Honeywell

Advanced Process Control

Profit Suite Toolkit

Rev 2.0
5/01

AP09-300

Total Plant

Honeywell

Advanced Process Control

Profit Suite ToolKit

Revision 2.0
5/01

AP09-300

Total Plant

Copyright, Notices, and Trademarks

Honeywell
Industrial Automation and Control
16404 N. Black Canyon Hwy
Phoenix, AZ 85053

Table of Contents

About This Publication

Statement of Work

The following table describes the audience, purpose, and scope of this book:

Purpose	This book is a combination of many different tools.
Audience	Process and control engineers

How This Book Is Organized

The following table summarizes what each section in this book tells you about this publication and about the Profit Suite Toolkit.

In This Section	You Can Find This Information
About This Publication (You are here)	• How to make the best use of this book, and how the information is ordered. • What information you can find in the different sections. • What writing conventions have been used throughout this book and the Profit library.
Moved - Model Converter see Profit Controller (RMPCT) Designer's Guide	How to convert controller models to Profit Controller format.
Section 1 TDC Data Converter	How to take PV retrieval data and make it compatible with RMPCT.
Section 2 Data Collector	**(Optional Item)** – How to collect TPS data for use in RMPCT.
Section 3 Step Test Builder	**(Optional Item)** – How to design and implement automated step testing
Section 4 Gain Scheduler	**(Optional Item)** – How to automatically update gains in an RMPCT controller.
Moved - (RMPCT Point Builder) see Profit Controller (RMPCT) Designer's Guide	How to build the points necessary to create a Profit Controller (RMPCT) application.
Section 5 Performance Monitor	**(Optional Item)** – How to monitor statistical performance of RMPCT.
Section 6 RMPCT Cascade	**(Optional Item)** – How to cascade the setpoint of a MV interface point in a primary RMPCT controller to the setpoint of a CV interface point in a secondary RMPCT controller.
Section 7 PV Validation	**(Optional Item)** – How to setup PV (Process Value) Validation for of an input process value.
Section 8 Simulation BackBuilder	**(Optional Item)** – How to capture DCS controller tuning and configuration.

Writing Conventions Used in This Book

The following writing conventions have been used throughout this book and other books in the Profit Suite library.

- Words in double quotation marks " " name sections or subsections in this publication.
- Words in *italics* name book titles, add grammatical emphasis, introduce words that are being referenced or defined, or represent mathematical variables. The context makes the meaning and use clear.
- Words in **bold type** indicate paragraph topics or bring important phrases to your attention.
- Shading brings paragraphs and table entries to your attention.
- Windows pull down menus and their options are separated by an angle bracket >. For example, Under Settings> Communications, set the baud rate.
- Messages and information that you type appear in `Courier` font.
- Acronyms, Scan parameters, point names, file names, and paths appear in UPPERCASE. The context makes the meaning and use clear.
- Command keys appear in UPPERCASE within angle brackets. For example, press <ENTER>.
- TPS user station touch-screen targets appear in rounded boxes. For example, touch MODIFY NODE.
- Graphic buttons appear in UPPERCASE within brackets [ ]. For example, touch [TAG].
- Point-dot-parameter means a point name and one of its parameters. For example, point-dot-SP means the SP parameter for the point.
- Zero as a value and when there is a chance for confusion with the letter O is given as Ø. In all other cases, zero as a numerical place holder is given as 0. For example, 1.0, 10, 101, CVØ1, parameter PØ.

- The terms *screen* and *display* are used inter changeably in discussing the graphical interfaces. The verbs *display* a screen and *call* a screen are also used inter changeably.
- These names, and may be used interchangeably.

Former Name	Product Name
RMPCT	Profit Controller
DQP	Profit Optimizer
APC Development Environment or APCDE	Profit Design Studio
RPID	Profit PID

References

The following comprise the Profit Suite library.

Documentation

Title	Number
General	
Profit Controller (RMPCT) Concepts Reference	RM09-400
Profit Controller (RMPCT) Designer's Guide (Off-Line Design)	RM11-410
Profit Optimizer Designer's Guide (Off-Line Design)	PR11-400
Profit Toolkit Designer's Guide	AP11-400
APC Identifier User's Guide	AP09-200
Profit-PID (RPID)	RM11-100
Profit Sensor User's Guide	PS09-100
Open	
Profit Suite Installation Guide for Open Systems Viewer - Controller - Optimizer - Toolkit	RM20-501
Profit Controller (RMPCT) User's Guide for Open Systems	RM11-401
Profit Optimizer User's Guide for Open Systems	PR11-421
Profit Trender User's Guide	RM11 431
Profit Toolkit User's Guide for Open Systems	AP11-401
Profit Toolkit Function Reference	AP11-410
FCCU Toolkit User's Guide for Open Systems	AP13-201
Fractionator Toolkit User's Guide for Open Systems	AP13-101
Lab Update User's Guide	AP13-111
Wrapper Builder User's Guide	AP11-411
Profit Bridge User's Guide	AP20-401
TPS System	
Profit Controller (RMPCT) Installation Reference for AM, AxM and Open LCN-Side	RM20-400
Profit Controller (RMPCT) Commissioning	RM20-410
Profit Controller (RMPCT) User's Guide for AM, AxM and Open LCN-Side	RM11-400
Profit Optimizer Installation Reference for AM and Open LCN-Side	PR20-400
Profit Optimizer User's Guide for AM and Open LCN-Side	PR11-420
Profit Suite ToolKit TDC Data Converter — Performance Monitor — Simulation BackBuilder Data Collector — RMPCT Cascade — Gain Scheduler Step Test Builder — PV Validation	AP09-300
Fractionator Toolkit (LCN)	AP13-100
FCCU Toolkit (LCN)	AP13-200
Furnace Pass Balance Temperature Control User's Guide	AP13-600
Non-Linear Level Control User's Guide	AP09-700
Embedded Uniformance	
Excel Companion User's Guide (Profit Embedded PHD)	AP20-510
Power Point Companion User's Guide (Profit Embedded PHD)	AP20-520
Process Trend User's Guide (Profit Embedded PHD)	AP20-530

For Technical Assistance

If You Need Assistance

If you need technical assistance, contact your local Honeywell Service Organization, as explained in the following paragraphs.

International Customers

Outside of the United States, contact your local Honeywell Service Organization. If you are not sure of the location or telephone number, call your Honeywell representative for information.

Customers Inside the United States

Within the United States, call the Technical Assistance Center (TAC) at the toll free number 1-800-822-7673.

Arizona Customers

Within Arizona, the local number for TAC is 602-313-5558.

Services Provided

Calls to TAC are answered by a dispatcher from 7:00 A.M. to 5:00 P.M., Mountain Standard Time (6:00 A.M. to 4:00 P.M. when daylight savings time is in effect).

Outside of these hours, emergency calls—those which affect your ability to control or view a process—will be received by an answering service, and returned within one hour. TAC maintains its own TPS network, and frequently can duplicate problems on this equipment.

Time Saving Tip

It is a good idea to make specific notes about the problem before making the call. This helps to reduce delays and expedite answers.

TDC Data Converter

(Optional Item)

Section 1 TDC Data Converter

1.1 Overview

In This Section

This section explains how to use the TDC Data Converter tool. The files created by it can be used as inputs to the Identifier.

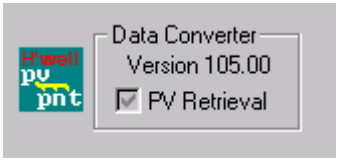
Read this document to find out how to:

Install your TDC Data Converter.
Use Process Variable Retrieval and Virtual Printers on the LCN to create an input file for the PC.
Create RMPCT PNT files from your TDC Virtual Printer files.
Create Excel spreadsheet files from your TDC Virtual Printer files.
Select whether your points are MVs, DVs, or CVs.
Stop the conversion before it is completed.

Version and Installation Information

TDC Data Converter functionality was introduced in version 110.00 of the APC Development Environment.

The TDC Data Converter is included in the standard installation of Profit Design Studio (APCDE). See Profit Controller Designer's Guide for installation instructions. When the Profit Design Studio is started, note that the TDC Data Converter is "checked" in the "About Box."



What TDC Data Converter Does

You can configure the TDC to output to a file instead of the printer by configuring the system for "virtual printers." By using the standard print command and specifying the virtual printer, you can write your data to a file in ASCII format. Using this mechanism together with the LCN's Process Variable Retrieval functionality, you create an input file that is transported to the PC.

Note: This tool assumes that the sampling rate of the data is one minute.

The TDC Data Converter converts your input file into multiple PNT files. PNT files are single point data files that can be used in the Identifier to create an RPID or Profit Controller (RMPCT) model. An Excel-formatted spreadsheet is also created as the output file.

Files Used to Convert a TDC File

Your input file is a TDC virtual printer file from the LCN that was created as output of a Process Variable Retrieval session. This is an ASCII text file, typically ending with a one-or-two-character extension starting with x, y, or z (e.g., DATA1.XT). However, the TDC Data Converter makes no assumptions about the input file extension. It may be any legal "Windows" filename.

Your output file will be an Excel spreadsheet file. By default, the output file will be created in the same directory as the input file and will have the same name but with an "xls" file extension (e.g., DATA1.xls). You may override the default with any legal "Windows" filename you prefer.

PNT files are created in the same directory as the input file and their filenames are taken from the point names in the input file. They follow the naming convention , pointname.pnt for an up-to-8 character point name (e.g., TIC60010.PNT). Names longer than 8 characters are truncated.

Sampling Frequency

This tool assumes that the sample rate at which the data was taken is one minute

1.2 Procedure

Preparing to Use the TDC Data Converter

To use the TDC Data Converter, you must prepare your input file on the LCN.

First, create a virtual printer on the TDC and configure the system to recognize it. For details, refer to the book *Implementation: Startup & Reconfiguration, Report to Output File* (TDC 2030-2 section 32) or the equivalent book for your release of the LCN.

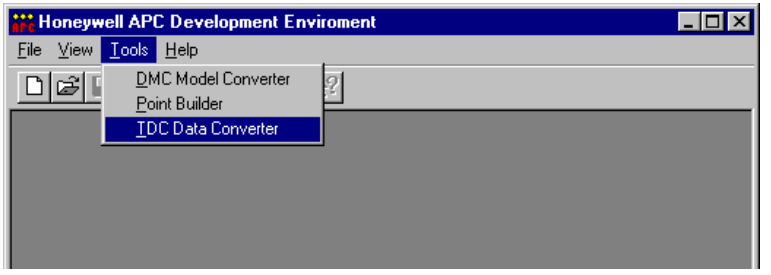
Then, from the Engineering Personality Main Menu, select System Menu. From the System Menu, select Process Variable Retrieval. Note that the TDC Data Converter assumes a one minute sampling rate. Choose the type of retrieval, the points or group that you wish to capture, and then select Print. The system will ask you for a printer number and this is where you enter the virtual printer file that you configured. This file will be used on the PC as your input file. For details on Process Variable Retrieval, refer to the book *Operation: Process Operations, Obtaining Process Histories: Logs, Reports, Journals* (TDC 2050 section 10) or the equivalent book for your release of the LCN.

Your virtual printer file can be moved to the PC using a number of different methods, including Text File Converter, File Link, or by dumping to the PC using Windows terminal emulation.

Using TDC Data Converter

To start the APC Development Environment, click on the icon labeled APCDE that was installed in the Windows Program Manager.

Select TDC Data Converter from the Tools menu.



This action brings up the TDC Data Converter dialog box. If the TDC Data Converter selection is “grayed out” under the Tools menu, then it probably has not been installed correctly. Be sure to install the TDC Data Converter in the same directory as the APCDE.

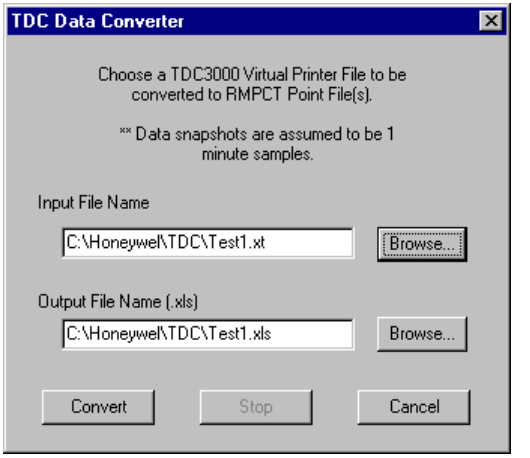
Errors and information about the progress of your conversion will be written into the APCDE Messages window.

Selecting Files

From the TDC Data Converter dialog box, type your input filename or select it using the input Browse button. If you use the Browse button, the tool will automatically set a default output name for you.

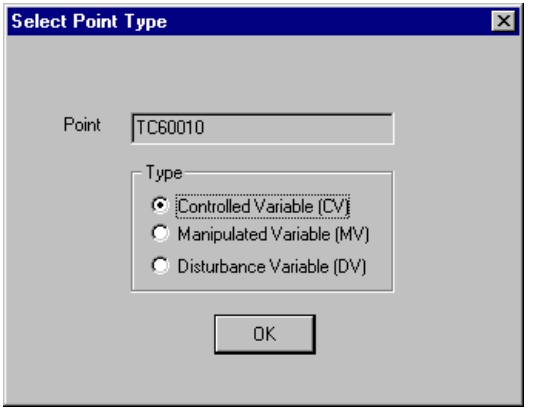
Then, select your output filename by typing it, selecting it with the output Browse button, or just accepting the default.

When you are satisfied with your entries, click on the Convert button. You may also cancel at anytime by using the Cancel button.



Selecting the Point Type

You must specify whether each point listed in your input file is a Manipulated Variable (MV), Disturbance Variable (DV), or Controlled Variable (CV). For each point found in the input file, a “Select Point Type” dialog box will pop up.

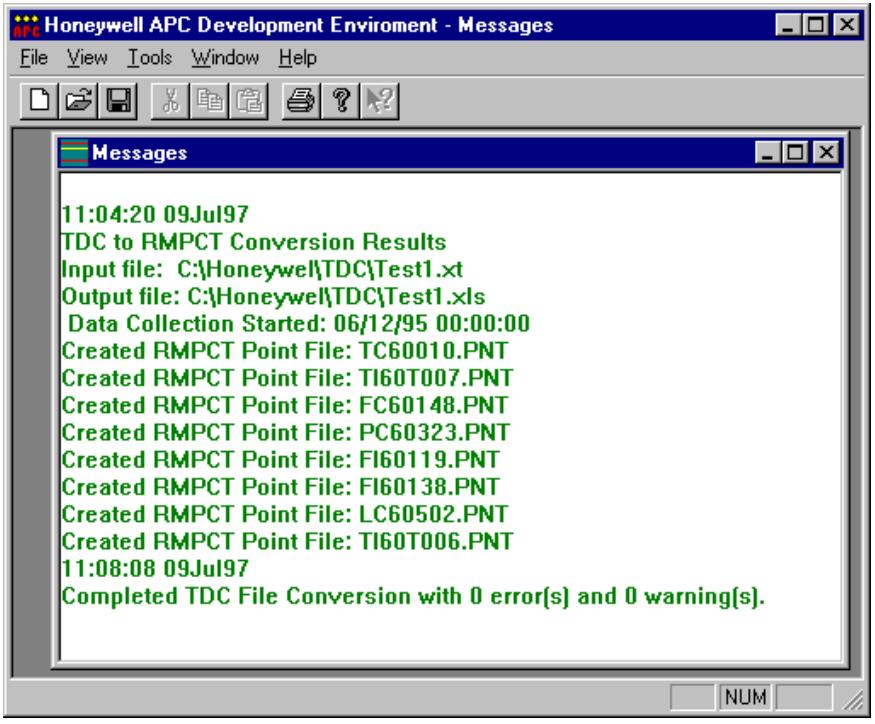


Choose the type for the given point, and click the OK button.

Completion

While the TDC Data Converter executes, it writes to the Messages window much like other APCDE functions do. It will write the date and time it started and ended, the input filename, the output filename, the date and time the data collection started, and all the PNT filenames.

If the tool is unable to complete successfully, you will receive a message in the Messages window. Error messages are usually due to a bad input file or because the user stopped it before completion.



Stopping the Conversion before Completion

You have the option of stopping the conversion during execution. Do so by pressing the Stop button on the TDC Data Converter dialog box. You will then be asked for confirmation. If you select Cancel, the program will continue execution from where it stopped. If you select OK, the conversion will stop and an error message will be written to the Message window saying that the execution was “Stopped by user.” Then the data conversion will be terminated without saving any results.

Data Collector

(Optional Item)

Section 2 --- Data Collector

2.1 Overview

In This Section

The data collector is a set of AM programs, builder files, and graphics which allows numerical process data to be stored in a file.

Purpose of the Data Collector

The data collector package is an engineering tool, designed to periodically collect numeric values from the LCN and store them in a file on the LCN History Module (HM). The file is specifically formatted for use with the RMPCT identifier. The files can also be read and modified by PC packages such as EXCEL, Word, etc.

The data collector graphics supply an easy means of specifying the data to be collected, monitoring the current values of the data, and of monitoring, debugging, and controlling the archiving of the data.

Parameters Limitations

Up to fifty real parameters {process variables (PV), setpoints (SP), outputs (OP), or outputs in engineering units (OPEU) in any mix} can be stored by each data collection point.

The data collector can only be configured to collect the PV, SP, OP, or OPEU of a point. Should a parameter other than these be required, a data acquisition point should be built which executes before the data collector and brings the desired parameter into the PV of the point.

Data collection of a large number of parameters(more than 10) should be performed slowly (period >= 1MIN) or on multiple data collectors. The number of parameters which can successfully be stored at a fast scan rate depends upon the AM loading and HM communications traffic. History module access limits the speed at which data can be stored.

Data Collection Information Flow

The collection and storage of the data to an HM file (referenced in Figure 1 as . XX Files) is performed by an AM resident custom point. Numeric data from the LCN is collected by a foreground AM program and stored in a buffer along with a timestamp on the data collector point. When one buffer is filled that buffer is marked as full, and data is stored to the other buffer. If a buffer is full, the data from that buffer is written to the HM file, after which that buffer is marked as empty.

When a new file is created by the data collection point the header data is written to the file. This data consists of tagname, parameter, descriptor, engineering units, date, and variable type (Manipulated/Controlled/Disturbance).

When data collection is completed the collection file may be copied to a floppy disk or Bernoulli drive in LCN format and converted to PC format using a TEXT FILE CONVERTER (Honeywell LCNBB program or TRANSFER For DOS). The converted file is directly usable by the RMPCT identification package. A block diagram of this process is shown in Figure 1.

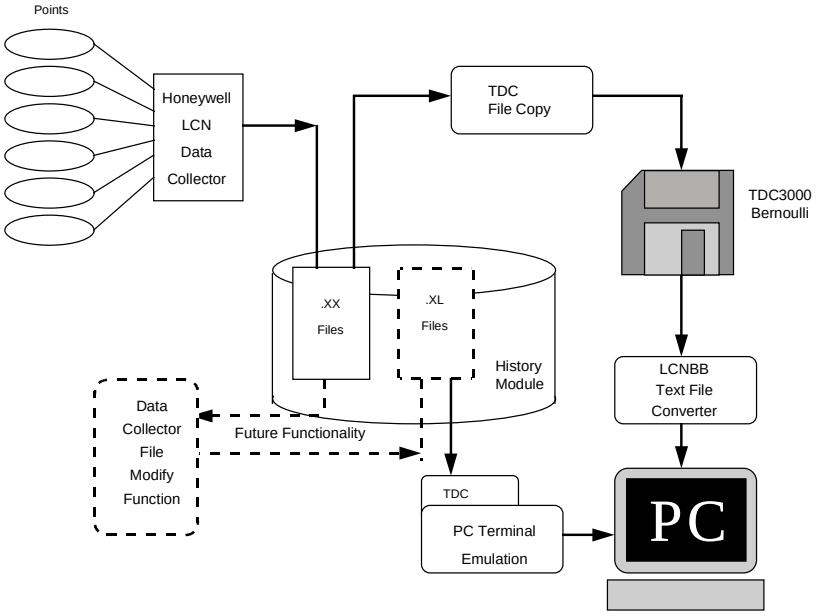


Figure 1--Block Diagram of Data Collector Information Flow

Archived Data Files

The filename is assigned by the user, however the extension to the file name is defined by the graphic as .XX. More than one collector point may be built and more than one may be collecting data concurrently. If more than one point is active each must have a different file name assigned for data storage.

An example of the data collection file is shown in Figure 02. The variables are:

26T356.OP	REACTOR TEMP	in DEGC
26T425.PV	CIRC-COKE BELOW J BEND	in DEGC
26T672.PV	SCRUBBER SOUTH DRAW	in DEGC

Multi-Point Data Files

Multi-point files (which must have an MPT extension) contain sampled values for multiple points. These files are created by the AM Data Collector and contain one variable per column (is eight character wide, and each column is separated by a blank.

The first nine rows contain header information:

Rows one and two allow for sixteen character tagnames for each variable;

Row three contains the parameter (OP, SP, PV, etc) of the point;

Row four, five, and six are used for a twenty four character point description;

Row seven contains the engineering units;

Row eight contains the Date stamp (m-d-y)

Row nine contains the point category.

Example File

This is what data looks like in an .mpt file.

```
26T356          26T425          26T672

OP              PV              PV
REACTOR         CIRC-COK        SCRUBBER
TEMP            E BELOW          SOUTH D
                J BEND          RAW
DEGC            DEG C           DEG C
12-01-94        12-01-94        12-01-94
MANIP           DISTURB         CONTROLD
85.142          309.304         309.304         09:55:52
85.142          309.304         309.304         09:56:52
85.142          309.304         309.304         09:57:52
85.142          309.304         309.304         09:58:52
36.5486         537.213         365.483         09:59:52
35.0382         537.518         365.483         10:00:52
36.0451         537.713         365.483         10:01:52
36.0451         537.879         365.361         10:02:52
35.7951         537.518         365.361         10:03:52
37.0278         537.574         365.118         10:04:52
```

Table 1--Sample Data File

2.2 Installation

Media Contents

Your Data Collector distribution Bernoulli contains the following files necessary for installation of the Data Collector:

File	Description	Directory
DCPTS.EB	An exception build file template for a data collector point and a dummy point for linking. The dummy point is an AM regulatory point with the parameters NAME, PTDESC, EUDESC, PV, SP, OP, and OPEU. This is needed for CL linking	EB
DC_PKG.CL	A CL package containing the custom data segment package which defines the custom parameters of the data collector point	CDS
DC_CL2.AO	A CL package which contains the blocks DC_FGD and DC_BKG which do the collection and storage of the data.	AO
DC_DDB.DF	The display database used by the data collector graphics	PICS
DC.DS	Data Collector Main Graphic	DC
DCOPER1.DS &.DO	Data Collector Collection control and Status Graphic	DC
DCPTS1.DS &.DO	Data Collector Points Setup Graphic	DC
DCPTS2.DS &.DO	Data Collector points current selected input values Graphic	DC
DCFILE1.DS &.DO	File modification graphic (future)	DC
DCMSG1.DS &.DO	Message modification for Error messaging	DC

Table 2 Installation Files

Backing Up the Media

If you have not already done so, make a backup copy of your distribution media and use the backup copy for the installation. The following instructions represent the drive in which the media is installed as $F*n*. As you follow these procedures substitute the name of the actual drive in which your backup media is installed for $F*n*.

Task 1 - Compile the CDS Package
(DC_PKG.CL)

Step	Action
1.	From the Engineering Main Menu select SUPPORT UTILITIES> MODIFY VOLUME PATHS
2.	From the Engineering Main Menu select COMMAND PROCESSOR
3.	The DC_PKG CDS package adds a package name to the LCN, but does not add any CDS names. All CDS names in this package should already exist on the LCN. At the command processor command line enter the command: CL $Fn>CDC>DC_PKG -UL The CDS package will be compiled and added to the system. Note: If an older version of the data collector exists use the -OCD command.

Task 2 - Build the Collector Point

Step	Action
1.	While still in the COMMAND PROCESSOR type: ED $Fn>EB>DCPTS.EB This is the exception build file for the collection point and the dummy linking point.
2.	Edit this exception build file (see Example Edit of DCPTS.EB on next page) a. Assign the name of your choice to the data collector point. b. You may change the data collector dummy linking point, but if you change the name, the parameter PT(0) of the data collector point must be changed to match it. c. Change the unit assignment of the dummy point and the collector point to the name of a unit assigned to the AM in which the collector is to be installed. d. Specify the period for the data collection. The default is 1 minute. You may assign any valid AM point execution period. We recommend, under normal operating circumstances, that you do not specify a period less than 10 seconds. The collection period should be an even divisor of the period at which the controller will be executed when completed. e. Exit the text editor.
3.	From the Engineering Main Menu Select the [BUILDER COMMANDS] target.
4.	From the builder command menu (Figure 6) select [EXCEPTION BUILD].
5.	Select [LOAD ENTITIES].
6.	Enter REFERENCE PATHNAME $F*n*>EB> Pathname for SOURCE file = DCPTS.EB Pathname for IDF = DCPTS.DB
7.	Press [ENTER]. The dummy link Point, (required for proper CL linking), and the collection point, with the name you assigned when you edited the file, will be built and loaded to the AM in the unit you designated in step 2.

Example of DCPTS.EB Editing

Dummy link point	
No changes needed	`{SYSTEM ENTITY DC0000( )  }` `&T REGAM`
Change name (optional)	`&N DC0000`
Change unit	`UNIT  = 01`
Change descriptor (optional)	`PTDESC  ="DATA COLLECTOR LINK PT  "` `EUDESC  ="  "`
Change keyword(optional)	`KEYWORD  ="DATA_COL"`

No changes needed	`PRIMMOD  = --`
	`~~`
	`CCINPT  = NO`

Data Collector Point	
No changes needed	`{SYSTEM ENTITY DATA_COL( )  }` `&T CUSTOMAM`
Change name (optional)	`&N DATA_COL`
Change unit	`UNIT  = 01`
Change descriptor & keyword (optional)	`PTDESC  ="dummy data collector  "` `KEYWORD  ="DC0001  "`

No changes needed
 	
Delete ALPRIOR for Release 500
	`CLSLOTS  = 2`
	`NOPKG  = 1`
	`PRIMMOD  = --`
	`ALPRIOR  = LOW`
	`ALENBST  = ENABLE`
	`PKGNAME(1)  ="DC_PKG  "`
	`PERIOD  = 1MIN`
	`BEFAFT  = NO`
	`PATHNAME(1)  = "NET>DC>"`
	`PATHNAME(2)  = "NET>DC>COLLECT.XX"`
	`HISFILE  = "COLLECT.XX"`
	`NUMPTS  = 6.000`

Change only if Dummy link point name changed	`PT(0)  = DC0000`

No changes needed	`PT(1)  = --`
	`~`
	`WIDTH  = 8.0`

Task 3 - Load the External Load Modules

Step	Action
If it is known that loader module FILE and loader module CONV are, on the target AM, then proceed to Task 5	
1.	Mount your Backup NCF volume on a system drive.
2.	From the Engineering Main Menu, select SUPPORT UTILITIES
3.	Select MODIFY VOLUME PATHS
4.	Enter $F*n*>&ASY> into NCF Backup Path where $F*n* is the drive in which your backup NCF volume is loaded.
5.	From the Engineering Main Menu, select LCN NODES. The LCN NODE CONFIGURATION display appears.
6.	From the LCN NODE CONFIGURATION display, select the AM Node to which the Data Collector is to be installed. The APPLICATION MODULE NODE display appears.
7.	Page forward twice to the External Load Module page.
8.	Check to see if the modules FILE and CONV appear in the installed modules table. If the modules are already loaded abort the change (press <CTL F5> and [ENTER], and proceed to Task 5. If the modules do not appear continue.
9.	Page back twice to the Application Module Node page.
10.	Select MODIFY NODE.
11.	Page forward twice to the External Load Module page.
12.	Select Yes for use Default Personality Type?
13.	Enter the word FILE in the table under name, then press <Enter>. The system will enter both FILE and CONV into the table.
14.	Check the NCF.WF by pressing <CTL> and <F1>.
15.	Press <CTL> and <F2> to load into the NCF.

Task 4 - Shutdown and Load the AM

Step	Action
1.	List all points in this AM (Use the documentation tools or other methods). Modify the control status of any AM applications which are running in this AM, such that operations is minimally effected by the AM shutdown. This action must be coordinated with plant operations.
2.	From the SYSTATS display, select APPLICATION MODULES.
3.	Select the target AM, then **SAVE DATA**.
4.	Wait for the AM to return to OK
5.	Select the target AM, then **SHUTDOWN**.
6.	After the AM shows QUALIFY, Reload the AM.
7.	With plant operations, ensure that all points and applications in this AM are in the proper operating mode.

Task 5 - Link CL Blocks to COLLECT point.

Step	Action
1.	Return to the COMMAND PROCESSOR (see Task 1 step 4).
2.	Enter the command: LK $Fn>AO >DC_CL2 *DATA_COL* (*DATA_COL* represents the name of your collection point).

Task 6 - Compile the DC graphic.

Step	Action
1.	Enter the Picture Editor
2.	Load the $Fn>PICS>DC_DDB
3.	Read the $Fn>DC>DC graphic
4.	Type DEF INIT
5.	Make your modifications to DEF INIT. (As shown in the example below. Changes are bold.) The variable INIT02 defines the number of data collectors. Entities ENT01 through ENT09 are used to define the collector points. ENT10 is the default (or primary) data collector point.

Initial Action

If there is more than one data collector point, then the other data collector points must be built prior to graphics modifications.

```
S_INT(INT02,3);     {NUMBER OF DATA COLLECTORS}
S_ENT(ENT01, 81DC001);  {NAME OF FIRST DATA COLLECTOR}
S_ENT(ENT02, 27DC001);  {NAME OF SECOND DATA COLLECTOR}
S_ENT(ENT03, 81DC002);  {NAME OF THIRD DATA COLLECTOR}
S_ENT(ENT10, 81DC001);   {FUTURE USE FOR FILE CONVERSION POINT}
S_INT($_SELIDX,0);       {FOR INITIALIZATION}
S_INT(INT03,0);          {FOR INITIALIZATION}
MULT_OV("DCOPER1",0,3,79,22);  {CALLS OPERATING FUNCT OVERLAY}
S_STR(STRING01, "COLLECTOR FUNCTIONS"); {SETS SCR HEADER STRING}
```

Example of DC graphic Initial Action

6.	Press <ENTER>.
7.	VERIFY the graphic. <VER>
During verification the Picture Editor will ask the type of the variable &I. &I is of type integer (I). "I" should be entered as the response.	
8.	COMPILE the graphic. COM DC
9.	Read, Verify and Compile the other graphics: DCPTS1DC_MSG1 DC_FILE1 DCPTS2 DCOPER1
10.	When complete type END.
11.	Copy all of the graphics to the executable graphics directory. From the Command processor Display: `Copy $Fn>DC>*.DO NET>pic_dir>=-D-V` [ENTER] Where pic_dir is the picture source directory specified in the schematic search path, which is found in the SYST_MENU, Organizational Summary page.

2.3 Graphics Interface Familiarization

Overview

1. Call the DC schematic on the Universal Station. <SCHEM> DC.
2. Touch the [APPLCN MENU] target (bottom left), and select your data collector.
3. Ensure that the presented data is reasonable.

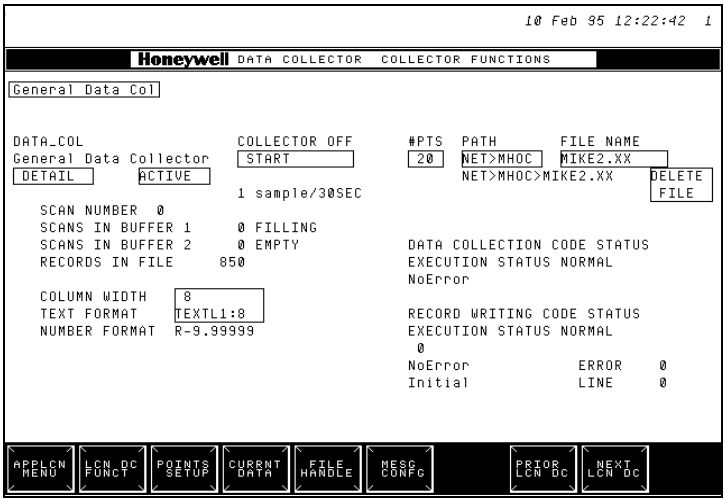
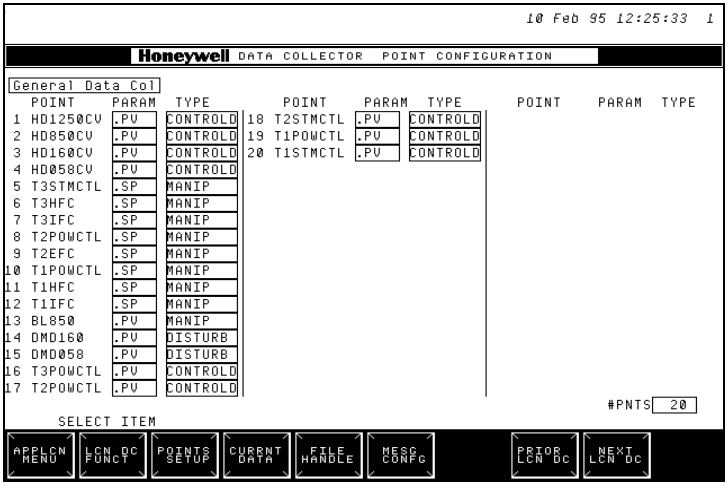
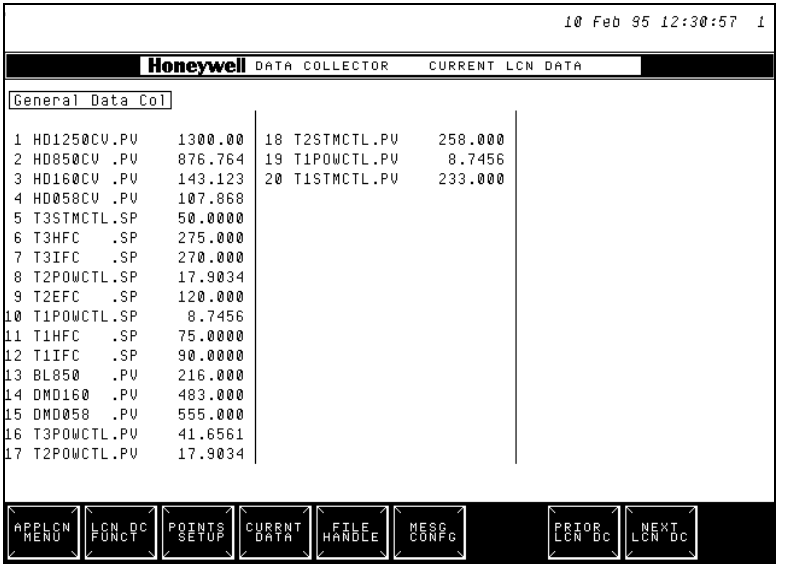


Figure 3. Data Collector - Collector Functions

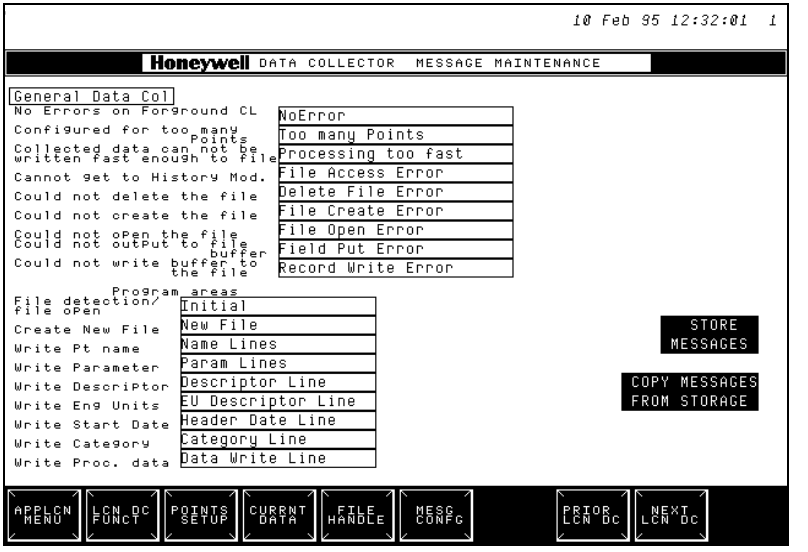
4. Select the [POINTS SETUP] target. Ensure that the DCPTS1 overlay (as follows) is shown:



5. Select the [CURRENT DATA] target. Ensure that the DCPTS2 overlay (as follows) is shown:



6. Select the [MESG CONFG] target. Ensure that the DCMSG1 overlay (as follows) is shown:



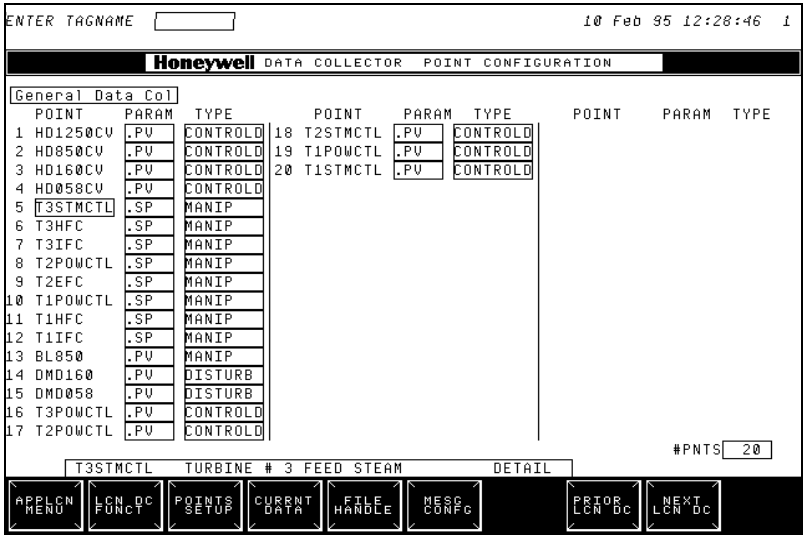
7. Select the remaining Menu Item Buttons to gain familiarity with the data collector interface graphics.
8. The message configuration page is for changes to different languages or verbiage in the messages.
9. The File Handle target is for future LCN Data Collector functionality.

2.4 Point Setup

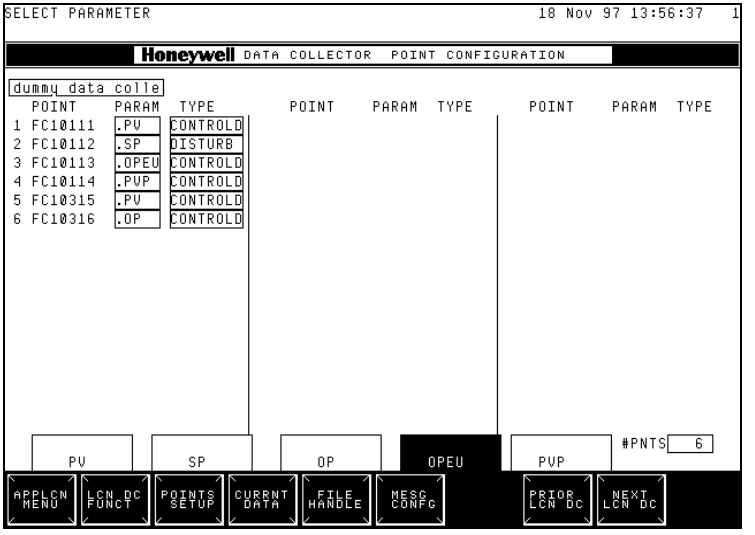
Point Setup

1. Call the DC graphic on the User Station.
2. Select the desired data collector from the Application Menu, or by typing in the name of the point after selecting the current point's description (upper left hand corner target).

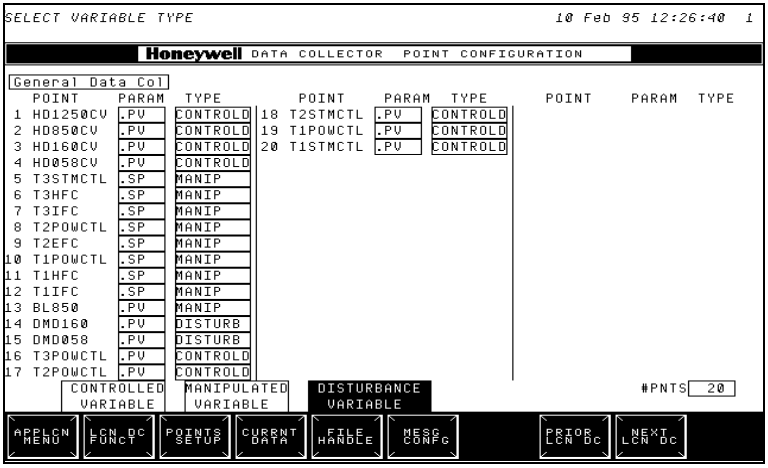
   Changes to the number of points and type of input should always be made with the data collector OFF.
3. Select the POINTS SETUP page.
4. Change the number of points to be sampled to the desired number (1 to 50) by selecting the target after the #PNTS on the display.
5. Add or change points, by selecting the point name.
6. Enter the tagname at the prompt.



7. Select the Parameter Target for the point and select the desired parameter (PV, SP, OP, or OPEU).



8. Select the Type Target for the point and indicate the type of variable ([CONTROLD], [MANIP], or [DISTURB]).



9. Repeat for all points and all data collectors.

10. Test the configuration by looking at the Current Data Page.

2.5 Collection Setup

Collection Setup

1. Return to the LCN DC FUNCTion page.
2. Select the desired data collector from the Application Menu, or by typing in the name of the point after selecting the current point's description (upper left hand corner).
3. Select the Column Width target and enter the width (8)of the data columns. *This allows the column width to be adjusted although RMPCT requires a fixed width of 8 characters with a delimiting space.*
4. Select the Path target and enter the LCN path.

   The data collector generally writes to the Network History module. This is much faster (and allows faster collection rates) than writing to a Bernoulli drive. Reference to a Bernoulli can be made using the PN:*nn*>DEV*xxmm*>*VOLDIR*> *notation*
   Where: *nn* = the US node number, *xx* = the drive number, *mm* = the device number on the node. This entry is not supported by the data collector graphics.
5. Select the file name target and enter an 8 character (or less) file name. The .XX extension will be added by the graphics. Ensure that this is done.
6. Activate the data collector point, if the point is inactive.

2.6 Operation

Overview

Operation of the data collector point functions are performed through the LCN DC FUNCTion display of the data collector. These functions are:

1. Start a data collection cycle
2. Suspend a data collection cycle
3. Resume a data collection cycle
4. Terminate a data collection cycle
5. Start a data collection cycle with file overwrite.

Starting a Collection Cycle

To start a collection cycle, select the [START] target on the LCN DC function page, and press enter. The collection cycle will start, and [START] will change to [COLLECTING]. The data archiving starts on the normal cycle of the point. This program will continuously store one set of data every execution of the point. Since the program was Off, the file writing program (background program) will run in this first cycle. This program checks for the existence of the file. If the file exists and file deletion is not selected, data will be appended to the existing file. If file deletion is selected and the file exists, the file is deleted and a new file is created.. If the file does not exist the new file is created. Header data is written to new files. The background program then waits for a buffer (10 sets of data taken) to be filled, after which it writes the data to file. After each subsequent ten data collection cycles the data is appended to the file until the collection cycle is terminated

Suspending a Collection Cycle

Selecting the [COLLECTING] target on the LCN DC function graphic and pressing enter will suspend a data collection cycle. Suspension stops data collection, causes all data to be written to the files, and writes a time break indication to the file. A time break indication consists of a NAN (Not a Number) indication for each data entry, and a 0:00:00 timestamp. The [COLLECTING] target will change from [COLLECTING] to [STOP REQUEST], and then to [START].

Resuming a Collection Cycle

To resume a collection cycle, select the [START] target, and press enter. Since the file exists, data will be appended to the file.

Terminating a Collection Cycle

To terminate a collection cycle, suspend the cycle and enter a new file name .

- or -

Enter a new file name. If a new filename is encountered, header data is written and subsequent data is written to the new file. *(This method should be avoided in high speed data collection of numerous points, since the writing of the header data may result in filling of both buffers.)*

Deactivation of the Data Collector

The data collector may be left active and off. Very little system resources are used in this mode. Deactivation of the collection point causes termination of any active collection cycle without writing data in the buffers to the HM.

Status Indications

The collection point has parameters which the user may use to determine the status of the collection function. These parameters are decoded on the LCN DC Functions display, and can be used for troubleshooting.

2.7 Point Structure

Overview

The Data Collector point is a custom AM point with one CDS package (DC_PKG) and two CL blocks (DC_FGD and DC_BKG). The CL blocks are described in detail in the following section. The CDS package is defined by the CL block DC_PKG.CL which is compiled on the target system.

Point Parameters

The data collector parameters are as follows:

Parameter Type	Index	Initial Value	Function
COMMAND logical	1	OFF	Set ON to collect
	2	OFF	Set ON to stop data collection
	3	OFF	ON indicates both buffers filled causing a pause in collection
	4	ON	On indicates collection was off
	5	OFF	Delete file on Start
XSTS real			
	1	0	Status of DC_FGD 0=no error 1=Points limit error 2=Scanning too fast for File writes
	2	0	Prior DC_FGD error
	3	0	Status of DC_BKG 0=no error
	4	0	Prior DC_BKG error
	5	0	DC_BKG error sub-status
BUFACTS logical	0		On if buffer 1 is the current buffer in use
	1		ON declares the buffer 1 full
	2		ON declares the buffer 2 full
DCOUNTS real	0		Scan number
VALUE 0 real	1	0	Number of entries in Buffer1.
	2	1	Number of entries in Buffer2.
	3	2	Number of records in the data file
PATHNAME string	1	"NET>DC>"	Directory of this file
	2	"NET>DC> COLLECT.XX"	full collector file pathname

Parameter Type	Index	Initial Value	Function
HISFILE string		COLLECT.XX	"'name.ext' of collection file"
NUMPTS real		1	No. of data items, max. 50
PT entity $REG_CTL (HREG_CTL at CL compile)	0	DC0000	Point for successful link of CL code
	1 to 50		Point names of data items
PNTTYPE string	1 to 50	"CONTROLD"	Category descriptions of data items Used by RMPCT
C1SRC real	1 to 50	1	Parameter to be recorded 1=PV 2=SP 3=OP 4=OPEU
WIDTH real		8	column width
AVFORMAT string	1	"R-9.99999"	Format for real values
	2	"DATE MM-DD-YY ENDDATE"	Format for date values
	3	"TIME HH:MM:SS ENDTIME"	Format for time values
	4	"TEXTL1:8"	Format for point names
T1 time	1 to 10		Time when data was scanned Buffer 1
T2 time	1 to 10		Time when data was scanned Buffer 2
B1 real	1 to 500		data from points scanned, Buffer 1
B2 real	1 to 500		data from points scanned, Buffer 2

Parameter Type	Index	Initial Value	Function
MSGTXT string	0	"NoError"	
	1	"Too many Points"	
	2	"Processing too fast"	
	3	"File Access Error"	
	4	"Delete File Error"	
	5	"File Create Error"	
	6	"File Open Error"	
	7	"Field Put Error"	
	8	"Record Write Error"	
	9	" "	
	10	"Initial"	
	11	"New File"	
	12	"Name Lines"	
	13	"Param Lines"	
	14	"Descriptor Line"	
	15	"EU Descriptor Line"	
	16	"Header Date Line"	
	17	"Category Line"	
	18	"Data Write Line"	
	19	" "	
	20	" "	

2.8 Customizing the Data Collector

Changing the Collector Frequency

The collector frequency is set by the Period of the point. This is changed by reconstituting the point from the Engineering Builder Commands display. The period can be changed to the following values:

1sec	2sec	5sec	10sec
15sec	30sec	1min	2min
1Smin	2Smin	5min	10min
15min	30min	1hr	8hr
12hr	24hr	NoPeriod	

It should be noted that when processing at high speeds (less than 1 minute), there is a possibility that both data collector buffers will fill before the data is written to the storage file. This is indicated by an error. The error is caused by insufficient time for the AM to write the data to the HM. This can be caused by insufficient background processing time in the AM or by high amounts of communication to the HM from the LCN. The possible solutions are:

1) The number of data points can be reduced,
2) The data collector can be moved to another AM,
3) Others points which write to the HM can be inactivated,
4) The file can be written to a different HM.

Adding Another Data Collector

The data collector graphics are set-up to handle a maximum of 9 data collector points. New data collectors and the data collector names are defined in the Initial target of the DC graphic.

The variable INIT02 defines the number of data collectors. Entities ENT01 through ENT09 are used to define the collector points. ENT10 is the default (or primary) data collector point.

Edit this graphic to change the Data Collector using the following steps:

1) Enter the picture editor
2) Load the DC_DDB
3) Read the DC graphic
4) Type DEF INIT and press ENTER
5) Make your modifications as per Task 3 section 3.2
6) Press ENTER
7) COMPILE the graphic and copy the .DO file to the proper directory.

```
S_INT(INT02,1);    {NUMBER OF DATA COLLECTORS}
S_ENT(ENT01,DATA_COL);
{S_ENT(ENT02,DATACOL2); }{SECOND DATA COLLECTOR}
{S_ENT(ENT03,DATACOL3); }{THIRD DATA COLLECTOR}
S_ENT(ENT10,DATA_COL);
S_INT($_SELIDX,0);
S_INT(INT03,0);
MULT_OV("DCOPER1",0,3,79,22);
S_STR(STRING01, "COLLECTOR FUNCTIONS");
```

Original Initial Target

```
S_INT(INT02,3);          {NUMBER OF DATA COLLECTORS}
S_ENT(ENT01,SLOWDC01);
S_ENT(ENT02,FASTDC01);   {SECOND DATA COLLECTOR}
S_ENT(ENT03,FASTDC02);   {THIRD DATA COLLECTOR}
S_ENT(ENT10,SLOWDC01);
S_INT($_SELIDX,0);
S_INT(INT03,0);
MULT_OV("DCOPER1",0,3,79,22);
S_STR(STRING01, "COLLECTOR FUNCTIONS");
```

Initial Target Modified for 3 Collectors

Storing Sets of Points to a File

After a data collector has been setup, store the setup for future use. The setup is stored by printing the system entity to a file. This is done from the Engineering Builder Commands Menu.

After the file is printed, the file should be edited to form an alter parameter file. In this file, only the items to be changed (points, and data types) appear. Other information (tagname, a description of when this data set is useful, etc.) is commented out by placing each comment line inside brackets { }.

Restoration of a stored data collector setup is done using the alter parameter function from the Engineering Builder Commands Menu. The file, generated above, is entered in the PARAM=VALUE list. This changes the parameters, even while the point is running, to those listed in the file. It is best to inactivate the data collector prior to this change.

2.9 Known Data Collector Problems

Foreground code configuration error

The data collector can be configured to collect a SP or OP of a point even though the point does not have a setpoint or an output. This is evident from the current data page.

The error can only be corrected by changing the parameter to be collected.

Background code configuration error

When a system is upgraded to a new LCN revision, and the Data Collector is rebuilt (such as when changing the period of the point) the background code can give a configuration error. This error results in a data collection file having no header data.

The only solution is to unlink and link the code on all of the data collection points. The unlink and link can be performed one by one but eventually all data collector points should be rebuilt and have the code unlinked and linked.

\

Step Test Builder

(Optional Item)

Section 3 Step Test Builder

3.1 Overview

Overview

The Step Test Builder is designed to provide a mechanism to generate and retain the best information possible from unit plant tests while minimizing disruptions to operations and production.

The Step Test Builder consists of two parts.

1. **Signal Generator** The first part is an offline PC tool called the Signal Generator which is available under the Profit Design Studio(APCDE). See Section 3.2.
2. **Automated Step Tester** The second part is LCN software called the Step Tester Builder. See Section 3.3.

3.2 Off-Line Signal Generator

Overview

This section starts with the procedure for installing the signal generator on the PC. Next, a general introduction is presented which describes the philosophy, features and background of this signal generator. Also included in the introduction is a description of the PRBS and Schroeder sequences which are the two basic signal types used in the generator. A description of the software itself is then presented, followed by the effective use and operation of this signal generator.

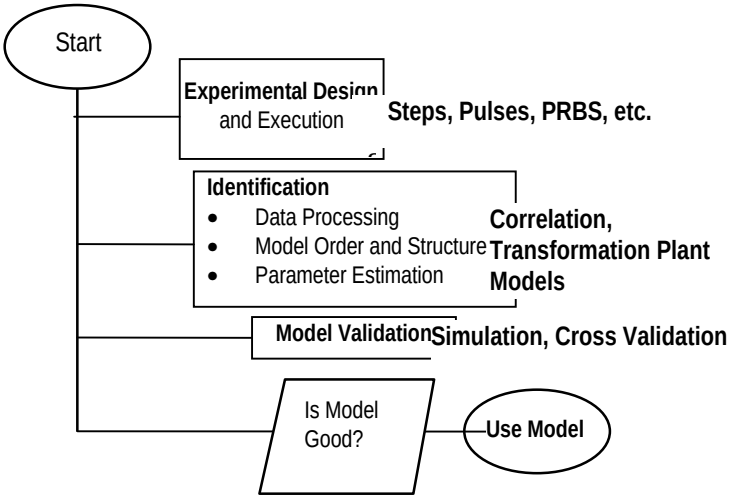
3.2.1 Introduction to the Signal Generator

Philosophy

With the Signal Generator, you can easily create a series of one or more sequences that can be used to properly excite the actual process. The generator has been designed to work in conjunction with APC Identifier. Sequential or/and simultaneous signals can be readily synthesized and evaluated. Signals are designed for minimum length and broadband uniform power.

A fundamental requirement for any advanced process control project is the determination of an acceptable process model. While many factors influence the success of the modeling task, none is more important than proper plant excitation. The rule is simple: To get 'good' models you must have 'good' (information rich) data. Proper choice of the input (excitation) signal is paramount to satisfying this rule. The APC Signal Generator is an automated tool to help design signals leading to information rich data.

Extracting models from process data for control purposes can require several steps. At a minimum, the diagram shown below illustrates the overall procedure.



This document is concerned only with the experimental design portion of the above diagram. Identification and model validation techniques are described in detail in the APC Identifier User's Guide.

Features

A variety of automated excitation tools are contained in Honeywell's windows based signal generation tool. This package offers the following characteristics:

- Gives the engineer a powerful tool to inspect signals
- Both sequential and simultaneous signals can be generated
- Different signal types are accommodated
  - Frequency matched Pseudo Random Binary Sequence (PRBS) (Default)
  - Schroeder Phased input (experimental)
  - User Specified
- Performance is given in terms of:
  - Signal profile
  - Correlation profile
  - Correlation targets
- One or more signals can be exported for on-line use.
- LCN Parameter lists are automatically generated

In conjunction with the Signal Generator software, the Automated Step Tester's LCN CL code is used for on-line implementation of the input signals.

Background

Model synthesis is the first step in the design of an advanced control project. In most instances, plants are too complex to be modeled in a cost effective manner based on first principles. By far the most common approach is the use of black-box models. In this approach, the models are obtained based on plant experiments. The task of obtaining 'good' models based on plant data is one of the most demanding and time consuming steps in any advanced control project. Inappropriate tests can result in poor or useless models. Retesting is extremely expensive and frustrating. It is the intent of this package to circumvent or at least reduce these problems.

To understand the approach, it is useful to first define the requirements of a good model. One possible definition, the one that will be used here, is that a good model is one that is consistent and unbiased. All the usual assumptions apply (i.e. linearity, stationarity, etc.). Unbiased implies that the expected values of the estimated model coefficients are the correct values. Consistency implies (as the number of samples goes to infinity) the estimated values converge to the correct values. While this definition is clearly academic, it does give guidance as to what is required for effective testing.

With the above definition of a good model, theory shows that the requirements for an unbiased consistent estimate are:

1. Model must have the correct structure
2. For FIR models, all inputs including DVs must be independent of the disturbances (uncrosscorrelated). This implies $\Phi_{uv}(\omega) = 0$, for all omega.
3. Inputs must exhibit persistent excitation for all frequencies. This implies $\Phi_u(\omega) \neq 0$, for all omega.

where : Φ is the input power spectrum and ω is the frequency. While Item 2 is not necessarily required for model forms other than FIR, it is nonetheless still very desirable. In fact it is in general desirable to have all inputs be un-auto/cross correlated to the extent possible.

It is the intent of the signal design software to directly address items two and three of the above list. The first item is addressed specifically by the identification software described in detail in the APC Identifier Users Guide

To aid in the experiment design, it is useful to understand what contributes to model errors. Error sources in estimation are given by:

$$e = bias + Var$$

where: e= total error

bias= error due to bias

Var= error due to variance

Bias are systematic errors caused by

- Input signal characteristics (power, correlation, etc.)
- Choice of model structure
- Mode of operation (open vs. Closed-loop)

Variance is the variability caused by

- presence of noise
- number of model parameters
- duration of the test

An expression for the model variance (open-loop) is given by:

$$Var \propto \frac{n\Phi_v(\omega)}{N\Phi_u(\omega)}$$

where : $\Phi_v(\omega)$ = disturbance power spectrum

$\Phi_u(\omega)$ = input power spectrum

n = number of parameters

N = number of data points

Open-loop testing is implicitly assumed in the current version of the APC Identifier. With this stipulation, the nonparametric model form (finite impulse response) can be bias free. To accomplish this, the input signals (MVs and DVs) should be uncorrelated with the disturbances, and have power at all frequencies of interest. Meeting this objective is the goal of proper signal design. However, even when the signals are uncorrelated and frequency rich, there can be errors due to the variance as shown above.

In theory, the estimates become error free as $N \to \infty$. Since this is impractical, there will always be a tradeoff between input power and disturbance power. Disturbance power can be due to either deterministic or stochastic events. To increase accuracy (reduce error) for a set of external conditions, either the test needs to be lengthened or the magnitude of the input power needs to be increased. In the signal design algorithm, issues related to correlation and spectrum are automatically addressed. Power magnitude and plant specific response times are user supplied.

Signals

While the signal generation tool has been designed to allow the user as much freedom as possible in the synthesis of signals, there are basically only three different signal types. One is the Auto Step which creates a series of steps of varying duration based on user specified conditions. This technique is heuristic and will not be described here. The next signal type is the PRBS. This method will create one or more signals that are not auto/cross correlated and that have a relative uniform power spectrum over the range of interest. The goal is signals of minimum length duration. The final signal type is the Schroeder phased input. This is an experimental signal type that is potentially more plant friendly than the PRBS but has a finite power spectrum.

Once the input signal magnitude and plant response times are specified, the objective of the design is to emphasize the power spectrum in the frequency region of interest for control. In the APC Signal Generator, the emphasis is placed in the mid to low frequency region thereby tailoring the sequence for extracting models that will be well suited for RMPCT. A brief discussion of the PRBS and Schroeder inputs is given below.

PRBS Sequence

As defined here, the PRBS signal is a 2-level, periodic, deterministic signal generated by using shift register modulo 2 addition. Its main usefulness lies in the fact that its auto- and cross-correlation properties closely resemble those of white noise. That is, it meets the requirements necessary for an unbiased estimate. Fortunately, since it is frequency matched to the process, it does not suffer from the practical limitations of a true (or even approximate) white noise signal.

This sequence is characterized by two parameters, the number of registers, n, and the switching time, T_{sw}, which is the minimum time between changes in the level of the signal as an integer multiple of the sample period T. The sequence repeats itself after NT_{sw} units of time, where $N = 2^n - 1$.

A very desirable feature of this signal is that it can be generated to have a relatively uniform power band in the desired frequency range. In addition, the power and frequency band can be precisely specified. Another advantage of this signal is that it can be conducted at lower signal to noise ratios than other more conventional signals such as step or pulse sequences. The power spectrum of this signal is given by:

$$\Phi_u(\omega) = \frac{a^2(N+1)T_{sw}}{N}\left[\frac{\sin\left(\frac{\omega T_{sw}}{2}\right)}{\frac{\omega T_{sw}}{2}}\right]^2$$

where a is the user specified input amplitude. The power reaches it bandwidth at $\omega = 2.8 / T_{sw}$. The flat band frequency range useful for identification is:

$$\frac{2\pi}{NT_{sw}} \le \omega \le \frac{2.8}{T_{sw}}$$

Schroeder Sequence

In addition to the PRBS signal, a sinusoid based signal referred to as the Schroeder signal is also supported by the design software. The Schroeder signal is composed of a harmonically related sum of sinusoids and is given by:

$$u_S(k) = \lambda \sum_{i=1}^{n_S} \sqrt{2\beta_i}\, \cos\left(\omega_i kT + \phi_i\right)$$

where

T = sample time

n_s = Number of sinusoids ($n_s \le N_s/2$)

N_s = Sequence length

β_i = Relative power

$\omega_i = 2\pi i/N_s T$

$\phi_i = 2\pi \sum_{j=1}^{i} j\beta_j$

λ = Scaling factor

λ is selected after generating the Schroeder signal such that the time domain peak magnitude does not exceed the user specified amplitude.

The total power is normalized as

$$\sum_{i=1}^{n_s} \beta_i = 1$$

where β_i is the relative power in each component.

To minimize peaking in the time domain, the sinusoids are phased according to:

$$\phi_i = 2\pi \sum_{j=1}^{i} j\beta_j$$

This signal has a discrete power spectrum with frequencies spaced $2\pi / N_S T$ intervals apart up to the Nyquist frequency π / T. The goal of this tool is to generate a low pass signal with power up to the frequency ω_{n_s}; this is accomplished by specifying β_i as:

$$\beta_i = \begin{cases} \frac{1}{n_s} & i = 1, \ldots, n_s \\ 0 & i = n_s + 1, \ldots, N_s / 2 \end{cases}$$

Since the Schroeder signal has zero power at frequencies > ω_{n_s}, this tool automatically adds a small PRBS series at the start of the sequence. In addition, the input design parameter α is a tuning knob that allows the user to adjust ω_{n_s}.

NOTE: No more than "1" Schroeder signals are run at a time, but multiple PRBS signals can be run.

There are no inherent limitations with this tool with respect to problem size. Any number of MVs and DVs can be accommodated. No restrictions are placed on the maximum number of data records. Only computer speed (MHz) and memory resources (RAM) will limit the application

No one step is more important than the design of the test signal used for plant testing. This is by far the most crucial part of an entire multivariable predictive control project. Preliminary tests should be conducted first to make sure all regulatory loops are properly tuned, all actuators and positioners are performing correctly, and to get initial estimates on process response times, gains, nonlinearties and noise levels.

Once the preliminary test is complete, this package can be used to ensure that the variables of interest will be persistently excited wherever possible. This step will enhance the prospects of obtaining good results. If the data is sufficiently rich (persistently excited), then the APC Identifier will extract the appropriate models.

Data should be recorded during all plant testing. Many options exist for saving this data. The Data Collector, which runs in the AM and is an optional part of the APC package, can be used to collect this data automatically.

3.2.2. Getting Started

Installing the Signal Generator

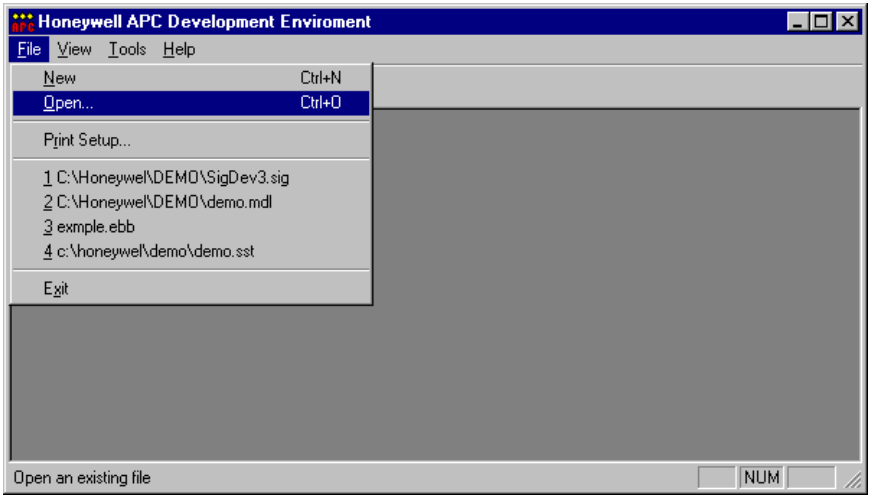
The Signal Generator is included in the standard installation of Profit Design Studio (APCDE). See Profit Controller Designer's Guide for installation instructions.

When the APC Development Environment is started, note that the Step Test Builder / Signal Generator is "checked" in the "About Box."

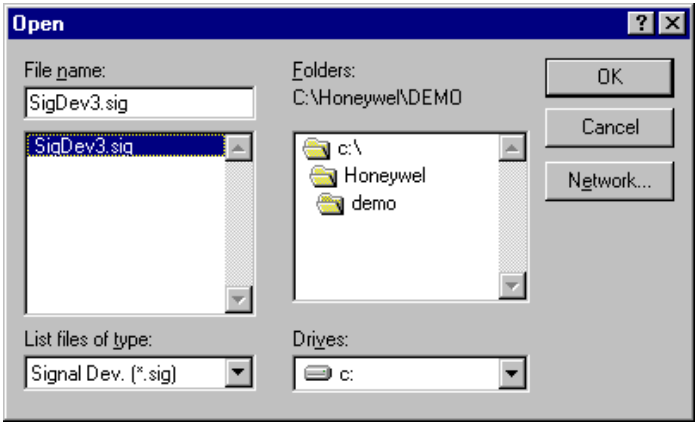
3.2.3. Starting a Signal Session

To Open an Existing Signal Session

A session is started by either opening an existing signal file or by starting a new session. Existing signal files will always have the .sig extension. Currently it is not possible to import non native data files into a working session. To open an existing signal session select File > Open as shown below:



Then simply select the .sig file type and appropriate path and file name from the file open dialog box which is illustrated in the following picture.

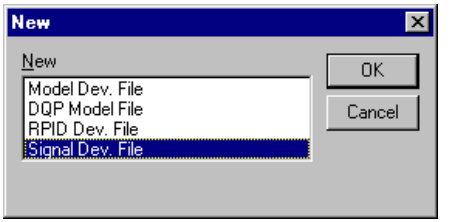


To Save a .sig File

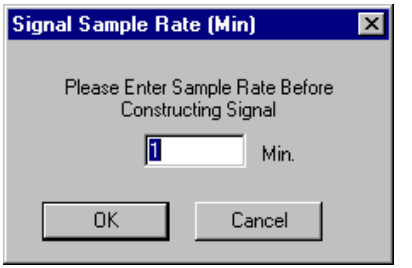
You can save a .sig file at any time and open it later to continue where you left off. To save a .sig file, select File>Save or click the toolbar button that looks like a diskette. To save a .sig file under a different name, for example to clone it for later experimenting, select File>Save As. Select a .sig file to resume work where you were when you previously saved the file.

Creating a New Signal Session

Any new or initial session must start by selecting File > New and choosing the Signal Dev. File option. This procedure is depicted below.



Clicking on OK will open an empty signal session. At this stage it becomes necessary to add information pertaining to the variables that are to be created. To do this select Edit>Var Info. When you edit variable information and no variables exist (as will happen at the beginning of each new session), you will be prompted to enter the scan rate at which you wish to build the signals. At this stage you should see the following information.

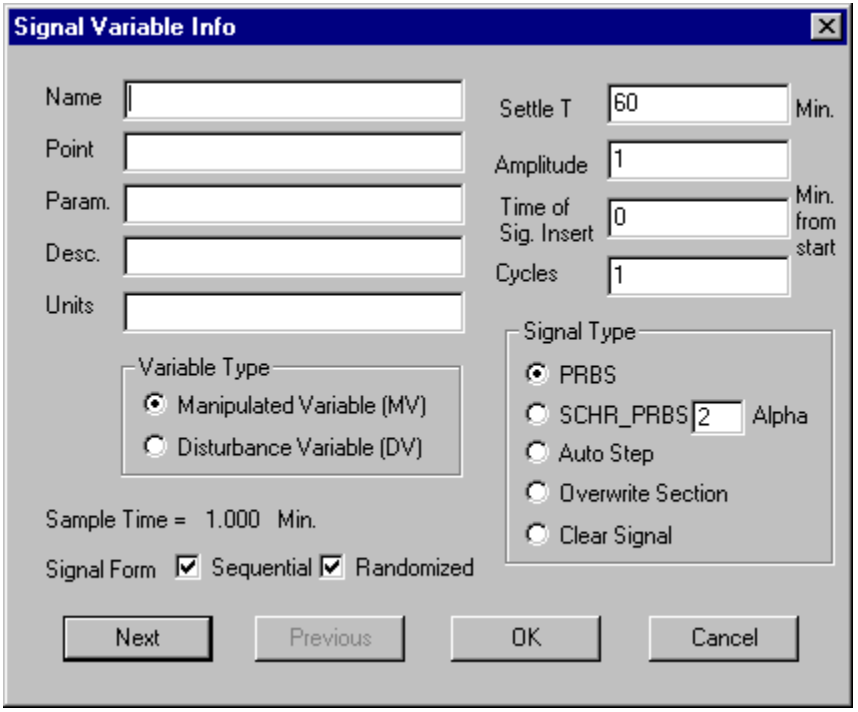


Example Explained

In the example shown above the scan rate was chosen to be 1 minute. There are no internal constraints on this parameter. As the ratio of process response time to scan rate increases, the length of the signal will increase. Remember that this value does impose a lower limit on the switch interval. This value should be relatively small compared to the process response time and it should be consistent with the execution frequency of the target implementation point. Once this value is entered, all parameters pertaining to the design of the various signals can be specified.

Parameter Specification

Signal parameters can be set or modified by selecting Edit>Var Info once the signal sample rate has been specified. When setting or modifying the parameters it is important to remember that when a signal is generated or recalculated for a specified independent variable, the existing signal is not necessarily destroyed. Thus complex user specified signals can be synthesized by combining one or more signal segments. The various user settable parameters are shown below in the Variable Info dialog box.



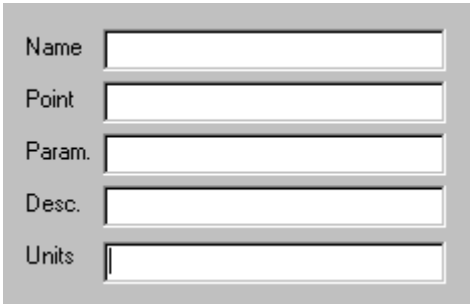
A description of these parameters follows.

Variable Descriptors

There are five fields available for describing the variable that will be used to represent the signal. The fields include :

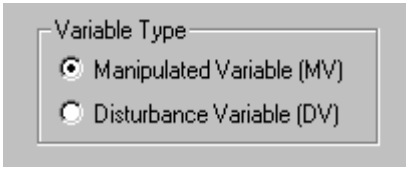
Field Name	Description
Name	Supplied to allow the user to enter a shortened string representing an actual process connected point. By default this is the descriptor used for all plots.
Point	Corresponds directly to the LCN tagname,
Param	Corresponds to the LCN .parameter (i.e. sp, pv, op).
Desc, Units	Both fields correspond to the detailed (24 character) description and engineering units found on an LCN point detail.

While it is a good practice to fill in all these fields, it is only necessary to fill in either the Name or Point field. Currently these fields are used for graphical display only. In the future they will be used to define process-connected points.



Variable Type

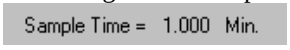
While the type is unimportant in the generation phase it will be critical in the control phase.



Manipulated Variable (MV) Generally signals will be designed for these variables.
Disturbance Variable (DV) If a disturbance can be independently excited, then it may be possible to design a signal for these variables.

Sample Time

At this level, the sample time is displayed for information only. The actual value is user specified in the sample time dialog box shown previously.



Signal Form

Two forms exist for each signal.

1 **Sequential -** If there is more than one signal and the sequential box is checked, then when the signal is built the current sequence will be inserted with overwrite (i.e. old signal data will be overwritten with new signal data) one interval after the previous signal ends. If the old signal is longer than the new signal, then trailing data will be unchanged. Any values existing prior to the insertion point will remain unchanged. If there is no existing signal or the signal has been cleared, then zero values will be specified prior to the insertion point. If the sequential box is not checked, then the signal will begin at the user specified Time of Sig. Insert (see below).

2 **Randomized** - In addition to specifying if the signal form is sequential or not, the user can specify if the signal is to be randomized. The randomization box applies only to signals of the Auto Step type (see below). If the Randomized box is checked then the step duration's will be based on a uniformly distributed random number.

Settle T

Specification of the frequency design criterion is accomplished through this parameter. The user specified value of this parameter should simply be the longest approximate settling time (response time in minutes - not time constant) expected for any controlled variables that are a function of this input. The Settle T used here is equivalent to the Settle T used in the APC Identifier. For PRBS and SCHROED_PRBS (see Signal Type below), this parameter is used to insure proper auto and cross-correlation characteristics and to insure a uniform power spectrum over the frequency band of interest. For Auto Step (see below) it is used to define the duration of the longest step. For Overwrite Section, this value is multiplied by the Cycles (see below) parameter to define the length of the overwrite signal.

This parameter is also used to set the axis for the corresponding auto and cross-correlation plots. It is easy to see extended correlation plots for a given signal by proper use of this parameter. For example, if a signal is to be built for a maximum settling time of one hour but there is concern about the correlation function beyond this time, then first build the signal (see next section) with Settle T = 60. Next set Settle T = 90. Then execute the correlation calculations with the signal function deselected. This will update the correlation functions without modifying the signals themselves.

Amplitude

Maximum and minimum values of the automated signals are established through this parameter. The amplitude establishes the level of the power spectrum. Reasonable values for this parameter should be established from plant conditions. For accurate models in a reasonable amount of time, the power of the input signal should dominate the power of the disturbance. As a rough estimate determine the value of the input that moves all CVs of concern enough to exceed three times the amount of the disturbances present during the test. This value can be used to define the amplitude. If the data is to be exported using the free file format (see section 3.2.5), then enter the value in the amplitude field show below.

NOTE: If the data is to be exported using the LCN format then enter a "1.0" in the Amplitude field and adjust the amplitude to the desired value in the Maximum Move Allowed field on the LCN Automated Step Test Builder (see section 3.3.)

Time of Sig. Insert

For non-sequential signals this field will specify the insertion point of the particular signal being built. Remember that signals are inserted with overwrite (i.e. old signal data will be overwritten with new signal data. If the old signal is longer than the new signal then trailing data will be unchanged.) Values prior to the time of insert will remain unchanged. If the signal length plus time of insert is shorter than the length of the existing signal, then the trailing values of the existing signal will also remain unchanged.

Cycles

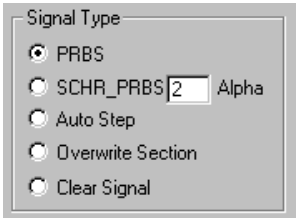
Both the PRBS and SCHROED_PRBS signals are deterministic fixed length signals. Design of these signals is based on a single cycle. This parameter is not used to specify any design parameters in the first two signal types. The default value of one should be used, unless due to process constraints, the amplitude is not of sufficient magnitude to dominate the immeasurable disturbances. In these cases, the number of cycles can be increased.[1] This will increase the duration of the test and reduce the variance and hence the expected error. For the Auto Step signal type, the Cycle parameter is used to specify the design of the signal (see below). In this instance the duration and frequency specification is defined based on the number of cycles. For the Overwrite signal type, the number of Cycles is multiplied times the Settle T value to define the duration of the overwrite.

[1] Note, Since the design of PRBS & Schroeder is based on a single cycle, design goals with respect to power and correlation cannot be theoretically guaranteed when multiple cycles are used.

Signal Types

Five distinct signal types are currently supported in this design software. The signals are:

1. PRBS,
2. SCHROED_PRBS,
3. Auto Step,
4. Overwrite Section
5. Clear Signal.



1. **PRBS**

This default signal type is a deterministic minimum length signal that is designed to have both a uniform power spectrum over the frequency range of interest (automatically determined by the Settle T parameter) and well behaved auto and cross-correlation function. The details of the design are given in the previous section

2. **SCHROED_PRBS**

With the experimental Schroeder based signal, the output sequence is potentially more plant friendly than the PRBS approach. The design of this signal, described previously, has the same correlation and power spectrum goals as the PRBS. Due to the finite frequency band of this signal, a user specified design parameter, ALPHA, is available for adjustment. This additional parameter allows the user to adjust the frequency content of the sequence. Decreasing or increasing ALPHA will respectively reduce or increase the frequency content of the signal. View the Single Graph Data Plots and Correlation Plots to observe the effects of ALPHA on the time domain response and correlation functions respectively.

3. **Auto Step**

If desired, more conventional sequences can be used or added to a signal. Choosing this option will allow the user to insert steps of a predefined structure. This option is heuristically based. When chosen, the sequence is based on the Cycle and Settle T parameters as follows. For Cycles = 1, one step of duration Settle T minutes will be generated, For Cycle = 2, there will be two steps of duration Settle T/2 and two steps of duration Settle T for a total of four steps. For Cycles = 3, there will be three steps of duration Settle T/3, three steps of duration 2 Settle T/3 and three steps of duration Settle T. For Cycles = N (where N > 3), there will be N steps of duration Settle T/3, N steps of duration 2 Settle T/3 and N steps of duration Settle T. When the randomized box is checked, these steps will be uniformly distributed in a random fashion.

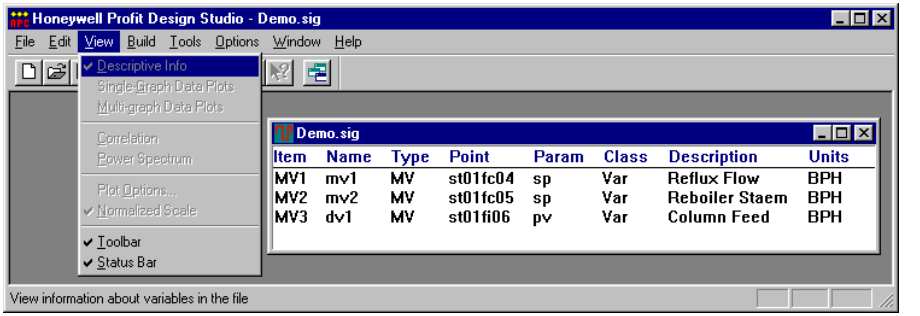
4. **Overwrite Section**

Any part of a sequence can be specified or overwritten by choosing this option. The value of the new segment is defined by the Amplitude parameter. The segment starts at Time of Sig. Insert and the duration of the segment is Settle T x Cycles.

5. **Clear Signal**

To eliminate an entire signal select this option. If any other nonzero signals exist, then all values of the signal selected will be set to zero. The length of the signal will be set to the longest existing nonzero signal (i.e. all signals will be of the same length, shorter signals are padded with zeros). Trailing zeros of the longest signal will be removed. If all values are zero, then the signals and their corresponding memory will be cleared. In this state the plots will not be accessible.

When selecting any options or specifying any parameters, remember that nothing will happen until a build function is invoked. For a new session there will be no signals present. At this stage, selecting View from the main menu will give results such as those shown below

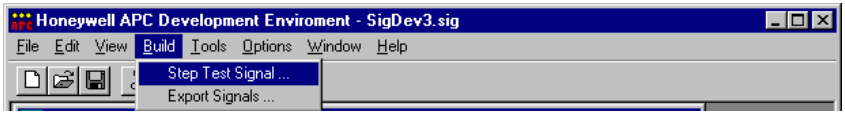


Once the parameters are set, the next step is to build and evaluate the signals. These operations are described in the next section.

3.2.4 Signal Synthesis and Evaluation

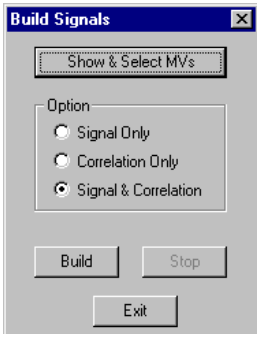
Overview

Signals can be easily generated evaluated and exported. The main functions associated with the signal generator are accessible through the main menu. To observe the main options do the following:
Select Build.
These options can be selected as illustrated below:



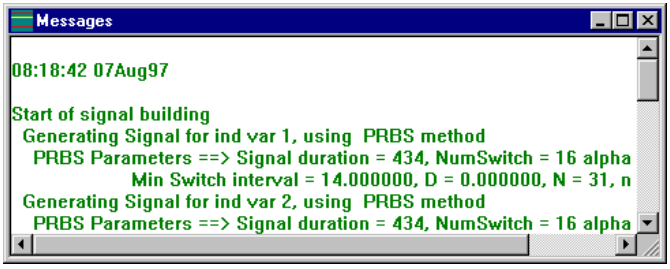
By selecting the Step Test Signal option, the user can choose to build: Signals Only, Correlation (functions) Only or both Signals & Correlation (functions). If no signals are present (this will happen in a new session or after all signals are cleared), then the Correlation Only (function) option will not be available.

Step Test Signal



Select the appropriate option (default is Signal & Correlation). Click the [Build] to perform the specified calculations. In the above SigDev3.sig Window on the previous page, the bottom two variables were selected. If none were selected it would imply that all variables are selected. Use the normal click, Ctrl, shift keys to select variables. Select one or more variables in any desired pattern. The build or view operation will apply only to those variables selected. Note: You can not build signals for auxiliary variables.

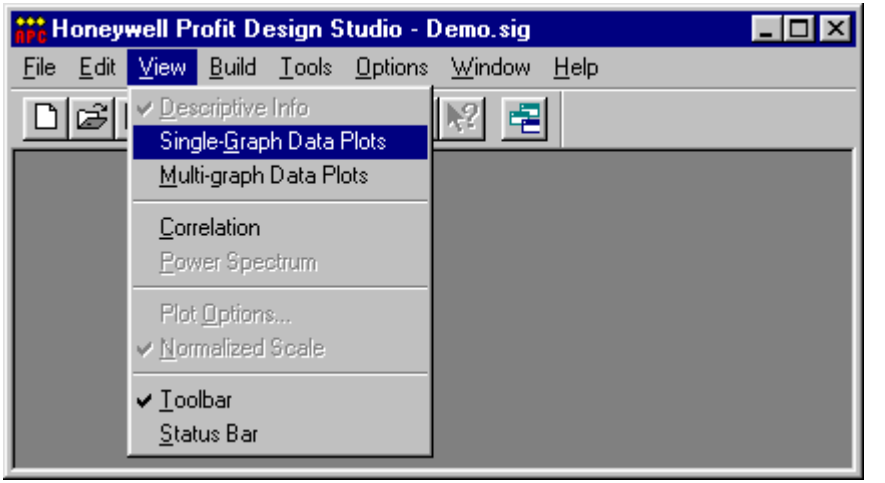
When the build option is selected, a message window will be created automatically if it is not already present. The message window will display the progress of the calculations along with specific information pertaining to the design process. A typical message window is shown below.



Check this window for any warning or error messages. When the calculations are complete the message window will be switched to background mode and the focus will be returned to the main .sig window.

Evaluate the Results

In order to evaluate the results after generating or updating the signals select View from the main menu as shown below.

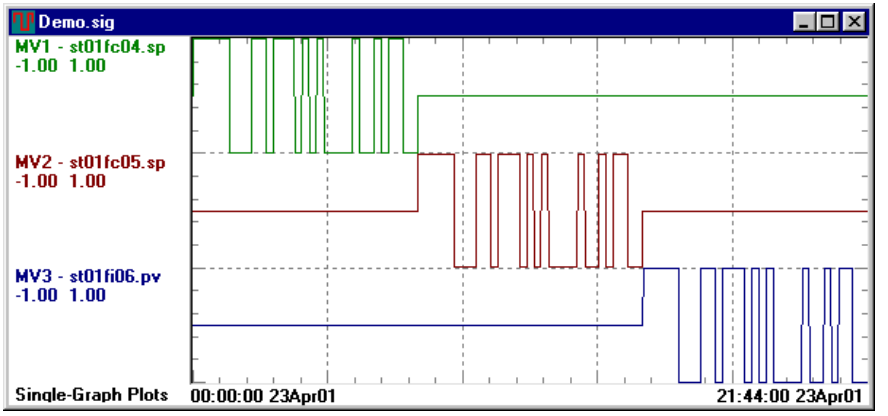


Five main options are listed. If any signals exist, the first four options will be selectable.

Option	Description
Descriptive Info	Shows all the variable descriptors
Single-Graph Data Plots	Allows the user to observe one or more signals (depending which are selected) as a function of time. See section “Single-Graph Data Plots” for more information.
Multi-graph Data Plots	Allows the user to observe one or more signals (depending which are selected) as a function of time.
Correlation	For viewing the Correlation Data. See section “Correlation” for more information.
Power Spectrum	This last option, Power Spectrum is reserved for future use depending on user request (Power spectrum will be a plot showing the magnitude of the signal power as a function of frequency).

Single graph Data Plots

In Single graph Data Plots view, each selected variable is displayed in its associated plot box. In Single Graph Data Plots, all selected variables are displayed on the same graph. In this view, the variables can be plotted with the Normalized Scale option either selected or not. When selected, the y axis will be independently scaled such that no variable traces overlap (each variable occupies its own band on the graph). When not selected, the y axis will span the full range of each variable (each variable occupies the full height of the graph). Selecting the Single Graph Data Plots option for the demo example will result in the following display. In this display the normalized option (default) has been used.



Always check this view after each build to ensure that signals were generated as expected. It is easy to inadvertently set a parameter incorrectly. The above picture shows the signature typical of a PRBS signal. It should be clear that these three signals were built in the sequential mode. To magnify the plot (zoom in), click and hold the left mouse button anywhere in the plot area and drag the cursor to open up a dashed rectangle. When you release the button the dashed rectangle will expand to fill the window. Scroll bars will then appear to allow translations at the current zoom factor. Repeat this procedure to get finer resolution.

Time/date information is displayed on the horizontal axis. Start time is always 00:00:00. The date is the current date. To observe the time of any data point, move the cursor into the time axis box. A vertical dashed line appears in the graph above the cursor and the time/date of this line appears in the center of the time axis box.

Selecting Data for Deletion

To delete a range of data, follow the steps below:

– Move the cursor within the time axis box to one end of the desired time range. The vertical dash dot line and the time /date in the center of the box show the current position. When the cursor is at the desired end of the time range, press and hold the left mouse button.

– Move the cursor to the other end of the desired time range. The second vertical dash dot line that appears and the time/date in the center of the box correspond to the other end of the range. Release the mouse button. The selected time range is shown with a gray background.

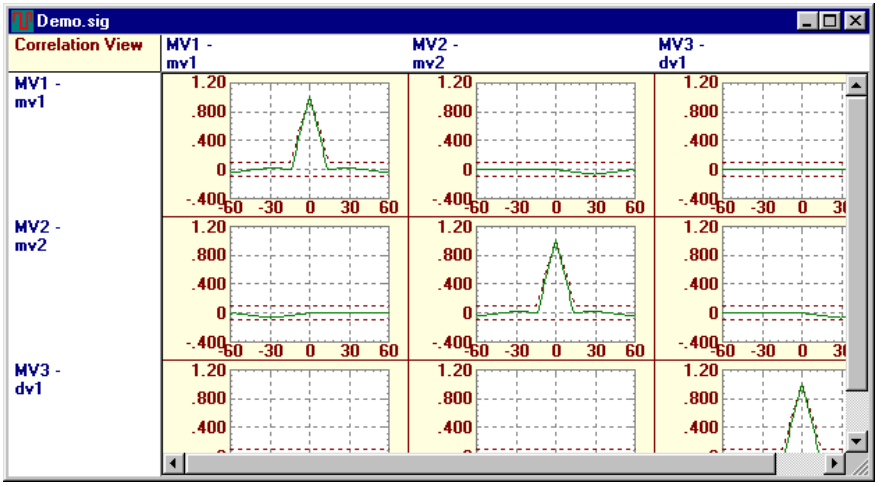
– Repeat these steps to select additional ranges.

– Hold down the CTRL key and use the above procedures to deselect all or part of a previously selected range

To actually delete the data, select Edit>Delete. Be sure you really wish to delete this data. WARNING: At this time there is no undo command. It is also important to realize that when ranges are selected for deletion, all data between these ranges will be deleted. In this instance, it does not matter which variables are selected. Unlike the delete function in the APC identifier, the signal delete function will NOT insert NaN markers in the data.

Correlation

Once the results have been reviewed using the Single Graph Data Plot, the next step is to review the correlation data. While the PRBS and SCHROED_PRBS have been designed with power and correlation concerns in mind, it is still informative to check the correlation view. In cases where the signals have been modified or it is desired to answer 'what if' questions, the correlation information should always be scrutinized. To observe correlation data, select View>Correlation.



Correlation information such as that shown above is very useful. The diagonal elements of the matrix represent the autocorrelation functions while the off-diagonal elements represent the crosscorrelation functions. The horizontal axis in each plot is time and is specified based on the Settle T parameter. The vertical axis in each plot is the correlation value. Since the correlation coefficient is simply the normalized value of the covariance coefficient, the vertical axis will always range between -.4 and 1.2.

Interpretation of the Correlation Plots

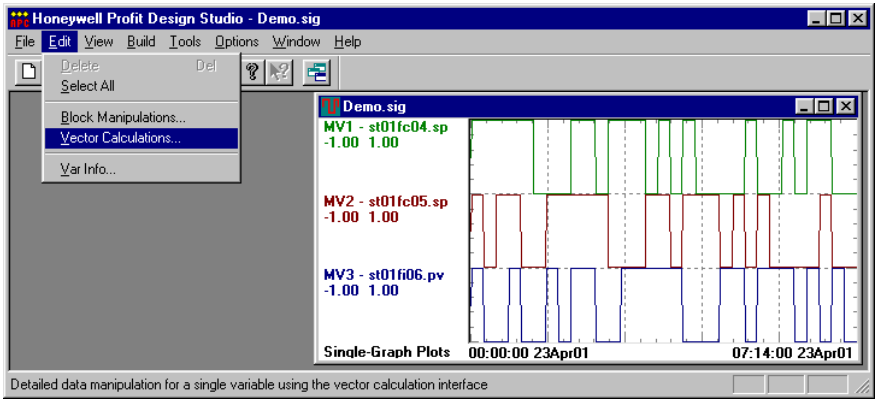
Rather than present the correlation information in a mathematical format, the correlation view is intended to present this information in a more intuitive fashion. In each plot box a high and low target value as a function of time will be displayed as a dashed red (default) line. The ultimate goal is to have the correlation function fall within this band. When it does, the signal will very closely approximate the ideal characteristics of a white noise signal. The targets are very conservative. Small excursions should be of no concern.

Values that exceed 0.5-0.6 and are outside the targets may cause a sensitivity in the resulting data. If this occurs, adjust the signal to reduce the correlation. Only the autocorrelation at time 0 should have a value equal to 1. If any other values are equal to 1, the resultant FIR solution in the APC Identifier will be potentially incorrect.

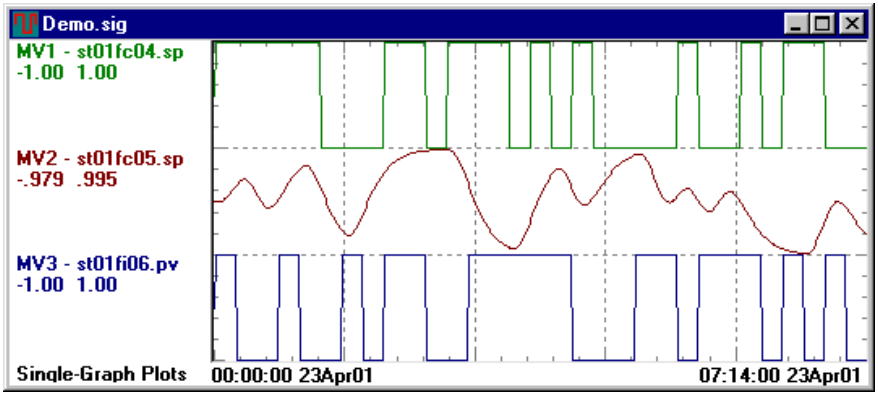
Correlation relates directly to the sensitivity encountered in the model identification phase. Perfectly uncorrelated signals would guarantee that the solution matrix used in the APC Identifier is full and well conditioned (no sensitivity). As the correlation increases so does the sensitivity. Sensitivity usually results in model separation as a function of settling time (see APC Identifier User's Guide) and therefore a reduction in model confidence. Correlation plots are excellent indicators of signal effectiveness for the PRBS and SCHROED_PRBS since these signals are designed to have a uniform power spectrum over the frequency range of interest. Since power spectrum concerns are not addressed in user specified signals (i.e. Auto Step), good correlation results do not necessarily imply good models.

Edit Data

Data vectors can be manipulated by selecting edit from the main menu as shown below.

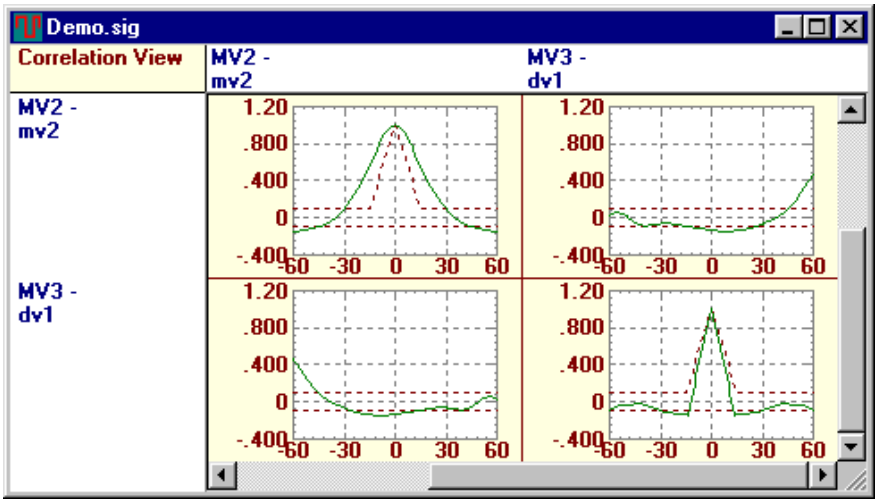


Either the “Block Manipulation” or “Vector Calculation” mode can be used to modify the data. For a full description of these editing functions see the APC Identifier User’s Manual. After editing data remember to always check the correlation curves for the modified data. For example if “MV2” is filtered as shown below,



then the correlation curves should be updated. To do this select Build>Step Test Signals from the main menu and remember to use the “Correlation Only” option. (If this is not done, the modified data will be overwritten with a new signal.).

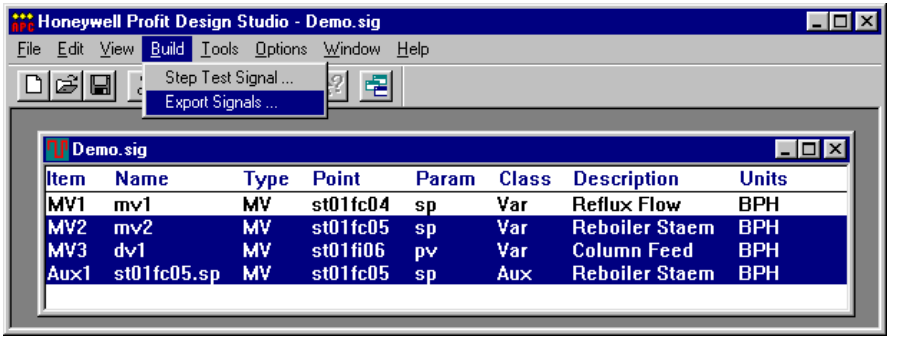
Correlation results for the signals given above are as follows.



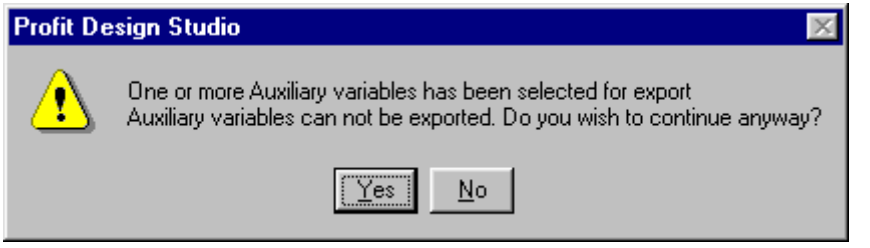
While design goals for both the power spectrum and the auto and cross-correlation functions are attained for unaltered signals, data modification may result in substantial performance deterioration. Note, for modified signals good correlation results do not necessarily imply a good power spectrum. In particular, filtering can have a drastic negative affect on the power spectrum (which as yet is not available). If filtering signals USER BEWARE.

Signal Export

Once the signals have been designed to have the desired characteristics, it is then necessary to make the signals available for external use. To do this select Export Signals from the Build dropdown dialog box as shown below

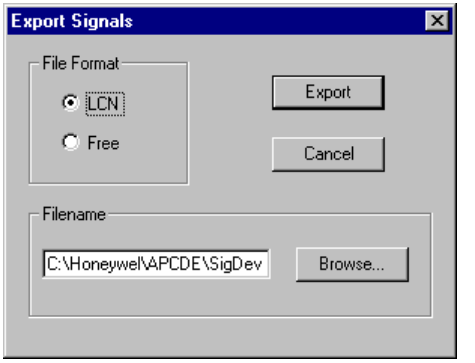


Note that auxiliary variables can not be exported. If they are selected as shown above then the following dialog box will be displayed.



LCN File Format

You can export signals to work with the LCN implementation of Honeywell's on-line Automated Step Test Application. The output of the export function is a series of TDC readable Parameter Lists. To generate these files select the Export option. The following dialog box will be displayed.



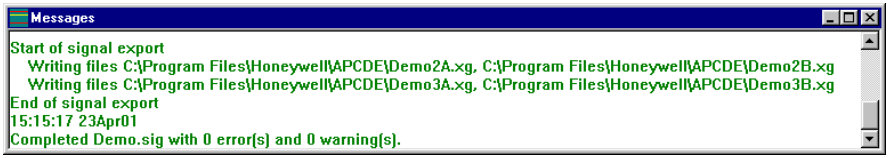
The default extension is .xg (LCN compatible). By browsing, the working path can be set to any directory in the normal fashion. When the Export button is hit, files will be generated only for those variables that are selected. In the picture above, the second and third variables would be exported.

Output Filename Convention - Files are saved based on the filename entered in the Export Signals dialog box and the particular variables selected. The convention is that all files that are created will use the first five characters (free format takes the first six characters) of the entered filename. The variable index will appear as the next character in the filename. For the selection given above the filenames would be SigDe2.XG and SigDe3.XG respectively.

Once the files are generated, it is then possible to implement the Automated Step Test Application. A description of the tool is given in Section 3.3.

One constraint to be aware of when exporting these signals is that the LCN Automated Step Test Application (receiver of these signals) is currently limited to signals with 1000 elements. If the signal is longer than this limit, then the export function will give an appropriate error message and request the signals to be rebuilt with a longer sample rate.

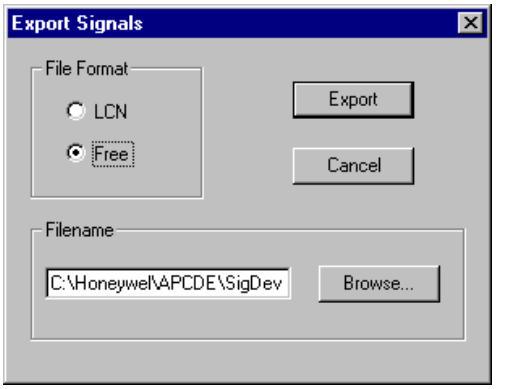
Placement of files created is recorded in the message window. For the example the message is shown below.



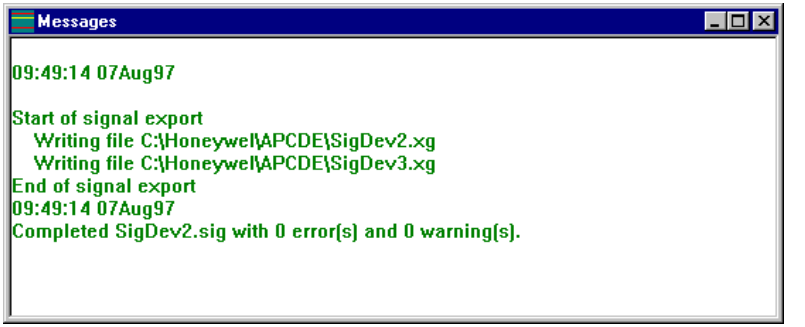
Notice that there are actually four files generated for this example. There is an A and B file created for each signal. Due to a parameter list read limitation on the LCN, export files are limited to 500 elements.

Free File Format

Use the Free File Format to export the signals to a file without the LCN file format limitations.



Message box created by this command is shown below.



3.3 Automated Step Tester

About this Section

This section describes the on-line portion of the Step Test builder. The description begins with a discussion of the installation procedure. This section is followed by sections describing the architecture, configuration and operation of the Step Tester..

LCN Hardware and Software Requirements

To use the Automated Step Tester on the LCN, the requirements described in the table below must be met.

Requirement	Description
Hardware Platform	TDC 3000 AM
Special Boards	None
Other Computing Systems	None
LCN Release	Release 410 or later
AM Load Modules	FILE, AMCL02, AMCL03 (Standard AM Load Modules)
US Load Modules	XY Plot (Supplied as part of RMPCT)
Other Packages	None
Other Control Applications	None
Software Inputs	None

Preparation and Installation

Step	Action
1.	Gather the following items: Removable media containing the monitoring software
2.	Make a backup copy of media/directory on the US with drives n and m configured as follows Media: • FCOPY $Fn $Fm Directory only: • CD $Fm>vol_dir>PICS • CD$Fm>vol_dir>4SCH • CD $Fm>vol_dir>CDS • CD $Fm>vol_dir>AO • CD $Fm>vol_dir>EB • COPY $Fn>PICS>*.* $Fm>PICS>=-V -D • COPY $Fn>4SCH>*.* $Fm>4SCH>=-V-D • COPY $Fn>CDS>*.* $Fm>CDS>=-V -D • COPY $Fn>AO>*.* $Fm>AO>=-V -D • COPY $Fn>EB>*.* $Fm>EB>=-V -D Where $Fn is the drive with the source media and $Fm is the drive with the target media

CDS Installation

This procedure must be done once per LCN installation.

Step	Action
1.	**Set Volume Parameters** From Modify volume Paths display: CL CUSTOM GDF: NET>CDSG> USER DEFLT PATH: $Fn>CDS
2.	**Compile CDS Parameters** From the Command Processor display, compile the CDS files: CL $Fm>CDS>STEP1CDS.CL -UL -NX CL $Fm>CDS>STEP2CDS.CL -UL -NX If it is necessary to change the CDS due to a software revision, refer to the *Application Module Data Control Language/Application Module Data Entry* Manual.

Building a Step Testing Point

A custom AM application point is required for each Step Testing variable.

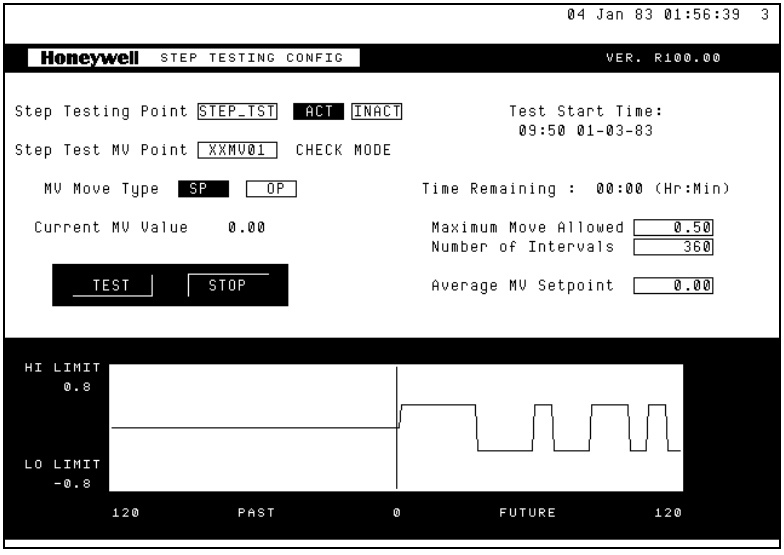
IMPORTANT! **For multiple MV testing, multiple step testing points must be built, one per variable. Testing of multiple MVs is a complex process and should NOT be attempted without intimate knowledge of both process and testing tools.**

Step	Action
1.	**Modify Exception Build File STEP_TST.EB** From the Command Processor display: ED $Fn>EB>STEP_TST.EB[ENTER] Edit template as follows: &N point name UNIT =unit number PTDESC =“point descriptor text” PERIOD =1MIN (default execution period - Alter as required. If the testing duration is longer than 1000 intervals, alter the execution frequency in the off-line software to 2 minutes or more. Likewise, the on-line step testing point will need to be altered to match the off-line execution frequency. Note: Release 500 will require alarm priority changes
2.	**Load EB File** From the Builder Commands display: Select the EXCEPTION BUILD target Fill in ports as: REFERENCE PATH NAME: $Fn>EB Load Entities (select target) Pathname for SOURCE file: STEP_TST.EB Pathname for IDF file: STEP_TST.DB [ENTER]
3.	**Verify Load** When the load is complete, verify point loading by accessing the point from the [DETAIL] button.

Configuration Graphics Installation

Graphics must be compiled and installed once per LCN

Step	Action
1.	**Picture Editor** Enter the Picture Editor, one of two ways: From the Engineering Main Menu select the PICTURE EDITOR target or From the Command Processor command line type: PE [ENTER]
2.	**Load DDB** Load Global variable definition file, DDB: L $Fn>PICS>STEP_DDB [ENTER]
3.	**Read File** Read in the picture file, STEP_TST (the name of the schematic should not be changed) R$Fn>4SCH>STEP_TST [ENTER] COM [ENTER]
4.	**Copy File** Copy STEP_TST.DO to the graphics directory: From the Command Processor display: COPY $Fn> 4SCH >*.DO NET>pic_dir>= -D [ENTER] Where pic_dir is the picture source directory specified in the Schematic Search Path.



Graphic STEP_TST.DO

Automated Step Tester Program Architecture

The tables in this section describe the APC automated step testing program architecture. This is the part of the Step Test Builder that resides on the LCN.

Point Structure

Point Type	AM Custom Point w/CL
PV_Type	None
CTL_Type	None
Custom Data Segment	2 CDS Packages - STEP1CDS.CL, STEP2CDS.CL
Algorithm	STEP_TST.AO
Insertion point	General
Slots	1CL Slot - STEP_TST
Output	The system information is stored to CDS values

Process Inputs

Parameter	Description	Units	Critical[2]	
			Yes	No
FLOW_PT(0..1)	Tagname of the MV to be tested	N/A	X	

Configuration Inputs (STEP2CDS)

Parameter	Description	Units
Flag	Turns the step testing routine ON and OFF	None
ENGPAR(1)	Number of steptest coefficients used	None
ENGPAR(2)	Maximum one direction step size (actual Max=2*value)	Process
ENGPAR(3)	Setpoint or Output Direct (0 => Setpoint, 1 => Output)	None
ENGPAR(4)	XYPlot History trend time span (1 . . . 120)	none
ENGPAR(5)	XYPlot Future trend time span (1 . . . 120)	none
XEULO	XYPlot Low limit	Process
XEUHI	XYPlot High limit	Process
X(1 . . . 1000)	Step test coefficient vector (generated by offline software)	None

Calculation Outputs

Parameter	Description	Units
REV_NO	Software revision number	None
CALC_VAL(1)	Current step test interval	None
CALC_VAL(2)	Starting / average value of the testing MV	Process
CALC_VAL(3)	Display update Flag used for XYPLOT	None
X2(1 . . . 120)	MV history information for plotting	Process
X3(1 . . . 120)	MV future information for plotting	Process
TIMEDESC(1)	Step test starting time	Time
TIMEDESC(2)	Steptest length	Time
TIMEDESC(3)	Steptest time remaining	Time

[2] Critical indicates that a bad input causes the output of the calculation to be set BAD.

Configuring an Automatic Step Test Application

Configuration of the step testing application can be done either through the graphic STEP_TST or through direct entry to the CDS ports on the Point Detail display.

Use of the application graphic is recommended.

Setup of the calculation point requires the following steps:

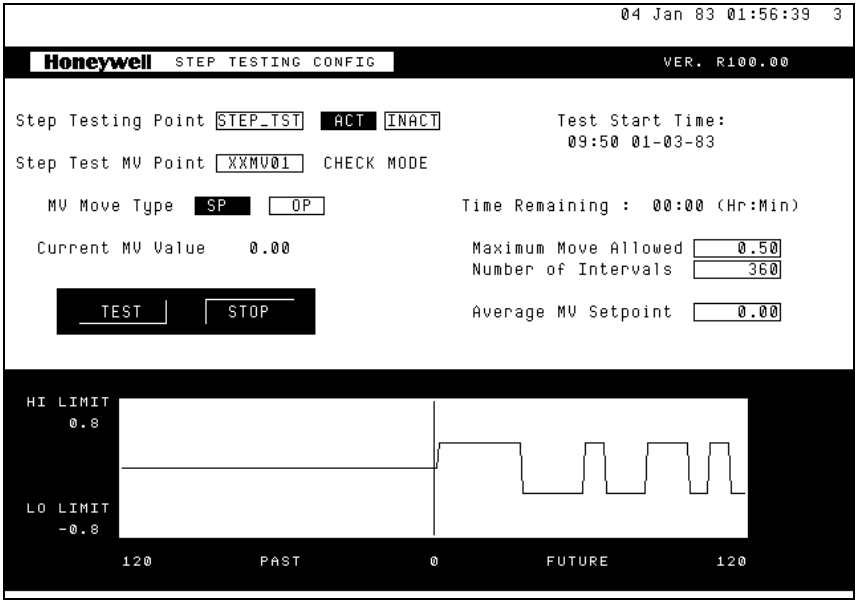
- Graphic or Non Graphic Configuration of Step Testing Point
- Linking CL Program

Note – Link Errors

Link errors may occur, when an improper point type is configured in a CDS parameter. This is caused by a missing parameter. A null point containing all required parameters can be used in the configuration for linking purposes only. After the CL is linked, the desired point is then entered into the proper CDS location.

Point Config Using Graphic STEP_TST

Each entry port on the automated step testing graphic, STEP_TST, is described below.



Graphic STEP_TST

STEP_TST Targets Explained

Selection Port	Parameter	Action
Step Testing Point	$_LCNPNT	Store the step testing point into a display database variable
Step Test MV Point	FLOW_PT(0)	Store the desired MV name into the step test application
MV Move Type	ENGPAR(3)	Defines the MV parameter to be adjusted(SP / OP)
Maximum Move Allowed	ENGPAR(2)	Defines the maximum move in a single direction (Total max. move is 2 * ENGPAR(2))
Number of Intervals	ENGPAR(1)	Number of step test coef.. - (off-line dependent)
Average MV Setpoint	CALC_VAL(2)	MV valve at start of test (Filled in Automatically)

Application Configuration through Direct CDS Entry

If the application graphic is not used, then the configuration data must be entered directly onto the step testing point. The required information and associated parameters are listed below.

Configuration Parameters

Parameter	Description	Comments
FLOW_PT(0)	Tagname of the MV to be tested	The software will copy this into FLOW_PT(1)
ENGPAR(2)	Maximum step size allow	This is a single direct step, the maximum testing step will be 2 times this value
ENGPAR(3)	Setpoint or output connection	Specifies whether your are going to write to an MV, SP, or OP for testing.
CALC_VAL(2)	Starting / Average MV at test start	This parameter may be altered during the course of the test in response to operation concerns
FLAG	Start or Stop the step test	Starts the test when set ON

Loading the Step Test Coefficients

Step testing coefficients are created by the off-line software. The signal generator will generate one or two files which need to be transferred and loaded onto the step testing point through an alter parameter function.

Step	Action
Go to Command Processor	Enter the Command Processor, one of two ways: From the Engineering Main Menu select the Builder Commands target or From the Command Processor command line type: CMD [ENTER]
Select the Alter Parameters target	Select field titled "ALTER PARAMETERS"
Reference Path	Fill in the Reference Path Name field $Fn>dir> Where (n) = drive specification dir = Directory containing the test files
Selection List	Enter the name of the step testing application point to be updated with the off-line information
Parameter Information	Enter the name of the file which contains the information generated by the off-line software and [ENTER] Recall that (2) files might be generated by the off-line software, therefore the above procedure may have to be executed twice, once for each file

Link CL Programs

Step	Action
Link STEP_TST	From the Command Processor Display: LK $Fm>AO>STEP_TST point_name [ENTER]
Activate point	Call up the point detail and activate the point.
Verify Operation	Verify that STEP_TST is running without any CL errors

On-line Error Messages

This section reviews the messages generated by the step test algorithm and provides a more detailed description of their meaning

Message	• Meaning
(1) "Step Test Program Move Parameter FAILED"	• This message is generated if the software encounters an error when copying the MV entity name listed in FLOW_PT(0) into FLOW_PT(1). This operation is typically done when a new entity name is entered through the display STEP_TST. • If this error occurs, check to make sure the entity name is correct and that LCN configuration allows access to the unit assigned to this entity.
(2) "Step Test Program Terminated" "Step Test Program Requires an Execution Period"	• If the step testing point was built with an execution period equal to "NOPERIOD" the software will terminate. An execution period is required for operation and for most cases should be set to 1 minute. Processes with unusually fast or slow dynamics may require different execution periods.
(3) "Step Test Program Terminated" "Step Test MV Mode must be P-AUTO"	• This message is generated when a step testing application has been started and the down stream MV is not in the proper mode or operations change the mode during the course of the test. If this error is encountered the test will terminate, clear the step testing coefficients, and send the above message to the message summary. • MV must be: • PROGRAM_AUTO $\Rightarrow$ • $\begin{bmatrix} P\_AUTO = SP \\ P\_MAN = OP \end{bmatrix}$ • PROGRAM_MAN $\Rightarrow$ • If P-AUTO MV must be "SPC" configured • then • P-MAN MV must be "DDC" configured.
(4) "Step Test Program Completed"	• This message is sent to the alarm summary to notify operations that the test has completed and they can now return the MV to its normal mode.

Gain Scheduler

(Optional Item)

.

Section 4 — Gain Scheduler

4.1 Overview

Definition

This document describes the software supplied, installation of the software, requirements to run the software, how to use the software and error diagnostics. This version supports any Profit Controller running on Honeywell's TPS system.

Application

The Profit Controller can be on, in warm, or off. The existing gains are changed to the user entered gains by updating the multipliers on the gain delay point and then notifying Profit Controller that new multipliers are available. This package can support up to 100 gain changes at a time.

Acronym List

Acronym	Term
AM	Application Module
DCS	Distributed Control System
LCN	Local Control Network
US	Universal Station
PV	Process variable
MV	Manipulated variable
RMPCT	Robust Multivariable Predictive Control Technology
PL	Parameter List
CDS	Custom data segment
AO	CL object code file extension

Hardware and Software Requirements

Requirements	Description
Hardware Platform	TDC 3000 AM
Special Boards	None
Other Computing Systems	None
LCN Release	Release 410 or later
AM Load Modules	None
US Load Modules	None
Other Packages	None
Other Control Applications	RMPCT Release 150 or later
Software Inputs	See Process Inputs

4.2 Software Description

Overview

This software package is designed to automatically update gains in a Profit Controller. The Profit Controller can be on, in warm, or off. The existing gains are changed to the user entered gains by updating the multipliers on the gain delay point and then notifying Profit Controller that new multipliers are available. This package can support up to 100 gain changes at a time.

Software Structure

The inputs to the software consist of the CV to change, the MV or DV to change, the new gain value, a tolerance by which the new gain must exceed before updating, a tolerance by which the new gain must not exceed before updating, a digital filter for allowing a transition between gain changes, and a flag to determine where messages are sent. The CDS parameters that correspond to the inputs are given in the following table.

Parameter	Description
P1	A list of CV locations whose gains will change - a row number.
P2	A list of the corresponding MVs or DVs to the CVs in P1 - a column number
G	A list of corresponding new gain value for each CV/MVDV pair.
TD	A list of corresponding digital filters for each gain.
X1	A list of corresponding minimum tolerance in % for each gain.
X2	A list of corresponding maximum tolerance in % for each gain.
F	A flag to determine where messaging will be sent. On - to operator. Off - to log only.

Software Supplied

This software is composed of three parts.

1. A CL object (RMPCGMAP.AO) that supports an AM custom point structure.
2. A CDS package (RGMAPCDS.CL) that holds data for the CL object.
3. A PL package (RGD_PL.CL) that is an update to the RMPCT RGD_PL package prior to RMPCT Release 160.

Software Installation

The software installation process consists of six steps. A Prerequisite for installing the software is that the Profit Controller software is already installed.

1. **Note**: this step is only necessary if the installed version of Profit Controller is prior to 160.
   Compile the RGD_PL.CL file by typing in

   CL $F*n*>PL>RGD_PL -UL -NX

   from the command line. Where $F*n* refers to the device where the delivered software is located.
2. Compile the RGMAPCDS.CL file by typing in

   CL $F*n*>CDS>RGMAPCDS -UL -NX

   From the command line. Where $F*n* refers to the device where the delivered software is located. Note that if this is an upgrade from previous versions the -OCD argument must also be included on the command line.

3. Build an AM custom point on the system. The execution time can be NOPERIOD if point will be PPSd or it can be scheduled. Specify one CL block, one package, and the package name RGMAPCDS.

4. From either the data entity builder or the point detail, enter in the name of the RMPCT main controller point in the ANAME CDS parameter and the name of the gain/delay point, associated with the RMPCT main controller point, in the BNAME CDS parameter.
5. Link the RMPCGMAP.AO to the point by typing in

   LK $Fn>AO>RMPCGMAP POINT_NAME

   From the command line. Where $Fn Refers to the device where the delivered software is located and POINT_NAME refers to the name of the gain updating point. Note that if you link without first entering the name of the RMPCT main controller point or the gain/delay point, the program will fail with a CONFIG error when executed. Also note that if you change the point name reference of a CV or MV interface point on either the gain/delay point or the main controller point, you must relink to establish the pointer to the new CV or MV interface point. Not doing so will cause the program to still use the old point name.
6. Before setting the point ACTIVE, make sure that the software is properly configured. Especially if connecting to an on-line RMPCT controller. Activating with improper configuration could cause a severe upset in plant operation.

Configuration

In order to configure the software, the user must supply entries to the aforementioned parameters. The user must identify the CV/MV or CV/DV pairs whose gains will be changed. This is done by identifying the CVs by their numerical order in the Profit Controller and identifying the MVs and DVs by their numerical order in the Profit Controller. Note that DVs must be treated as an extension to the MVs. For example: Let's say that Profit Controller had five CVs three MVs and two DVs. If the user wanted to change the gains of CV3 and MV2 to 5, CV3 and DV2 to 2.2, CV4 and MV1 to 0.25, CV4 and MV3 to 0.1, and CV4 and DV1 to 0.5, the corresponding values of parameters P1, P2 and G would be as follows.

Array Location	P1	P2	G	Description
1	3	2	5	Change gain of CV3 and MV2 to 5
2	3	5	2.2	Change gain of CV3 and DV2 to 2.2
3	4	1	0.25	Change gain of CV4 and MV1 to 0.25
4	4	3	0.1	Change gain of CV4 and MV3 to 0.1
5	4	4	0.5	Change gain of CV4 and DV1 to 0.5

Note that the array location where the CV/MV or CV/DV pair is entered is not relevant. All that the user must ensure is that the CV number and MV/DV number that identify the pair and the new gain are entered into the same their respective array with the same index. If either P1 or P2 contains a zero or a negative value in the array, the code will terminate at that location in the array without updating any more gains. P1 and P2 must be integers.

In addition to entering the location of the CV/MV or CV/DV pair and the new gain, the user can enter a minimum and maximum tolerance value. The minimum tolerance value is in percent. It indicates that the new gain must change from the old gain by more than this percentage or the update will be ignored. The allowed values range from zero (which is the default) to any number. The maximum tolerance value is in percent. It indicates that the new gain must change from the old gain by less than this percentage or the update will be ignored. The allowed values range from zero to any number (the default is 100).

The digital filter allows the user to apply weighting to the new entered gain and old gain in order to determine the ultimate new gain. The allowed values range from zero to one (one being the default). A value of one corresponds to taking the new entered gain with no weight from the old gain. A value of 0.5 corresponds to taking half of the new entered gain and half of the old gain to calculate the ultimate new gain, and etc. The gain scheduler point should be scheduled to run periodically to take full advantage of this feature.

Note that changing the sign of a gain is allowed as long as the percent of the difference lies between the maximum and minimum tolerances.

Limitations

This software is limited to a maximum of 100 gain elements per execution. If more than 100 elements is required, the user can build a second point to update the gains of the second 100 elements. If more than 200 gains need to be updated, then build a third point and so on. Note that Profit Controller is designed to only accommodate gain changes for the first 1000 non-zero gain elements. Therefore, if you have a very large matrix, it is recommended that you set up Profit Controller so that the CVs that require gain updates are within the first 1000 non-zero gains.

Trouble Shooting

The package is built to check and report error conditions as well as flag whether a gain was updated or updating was bypassed. If an error condition was encountered, the software is designed to send a message to the operator message summary. If desired, this can be suppressed and messages will only be sent to the message log. Additionally, when an error is encountered, the status of the individual gain, that had the error, will be set to a value corresponding to the error. If no error occurred, but the gain updating was skipped due to tolerance violation, there is no message, but the status value will be set to flag the reason for skipping the updating. An error message once detected is only raised once in order to prevent the same message from being re-issued every time the gain scheduler runs. The following table describes the error codes and messages.

4.3 Error Messages

Error Code	Error Message	Error Description	Recommendation
100	Auto gain scheduling was bypassed for *GU_PT_NAME*. Error occurred at time = *Time*. NULL value for main controller point name.	The Profit Controller that the gain updater is configured for was not configured or has become unavailable.	Ensure that the main controller point name was entered in parameter ANAME before linking and that the main point exists on the system.
101	Auto gain scheduling was bypassed for *GU_PT_NAME*. Error occurred at time = *Time*. Main controller point *MAIN_PT_NAME* INACTIVE.	The Profit Controller that the gain updater is configured for is not ACTIVE.	Check that the main controller point name is ACTIVE. Otherwise, gain updating does not make sense.
102	Auto gain scheduling was bypassed for *GU_PT_NAME*. Error occurred at time = *Time*. NULL value for Gain/Delay point name.	The Profit Controller gain/delay point that the gain updater is configured for was not configured or has become unavailable.	Check that the gain/delay point name was entered in parameter BNAME before linking and that the gain/delay point exists on the system.
103	Auto gain scheduling was bypassed for *GU_PT_NAME*. Error occurred at time = *Time*. Gain/Delay point *G/D_PT_NAME* INACTIVE.	The Profit Controller gain/delay point that the gain updater is configured for is not ACTIVE.	Check that the gain/delay point name is ACTIVE. Otherwise, gain updating does not make sense.
104	Auto gain scheduling was bypassed for GU_PT_NAME. Error occurred at time = *Time*. BAD G/D index for CV number = *i* and MV/DV number = *j*. Make sure RMPCT MAIN_PT_NAME is properly configured.	The gain/delay index for the i^{th} CV and j^{th} MV/DV was a bad value. This is typically due to improper configuration of the main Profit Controller point.	Check to make sure that the main controller point and the gain/delay point have been activated and are properly configured.
105	Auto gain scheduling was bypassed for GU_PT_NAME. Error occurred at time = *Time*. Bad gain for CV number = *i* and MV/DV number = *j*. Make sure RMPCT MAIN_PT_NAME is properly configured.	The gain from the off-line design for the i^{th} CV and j^{th} MV/DV is a bad value. This is typically due to improper configuration of the main Profit Controller point.	Check that the main controller point and the gain/delay point have been activated and are properly configured.
10	Index for P1 array location = *i* is outside the bounds of RMPCT MAIN_PT_NAME. Updating for this CV/(MV/DV) pair skipped.	The CV number entered into the P1 parameter at array location *i* is larger than the number of CVs specified in the configured Profit Controller or the value specified is a fraction.	Check that the CV number entered in this array element is within bounds or that you have connected to the proper main controller and/or gain/delay point.
11	Index for P2 array location = *i* is outside the bounds of RMPCT MAIN_PT_NAME. Updating for this CV/(MV/DV) pair skipped.	The MV/DV number entered into the P2 parameter at array location *i* is larger than the number of MVs + DVs specified in the configured Profit Controller, or the value	Check that the MV/DV number entered in for this array element is within bounds and that you have connected to the proper main controller and/or

Error Code	Error Message	Error Description	Recommendation
		specified is a fraction.	gain/delay point.
12	G/D index for CV number = *i* and MV/DV number = *j* is greater than 1000. Updating for this CV/(MV/DV) pair skipped.	The gain/delay index for the i^{th} CV and j^{th} MV/DV is greater than 1000. The current limitation in Profit Controller is 1000.	The elements are counted starting from CV1 and all its MV/DV models then CV2 and so on. If this gain is necessary to update, you must move this CV up in the order.
13	Zero G/D index for CV number = *i* and MV/DV number = *j*. You cannot update a gain that is null. Updating for this CV/(MV/DV) pair skipped.	The gain from the off-line design for the i^{th} CV and the j^{th} MV/DV is zero. Changing the multiplier will not change the gain.	Make the off-line gain non-zero if updating this gain is required.
14	Bad gain for G array location = *i*. Updating for this CV/(MV/DV) pair skipped.	The new gain entered into the G parameter array location *i* is a bad value. The updating for the gain of the *CV number entered into the P1 parameter array location i and the MV/DV number entered into the P2 parameter array* location i was skipped over.	Ensure that the gain entered in this location is a good value.
15	Bad filter for TD array location = *i*. Updating for this CV/(MV/DV) pair skipped.	The filter entered into the TD parameter array location *i* is a bad value. The filter must be between 0 and 1.	Ensure that the filter value in this location is between 0 and 1.
1	No Message	No error has occurred, but the gain update was skipped since its change is smaller than the minimum change tolerance	
2	No Message	No error has occurred, but the gain update was skipped since its change is larger than the maximum change tolerance	

On occasion, the user may get a CL error. This error will typically be a CONFIG error. If this is the case, the user should make sure that a main controller point name was entered into the ANAME parameter and that a gain/delay point name was entered into the BNAME parameter before the RMPCGMAP.AO was linked.

Performance Monitor

(Optional Item)

Section 5 ---- Performance Monitor

5.1 Overview

Definition

The Performance Monitor is designed to provide a mechanism to track unit performance with and without an Profit Controller cascaded to downstream controllers.

Application

The performance monitor collects information related to a specific controller and generates a report based on the user's configuration. Statistical information such as averages, standard deviations, and percentages are provided. If the controller is not active, averages and standard deviations are determined and provided for a base-line for comparison.

Calculation

The Performance Monitor calculates statistical information based on information from:

Process inputs:	Profit Controller Tagname
Calculated values:	Controller percentage uptime and additional statistical information related to the controller's performance.

Purpose

Provide information as to the amount of time the controller was actively controlling the process.

Provide information related to which controller constraints were active and therefore a bottle neck for the unit.

Provide statistical information for the unit while the controller was NOT active which provides a performance baseline.

Hardware and Software Requirements

Requirement	Description
Hardware Platform	TDC 3000 AM
Special Boards	None
Other Computing Systems	None
LCN Release	Release 410 or later
AM Load Modules	FILE, AMCL02, (Standard AM Load Modules)
US Load Modules	None
Other Packages	None
Other Control Applications	RMPCT Release 120 or later
Software Inputs	None

5.2 Detailed Description

Overview

The tables in this section describe the Performance Monitor program architecture:

- Point Structure
- Process Inputs
- Configuration Inputs
- Calculation Outputs.

Point Structure

Point Structure	
Point Type	**AM Custom, CL**
AM Custom	None
Custom Data Segment	RPRF_CDS.CL
Algorithm	RMPC_PRF.AO , RMPC_RPT.AO
Insertion Points	General and Background
Slots	7 CL Slots - (1/3/5/7) General, (1/3/5) Background
Output	The system information is stored to CDS values.

Process Inputs

Process Inputs				
			Critical[3]	
Parameter	**Description**	**Units**	**Yes**	**No**
ANAME	Tagname of the RMPCT controller	N/A	**X**	
P1(0)	Tagname of the CV Dummy point	N/A	**X**	
P2(0)	Tagname of the MV Dummy point	N/A	**X**	

All additional information regarding controller MV's and CV's is determined from the controller point. During the "CONFIGURATION" phase the monitor will examine the controller and store all required information to CDS parameters.

[3] Critical indicates that a bad input causes the output of the calculation to be set BAD.

Configuration Inputs

RPRF_CDS

Configuration Inputs (RPRF_CDS)		
Parameter	Description	**Units**
FL(1)	Monitor Activation Status (ON => Active)	**None**
FL(4)	Reporting Flag (ON => Monthly, OFF => Daily)	None
FL(5)	Reporting Flag (ON => Initialize value after report)	None
ENGPAR(1)	Number of days within a daily reporting cycle	Days
PATHNAME	File Pathname (i.e. NET>RMPC>FILE.XX)	None

Calculation Outputs

Calculation Outputs		
Parameter	**Description**	**Units**
DESCRIPT	RMPCT Controller description	**None**
MONTH	Current monitoring month - (String)	Months
DAY	Current monitoring day - (String)	Days
NUMPTS(1)	Number of controller CV points	None
NUMPTS(2)	Number of controller MV points	None
CALC_VAL(1)	Total number of monitoring counts	Counts
CALC_VAL(2)	RMPCT Controller ON counts	Counts
CALC_VAL(3)	RMPCT Controller OFF counts	Counts
CALC_VAL(4)	RMPCT Controller OPT counts	Counts
CALC_VAL(5)	RMPCT Controller CTL counts	Counts
CALC_VAL(6)	RMPCT Controller HDL counts	Counts
CALC_VAL(7)	Number of days within the current reporting period	Counts
MODEAPPL(1)	RMPCT percent up time	%
MODEAPPL(2)	RMPCT percent optimizing time	%

Calculation Outputs

Calculation Outputs		
Parameter	**Description**	**Units**
MODEAPPL(3)	RMPCT percent control time	%
MODEAPPL(4)	RMPCT percent handling constraint time	%
TIMEDESC(1)	Last initialization time	Time
TIMEDESC(2)	Last execution time	Time
TIMEDESC(3)	Time difference	Time
P1(0..40)	Profit Controller CV Points (0 = Null Point RMPCCV00)	Entities
P2(0..20)	Profit Controller MV Points (0 = Null Point RMPCMV00)	Entities
SPLOLM	Minimum MV LOW limit entered	MV Units
SPEULO	Maximum MV LOW limit entered	MV Units
SPLOTR	Average MV LOW limit	MV Units
SPHILM	Minimum MV HIGH limit entered	MV Units
SPEUHI	Maximum MV HIGH limit entered	MV Units
SPHITR	Average MV HIGH limit	MV Units
SPLOFL	% Time at MV LOW limit	Percent
SPHIFL	% Time at MV HIGH limit	Percent
SP	MV average setpoint (w/ Profit Controller ON)	MV Units
SPP	MV setpoint standard deviation (w/ Profit Controller ON)	MV Units
SPTV	MV average setpoint (w/ Profit Controller OFF)	MV Units
SPTVP	MV setpoint standard deviation (w/ Profit Controller OFF)	MV Units
SPLOCK	% Time the MV experienced WINDUP	Percent
SPREC	% Time the MV was under operator control (w/ Profit Controller ON)	Percent
SPSTS	% Time the MV was MAX MOVE limited by Profit Controller	Percent
SPOPT	Average MV steady state target value	MV Units

Calculation Outputs		
Parameter	**Description**	**Units**
X	MV controlled by Profit Controller count	Counts
X1	MV at LOW limit count	Counts
X2	MV at HIGH limit count	Counts
X3	MV was MAX MOVE limited count	Counts
X4	MV under OPR control count	Counts
X5	MV experienced WINDUP count	Counts
PVLOLM	Minimum CV LOW limit entered	CV Units
PVEULO	Maximum CV LOW limit entered	CV Units
PVLOTR	Average CV LOW limit	CV Units
PVHILM	Minimum CV HIGH limit entered	CV Units
PVEUHI	Maximum CV HIGH limit entered	CV Units
PVHITR	Average CV HIGH limit	CV Units
PVLOFL	% Time at CV LOW limit	Percent
PVHIFL	% Time at CV HIGH limit	Percent
PV	CV average setpoint (w/ Profit Controller ON)	CV Units
PVP	CV setpoint standard deviation (w/ Profit Controller ON)	CV Units
PVTV	CV average setpoint (w/ Profit Controller OFF)	CV Units
PVTVP	CV setpoint standard deviation (w/ Profit Controller OFF)	CV Units
PVLST	% Time a CV violated its limits	Percent
PVSTS	% Time the CV status was GOOD	Percent
CTLOPT	Average CV steady state target	CV Units
Q	Average Error Model versus Plant - (NOT IMPLEMENTED)	N/A
QSTS	Standard Deviation of model error (NOT IMPLEMENTED)	N/A
B	CV status GOOD count	Counts
B1	CV at a LOW limit count	Counts
B2	CV at a HIGH limit count	Counts
B3	CV limit violation count	Counts
PVT	CV limit violation tolerance - (Default is 0.10)	CV Units
STATUS	Routine Error codes used for diagnostics	None

5.3 Installation Procedure

Overview

This section describes the installation procedure for the Performance monitoring application on the TPS and covers the following topics:

- Preparation for Installation
- CDS and PL Installation
- Building a Performance Monitoring Point
- Graphics Installation.

Preliminary Requirement

Prior to building a Performance Monitor, one Profit Controller with at least one manipulated variable (MV) and one controlled variable (CV) must exist on the control system.

Task 1 Prepare for Installation

Step	Action
1.	Gather the following items: Removable media containing the monitoring software.
2.	Make Media Backup : Copy each Directory For each directory on the source media, create the directory on the backup media and copy all files to the backup media's directory: CD $Fm>vol_dir> src_dir COPY $Fn>src_dir>*.* $Fm>src_dir>= -V -D Where $Fm is the backup media drive $Fn is the source media drive vol_dir is the backup media's root directory src_dir is one of the source media's directories
	Example: CD $F2>STD> AO COPY $F1>AO>*.* $F2>AO>= -V -D CD $F2>STD> CDS COPY $F1>CDS>*.* $F2>CDS>= -V -D

Task 2 CDS & PL Installation

Step	Action	
	This task must be done once per LCN installation.	
1.	**Set volume pathnames**	From Modify Volume Paths display: CL CUSTOM GDF: NET>CDSG> USER DEFLT PATH: $Fn>4SCH

Step	Action	
2.	**Compile Param List RPRF_PL.CL**	From the Command Processor display, compile the PL file, RPRF_PL: CL $Fn>PL>RPRF_PL.CL -UL -NX If it is necessary to change the PL due to a software revision, refer to the Application Module Data Control Language/Application Module Data Entry
3	**Compile CDS Param RPRF_CDS.CL**	From the Command Processor display, compile the CDS file, RPRF_CDS: CL $Fn>CDS>RPRF_CDS.CL -UL -NX If it is necessary to change the CDS due to a software revision, refer to the Application Module Data Control Language/Application Module Data Entry

Task 3 Building Performance Monitoring Point

Step	Action
1	Modify Exception Build file, RMPC_PRF.EB A custom AM application point is required for each Profit Controller monitoring point.
	From the Command Processor display: ED $Fn>EB>RMPC_PRF.EB [ENTER] Edit template as follows: &N *{ENTER NEW MONITOR POINT NAME}* UNIT = *Enter unit number* PTDESC = "*Enter Descriptor for point* " KEYWORD = "PERF_MON" CLSLOTS = 7 NOPKG = 1 PKGNAME(1) = "RPRF_CDS" PERIOD = 1MIN *{Change period if needed}* ANAME = *Enter RMPCT controller name* ENGPAR(1) = 1.0 { Desired number of days } ENGPAR(2) = 0.0 { SPARE } ENGPAR(3) = 0.0 { SPARE } PATHNAME = "NET>DC>PERFILE1.XX" *{Change pathname & File}* P1(0) = PRP1CV01 {Actual RMPC CV interface point name} P2(0) = PRP1MV01 {Actual RMPC MV interface point name}

Step	Action
2.	Load EB file. From the Builder Commands display: Select the EXCEPTION BUILD target. Fill in ports as: REFERENCE PATH NAME: $Fn>EB Load Entities (select target) Pathname for SOURCE file: RMPC_PRF.EB Pathname for IDF file: RMPC_PRF.DB [ENTER]
3.	Verify load When the load is complete, verify point loading by calling the point detail from the [DETAIL] button

Task 4 Configuration Graphics Installation

Step	Action	Comments
	Graphics must be compiled and installed once per LCN.	
1	Go to Picture Editor	Enter the Picture Editor, one of two ways: From the Engineering Main Menu select the PICTURE EDITOR target or From the Command Processor command line type PE [ENTER]
2.	Load DDB	Load Global variable definition file, DDB: L $Fn>PICS>DDB [ENTER]

Note on verification of the graphics

During verification the Picture Editor will ask the type of the variable `&I`.
`&I` is of type Integer or `I`. `I` should be entered as the response

3.	Read Files	

Task 4 Continued

Step	Action	Comments
	Read RMPC_PRF	Read in the picture file, RMPC_PRF R $Fn>4SCH>RMPC_PRF [ENTER] VER [ENTER] COM [ENTER]
	Read RPRF_CTL	Read in the picture file, RPRF_CTL R $Fn>4SCH>RPRF_CTL [ENTER] VER [ENTER] COM [ENTER]
	Read RPRF_MVL	Read in the picture file, RPRF_MVL R $Fn>4SCH>RPRF_MVL [ENTER] VER [ENTER] COM [ENTER]
	Read RPRF_MVS	Read in the picture file, RPRF_MVS R $Fn>4SCH>RPRF_MVS [ENTER] VER [ENTER] COM [ENTER]
	Read RPRF_MVA	Read in the picture file, RPRF_MVA R $Fn>4SCH>RPRF_MVA [ENTER] VER [ENTER] COM [ENTER]
	Read RPRF_CVL	Read in the picture file, RPRF_CVL R $Fn>4SCH>RPRF_CVL [ENTER] VER [ENTER] COM [ENTER]
	Read RPRF_CVM	Read in the picture file, RPRF_CVM R $Fn>4SCH>RPRF_CVM [ENTER] VER [ENTER] COM [ENTER]
	Read RPRF_CVS	Read in the picture file, RPRF_CVS R $Fn>4SCH>RPRF_CVS [ENTER] VER [ENTER] COM [ENTER]
	Read RPRF_CVA	Read in the picture file, RPRF_CVA R $Fn>4SCH>RPRF_CVA [ENTER] VER [ENTER] COM [ENTER]
4.	Copy all of the Performance Monitor Graphics to the Executable graphics directory.	From the Command Processor display: COPY $Fn>4SCH>*.DO NET>pic_dir>= -D-V [ENTER] Where pic_dir is the picture source directory specified in the Schematic Search Path, which is found in the SYST_MENU, Organizational Summary page.

5.4 Configuring a Monitoring Application

Overview

Configuration of the Performance Monitor can be done either through the graphic RMPC_PRF or through direct entry to the CDS ports on the Point Detail display. Use of the application graphic is recommended.

Setup of the Calculation Point

Setup of the calculation point requires the following steps:

Graphic or Non Graphic Configuration of Performance Monitoring Point

Linking CL Program.

Notes: Configuration errors may occur if associated points are deleted. To correct this problem, the AO files must be unlinked and then relinked to reestablish dynamic indirection.

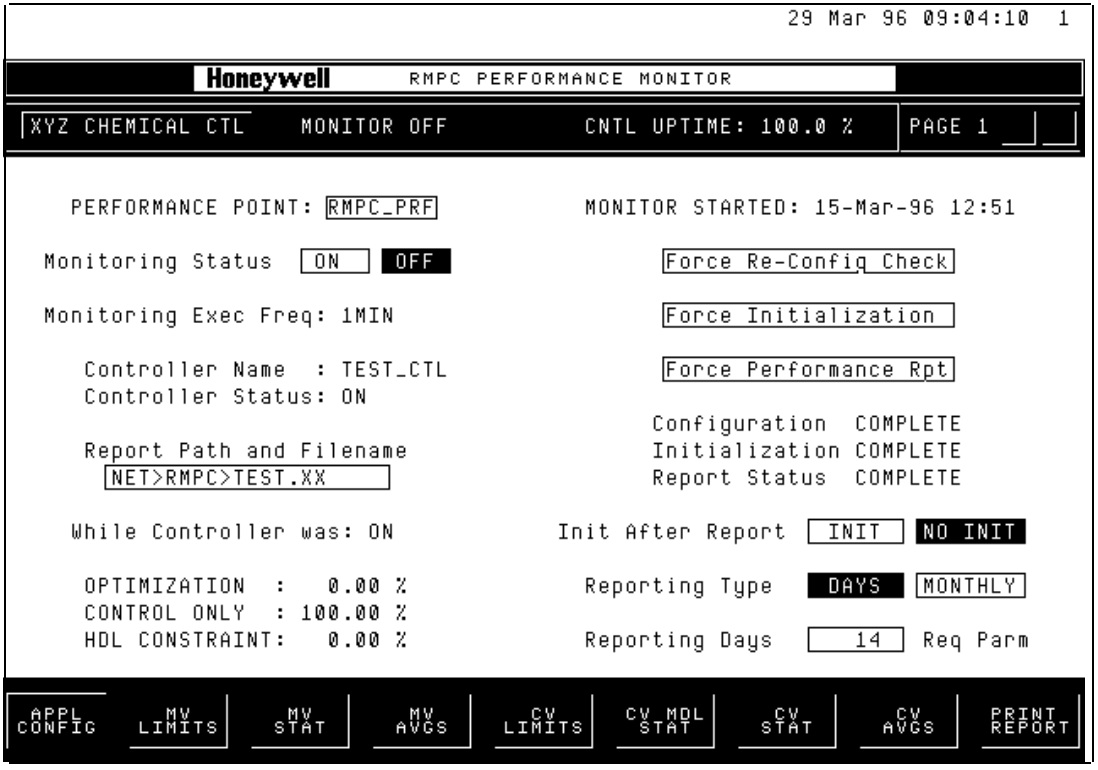
Link errors may occur, when an improper point type is configured in a CDS parameter. This is caused by a missing parameter. A dummy point containing all required parameters can be used in the configuration for linking purposes only. After the CL is linked, the desired point is then entered into the proper CDS location.

Any dummy point used in the P1(0) pointname must have the following parameters: N(1), N(2), PV, T(3), T(7), T(9), X(1), X(2), X(17), X(18)

Any dummy point used in the P2(0) pointname must have the following parameters: D(1), D(2), T(1), T(12), T(4), T(5), X(1), X(2), X(17), X(18)

Point Configuration Using Graphic RMPC_PRF

Each entry port on the performance monitoring graphic, RMPC_PRF, is described below.



Graphic RMPC_PRF

Link CL Programs

Step	Action
Check ANAME	Make sure that the desired Profit Controller name is listed within the CDS field ANAME
Check P1(0)	Ensure that the P1(0) parameter contains the name of an actual RMPC CV interface point.
Check P2(0)	Ensure that the P2(0) parameter contains the name of an actual RMPC MV interface point.
Link RMPC_PRF	From the Command Processor Display: LK $Fn>AO>RMPC_PRF point_name [ENTER]
Link RMPC_RPT	From the Command Processor Display: LK $Fn>AO>RMPC_RPT point_name [ENTER]
Activate point	Call up the point detail and activate the point.
Verify Operation	Verify that RMPC_PRF is running without any CL errors.

Point Configuration Using Graphic RMPC_PRF

Selection Port	Parameter	Action
Performance Point	ANAME	Enter the Performance Monitoring point name.
Report Path and File Name	PATHNAME	Enter the full pathname NET>RMPC>FILE.XX
Reporting Days	ENGPAR(1)	Desired number of reporting days (1..365)
Monitoring Status	FL(1)	Activate the monitoring application
Reporting Type	FL(5)	Select reporting period Days / Months

Application Configuration through Direct CDS Entry

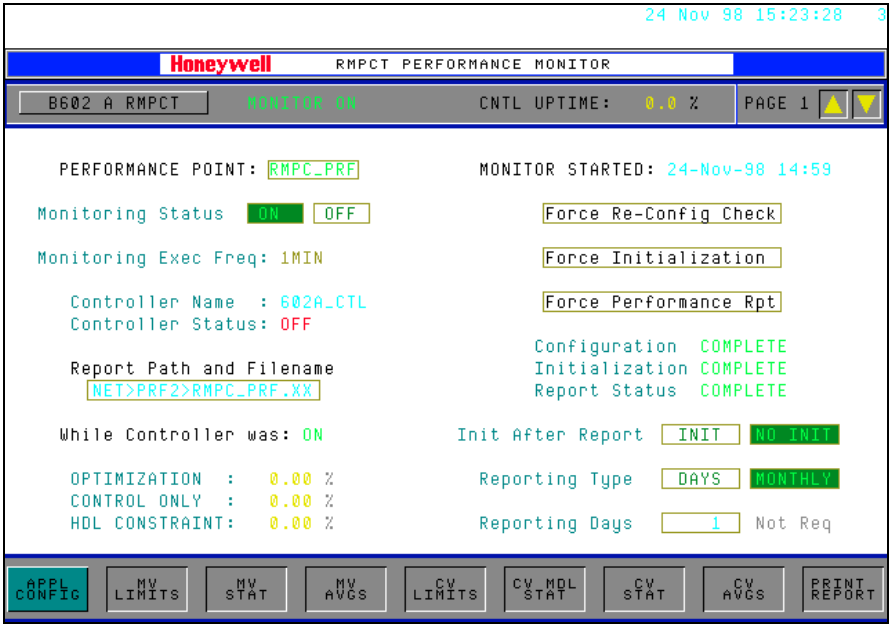
If the application graphic is not used, then the configuration data must be entered directly onto the calculation point. The required information and associated parameters are listed below.

Parameter	Description	Comments
ANAME	Tagname of the Profit Controller	This entity name must be entered before linking the application AO.
PATHNAME	String containing the full path and file name with ext	NET>RMPC>RMPC_RPT.XX
FL(5)	Flag which determines whether to generate reports based on days or months (ON=>DAYS)	Flag status is either ON or OFF.

5.5 Overview of the RMPCT Monitor Displays

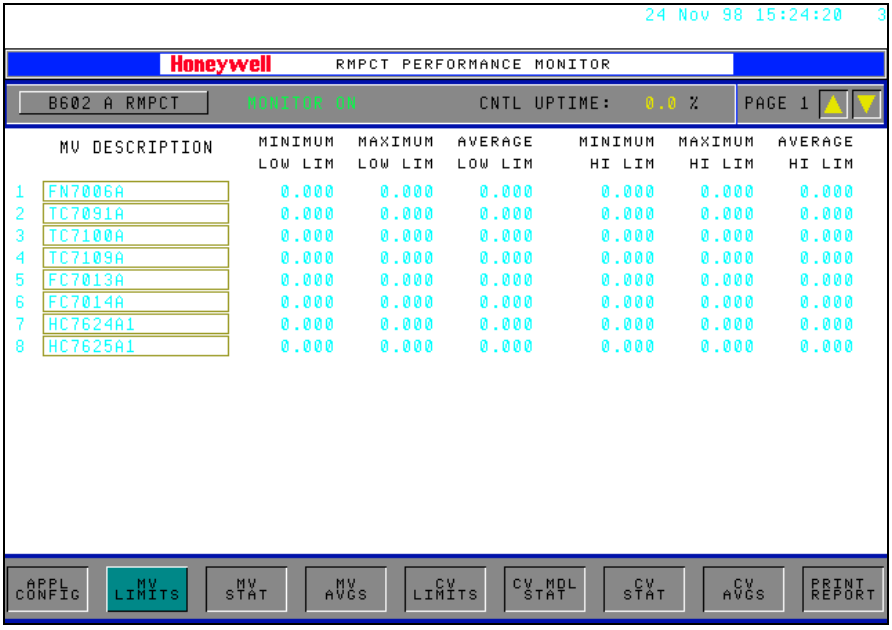
Application Overview

The application overview display provides a quick review of the configuration and controller performance information. This display informs the user of the controller name, the controller status, the controller uptime percentages, the monitoring execution frequency, and the monitoring start time and date.



MV Limit Information

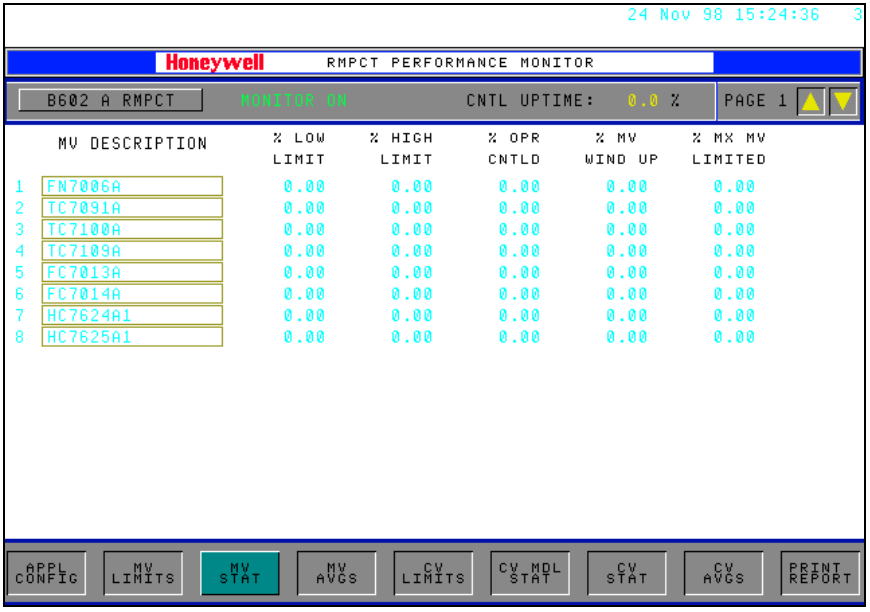
MV limit information provides the working ranges within which the controller must operate. Minimum and maximum LOW limit values define the lower constraint bounds, while the average provides a sense of the normal lower operating limit. Minimum and maximum HI limit values define the upper constraint bounds, while the average provides a sense of the normal upper operating limit.



MV Statistic Information

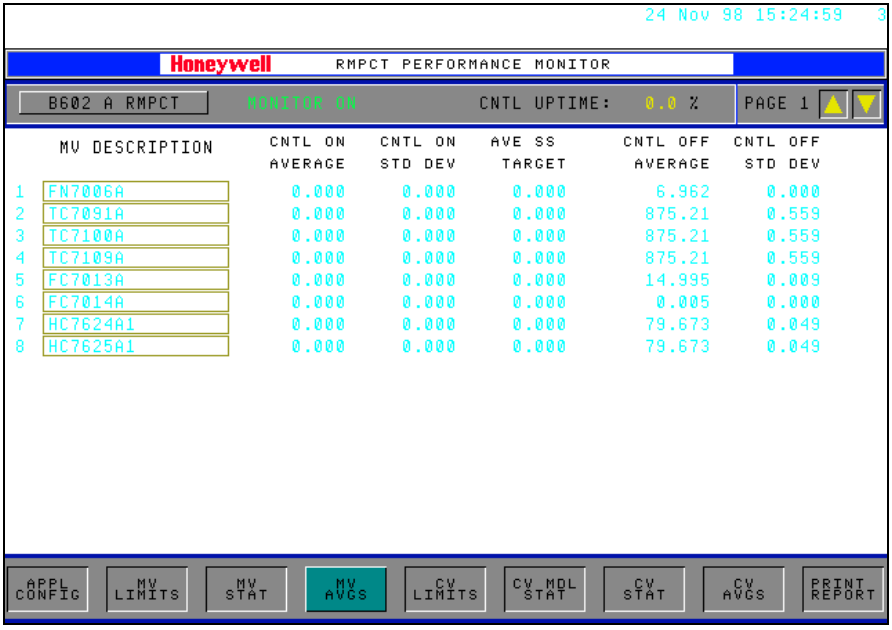
MV statistical information is provided to track control limitation or unit constraints that reduce unit performance.

% LOW LIMIT	Defined as: LOW LIMIT + ΔSOFT LOW Tracks the percent of time an MV was constrained at the low bounds.
% HIGH LIMIT	Defined as: HI LIMIT + Δ SOFT HI Tracks the percent of time an MV was constrained at an upper bounds
% OPR CNTLD	Tracks the percent of time an MV was under operator control rather than available for RMPCT control.
% MV WIND UP	Tracks the percent of time an MV was unavailable for control due to system conditions (i.e. valve saturation).
% MX MV LIMITED	Tracks the percent of time an MV was max move limited within the RMPCT controller. The maximum move allowed is configured within the RMPCT MV tuning display.



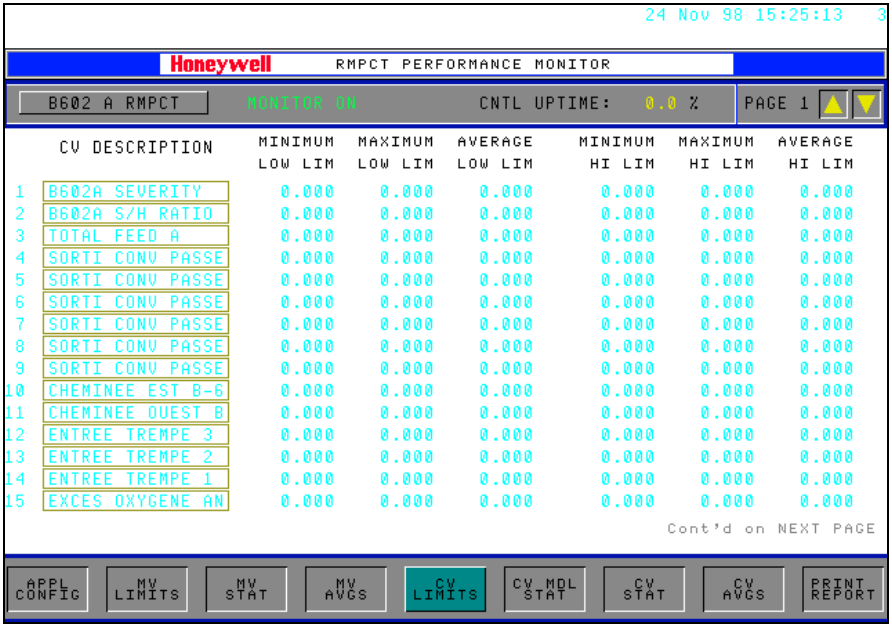
MV Averages and Standards Deviations

MV averages and standard deviations provide information related to amount of energy expended by RMPCT to control and optimize a unit. The "AVE SS TARGET" information provides the average steady state target for each MV within the monitoring window. In addition to controller information, averages and standard deviations are calculated for periods when the unit is under operator control.



CV Limit Information

CV limit information is tracked to provide the working range within which the controller must operate. Minimum and maximum LOW limit values define the lower constraint bounds, while the average provides a sense of the normal lower operating limit. Minimum and maximum HI limit values define the upper constraint bounds, while the average provides a sense of the normal upper operating limit.



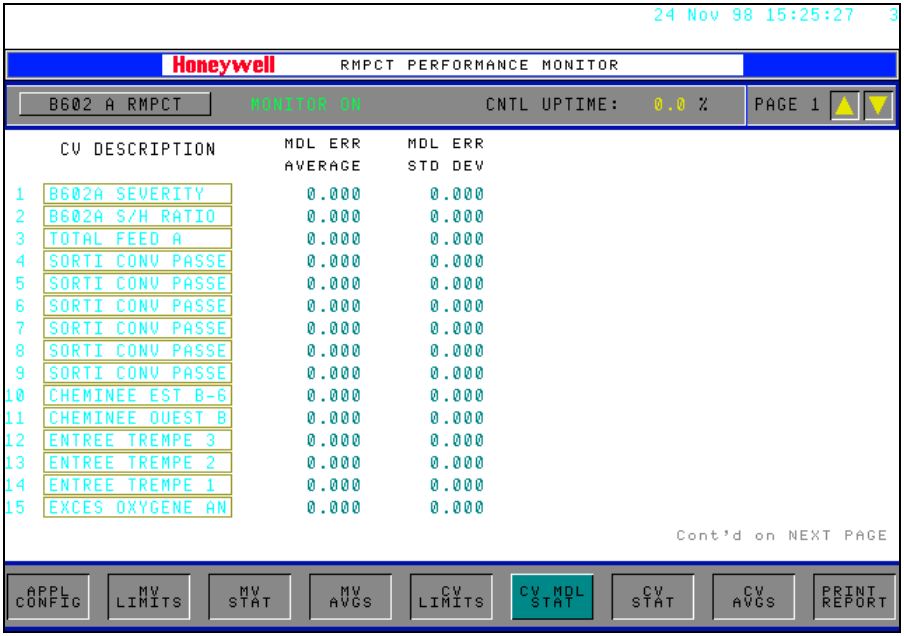
CV Model Statistic Information

CV model statistical information is track to provide information related to the model accuracy.

NOTE: This page will only be available for future release of the Performance Monitor. Currently the values are not updated.

MDL ERR AVERAGE — Tracks the average model error.

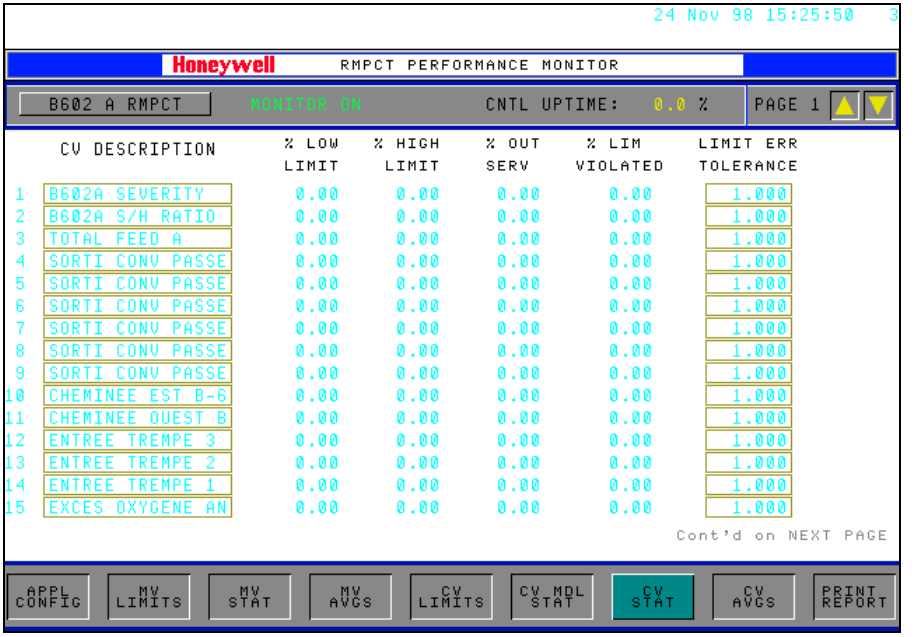
MDL ERR STD DEV — Displays the standard deviation of the CVs model versus plant error



CV Statistic Information

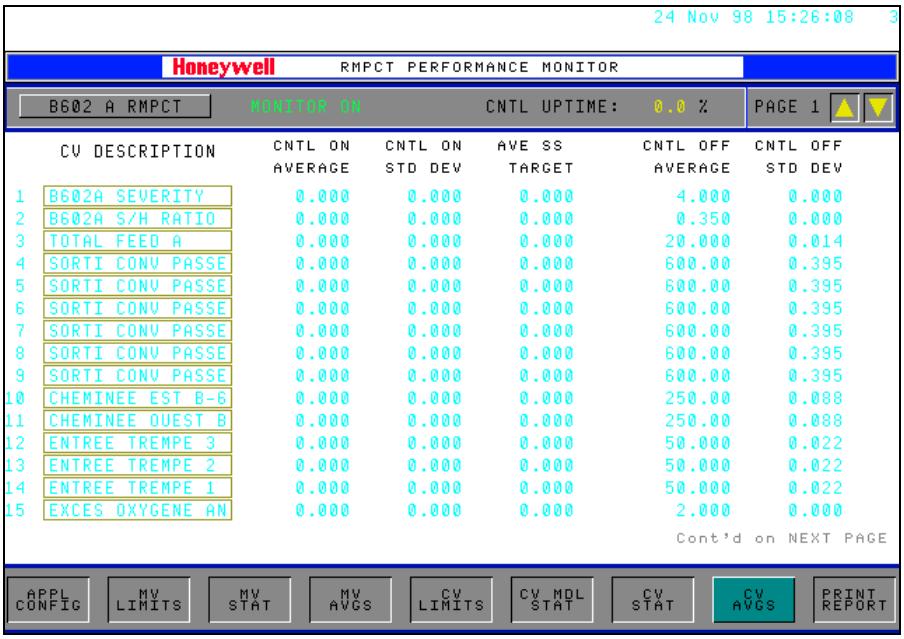
CV statistical information is provided to track control limitation or unit constraints which reduce unit performance.

% LOW LIMIT	Defined as: LOW LIMIT + ΔSOFT LOW Tracks the percent of time a CV was constrained at or below a low bounds.
% HIGH LIMIT	Defined as: HI LIMIT + ΔSOFT HI Tracks the percent of time a CV was constrained at or above an upper bounds.
"% OUT SERV"	Tracks the percent of time a CV was out of service or not available for RMPCT control.
"% LIM VIOLATED"	Tracks the percent of time a CV violates its upper or lower bounds based on CV limit tolerances.
"% LIMIT ERR TOLERANCE"	Displays the CV limit tolerance corresponding to each CV.



CV Averages and Standards Deviations

CV averages and standard deviations provide information related to the performance of RMPCT control and optimization. The “AVE SS TARGET” information provides the average steady state target for each CV within the monitoring window. In addition to controller information, averages and standard deviations are calculated for periods when the unit is under operator control.



5.6 Viewing Different Monitoring Points

Overview

The performance monitoring schematics are completely generic and therefore can display any monitoring point established on the system.

View Specific Monitor Applications

The following steps outline the procedure to display or view specific monitoring applications.

Select the SCHEM button from the TDC operator console and enter the schematic name “RMPC_PRF”.

If the display data base (DDB) does not contain a monitoring point, many of the schematic field will appear blank. Notice that the display header is flashing “Select Monitor” and that a red asterisk (*) is flashing next to a blank data box.

Selecting the blank data box prompts the user to enter a performance monitoring point. Enter the desired application tagname and press ENTER. The monitoring schematic should now contain information related to the selected application.

If the selected application has not yet been activated, the display header will display “INACTIVE”. To activate the application go to the monitoring point and set the point activity status to ACTIVE. The monitoring application will immediately begin a configuration and initialization check.

To view another application, simply select the “PERFORMANCE POINT” data box and enter the desired monitoring point, the new selection will now be displayed.

If the filename and file path are correct the monitoring application can be initiated by setting the “Monitoring Status”. Once the monitoring status has been set to ON, the application begins tracking the application during both RMPCT and operator control.

5.7 Monitoring Reports and Filenames

Viewing or Altering the Report Filename

Performance reports are typically written to the TDC history module (HM). The user must specify the full path and file name for the application. To view or alter the report filename follow the guideline below.

Select the SCHEM button from the TDC operator console and enter the schematic name “RMPC_PRF”.

Changing the Displayed Monitor

If the monitor displayed within the schematics is not the desired application, select the performance point data box and enter the desired monitoring tagname.

Path Filenames

The application path and filename are displayed directly below the “Report Path and Filename” heading. the filename must not exceed 8 characters. The filename must also include a file extension, typically denoted by .XX or .XT. Selecting the data box will prompt the user for the desired file path and name. The file directory must exist on the HM.

Examples of File Pathnames

The following are several examples of complete file pathnames;

NET>RMPC>ATM_RPT.XX

NET>DATA>FCCU_RPT.XT

NET>D1>TST.XX

* $F1>DATA>REPORT.XX

* Note: For a report to be sent to a disk drive ($Fn), the removable media must be mounted within the disk drive and contain the specified directory.

5.8 Configuring the Reporting Frequency

Viewing or Altering the Reporting Frequency

The frequency at which performance reports are generated is best configured from the monitoring schematics. To view or alter the reporting frequency follow the guideline below.

Select the SCHEM button from the TDC operator console and enter the schematic name “RMPC_PRF”.

If the monitor displayed within the schematics is not the desired application, select the performance point data box and enter the desired monitoring tagname.

The frequency at which reports are generated is defined by the “Report Type”. The user can select either “DAYS” or “MONTHLY” reports.

Monthly Reports

These reports are generated at midnight for the completion of the current month. If the filename does not exist, within the specified directory it is created. If the file does exist the current report is appended to the existing file.

Days Reports

These reports are generated at midnight for the completion of the configured number of days. To alter the reporting period, select the “Reporting Days” data box and enter the number of days desired for the monitoring window. If the filename does not exist, within the specified directory it is created. If the file does exist the current report is appended to the existing file.

Initializing Averages, Standard Deviations, and Percentages

The final consideration is whether or not the user wants to initialize the monitoring information after generating a report. If initialization [INIT] is selected, all averages and standard deviations are set to zero for the next monitoring window. If the user selects no initialization [NO INIT], the previous monitoring information is averaged into the following monitoring window.

Definition of Standard Deviation

$$T = \sqrt{\frac{n \sum (x^2) - n\left(\sum (x)\right)^2}{n^2}}$$

For samples < 60, the standard deviation will be slightly inaccurate.

5.9 Monitoring Re-Configuration

Configuration Check

If an RMPCT controller is updated or altered, the monitoring application should perform a configuration check to ensure that the new controller information is correctly loaded. To perform this configuration check follow the steps outlined below.

Select the SCHEM button from the TDC operator console and enter the schematic name “RMPC_PRF”.

If the monitor displayed within the schematics is not the desired application, select the performance point data box and enter the desired monitoring tagname.

Configuration Based on Two Events

The performance monitoring application will check the controller configuration based on two events, either the monitoring point being set INACTIVE and then ACTIVE or by the selection of the “Force Re-Config Check” target.

INACTIVE - Every time the monitoring point is first activated the application performs a configuration check of the RMPCT controller. Therefore by toggling the point activation status, any controller changes will be updated within the performance monitor.

RE-CONFIG - Within the application overview display is a target which initiates a configuration check of the controller. Selecting “Force Re-Config Check” will therefore initiate an examination of the RMPCT and any changes will be updated within the performance monitor.

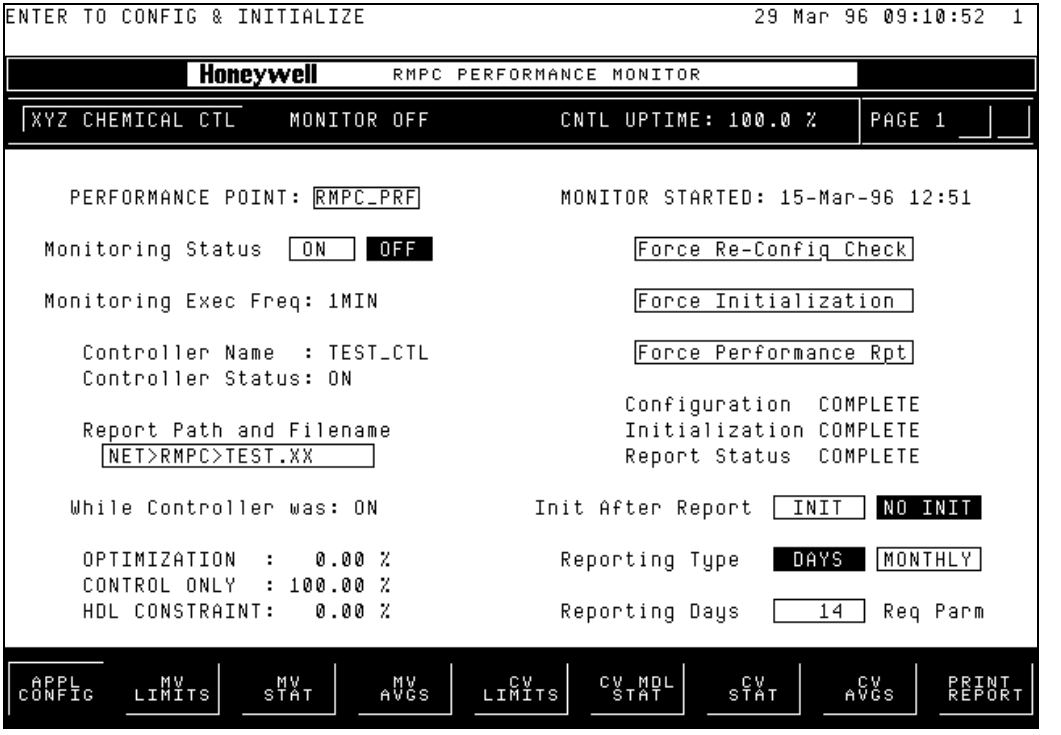
Viewing the Progress of the Configuration Checks

The user can view the progress of the configuration checks from the monitoring display. The status of the “Configuration”, “Initialization”, and “Report Status” fields provide feedback as to the progress of a configuration check. Once each of the fields display “COMPLETE”, the system is once again ready to begin monitoring.

5.10 Spot Reports

Requesting Spot Reports

Spot reports can be requested at any time during the monitoring window. There are two methods which allow the user to request spot reports. First with a target [FORCE PERFORMANC RPT] within the application overview display and second, the menu bar button [PRINT REPORT].



Generating Spot Reports

Selecting either of the two targets will generate a prompt asking the user to confirm by pressing ENTER. Reports generated by these methods will not initialize the performance information or interrupt the normal reporting cycle.

5.11 Appendix -- Error Codes

Overview

The tables in this section describe the following program error codes:

Configuration and Initialization error codes
Controller information error codes.
MV information error codes.
CV information error codes.
MV Report generation error codes.
CV Report generation error codes.
Software License error codes.

Configuration/ Initialization

Configuration/Initialization Error Codes		
Parameter	**Value**	**Description**
STATUS(1)	0.0	No errors
	1.0	Null entity entered for the controller tagname
	2.0	Error transferring the number of CV's
	3.0	Error transferring the number of MV's
	4.0	Limit violation for the number of CV (1..40)
	5.0	Limit violation for the number of MV (1..20)
	6.0	Null entity encountered during CV transfer
	7.0	Error encountered transferring CV points
	8.0	Null entity encountered during MV transfer
	9.0	Error encountered transferring CV points
	10.0	Error converting Date/Time string for CDS
	11.0	Error truncating system Date to string (Day)
	12.0	Error truncating system Date to string (Month)
	13.0	Error moving system date string to CDS
	14.0	Error moving system date string (Update Condition)
	15.0	Error moving system month string to CDS
	16.0	Error moving CV point PVCALC to CDS
	17.0	Error moving MV point T(1) to CDS

Configuration/ Initialization

Configuration/Initialization Error Codes		
Parameter	**Value**	**Description**
STATUS(3)	0.0	No errors
	1.0	NaN real value was stored (comerr / badvalst)
	2.0	Local enum store with value greater than max (cnferr)
	3.0	Local self defined enum store with value > than max (cnferr)
	4.0	Source and destination data type not the same (cnferr)
	5.0	Source and destination array type not the same (cnferr)
	6.0	Value fetch or store failed (data owner dependent)
	7.0	Entire array moves exceed maximum limit (arraylim)

Controller Information Error Codes

Controller Information Error Codes		
Parameter	**Value**	**Description**
STATUS(4)	0.0	No errors
	1.0	Null entity entered for the controller tagname
	2.0	Bad value for controller point M - Controller ON/OFF

MV Information Error Codes

MV Information Error Codes		
Parameter	**Value**	**Description**
STATUS(5)	0.0	No errors
	1.0	Null entity entered for the controller tagname
	2.0	Bad value for controller point M - Controller ON/OFF
	100.0	Null entity encountered within MV entity array
	101.0	BAD value encountered for MV Setpoint
	102.0	BAD value encountered for MV Steady State value
	103.0	BAD value encountered for MV Status
	104.0	BAD value encountered for MV Low Limit
	105.0	BAD value encountered for MV High Limit
	106.0	BAD value encountered for MV Max Move Low Limit
	107.0	BAD value encountered for MV Max Move High Limit
	108.0	BAD value encountered for MV current move
	201.0	Error during Average of MV Low Limit
	202.0	Error during Average of MV High Limit
	203.0	Error during Average of MV Steady State value
	204.0	Error during Average of MV Setpoint (Cntl ON)
STATUS(5)	205.0	Error during Standard Deviation of MV Setpoint (Cntl ON)
	300.0	Error during move of MV Setpoint (Cntl OFF)
	301.0	Error during Average of MV Setpoint (Cntl OFF)
	302.0	Error during Standard Deviation of MV Setpoint (Cntl OFF)
STATUS(6)	0.0	No errors
	1..20	Array location for a MV move parameter failure.

CV Information Error Codes

CV Information Error Codes		
Parameter	**Value**	**Description**
STATUS(7)	0.0	No errors
	1.0	Null entity entered for the controller tagname
	2.0	Bad value for controller point M - Controller ON/OFF
	100.0	Null entity encountered within CV entity array
	101.0	BAD value encountered for CV Present Value
	102.0	BAD value encountered for CV Un-Biased Prediction
	103.0	BAD value encountered for CV Steady State
	104.0	BAD value encountered for CV Status
	105.0	BAD value encountered for CV Low Limit
	106.0	BAD value encountered for CV High Limit
	201.0	Error during Average of CV Low Limit
	202.0	Error during Average of CV High Limit
	203.0	Error during Average of CV Steady State value
	204.0	Error during Average of CV Present Value (Cntl ON)
	205.0	Error during Standard Deviation of CV Present Value (Cntl ON)
	300.0	Error during move of CV Present Value (Cntl OFF)
	301.0	Error during Average of CV Present Value (Cntl OFF)
	302.0	Error during Standard Deviation of CV Present Value (Cntl OFF)
STATUS(8)	0.0	No errors
	1..40	Array location for a CV move parameter failure.

MV Reporting File Error Codes

MV Reporting File Error Codes		
Parameter	**Value**	**Description**
STATUS(9)	0.0	No errors
	1.0	Error during File EXISTS check
	2.0	Error during File OPEN routine
	3.0	Error during File CREATE routine
	4.0	Error during secondary File OPEN routine
	5.0	Error during controller name WRITE
	6.0	Error during starting date & time WRITE
	7.0	Error during ending date & time WRITE
	8.0	Error during format line WRITE
	9.0	Error during controller uptime WRITE
	10.0	Error during controller OPT time WRITE
	11.0	Error during controller CNTL time WRITE
	12.0	Error during controller CNSTRT time WRITE
	13.0	Error during format line WRITE
	14.0	Error during MV Limits header WRITE
	15.0	Error during format line WRITE
	16.0	Error during MV Limit Descriptions WRITE
	17.0	Error during format line WRITE
	18.0	Error during MV limit information WRITE
	19.0	Error during format line WRITE
	20.0	Error during format line WRITE
	21.0	Error during MV Statistics header WRITE
	22.0	Error during format line WRITE
	23.0	Error during MV Statistics Descriptions WRITE
	24.0	Error during format line WRITE
	25.0	Error during MV statistics information WRITE
	26.0	Error during format line WRITE
	27.0	Error during format line WRITE
	28.0	Error during MV Averaged header WRITE
	29.0	Error during format line WRITE
	30.0	Error during MV Averaged Descriptions WRITE
	31.0	Error during format line WRITE
	32.0	Error during MV averaged information WRITE
	33.0	Error during format line WRITE

MV Reporting File I/O Error Codes

MV Reporting File I/O Error Codes		
Parameter	**Value**	**Description**
STATUS(10)	0.0	No errors
	1.0	NaN real value was stored (comerr / badvalst)
	2.0	Local enum store with value greater than max (cnferr)
	3.0	Local self defined enum store with value > than max (cnferr)
	4.0	Source and destination data type not the same (cnferr)
	5.0	Source and destination array type not the same (cnferr)
	6.0	Value fetch or store failed (data owner dependent)
	7.0	Entire array moves exceed maximum limit (arraylim)

CV Reporting File Error Codes

CV Reporting File Error Codes		
Parameter	**Value**	**Description**
STATUS(11)	0.0	No errors
	1.0	Error during File EXISTS check
	2.0	Error during File OPEN routine
	3.0	Error during File CREATE routine
	4.0	Error during secondary File OPEN routine
	5.0	Error during CV Limits header WRITE
	6.0	Error during format line WRITE
	7.0	Error during CV Limit Descriptions WRITE
	8.0	Error during format line WRITE
	9.0	Error during CV limit information WRITE
	10.0	Error during format line WRITE
	11.0	Error during format line WRITE
	12.0	Error during CV Statistics header WRITE
	13.0	Error during format line WRITE
	14.0	Error during CV Statistics Descriptions WRITE
	15.0	Error during format line WRITE
	16.0	Error during CV statistics information WRITE
	17.0	Error during format line WRITE
	18.0	Error during format line WRITE
	19.0	Error during CV Averaged header WRITE
	20.0	Error during format line WRITE
	21.0	Error during CV Averaged Descriptions WRITE
	22.0	Error during format line WRITE
	23.0	Error during CV averaged information WRITE
	24.0	Error during format line WRITE

CV Reporting File I/O Error Codes

CV Reporting File I/O Error Codes		
Parameter	**Value**	**Description**
STATUS(12)	0.0	No errors
	1.0	NaN real value was stored (comerr / badvalst)
	2.0	Local enum store with value greater than max (cnferr)
	3.0	Local self defined enum store with value > than max (cnferr)
	4.0	Source and destination data type not the same (cnferr)
	5.0	Source and destination array type not the same (cnferr)
	6.0	Value fetch or store failed (data owner dependent)
	7.0	Entire array moves exceed maximum limit (arraylim)

Software License Error Codes

Software License Error Codes		
Parameter	**Value**	**Description**
ERRCODE	0.0	No errors
	1.0	Software expiration date has expired
	2.0	Software CDS package name error (location CDS)
	3.0	Software AM node number error (location CDS)
	4.0	Software AM node number error (location Point)
	5.0	Software time cross check error (location CDS)
	6.0	Software error contact Honeywell

RMPCT Cascade

(Optional Item)

Section 6 — RMPCT Cascade

6.1 Overview

In This Section

The Cascaded RMPCT Utility allows one RMPCT controller to cascade a setpoint to another RMPCT controller. The utility consists of a single AM/CL program, a modified RMPCT CV Summary display, and some minor configuration changes.

Requirements

Requirement	Description
Hardware Platform	TDC 3000® AM
Special Boards	None
Other Computing Systems	None
LCN Release	Release 300 or later
AM Load Modules	None
US Load Modules	None
Other Packages	None
Other Control Applications	Honeywell RMPCT™ On-line Software
Software Inputs	None

6.2 Detailed Description

This utility allows an MV interface point in a primary RMPCT controller to cascade a setpoint to a CV interface point in a secondary RMPCT controller. A program linked to the secondary controller's CV interface point handles windup status propagation and shedding. There may be more than one MV/CV cascade pair configured. The primary controller MV interface point, the primary controller output point, and the secondary CV interface point must be re-configured.

Configuration Change Summary

The following tables list CDS parameters, which require re-configuration.

PRIM_CTL = Primary controller point
PRIM_OUT = Primary controller output point
PRIM_MV = Primary controller MV interface point
SEC_CTL = Secondary controller point
SEC_CV = Secondary controller CV interface point

SEC_CV Configuration Changes	
Parameter	Value
CTLALGID	CL
NOCOPTS	0
CVEUHI	PVEUHI value
CVEULO	PVEULO value
SPEUHI	PVEUHI value
SPEULO	PVEULO value
SPHILM	PVEUHI value
SPLOLM	PVEULO value
CLSLOTS	1
NOPKG	2
PKGNAME(2)	RCAS_CDS
SNAME(1)	PRIM_CTL tag name
SNAME(2)	SEC_CTL tag name
ANAME	PRIM_MV tag name
PARNAME	PRIM_OUT tag name
T1	Primary controller output point M array index for MV/CV pair.

PRIM_MV Configuration Changes	
Parameter	Value
PISRC(1)	SEC_CV.SP
PISRC(2)	SEC_CV.PV
PISRC(3)	SEC_CV.PV
CODSTN(1)	SEC_CV.SP

PRIM_OUT Configuration Changes	
Parameter	Value
M(i)	AUTO; where i = T1 in SEC_CV above
P4(j)	SEC_CV tag name; where j = the index corresponding to PRIM_MV in the P2(j) parameter list.

6.3 Installation Procedure

Preparation for Installation

Step	Action
Gather Media	Gather the following items: • Removable media containing the files for the Remote Cascade routine
Make Media Backup	Make a backup copy of media/directory on a US with drives n and m configured as follows: Media: FCOPY $Fn $Fm

Custom Data Segment (CDS) and Parameter List (PL) - This procedure must be done once per LCN installation

Step	Action

Set Volume Paths	From Modify Volume Paths display:
	`CL CUSTOM GDF: NET>CDSG>`
	`USER DEFLT PATH: $Fn>CL>`
	`CL PARAM LIST: NET>CL`
	`CL SOURCE/OBJ: $Fn>CL>`
	Where $Fn is the drive with the source media.

Compile ROUT_PL.CL	From the Command Processor Display, compile the Parameter List file, ROUT_PL: `CL $Fn>PL>ROUT_PL –UL –NX`
Compile RCAS_CDS.CL	From the Command Processor Display, compile the CDS file, RCAS_CDS: `CL $Fn>CDS>RCAS_CDS -UL –NX`

Installing a Different CV Summary Display

A different version of the CV Summary Display is required to interface with the Cascaded RMPCT feature. The following procedure will install this version on the system.

Step	Action
Load the picture editor	From the main Engineering display, select the PICTURE EDITOR target.
Load DDB	Load Global variable definition file, DDB: `L $Fn>4SCH>RMPC_DDB [ENTER]`
Read in the schematic	In the command line at the bottom of the display, type `R $Fn>4SCH>RMPC_CV1 [ENTER]` Where $Fn is the drive with the source media.
Verify the schematic	In the command line at the bottom of the display, type: `VER [ENTER]`
Compile the schematic	In the command line at the bottom of the display, type: `COM [ENTER]`
Copy the object file to the system directory which hold schematic object files	1. Press the ESC key to escape to the command processor. 2. Type: `CP $Fn>4SCH>RMPC_CV1.DO NET>xxxx>= -D` Where "xxxx" is the system directory with the object files (probably "RMPC"). 3. Press CTL + HELP key to return to picture editor. 4. Press CTL + HELP again to exit from picture editor.

6.4 Configuring the RMPCT Points

MV/CV Pairs

The following procedure should be used to configure a cascaded RMPCT controller MV/CV pair.

PRIM_CTL = Primary controller point
PRIM_OUT = Primary controller output point
PRIM_MV = Primary controller MV interface point
SEC_CTL = Secondary controller point
SEC_CV = Secondary controller CV interface point

Point Configuration

Step	Point	Description
0		Build both the primary and secondary controllers and all of their associated points following the standard RMPCT build procedures.
1	PRIM_CTL, SEC_CTL	Inactivate the primary and secondary controller main points.
2	PRIM_OUT, PRIM_MV, SEC_CV	Inactivate the primary MV interface and output points, and the secondary CV interface point.
3	SEC_CV	Reconstitute *SEC_CV* and make the following changes: • Specify a "CL" Control Algorithm • Set/Verify the number of output connections to 0 • Set CVEULO = PVEULO • Set CVEUHI = PVEUHI • Set SPEULO = PVEULO • Set SPEUHI = PVEUHI • Set SPLOLM = PVEULO • Set SPHILM = PVEUHI • Increase the number of CDS packages by one • Add the CDS package "RCAS_CDS" • Set SNAME(1) = *PRIM_CTL* tag name • Set SNAME(2) = *SEC_CTL* tag name • Set ANAME = *PRIM_MV* tag name • Set PARNAME = *PRIM_OUT* tag name • Set T1 = the primary controller output point shed mode index for this MV/CV pair
4	SEC_CV	Load *SEC_CV* with overwrite.

Step	Point	Description
5	SEC_CV	Link the RMPC_CAS object code to *SEC_CV* • LK $Fn>AO>RMPC_CAS *SEC_CV* Where $Fn is the drive with the source media, and *SEC_CV* is the CV interface tag name.
6	SEC_CV	Activate *SEC_CV*.
7	PRIM_MV	Reconstitute *PRIM_MV* and make the following changes: • Set PISRC(1) = *SEC_CV*.SP • Set PISRC(2) = *SEC_CV*.PV • Set PISRC(3) = *SEC_CV*.PV • Set CODSTN(1) = *SEC_CV*.SP
8	PRIM_MV	Load *PRIM_MV* with overwrite.
9	PRIM_MV	Activate *PRIM_MV*. • Note: There will be a "STOREFAIL" error on the control output for this point when it is set active. This error will clear when *SEC_CV* is set to CAS MODE.
10	PRIM_OUT	On the *PRIM_OUT* point, locate the P2 array index which contains *PRIM_MV*. This value will be referred to as "i" in the next step.
11	PRIM_OUT	On the *PRIM_OUT* point, set P4(i) = *SEC_CV* tag name.
12	PRIM_OUT	On the *PRIM_OUT* point, locate the M array index "j" for this MV/CV pair. • Note: If all of the MV's in the primary controller have only one cascaded controller, then "j" in step 12 will be the same as "i" in step 10. If not, then "i" and "j" will not be equal.
13	PRIM_OUT	On the *PRIM_OUT* point, set M(j) = AUTO.
14	PRIM_OUT	Activate *PRIM_OUT*.
15	PRIM_CTL, SEC_CTL	Activate the primary and secondary controller main points.
16		Use the MV Tuning (Control Tuning) display for the secondary RMPCT controller to set the PB/SPTK RATIO value to 0.0 for any MV's that have a model with any of the SEC_CV points. If there is a non-zero value for this parameter on any of the MV's which affect a SEC_CV, then the SEC_CV will not become wound up (WDUP) and the windup status will not be propagated to the PRIM_MV. The PRIM_MV should have a non-zero PB/SPTK RATIO to prevent prolonged windup.

6.5 RMPCT Cascade Operation

When a primary RMPCT controller is cascading to a secondary RMPCT controller, at least one MV in the primary controller is providing a setpoint for a corresponding CV in the secondary controller. The operator may not alter the CV's setpoint (or low or high limit) when it is being cascaded to. There are only two operations involved with this cascade feature. They are initiating the cascade, and breaking the cascade.

To initiate an MV to CV cascade:

If ...	Step	Description
Primary controller is OFF Secondary controller is OFF	1	Set the desired MV MODE to RMPC from the Primary controller MV Summary display (see display below).
	2	Turn the Primary controller ON. **Note: This will automatically turn the Secondary controller ON.**
	3	Verify both controllers are turned ON, the MV is in RMPC MODE on the Primary controller MV Summary display (see display below) with a STATUS of GOOD, and the corresponding CV is in RMPC mode on the Secondary controller CV Summary display (see display below).
Primary controller is OFF Secondary controller is OFF	1	Set the desired MV MODE to RMPC from the Primary controller MV Summary display (see display below).
	2	Verify the MV is in RMPC MODE on the Primary controller MV Summary display (see display below) with a STATUS of GOOD, and the corresponding CV is in RMPC mode on the Secondary controller CV Summary display (see display below).

If ...	Step	Description
Primary controller is OFF Secondary controller is ON	1	Turn the Primary controller ON.
	2	Set the desired MV MODE to RMPC from the Primary controller MV Summary display if necessary (see display below).
	3	Verify the MV is in RMPC MODE on the Primary controller MV Summary display (see display below) with a STATUS of GOOD, and the corresponding CV is in RMPC mode on the Secondary controller CV Summary display (see display below).
Primary controller is ON Secondary controller is OFF	1	Turn the Secondary controller ON.
	2	Set the desired MV MODE to RMPC from the Primary controller MV Summary display if necessary (see display below).
	3	Verify the MV is in RMPC MODE on the Primary controller MV Summary display (see display below) with a STATUS of GOOD, and the corresponding CV is in RMPC mode on the Secondary controller CV Summary display (see display below).

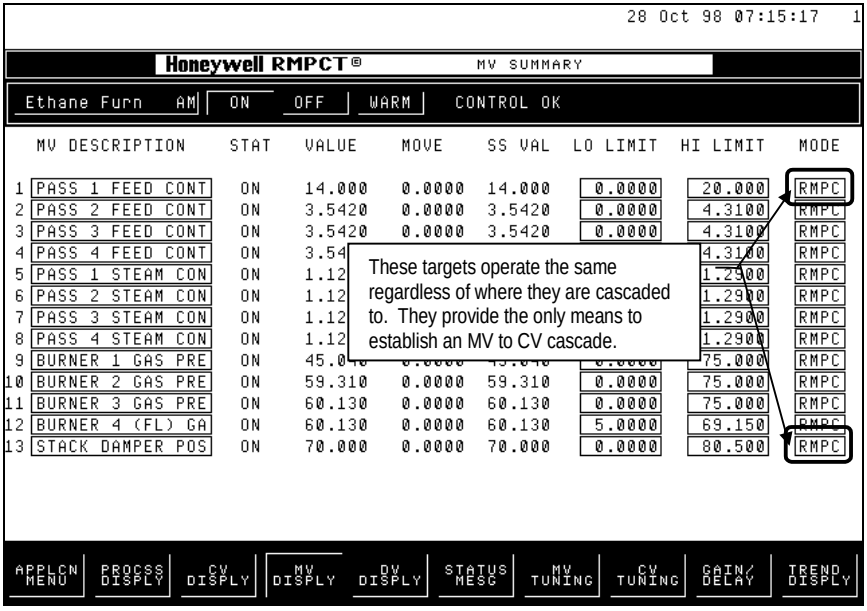
6.6 To Break an MV to CV Cascade

Primary Controller

There are two methods that can be used to break the MV to CV cascade.
From the Primary Controller MV Summary display

Step	Description
1	Set the desired MV MODE to MAN.
2	Verify the MV is in OPR with a STATUS of GOOD, and the corresponding CV is no longer in RMPC mode on the Secondary controller CV Summary display.

Primary Controller MV Summary Display

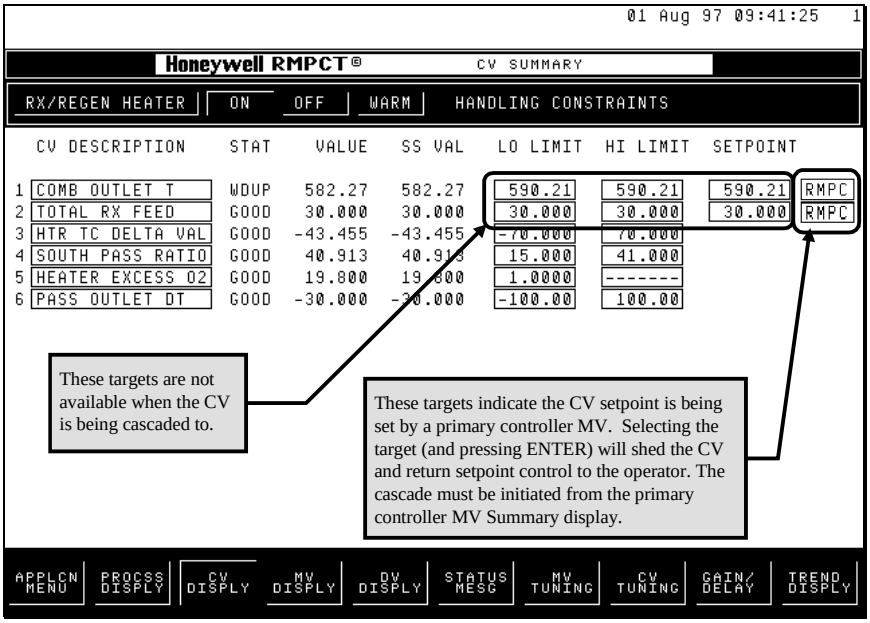


Secondary Controller

From the secondary controller CV Summary Display

Step	Description
1	Select the RMPC target for the desired CV and press ENTER (see display below).
2	Verify the RMPC target becomes hidden and the SETPOINT and LO and HI LIMIT targets become available. Also verify the MV mode becomes OPR from the Primary controller MV Summary display. Note: If the MV is designated as critical or if the Primary controller is configured to stop on non-critical MV cascade loss then the user will not be able to break the cascade from the CV Summary display. In this case the cascade may only be broken by turning either controller OFF.

Secondary Controller CV Summary Display



Process Value (PV) Validation

(Optional Item)

.

Section 7 —PV Validation

7.1 Overview

Definition

The PV (Process Value) Validation routine determines the validity of any input process value subject to user criteria. The routine also enables validity checking and updating for RMPCT asynchronous controlled variables. This provides the user a mechanism to determine which process input values to use in various advanced control applications.

Application

The PV Validation routine is designed to work with any of the Honeywell Hi-Spec Solutions inferential property calculations and RMPCT applications.

Incentive

To provide valid process values to inferential property calculations and RMPCT applications subject to user validity criteria.

Acronym List

Acronym	Term
AM	Application Module
AO	CL object code file extension
CDS	custom data segment
CL	control language
CVs	controlled variables
LCN	Local Control Network

Hardware and Software Requirements

Requirement	Description
Hardware Platform	TDC 3000 AM
Special Boards	None
Other Computing Systems	None
LCN Release	Release 300 or later
AM Load Modules	None
US Load Modules	None
Other Packages	Any of the Honeywell Hi-Spec Solutions Inferential Property routines and RMPCT applications (Asynchronous CVs).
Other Control Applications	None
Software Inputs	The current process value (PVCALC) and validity check criteria.

7.2 Installation Procedure

This document describes the installation procedure for the PV Validation Routine on the TPS System AM

This section covers the following topics:

•Preparation for Installation

•CDS Installation

•Building / Reconfiguring AM Regulatory Points

7.3 Preparation for Installation

This document describes the installation procedure for the PV Validation routine on the TPS System AM

Step	Action
Gather media	Gather the following items: • Removable media containing the files for the PV Validation routine • Commissioning Worksheet
Make media backup	Make a backup copy of media/directory on a US with drives n and m configured as follows: Media: FCOPY $Fn $Fm

CDS Installation

This procedure must be done once per LCN installation.

Step	Action
Set volume pathnames	From Modify Volume Paths display: CL CUSTOM GDF: NET>CDSG> USER DEFLT PATH: $Fn>CDS
Compile PVAL_CDS.CL	From the Command Processor display, compile the CDS file, PVAL_CDS: CL $Fn>CDS>PVAL_CDS.CL -UL If it is necessary to change the CDS due to a software revision, refer to the Application Module Data Control Language/Application Module Data Entry

7.4 Building / Reconfiguring the AM Regulatory Point

The following describes key point building or reconfiguration parameters for RMPCT and non-RMPCT applications of the PV Validation routine.

RMPCT Applications

The following describes changes in the configuration of a standard RMPCT CV Interface point for use with the PV Validation routine.

Parameters	Notes
CL Slots = 2	The number of CL Slots changes from 0 to 2.
Number of Packages = 2	The number of CDS packages changes from 1 to 2.
PKGNAME(2) = PVAL_CDS Example: PKGNAME(1) = RCV_CDS PKGNAME(2) = PVAL_CDS *** No Deviations Allowed***	**IMPORTANT NOTE:** The PV Validation CDS Package, PVAL_CDS, **MUST** be configured as the second CDS Package. The CDS Package RCV_CDS **MUST** remain configured as the first CDS Package.

Non-RMPCT Applications

The following describes key parameters in building AM regulatory points for use with the PV Validation Routine.

Parameters	Notes
PV Algorithm = DATAACQ	None
CL Slots = 1	This will be used for PV_VAL.AO
Number of Packages = 1	This will be used for PVAL_CDS.CL
PKGNAME(1) = PVAL_CDS	Package name for PV Validation routine.

7.5 Detailed Description

Overview

The information provided within this section describes the PV Validation Routine architecture and custom data segments.

This section covers the following topics:

• Point Structures

• Custom Data Segments

Point Structures

Input to Inferential Calculations - The validation routine checks for violations of user entered hi limit, low limit, rate of change, freeze tolerances, and bad input values.

Point Structure (AM Regulatory Point)	
Point Type	**Application Module Regulatory Point**
PV Algorithm	DATAACQ (if process variable does not reside in the AM) None (if process variable does reside in the AM)
CTL Algorithm	None
Custom Data Segment	PVAL_CDS.CL
Insertion Point	PST_PVAG(3)
Output	PVCALC ; CALC_VAL(1)

Input to RMPCT Applications - This validation routine is used for Both continuous and or asynchronous controlled process inputs. The validation routine checks for violations of user entered hi limit, low limit, rate of change and freeze tolerances, and bad input values. In addition, the routine also "flags" the RMPCT controller to update with a new process value when all validity checks are cleared.

The standard RMPCT CV Interface Point structure is used plus the following additions.

Point Structure (AM RMPCT Asynchronous CV Interface Point)	
Point Type	**Application Module RMPCT Asynchronous CV Interface Point**
Custom Data Segment	PVAL_CDS.CL
Insertion Point	PST_PVAG(3) PST_PVAG(5)
Output	PVCALC ; CALC_VAL(1)

Custom Data Segments

The following section outlines the custom data segments (CDS) which are attached to the process value validity routine points. The tables provide a brief description of the parameters and their usage.

The following CDS parameters are attached to any point that will execute the validity check routine.

Custom Data Segments (PVAL_CDS)		
Parameter	**Description**	**Default Values**
ENGPAR(1)	User allowed valid process hi limit value	Default = 100
ENGPAR(2)	User allowed valid process lo limit value	Default = 0
ENGPAR(3)	Maximum user allowed rate of change between two consecutive process values in order to be considered valid	Default = 50
ENGPAR(4)	Minimum change allowed between two consecutive process values in order to be considered valid (Freeze tolerance)	Default = 100
ENGPAR(5)	Maximum time allowed for process value to be in a frozen state (in minutes)	Default = 100
ENGPAR(6)	Maximum time allowed for a process value to be in a violated state (in minutes). Violated state includes hi limit, lo limit, rate of change, and bad value violations.	Default = 100
ENGPAR(7)	Current process value valid flag. [Set current value valid = 1 ; Do not set current value valid = 0] *Note: Do not set this flag if current process value is violating the user entered hi or lo limit, or if the current value is bad.*	Default = 0
ENGPAR(8)	Current process values less than zero to be set equal to zero flag. [Allow program to set process values less than zero equal to zero = 1 ; Do not allow program to set process values less than zero equal to zero = 0]	Default = 0

Custom Data Segments (PVAL_CDS)		
Parameter	**Description**	**Default Values**
ENGPAR(9)	RMPCT update flag. Used for RMPCT Asynchronous CVs. [Update RMPCT = 1 ; Do not update RMPCT = 0] *Note: This parameter is set by the validation routine, not the user.*	Default = 0
ENGPAR(10)	Available for future use.	Default = 0
TIMEDESC	Last execution Date/Time stamp	00:00:00
CALC_VAL(1)	Current input process value	Default = 0
CALC_VAL(2)	Counter tracking process value freeze state	Default = 0
CALC_VAL(3)	Counter tracking any other process value violation state	Default = 0
CALC_VAL(4)	Last good process value used for rate of change violation reference	Default = 0
CALC_VAL(5)	Input process value from previous execution	Default = 0
STATUS(1)	Bad value error status	Default = 0
STATUS(2)	Current error	Default = 0
REV_NO	Revision Number of the CDS package	N/A

7.6 System Configuration

Configuration of the PV Validation is accomplished through direct entry to the CDS ports on the AM Regulatory Point.

Setup of the PV Validation requires the following steps:

- CDS Configuration of AM Regulatory Point
- Linking CL Program.

7.7 AM Regulatory Point Configuration (Direct CDS Entry)

Configuration data must be entered directly onto the AM regulatory point. The required information and associated parameter are listed below.

Note: The same procedure is used for RMPCT and non-RMPCT applications.

Parameter	Description	Comments
ENGPAR(1)	User allowed process value hi limit.	Default = 100
ENGPAR(2)	User allowed process value lo limit.	Default = 0
ENGPAR(3)	User allowed process value rate of change.	Default = 50
ENGPAR(4)	Minimum allowed process value change allowed between two consecutive inputs to be considered valid. (Freeze tolerance)	Default = 100
ENGPAR(5)	Maximum time (in minutes) allowed for process value to stay within a given freeze tolerance (Freeze time)	Default = 100
ENGPAR(6)	Maximum time (in minutes) allowed for a process value to be in a hi limit, lo limit, bad value, or rate of change violation.	Default = 100
ENGPAR(7)	Reset flag that allows the user to set the current process value valid. 0 => Do not reset 1 => Reset	Default = 0 ; This resets the AM Regulatory point's PVCALC parameter equal to the current process value. Note: Do not set this flag when the current process value is in violation.
ENGPAR(8)	Flag that resets any input process value less that zero equal to zero. 0 => Do not reset 1=> Reset	Default = 0
ENGPAR(9)	This parameter sets a flag to update RMPCT that a new value is available. 0 => Do not update RMPCT 1 => Update RMPCT	Default = 0 ; This parameter is set by the program and only used for RMPCT applications. If the CL block PV_ASYNC is not used (non-RMPCT applications), the value of this parameter does not affect the validation routine.

7.8 Linking CL Programs

Linking RMPCT Applications

The following procedure is used for RMPCT applications with asynchronous CVs.

Step	Action
Link PV_VAL	From the Command Processor Display: LK $Fn>AO>PV_VAL (RMPCT CV interface point) [ENTER]
Link PV_ASYNC	From the Command Processor Display: LK $Fn>AO>PV_ASYNC (RMPCT CV interface point) [ENTER] (Required only for asynchronous CV's)
Activate point	Call up the point detail and activate the point.
Verify Operation	Verify that PV_VAL and PV_ASYNC are running without any CL errors.

Linking Non-RMPCT Applications

The following procedure is used for any non-RMPCT application.

Step	Action
Link PV_VAL	From the Command Processor Display: LK $Fn>AO>PV_VAL (process/unit point) [ENTER]
Activate point	Call up the point detail and activate the point.
Verify Operation	Verify that PV_VAL is running without any CL errors.

7.9 PV Validation Operation

Overview

This section deals with the functionality of PV Validation when a validation check has been violated. It also describes the usage of PV Validation when used with a RMPCT CV Interface Point.

Validation errors that clear automatically

The Hi/Lo limit violations and Bad Value violations are cleared automatically when the PV returns to normal.

Validation errors that the user must clear

The user must clear all freeze and rate of change violations. This can be done by setting the reset flag equal to 1.0 (ENGPAR(7) = 1.0).

Using PV Validation in conjunction with RMPCT CV Interface Point

If the PV Validation is configured on a RMPCT CV Interface point then the status of the PV validation can be viewed on the CV Detail display. Whenever a check is violated the CV process value is displayed as bad.

Selecting the PV Value and then selecting the RESET target will clear the violation. Note that the resetting functionality is only available for RMPCT Release 160 or later.

7.10 Appendix - Error Codes

Bad Value Error Codes

Configuration of the PV Validation is accomplished through direct entry to the CDS ports on the AM Regulatory Point.

Bad value Error Codes		
Parameter	**Value**	**Description**
STATUS(1)[4]	0.0	No errors
	1.0	Input process value has a: Bad value Hi limit violation Lo limit violation Rate of change violation
	2.0	Input process value has a freeze state violation

Configuration of the PV Validation is accomplished through direct entry to the CDS ports on the AM Regulatory Point.

Setup of the PV Validation requires the following steps:

- CDS Configuration of AM Regulatory Point
- Linking CL Program.

Diagnostic Error Codes

Subroutine Error Codes		
Parameter	**Value**	**Description**
STATUS(2)	0.0	No errors
	1.0	Input process value has a bad pv
	2.0	Input process value has violated a hi limit
	3.0	Input process value has violated a lo limit
	4.0	Input process value has violated a rate of change limit
	5.0	Input process value is in a frozen state

[4] STATUS(1) indicates errors in the calculation.

Simulation BackBuilder

(Optional Item)

.

Section 8 — Simulation BackBuilder

8.1 Overview

Definition

The RMPCT Settings File (.xs) Back-Builder is designed to provide a mechanism to capture DCS controller tuning and configuration. The ".xs" file can be read either by an on-line application or by the off-line software.

Application

The settings file Simulation BackBuilder examines the defined RMPCT controller to acquire the matrix size and associated point tagnames. The routine then examines each of the controller interface points, collecting tuning and configuration information.

Calculation

The RMPCT Settings File Back-Builder performs no on-line calculations, instead it generates a system file containing the controller tuning and configuration information:

Acronym List

Acronym	Term
AM	Application Module
DCS	Distributed Control System
LCN	Local Control Network
US	Universal Station
PV	Process variable
MV	Manipulated variable
RMPCT	Robust Multivariable Predictive Control Technology
PL	Parameter List
CDS	Custom data segment
AO	CL object code file extension

.

Hardware and Software Requirements

Requirements	Description
Hardware Platform	TDC 3000 AM
Special Boards	None
Other Computing Systems	None
LCN Release	Release 410 or later
AM Load Modules	FILE, CONV, AMCL01, AMCL02 (Standard AM Load Modules)
US Load Modules	None
Other Packages	None
Other Control Applications	RMPCT Release 150 or later
Software Inputs	See Process Inputs

8.2 Detailed Description

Overview

The tables in this section describe the RMPCT Setting File Back-Builder program architecture:

- Point Structure
- Process Inputs
- Configuration Inputs
- Calculation Outputs.

Point Structure

Point Structure	
Point Type	**AM Custom, CL**
PV_Type	None
CTL_Type	None
Custom Data Segment	RXSG_CDS.CL
Algorithm	RXSG_CFG.AO , RXSG_WRT.AO
Insertion Point	Background
Slots	2 CL Slots - (1 and 3) Background
Output	The system configuration is stored to a file.

Process Inputs

Process Inputs				
			Critical	
Parameter	Description	Units	Yes	**No**
ANAME	Tagname of the RMPCT controller	N/A	**X**	
P1(0)	Tagname of a CV interface point	N/A	**X**	
P2(0)	Tagname of a MV interface point	N/A	**X**	
P3(0)	Tagname of a DV interface point	N/A	**X**	

All additional information regarding controller CV's, MV's and DV's is determined from the RMPCT controller point. During the "CONFIGURATION" phase the routine examines the controller and store the names of the controller interface points to CDS parameters.

Configuration Inputs

Configuration Inputs(RXSG_CDS)		
Parameter	Description	Units
PATHNAME	File Pathname (i.e. NET>RMPC>FILE.XS)	None

Calculation Outputs

Calculation Outputs		
Parameter	Description	Units
STATUS	Routine Error codes used for diagnostics	None

8.3 Error Codes

The tables in this section describe the following program error codes:

- Application location error codes
- Array index error codes.

Calculation Outputs		
Parameter	**Value**	**Description**
STATUS(1)	0.0	No errors
	1.0	Null entity entered for the RMPCT controller tagname
	2.0	Error transferring the number of CV's
	3.0	Error transferring the number of MV's
	4.0	Error transferring the number of DV's
	5.0	Limit violation for the number of CV (1..40)
	6.0	Limit violation for the number of MV (1..20)
	7.0	Limit violation for the number of DV (1..20)
	10.0	Null entity encountered during CV transfer
	11.0	Error encountered transferring CV points
	15.0	Null entity encountered during MV transfer
	16.0	Error encountered transferring MV points
	20.0	Null entity encountered during DV transfer
	21.0	Error encountered transferring DV points
	101.0	EXISTS check for file name has encountered an error
	102.0	DELETE file function has encountered an error
	103.0	CREAT file function has encountered an error
	104.0	OPEN file function has encountered an error
	105.0	Writing the software revisions number has encountered an error
	106.0	Writing the # CVs, MVs, DVs to file has encountered an error
	107.0	Writing the IJP information to file has encountered an error
	108.0	Writing the IJP information to file has encountered an error
	109.0	Writing of controller information has encountered an error
	110.0	Writing of CV data line 1 has encountered an error
	111.0	Writing of CV data line 2 has encountered an error
	112.0	Writing of MV data line 1 has encountered an error
	113.0	Writing of MV data line 2 has encountered an error
	114.0	Writing of DV data line 1 has encountered an error

Calculation Outputs		
Parameter	**Value**	**Description**
	115.0	Writing the Header for Open RMPCT has encountered an error
	116.0	Writing of controller execution frequency encountered an error
	117.0	Writing of controller CV values encountered an error
	118.0	Writing of controller MV values encountered an error
	119.0	Writing of controller DV values encountered an error

Array Index Location Error Codes

Controller Information Error Codes		
Parameter	Value	Description
STATUS(2)	0.0	No errors
	1..40	Array index of the CV, MV, or DV point which has caused the write error (see STATUS(1))

8.4 Installation Procedure

This section describes the installation procedure for the RMPCT settings file back-builder on the TDC 3000.

This section covers the following topics:

- Preparation for Installation
- CDS and PL Installation
- Building a Setting File Back-Builder Point
- Linking the Object Code

Preparation for Installation

Step	Action
Gather media	Gather the following items: •Removable media containing the monitoring software
Make media backup	Make a backup copy of media/directory on a US with drives n and m configured as follows: Media: FCOPY $Fn $Fm Where $Fn is the drive with the source media and $Fm is the drive with the target media

CDS and PL Installation

This procedure must be done once per LCN installation.

Step	Action
Set volume pathnames	From Modify Volume Paths display: CL CUSTOM GDF: NET>CDSG> CL PARAM LIST: NET>CL USER DEFLT PATH: $Fn>CL
Compile Param List RXSG_PL.CL	From the Command Processor display, compile the PL file, RXSG_PL: CL $Fn>PL>RXSG_PL.CL -UL -NX If it is necessary to change the PL due to a software revision, refer to the Application Module Data Control Language/Application Module Data Entry
Compile CDS Param RXSG_CDS.CL	From the Command Processor display, compile the CDS file, RXSG_CDS: CL $Fn>CDS>RXSG_CDS.CL -UL -NX If it is necessary to change the CDS due to a software revision, refer to the Application Module Data Control Language/Application Module Data Entry

8.5 Building a Simulation BackBuilder Point

Steps to Build the Point

Step	Action
Modify Exception Build file, RMPC_XSG.EB	From the Command Processor display: ED $Fn>EB>RMPC_XSG.EB [ENTER] Edit template as follows: &N point name UNIT = unit number PTDESC ="point descriptor text" ANAME = RMPCT Controller Point RMPCMV00 UNIT = unit number RMPCCV00 UNIT = unit number RMPCDV00 UNIT = unit number
Load EB file.	From the Builder Commands display: Select the EXCEPTION BUILD target. Fill in ports as: REFERENCE PATH NAME: $Fn>EB> Load Entities (select target) Pathname for SOURCE file: RMPC_XSG.EB Pathname for IDF file: RMPC_XSG.DB [ENTER]
Verify load	When the load is complete, verify point loading by calling the point detail from the [DETAIL] button

Application Configuration through CDS Entry

Prior to linking the AM object code, some of the CDS fields must be entered to ensure proper memory allocation. The required information and associated parameters are listed below.

Parameter	Description	Comments
ANAME	Tagname of any RMPCT controller	This entity name must be entered before linking the application AO.
P1(0)	Tagname of any existing RMPCT CV interface point.	The NULL entity RMPCCV00 is the default tagname within the EB file
P2(0)	Tagname of any existing RMPCT MV interface point.	The NULL entity RMPCMV00 is the default tagname within the EB file
P3(0)	Tagname of any existing RMPCT DV interface point.	The NULL entity RMPCDV00 is the default tagname within the EB file

Linking CL Programs

Step	Action
Check ANAME	Make sure that the desired RMPCT controller name is listed within the CDS field ANAME
Check P1	Make sure that the CV NULL point RMPCCV00 is listed as the first entry within the CDS field P1. example: [P1(0) = RMPCCV00]
Check P2	Make sure that the MV NULL point RMPCMV00 is listed as the first entry within the CDS field P2. example: [P2(0) = RMPCMV00]
Check P3	Make sure that the DV NULL point RMPCDV00 is listed as the first entry within the CDS field P3. Example: [P3(0) = RMPCDV00]
Link RMPC_XSG	From the Command Processor Display: LK $Fn>AO>RMPC_XSG point_name [ENTER]
Activate point	Call up the point detail and activate the point.
Verify Operation	Verify that RMPC_XSG is running without any CL errors and that both STATUS(1) and STATUS(2) are equal to zero. * Note: At this point NO settings files have been written.

Setting the Path and File Name

Back built controller settings files are written to the TDC history module (HM). The user must specify the full path and file name for the application. To view or alter the application filename follow the guideline below.

1. Select the SCHEM button from the TDC operator console and enter the schematic name “DATACHNG”.
2. Select one of the user fields and enter the tagname.parameter you wish to view or modify, (i.e. “RMPC_XSG.PATHNAME”).

The display will now show the current “PATHNAME” stored in CDS. To change / modify the pathname select the field and enter the desired FULL pathname with extension.

The following are several examples of complete file pathnames;

- NET>RMPC>ATM_CTL.XS
- NET>MDL>FCCU_CTL.XS
- NET>D1>TST.XS

The filename can be 1 to 8 character in length and must have the extension ".XS" to be RMPCT compatible. The directory name can be 1 to 4 characters in length and must exist on the history module.

NOTE: Do **NOT** use the same file name as the off-line design software. The LCN application will check the HM for the defined file name. IF A FILE WITH THE DEFINED NAME IS DETECTED **IT WILL BE DELETED AND REPLACED**. Therefore, always use a different file name for each controller.

Generating Settings Files

To generate the settings file for a specified controller one only needs to process the application point. The following steps outline the procedure:

1. Select "DETAIL" and enter the tagname of the back-builder point.
2. Select the "PROCESS" target and press ENTER to execute.

Each time the application is executed, the routine examines the specified controller, downloads the MV, DV, and CV tagnames, and generates a settings file. Always check to make sure the application completed without encountering an error by paging forward to the STATUS parameters. If either STATUS(1) or STATUS(2) is greater than zero, the application had a problem completing the setting file.

NOTE: Do NOT attempt to read a settings file which has encountered an error during the build process. The file will be incomplete and any attempt to read the file by RMPCT will generate a "READ" error.

Back-Building Different RMPCT Controllers

One Simulation BackBuilder point can be used to generate settings files for all of the system controllers.

The follow list outlines the procedure to select and generate files for different controllers:

1. Select the SCHEM button from the TDC operator console and enter the schematic name "DATACHNG".
2. Select one of the user fields and enter the tagname.parameter you wish to view or modify, the controller tagname is stored in "ANAME". (i.e. "RMPC_XSG.ANAME").
3. Select one of the user fields and enter the tagname.parameter you wish to view or modify, the file pathname is stored in "PATHNAME". (i.e. "RMPC_XSG.PATHNAME").
4. With the correct controller selected and the correct file name defined, select "DETAIL" and enter the tagname of the back-builder point (i.e. "RMPC_XSG")
5. Select the "PROCESS" target and press ENTER to execute.
6. Check the error status parameters.

CV Information Captured

The settings file contains a variety of information related to the configuration and tuning of the controller CV's. The following list outlines which parameters are captured and stored in the controller ".XS"file:

- Active low limit
- Active high limit
- Low ramp rate
- High ramp rate
- Low limit error weight
- High limit error weight
- Optimization quadratic coefficient
- Optimization linear coefficient
- Optimization quadratic desired value / target
- Performance ratio
- Closed loop response interval
- Feedforward to feedback performance ratio
- Compensation ratio for the PV value
- Number of blocks
- Minimum funnel opening
- Optimization delta soft low limit
- Optimization delta soft high limit
- State estimation configuration
- Optimization error tolerance

MV Information Captured

The settings file contains a variety of information related to the configuration and tuning of the controller MV's. The following list outlines which parameters are captured and stored in the controller ".XS"file:

- Active low limit
- Active high limit
- Maximum move down permitted
- Maximum move up permitted
- High limit ramp rate

- Low limit ramp rate
- Optimization quadratic coefficient
- Optimization linear coefficient
- Optimization quadratic desired value / target
- MV weight
- Number of blocks
- Predict-Back or Anti-Windup ratio
- Optimization delta soft low limit
- Optimization delta soft high limit

NOTE: Some additional reserved parameters are collected in addition to those noted above.