Control System Migrations Gone Wild!

Best Practices and Lessons Learned

COMBINING THE ELEMENTS

EMERSON GLOBAL USERS EXCHANGE

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Thank you.

Presenters

- Laurie R. Ben

Director, Modernization Business Developmen

- James Beall

Principal Process Control Consultant

- Scott Ross

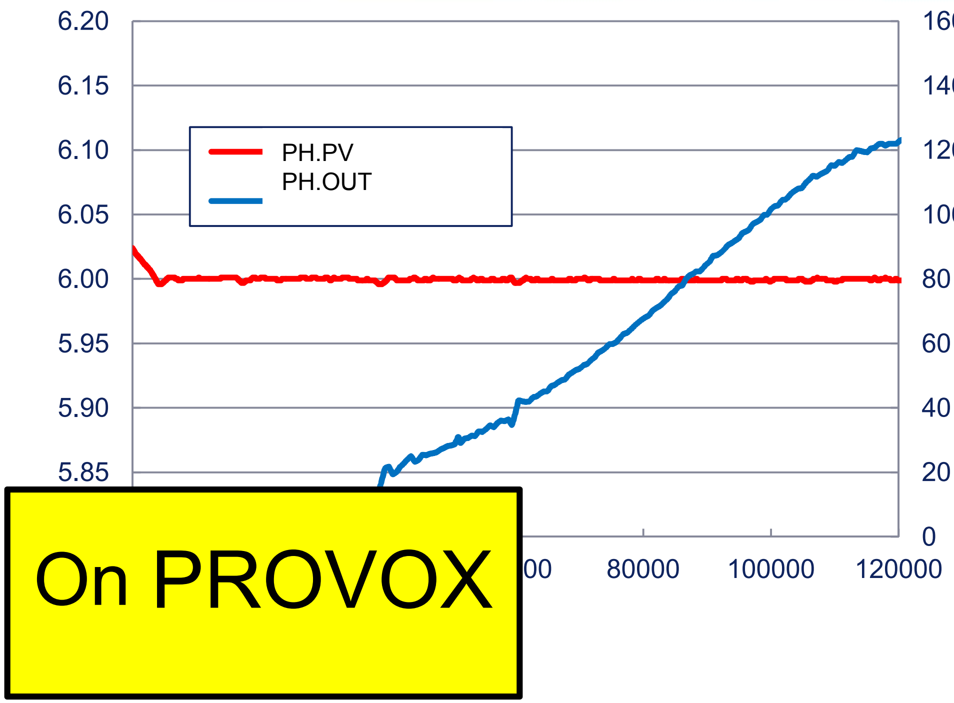
Modernization Consultant (Legacy Emerson)

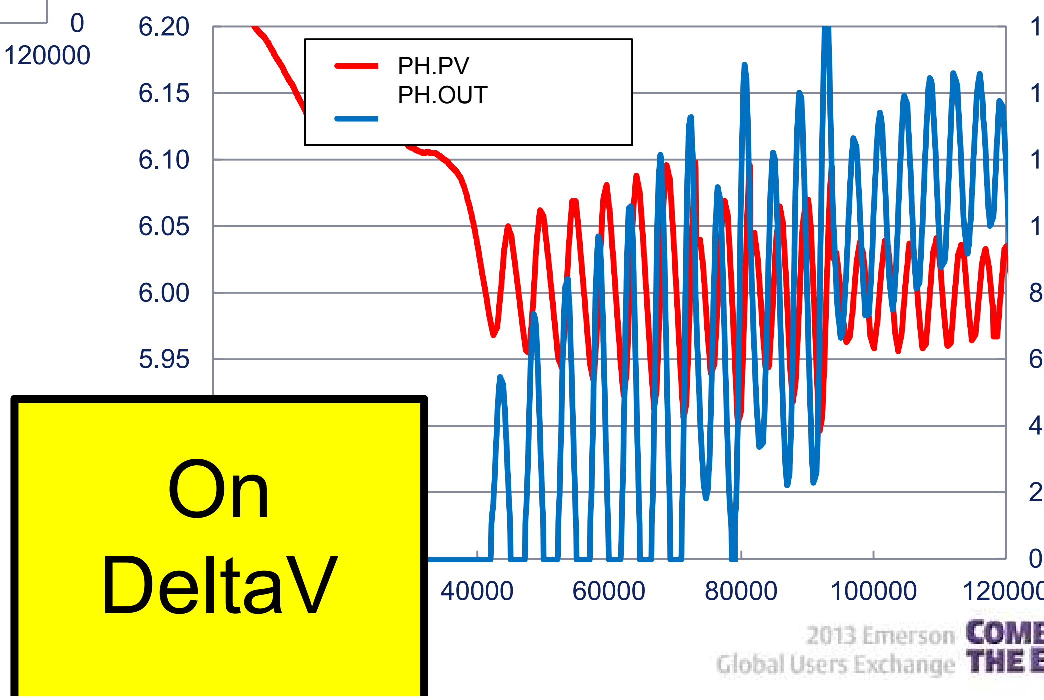
Introduction / Agenda

- What it looks like when it goes Wild?
  - Cycling Outputs
  - Controlling Super Slow or Super Fast (Unstable Control)
  - Controlling, but never stabilizing at Set Point
- Why it happens? Common Conversion Mistakes
- How to Avoid? (Tips, Tools, & Techniques)
- Summary
- Where to go for More Information

What it Looks Like when it goes Wild - Cycling Outputs

- 14 Fermenters on PROVOX for years
- 2 Fermenters migrated to DeltaV
- pH staying in spec, <u>but</u> Cycling - Ugly





Why It Happens? Cycling Outputs

- Wrong PID Form Selected for Conversion
- Compounded By Derivative (Rate) Action

Difference suggests that even properly converted tuning may have too fast of integral action

Control Action	PROVOX Classical or Series, as-found all fermenters	DeltaV Tuning, Standard Form (in-correctly converted)	DeltaV Standard, correctly converted	Lambda=1000 with guessed* process dynamics
Proportional (Gain)	0.5	0.5	11.75	11.4
Integral Time (a.k.a Reset)	3 rep/min or 20 sec	20	470	2040
Derivative Time	7.5 min or 450 sec	450	19	0

*from analysis of as-found cycle and experience on other fermenters with aqueous solutions & weak base reagents. This should be replaced by data from step tests.

Recommend to put in Manual for correction, OR 1st change the Reset, 2nd the Rate, 3rd the Gain!

How to Avoid?
Know the PID Forms in Your Legacy Systems

1. **PROVOX** = "Series" form
   - DeltaV is selectable – "Series" or "Standard"
     - "Standard" is the DeltaV default selection
   - If Derivative is not used (Rate = 0 min), then "Series" and "Standard" are the same, so choose Standard
     - "Standard" Form is more flexible from a tuning standpoint and is more common than Series (and Parallel)
   - If you have loops in PROVOX with Derivative action, choose DeltaV Form = Series for ease of conversion
2. **RS3** = Standard form, so choose DeltaV=Standard (default) for ease of conversion
   - Then, DeltaV Tuning will be simply a conversion of units

How to Avoid?
Know the PID Forms in Your Legacy Systems

Some Non-Emerson Legacy System Forms

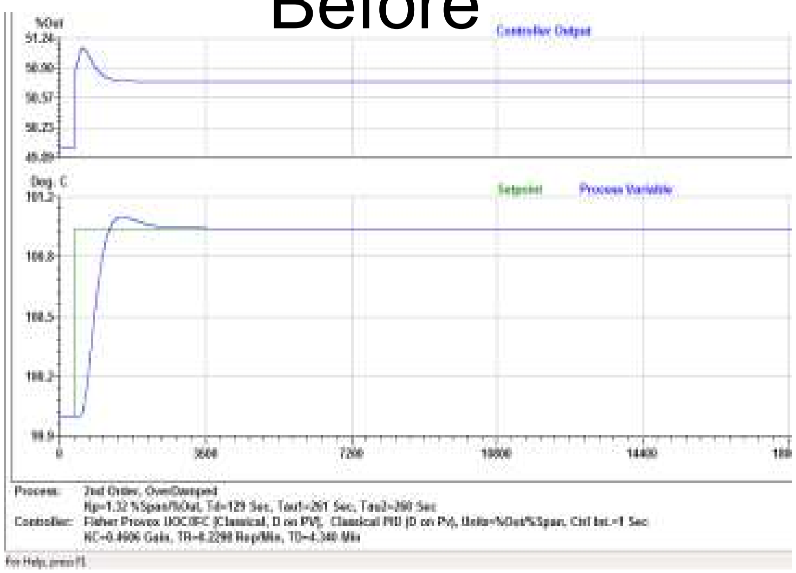
Standard Form Platforms	Series Form Platforms
ABB Masterpiece/ADVANT	Bailey Infi90*
VALMET Damatic Classic	MOD 300*
Measurex Open, Vision 2000	Fischer-Porter, Micro DCI
Texas Instrument	MOORE-APACS
Honeywell	Honeywell
Yokogawa	FOX I/A, Spec 200
Modicon 984	L&N: 440, 446-3, Electromax V

*Note: These platforms have other PID forms available

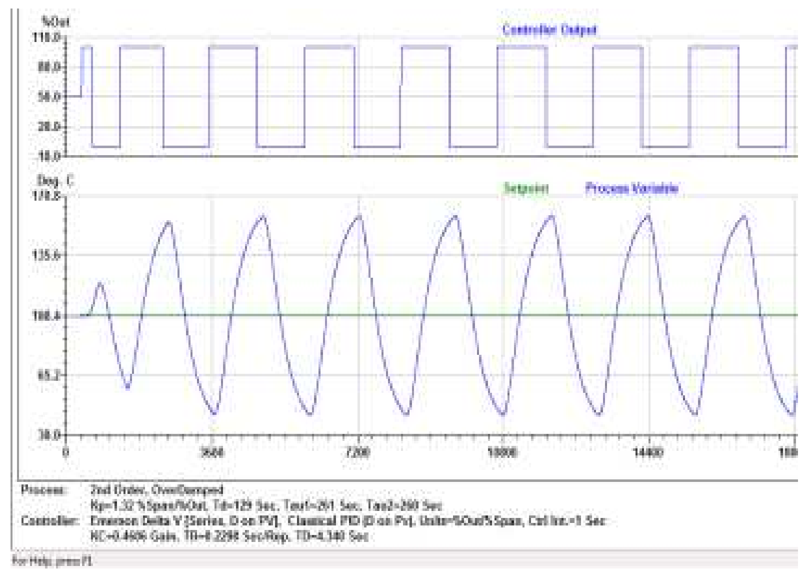
What it Looks Like when it goes Wild!
Control Super Slow or Super Fast

- PROVOX tuning was Gain=4.6, Reset=0.23 rep/min, Rate=4.3 minutes
- Tuning numbers, without units conversion were Gain=4.6, Reset=0.23 sec, Rate=4.3 sec

Before



After



Why It Happens?
Control Super Slow or Super Fast

- Incorrectly Converted Parameter Units
- Some Legacy Systems allow selectable Units per Individual PID vs. System Wide

Parameter	RS3 (Standard)	DeltaV (Standard Form)
Gain	%PB	Gain = 100/%PB
	Gain	Gain = Gain
Reset	Ti - seconds	Reset = Ti
	Ti - minutes	Reset = 60*Ti
	Ti - hours	Reset = 3600*Ti
Rate	Td - seconds	Rate = Td
	Td - minutes	Rate = 60*Td
	Td - hours	Rate = 3600*Td

Why It Happens?
Control Super Slow or Super Fast

Parameter	PROVOX	DeltaV (Series)	DeltaV (Standard) Rate<> 0 Using DeltaV Series Conversions
Gain	Gain$_{PROVOX}$	Gain= Gain$_{PROVOX}$	Gain x (Reset + Rate)/Reset
Reset	Reset$_{PROVOX}$ (rep/min)	Reset (sec) = 60/(Reset$_{PROVOX}$)	Reset + Rate
Rate	Rate$_{PROVOX}$ (min)	Rate (sec) = 60*(Rate$_{PROVOX}$)	(Reset x Rate)/(Reset + Rate)
PV_Filter	PV_Filter$_{PROVOX}$ (min)	PV_Filter (sec) = 60*PV_Filter$_{PROVOX}$	PV_Filter (sec) = 60*PV_Filter$_{PROVOX}$

- If Rate = 0, Tuning for the DeltaV Standard will be the same as for the Series Form

DeltaV PID Form/Units – An Example Summary

	PROVOX	DeltaV (Series)	DeltaV (Standard)	Difference
Gain	4	4	6	+50%
Reset	0.25 rep/min	240 sec.	360 sec.	+50%
Rate	2 minutes	120 sec.	80 sec.	-33%
PV Filter	0.1 minute	6 sec.	6 sec.	0%

Non-Emerson Legacy Conversion Units*

Platform	P Units	I Units	D Units	Other Notes
Bailey Infi90*	• Gain Multiplier (normalize EUs) • K_P (Proportional Gain)	Resets/Min	Minutes	K_I = Manual Reset Time (min) K_A = Derivative Lag Constant
MOORE-APACS	PG	Minutes	Minutes	DG (derivative gain) DeltaV α = 1/DG
Foxboro I/A*	PB %	Minutes	Minutes	KD (derivative gain) DeltaV α = 1/KD
Honeywell HPM*	Gain Value	Minutes	Minutes	Gain Value is based on chosen option
Honeywell HG	Gain Constant	Minutes	Minutes	

*Important to verify the information per platform

How to Avoid

- Know your Legacy Conversion Units
- Export Database, use appropriate tool
- Don’t make system wide assumptions
  - RS3 units selectable by PID
- Make sure to verify all critical loops.

PROVOX to DeltaV Conversion Tool

POINT TAG	Provox(Series)			DeltaV(FORM=Std)			DeltaV(FORM=Series)		
	GAIN (%/%)	RESET (rep/min)	RATE (min)	GAIN (%/%)	RESET (sec/rep)	RATE (sec)	GAIN (%/%)	RESET (sec/rep)	RATE (sec)
TIC101	0.48	0.46	0.1	0.50	136.43	5.74	0.48	130.43	6.00
TIC102	0.5	0.1	0.1	0.51	606.00	5.94	0.50	600.00	6.00
TIC103	0.33	0.5	0	0.33	120.00	0.00	0.33	120.00	0.00
LIC202	0.96	1.4	0	0.96	42.86	0.00	0.96	42.86	0.00
PIC601	2.5	0.4	0.007	2.51	150.42	0.42	2.50	150.00	0.42
PIC602	2	0.25	0	2.00	240.00	0.00	2.00	240.00	0.00
				0.00	0.00	0.00	0.00	0.00	0.00

RS3 Database Documented Using Control Studio

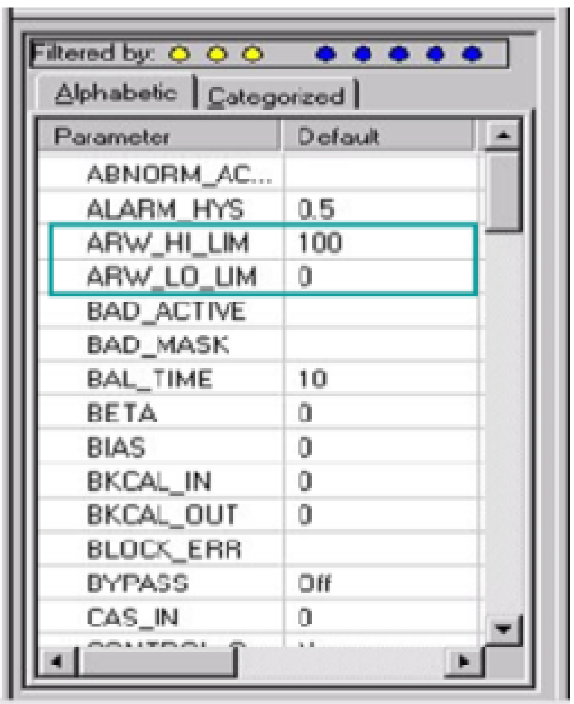
ype	Address	Tagname	Descriptor	AlarmPriority	PlantArea	PIAction	DAction	ControlAction	Gain	ProportionalBand	IntegralTime	DerivativeTime	Option
ID	=1A-09	PIC-720	C-400 TEMP CONTROL	0	12	Err	PV	Direct	1.11111	90.	30. S	0. S	None
ID	=1A-10	FIC-943	REGEN GAS FLOW	0	2	Err	PV	Reverse	.444444	225.	30. S	0. S	None
ID	=1A-11	LIC-911	REGEN GAS SCRUBBER	0	2	Err	PV	Direct	2.	50.	10. S	0. S	None
ID	=1A-12	TIC-929	REGEN GAS HTR OUTLET	0	2	Err	PV	Reverse	2.22222	45.	7.5 M	0. S	None
ID	=1A-13	FIC-1001	LEAN AMINE FLOW	0	13	Err	PV	Reverse	1.11111	90.	30. S	0. S	None
ID	=1A-14	FIC-1034	LEAN AMINE FLOW BYP	0	13	Err	PV	Direct	.5	200.	30. S	0. S	None
ID	=1A-15	PIC-707	RESIDUE COMP	0	12	Err	PV	Reverse	2.85714	35.	20. S	0. S	None
ID	=1A-16	LIC-2089	C-300 HECLMN TO SECT LVL	0	22	Err	PV	Direct	1.	100.	6. M	0. S	None
ID	=1A-17	LIC-2067	S-8 LN2 SEPARATR	0	22	Err	PV	Direct	1.	100.	4. M	0. S	None
ID	=1A-18	PIC-2040	C-100 DEMETH OVHD PRS	0	23	Err	PV	Direct	1.66667	60.	30. S	0. S	None
ID	=1A-19	PIC-731	RESID SCRB IN TO FLARE	0	12	Err	PV	Direct	3.33333	30.	25. S	0. S	None

What it Looks Like when it goes Wild!
Poor Control, Never Stabilizing at Setpoint

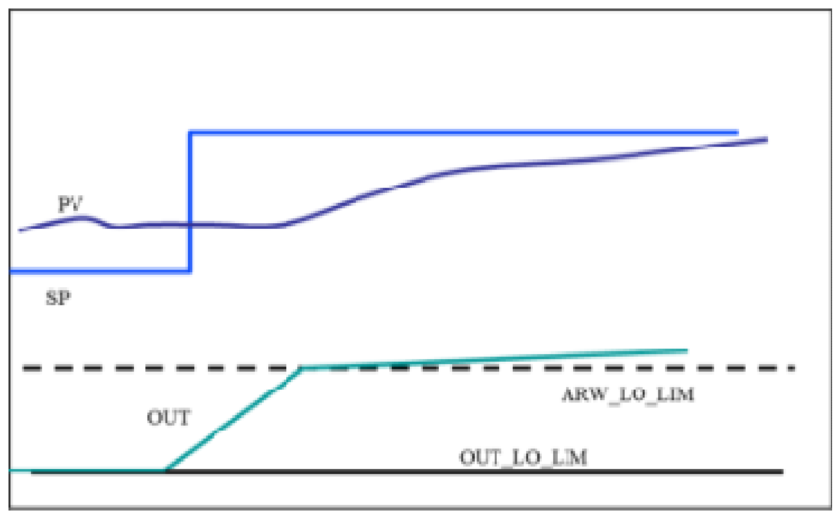
- Incorrect DeltaV ARW Limits will cause poor control action!!

Why It Happens?
Erratic Control, SP-PV Offset

- Anti- Reset Windup (ARW) Settings incorrectly converted!
- ARW's set correctly, improves process recovery from saturated conditions
- ARW settings in PROVOX are in 0-100% OUT, in DeltaV they are in EU's of the OUT
  - reset time will automatically be decreased by 16X (faster integral action) if the OUT is outside the low or high ARW limit AND the PID is moving the OUT toward being back inside the ARW limits



Parameter	Default
ABNORM_AC...	
ALARM_HYS	0.5
ARW_HI_LIM	100
ARW_LO_LIM	0
BAD_ACTIVE	
BAD_MASK	
BAL_TIME	10
BETA	0
BIAS	0
BKCAL_IN	0
BKCAL_OUT	0
BLOCK_ERR	
BYPASS	Off
CAS_IN	0



How to Avoid?
Controlling, but Never Stabilizing

Parameters - PID Function Block

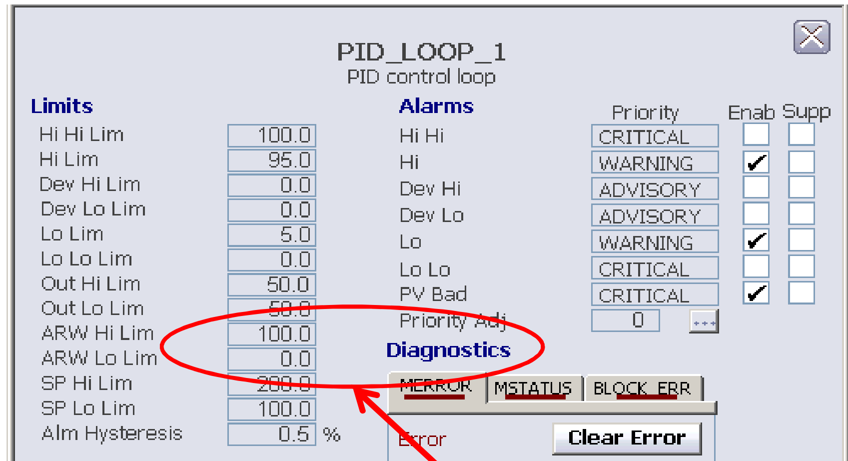
The following table lists the system parameters for the PID function block:

PID Function Block System Parameters

Parameter	Units	Description
ABNORM_ACTIVE	None	The indication that a block error condition not selected in BAD_MASK (on the function block level) is True (Active).
ALARM_HYS	Percent	The amount the alarm value must return within the alarm limit before the associated active alarm condition clears. ALARM_HYS is limited to 50% of scale.
ALERT_KEY*	None	A user-assigned identification number reported in alarm messages from the block that allows HMI applications to sort and filter alarms and events. Set this parameter for each function block to indicate the physical unit the function block is associated with. This information can be used in the host for sorting alarms, and so on.
ALPHA**	None	The filter factor for derivative action. The default value is 0.125. The valid range in run time is 0.05 to 1.0. Increasing ALPHA increases damping of derivative action. Adjusting ALPHA can impact the noise protection provided when RATE is utilized. Because of this ALPHA should typically NOT be changed.
ARW_HI_LIM**	OUT	High limit of Anti-Reset Windup. When the output is beyond ARW_HI_LIM and the integral action is returning toward the limit, then the applied RESET time is reduced by a factor of 16. Enter a value between OUT_HI_LIM and OUT_LO_LIM.
ARW_LO_LIM**	OUT	Low limit of Anti-Reset Windup. When the output is beyond ARW_LO_LIM and the integral action is returning toward the limit, then the applied RESET time is reduced by a factor of 16. Enter a value between OUT_HI_LIM and OUT_LO_LIM.
BAD_ACTIVE	None	The indication that a block error condition selected in BAD_MASK (at the function block level) is True (Active).
BAD_MASK	None	The set of active error conditions that triggers a user-defined Bad condition. The user selects a subset of block error (BLOCK_ERR) conditions in the BAD_MASK parameter. When any of these conditions are True, the BAD_ACTIVE parameter becomes True. When any of the BLOCK_ERR conditions that are not included in BAD_MASK are True, ABNORM_ACTIVE becomes True.
BAL_TIME**	Seconds	The time over which an internal balancing bias will be dissipated. Only has practical meaning when the STRUCTURE parameter is a P + D selection.

PID Loop Detail Display (LOOP_DT)

The information in this topic also applies to FFLP_DT and FLC_DT, which are very similar in ap



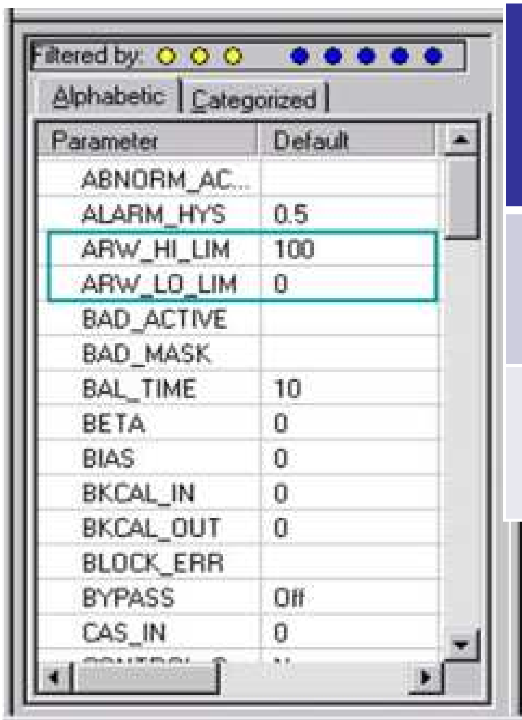
ARW limits are in Engineering Units of the OUT_SCALE.

OUT_SCALE default is 0-100

If OUT_SCALE is other than 0-100, be sure to initially set ARW limits to the OUT_SCALE limits.

How to Avoid?
Controlling, but Never Stabilizing

- Know your Legacy System ARW Settings!
  - RS3 has no separate ARW Limits
    - Difference Function
  - PROVOX ARW settings in %OUT and the out scale is always 0-100%



DeltaV Output Scale	PROVOX ARW	DeltaV ARW
0-100%	0-100%	0-100
0-1500 lbs/hr	0-100%	0-1500

Other Things to Consider

- PID Structure
- Other RS3 Considerations
- Looking in Old Documentation
- Power Infrastructure
- Legacy Firmware Compatibility
- Legacy Custom Firmware
- Legacy Spares

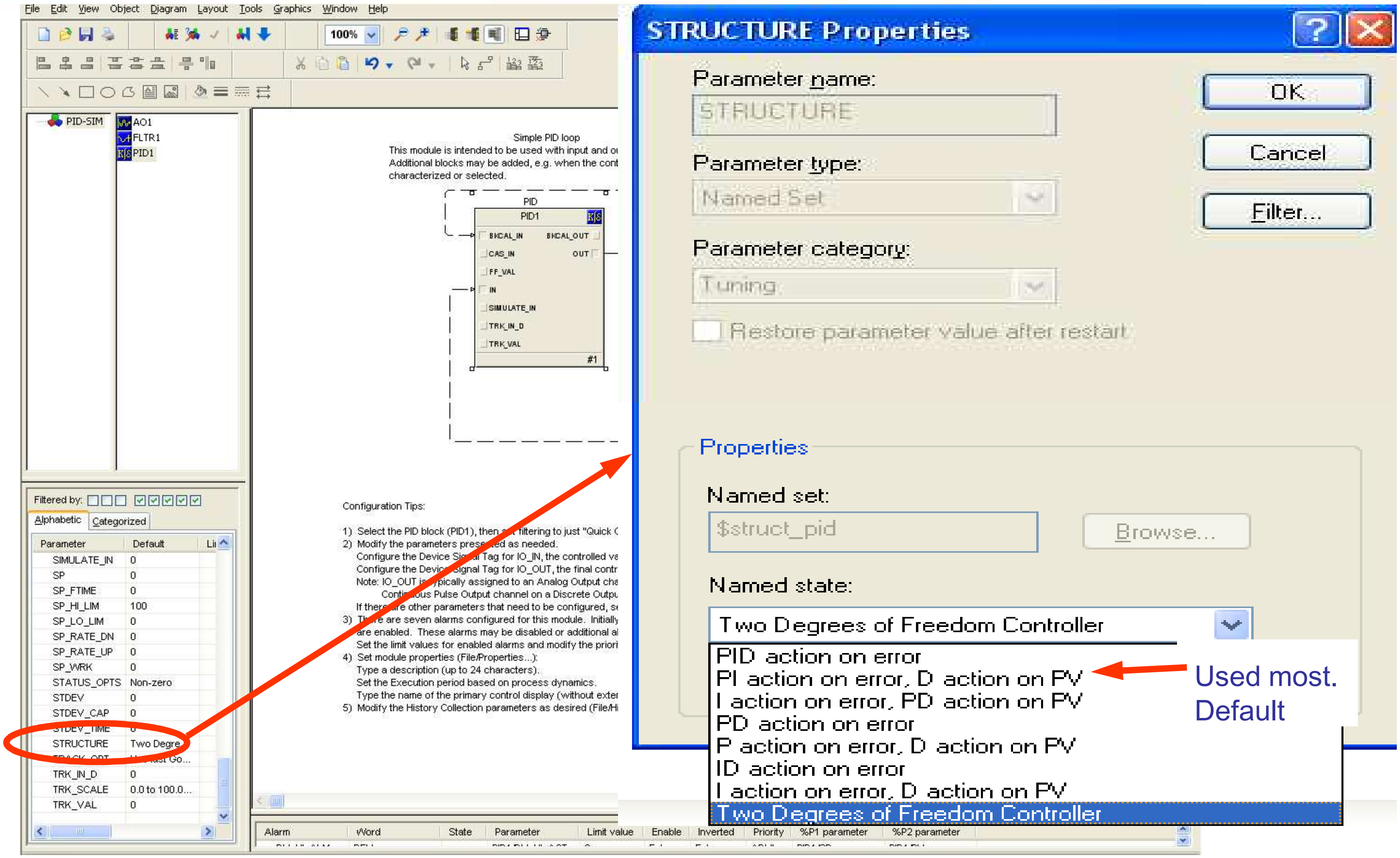
PID “Structure”

- PID “Structure” has to do with whether the Gain and Derivative act on the Error (SP-PV) or on the PV
  - Remember: Integral action is always on Error

1. PROVOX PID Structure is “PI action on Error, D action on PV”
2. RS3 allows you to choose whether the Proportional (P) Acts on Error, PV or SP
3. RS3 allows you to choose whether the Derivative (D) acts Error, PV or SP.

- There are several DeltaV PID Structure options.
  - Select “PI action on Error, D action on PV” to match PROVOX
  - RS3: DeltaV does not allow P and D on SP.
  - Most common is PI on error, D on PV

PID Function Block "Structure" Parameter



Other RS3 PID Considerations

- RS3 PID has a both the "positional"(default) and a "velocity" PID implementation.
- DeltaV has only the "positional" PID implementation.
  - Warning: If using Velocity in RS3 it may act differently when the output comes out of a limit when you migrate to positional
- Check feed forward scaling systems
  - Both RS3 and DeltaV use a "Feed forward Gain" but the DeltaV PID block has a "feed forward scale".

RS3 PV Filtering

- PV filtering is provided on the Analog-In block
  - It is a first order filter, enter the time constant in seconds
- Additional filtering is provided in the PID block if Derivative is activated (PID, PD or ID), <u>even if Rate = 0</u>.
- PID filter is non adjustable and its first order time constant is the greater of (2*Sample time) or (Rate/8).
  - Note: "sample time" is the greater of the ControlBlock sample time, if configured, or the Controller Processor card scan time.
  - Units are selectable as seconds, minutes or hours.
- PID filter applies to the value being acted upon by the Proportional, Integral and Derivative terms.
  - Different than DeltaV where this filter (α*Rate) is applied only to the value going to the Derivative function

Looking in Old Documentation
Bailey

Potential Confusion: Control System Terminology

Clue: Parallel Blocks

Clue: S Domain Transfer Functions

G PID CONTROLLER

Standard form of a noninteracting PID c

$$Output = \left(K + \frac{1}{T_1 s} + \frac{T_D s}{T_D a s + 1}\right) error$$

where:

error SP – PV rever

error PV – SP direc

Advanced PID controller block parameters.

S11 = Gain multiplier K.
S12 = Proportional gain K_P.
S13 = Integral reset (resets per min.) K_I
S14 = Derivative rate action (min.) K_D.
S15 = Derivative lag constant (typically

NOTE: This controller works in seconds interna that K_I and K_D are in resets per minute and min The **60** term converts K_I and K_D into resets per onds, respectively.

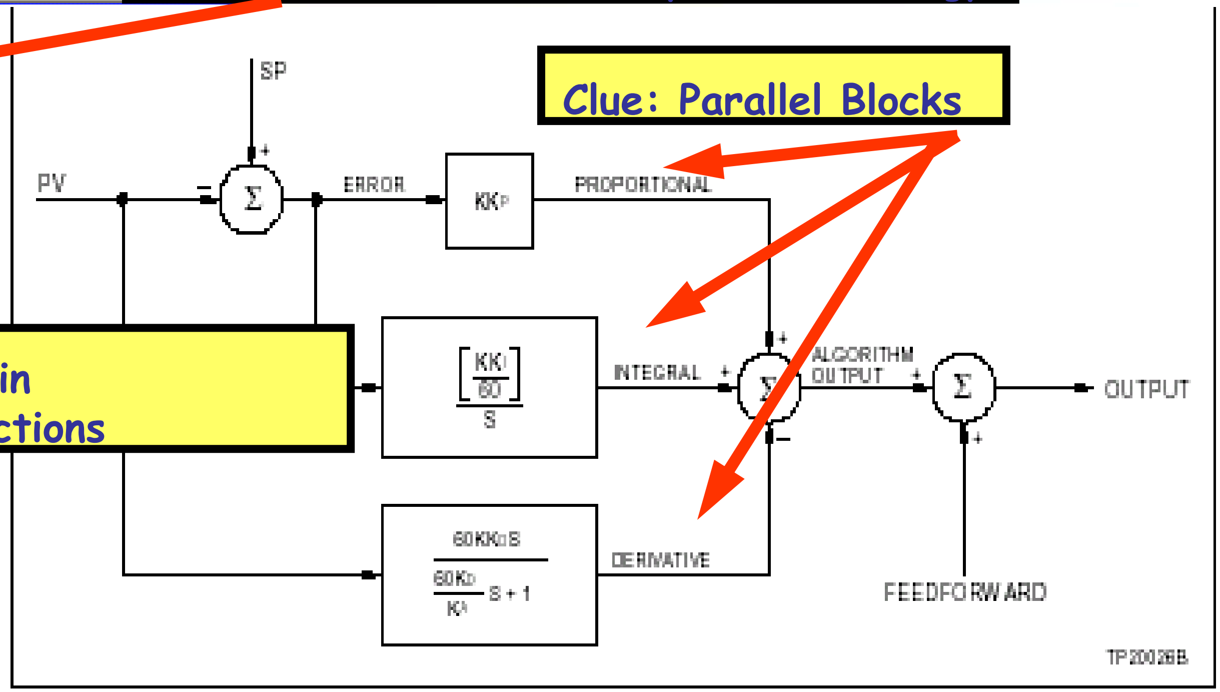


Figure 156-4. Reverse Mode Noninteracting Controller

Substituting block parameters into the original equation.

$$Output = K\left(K_P + \frac{K_I/60}{s} + \frac{60K_D s}{\frac{60K_D}{K_A}s + 1}\right) error$$

Bailey Documentation Function Code 156

x 10.99 in

Looking in Old Documentation
Multiple Form Options may Exist ...

CLASSICAL PID CONTROLLER

Specification S18 selects the type of algorithm for the PID calculation:

0 = classical - PID output is calculated using a classical interactive controller. Tuning any of the proportional, integral or derivative terms changes the effective value of the other terms.

1 = noninteracting - PID output is calculated using a noninteracting control algorithm. Tuning the proportional, integral or derivative terms individually has no effect on the other terms. This is the same type as function code 19.

2 = classical with external reset - cascade and override configurations use this type of algorithm. The PID output is calculated using the classical interactive control algorithm. The integral contribution is calculated as a function of the external reset signal.

3 = manual reset noninteracting - PID output is calculated from the proportional and derivative terms with manual reset. For manual reset control, a manual reset time constant (S13) is used for bumpless tra[nsfer] between the track and release states.

NOTE: The transfer is not bumpless if the manual reset time co[n]stant (S13) is set to zero. Any change in the manual reset is fi[l]tered by a first order lag with the manual reset time specified.

rd form of a classical PID cor

$$tput = K\left(1+\frac{1}{T_i s}\right)\left(\frac{T_D s+1}{T_D a s+1}\right) error$$

Bailey Documentation Function Code 156

Looking in Old Documentation Honeywell

19.4 OPTIONS AND SPECIAL FEATURES

19.4.1 Interactive and Noninteractive PID Forms

During configuration, select one of these two forms. They differ as follows:

- Interactive (Real) Form—This form emulates traditional pneumatic-PID controllers. The P, I, and D terms are calculated as the sum of P and I, multiplied by D. D interacts in the time domain with the P and I terms. An advantage of this form is that the poles (lags) and zeros (leads) can be easily placed (See the equations under 19.5). The poles and zeros must be real.

- Noninteractive (Ideal) Form—In this form, P, I, and D are added in the time domain. D is a pure derivative. This form is often called the digital-computer version of the PID controller.

Potential Confusion: Control System Terminology
Interactive = Real = Classic
Non-interactive = Ideal = Standard

Remember Bailey Non-Interactive meant Parallel

19.5 EQUATIONS

You can select one of four equations when you configure a data point that uses the PID control algorithm. Equations A through D differ in the interactive and noninteractive forms of the algorithm.

For the Interactive form:

Equation A—P, I, and D act on the error

```
           1 + T1*s   1 + T
CV(s)  = K*[--------*--------
            T1*s    1 + a*T
```

Equation B—P and I act on error, D

```
           1 + T1*s    1 +
CV(s)  = K*[--------*-------
            T1*s      1 +
```

Equation C—I acts on error, P and D

```
           1 + T1*s    1 +
CV(s)  = K*[--------*-------
            T1*s      1 +
```

Equation D—Integral control, only

```
          1
CV(s) = [------*(PVP(s) - SPP(s))]
         T1*s
```

For the Noninteractive form:

Equation A—P, I, and D act on the error

```
             1 + T1*s
CV(s)  = K*[(-------- + T2*s)*(PVP(s) - SPP(s))]
              T1*s
```

Equation B—P and I act on error, D acts on PV

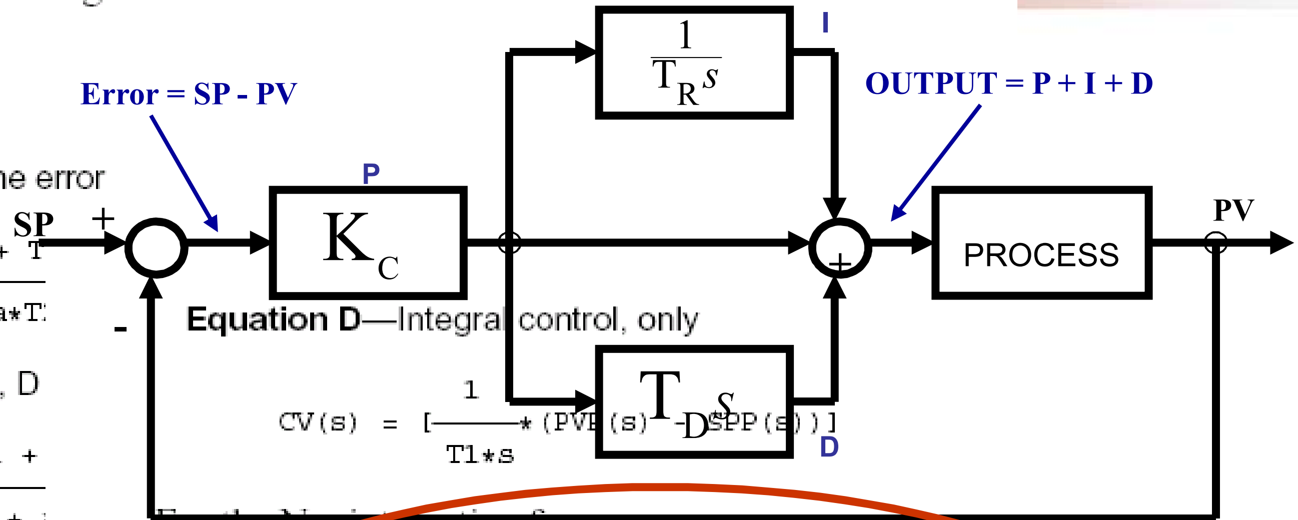
```
             1 + T1*s                    1 + T1*s
CV(s)  = K*[(-------- + T2*s)*PVP(s) - ---------*SPP(s)]
              T1*s                        T1*s
```

Equation C—I acts on error, P and D act on PV

```
             1 + T1*s
CV(s)  = K*[(-------- + T2*s)*PVP(s) - -------*SPP(s)]
              T1*s                      T1*s
```

Equation D—Integral control, only

Honeywell Documentation



Clue: Standard S Domain Transfer Functions

Power Infrastructure

- Power infrastructures are as old if not older than the DCS
- BEWARE: Electrolytic capacitors and expected failure rates

Knowledge Base Article

Power Converter, Electrolytic Capacitor Degradation

Article ID:	NA-0200-0127
Publish Date:	05 Aug 2011
Article Status:	Approved
Article Type:	General Product Technical Information
Required Action:	Information Only
User Discipline:	Maintenance

Recent Article Revision History:

Revision/Publish	Description of Revision
05 Aug 2011	Added more products to the l

(See end of article for a complete revision history listing.)

Affected Products:

Product Line	Category	Device
PRoVOX	Communication	CL6620 Series 20 / SR90 Power Convertor Card
PRoVOX	Communication	CL7701 SR90/Bridge Redundant CIAI Card
PRoVOX	Communication	CP6101 AC/DC System Power Supply
PRoVOX	Communication	CP6103 600/1200Watt AC/DC System Power Supply
PRoVOX	Communication	CP7202 +5 -28 Volt Power Convertor Card
PRoVOX	Communication	DH7010 +5 Volt Power Convertor Card
PRoVOX	Communication	DM6007 UNIVOX In-Line AC/DC Power Supply
PRoVOX	Console	DC6400 PROVUE Console Keyboard Electronics and Power Supply
PRoVOX	Console	DC6450/60 PROVUE Console Electronics Power Supply
PRoVOX	Console	DC6490 VME/microPROVOX Power Supply
PRoVOX	Console	DC9450 OWP VaxStation 4000 Power Supply
PRoVOX	Controller	CL6641 Backup Control Unit (SRx-BCU)
PRoVOX	Controller	CL6643 Multiplexer (SRx-MUX)
PRoVOX	Controller	CL6645 Integrated Function Controller (SRx-IFC)
PRoVOX	Controller	CL6647 Unit Operations Controller (SRx-UOC)
PRoVOX	Controller	CL6649 Expanded Multiplexer Controller (SRx-EMX)
PRoVOX	Controller	CP6121 SR90/Bridge Power Convertor Card
PRoVOX	Controller	CP6701 Control I/O Card File

Knowledge Base Article

Power Regulator, Electrolytic Capacitor wearout.

Article ID:	AUS1-164-00120110551
Publish Date:	14 Feb 2012
Article Status:	Approved
Article Type:	General Product Technical Information
Required Action:	Information Only
User Discipline:	Maintenance

Recent Article Revision History:

Revision/Publish	Description of Revision
14 Feb 2012	Added more product details to th

(See end of article for a complete revision history listing.)

Affected Products:

Product Line	Category	Device
RS3	Consoles	6X00cons BasicCC, EnhancedCC, Minicon
RS3	Control File	6X00CTFpwr Power regulators
RS3	Control File	6X00CTFpwr Power regulators
RS3	Input Output	6X00MUX Multiplexer I/O
RS3	Power	6X00power Power other

The purpose of this article is to provide users with some reliability information that can be used for preventive maintenance of Power Supplies and Power Converter/Regulator cards used in the RS3™ distributed control system. This information only pertains to the RS3 assemblies listed in the effected product table.

Electrolytic capacitors are a limited-life component and are therefore subject to a wear-out mechanism known as "electrolytic evaporation". This wear-out mechanism simply means that the capacitor may no long meet its original capacitance specification and that the capacitance value has degraded to a level below its minimum specified value. Electrolytic capacitors are used in many power supply applications including most RS3 Power Supply and Power Converter/Regulator cards. The capacitance degradation due to electrolytic evaporation is related to a number of temperature related factors. For an electrolytic capacitor with a temperature rating of 105 degrees C, operating at an average ambient temperature of approximately 35 degrees C (95 degrees F), the average life is approximately 29 years. As a general rule, the average life of the electrolytic capacitor will decrease by half for every 10 degree C increase in ambient temperature. This condition might cause long term reliability issues for Power Supplies and Power Converter/Regulator cards.

Legacy Firmware Compatibility

- Revisions of FIC's and FIM's firmware must be compatible with tested solution
- Too Late! once ControlFile is removed
- No easy way to get cards updated
  - Send in to Emerson for repair ($$$$ and time)
  - Take to another location and/or system, install and upgrade
  - Tapes with the firmware images must be sourced prior to the migration

DeltaV Product Data Sheet
January 2013 – Page 9
DeltaV Controller Interface for RS3 I/O

Supported RS3™ I/O				
IO Card Type	IO Card Tested		Current Versions (from P1R4.2 Release Notes)	
Description	SW Rev	FW Rev	SW Rev	FW Rev
Analog FIC	1.6, 3.8, 4.7, 4.8	1.0, 2.1	4.8	2.1
Analog FIC HART	4.8	2.1	4.8	2.1
Analog FIC TC/RTD	2.11, 3.1	1.8	3.1	1.8
Pulse FIC	n/a	2.4, 2.7	n/a	2.7
Contact FIC	n/a	2.0, 3.1	n/a	3.1
MAI-16 FIM	2.2, 2.4, 3.4	1.1, 4.0, 4.1, 5.0	3.4	5.0
MAI-32 FIM	3.4	5.1	3.4	5.1
MAO-16 FIM	2.2, 2.6, 3.4	4.1, 5.1	3.4	5.1
MDIO FIM	3.0, 3.1, 3.2, 3.4, 4.0	1.1, 6.6, 6.7	4.0	6.6 (low side) 6.7 (high side)

Legacy Custom Firmware

- PROVOX External Interface Cards (EIC's)
- Lots of custom firmware that interface to weigh scales, third party devices (corrosive meters, flow computers, etc.), and PLC's.
- Special interfaces must be investigated prior to the migration
  - Special firmware may be needed for DeltaV programmable serial card (PSC)
- Original device documentation will be required in order to write the special firmware
  - In a few cases the device may have multiple protocol outputs

```
@1-13 FILE 3  CARD 10
      DIO
      DISCRETE I/O CARD          11B7596X062    P1.4

@1-13 FILE 3  CARD 12
      EXTERNAL INTRFC
      Modbus w/ EEPROM           S550022        REV E

@1-13 FILE 13 CARD 1
      EXTERNAL INTRFC
      Modbus w/ EEPROM           S550022        REV E
```

```
@1-4  FILE 2  CARD 9
      DIO
      DISCRETE I/O CARD          11B7596X062    P1.4

@1-4  FILE 15 CARD 11
      EXTERNAL INTRFC
      FISHER ROC I/F             S550031        REV D

@1-4  FILE 15 CARD 12
      EXTERNAL INTRFC
      FISHER ROC I/F             S550031        REV D
```

Legacy Spares – Harvesting Spare Parts

- Do complete inventory of Legacy spares
- Make sure they match your existing system
- 'The Myth of Harvested Spare Parts'
  - 'Control System Migration Lessons Learned', ARC Report April 2013
  - As many as 1/3 or more of all 'used' spare parts are not serviceable
  - Environmental conditions or use or abuse will shorten life span
    - 'parts from a dismantled legacy system, even if cleaned and placed on shelf may still be DOA, when plugged into running system'

'Don't rely on very old parts from previous decommissioned systems as a long term strategy'

Summary

- What it looks like when it goes Wild?
  - Cycling Outputs
  - Controlling Super Slow or Super Fast (Unstable Control)
  - Controlling, but never stabilizing at Set Point
- Common Conversion Mistakes
- Tips, Tools, & Techniques
- Other Gotcha's!

Where To Get More Information

- Business Card or Sign up Sheet:
  - Give us your name and email address. We will mail you the PROVOX Conversion Tool and more in-depth presentations on RS3 and PROVOX Conversions
- "Interesting and Useful Features of the DeltaV PID, Ratio and Bias/Gain Control Blocks"
  - by James Beall, 2010 Emerson Exchange
  - We can send a copy if you don't have it!
- Entech Training: Course 9030, Course 9032
- See us at the Exhibit Hall! (Monday - Wednesday this week)

Thank You for Attending!

Enjoy the rest of the conference.

COMBINING THE ELEMENTS

EMERSON GLOBAL USERS EXCHANGE