching the hardware maximum value closest to 2000. *This value MUST be higher than the minimum value.*

Multiplier Select the multiplication factor to obtain the range that matches the range of the hardware connected to this Analog Input and give the desired resolution

Unit Free programmable unit *for DPC version 2.I or higher only*. Up to 4 characters can be used. *For DPC versions 2.G or lower* select the appropriate Unit from the pull-down menu.

Range The range will be calculated automatically from the minimum, maximum and multiplier values *for DPC version 2.I or higher only*. *For DPC versions 2.G or lower* select the appropriate Range from the pull-down menu that matches the hardware connected to this Analog Input.

Description Optionally give a description of the Analog Input.

NOTE

Press  to save the entered data or confirm the question Save Data, or all data will be lost!

The complete list of Analog Inputs can be printed using the Print button.

A list of predefined Analog Inputs (from another tube matching the same hardware) may be imported using the Import button.

WARNING

After import check new settings to match the actual tube hardware

7.2.1.2 Analog Outputs

The Analog Output supplies the setpoint to for example an MFC or a bubbler temperature controller with a range of 0-5V. The corresponding linked analog input is used for monitoring the actual flow. Select "AO" (Analog Outputs) to open the following screen:

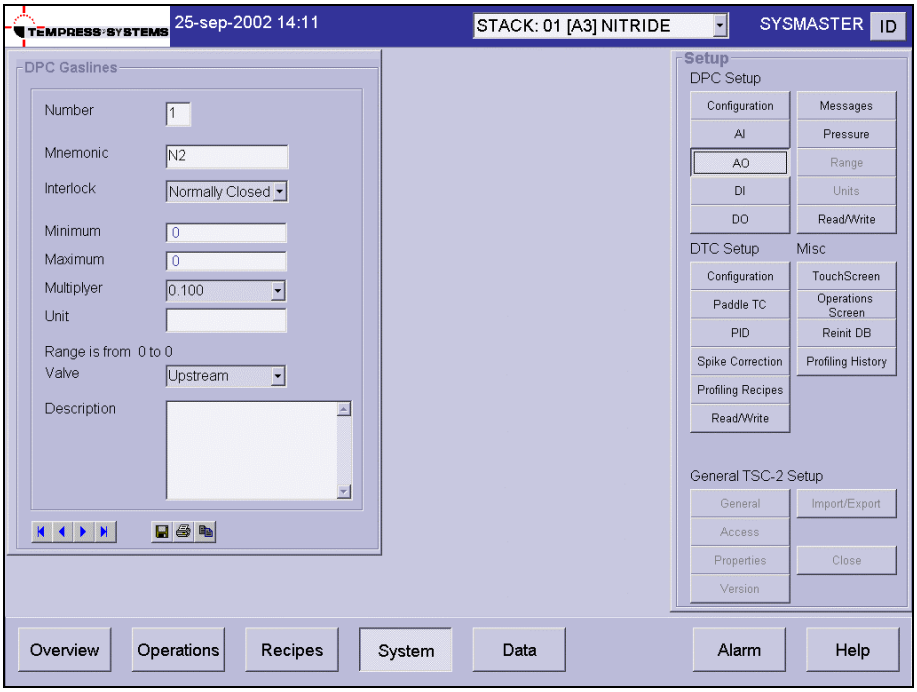


FIGURE 7-3: ANALOG OUTPUT CONFIGURATION

The Analog Outputs that must be defined here can be found in the electrical drawings of the furnace. For a safe and reliable operation of the tube using TSC-2 the Analog Outputs described here **MUST** match actual tube hardware.

Number Enter the number of the Analog Output

Mnemonic Enter the name for the Analog Output

Interlock The interlock feature allows automatic control of the corresponding Digital Output Number with the setpoint of the Analog Output Number. A setpoint of 0 (zero) automatically closes the related Digital Output, a setpoint higher than 0 (zero) automatically opens the related Digital Output with the *Softstart* feature. See the REFERENCE MANUAL DPC for details on the interlock and softstart feature. The interlock selection must match the type of Digital Output and can be one of the following options: Normally Open, Normally Closed, None or Press/Atm Control.

NOTE

Only one analog output channel can be defined as Pressure/Atm. Control.

NOTE

The Pressure/Atm Control interlock is only available if the internal pressure controller is selected in the DPC CONFIGURATION.

Minimum Enter the lowest value

Maximum Enter the value matching the hardware maximum value closest to 2000. *This value MUST be higher than the minimum value.*

Multiplier Select the multiplication factor to obtain the range that matches the range of the hardware connected to this Analog Output

Unit Free programmable unit *for DPC version 2.I or higher only*. Up to 4 characters can be used. *For DPC versions 2.G or lower* select the appropriate Unit from the pull-down menu.

Range The range will be calculated automatically from the minimum, maximum and multiplier values *for DPC version 2.I or higher only. For DPC versions 2.G or lower* select the appropriate Range from the pull-down menu that matches the hardware connected to this Analog Input.

Valve The upstream or downstream position of the interlocked Digital Output compared to the Analog Output can be entered here *for DPC version 2.I or higher only*.

NOTE

Setting the Valve position incorrectly may results in gas bursts during startup of Analog Outputs.

Description Optionally give a description of the Analog Output.

NOTE

Press  to save the entered data or confirm the question Save Data, or all data will be lost!

The complete list of Analog Outputs can be printed using the Print button.

A list of predefined Analog Outputs (from another tube matching the same hardware) may be imported using the Import button.

WARNING

After import check new settings to match the actual tube hardware

7.2.1.3 Digital Inputs

Digital Input Ports can be connected to any sensor that gives a digital signal, such as pressure sensors, door switches, safety switches and comparison devices. Select "DI" to open the following screen:

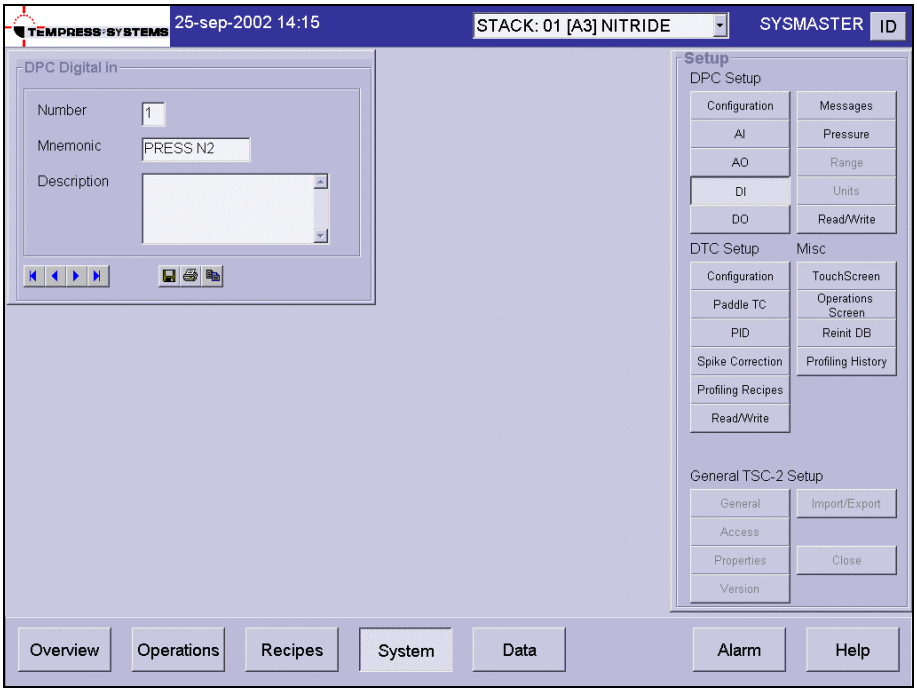


FIGURE 7-4: DIGITAL INPUT CONFIGURATION

The Digital Inputs that must be defined here can be found in the electrical drawings of the furnace. For a safe and reliable operation of the tube using TSC-2 the Digital Inputs described here **MUST** match actual tube hardware.

Number Enter the number of the Digital Input

Mnemonic Enter the name for the Digital Input

Description Optionally give a description of the Digital Input.

NOTE

Press  to save the entered data or confirm the question Save Data, or all data will be lost!

The complete list of Digital Inputs can be printed using the Print button.

A list of predefined Digital Inputs (from another tube matching the same hardware) may be imported using the Import button.

WARNING

After import check new settings to match the actual tube hardware

7.2.1.4 Digital Outputs

Digital Outputs can be used to open valves or start an external torch. Select "DO" to open the following screen:

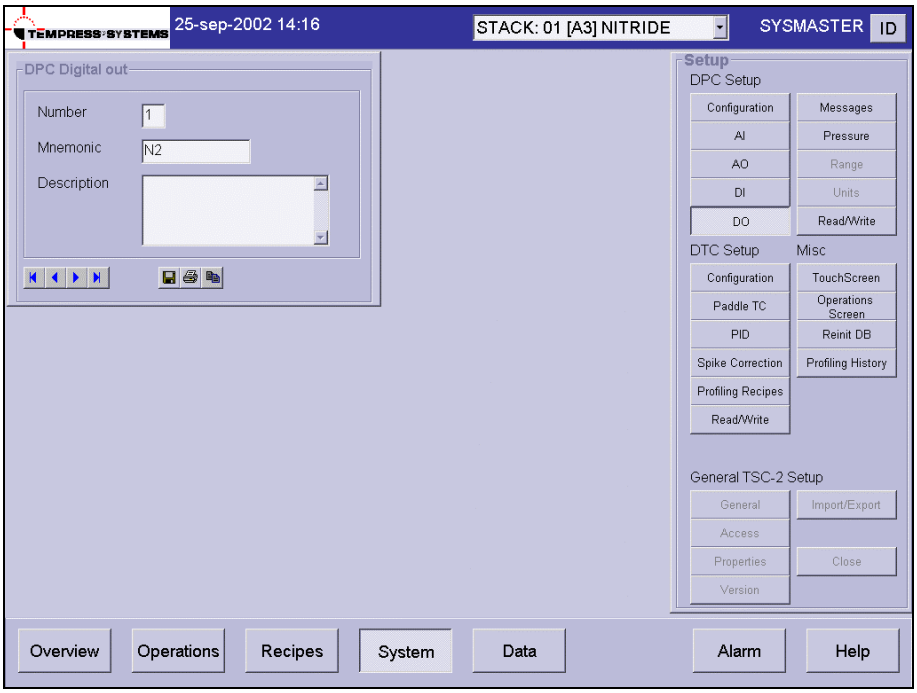


FIGURE 7-5: DIGITAL OUTPUT CONFIGURATION

The Digital Outputs that must be defined here can be found in the electrical drawings of the furnace. For a safe and reliable operation of the tube using TSC-2 the Digital Outputs described here **MUST** match actual tube hardware.

Number Enter the number of the Digital Output

Mnemonic Enter the name for the Digital Output

Description Optionally give a description of the Digital Input.

NOTE

Press  to save the entered data or confirm the question Save Data, or all data will be lost!

The complete list of Digital Outputs can be printed using the Print button.

A list of predefined Digital Outputs (from another tube matching the same hardware) may be imported using the Import button.

DANGER

After import check new settings to match the actual tube hardware.

7.2.1.5 Messages

Messages can be used to notify the user about the status of the current process step. The message command will be displayed throughout the execution of the step. Select "Messages" to open the following screen:

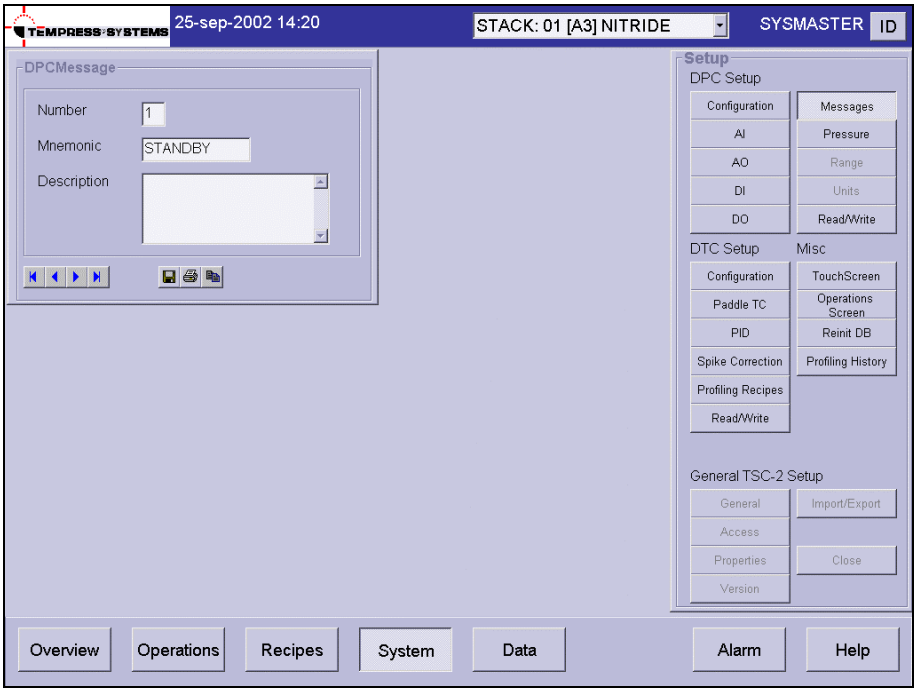


FIGURE 7-6: MESSAGES CONFIGURATION

The messages can be freely defined up to 12 characters long. It is recommended to use simple and clear messages.

Number Enter the number of the Message

Mnemonic Enter the name of the Message (max. 12 characters)

Description Optionally give a description of the Message.

NOTE

Press  to save the entered data or confirm the question Save Data, or all data will be lost!

The complete list of the Messages can be printed using the Print button.

A list of predefined Messages (from another tube matching the same hardware) may be imported using the Import button.

7.2.1.6 Pressure control

If one analog output port is defined as pressure/atm control the Pressure screen can be activated. The Pressure screen contains the pressure controller PID parameters. These are the proportional factor P in the range 0 to 255, the integral time I in the range 0 to 25.5 seconds and the derivative time D in the range 0 to 255 seconds. The PID values can be divided in up to 5 pressure ranges. Select "Pressure" to open the following screen:

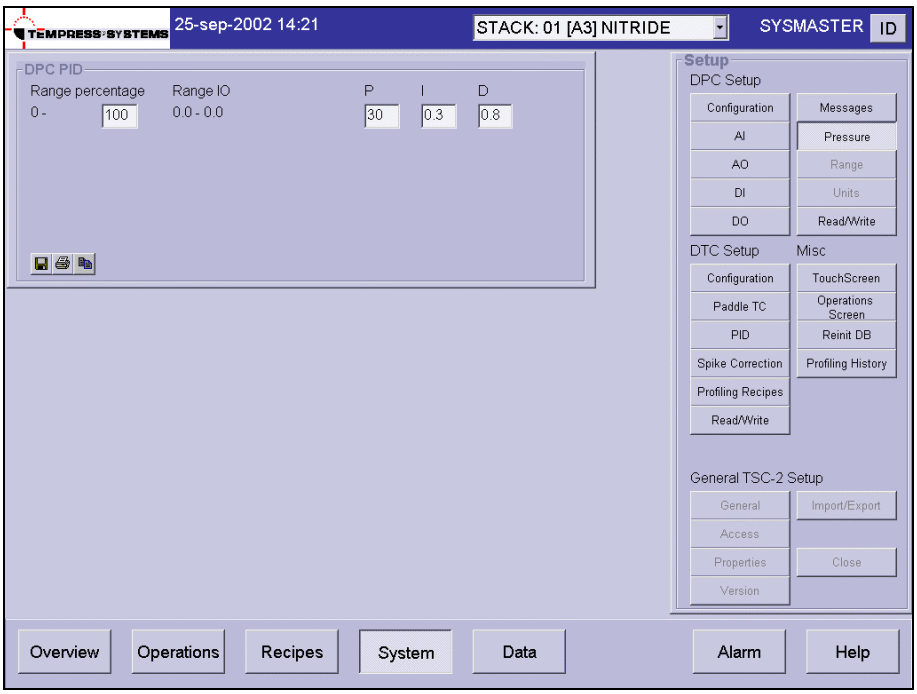


FIGURE 7-7: PRESSURE CONTROLLER PID CONFIGURATION

Range Percentage	Enter the range in percentage of maximum scale of the corresponding Analog Output. Up to 5 ranges may be defined.
P	Enter the proportional factor in the range 0 to 255
I	Enter the integral time in the range 0 to 25.5 seconds
D	Enter the derivative time in the range 0 to 255 seconds

NOTE

Press  to save the entered data or confirm the question Save Data, or all data will be lost!

The complete list of the Pressure Control PID settings can be printed using the Print button.

A predefined Pressure Control PID setting (from another tube matching the same hardware) may be imported using the Import button.

7.2.1.7 Range

For DPC version 2.G or lower the range used in the analog inputs and analog outputs is hardware encoded and can not be altered. For DPC version 2.I or higher the range can be freely programmed in the Analog Output menu.

7.2.1.8 Units

For DPC version 2.G or lower the units used in the analog inputs and analog outputs are hardware encoded and cannot be altered. For DPC version 2.I or higher the units can be freely programmed in the Analog Output menu.

7.2.1.9 Read/Write DPC

The Read/Write DPC menu is used to store the DPC Setup in the memory of the DPC or read the DPC memory contents. Select "Read/Write" to open the following screen (only available if a DPC is connected):

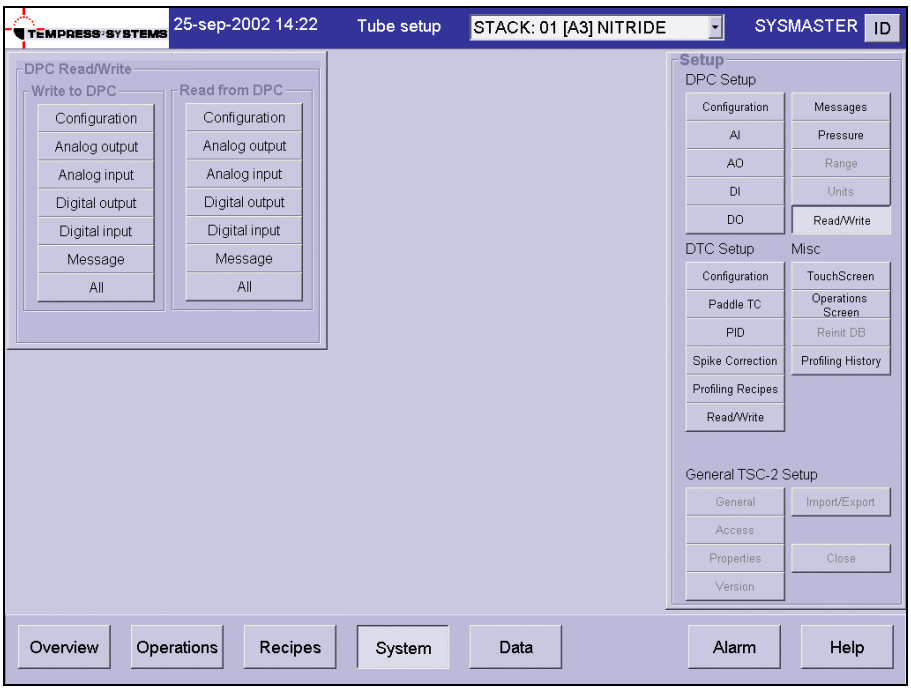


FIGURE 7-8: READ/ WRITE DPC MENU

Select the desired option to read from DPC or write to DPC. A confirmation message is presented for successful read/write actions.
In case problems occur when using the 'All' option the individual options should be used.

NOTE

Current information will be overwritten..

7.2.2 DTC SETUP

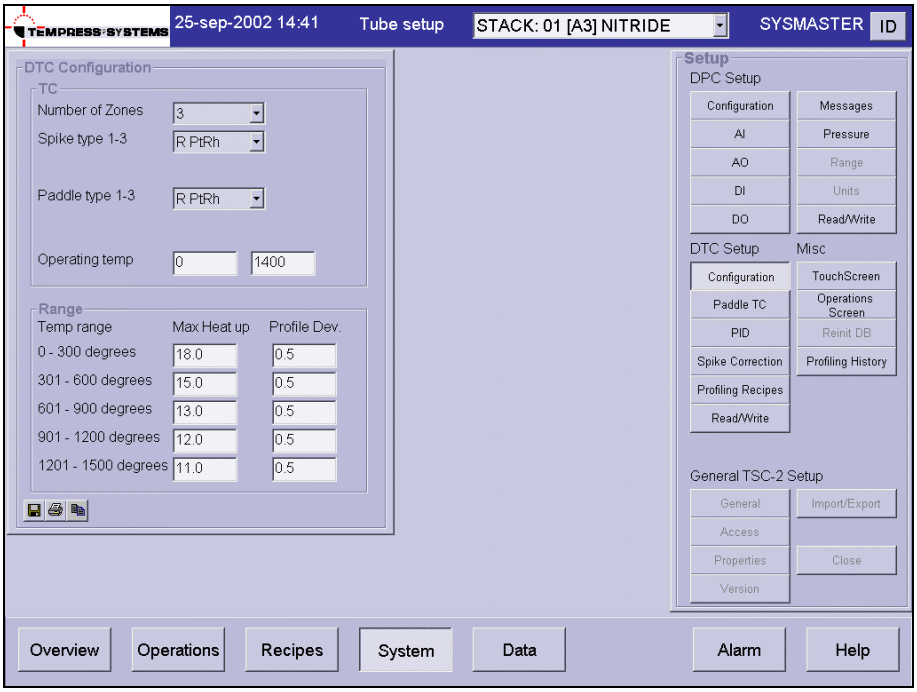


FIGURE 7-9 DTC CONFIGURATION

The DTC Setup allows the setup of the temperature related items. It includes the number of heating zones and the type of thermocouples used, the maximum heat up rate, the calibration tables for profile thermocouples, the PID settings used in the temperature controller, the maximum allowed deviation at the spike thermocouples, the profiling temperatures and allows to read/write data from and to the DTC.

7.2.2.1 DTC configuration

The DTC Configuration contains the number of heating zones, the type of thermocouple used, the operating temperature range, the maximum profile deviation and may include software restriction in the maximum heat up rate. The following screen will appear:

Number of zones Enter the number of heating zones for the tube. The possible values are 3, 4, 5 or 6, with the most common 3 or 5 zones.

Spike type 1-3 Select the type of spike thermocouple for zones 1 to 3. Type K, Platinel, R, S and B are available. See the REFERENCE MANUAL DTC for more details about thermocouple type modification.

Spike type 4-6 Select the type of spike thermocouple for zones 4 to 6 when present. Type K, Platinel, R, S and B are available.

Paddle type 1-3 Select the type of profile thermocouple for zones 1 to 3. Type K, Platinel, R, S and B are available.

Paddle type 4-6 Select the type of profile thermocouple for zones 4 to 6 when present. Type K, Platinel, R, S and B are available.

Operating Temp Enter the minimum and the maximum operating temperature of the tube. This depends on the type of heating element used. The appropriate thermocouple type must be selected for safe and reliable operation. The range 0 to 1400°C.

Max heat up Enter the maximum heat-up rate for the 5 temperature ranges. This parameter sets the limit on the maximum ramp-up speed for each temperature range and is used to increase lifetime of both heating element and process tube. The range of possible values for this parameter is 0.0 to 25.5 °C/min. If the rate is set on 0.0 °C the maximum heat-up rate is determined by the power transformer and heating element performance.

Profile deviation Enter the maximum profile deviation for the 5 temperature ranges. This parameter is a limit used in profiling a tube. The temperature in all zones must have been within this limit for at least 15 minutes to allow the profile table to be filled. The range for this parameter is 0.5 to 9.9 °C.

NOTE

Press  to save the entered data or confirm the question Save Data, or all data will be lost!

The complete setup of the DTC configuration can be printed using the Print button.

A predefined setup of the DTC configuration (from another tube matching the same hardware) may be imported using the Import button.

WARNING

After import check new settings to match the actual tube hardware

7.2.2.2 Paddle TC calibration table

The paddle thermocouple (or profile TC) calibration table is used to store calibrated temperatures for a paddle (profile) thermocouple. A pull-down menu allows the selection of the correct paddle thermocouple and should include the unique name or serial number of that paddle TC. The temperature values must be in ascending order and will be automatically sorted when this menu is exited.
Select "Paddle TC" to open the following screen:

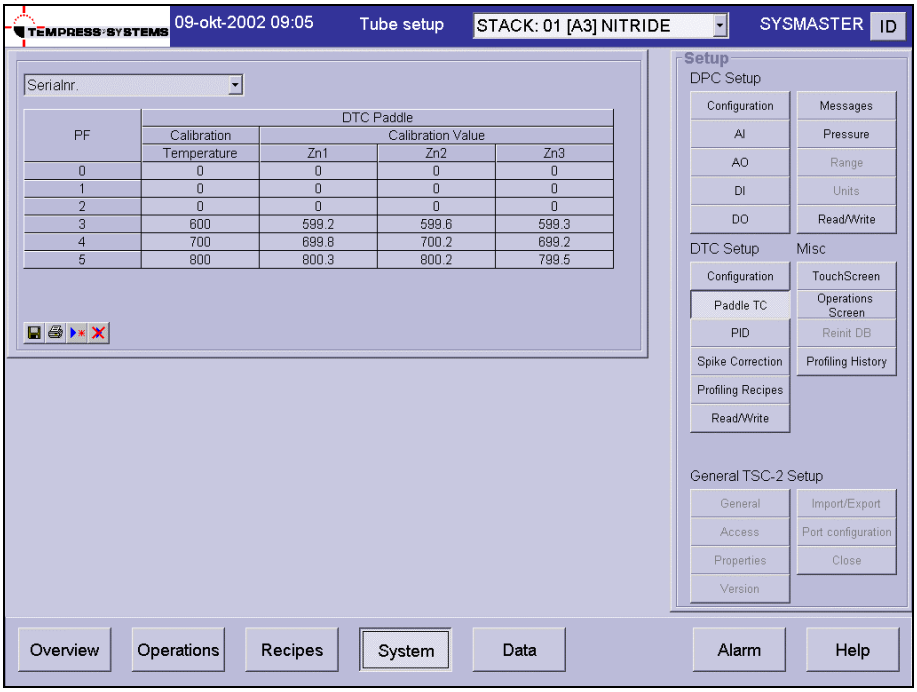


FIGURE 7-10: CALIBRATION TEMPERATURE FOR THE PADDLE THERMOCOUPLES

To create a new paddle TC entry press  and enter the unique name or serial number for this paddle TC.
Select the newly added paddle TC and fill in the calibration temperature and real measured values.

Calibration Temperature

Enter the values at which the thermocouples have been calibrated. These values must be ascending order and in the range 0.0 to 1500.0 °C and will be automatically sorted.

Calibration Value

For each paddle enter the calibrated value corresponding to the calibration temperature. These values must be within ± 20 ° C of the calibration temperature.

NOTE

Press  to save the entered data or confirm the question Save Data, or all data will be lost!

The paddle TC calibration table can be printed using the Print button.

7.2.2.3 PID parameter table

The PID parameter table displays the proportional, integral, derivative and gain parameters for the spike thermocouple and the integral and derivative parameters, in all the zones, for the paddle thermocouple over the five temperature ranges.
The default settings apply for the majority of all systems, only in specific situations with temperature stability and overshoot problems should these settings be modified. Select "PID" to open the following screen:

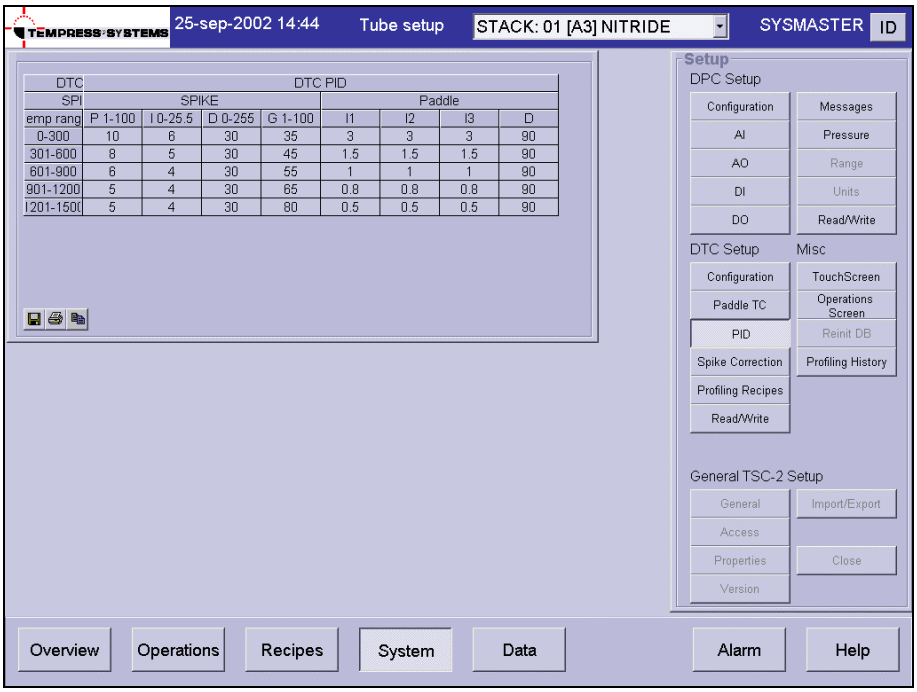


FIGURE 7-11: PID PARAMETER TABLE

Spike Proportional Parameter

Enter the spike proportional parameter for each temperature range. The range of values is 1 to 100 ^{0}C.

Spike Integral Parameter

Enter the spike integral parameter for each temperature range. The range of values is 0.0 to 25.5 minutes.

Spike Derivative Parameter

Enter the spike derivative parameter for each temperature range. The range of values is 0 to 255 seconds.

Spike Gain Parameter

Enter the spike gain parameter for each temperature range. The range of values is 1 to 100%.

Paddle Integral Parameter

Enter the paddle integral parameter for each temperature range and each zone. The range of values is 0.0 to 25.5 minutes.

Paddle Derivative Parameter

Enter the paddle derivative parameter for each temperature range. The range of values is 0 to 255 seconds.

NOTE

Press  to save the entered data or confirm the question Save Data, or all data will be lost!

The complete setup of the PID parameters can be printed using the Print button.

A predefined setup of the PID parameters (from another tube matching the same hardware) may be imported using the Import button.

7.2.2.4 Maximum spike correction table

The Maximum Spike Correction Table is used for a specific situation: the combination of paddle control (while using a paddle TC) and a "Boat Out" command. Cold cleanroom air will enter the process tube and cool down the first (2) paddle thermocouples by as much as 100°C or more. The DTC will respond with a power increase to the first (2) heating zones. The latent heat that will be stored in the first (2) heating zones will result in a large overshoot and long stabilization times upon boat in. The Maximum Spike Correction Table restricts the power output to the first (2) heating zones to the maximum indicated in this table. The result is a smaller overshoot and shorter stabilization times upon "Boat in" command. Select "Spike Correction" to open the following screen:

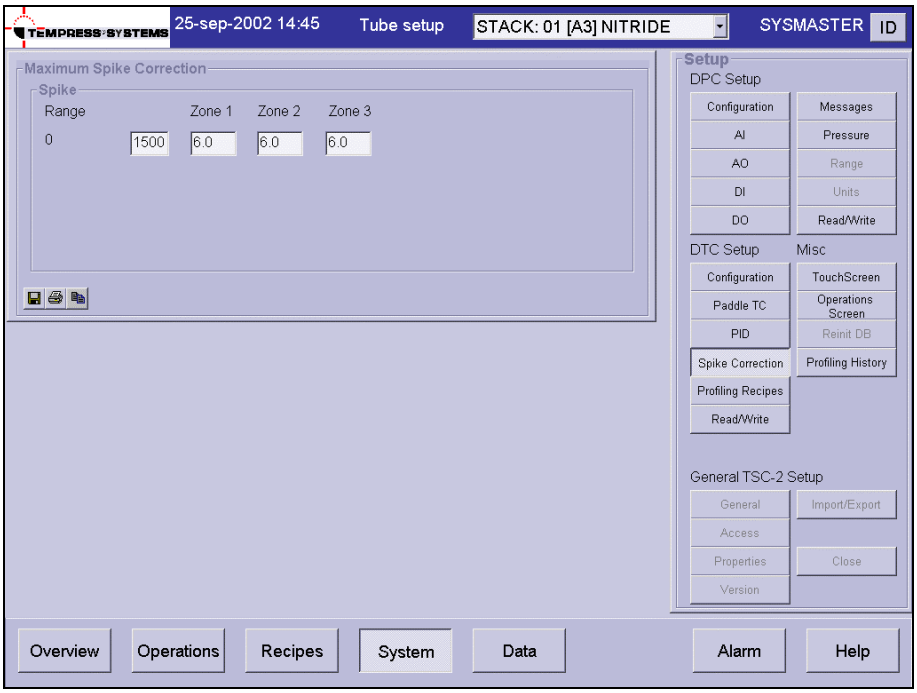


FIGURE 7-12: MAXIMUM SPIKE CORRECTION TABLE

Up to 4 different temperature ranges may be entered, with a maximum of 1500°C. The maximum temperature correction that is allowed can be programmed in the range 0.0-25.5°C.

NOTE

Press  to save the entered data or confirm the question Save Data, or all data will be lost!

The complete Maximum Spike Correction Table can be printed using the Print button.

A predefined Maximum Spike Correction Table (from another tube matching the same hardware) may be imported using the Import button.

7.2.2.5 Profiling Recipes table

The *Profiling Recipes* menu allows the profile temperature table to be configured. Four (4) profile temperature tables (A, B, C and D) are available, each table contains up to 16 profile temperature recipes. Select "Profiling Recipes" to open the following screen:

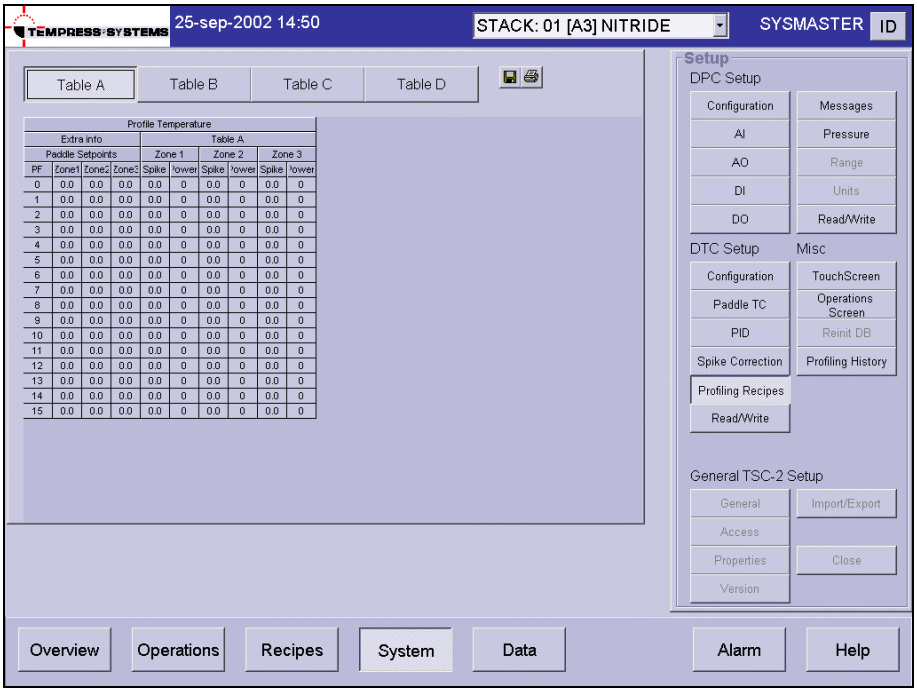


FIGURE 7-13: PROFILE TEMPERATURE TABLE

The profile temperature table contains the *Profile recipe number PF*, the *Paddle Setpoint* of each heating zone, the corresponding *Spike value* and the required *Output power*.
Four (4) different Profile Temperature Tables (A-B-C-D) are available for use in different process environments, such as dry-wet or atmospheric-vacuum.
The paddle temperature setpoints defined in one profile temperature table are used in the other 3 tables as well. That provides a maximum of 16 profile temperature recipes.

NOTE

The profile temperature recipes MUST be in ascending order.

Paddle Setpoint: Enter the paddle thermocouple setpoint for the profile temperature recipe.

Spike Value: The spike thermocouple value will be automatically stored in the corresponding profile temperature recipe if the temperature is stable for 15 minutes within the maximum profile deviation as described in section 7.2.2.1. Manually adding values is possible should a printed copy be the only backup. Values must be within ±20 ^{0}C of the paddle setpoint.

Output Power: The required output power will be stored after the spike temperature values are added to the profile temperature table recipe. Values must be in the range 0 to 99%.

NOTE

Press  to save the entered data or confirm the question Save Data, or all data will be lost!

The complete Profile Temperature Table can be printed using the Print button.

7.2.2.6 Read/Write DTC

The Read/Write DTC menu is used to store the DTC Setup in the memory of the DTC or read the DTC memory contents. Select "Read/Write" to open the following screen (only available if a DPC is connected):

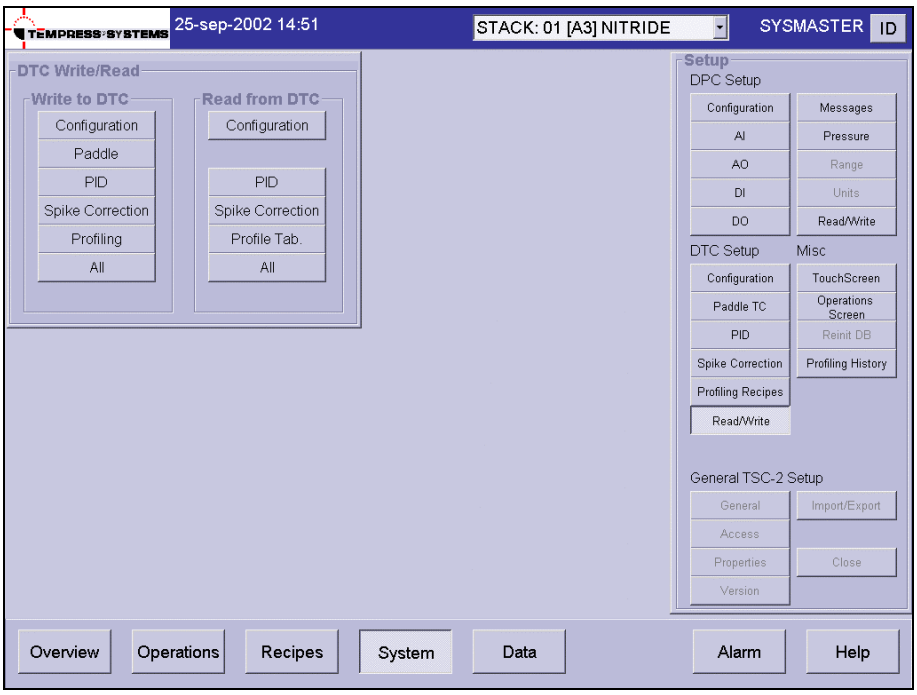


FIGURE 7-14: READ/WRITE DTC MENU

Select the desired option to read from DTC or write to DTC. A confirmation message is presented for successful read/write actions.
Should problems occur when using the 'All' option the individual options should be used.
Reading the Paddle Calibration Table from DTC is not possible. Control of which calibrated paddle (=profile) TC is used during the profiling process is provided through TSC-2.

NOTE

Current information will be overwritten.

7.2.3 MISCELLANEOUS SETUP

The Miscellaneous Setup contains general configuration screens. It allows a backup of the graphical screen layout of the Touchscreen (FPD) to be made, the Operations Screen to be configured, the Database Reinitialization to be started and the Profiling History to be reviewed.

7.2.3.1 Touch screen configurations

The Touch screen menu provides a backup of the graphical screen layout that is used on the touch screen/FPD. Select "Touch screen" to open the following screen:

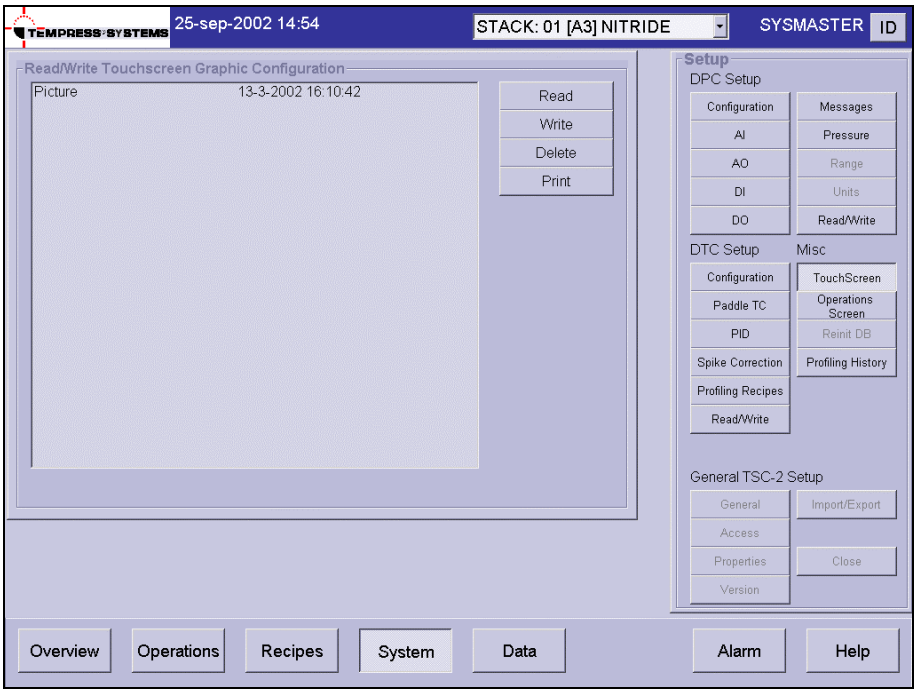


FIGURE 7-15: TOUCH SCREEN GRAPHICAL LAYOUT BACKUP CONFIGURATION

Select "Read" to create a backup of the touch screen graphical layout from the DPC.
Select "Write" to restore a backup of the touch screen graphical layout to the DPC.
Select "Delete" to remove a backup of the touch screen graphical layout from the list.
Select "Print" to create a printed hardcopy of the touch screen graphical layout.

7.2.3.2 Operations screen configuration

The operations screen editor is used to create or modify a graphical screen layout for TSC-2. Select "Operations screen" to open the following screen:

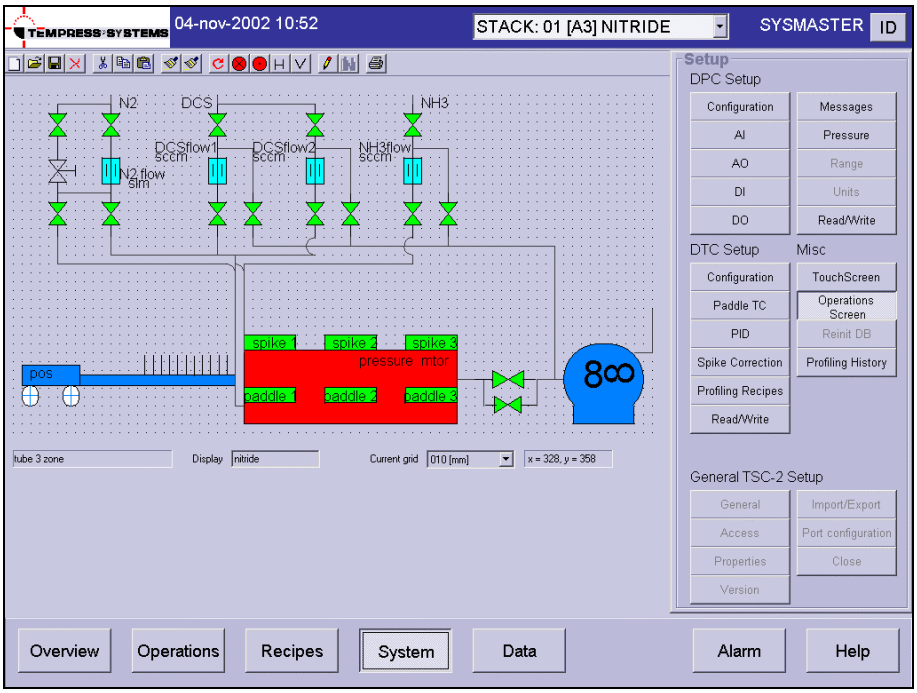


FIGURE 7-16: OPERATIONS SCREEN EDITOR

The following buttons are available in the title bar of the editor:


Create a new operations screen


Open a operations screen


Save the operations screen


Delete the operations screen


Cut


Copy


Paste


Flip horizontal


Flip vertical


Move to the background


Move to the foreground


Show Library objects


Edit Library objects


Print operations screen layout


Line color


Fill color


Rotate object


Help


About

Information about the current operations screen is available in the bottom:

Current operations screen display name

Grid size and cursor position

7.2.3.2.1 Creating a new operations screen

A new operations screen can be created by selecting "New". The following screen will open:

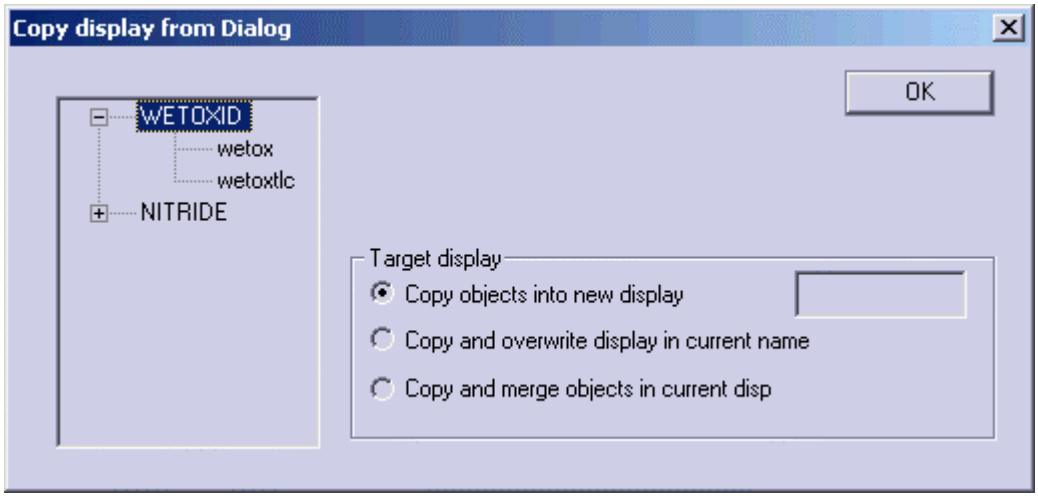


FIGURE 7-17: CREATE A NEW OPERATIONS SCREEN

- *Copy objects into new display* allows the user to copy an existing operations screen layout (from any tube on the selected server) into a new display name.
- *Copy and overwrite display in current name* allows the user to copy an existing operations screen layout (from any tube) into an existing display name.
- *Copy and merge objects in current display* allows the user to copy and merge an existing operations screen layout (from any tube) into an existing display.
- *Create empty display* allows the user to generate a new empty display.

7.2.3.2.2 Open an operations screen

An existing operations screen can be opened by selecting "Open". The following screen will open:

FIGURE 7-18: SELECT AN EXISTING OPERATIONS DISPLAY

7.2.3.2.3 Creating operations screen objects

To add objects into the new operations screen the available library objects can be accessed by pressing  . The following screen will open:

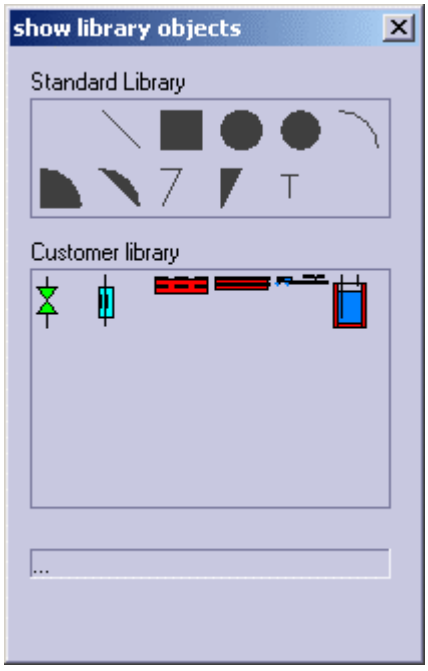


FIGURE 7-19: DEFAULT LIBRARY OBJECTS

Two sections present the Standard Library and the Customer Library.
The Standard Library contains objects to create a line, block, circle, ellipse, arc, polyline and text.
The Customer Library contains a valve, MFC, 3-zone and 5-zone furnace, boat loader, bubbler and orifice and can be expanded by creating and/or editing library objects as described in section 7.2.3.2.4.

To select an object click once on the desired object, move the mouse pointer at the screen and click again.
To erase an object, select the object with the pick tool and press delete on the keyboard.
To move an object, select the object with the pick tool and drag the object to the desired position.

The position, size and rotation of the inserted object can be modified at all times. Conditional properties may have been activated in section 7.2.3.2.4 and can be modified by selecting the desired object with the Right Mouse Button. An example screen is given below:

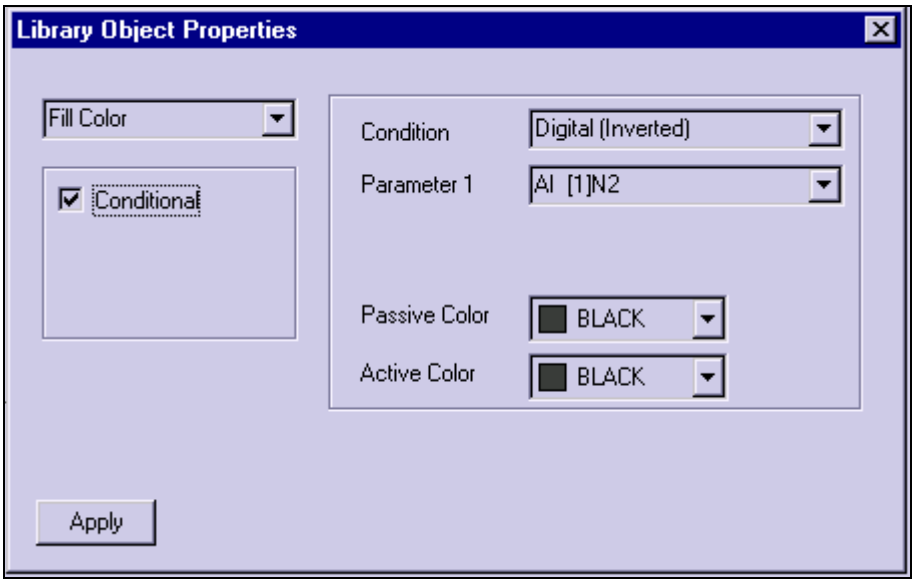


FIGURE 7-20: OPERATIONS SCREEN OBJECT PROPERTIES

Select the desired property from the pull down menu, select the desired condition and adjust the related parameters.

Condition	Purpose
Digital (inverted)	Valves, Off or On condition (Normally Open)
Digital	**Valves**, On or Off condition (Normally Closed)
Absolute	**Text** for temperature, gasflow, boat position
Absolute with multiply	Absolute number multiplied
Relative	Position, Relative on the screen

Relative with multiply	**Boat position**, relative on the screen and multiplied to fit within the screen
Data1 AND Data2	Both condition must be On
Data1 OR Data2	Either condition must be On
Data above value	**MFC**, to change when gasflow is above the parameter value (0-1)
Data below value	to change when gasflow is below the parameter value (0-1)
String value	Text content.

Example conditions are indicated in **bold**.
Press "apply" to set the conditional properties. Close the dialog box by pressing the cross in the upper right corner of the dialog box.

Press save to store the modified operations screen.

7.2.3.2.4 Edit customer library objects

The customer library can be expanded and existing objects modified by selecting  . The Standard Library Objects are available to create and/or modify the custom designed library objects.
The properties of the custom designed objects may be set conditional, which gives the possibility to create animated objects.

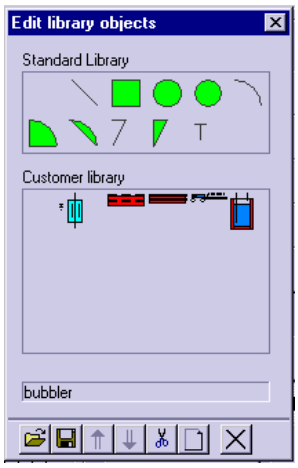


FIGURE 7-21: EDIT CUSTOMER LIBRARY OBJECTS

7.2.3.2.5 Set object properties

Every object may have conditional properties, which are defined in the Edit customer library objects section. These conditional properties can be linked to any signal from the DPC and/or DTC, thus creating animated objects.
Figure 7-22 shows the conditional properties that can be activated for the selected object:

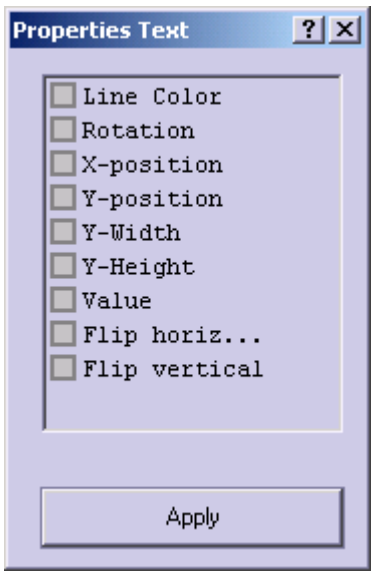


FIGURE 7-22: LIBRARY OBJECT CONDITIONAL PROPERTY SELECTION LIST

7.2.3.3 Reinit dbase

If DPC or DTC configurations have been modified and saved the TSC-2 database needs to be re-initialized. To re-init the database press "Reinit DB". A window will automatically pop up if another menu is selected. The following window will appear:

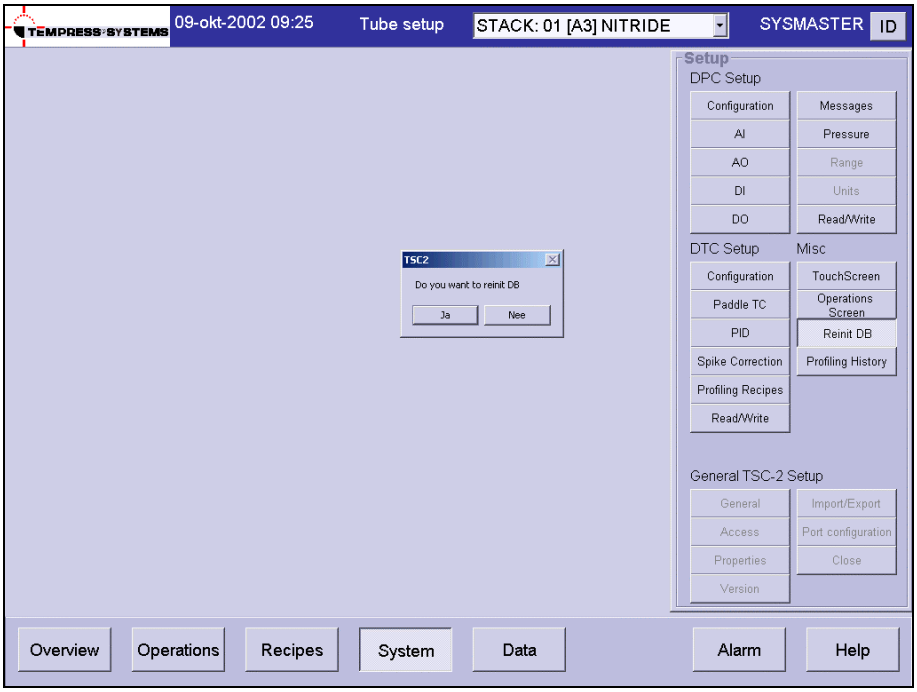


FIGURE 7-23: REINIT DATABASE

7.2.3.4 Profiling history

The profiling history menu is used to compare the contents of the new profile temperature table with previous values. Select Short Term to compare two profile tables, select Long term to compare more than 2 profile tables.
In general, profiling is performed regularly and 2-5 degrees difference is acceptable. More than 10 degrees difference indicates too long profiling intervals and it is recommended to increase the profiling frequency. Select "Profiling History" to open the following screen:

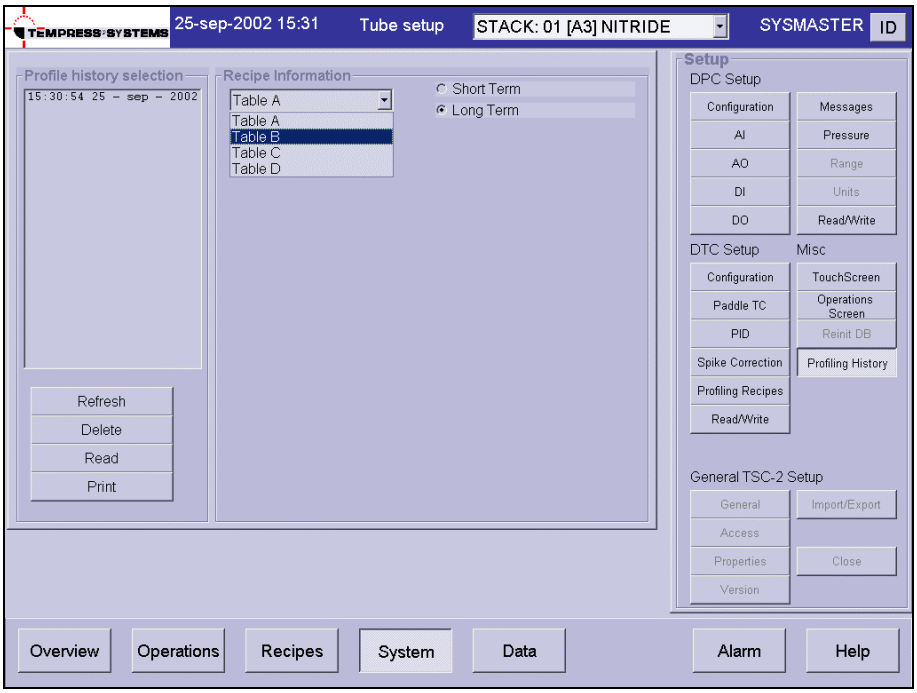


FIGURE 7-24: PROFILING HISTORY

Refresh Select to refresh History Data after selecting profile tables

Delete Select to delete a file with History Data

Read Select to read a profile temperature table from the DPC

Print Select to print the Profile Comparison data

7.3 GENERAL TSC-2 SETUP

The general TSC-2 setup controls the TSC-2 looks and which tubes are connected to TSC-2. To activate the general TSC-2 setup the server must be selected. The TSC-2 setup menu contains the following items:

General	Add or remove tubes, edit tube communication setup and add TSC-2 servers and/or clients
Access	Change the user access rights to TSC-2
Properties	Customize TSC-2 language and color
Version	View software and DPC/DTC version numbers
Import/export	Import/export tubes
Export Data	Export tube certifications and server data
Close	Exit TSC-2

7.3.1 GENERAL

The General Menu is used to add or modify tubes to TSC-2, to set the tube communication configuration, to set the logging file size and to give clients access to the tube. It is accessed by selecting the System Menu button while a server (not a tube) has been selected.

7.3.1.1 DEFINING A TUBE

To define a tube, select the option "General" of the General TSC-2 Setup. The following screen will appear:

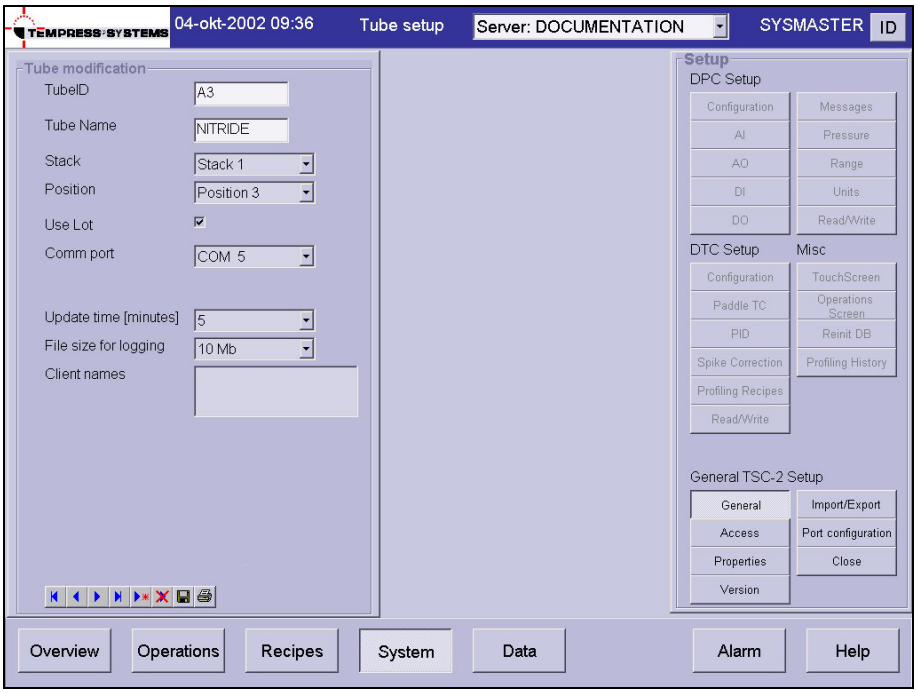


FIGURE 7-25: ADDING A TUBE TO TSC-2

1) Add a tube by pressing the "New" symbol.
2) Settings from an existing tube may be used as initial settings. Select a tube from the pull down menu and press OK.
3) Fill in or modify the tube name, stack number, tube position.
4) Select "Use Lot ID" to activate this function in the Operations Screen.
5) Select the communication port
6) Select update time (this specifies forced logging every x minutes)
7) Divide the total remaining disk space by the number of tubes.
8) Select the available logging file size.
9) (Define the SECS-GEM configuration.)
   Note: This option is only available with the appropriate license. Contact Tempress Systems Inc. for information.

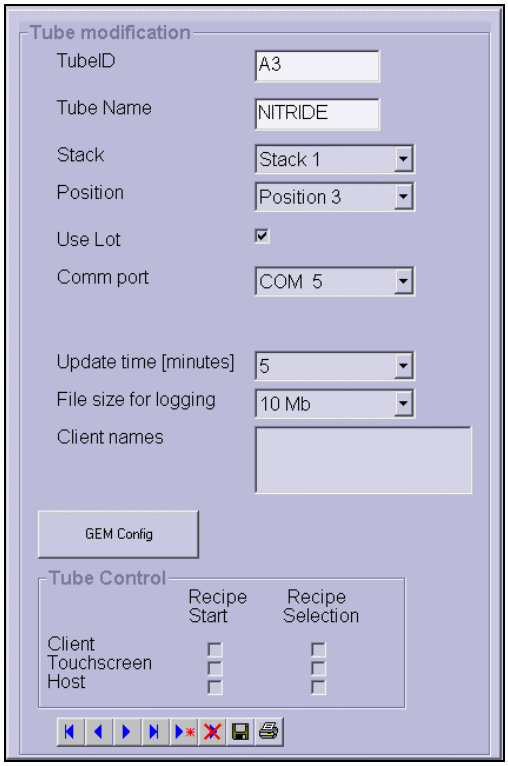


FIGURE 7-26 DEFINING SECS/GEM CONFIGURATION

NOTE

Changing the logging file size results in loss of all existing logged data of this tube.

10) Save data.
11) Repeat this procedure for other tubes.

12) When finished use the Right Mouse Button on the System menu button and press update. This will restart the TSC-2 server communication program so that the added or modified tubes are available to the user.

7.3.2 SELECTING SERVER/CLIENT FOR NETWORKING

TSC-2 has the capability for a server/client interactive network. The servers are connected to the tube controllers. Servers can be accessed by clients, and a server may also operate as a client to another server. Up to 16 servers can be connected in the same network and each server can handle up to 16 furnace tubes. This provides a total of 256 tubes that can be controlled in a network. Each tube can be accessed by 8 different clients which is set at the tube configuration of the TSC-2 General setup. A client can access one to ALL tubes (User selection).
Server computers are located at the furnace area.
Client computers can be located anywhere, in the furnace area, the service area, in the office or even fully remote.
All tube functions are available on each server and are also available on each configured client. This includes remote Recipe Editing, Data Analyses and Alarm Status.

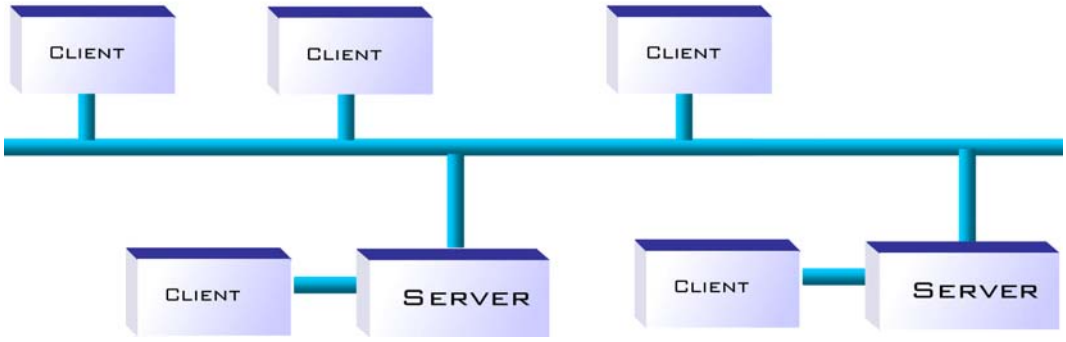


FIGURE 7-27: OVERVIEW OF THE CLIENT/SERVER ARCHITECTURE

There is one restriction in the client/server architecture of Figure 7-27: The client running on the server computer has always access to all tubes of this server. This provides increased safety and operability in case the network fails.

7.3.3 ADDING A CLIENT

To add a client to the network go to General TSC-2 Setup and select General. The following screen will appear:

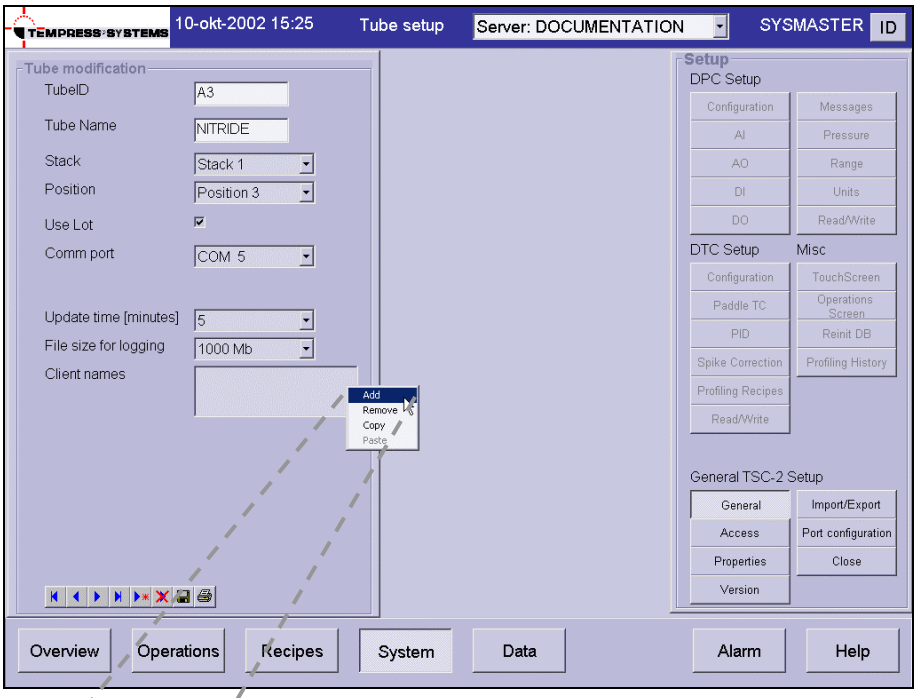


FIGURE 7-28: ADDING A CLIENT TO THE NETWORK

Each tube must be specifically set available for the clients that exist in the network. Go to the "Client Names" field and enter the names of the client computers that need access to this tube. A maximum of 8 clients can be granted access per tube.

1) Click with the right mouse button in this field. The following options are presented: Add, Remove, Copy, Paste.
2) Select ADD to add a new client. Enter the client computer name. Press OK.
3) Press SAVE to save the entered client name.

NOTE

The client names only apply in case a license for remote clients is purchased.

7.3.4 ADDING A SERVER

To add a server to the network use the Right Mouse Button on the System Menu. The following screen will appear:

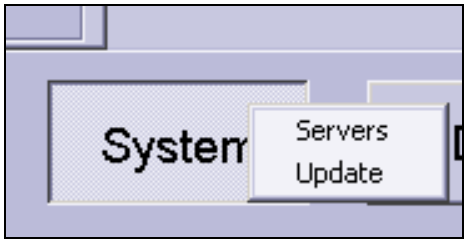


FIGURE 7-29: ADDING A SERVER TO THE NETWORK

1) Go to System in the navigation bar. Click with the right mouse button on "System". The next options will be shown: Servers and Update.
2) Select "Servers". A new window will appear with the options to Add, Delete or Save a server.
3) Select Add. Enter the Server name.
4) Select Save.
5) After saving the server name, click with the right mouse button on "System" and select "Update". The system will try to make connection to all servers defined in step 3.
6) Every tube must have granted access to the server to allow communication and control screen.

NOTE

The stack number must be unique with in the network. (For example: for 2 servers with 8 tubes per server, the first tube of the second server must be named: stack 3, tube 1).

7.3.5 ACCESS CONTROL SCREEN

Every user can be specifically granted access to each function of TSC-2. All actions are logged with user name, time and date and action.
The user Sysmaster is encoded in the software and can not be modified. The username and password of the user Sysmaster are SYSMASTER (name) and SM (password).

Select Access in the General TSC-2 Setup to add a new user or template, or change access rights of existing users. The following screen will appear:

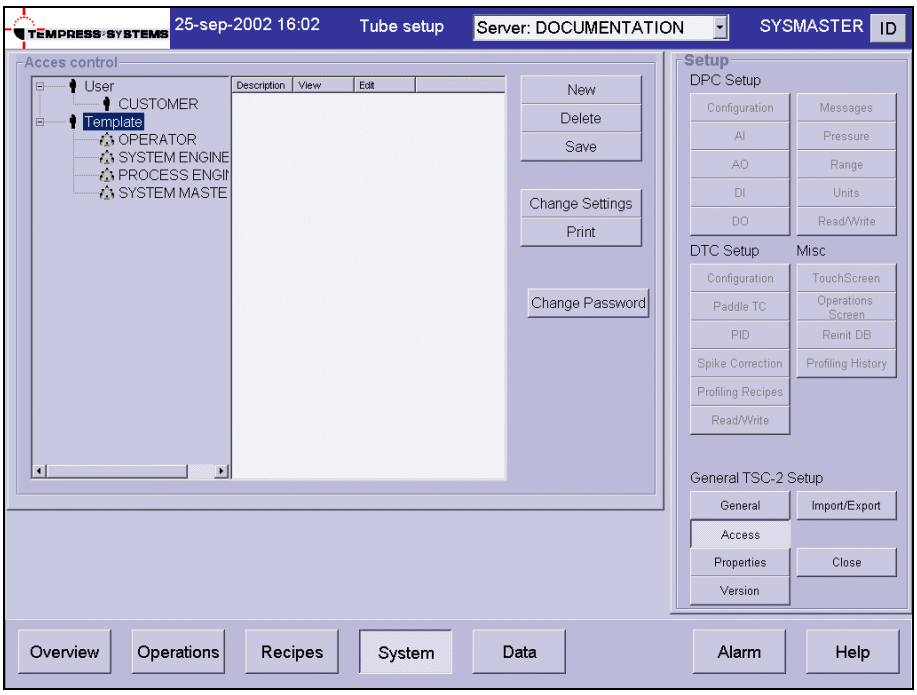


FIGURE 7-30: ACCESS CONTROL SCREEN

The Access control menu contains editor buttons on the right, a user and template browser on the left and setting information in the center.

New	Add a new User or Template
Delete	Delete a User or Template
Save	Save the new or modified User or Template
Change Settings	Change the access settings of the selected function
Print	Print the access rights for the selected User or Template.
Change Password	Change the password of a User.

7.3.5.1 ADD A NEW USER OR TEMPLATE

1) Select "New". Select "Yes" to add new User.
2) Select "Yes" again if a new Template is wanted. Enter the name of the new Template.
3) Select "No" to create a new User. Enter the name of the new User.
4) Enter the password twice and press OK.
5) Modify the user rights as described in section 7.3.5.2.
6) Press "Save" to save the new User.
7) Press "YES" to update the user and save the changes.

7.3.5.2 CHANGE ACCESS SETTINGS

Each user may be granted access to the main functions of TSC-2. This includes viewing recipes, editing recipes, monitoring real time data, modify system setup and even modify user access rights. To allow a user to view the contents of specific menus activate the View setting to 'Yes'. To allow a user to edit functions activate the Edit setting to 'Yes' as well.

1) Select a User or Template from the user/template browser. The center screen shows the current access settings to the TSC-2 main functions.
2) Select a particular function to change the access rights. Press "Change Settings" once to change "View" only, press "Change Settings" again to change "Edit".
3) To change the access rights to several functions at the same time make the appropriate selection using the SHIFT or CTRL + left mouse button. Press "Change Settings" once to change "View" only, press "Change Settings" again to change "Edit".
4) Press "Save" to update the user or template.

7.3.5.3 CHANGE PASSWORD

1) To change the password of a User, select the option "Change Password". Confirm the question by pressing "Yes".
2) After the old password has been confirmed, the new password can be entered twice. Press "Apply" to use the new password.

7.3.5.4 USE OF TEMPLATES

Templates can be used to create settings for a group of users. This allows quick generation of new user settings by dragging and dropping a selected Template on a user.

1) select a template
2) drag and drop the selected template by clicking and holding the left mouse button on the desired user
3) Confirm to update the user with the new settings.

7.3.6 TSC-2 LANGUAGE AND COLOR PROPERTIES

This option can be selected to customize TSC-2 to the desired language and color. Select "Properties" to open the following screen:

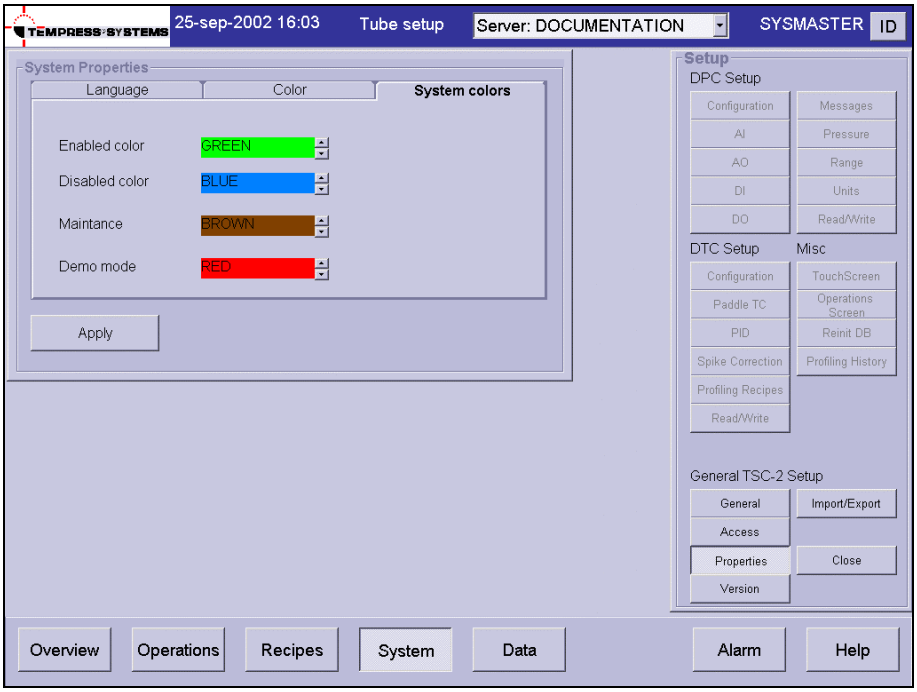


FIGURE 7-31: TSC-2 LANGUAGE AND COLOR PROPERTIES

In the TSC-2 System Properties the following tabs are available:

Language — To change the language. Three languages are available: English, German and Dutch. The tab Numbers is used for software debugging and should not be used by customers. Press "Apply" to use the new language.

Color — 48 colors are available for the operations screen layout.
Select the colored box to open the color palette with basic colors and custom colors. Press "Define Custom Colors" and set the R(ed), G(reen), B(lue) numbers within a range from 0 to 255. Press "Add to custom colors". The new color is now available to be placed in any of the 48 color positions. Press "Apply" to use the new colors.

System Color — To change the color setting of a tube in the Overview screen to indicate Enabled, Disabled, Maintenance or Demo Mode. **NOT FUNCTIONAL YET.**

7.3.7 TSC-2 VERSION

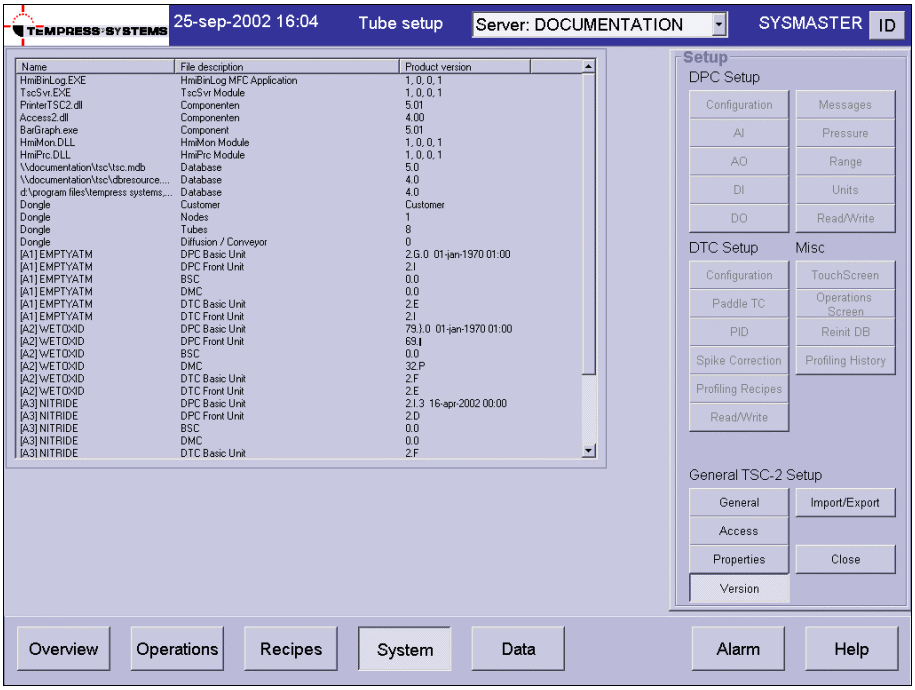


FIGURE 7-32: TSC-2 PRODUCT VERSION NUMBERS

The Version menu shows all product versions of the TSC-2 and connected DPC and DTC. Not connected DPCs and DTCs will be presented as dated jan-1970.

7.3.8 IMPORT/EXPORT TUBE DATA

To import or export tube configuration data for backup purposes the "Import/Export" menu must be selected in the General TSC-2 Setup. The following screen will appear:

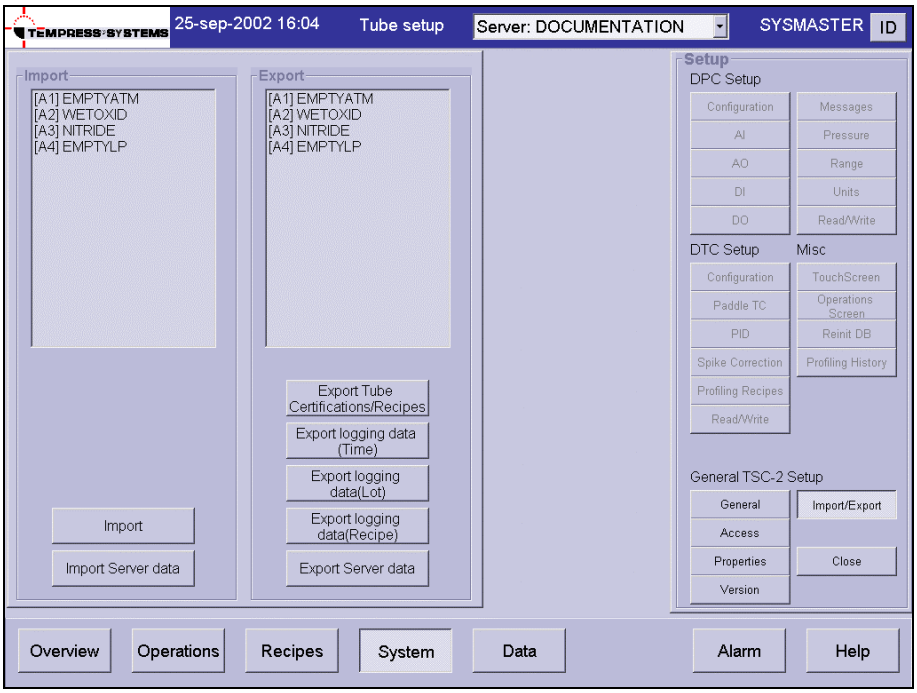


FIGURE 7-33: IMPORT /EXPORT A TUBE

Two columns provide Import and Export functions. They include the following items:

Import a tube	Import a tube database
Import Server Data	Import general server data
Export Tube Certifications/Recipes	Export the selected tube data to file.
Export Logging Data – Time	Export logged data within a selected time range to file
Export Logging Data – Lot	Export logged data of selected lots to file. A start and end time can be entered as filter for searching lots
Export Logging Data – Recipe	Export logged data of selected process recipes to file. A start and end time can be entered as filter for searching recipes
Export Server Data	Export general server data to file.

Select the tube or data that has to be imported or exported. Confirm the export or import action by pressing "Yes". Select in the browser the file where the tube has to be exported to or imported from.

7.3.9 SHUTTING DOWN THE TSC

To shutdown TSC-2 and exit the program from the system main menu, select "Close". The following screen will appear:

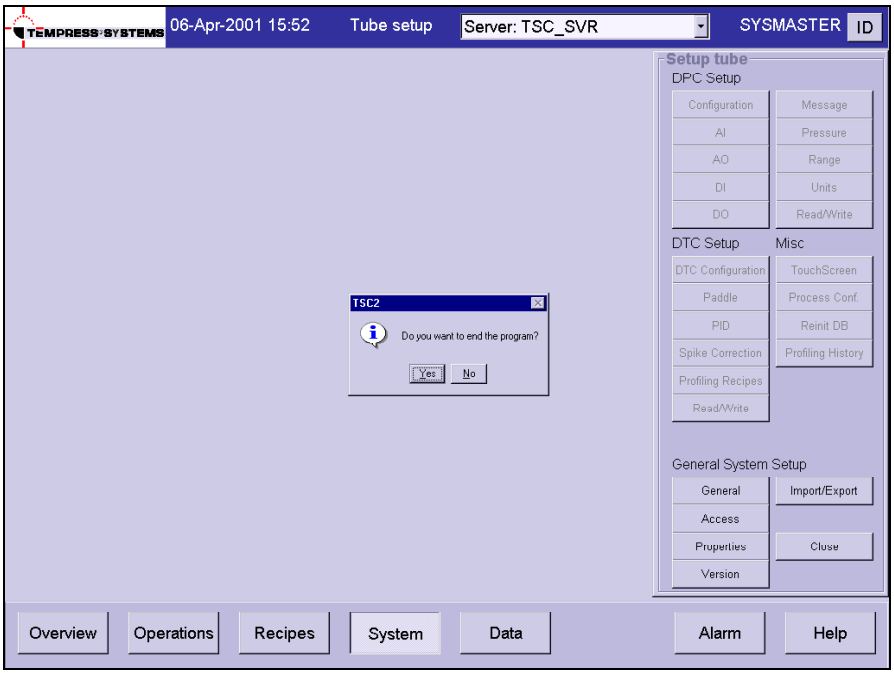


FIGURE 7-34: SHUTTING DOWN TSC-2

Confirm the question to end the program by pressing "Yes". The TSC-2 client program will be closed. The server communication program must be closed manually by pressing CTRL-C.

8 DATA

The Data menu is used for real time monitoring of connected tubes and review logging data. Its features include:

- All data generated by the tube controllers is automatically logged every second.
- Only changed data will be stored.
- All events like start, stop, continue, set and reset of alarms are logged in an 'event log file' to provide a quick events check.
- Provides an excellent base for data capture and storage required for ISO 900X.
- Data is easily retrievable for process set-up analysis and fault finding.
- Wafer Lot information is stored with the run data, and can also be used as search criteria for logged data.

Batch or Lot identification is widely used in the industry to track wafers throughout the production process. TSC-2 provides Lot Identification during process start and allows process review based on Lot Identification.

- At every recipe start the system can be set up to use the wafer LOT ID. This LOT ID will be stored with the actual run data.
- Retrieving data for a specific LOT ID provides all process recipes that a lot has been running in one or any of the tubes connected to the TSC-2 network. From the list of runs one can select the run that is required, and view the actual data in graphical for or actual numbers.

The DATA screen contains two selection menus, GENERAL and TUBE. The General data shows the Logging Data (History) and Run (Real-time) from all tubes. The Tube Data shows the real-time data per tube (Main Details, Temperature, Normal Temperature Table, Profile Temperature Table and Recipe).

8.1 LOGGING DATA

The Logging Data menu allows process results to be reviewed and current running status of all connected tubes to be monitored.

Press Log data to open the logging screen:

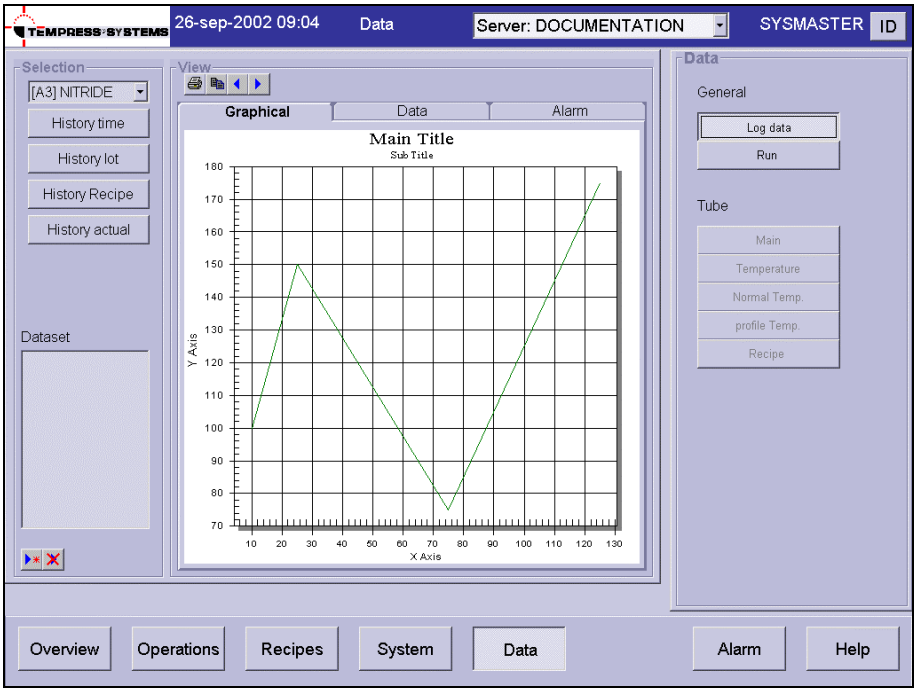


FIGURE 8-1: LOGGING DATA MAIN SCREEN

The logging data main screen contains two sections, Selection and View. The Selection menu allows a tube to be selected from a pull down menu, define the search conditions in the History and define the Datasets that are used to present requested process information.

A Dataset needs to be defined first to select the requested process information, such as spike temperature, gasflows, boat position and digital input signals.
The History Time, History Lot , History Recipe and History Actual can be used to make a selection from the logging files based on time, lot ID, recipe name or real time.

8.1.1 DEFINING A DATASET

A dataset is a set of parameters selected from all available DPC and DTC signals that will be presented graphically or numerically.
To create a new dataset press the "New" button. Give a logical name and press "OK". To modify an existing dataset double click on the desired dataset. The following screen will appear:

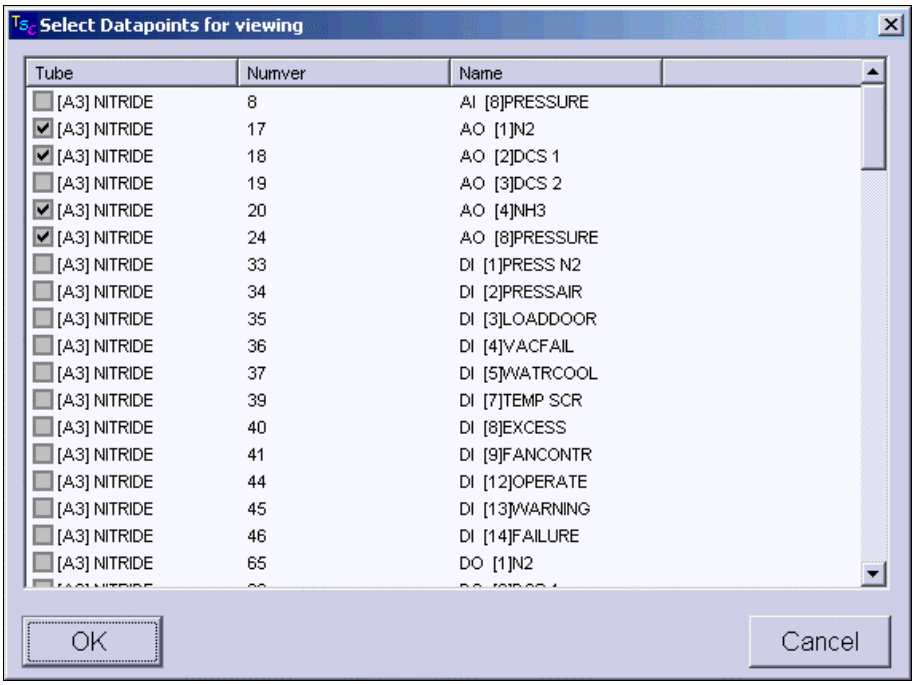
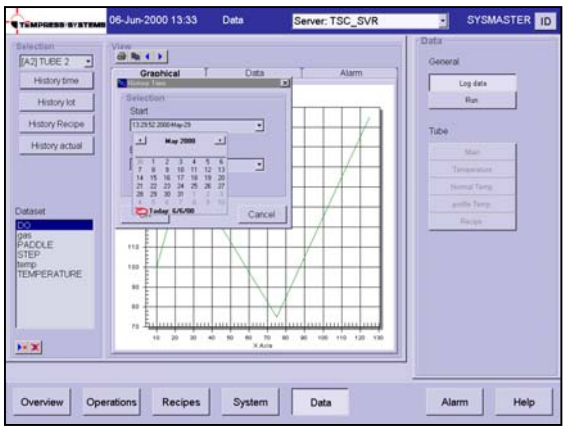


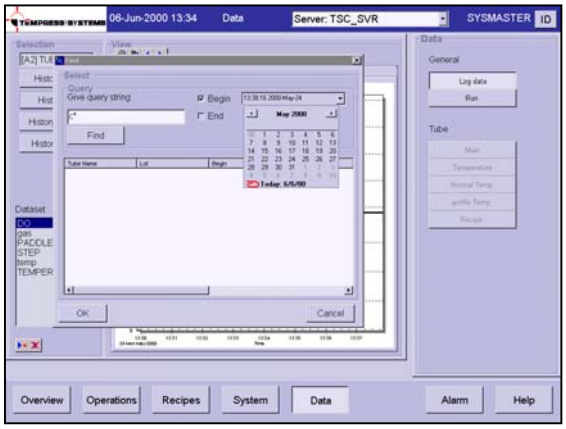
FIGURE 8-2 : DATASET PARAMETER SELECTION

A window with all available DPC and DTC signals will be shown. Select the desired parameters by checking the selection box and press OK. The dataset is now ready to be used to present data that is selected by one of the History menus.



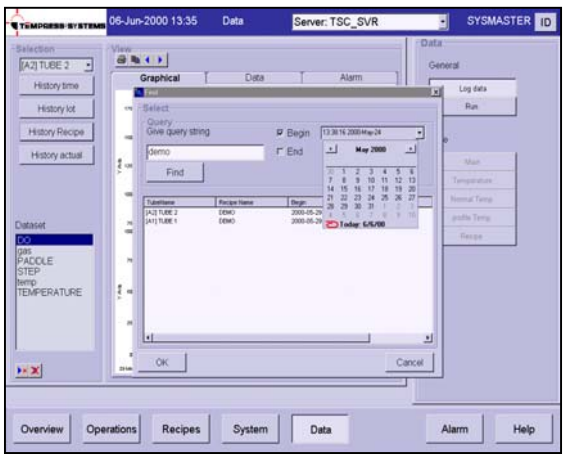
8.1.2 HISTORY TIME

To select a specific period of time enter the beginning and the end time. The start time may not be later than the stop time. The logged data from this selected period as defined in the dataset will be shown in the View screen in tabular or graphical form.



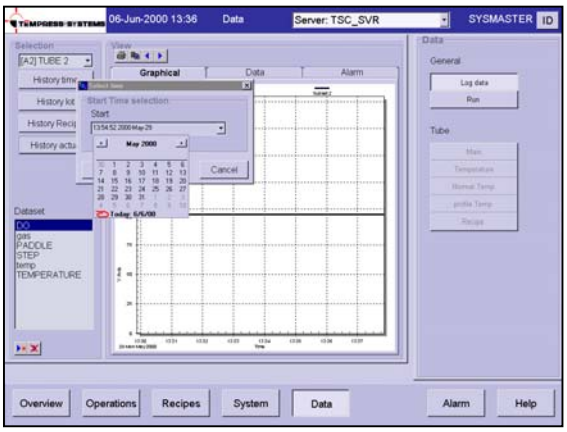
8.1.3 HISTORY LOT

Enter the name of the Lot ID to search for. Use wildcards to speed up searching.
Checking the "Find all tubes" option searches for the Lot ID in all tubes logging files.
If no begin/endtime and Lot ID are entered all Lot ID's will be shown.
Press "Find" to start searching. Optionally the begin and end time can be entered as a filter.



8.1.4 HISTORY RECIPE

Enter the name of the recipe to search for. Use wildcards to speed up searching.
Checking the "Find all tubes" option searches for the Lot ID in all tubes logging files.
If no begin/endtime and recipe name is entered all recipes will be shown.
Press "Find" to start searching. Optionally the begin and end time can be entered as a filter.



8.1.5 HISTORY ACTUAL

The real time data may be reviewed by selecting the History Actual.
Select the start time to present the real time information from that point on.

8.2 DISPLAYING DATA

There are two methods of displaying logged data. The data can be plotted in a graph or given in tabular form by selecting the appropriate tab.
Zooming in can be achieved by pressing and holding the left mouse button and drag the mouse to select the desired zoom data.

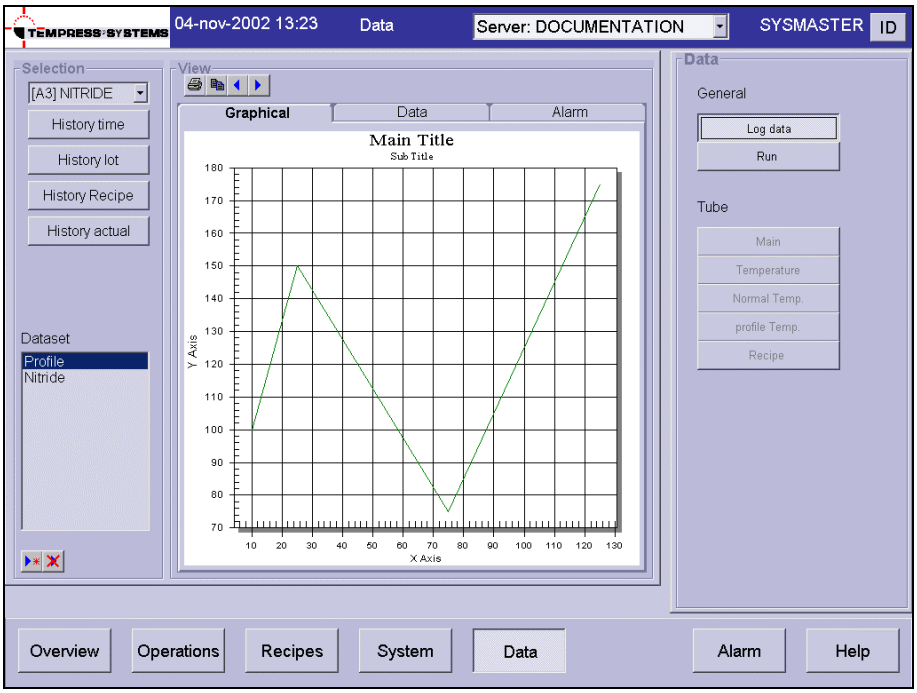


FIGURE 8-3 LOGGING DATA

8.2.1 LOGGING DATA GRAPHICAL PRESENTATION

A graphic presentation can be customized to add titles, change fonts size and colors and gridlines by pressing the right mouse button anywhere on the graphic.

FIGURE 8-4: LOGGING DATA CUSTOMIZATION GRAPHICS

The customization menu contains the following options:

Viewing Style	Color
	Monochrome
	Monochrome + Symbol
Font Size	Large
	Medium
	Small
Numeric Precision	No Decimals
	1 Decimals
	2 Decimals
	3 Decimals
Plotting method	Point
	Line
	Bar
	Area
	Stick
	Points+Best fitline
	Points+Best fit curve
	Points+line
	Points+splitline
	Spline
Data Shadows	Off

	Shadow
	3D
Grid Lines	Both X and Y axes
	Y axe
	X axe
	No grid
Grid in Front	
Include Data Labels	
Mark Data Points	
Maximize	
Customization Dialog	
Export Dialog	
Help	

A customized graphic can be printed on paper or exported to a file or the clipboard using the print and export buttons.

8.2.2 LOGGING DATA NUMBERS PRESENTATION

The graphical information is deduced from absolute values, which can be reviewed, printed and exported as well. The actual values are available at the "Data" tab.
The actual values can be printed on paper or exported to a file or the clipboard using the print and export buttons.

8.2.3 LOGGING DATA ALARMS AND EVENTS PRESENTATION

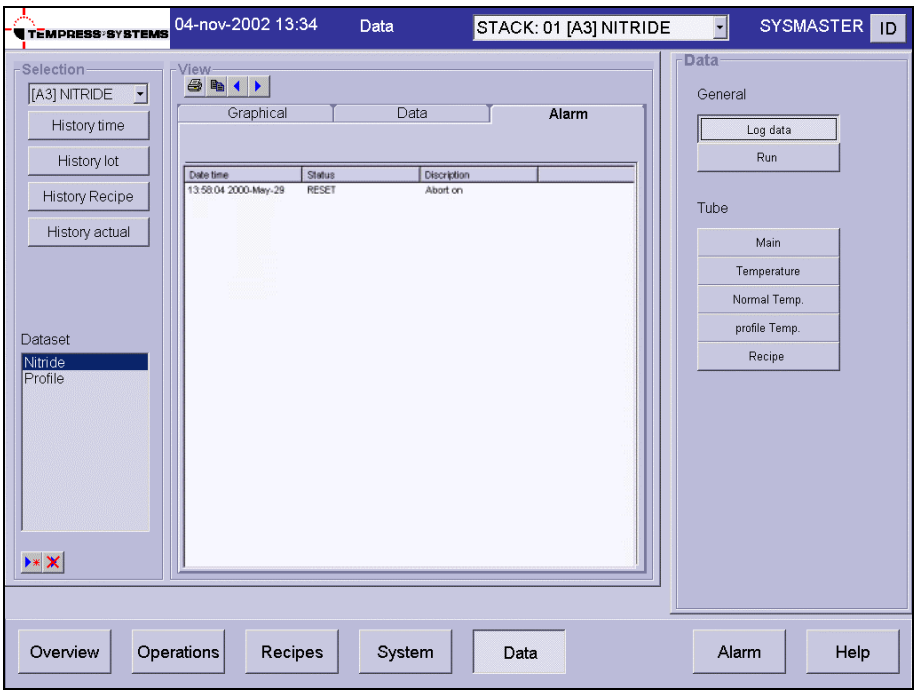


FIGURE 8-5:LOGGING DATA ALARM AND EVENTS

The Alarm and events tab displays all alarms and events that occurred during the History selection.
Alarm signals that become active are SET and alarm signals that become de-active are RESET. Operator actions such as START, STOP and ABORT will be presented as well.

8.3 RUN DATA ACTIVE TUBES

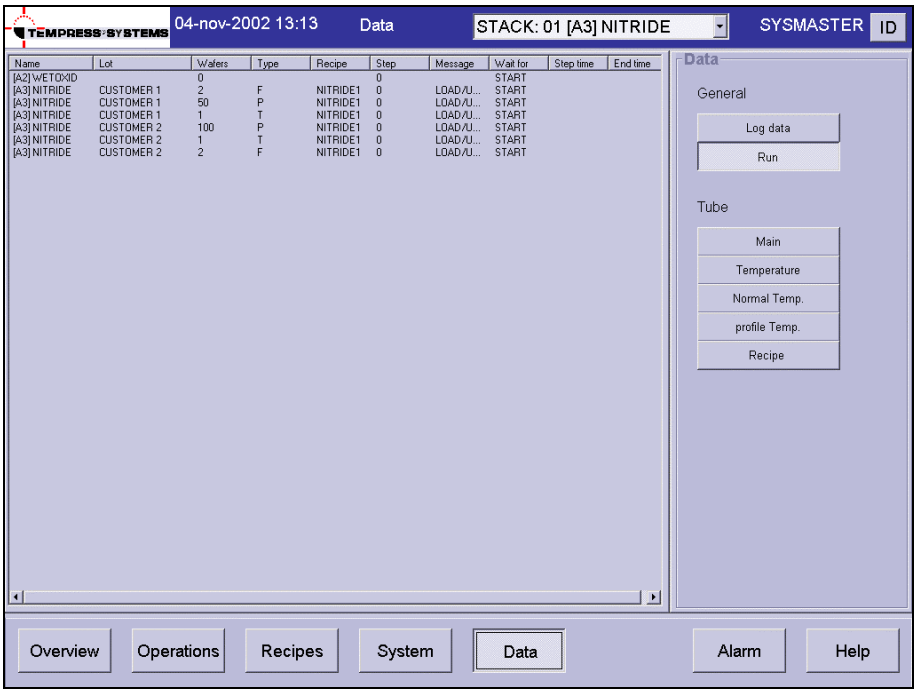


FIGURE 8-6: LOGGING DATA ACTIVE TUBES

The Run screen displays the tube ID and name, the Lot IDs and current process information including the current Recipe, Recipe Step, Message, Wait For and the expected Step Time and End Time.

8.4 TUBE REAL TIME MONITORING

The Tube Data menu allows the real time monitoring of a selected tube. Therefore, this menu is only accessible when a tube is selected. It includes Main detail status, Temperature details, Normal temperature table, Profile temperature table and Recipes.
The information is real time monitored from the DPC and DTC memory and can be used to check the current tube status and its temperature configuration.

NOTE

The Tube Data is actual DPC/DTC information, not a TSC-II hard disc copy.

8.5 MAIN DETAIL STATUS

The Main Detail screen displays a summary of the current tube status. An example screen is presented below:

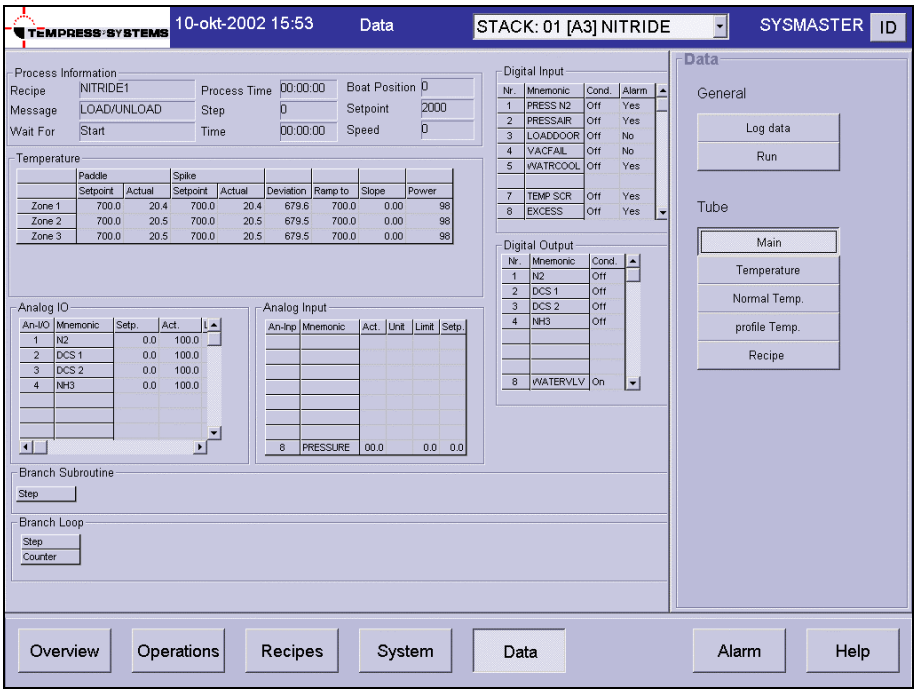


FIGURE 8-7: MONITORING MAIN DETAIL STATUS

The Main detail screen is divided in Process Information, Temperature, Analog IO, Analog Input, Digital Input and Digital Output sections, Branch Subroutine and Branch Loop.

The Process Information sections contains the following items:

- The tube ID and name.
- The recipe ID and name.
- The message for the current step.
- The process time.
- The step number and time.
- The action for which the controller is waiting.
- The boat position, setpoint and speed.

The temperature section contains the following items for each zone:

- The paddle setpoint and actual value
- The spike setpoint and actual value
- The deviation from the setpoint of the paddle thermocouple
- The ramp, slope and power

The analog IO section contains the following items for each analog I/O:

- The name of the gas
- The setpoint value
- The actual value
- The alarm limits
- The units.

The digital input section contains the following items for each digital input:

- The name of the digital input
- The condition (On or Off)
- The alarm signal monitored (Yes or No)

The mnemonic, condition and alarm active fields are empty if a digital input is not defined.

The digital output section contains the following items for each digital output:

- The name of the digital output
- The condition (On or Off)

The mnemonic, condition and alarm active fields are empty if a digital output is not defined.

The branch subroutine shows the step number to which each subroutine branches to. The branch loop shows the number of times each loop has to be executed.

8.5.1 TEMPERATURE DETAIL STATUS

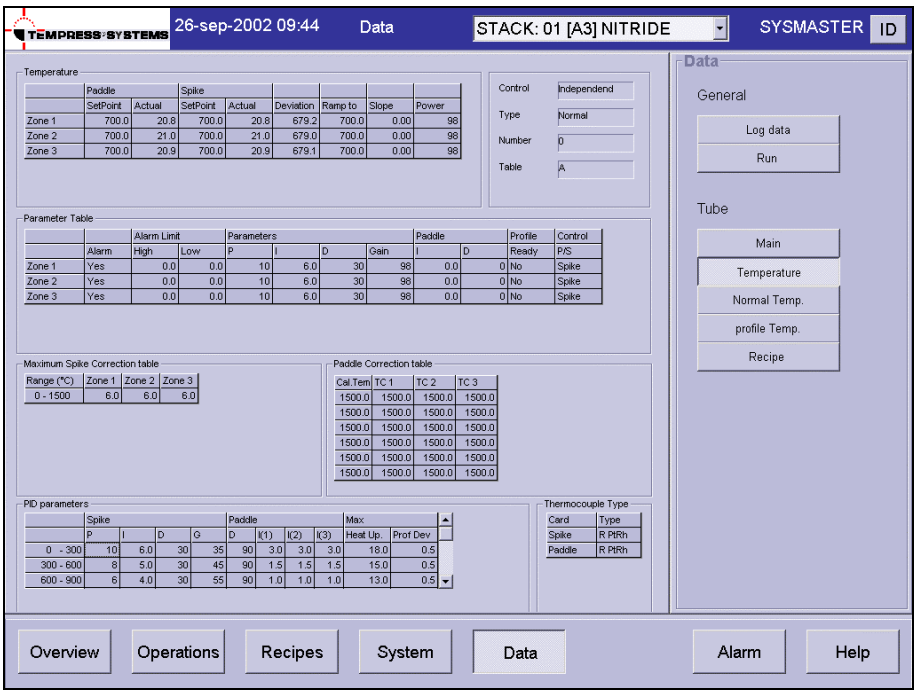


FIGURE 8-8: MONITORING TEMPERATURE DETAILS

The monitoring temperature screen displays all the temperature data for the zones of the furnace. The information for each zone consists of the following:

Temperature:

- Setpoint and actual temperature for the paddle thermocouple.
- Setpoint and actual temperature for the spike thermocouple.

- Deviation from the setpoint of the paddle thermocouples.

- The rate of increase in temperature (slope).
- The power.
- The type of control, INDEPENDENT or MASTER/SLAVE.
- The temperture recipe number in use.

Parameter table:
- Whether or not a temperature alarm is set.
- The high and low limits.
- The spike PID and gain parameters.
- The paddle I and D parameters.
- The type of control, spike or paddle.

Maximum Spike Correction table
- Maximum temperature range, with a maximum of 1500 ^{0}C.
- Maximum Spike Correction Temperature of 0 to 25^{0}C for each zone.

Paddle Correction table
- Calibration Temperature
- The calibration value for each zone.

PID Parameters
This shows the spike PID and gain value. The integral parameter for each zone and the derivative parameter values of the paddle are then shown for the 5 temperature ranges. Finally the maximum heat-up and maximum profile deviation is shown for each temperature range.

Thermocouple types
- Shows the type of the thermocouple in use.

8.5.2 NORMAL TEMPERATURE TABLE

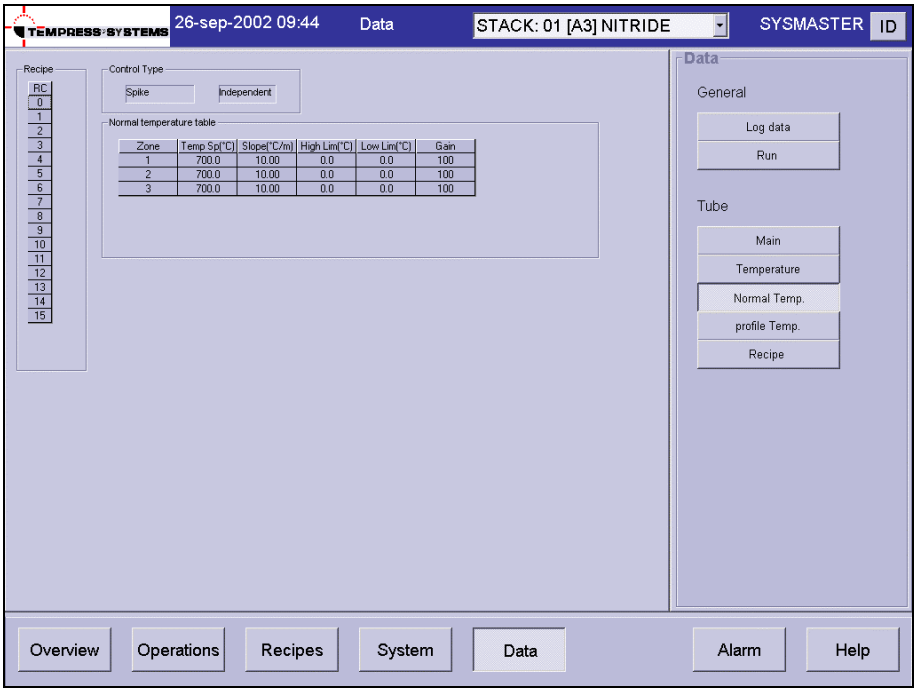


FIGURE 8-9: MONITORING NORMAL TEMPERATURE TABLE

The Normal Temp screen shows the temperatures and limits used in all the zones of a tube during the normal operation of the furnace. The fields contain the following information:

Recipe Number

This allows any of the 16 possible recipes to be selected.

Control

This shows the type of control, (independent or master/slave) and the thermocouple on which the control is to be exercised.

Temperature Setpoint

Shows the temperature setpoint for each zone which has been set in the tube configuration.

Slope

Shows the rate of increase in temperature for each zone in a range from 0.0 to 99.0 ^{0}C.

High/Low Limits

The high limit shows the allowed maximum deviation above the temperature setpoint before an alarm is generated. The low limit shows the allowed maximum deviation below the temperature setpoint before

an alarm is generated. Both parameters must be in the range 0.0 to 25.5 ^{0}C.

Gain

Shows the gain setpoint for each zone. This must be in the range 0 to 255%.

8.5.3 PROFILE TEMPERATURE TABLE

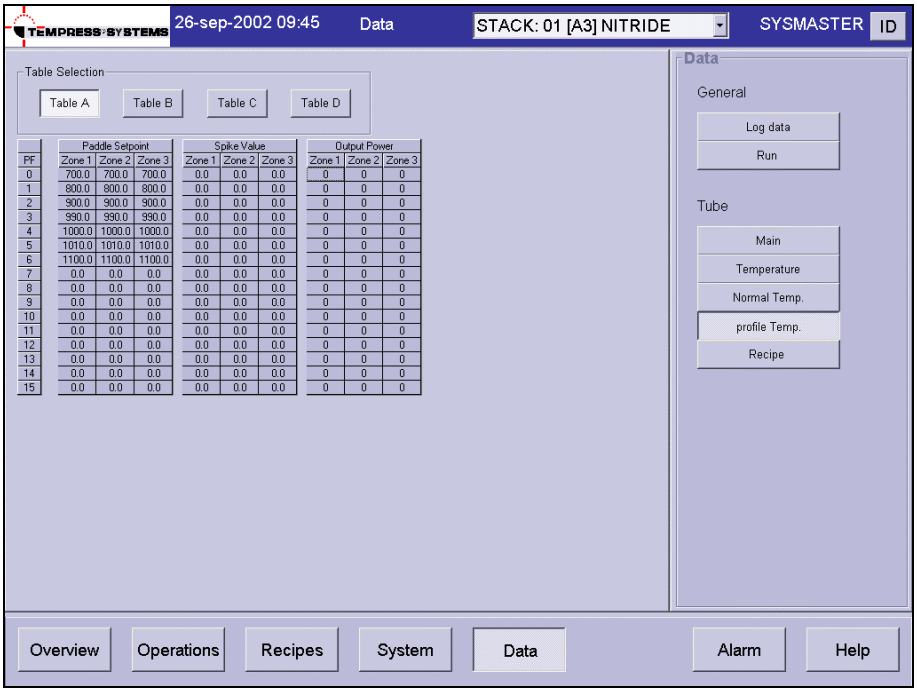


FIGURE 8-10: MONITORING PROFILE TEMPERATURE TABLE

The Profile temp screen shows the four profile temperature tables. Each table contains values for all the 16 possible profile temperature recipes. To select a profile temperature table press <A>, <B>, <C> or <D>.

PF Profile temperature recipe number

Paddle Setpoint Shows the paddle thermocouple setpoint for the corresponding profile recipe.

Spike Value Shows the spike thermocouple value for the corresponding profile recipe. This must be within ±20 ^{0}C of the paddle setpoint.

Output Power Shows the output power for the corresponding profile recipe. This must be in the range 0 to 99%.

8.5.4 RECIPE CONTENTS

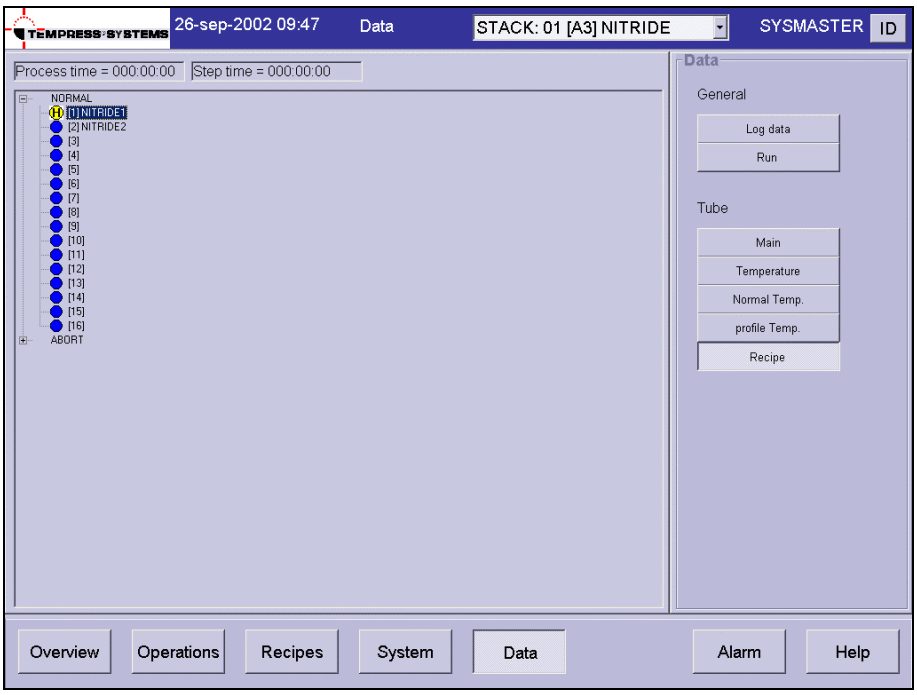


FIGURE 8-11: MONITORING RECIPES

The Recipe screen displays all recipes stored in the DPC. The selected recipe and its status is shown. The first line shows the remaining process and step time.

The process recipe is running at the indicated process step.

The process recipe is halted at the indicated process step.

9 ALARM

The Alarm menu shows an overview of all alarms of all tubes when the TSC-2 server is selected. The Alarm button will flash RED should an alarm occur that is not acknowledged yet. All alarms for a specific tube can be viewed after selecting the desired tube.

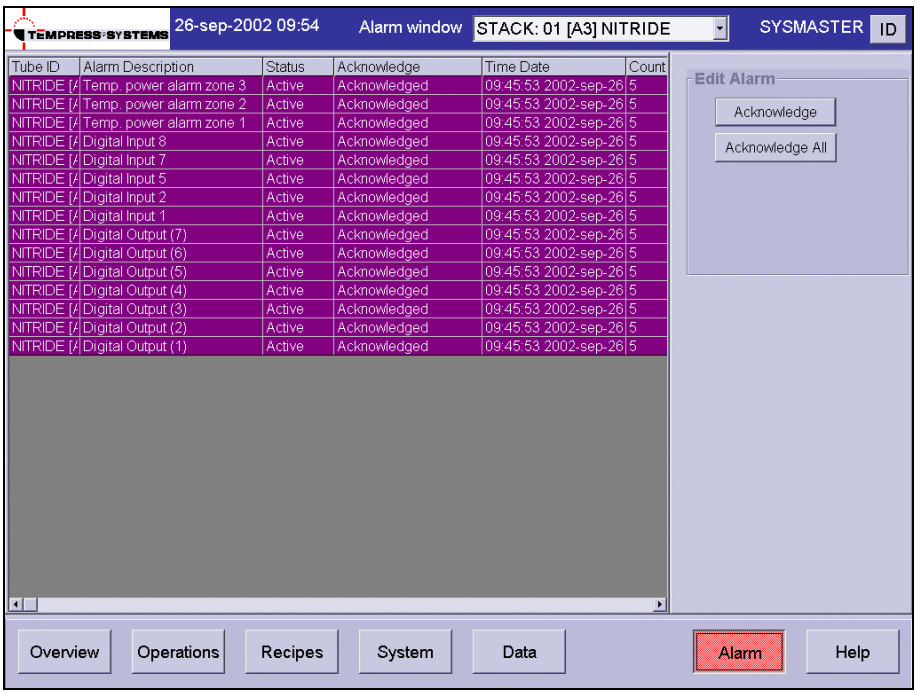


FIGURE 9-1: ALARM WINDOW

The fields contain the following information:

- **Tube ID** — Tube name and ID
- **Alarm Description** — Gives a description of the occurred alarms
- **Status of an alarm** — Active / Not active
- **Acknowledge** — Acknowledged or Not acknowledged
- **Time Date** — Shows the time and date the alarm occurred
- **Count** — Counts how many times the same alarm occurred in the current process run.
- **Use of color** — Active: red
  Not active: grey
  Acknowledged Alarms: purple

To acknowledge any alarm the alarming tube must be selected. This is quickly assessed in the Overview screen. Select the tube and press the acknowledge button to confirm that the alarm has been seen. The not active alarms will be removed from the list after acknowledging.

10 HELP

Not available yet.

11 SECS/GEM (Optional module)

11.1 INTRODUCTION

This chapter contains all documentation about SECS/GEM interface and describes its installation and functionality. SECS/GEM is optionally available to extend TSC-II software functionality and is only accessible with the appropriate license. This license can be purchased from Tempress Systems Inc.
The document is intended for two groups of users:

- System / support engineer. This engineer can use this manual to understand the SECS/GEM protocol and how it is implemented in the TSC application. He/she will find the chapters 11.3, 11.4 and 11.5 the most useful.
- Programmer of host application. This programmer can use this manual to get a list of all the functions he/she can use to communicate with the Equipment. This manual also provides him/her with the implemented GEM scenarios. Chapters 6, 7 and 8 are especially useful for this programmer.

This manual describes the implementation of the standard for the specific TSC-II application. It does not describe all the details. These details are described in the SEMI-standards [SEMI E5-0600] (SECSII) and [SEMI E30-0600] (GEM).

11.2 DEFINITIONS AND ABBREVIATIONS

11.2.1 DEFINITIONS

Item	*Definition*
Equipment	The Tempress System Controller
Host	The computer that is connected to the equipment via the SECS/GEM interface
Operator	The person who physically has access to the equipment's control panel. This is the person who operates the TSC.

11.2.2 ABBREVIATIONS

Abbreviation	*Description*
DPC	Digital Process Controller
DTC	Digital Temperature Controller
TSC	Tempress System Controller
SECS	SEMI Equipment Communications Standard
GEM	Generic Equipment Model
HSMS	High-Speed SECS Message Services
EC	Equipment Constant

ECID	Equipment Constant Identifier
SV	Status Variable
SVID	Status Variable Identifier
DVVAL	Data Value
DVNAME	Data Value Identifier
ALID	Alarm ID
CEID	Collection Event ID
PPID	Process Program ID (Recipe ID)
DV	Data Variable
RID	Report ID

11.3 SYSTEM OVERVIEW

Figure 11-1 shows the basic system architecture:

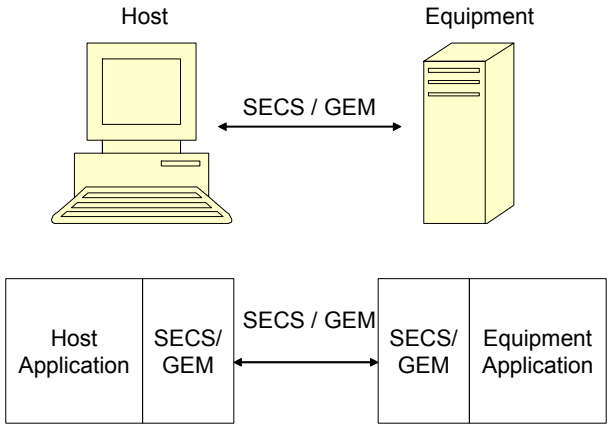


FIGURE 11-1: BASIC SYSTEM ARCHITECTURE

The Equipment consists of the DPC/DTC connected to the TSC Server. This server runs the SECS/GEM driver. The Host is a regular PC running some kind of SECS/GEM Host application. These PC's are connected through an Ethernet connection or a serial connection. This manual describes the SECS/GEM interface running on the Equipment PC.

Figure 11-2 shows the configuration when Host and Equipment communicate through a serial (RS-232) connection.

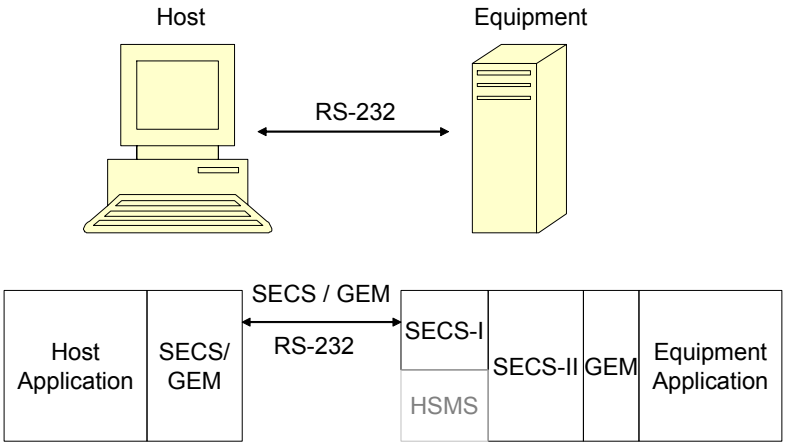


FIGURE 11-2: SYSTEM CONFIGURATION USING RS-232

The Equipment Application makes calls to a GEM module. This module handles the GEM specific functionality, like creating event and alarm reports, handling remote commands, etc. The GEM module calls the specific SECS-II messages, like S6F11, S10F3 in the SECS-II module. The SECS-II module warps these messages into packages to be transmitted. Next it calls the appropriate communication module: SECS-I for serial communication and HSMS

for Ethernet (TCP/IP) communication. These modules handle the hardware-specific functionality.

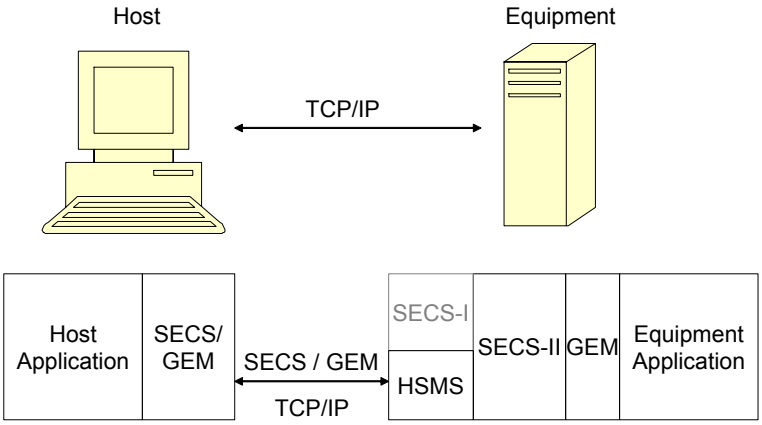


FIGURE 11-3: SYSTEM CONFIGURATION USING TCP/IP

Figure 11-3 shows the configuration when Host and Equipment communicate through an Ethernet (TCP/IP) connection.

The Equipment usual consists of several tubes. Each tube can have its own SECS/GEM interface. This means that each tube can have its own connection with a separate Host Application on a separate PC. Every connection has its own interface with a unique Device ID. The Device ID is a number that is known by the Host and the Equipment and is used to communicate.

To communicate the SECS/GEM interface has to know which 'physical' port is going to be used. Therefore a Port (with a PortID) is linked to every device (Tube) on the Equipment. In case of a TCP/IP port is it possible for different devices to use the same Port (Port ID).

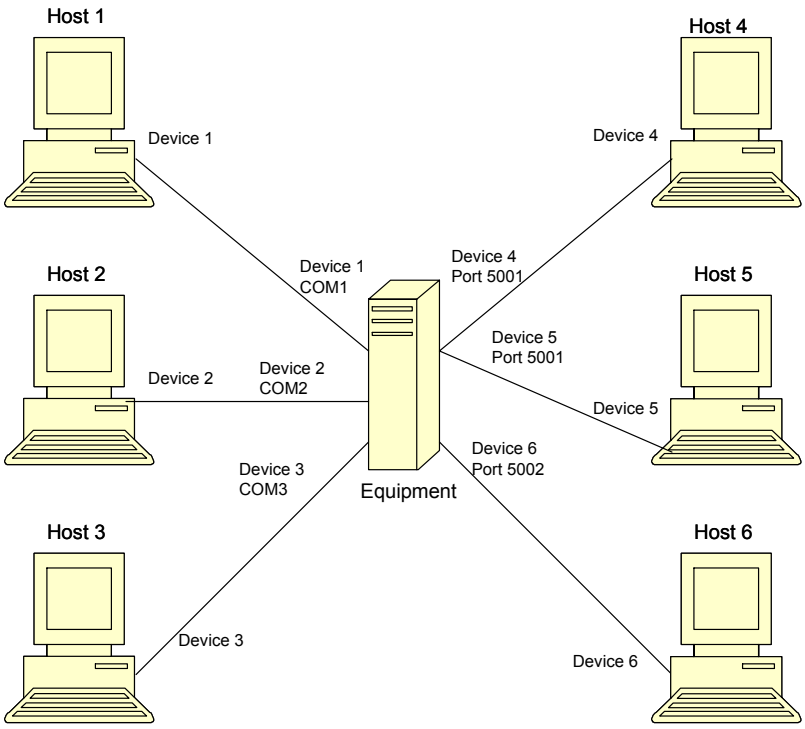


FIGURE 11-4: EXAMPLE LAYOUT

Figure 11-4 is a possible layout of a SECS/GEM network, where different Hosts are connected to 1 Equipment. Every Device is connected to a separate tube.

11.4 BASIC OPERATION

This chapter describes how a user can configure and start the SECS/GEM communication on the Equipment. This chapter is not intended to be a manual for the TSC Client application. See chapter General TSC-2 setup for specific topics.

There are three steps in setting up a SECS/GEM connection with a Host:

1. Configuring port
2. Configuring device
3. Starting communication

11.4.1 CONFIGURING PORT

The user can configure a SECS/GEM port on the Client application by selecting *Port Configuration* under *General System Setup*. Figure 11-5 shows the window. Select a type for the port: TCP/IP or RS-232. If TCP/IP is selected, a Port address must be entered. This is the IP-address or Computer Name of the Host PC.

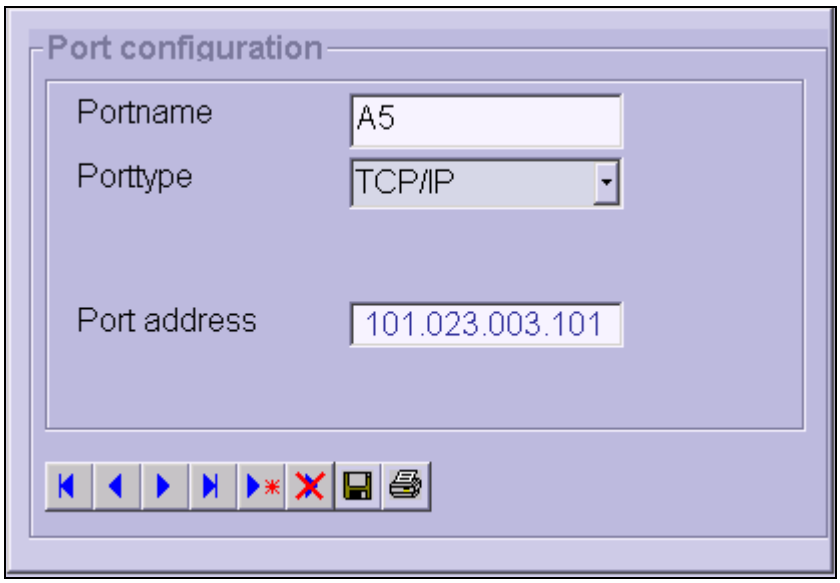


FIGURE 11-5: SETTING PORT CONFIGURATION TCP/IP PORT

Figure 11-6 shows the same configuration screen for a serial port. Here the user has to select to which COM port on the Equipment the Host PC is connected.

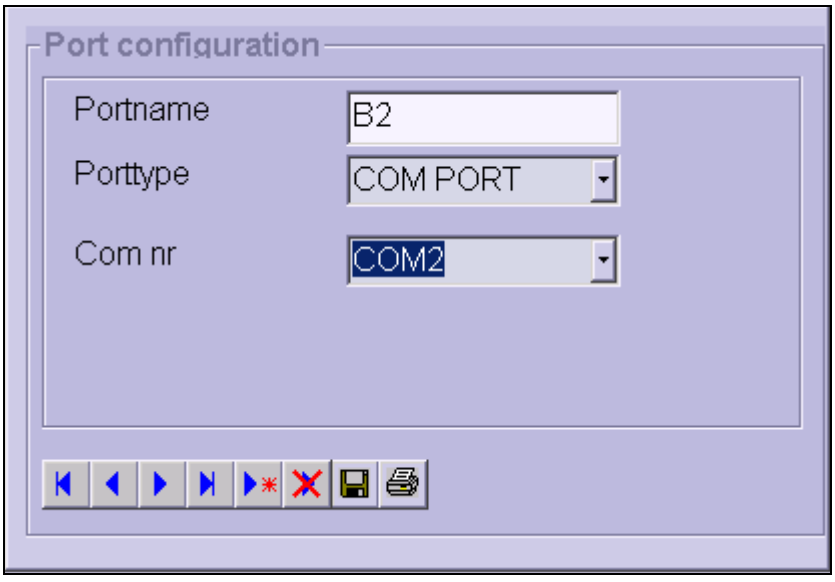


FIGURE 11-6: SETTING PORT CONFIGURATION RS-232 PORT

11.4.2 CONFIGURING DEVICE

A SECS/GEM interface connects, as mentioned before, a tube on the Equipment PC with a Host PC. Every connection has its own Device ID. The user has to configure this device. To do this he opens the *Device Configuration* for the tube on the Client application (*Tube Modification – GEM Config*). Figure 11-7 shows the setup screen.

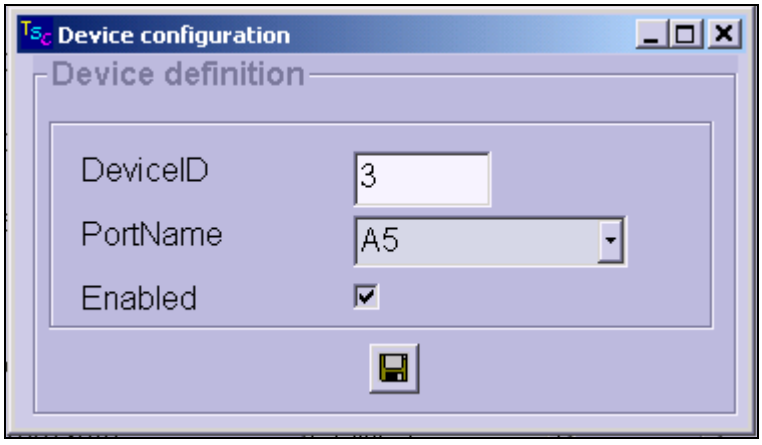


FIGURE 11-7: SETTING DEVICE CONFIGURATION

The user chooses a unique Device ID and selects a port.

11.4.3 STARTING COMMUNICATION

To start the SECS/GEM communication with the host the user has to go to the Operations screen for the tube. There he/she pushes the button *Disabled* in the Secs/Gem section. See Figure 11-8. The Secs/Gem interface is enabled and it will try to start the communication automatically.

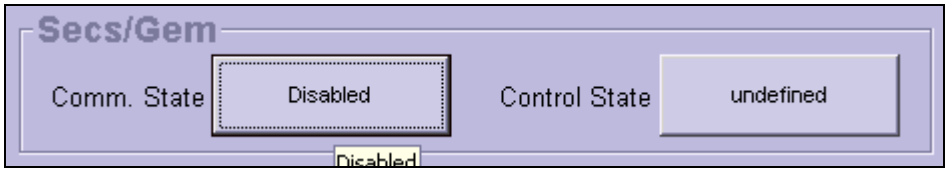


FIGURE 11-8: STARTING SECS/GEM

11.5 TECHNICAL SPECIFICATIONS SECS

11.5.1 INTRODUCTION

This chapter contains the technical specifications of the SECS protocol. This protocol contains the SECS-I protocol for low-level serial communications, the HSMS protocol for low-level TCP/IP communications and the SECS-II protocol. The SECS-II protocol defines a method to transmit information between Host and Equipment in the form of messages. These messages are organized into categories of activities, called streams, which contain specific messages, called functions.

The objective of this chapter is to provide the support engineer with enough information to understand the SECS protocol. Further technical specifications can be found in the following SEMI standards:

Standard	**Description**
SEMI E4-0699	**SECS-I**
SEMI E32-0298	**HSMS**
SEMI E5-0600	**SECS-II**

11.5.2 SERIAL COMMUNICATION (SECS-I)

The SECS-I module on the Equipment has to be configured so it can communicate with the Host PC. The following communication parameters are used:

Parameter	Value	**Description**
Port	COM x	**Communication port used**
Baud rate	**9600**	**Baud rate of serial communications**

11.5.3 ETHERNET COMMUNICATION (HSMS)

The HSMS module on the Equipment has to be configured so it can communicate with the Host PC. The following communication parameters are used:

Parameter	Value	**Description**
Port	5001	**Tcp Portnumber used**
Active/Passive	**Active**	**The equipment behaves as Active. Building of the communication link is always initiated by the equipment (TSC) The host should listen on port 5001. The source tcp portnumber is random**

11.5.4 SECS-II MESSAGE SUMMARY

The following messages are supported by the TSC SECS/GEM Interface:

Stream/Function	**Name**
S1F0	**Abort Transaction**
S1F1	**Are you there**
S1F2	**On Line Data (Equipment to Host)**
S1F3	**Selected Status Request**
S1F4	**Selected Status Data**
S1F11	**Status Variable Namelist Request**
S1F12	**Status Variable Namelist Reply**
S1F13	**Connect Request**
S1F14	**Connect Request Acknowledge**
S1F15	**Request Off-Line**
S1F16	**Off-line Acknowledge**
S1F17	**Request On-Line**

S1F18	**On-Line Acknowledge**
S2F0	**Abort Transaction**
S2F13	**Equipment Constant Request**
S2F14	**Equipment Constant Data**
S2F15	**New Equipment Constant Send**
S2F16	**Equipment Constant Send Acknowledge**
S2F17	**Date And Time Request**
S2F18	**Date and Time Data**
S2F23	**Trace Initialize Send**
S2F24	**Trace Initialize Acknowledge**
S2F29	**Equipment Constant Namelist Request**
S2F30	**Equipment Constant Namelist Reply**
S2F31	**Date and Time Set Request**
S2F32	**Date and Time Set Acknowledge**
S2F33	**Define Report**
S2F34	**Define Report Acknowledge**
S2F35	**Link Event Report**
S2F36	**Link Event Report Acknowledge**
S2F37	**Enable / Disable Event Report**
S2F38	**Enable / Disable Event Report Acknowledge**
S2F39	**Multi-block Inquire**
S2F40	**Multi-block Grant**
S2F41	**Host Command Send**
S2F42	**Host Command Acknowledge**
S2F43	**Reset Spooling Streams and Functions**
S2F44	**Reset Spooling**
S2F45	**Define Variable Limit Attributes**
S2F46	**Variable Limit Attribute Acknowledge**
S2F47	**Variable Limit Attribute Request**
S2F48	**Variable Limit Attributes Send**
S5F0	**Abort Transaction**
S5F1	**Alarm Report Send**
S5F2	**Alarm Report Acknowledge**
S5F3	**Enable / Disable Alarm Send**
S5F4	**Enable / Disable Alarm Acknowledge**
S5F5	**List Alarm Request**
S5F6	**List Alarm Data**
S5F7	**List Enabled Alarm Request**
S5F8	**List Enabled Alarm Data**
S6F0	**Abort Transaction**
S6F1	**Trace Data Send**
S6F2	**Trace Data Acknowledge**
S6F5	**Multi-block Data Send Inquire**
S6F6	**Multi-block Grant**
S6F11	**Event Report Send**

S6F12	**Event Report Acknowledge**
S6F15	**Event Report Request**
S6F16	**Event Report Data**
S6F19	**Individual Report Request**
S6F20	**Individual Report Data**
S6F23	**Request Spooled Data**
S6F24	**Request Spooled Data Acknowledgement Send**
S7F0	**Abort Transaction**
S7F1	**Process Program Load Inquire**
S7F2	**Process Program Load Grant**
S7F3	**Process Program Send**
S7F4	**Process Program Acknowledge**
S7F5	**Process Program Request**
S7F6	**Process Program Data**
S7F19	**Current EPPD Request**
S7F20	**Current EPPD Data**
S9F0	**Abort Transaction**
S9F1	**Unrecognized Device ID**
S9F3	**Unrecognized Stream Type**
S9F5	**Unrecognized Function Type**
S9F7	**Illegal Data**
S9F9	**Transaction Timer Timeout**
S9F11	**Data Too Long**
S9F13	**Conversation Timeout**
S10F0	**Abort Transaction**
S10F1	**Terminal Request**
S10F2	**Terminal Request Acknowledge**
S10F3	**Terminal Display, Single**
S10F4	**Terminal Display, Single Acknowledge**

11.5.5 VARIABLES

The Equipment has a fixed set of variables that can be read by the Host. Each variable is identified by a unique Variable ID (VID). The variables that exist are shown in Appendix A.

There are three types of variables: Status Variables (SV), Data Variables (DV) and Equipment Constants (EC). The Host can read Variables of any type, but can set values only for Equipment Constants. The Host can read values for Status Variables and Equipment Constants whenever the Equipment is On-Line, but the values for Data Variables are typically meaningful only immediately after certain (Collection) Events (CEIDs), and so are typically reported only in Event Reports (S6F11).

11.6 TECHNICAL SPECIFICATIONS GEM

This standard describes a set of capabilities to which an interface should conform to. If all the necessary capabilities are implemented the interface is GEM compliant. Table 11-1 is the GEM Compliance Statement for this GEM interface. It also contains a reference to the section where the capability is described.

TABLE 11-1: GEM COMPLIANCE STATEMENT

FUNDAMENTAL GEM REQUIREMENTS	IMPLEMENTED	GEM-COMPLIANT	SECTION
State Models	Yes	-	11.6.4, 0
Equipment Processing States	Yes	-	0
Host-Initiated S1- F13/F14 Scenario	Yes	-	11.6.4
Event Notification	Yes	-	11.6.7.1
On-line Identification	Yes	-	0
Error Messages	Yes	-	11.6.16
Documentation	Yes	-	-
Control (Operator Initiated)	Yes	-	0
ADDITIONAL CAPABILITIES	**IMPLEMENTED**	**GEM-COMPLIANT**	**SECTION**
Establish Communications	Yes	Yes	11.6.4
Dynamic Event Report Configuration	Yes	Yes	11.6.7.2
Variable Data Collection	Yes	Yes	11.6.8
Trace Data Collection	Yes	Yes	11.6.9
Status Data Collection	Yes	Yes	11.6.8
Alarm Management	Yes	Yes	11.6.12
Remote Control	Yes	Yes	0
Equipment Constants	Yes	Yes	11.6.8
Process Program Management	Yes	Yes	11.6.14
Material Movement	No	No	-
Equipment Terminal Services	Yes	Yes	11.6.15
Clock	Yes	Yes	11.6.17
Limits Monitoring	Yes	Yes	11.6.10
Spooling	Yes	Yes	11.6.18
Control (Host-Initiated)	Yes	Yes	0

11.6.1 PROPERTIES

The Equipment has a fixed set of Properties for SECS/GEM. These Properties define the behavior of the SECS/GEM Interface. They are part of the complete set of Properties for the TSC II application and can be handled in the same way. A complete list of Properties for SECS/Gem is provided in Appendix B.

11.6.2 VARIABLES

The Equipment also has a fixed set of Variables for SECS/GEM. Appendix A contains a complete list of all the variables that are implemented. Every section in this chapter has a list of the variables that are used with the capability described.

11.6.3 EVENT CONFIGURATION

A SECS/GEM interface on a typical equipment has in normal operation a number of predefined events. These events are triggered on certain occasions.
For the TSC application a different strategy is chosen. The TSC application contains a number of Equipment variables called Dbi points. These points represent the complete dynamic behavior of the Equipment. To give the system configurator as much freedom as possible a strategy is chosen where he/she can link events to Dbi points. A change in the value of a Dbi point triggers an event. With this method any event can be configured and any report can be linked to these events.

To be compliant with the SECS/GEM standard and to speed up the configuration of the system, a limited number of events is preconfigured. These events are listed in Appendix B.

11.6.4 COMMUNICATION

This paragraph describes the different states and state transitions of communication between the host and the equipment.

11.6.4.1 States

The possible communication states are:

DISABLED
In this state communication with a host computer does not exist. If the operator switches from ENABLED to DISABLED all communications cease immediately.

ENABLED
The communication is enabled. ENABLED has two sub states: COMMUNICATING and NOT COMMUNICATING. Whenever communications are enabled, either during system initialization or through operation selection, the sub state of NOT COMMUNICATING is active until communications are formally established.

ENABLED / NOT COMMUNICATING
Communication is enabled but not established yet. The Equipment shall attempt to establish communications. No other messages shall be sent. This state has two sub states: EQUIPMENT-INITIATED CONNECT and HOST-INITIATED CONNECT.

NOT COMMUNICATING / EQUIPMENT INITIATED CONNECT
The Equipment has tried to establish communication with the Host. This state has two sub states: WAIT CRA and WAIT DELAY.

NOT COMMUNICATING/EQUIPMENT-INITIATED CONNECT / WAIT CRA

An Establish Communications Request has been sent. The equipment waits for the host to acknowledge the request.

NOT COMMUNICATING/EQUIPMENT-INITIATED CONNECT / WAIT DELAY

A connection transaction failure has occurred. The *CommDelay* timer has been initialized. The Equipment waits for the timer to expire.

NOT COMMUNICATING / HOST-INITIATED CONNECT

This state describes the behavior of the equipment in response to a host-initiated connection request.

NOT COMMUNICATING / HOST-INITIATED CONNECT / WAIT CR FROM HOST

The Equipment waits for a Connection Request from the Host.

ENABLED / COMMUNICATING

Communications have been established. The Equipment may receive any message from the Host.

11.6.4.2 State Transitions

The Finite State Diagram in Figure 11-9 shows the different state transitions of the communication between the Equipment and the Host. These state transitions are described in Table 11-2.

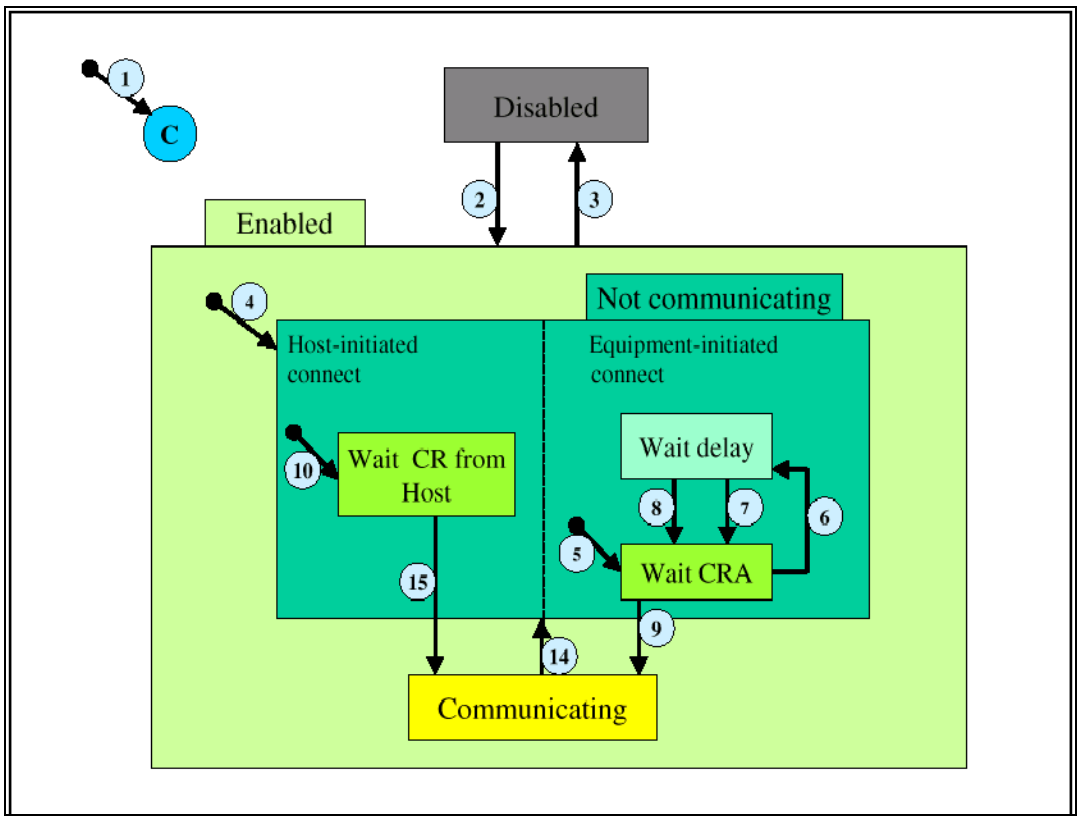


FIGURE 11-9: COMMUNICATION STATE MODEL

TABLE 11-2: COMMUNICATION STATE TRANSITIONS

	Current State	Trigger	New State	Comment
1	(Entry to COMMUNICATIONS)	System initialization.	System Default	The system default may be set to DISABLED or ENABLED (property 300005)
2	DISABLED	Operator switches from DISABLED to ENABLED	ENABLED	SECS-II communications are enabled.
3	ENABLED	Operator switches from ENABLED to DISABLED	DISABLED	No SECS-II communications.
4	(Entry to ENABLED)	Any entry to ENABLED state.	NOT COMMUNICATING	May enter from system initialization to ENABLED or through operator switch to ENABLED.
5	(Entry to EQUIPMENT-INITIATED CONNECT)	(Any entry to NOT COMMUNICATING)	WAIT CRA	Attempt to establish communications by sending request to Host (SlF13).
6	WAIT CRA	Connection transaction failure.	WAIT DELAY	Delay timer is started. Wait for timer to expire.
7	WAIT DELAY	CommDelay timer expired.	WAIT CRA	Wait for Acknowledge (S1F14) from Host. May receive Request (S1F13) from Host.
8	WAIT DELAY	Received a message other than Communication	WAIT CRA	Indicates opportunity to establish communications. Try again by sending Request (S1F13).

		Request (SlF13).		
9	WAIT CRA	Received expected Acknowledge (SlF14).	COMMUNICATING	Communications are established.
10	(Entry to HOST-INITIATED CONNECT)	(Any entry to NOT COMMUNICATING)	WAIT CR FROM HOST	Wait for Communication Request (SlF13) from Host.
14	COMMUNICATING	Communication failure.	NOT COMMUNICATING	
15	WAIT CR FROM HOST	Received Communication Request (SlF13).	COMMUNICATING	Communications are established. Reply (S1F14) is sent.

The variables used are:

Variable
Communication State
EstablishCommunicationTimeout

11.6.5 CONTROL STATE

The Control State model defines the level of cooperation between the Equipment and the Host. It also specifies how the operator may interact at the different levels of Host Control.

The Control model provides the host with three basic levels of control. In the highest level (REMOTE), the host may control the Equipment to the full extent possible. The middle level (LOCAL) allows the host full access to information, but places some limits on how the host can affect equipment operation. In the lowest level (OFF-LINE), the equipment allows no host control and only very limited information.

11.6.5.1 States

The following Control States are defined:

OFF-LINE
When the OFF-LINE state is active, operation of the equipment is performed by the operator at the operator console. While the Equipment is OFF-LINE, message transfer is possible, however severely restricted.
OFF-LINE has three sub states: EQUIPMENT OFF-LINE, ATTEMPT ON-LINE and HOST OFF-LINE.

OFF-LINE / EQUIPMENT OFF-LINE
System awaits operator instructions to go ON-LINE.

OFF-LINE / ATTEMPT ON-LINE
The Equipment has responded to an operator instruction to attempt to go to the ON-LINE state. The Equipment sends request to Host to go ON-LINE.

OFF-LINE / HOST-OFFLINE

The Equipment has tried to go to ON-LINE, but the Host denied the request, or switched to OFF-LINE itself. The Equipment is now waiting for the Host to send a request to go ON-LINE.

ON-LINE
The Host is ON-LINE with the Equipment, which means that the Host has certain (limited) capabilities to operate the Equipment.
The ONLINE state has two sub states: LOCAL and REMOTE.

ON-LINE / LOCAL
Operation of the Equipment by direct action of the operator.
The Host has the all the available capabilities except the use of remote commands.

ON-LINE / REMOTE
Operation of the Equipment by direct action of the operator or remotely by Host. The Host can use all the available capabilities.

11.6.5.2 State Transitions

The Finite State Diagram in Figure 11-10 shows the different state transitions of the Control model. These state transitions are described in Table 11-3.

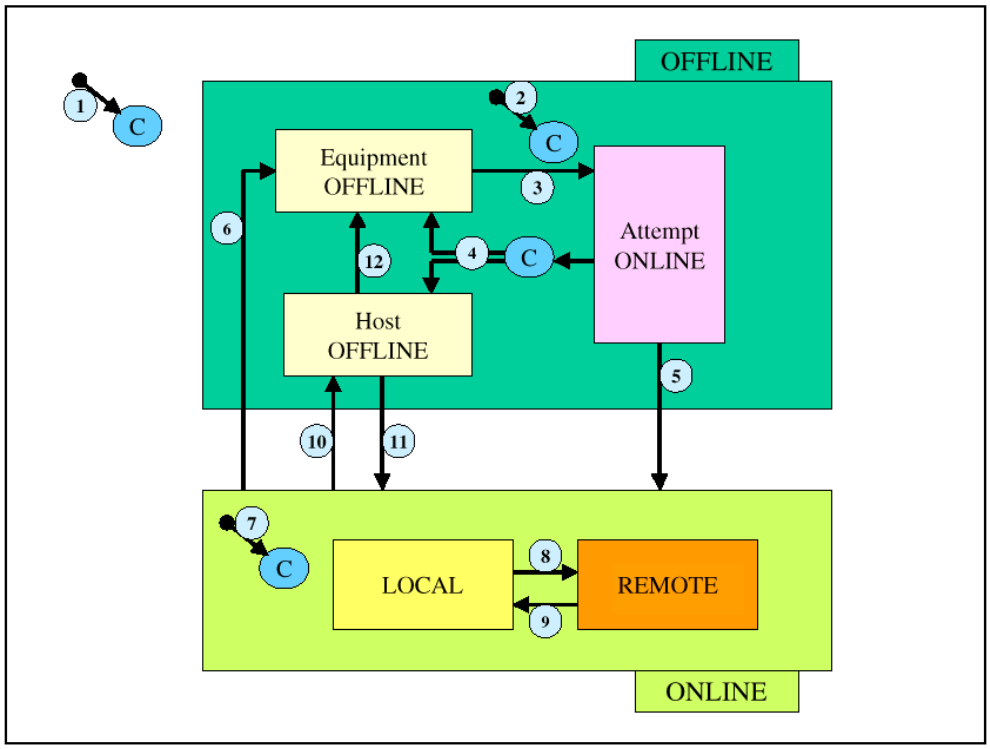


FIGURE 11-10: CONTROL STATE MODEL

TABLE 11-3: CONTROL STATE TRANSITION TABLE

#	Current State	Trigger	New State	Comments
1	(Undefined)	Entry into CONTROL state (system initialization)	CONTROL (Sub state conditional on configuration)	Equipment may be configured to default to ON-LINE or OFF-LINE (Property 300002)
2	(Undefined)	Entry into OFF-LINE state.	OFF-LINE (Sub state conditional on configuration.)	Equipment may be configured to default to any sub state of OFF-LINE (Property 300003)
3	EQUIPMENT OFF-LINE	Operator actuates ON-LINE switch.	ATTEMPT ON-LINE	Equipment sends request to Host to go ON-LINE (S1F1).
4	ATTEMPT ON-LINE	Failure (SlF0)	New state conditional on configuration (Property 300010).	Configuration may be set to EQUIPMENT OFF-LINE or HOST OFF-LINE
5	ATTEMPT ON-LINE	Equipment receives expected Acknowledge message (S1F2) from the host.	ON-LINE	Host is notified of transition to ON LINE at transition 7.
6	ON-LINE	Operator actuates OFF-LINE switch.	EQUIPMENT OFF-LINE	-
7	(Undefined)	Entry to ON-LINE state.	ON-LINE (Sub state conditional on REMOTE/LOCAL switch setting, Property 300004)	-
8	LOCAL	Operator sets front panel switch to REMOTE.	REMOTE	-
9	REMOTE	Operator sets front panel switch to LOCAL.	LOCAL	-
10	ON-LINE	Equipment accepts "Set OFF-LINE" message from host (SlF15).	HOST OFF-LINE	-
II	HOST OFF-LINE	Equipment accepts host request to go ON-LINE (SlF17).	ON-LINE	-
12	HOST OFF-LINE	Operator actuates OFF-LINE switch.	EQUIPMENT OFF-LINE	-

The variables used are:

-	Variable
-	Control State

11.6.6 PROCESS STATE

The Process State is the state of the running process. Through the SECS/GEM interface the Host can control part of the process steps. The SECS/GEM interface holds a simplified model of the Process State Model.

11.6.6.1 States

The following Process States are defined:

IDLE
In this state the Equipment is awaiting instructions.

RUNNING
Running is the state in which the Equipment is executing a recipe automatically and can continue to do so without external intervention.

HOLD
In this state processing is suspended and the Equipment is awaiting a command.

11.6.6.2 State Transitions

The Finite State Diagram in Figure 11-11 shows the different state transitions of the process. These state transitions are described in Table 11-4.

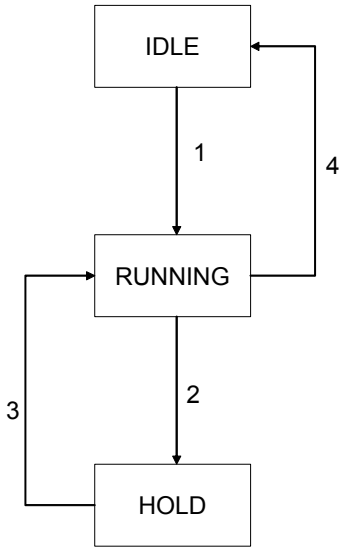


FIGURE 11-11: PROCESS STATE MODEL

TABLE 11-4: PROCESS STATE TRANSITION TABLE

#	Current State	Trigger	New State	Comments
1	IDLE	Equipment has received a START command from the host or the operator console.	RUNNING	-
2	RUNNING	Equipment has received a PAUSE command from the host or the operator console.	HOLD	-
3	HOLD	Equipment has received a RESUME command from the host or the operator console.	RUNNING	-
4	RUNNING	Equipment has received an ABORT command from the host or the operator console.	IDLE	-

The variables used are:

-	**Variable**
-	Process State New
-	Process State Old

11.6.7 EVENT REPORTS

This capability provides a dynamic and flexible method for the user to configure the Equipment to send user-defined data reports on events. The functionality can be broken into two logical parts: host notification when an event occurs and dynamic configuration of the data attached to the event notification.

11.6.7.1 Event Notification

The purpose of this capability is to provide data to the host at specified points in equipment operation. Events on the Equipment may trigger activity on the part of the host.

The Equipment supplies a set of predefined events (CEIDs). The Host creates reports and links these to certain events (see section 11.6.7.2).When an event (CEID) occurs the Equipment will send the configured report containing data values to the Host.
The Host can enable/disable the event reporting per event.
The Host can request an event report for a certain event (CEID).

11.6.7.2 Dynamic Event Report Configuration

This capability allows the Host to dynamically modify the Equipment event reporting setup. It contains the following functionality:

- Host definition / deletion of custom reports (RIDs).
- Host linking / unlinking of defined reports to specific events (CEIDs).
- Host enabling / disabling the reporting of specified collection events.

A report is a list of variables (SV, DV, EC). The Host sends this report with its ID (RID) to the host. Then the Host sends a message containing the link between this RID and an event (CEID). The last step is enabling the event reporting for this event. After this step the Equipment will send the report (RID) every time the specific event (CEID) occurs.

11.6.8 VARIABLE DATA COLLECTION

This capability allows the host to query for the equipment data variables and is useful during initialization and synchronization. It contains the following function(s):

- The Host can request a report containing data variables from the Equipment by specifying the Report ID (RID). It is assumed that the report has been previously defined (See section 11.6.7.2: Dynamic Event Report Configuration).
- The host can request the value(s) of Status Variables (SV) by specifying the desired SVIDs.
- The host can request the names of Status Variables (SV) by specifying the desired SVIDs.
- The Host can read and change the value of selected Equipment Constants (ECs).
- The host can request the names of Equipment Constants (ECs) by specifying the desired ECIDs.

The variables used are:

-	Variable
-	ECIDChanged

11.6.9 TRACE REPORTS

Trace reports provide a way to monitor data variables on a periodic basis. This is especially useful for monitoring continuous data.

The Trace reporting procedure is as follows:

- The Host creates a list of variables (a trace report) to be monitored. He/she then determines the time interval (DSPER), the total number of samples to be taken (TOTSMP) and the number of samples per trace report (REPGSZ). The Host sends this information to the Equipment.
- The Equipment samples the specified data variables at the interval designated by the host and sends the Host-defined trace report to the Host.
- The Equipment deletes the Trace Report configuration after the last trace report has been sent.
- The Host can change or re-initiate a configured trace report at all times.

11.6.10 LIMITS MONITORING

The limits monitoring capability provides the host a means of monitoring equipment conditions. The Host can configure the Equipment to monitor specific variables. If one of these variables crossed a Host-defined limit, a limit transition event occurs.

This capability has the following functionality:

- The Host can define a standard set of monitoring zones and limits per variable (up to 7 limits per variable).
- Reporting to the Host when selected Equipment variables transition between monitoring zones.
- Lets the Host modify the values of the variable limit attributes.

The Host provides two values per limit: the UPPERDB and the LOWERDB. The UPPERDB defines the upper boundary of the deadband of a limit. The LOWERDB defines the lower boundary of the deadband of a limit. When the variable value crosses one of these boundaries, an event will occur. Figure 11-12 shows how it works.

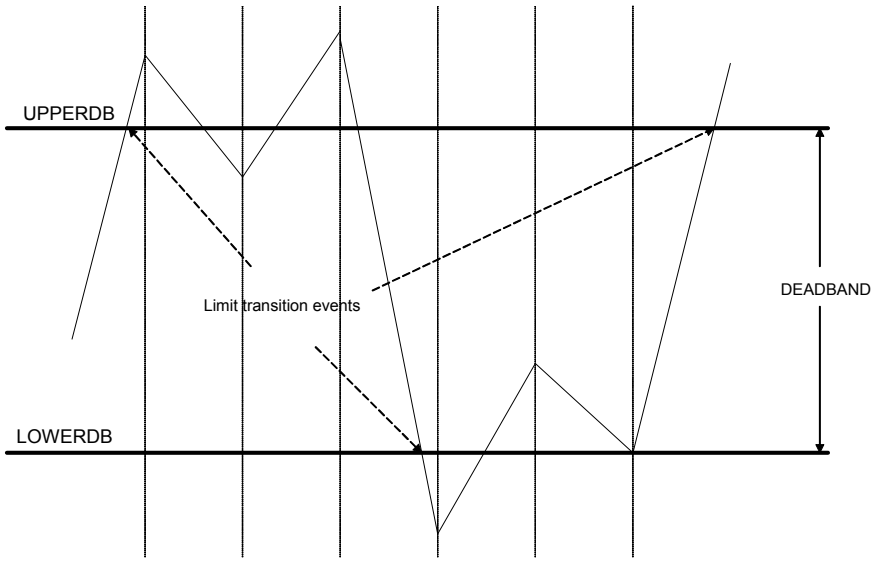


FIGURE 11-12: EXAMPLE LIMITS

11.6.10.1 States

The following Limit States are defined:

ABOVE LIMIT
A variable is considered to be above limit when its value increases to equal or exceed the upper boundary of the deadband, UPPERDB.

BELOW LIMIT
A variable is considered to be below limit when its value decreases to equal or fall below the lower boundary of the deadband, LOWERDB.

NO ZONE
In some circumstances it is possible for the variable value to be in neither the upper zone nor the lower zone. This may occur upon definition of a new limit or upon equipment startup when the value of the variable lies within the deadband.

11.6.10.2 State Transitions

The Finite State Diagram in Figure 11-13 shows the different state transitions of the limit. These state transitions are described in Table 11-5.

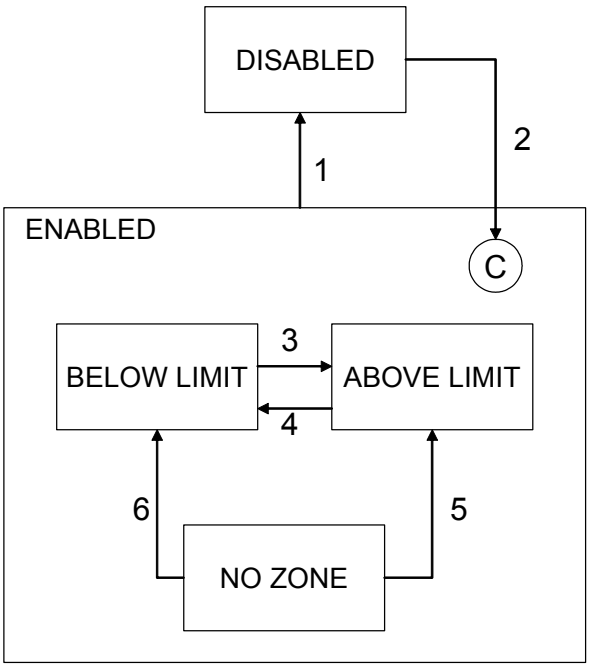


FIGURE 11-13: LIMITS STATE TRANSITIONS

TABLE 11-5: LIMIT STATE TRANSITION TABLE

#	*Current Stale*	*Trigger*	*New State*	*Comment*
1	DISABLED	Limit attributed defined (S2F45).	ENABLED	The sub state of ENABLED is determined by the current value of the monitored variable.
2	ENABLED	Limit attributes set to undefined (S2F45).	DISABLED	None
3	BELOW LIMIT	Variable Increased to be ≥UPPERDB	ABOVE LIMIT	Zone Transition.
4	ABOVE LIMIT	Variable decreases to be LOWERDB	BELOW LIMIT	Zone Transition.
5	NO ZONE	Variable decreases to be LOWERDB	BELOW LIMIT	Zone Transition.
6	NO ZONE	Variable increases to be ≥UPPERDB	ABOVE LIMIT	Zone Transition.

The variables used are:

-	**Variable**
-	EventLimit
-	LimitVariable

11.6.11 ON-LINE IDENTIFICATION

The ability to verify the presence of the Equipment and the abibility to request the current Equipment version: Equipment Model Type (MDLN) and the Equipment Software Revision Code (SOFTREV).

11.6.12 ALARM MANAGEMENT

The alarm management capability provides for Host notification and management of alarm conditions occurring on the Equipment. This capability contains:

- Reporting an alarm state change to the Host;
- Uploading a list of alarm texts;
- Enabling and disabling the notification of specific alarms;
- Host query of alarms set and enabled on the equipment.

The variables used are:

-	**Variable**
-	RequestActiveAlarms

11.6.13 REMOTE COMMANDS

This capability gives the Host a level of control over Equipment operations. The Host sends a request to run a command with certain parameters on the Equipment. The following commands are implemented:

Command	Parameters	**Description**
START	-	**Start executing process on Equipment (see section 11.6.6)**
ABORT	-	**Abort executing process on Equipment (see section 11.6.6)**
PAUSE	-	**Pause executing process on Equipment (see section 11.6.6)**
RESUME	-	**Resume executing process on Equipment (see section 11.6.6)**
CHANGE VALUE	- Equipment Constant ID (ECID) - New value	**Change the value of an Equipment Constant**
GoToLocal	-	**Switch Control State to LOCAL (see section 11.6.6))**
GoToRemote		**Switch Control State to REMOTE (see section 11.6.6))**
PP SELECT	**- Recipe number**	**Select Recipe**

The Host only gets permission to execute these commands on the Equipment if the Control state is set to ON-LINE / REMOTE.

11.6.14 PROCESS PROGRAM MANAGEMENT

Process program management provides a way to transfer recipes between Host and Equipment. The Recipes are always unformatted: the binary code is transferred between Host and Equipment.

This capability contains the following functions:

- Request a list of recipes
- Host-Initiated Unformatted Recipe Upload (Equipment to Host)
- Equipment-Initiated Unformatted Recipe Upload (Equipment to Host)
- Host-Initiated Unformatted Recipe Download (Host to Equipment)
- Equipment-Initiated Unformatted Recipe Download (Host to Equipment)

The variables used are:

-	Variable
-	PPChangeName
-	PPChangeStatus

11.6.15 EQUIPMENT TERMINAL SERVICES

Equipment Terminal Services allows the Host to display information on the Equipment's display device or the operator of the Equipment to send information to the Host.

The variables used are:

-	Variable
-	Terminal ID
-	Terminal Text

11.6.16 ERROR MESSAGES

Error messages provide the Host with information describing the reason for a particular message or communication fault detected by the Equipment. The following faults are detected by the Equipment and reported to the Host.

- Unknown Device ID
- Unknown Message Stream Type
- Unknown Message Function
- Wrong Message format
- Wrong Data format
- Message too long
- No reply within set period (Transaction timer expired).

11.6.17 CLOCK

This capability enables the Host or Equipment to set or read the value of the internal clock of the other. It can be used to synchronize times for time-stamping purposes. The functions are:

- Equipment requests time value from the Host
- Host sets time value on Equipment
- Host requests time value from the Equipment

The variables used are:

-	Variable
-	TimeFormat

11.6.18 SPOOLING

Spooling is a capability whereby the Equipment queues messages intended for the Host during times of communication failure. When communication is restored these messages can be delivered to the Host. This way no messages are lost during communication failures. Only Primary messages are spooled. Primary messages are the first message in a scenario: they are not a reply on any other message from the Host.
The Host has the following possibilities:

- Enable / Disable spooling
- Define streams and functions to be spooled
- Request for spooled messages to be transmitted.
- Request for spooled messages to be deleted (purged).
- Set the maximum number of spooled messages to be transmitted after a request (Equipment Constant *MaxSpoolTransmit*).

The Spooling State Model describes the functionality.

11.6.18.1 States

The following Spooling States are defined:

POWER OFF
The Equipment has lost power for any reason.

POWER ON
The Equipment is powered up.

SPOOL INACTIVE
This is the normal operating mode. No spooling occurs. The Spool Area is empty.

SPOOL ACTIVE
All primary SECS-II messages are put in the spool area if Spooling is enabled. The Equipment still tries to send Secondary messages (answers) to the Host. These messages are not put in the spool area.
This state has two sub-states: SPOOL LOAD and SPOOL UNLOAD. These states can operate independently at the same time.

SPOOL LOAD:
He Equipment enters messages into spool area.
This state has two sub states: SPOOL NOT FULL and SPOOL FULL.

SPOOL NOT FULL
Spool area is not full: messages are put into Spool area.

SPOOL FULL
The Spool area is full. The Equipment can be configured to overwrite old spool messages or to discard new messages. This depends on the Equipment Constant *OverwriteSpool*.

SPOOL UNLOAD:
The Equipment handles the transmission of spooled messages to the Host.
This state has two sub states: SPOOL OUTPUT and NO SPOOL OUTPUT.

NO SPOOL OUTPUT
No messages are removed from the Spool area.

SPOOL OUTPUT
Removal of messages from the Spool area.
This state has two sub-states: TRANSMIT SPOOL and PURGE SPOOL

TRANSMIT SPOOL
The Host has requested the transmission of the spooled messages. The Equipments sends the messages.

PURGE SPOOL
The Host has requested to purge the spooled messages. The Equipment removes all messages from the spool area and does not send them to the Host.

11.6.18.2 State Transitions

The Finite State Diagram in Figure 11-14 shows the different state transitions of the spooling. These state transitions are described in Table 11-6.

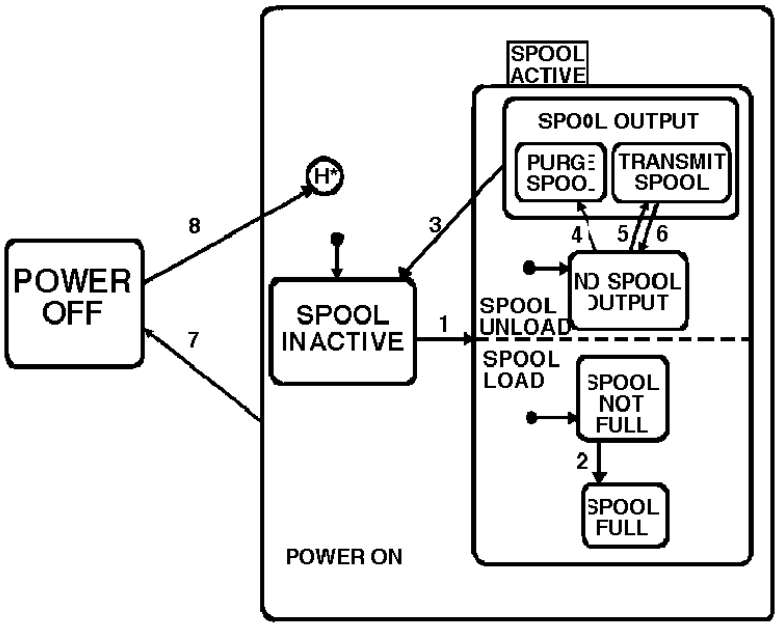


FIGURE 11-14: SPOOLING STATE TRANSITIONS

TABLE 11-6: SPOOLING STATE TRANSITIONS

	Current State	Trigger	New State	Comment
1	SPOOL INACTIVE	Communication state changes from COMMUNICAT-ING to NOT COMMUNICAT-ING or from WAIT CRA to WAIT DELAY and Enable Spool (property 300009) is true.	SPOOL ACTIVE	The default state in each sub state is entered. The message which could not be sent remains in the send queue and is dealt with in Spool Active state.
2	SPOOL NOT FULL	Message generate which will not fit into spool area.	SPOOL FULL	The message which would not fit into the spooling area is dealt with after the transition.
3	SPOOL OUTPUT	Spool area emptied.	SPOOL INACTIVE	-
4	NO SPOOL OUTPUT	Purge request (S6F23) received from Host.	PURGE SPOOL	Initiates purging process.
5	NO SPOOL OUTPUT	Transmit request (S6F23) received from Host.	TRANSMIT SPOOL	Initiates message transmission from spool.
6	TRANSMIT SPOOL	Communication failure or MaxSpoolTransmit reached	NO SPOOL OUTPUT	-
7	POWER ON	Equipment power off	POWER OFF	-
8	POWER OFF	Equipment power on	POWER ON	If spooling were active prior to power down, it shall continue.

The variables used are:

-	**Variable**
-	EnableSpooling
-	MaxSpoolTransmit
-	OverwriteSpool
-	SpoolCountActual
-	SpoolCountTotal
-	SpoolFullTime
-	SpoolStartTime

11.7 SECS-II MESSAGES

This chapter provides a list of all implemented SECS-II messages and a description of the layout of these messages. The objective of this chapter is to provide the programmer of a Host application with the necessary message detail.

11.7.1 SML NOTATION

Message descriptions are shown using SECS Message Language (SML) notation. SML is a general notation developed by GW Associates for describing SECS messages. SML is similar to the notation used in the SECS Standards documents, but SML is a more precise and regular notation. In SML, the format for a data item is as follows:

< type [count] value >

The components are:

<> Angle Brackets. Each Data Item within angle brackets (les than, greater than). This notation implies that each Data Item has a Data Item Format and Data Item Length as required by SECS-II.

Type This specifies the SECS-II Data Item format. It will have one of the following values:

A	ASCII
B	Binary
I1, I2, I4, I8	Signed Integers
U1, U2, U4, U8	Unsigned Integers
F4, F8	Floating Point
BOOLEAN	True/ False
V	Variant: all formats are allowed

Count Count of the element values that make up the item. If present, the count is enclosed within square brackets []. The count may be omitted, in which case the square brackets are also omitted.

The count specifies the number of value elements in the Data Item Value. For String formats (ASCII, Binary), count specifies the number of characters in the string. For Numeric formats (I1, I2, I4, I8, U1, U2, U4, U8, F4, F8, BOOLEAN), count specifies the number of values in the array. For simple scalar numeric values, count is usually 1. For LIST items, count specifies the number of items in the list.

If count is omitted, then the length of the Data Item is implied by the value which follows. The count can range between known limits. It may be specified as minimum and maximum counts, separated by two dots (For example, [0..40]).

Value Value is a single item element. Values are shown in a notation that depends on the item type. For example, ASCII values are shown as characters enclosed in quotes, Unspecified Binary values are shown in hexadecimal.

… Ellipses (…) is used to indicate additional elements may occur, as for example where substructures may repeat in the List structure.

All the possible SECSII functions are described in detail in the SEMI standard [SEMI E5-0600]. In this chapter all the implemented functions are listed with a brief description.

The data-items specific to SECSII are written in captions. These data-items are described in detail in the same SEMI standard [SEMI E5-0600].

11.7.2 MULTI-BLOCK

SECS-II messages that are longer than 244 bytes are referred to as multi-block messages. If the sender has a multi-block message to send, then he/she must receive permission from the receiver prior to sending the data. For this purpose there are some special functions created: the so called Inquire/Grant functions. The sender 'inquires' if it is possible to send the multi-block message. The receiver can 'grant' the transmission or 'reject' it. After reception of the 'grant', the sender can send the message. If the sender receives a 'reject' from the receiver, he has to cancel the transmission of the multi-block message.

11.7.3 STREAM 1: EQUIPMENT STATUS

This stream provides a means for exchanging information about the status of the equipment.

11.7.3.1 S1F0 – Abort Transaction

Description:	Used as a reply when the transaction is aborted. Function 0 is defined in every stream and has the same meaning in every stream
Structure:	Header only
Answer:	-
Direction:	E <-> H
Exception:	-

11.7.3.2 S1F1 – Are you there

Description:	Establishes if the equipment or host is on-line
Structure:	Header only
Answer:	S1F2
Direction:	E <-> H
Exception:	-

11.7.3.3 S1F2 – On Line Data (Equipment to Host)

Description:	Data signifying that the equipment or host is alive
Structure:	< L[2] < A[6] MDLN > < A[6] SOFTREV > >
Answer:	-
Direction:	E <-> H
Exception:	<L[0]>

11.7.3.4 S1F3 - Selected Status Request

Description:	A request to the equipment to report selected values of its status. A zero-length list means report all SVIDs.
Structure:	< L[NoOfItems <= 1000] < V[1] SVID >

	>
Answer:	S1F4
Direction:	H <- E
Exception:	-

11.7.3.5 S1F4 – Selected Status Data

Description:	The equipment reports the value of each SVID requested in the order requested. The host remembers the names of values requested.
Structure:	< L[NoOfItems <= 1000] < V[1] SV > >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.3.6 S1F11 – Status Variable Namelist Request

Description:	A request to the equipment to identify certain status variables. A zero length list means report all SVIDs.
Structure:	< L[NoOfItems <= 1000] < V[1] SVID > >
Answer:	S1F12
Direction:	H -> E
Exception:	-

11.7.3.7 S1F12 – Status Variable Namelist Reply

Description:	The equipment reports to the host the name and units of the requested SVs.
Structure:	< L[NoOfItems <= 1000] < L[3] < V[1] SVID > < A[len2 <= 1000] SVNAME > < A[len3 <= 1000] UNITS > > >
Answer:	-
Direction:	E -> H
Exception:	Zero-length ASCII items for both SVNAME and UNITS indicates that the SVID does not exist.

11.7.3.8 S1F13 Connect Request

Description:	Attempt to initialize communication, connection request
Structure:	< L[2]

	< A[6] MDLN > < A[6] SOFTREV > >
Answer:	S1F14
Direction:	E <-> H
Exception:	<L[0]>

11.7.3.9 S1F14 Connect Request Acknowledge

Description:	Accept or Deny Establish Communication Request (S1F13).
Structure:	< L[2] < B[1]COMMACK > < L[2] < A[6] MDLN > < A[6] SOFTREV > > >
Answer:	-
Direction:	E <-> H
Exception:	Request denied: MDLN and SOFTREV are not available < L[2] < B[1] COMMACK > < L[0] > >

11.7.3.10 S1F15 – Request Off-Line

Description:	The host requests that the equipment transitions to the OFF-LINE Control state.
Structure:	Header only
Answer:	S1F16
Direction:	H -> E
Exception:	-

11.7.3.11 S1F16 – Off-line Acknowledge

Description:	Request to go OFF-LINE acknowledge or error
Structure:	< B[1] OFLACK >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.3.12 S1F17 – Request On-Line

Description:	The host requests that the equipment transitions to the ON-LINE Control state
Structure:	Header only

Answer:	S1F18
Direction:	H -> E
Exception:	-

11.7.3.13 S1F18 – On-Line Acknowledge

Description:	Request to go ON-LINE acknowledge or error
Structure:	<B[1] ONLACK >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.4 STREAM 2: EQUIPMENT CONTROL AND DIAGNOSTICS

Messages which deal with control of the equipment from the host.

11.7.4.1 S2F0 – Abort Transaction

Description:	Used as a reply when the transaction is aborted. Function 0 is defined in every stream and has the same meaning in every stream
Structure:	Header only
Answer:	-
Direction:	E <-> H
Exception:	-

11.7.4.2 S2F13 – Equipment Constant Request

Description:	Equipment constants (EC) can be obtained using this message. A zero-length list means report all ECVs.
Structure:	< L[NoOfECIDs <= 1000] < V[1] ECID > >
Answer:	S2F14
Direction:	H -> E
Exception:	-

11.7.4.3 S2F14 – Equipment Constant Data

Description:	List of equipment constants as requested
Structure:	< L[NoOfECVs <= 1000] < V[1] ECV> >
Answer:	-
Direction:	E -> H
Exception:	If ECV_i does not exist: ECV item in list is empty

11.7.4.4 S2F15 – New Equipment Constant Send

Description:	Change one or more Equipment Constants
Structure:	< L[NoOfECIDs <= 1000] < L[2] < V[1] ECID > < V[1] ECV > > >
Answer:	S2F16
Direction:	H -> E
Exception:	-

11.7.4.5 S2F16 – Equipment Constant Send Acknowledge

Description:	Acknowledge on change of one or more Ecs
Structure:	< B[1] EAC >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.4.6 S2F17 – Date And Time Request

Description:	Request for date and time from Equipment or Host
Structure:	Header only
Answer:	S2F18
Direction:	E <-> H
Exception:	-

11.7.4.7 S2F18 – Date and Time Data

Description:	Actual date and time
Structure:	< A[16] TIME >
Answer:	-
Direction:	E <-> H
Exception:	Time does not exist: zero-length item

11.7.4.8 S2F23 – Trace Initialize Send

Description:	The Host requests the Equipment to initialize a time driven trace operation.
Structure:	< L[5] < V[1] TRID > < A[6] DSPER > < V[1] TOTSMP > < V[1] REPGSZ > < L[NoOfVIDs <= 10000]

	< V[1] SVID > > >
Answer:	S2F24
Direction:	H -> E
Exception:	-

11.7.4.9 S2F24 – Trace Initialize Acknowledge

Description:	Acknowledge or error on trace initialization request
Structure:	< B[1] TIAACK >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.4.10 S2F29 – Equipment Constant Namelist Request

Description:	Request of information about available Equipment Constants (EC). A zero-length list means send information for all ECs.
Structure:	< L[NoOfECIDs <= 1000] < V[1] ECID > >
Answer:	S2F30
Direction:	H -> E
Exception:	-

11.7.4.11 S2F30 – Equipment Constant Namelist Reply

Description:	List of requested ECs and corresponding information.
Structure:	< L[NoOfECIDs <= 1000] < L[6] < V[1] ECID > < A[ECNamelength <= 1000] ECNAME > < V[1] ECMIN > < V[1] ECMAX> < V[1] ECDEF > < A[Unitslength <= 1000]UNITS > > >
Answer:	-
Direction:	E -> H
Exception:	Zero-length ASCII items for ECNAME, ECMIN, ECMAX, ECDEF and UNITS indicates that the ECID does not exist.

11.7.4.12 S2F31 – Date and Time Set Request

Description:	Request from Host to set the date and time for Equipment
Structure:	< A[16] TIME >
Answer:	S2F32
Direction:	H > E
Exception:	-

11.7.4.13 S2F32 – Date and Time Set Acknowledge

Description:	Acknowledge on set date/time request
Structure:	< B[1] TIACK >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.4.14 S2F33 – Define Report

Description:	Define / removes a group of reports for the Equipment. A list of zero-length following DATAID deletes all report definitions and associate links. A list of zero-length following RPTID deletes report type RPTID. All CEID links to this RPTID are also deleted (see S2F35).
Structure:	< L[2] < V[1] DATAID > < L[NoOfReports <= 10000] < L[2] < V[1] RPTID > < L[NoOfVIDs <= 10000] < V[1] VID > > > > >
Answer:	S2F34
Direction:	H -> E
Exception:	-

11.7.4.15 S2F34 – Define Report Acknowledge

Description:	Acknowledge or error on Define Report Request.
Structure:	< B[1] DRACK >
Answer:	-
Direction:	E -> H
Exception:	If an error condition is detected the entire message is rejected.

11.7.4.16 S2F35 – Link Event Report

Description:	Request to link a number of reports to an event. A zero-length list following CEID deletes all report links for that event.
Structure:	< L[2] < V[1] DATAID > < L[NoOfEvents <= 1000] < L[2] < V[1] CEID > < L[NoOfRIDs <= 10000] < V[1] RPTID > > > > >
Answer:	S2F36
Direction:	H -> E
Exception:	-

11.7.4.17 S2F36 – Link Event Report Acknowledge

Description:	Acknowledge or error on Link Request (S2F35).
Structure:	< B[1] LRACK >
Answer:	-
Direction:	E -> H
Exception:	If an error condition is detected the entire message is rejected.

11.7.4.18 S2F37 – Enable / Disable Event Report

Description:	Enable or disable reporting for a group of events (CEIDs). A list of zero-length following CEED means all CEIDs.
Structure:	< L[2] < BOOL[1] CEED > < L[NoOfCEIDs <= 1000] < V[1] CEID > > >
Answer:	S2F38
Direction:	H -> E
Exception:	<L[0]>

11.7.4.19 S2F38 – Enable / Disable Event Report Acknowledge

Description:	Acknowledge or error on Enable/Disable Event Report Request (S2F37).
Structure:	< B[1] ERACK >
Answer:	-

Direction:	E -> H
Exception:	If an error condition is detected the entire message is rejected.

11.7.4.20 S2F39 – Multi-block Inquire

Description:	Request a multi-block message transmission (Only for S2F23, S2F33, S2F35, S2F45, S2F49).
Structure:	<L[2] <V[1] DATAID > <V[1] DATALENGTH > >
Answer:	S2F40
Direction:	H -> E
Exception:	-

11.7.4.21 S2F40 – Multi-block Grant

Description:	Grant or reject permission to send multi-block message
Structure:	< B[1] GRANT >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.4.22 S2F41 – Host Command Send

Description:	Request from Host to Equipment to perform a specified remote command with the associated parameters.
Structure:	< L[2] < V[1] RCMD > < L [NoOfParams <= 256] < L[2] < V[1] CPNAME > < V[1] CPVAL > > > >
Answer:	S2F42
Direction:	H -> E
Exception:	-

11.7.4.23 S2F42 – Host Command Acknowledge

Description:	Acknowledge or error on Host Command Request.
Structure:	< L[2] < B[1] HCACK> < L [NoOfParams <= 256] < L[2]

	< V[1] CPNAME > < B[1] CPACK > > > >
Answer:	-
Direction:	E -> H
Exception:	If there are no invalid parameters, then a list of zero-length will be sent (NoOfParams = 0). If command is not accepted due to one or more invalid parameters (HCACK = 3), then a list of invalid parameters will be returned containing the parameter name and reason for being invalid.

11.7.4.24 S2F43 – Reset Spooling Streams and Functions

Description:	Request to spool certain streams and functions. A zero-length list (STREAM = 0) turns off spooling for all streams and functions. A zero-length list (FUNCTION = 0) turns off spooling for all functions for the associated stream
Structure:	< L[STREAM <= 256] < L[2] < U1[1] STRID > < L[FUNCTION <= 256] < U1[1] FCNID > > > >
Answer:	S2F44
Direction:	H -> E
Exception:	

11.7.4.25 S2F44 – Reset Spooling Acknowledge

Description:	Acknowledge or error on Reset Spooling Request
Structure:	< L[2] < B[1] RSPACK > < L [STREAM <= 256] < L[3] < U1[1] STRID > < B[1] STRACK > < L[FUNCTION <= 256] < U1[1] FCNID > > > > >

Answer:	-
Direction:	E -> H
Exception:	If RSPACK = 0, a zero-length list (STREAM) is given, indicating no streams or functions in error. A zero-length list (FUNCTION) indicates no functions in error for specified stream.

11.7.4.26 S2F45 – Define Variable Limit Attributes

Description:	Define a set of limits for a single variable or a set of variables. A zero-length list, NoOfVIDS=0, sets all limit values for all monitored VIDS to "undefined". A zero-length list, NoOfLimits=0, sets all limit values for that VID to "undefined". A zero-length list after LIMITID sets that limit to "undefined".
Structure:	< L[2] < V[1] DATAID > < L [NoOfVIDS <= 1000] <L[2] <V[1] VID > < L [NoOfLimits <= 7] <L[2] <B[1] LIMITID > <L[2] <V[1] UPPERDB> <V[1] LOWERDB> > > > > >
Answer:	S2F46
Direction:	H -> E
Exception:	-

11.7.4.27 S2F46 – Variable Limit Attribute Acknowledge

Description:	Acknowledge or report error for Define Variable Limit Request.
Structure:	< L[2] <B[1] VLAACK> <L[0]> >
Answer:	-
Direction:	E <-> H
Exception:	If the Request (S2F45) is not accepted due to one or more invalid parameters (LIMITACK=3), then a list of invalid parameters is returned:

	< L[2] <B[1] VLAACK > <L[NoOfVIDS <= 1000] <L[3] <V[1] VID > <B[1] LVACK > <L[2] <B[1] LIMITID > <B[1] LIMITACK > > > > A zero-length list (after LVACK) indicates no invalid limit values for that VID.

11.7.4.28 S2F47 – Variable Limit Attribute Request

Description:	Request for currently defined variable limit attribute definitions. A zero-length list requests a list of all VID values that can have variable limit attributes.
Structure:	< L[NoOfVIDS <= 1000] <V[1] VID> >
Answer:	S2F48
Direction:	E <-> H
Exception:	-

11.7.4.29 S2F48 – Variable Limit Attributes Send

Description:	Values of requested variable limit attribute definitions in the order requested.
Structure:	< L[NoOfVIDS <= 1000] <L[2] <V[1] VID> < L[4] <A[Unitslength <= 1000] UNITS> <V[1] LIMITMIN> <V[1] LIMITMAX> <L [NoOfLimits <= 7]> <L[3] <B[1] LIMITID> <V[1] UPPERDB> <V[1] LOWERDB> > > >

	>> >
Answer:	-
Direction:	E -> H
Exception:	A zero-length list (after VID), indicates that limits are not supported for the VID: < L[NoOfVIDS <= 1000] <L[2] < V[1] VID> < L[0] > > > A zero-length list, NoOfLimits=0, means no limits are currently defined for the specified variable.

11.7.5 STREAM 5: EXCEPTION HANDLING

This stream contains messages regarding binary and analog equipment exceptions. Exceptions are classified into two categories: errors and alarms. Only the alarm functions are implemented.

11.7.5.1 S5F0 – Abort Transaction

Description:	Used as a reply when the transaction is aborted. Function 0 is defined in every stream and has the same meaning in every stream
Structure:	Header only
Answer:	-
Direction:	E <-> H
Exception:	-

11.7.5.2 S5F1 – Alarm Report Send

Description:	Report of a change in or presence of an alarm condition.
Structure:	**< L[3]** **< B[1] ALCD >** **< V[1] ALID >** **< A[length <= 40] ALTX >** >
Answer:	S5F2
Direction:	E -> H
Exception:	-

11.7.5.3 S5F2 – Alarm Report Acknowledge

Description:	Acknowledge or error of an Alarm Report
Structure:	< B[1] ACKC5 >
Answer:	-

Direction:	H -> E
Exception:	-

11.7.5.4 S5F3 – Enable / Disable Alarm Send

Description:	Request to enable or disable reporting of a specific alarm of alarms. A zero-length item for ALID means all alarms.
Structure:	**< L[2]** **< B[1] ALED >** **< V[1] ALID >** >
Answer:	S5F4
Direction:	H -> E
Exception:	-

11.7.5.5 S5F4 – Enable / Disable Alarm Acknowledge

Description:	Acknowledge or error on enable/disable alarm report request.
Structure:	< B[1] ACKC5 >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.5.6 S5F5 – List Alarm Request

Description:	Request for alarm information. A zero-length item list requests all possible alarms.
Structure:	< U4[NoOfALIDs <= 256] ALID >
Answer:	S5F6
Direction:	H -> E
Exception:	-

11.7.5.7 S5F6 – List Alarm Data

Description:	Requested alarm information.
Structure:	**< L[NoOfALIDs <= 1000]** **< L[3]** **< B[1] ALCD >** **< V[1] ALID >** **< A[length <= 40] ALTX >** > >
Answer:	-
Direction:	E -> H
Exception:	Zero-length list (NoOfALIDs = 0): no alarm information found. A zero-length item for ALCD or ALTX means that the alarm does not

	exist.

11.7.5.8 S5F7 – List Enabled Alarm Request

Description:	Request for a list of alarms that are enabled. A zero-length list request all enabled alarms.
Structure:	< U4[NoOfALIDs <= 256] ALID >
Answer:	S5F8
Direction:	H -> E
Exception:	-

11.7.5.9 S5F8 – List Enabled Alarm Data

Description:	Requested alarm information for enabled alarms.
Structure:	**< L[NoOfALIDs <= 1000]** **< L[3]** **< B[1] ALCD >** **< V[1] ALID >** **< A[length <= 80] ALTX >** **>** >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.6 STREAM 6: DATA COLLECTION

This stream is intended to cover the needs of in-process measurements and equipment monitoring.

11.7.6.1 S6F0 – Abort Transaction

Description:	Used as a reply when the transaction is aborted. Function 0 is defined in every stream and has the same meaning in every stream
Structure:	Header only
Answer:	-
Direction:	E <-> H
Exception:	-

11.7.6.2 S6F1 – Trace Data Send

Description:	This function sends trace reports (time-driven) to the host.
Structure:	**< L[4]** **< V[1] TRID >** **< V[1] SMPLN>** **< A[16] STIME >**

	< L[NoOfVids <= 10000] **< V[1] SV >** **>** >
Answer:	S6F2
Direction:	E -> H
Exception:	A zero-length STIME means no value is given and that the time is to be derived from SMPLN along with knowledge of the request.

11.7.6.3 S6F2 – Trace Data Acknowledge

Description:	Acknowledge or error on Trace Report
Structure:	<B[1] ACKC6 >
Answer:	-
Direction:	H -> E
Exception:	-

11.7.6.4 S6F5 – Multi-block Data Send Inquire

Description:	Request a multi-block message transmission (Only for S6F11).
Structure:	**< L[2]** **< V[1] DATAID >** **< V[1] DATALENGTH >** **>**
Answer:	S6F6
Direction:	E -> H
Exception:	-

11.7.6.5 S6F6 – Multi-block Grant

Description:	Grant or reject permission to send multi-block message
Structure:	<B[1] GRANT6 >
Answer:	-
Direction:	E <-> H
Exception:	-

11.7.6.6 S6F11 – Event Report Send

Description:	Sending of a defined, linked and enabled group of reports from the Equipment to the Host on the occurrence of an event.
Structure:	**< L[3]** **< V[1] DATAID >** **< V[1] CEID >** **< L[NoOfReports <= 1000]** **< L[2]** **< V[1] RPTID >**

	< L[NoOfValues <= 1000] **< V[1] V >** **>** **>** **>** **>**
Answer:	S6F12
Direction:	E -> H
Exception:	If there are no reports linked to the event an empty report is assumed. A zero-length list for the number of reports means there are no reports linked to the given event (CEID)

11.7.6.7 S6F12 – Event Report Acknowledge

Description:	Acknowledge or error of Report Send message.
Structure:	<B[1] ACKC6 >
Answer:	-
Direction:	H -> E
Exception:	-

11.7.6.8 S6F15 – Event Report Request

Description:	Request for reports that are linked to specified event (CEID).
Structure:	< V[1] CEID >
Answer:	S6F16
Direction:	H -> E
Exception:	-

11.7.6.9 S6F16 – Event Report Data

Description:	Reports linked to the specified event (CEID).
Structure:	**< L[3]** **< V[1] DATAID >** **< V[1] CEID >** **< L[NoOfReports <= 1000]** **< L[2]** **< V[1] RPTID >** **< L[NoOfValues <= 1000]** **< V[1] V >** **>** **>** **>** >
Answer:	-
Direction:	E -> H

Exception:	A zero-length list (NoOfReports = 0) means there are no reports linked to the given event (CEID).

11.7.6.10 S6F19 – Individual Report Request

Description:	Request for a specified report (RPTID).
Structure:	< V[1] RPTID >
Answer:	S6F20
Direction:	H -> E
Exception:	-

11.7.6.11 S6F20 – Individual Report Data

Description:	Requested report data.
Structure:	**< L[NoOfItems <= 10000]** **< V[1] VID >** **>**
Answer:	-
Direction:	E -> H
Exception:	A zero-length list means report (RPTID) is not defined.

11.7.6.12 S6F23 – Request Spooled Data

Description:	Request from Host to transmit or delete the messages currently spooled by the Equipment.
Structure:	< U1[1] RSDC >
Answer:	S6F24
Direction:	H -> E
Exception:	-

11.7.6.13 S6F24 – Request Spooled Data Acknowledgement Send

Description:	Acknowledge request for transmission of deletion of spooled data,.
Structure:	< B[1] RSDA >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.7 STREAM 7: PROCESS PROGRAM MANAGEMENT

The functions in this stream are used to manage and transfer process programs.

11.7.7.1 S7F0 – Abort Transaction

Description:	Used as a reply when the transaction is aborted. Function 0 is defined in every stream and has the same meaning in every stream

Structure:	Header only
Answer:	-
Direction:	E <-> H
Exception:	-

11.7.7.2 S7F1 – Process Program Load Inquire

Description:	Initiate the transfer of a multi-block process program (must precede multi-block S7F3/S7F4 messages).
Structure:	**< L[2]** **< V[1] PPID >** **< V[1] LENGTH >** >
Answer:	S7F2
Direction:	E <-> H
Exception:	-

11.7.7.3 S7F2 – Process Program Load Grant

Description:	Permission for the transfer of the specified multi-block process program.
Structure:	< B[1] PPGNT >
Answer:	-
Direction:	E <-> H
Exception:	-

11.7.7.4 S7F3 – Process Program Send

Description:	Sending of a process program.
Structure:	**< L[2]** **< V[1] PPID >** **< V[1] PPBODY >** >
Answer:	S7F4
Direction:	E <-> H
Exception:	-

11.7.7.5 S7F4 – Process Program Acknowledge

Description:	Acknowledge or error after receiving Process Program
Structure:	< B[1] ACKC7 >
Answer:	-
Direction:	E <-> H
Exception:	-

11.7.7.6 S7F5 – Process Program Request

Description:	Request the transfer of a Process Program.
Structure:	< V[1] PPID >
Answer:	S7F6
Direction:	E <-> H
Exception:	-

11.7.7.7 S7F6 – Process Program Data

Description:	Send Process Program on request.
Structure:	**< L[2]** **< V[1] PPID >** **< V[1] PPBODY >** >
Answer:	-
Direction:	E <-> H
Exception:	**A zero-length list means request denied:** <L[0] >

11.7.7.8 S7F19 – Current EPPD Request

Description:	Request for a list of all the Process Programs.
Structure:	Header Only
Answer:	S7F20
Direction:	H -> E
Exception:	-

11.7.7.9 S7F20 – Current EPPD Data

Description:	Send list of all the Process Programs stored in Equipment.
Structure:	**< L[NoOfPP <= 1000]** **< V[1] PPID >** >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.8 STREAM 9: SYSTEM ERRORS

This stream provides a method of informing the host that a message block has been received which cannot be handled or that a timeout on a transaction (receive) timer has occurred.

11.7.8.1 S9F0 – Abort Transaction

Description:	Used as a reply when the transaction is aborted. Function 0 is defined in every stream and has the same meaning in every stream

Structure:	Header only
Answer:	-
Direction:	E <-> H
Exception:	-

11.7.8.2 S9F1 – Unrecognized Device ID

Description:	The Device ID in the message block header did not correspond to any known device ID.
Structure:	< B[10] MHEAD >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.8.3 S9F3 – Unrecognized Stream Type

Description:	The equipment does not recognize the stream type in the message block header. This stream is not used.
Structure:	< B[10] MHEAD >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.8.4 S9F5 – Unrecognized Function Type

Description:	This message indicated that the function in the message ID is not recognized by the Equipment. This function does not exist.
Structure:	< B[10] MHEAD >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.8.5 S9F7 – Illegal Data

Description:	The stream and function are recognized, but the data format of the message could not be interpreted (not according to protocol).
Structure:	< B[10] MHEAD >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.8.6 S9F9 – Transaction Timer Timeout

Description:	This message indicated that a transaction (receive) timer has timed out and the corresponding transaction has been aborted.
Structure:	< B[10] MHEAD >

Answer:	-
Direction:	E -> H
Exception:	-

11.7.8.7 S9F11 – Data Too Long

Description:	This message indicates that a message to the Equipment is too long: the Equipment can not handle it.
Structure:	< B[10] MHEAD >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.8.8 S9F13 – Conversation Timeout

Description:	Data were expected but none were received within a reasonable length of time.
Structure:	**< L[2]** **< A[6] MEXP >** **< V[1] EDID >** >
Answer:	-
Direction:	E -> H
Exception:	-

11.7.9 STREAM 10: TERMINAL SERVICES

The purpose of the functions of this stream is to pass textual messages between the operator terminals attached to the Equipment and the Host.

11.7.9.1 S10F0 – Abort Transaction

Description:	Used as a reply when the transaction is aborted. Function 0 is defined in every stream and has the same meaning in every stream
Structure:	Header only
Answer:	-
Direction:	E <-> H
Exception:	-

11.7.9.2 S10F1 – Terminal Request

Note: Messages are supported, but not implemented yet.

Description:	Send a terminal text message to the Host.
Structure:	**< L[2]** **< B[1] TID >**

	< V[1] TXT > >
Answer:	S10F2
Direction:	E -> H
Exception:	-

11.7.9.3 S10F2 – Terminal Request Acknowledge

Description:	Acknowledge (or error on) receipt of terminal text message
Structure:	< B[1] ACKC10 >
Answer:	-
Direction:	E <-> H
Exception:	-

11.7.9.4 S10F3 – Terminal Display, Single

Description:	Send text from Host to specific terminal on Equipment
Structure:	**< L[2]** **< B[1] TID >** **< V[1] TXT >** >
Answer:	S10F4
Direction:	H -> E
Exception:	-

11.7.9.5 S10F4 – Terminal Display, Single Acknowledge

Description:	Acknowledgement of (or error on) receipt of terminal text
Structure:	< B[1] ACKC10 >
Answer:	-
Direction:	E -> H
Exception:	-

11.8 SCENARIOS

This chapter provides an overview of all the mayor GEM scenarios possible between Equipment and Host. The objective of this chapter is to provide the programmer of a Host application a description of how the different scenarios should be implemented.

The scenarios described in this chapter are the most common scenarios and do not include all the possible exceptions. Chapter 11.7: SECS-II Messages contains all the messages possible and also the exceptions.

The scenarios do not contain any event reporting (except the actual event reporting scenario S6F11). This is the case because the TSC application uses a strategy where one has a 100% freedom on choosing the event configuration. See section 11.6.3: Event configuration for more information.

The data-items specific to SECSII are written in Italic font. These data-items are described in detail in the same SEMI standard [SEMI E5-0600].

11.8.1 COMMUNICATIONS

11.8.1.1 Equipment establishes communication

Assumption: Equipment's Communication State is Enabled / Not Communicating.

Step	SECS Message	Direction	Description
1.	S1F13	E->H	Equipment sends Establish Communication Request
2.			Wait for reply. If timer delay, specified in *EstablishCommunicationsTimeout* has ended, go back to step 1.
3.	S1F14	H->E	If *COMMACK* = Accept go to Step 4, else go to Step 1
4.			Communication is established

11.8.1.2 Host establishes communication

Assumption: Equipment's Communication State is either Enabled / Not Communicating or Enabled / Communicating.

Step	SECS Message	Direction	Description
1.	S1F13	H->E	Host sends Establish Communication Request
2.	S1F14	E->H	*COMMACK* = Accept
3.			Communication is established

11.8.1.3 Simultaneous attempts to establish communication

Assumption: Equipment's Communication State is Enabled / Not Communicating.

Step	SECS Message	Direction	Description
1.	S1F13	E->H	Equipment sends Establish Communication Request
2.	S1F13	H->E	Host sends Establish Communication Request
3.	S1F14	E->H	The equipment responds with Establish Communications Acknowledge. After this message is successfully sent, communications is established.
4.	S1F14	H->E	The Host responds with Establish Communications Acknowledge. This step could occur before step 3, in which case communications would be established in this step.
5.			Communication is established

11.8.2 CONTROL

11.8.2.1 Host Accepts ON-LINE request from Equipment

Assumption: Control State is OFF-LINE.

Step	SECS Message	Direction	Description
1.	S1F1	E->H	Equipment requests ON-LINE
2.	S1F2	H->E	Host grants ON-LINE

11.8.2.2 Host Denies ON-LINE request from Equipment

Assumption: Control State is OFF-LINE.

Step	SECS Message	Direction	*Description*
1.	S1F1	E->H	*Equipment requests ON-LINE*
2.	**S1F0**	**H->E**	*Host denies ON-LINE*

11.8.2.3 Host sets OFF-LINE

Assumption: Equipment is ON-LINE.

Step	SECS Message	Direction	Description
1.	S1F15	H->E	Host requests OFF-LINE
2.	S1F16	E->H	Equipment acknowledges request and transitions to OFF-LINE.

11.8.2.4 Host sets ON-LINE

Assumption: Equipment's Communication State is Enabled / Not Communicating.

Step	SECS Message	Direction	Description
1.	S1F17	H->E	Host requests ON-LINE
2.	S1F18	E->H	If Equipment is in HOST OFF-LINE state then send Acknowledge, else send Request denied.

11.8.3 PROCESS

The Process on the Equipment can be controlled by using Remote Commands. See section 11.8.10: Remote Commands.

11.8.4 EVENT REPORTS

11.8.4.1 Event Notification

11.8.4.1.1 Collection Event occurs on the Equipment

Step	SECS Message	Direction	Description
1.	S6F5	E->H	If Event Report is multi-block then send Multi-block inquire. Else go to step 3.
2.	S6F6	H->E	Host sends Multi-Block Grant if it can receive message. Else it will reject the Inquire and the scenario ends.
3.	S6F11	E->H	Equipment sends Event Report
4.	S6F12	H->E	Host acknowledges Event Report

11.8.4.1.2 Host requests event report

Step	SECS Message	Direction	Description
1.	S6F15	H->E	Host requests an Event Report for a specific event (CEID).
2.	S6F16	E->H	Equipment sends the requested event report.

11.8.4.2 Dynamic Event Report Configuration

11.8.4.2.1 Collection Event Reporting Set-up

Step	SECS Message	Direction	Description
1.	S2F39	H->E	If Define Report is Multi-Block then send Multi-Block inquire. Else go to step 3.
2.	S2F40	E->H	Multi-block grant.
3.	S2F33	H->E	Send Report definitions. The Equipment will erase report definitions with the same RID.
4.	S2F34	E->H	Report Definitions Receive Acknowledge.
5.	S2F39	H->E	If Link Event/Report message is Multi-Block then send Multi-Block Inquire. Else go to step 7.
6.	S2F40	E->H	Multi-Block Grant.
7.	S2F35	H->E	Link reports to events. Any links from previous reports/events are erased.
8.	S2F36	E->H	Link Report/Event Definitions Receive Acknowledge.
9.	S2F37	H->E	Enable specific event (CEID) reporting.
10.	S2F38	E->H	Enable Event Reporting Receive Acknowledge.

11.8.5 VARIABLE DATA COLLECTION

11.8.5.1 Host Requests Report:

Step	SECS Message	Direction	Description
1.	S6F19	H->E	Host requests data variables contained in report (RPTID).
2.	S6F20	E->H	Equipment responds with a list of variable data for the given RPTID, if the RPTID exists. Else an empty list is returned.

11.8.5.2 Host Requests Equipment Status Report:

Step	SECS Message	Direction	Description
1.	S1F3	H->E	Host requests report of selected status variables (VIDs).
2.	S1F4	E->H	Equipment responds with the requested status variable data.

11.8.5.3 Host Requests Equipment Status Variable Name list:

Step	SECS Message	Direction	Description
1.	S1F11	H->E	Host requests Equipment to send descriptions (name) of selected status variables (SVs).
2.	S1F12	E->H	Equipment responds with the requested status variable descriptions.

11.8.5.4 Host Sends Equipment Constants:

Step	SECS Message	Direction	Description
1.	S2F15	H->E	Host requests change of Equipment Constants (ECs).
2.	S2F16	E->H	Equipment responds with the requested status variable descriptions.

11.8.5.5 Host Equipment Constants Request:

Step	SECS Message	Direction	Description
1.	S2F13	H->E	Host requests value of Equipment Constant(s) (ECs).
2.	S2F14	E->H	Value of Equipment Constant(s).

11.8.5.6 Host Equipment Constant Namelist Request:

Step	SECS	Direction	Description

	Message		
1.	S2F29	H->E	Host requests name of Equipment Constant(s) (ECID).
2.	S2F30	E->H	Name(s) of requested Equipment Constant(s).

11.8.6 TRACE REPORTS

11.8.6.1 Host Initiates Trace Report:

Step	SECS Message	Direction	Description
1.	S2F23	H->E	Host sends a Trace Data initialization Request containing the trace setup information. The Host also can send a request to terminate trace by using the Trace ID and setting the total samples to 0.
2.	S2F24	E->H	Acknowledge, trace initiated.
3.	S6F1	E->H	Send Trace Report.
4.	S6F2	H->E	Acknowledge receipt of Trace Report.

11.8.7 LIMITS MONITORING

11.8.7.1 Host defines Limit Attributes:

Step	SECS Message	Direction	Description
1.	S2F39	H->E	If Define Limits message Multi-Block then send Multi-Block Inquire. Else go to step 3.
2.	S2F40	E->H	Multi-Block Grant.
3.	S2F45	H->E	Host defines new variable limit attributes.
4.	S2F46	E->H	Equipment acknowledges receipt of Limit Define message.

11.8.7.2 Host initiated:

Step	SECS Message	Direction	Description
1.	S1F1	H->E	Are you there?
2.	S2F48	E->H	Equipment replies with attributes (MDLN and SOFTREV).

11.8.8 ON-LINE IDENTIFICATION

11.8.8.1 Host queries equipment for current Limits:

Step	SECS Message	Direction	Description
1.	S2F47	H->E	Host queries Equipment for current variable limit attributes definitions.
2.	S2F48	E->H	Equipment returns report containing requested variable limit attributes values.

11.8.9 ALARM MANAGEMENT

11.8.9.1 Enable / disable alarms:

Step	SECS Message	Direction	Description
1.	S5F3	H->E	Host requests to enable or disable certain alarms (ALIDs).
2.	S5F4	E->H	Acknowledge of Host Enable/Disable Alarm request.

11.8.9.2 Upload Alarm Information:

Step	SECS Message	Direction	Description
1.	S5F5	H->E	Host requests information (current state, text) about alarms (ALIDs).
2.	S5F6	E->H	Equipment sends Alarm information if the alarm is enabled.

11.8.9.3 Send Alarm Report:

Step	SECS Message	Direction	Description
1.	S5F1	E->H	Alarm state change: Equipment sends alarm report to Host if this alarm is enabled.
2.	S5F2	H->E	Acknowledge on Alarm Report.

11.8.10 REMOTE COMMANDS

11.8.10.1 Host Command Send Scenario

Step	SECS Message	Direction	Description
1.	S2F41	H->E	Host command Request

2.	S2F42	E->H	Acknowledge on Host command: Host command Accepted or Rejected.

11.8.11 PROCESS PROGRAM MANAGEMENT

11.8.11.1 Process Program Directory Request:

Step	SECS Message	Direction	Description
1.	S7F19	H->E	Request of current list of Recipes.
2.	S7F20	E->H	Current list of Recipes.

11.8.11.2 Host-Initiated Recipe Upload - Unformatted:

Step	SECS Message	Direction	Description
1.	S7F5	H->E	Request for upload of recipe with certain number (PPID).
2.	S7F6	E->H	Recipe data for recipe with requested PPID.

11.8.11.3 Equipment-Initiated Recipe Upload - Unformatted:

Step	SECS Message	Direction	Description
1.	S7F1	E->H	If the Recipe message is Multi-Block: send a Multi-Block Inquire first. Else go to step 3.
2.	S7F2	H->E	Multi-Block Grant.
3.	S7F3	E->H	Recipe data send.
4.	S7F4	H->E	Recipe data receipt acknowledge.

11.8.11.4 Host-Initiated Recipe Download - Unformatted:

Step	SECS Message	Direction	Description
1.	S7F1	H->E	If the Recipe message is Multi-Block: send a Multi-Block Inquire first. Else go to step 3.
2.	S7F2	E->H	Multi-Block Grant.
3.	S7F3	H->E	Recipe data send.
4.	S7F4	E->H	Recipe data receipt acknowledge.

11.8.11.5 Equipment-Initiated Recipe Download - Unformatted:

Step	SECS Message	Direction	Description
3.	S7F5	E->H	Recipe data send request.

4.	S7F6	H->E	Recipe data send.

11.8.12 EQUIPMENT TERMINAL SERVICES

11.8.12.1 Operator sends information to Host:

Step	SECS Message	Direction	Description
1.	S10F1	E->H	Operator sends textual information via Equipment terminal x to Host.
2.	S10F2	H->E	Host acknowledges receipt of operator initiated message.

11.8.12.2 Host sends information to an equipment's display device:

Step	SECS Message	Direction	Description
1.	S10F3	H->E	Host sends textual information to Equipment for display to the operator on terminal x.
2.	S10F4	E->H	Equipment acknowledges request to display text.

11.8.13 ERROR MESSAGES

11.8.13.1 Message Fault Due to Unrecognized Device ID:

Step	SECS Message	Direction	Description
1.	SxFy	H->E	Host sends a message.
2.	S9F1	E->H	Equipment detects an unrecognized device ID within the message from the Host: it reports to the host that an "unrecognized device ID" was detected in the received message.

11.8.13.2 Message Fault Due to Unrecognized Stream Type:

Step	SECS Message	Direction	Description
1.	SxFy	H->E	Host sends a message.
2.	S9F3	E->H	Equipment detects an unrecognized stream type within the message from the Host: it reports to the host that an "unrecognized stream type" was detected in the received message.

11.8.13.3 Message Fault Due to Unrecognized Function Type:

Step	SECS Message	Direction	Description
1.	SxFy	H->E	Host sends a message.
2.	S9F5	E->H	Equipment detects an unrecognized function type within the message from the Host: it reports to the Host that an "unrecognized function type" was detected in the received message.

11.8.13.4 Message Fault Due to Illegal Data Format:

Step	SECS Message	Direction	Description
1.	SxFy	H->E	Host sends a message.
2.	S9F7	E->H	Equipment detects illegal data format within the message from the Host: it reports to the Host that an "illegal data format" was detected in the received message.

11.8.13.5 Communication Fault Due to Transaction Timer Timeout:

Step	SECS Message	Direction	Description
1.			Equipment does not receive an expected reply message from the Host and a transaction timer timeout occurs.
2.	S9F9	E->H	Equipment reports to the Host that a Transaction Timer timeout occurred.

11.8.13.6 Message Fault Due to Data Too Long:

Step	SECS Message	Direction	Description
1.	SxFy	H->E	Host sends a message.
2.	S9F11	E->H	Equipment detects that the message from the Host contains more data than it can handle: it reports to the Host that "data too long" was detected in the received message.

11.8.13.7 Message Fault Due to Data Too Long:

Step	SECS Message	Direction	Description
1.	SxFy	H->E	Host sends a message.
2.	SxFy+1	E->H	Equipment sends reply. Equipment is now expecting a specific message from the host as a result of the previous transaction.
3.	S9F13	E->H	Equipment has not received the expected message from

			the Host and a conversation timeout occurs: it reports to the Host that a conversation timeout occurred.

11.8.14 CLOCK

11.8.14.1 Equipment Requests Time Value:

Step	SECS Message	Direction	Description
1.	S2F17	E->H	Equipment request the current time value from the Host.
2.	S2F18	H->E	Current time value from Host.

11.8.14.2 Host instructs Equipment to Set Time Value.

Step	SECS Message	Direction	Description
1.	S2F31	H->E	Host sends a request to the Equipment to set its time to a certain value.
2.	S2F32	E->H	Acknowledge of change of internal time value to requested time value.

11.8.14.3 Host Requests Equipment's Current Time Value

Step	SECS Message	Direction	Description
1.	S2F17	H->E	Host requests Equipment's current time value.
2.	S2F18	E->H	Equipment's current time value.

11.8.15 SPOOLING

11.8.15.1 Define the Set of Messages to be Spooled

Step	SECS Message	Direction	Description
1.	S2F43	H->E	Host defines messages to be spooled in case of communication failure.
2.	S2F44	E->H	Acknowledgement on spooling messages definition.

11.8.15.2 Request or Delete Spooled Data

Assumption: Communications were lost and then re-established.

Step	SECS Message	Direction	Description

1.	S6F23	H->E	Host requests transmission or deletion of the spooled data.
2.	S6F24	E->H	Acknowledgement on request to transmit or delete spooled data. If it is a request to transmit data then the Equipment starts sending messages until maximum number of message to transmit (MaxSpoolTransmit) is reached. If it is a request to purge the data, then the Equipment deletes all messages and goes to step 5.
3.	S6F23	H->E	Host recognizes that MaxSpoolTransmit is reached. Host requests additional spooled data.
4.	S6F24		Acknowledgement on request to transmit or delete spooled data. The Equipment starts sending messages until maximum number of message to transmit (MaxSpoolTransmit) is reached. Go to step 3.
5.			All messages are deleted from the spool area. Spooling is INACTIVE again.

Appendix A Variables

Name	Class	Format	Dbi#	Description
Clock	SV	A[20]	547	The Equipment's current date and time. See [SEMI E5] for format.
Communication State	SV	I4	532	The current Communication State
Control State	SV	I4	524	The current Control State
ECIDChanged	SV	I4	558	The last triggered event (CEID)
EnableSpooling	EC	I4	548	Enable Spooling flag. 0= no spooling; 1= spooling.
EstablishCommunicationTimeout	EC	I4	533	Time in seconds defining how long the Equipment will delay after an unsuccessful Connect Request before sending another.
EventLimit	DV	I4	535	The LimitID relating to the most recent Limits Monitoring transition event that occurred.
LimitVariable	DV	I4	536	The VID relating to the most recent Limits Monitoring transition.
MaxSpoolTransmit	EC	I4	543	The maximum number of spooled messages the equipment will send each time the Host reads the spool.
OverWriteSpool	EC	I4	544	This EC determines the action to be taken by the Equipment when the Spool file reaches its capacity: True: Overwrite Spool False: Do Not Overwrite Spool
PPChangeName	DV	A[20]	537	PPID of the Process Program most recently created, changed or deleted.
PPChangeStatus	DV	I4	538	The action (create, change, delete) taken on a Process Program.
Process State New	SV	I4	529	The new value of the

				Process State
Process State Old	SV	I4	530	The previous value of the Process State
RequestActiveAlarms	SV	I4	559	A list of all active alarms.
SpoolCountActual	SV	I4	554	A count of the number of messages actually present on the spool disk, adjusted for any messages which have been overwritten or otherwise discarded.
SpoolCountTotal	SV	I4	555	A count of the number of messages the equipment attempted to write to the Spool.
SpoolFullTime	SV	A[20]	556	The date and time at which the Spool area became full.
SpoolStartTime	SV	A[20]	557	The date and time at which the first message was written to the current Spool.
Terminal ID	SV	I4	526	The ID of the terminal to which the last text message was sent.
Terminal Text	SV	A[20]	527	The text message last sent to a terminal.
TimeFormat	EC	I4	560	The setting of this EC controls whether the equipment shall send the Data Items STIME and TIME in 12 or 16-byte format. 0 = 12-byte format 1 = 16-byte format
Spool State	SV	I4	565	The current Communication State

Appendix B Preconfigured Events

Name	Type*	Dbi	CEID	Description
Communication State Change	<>	532	10001	Change of the Communication State.
Control State OFF-LINE	C	524	10002	Control State ON-LINE -> OFF-LINE
Control State LOCAL	C	524	10003	Control State REMOTE -> LOCAL or OFF-LINE -> LOCAL
Control State REMOTE	C	524	10004	Control State LOCAL -> REMOTE or OFF-LINE -> REMOTE
Processing Started	C	529	10005	Entry into RUNNING state.
Processing Completed	C	529	10006	Normal exit of RUNNING state.
Processing Stopped	C	529	10007	Result of ABORT command from Host or Operator.
Processing State Change	<>	529	10008	Change of the Processing State.
Equipment Constant Change	<>	558	10009	Change of any Equipment Constant.
Process Program Selected	<>	537	10010	Recipe download
Spooling Activated	C	565	10011	Spooling State SPOOL INACTIVE ->SPOOL ACTIVE
Spooling Deactivated	C	565	10012	Spooling State SPOOL OUTPUT -> SPOOL INACTIVE
Spool Transmit Failure	C	565	10013	Spooling State TRANSMIT SPOOL -> NO SPOOL OUTPUT
Message Recognition	<>	527	10014	Terminal Text Sent

* Type event: <>=on change ; C=custom behaviour

Appendix C Properties

Number	Default Value	Description
300002	0	Control State: 0=OFFLINE 1=ONLINE
300003	1	Control Offline Sub state: 0=EQUIP_OFF 1=HOST_OFF 2=ATTEMPT_ONLINE
300004	1	Control Online Sub state: 0=LOCAL 1=REMOTE
300005	1	Communication State: 0=DISABLED 1=ENABLED
300006	15	Establish Communication Timeout
300009	0	Spooling enabled (default) 0 = DISABLED 1 = ENABLED This property will be used if Equipment Variable EnableSpooling is not initialized yet (first-time startup)
300010	0	Control Attempt Online Sub state: 0=EQUIP_OFF 1=HOST_OFF

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