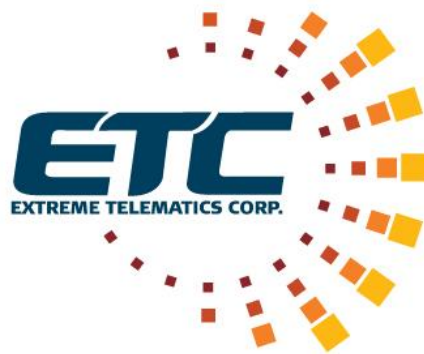


Application Note – Sasquatch Plunger Velocity Sensor

Integration Guide for Production Manager Well Optimization and ROC controllers



Revision 1

July 11, 2016

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Revision History

| Revision | Date | Author | Changes |
|----------|--------------|----------------|-----------------|
| 1 | 11 July 2016 | Valens D'Silva | Initial Version |

Acronyms

| | |
|-------------|---|
| PMWO | Production Manager Well Optimization |
| PMSC | Production Manager Surface Controls |
| AB | Action Block |
| | |

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1 Introduction

1.1 Overview

Sasquatch Plunger Velocity Sensor (“Sasquatch”) is the next state in the evolution of plunger detection. Sasquatch will measure the surface velocity of the plunger in addition to detection the plunger arrival.

Production Manager Well Optimization (“PMWO”) is an advanced user program for the designed to maximize production from oil and gas wells. The program is intended for either the ROC800-Series Remote Operations Controller or the FloBoss™ 107 Flow Manager.

1.2 Purpose

This application note will detail the device setup so PMWO can communicate with Sasquatch. Additional configuration to retrieve and store the surface velocity in PMWO’s logging features will be described in later sections.

2 Device Setup and Configuration

Connect both terminals on Sasquatch to the controller. The Signal pin on Sasquatch should be connected to a Digital Input on the controller. Sasquatch’s Signal pin acts as a dry contact so the input on the controller could require a pullup resistor. Refer to the user manual for the controller.

The COM1 port must be connected to a RS485 capable port on the controller. Refer to the Sasquatch User Manual and the appropriate manual for the controller.

2.1 Communication Port Configuration

The default communication port configuration is shown in the figure below.

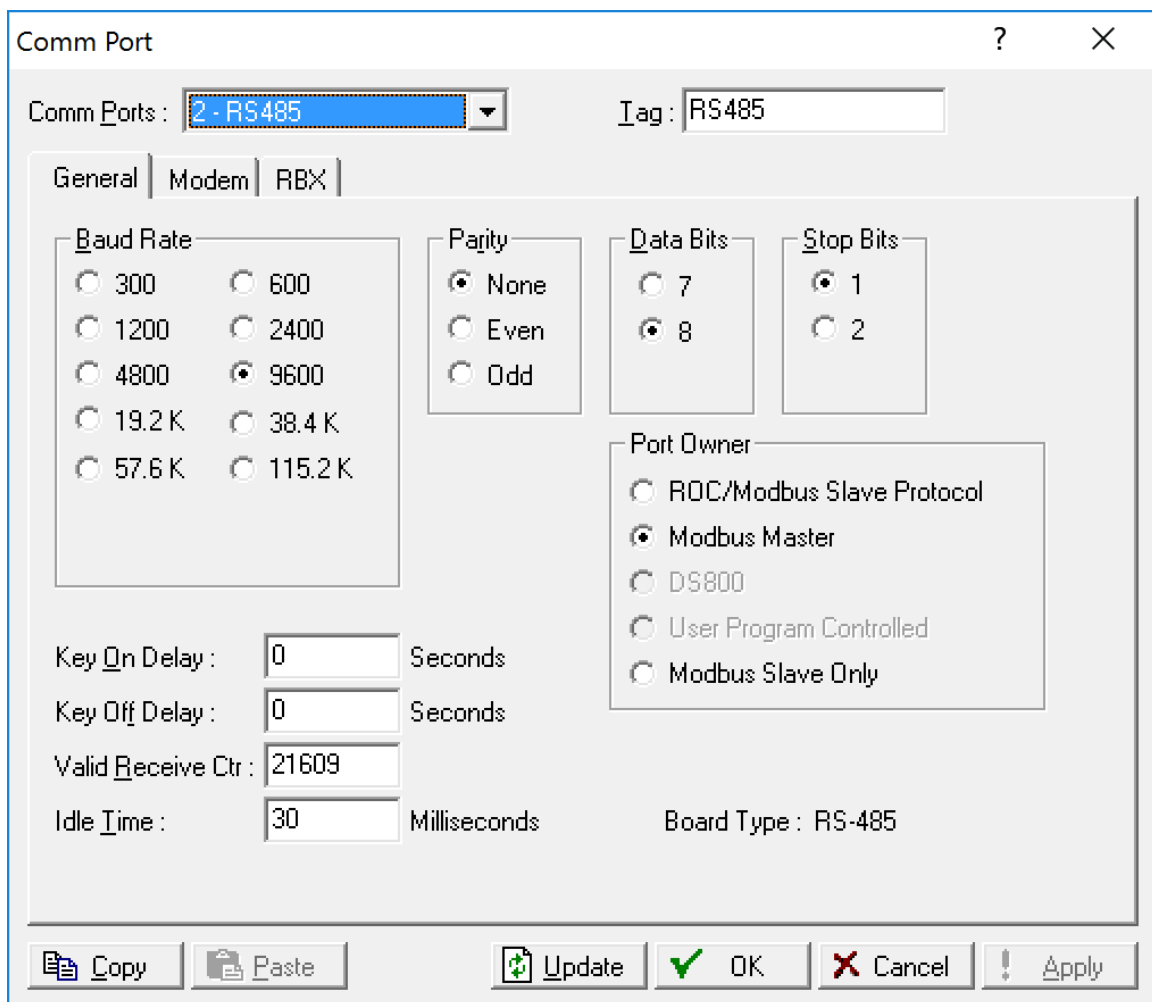


Figure 1: Communication Port Setup

2.2 Modbus Setup

The following figures detail the Modbus Configuration

The screenshot shows the 'Modbus Configuration' window with the 'General' tab selected. At the top, 'Comm Port' is set to '2 - RS485'. Below this are four sub-sections: 'Byte Order' with radio buttons for 'Least Significant Byte First' (unselected) and 'Most Significant Byte First' (selected); 'Comm Mode' with radio buttons for 'RTU' (selected) and 'ASCII' (unselected); 'Slave Mode' with a text field for 'Exception Status' containing 'Invalid Message'; and 'Event Logging' with radio buttons for 'Enabled' (unselected) and 'Disabled' (selected).

Figure 2: Modbus Configuration - Byte Order

At least three registers should be configured as Soft Points in PMWO. They are

1. Plunger Velocity Log Surface Velocity Entry 1 (most recent plunger surface velocity)
 - a. Register (Address) - 822 (821)
 - b. Size – 16 bit (SHORT)
 - c. Function Code – 4 (Read Input Register)
2. Plunger Velocity Log Velocity Confidence Code Entry 1 (most recent velocity confidence code)
 - a. Register (Address) – 942 (941)
 - b. Size – 16 bit (SHORT)
 - c. Function Code – 4 (Read Input Register)
3. Units - for reporting plunger velocity
 - a. Register (Address) – 5 (4)
 - b. Size – Coil (BYTE)
 - c. Function Code – 5 (Force Single Coil)
 - d. Value – 0 (Imperial), 1 (Metric)

The following figure below shows the configuration for all the above items.

Modbus Configuration

Comm Port : 2 - RS485

General | Scale Values | **Master Table** | Registers | History Table

Logical Point : 1 - MastTbl 1 (RS485) Tag : MastTbl 1

| | RTU Address | Function Code | Slave Register | Master Register | Number of Registers | Comm Status | Comm Status Text |
|---|-------------|--------------------------|----------------|-----------------|---------------------|-------------|------------------|
| 1 | 1 | 4 - Read Input Registers | 821 | 821 | 1 | 8 | Valid Response |
| 2 | 1 | 5 - Force Single Coil | 4 | 4 | 1 | 8 | Valid Response |
| 3 | 1 | 4 - Read Input Registers | 941 | 941 | 1 | 8 | Valid Response |

Figure 3 - Modbus Master Table

General | Scale Values | Master Table | **Registers** | History Table

Table : 1 Tag : Reg Map 1

| Index | Start Register | End Register | Device Parameter(s) | Indexing | Conversion | Comm Port |
|-------|----------------|--------------|---------------------|----------|------------|----------------|
| 1 | 821 | 821 | ESFP 1, SHORT1 | Point | 0 | All Comm Ports |
| 2 | 4 | 4 | ESFP 1, BYTE1 | Point | 0 | All Comm Ports |
| 3 | 941 | 941 | ESFP 1, SHORT2 | Point | 0 | All Comm Ports |

Figure 4 - Modbus Registers

The Modbus Master Mode can be configured with the following timeout and retry settings.

Master Mode

Start Polling :

Starting Request : 1 Timeout : 1 Seconds

Number of Requests : 2 Retries : 1

Continuous Polling

Enabled
 Disabled

Request Delay : 1.0 Seconds

Figure 5 - Modbus Master

3 Capturing Surface Velocity on Plunger Arrival

When Sasquatch is continuously powered it will monitor the plunger when it is rising and falling at the surface. Sasquatch can report a velocity in each case. Sasquatch can also measure plunger

velocity when the plunger is bouncing at the surface, depending on well conditions. Production Manager Surface Controls (PMSC) Action Blocks will be used to record the plunger velocity associated with when it first arrives at the surface.

3.1 PMSC Action Blocks

The Action Blocks (AB) should be configured to record the Modbus registers when both the following conditions are met:

1. The PMWO program is in the Lifting portion of the Cycle
2. Sasquatch sensor closes the switch

Point Number: 1 - Arrival

PM SURFACE CONTROLS: ACTION BLOCKS

Block Logic Operation

Block Tag: Arrival

Enable

Value #1
Input Pt Def: DIN B13, STATUS ...
Input Value: 0.0

Operator: EQ (==)

Value #2
Set Pt Def: Undefined ...
Set Pt Value: 1.0

Delay
Preset: 0 Seconds
Elapsed: 0 Seconds

Result
DeadBand EU: 0.0
Block Trip Status (Before Bypass): False

Bypasses

Types Currently Active

Local Latched Class B
 Remote Latched Class C
 Class B/C

Local Bypass
 Demand Bypass (Latched)

Remote Bypasses

1. Use Action Block
Undefined 0 Latched

2. Use Action Block
Undefined 0 Latched

3. Use Action Block
Undefined 0 Latched

Class B Timer Seconds
Preset: 300 Elapsed: 0

Class C Deadband / Arm Delay
DeadBand EU: 0.0
Preset: 5 Elapsed: 0

Block Trip Status (After Bypass): False

Chain

To: Undefined 0 Inst Status

Type: OR Is End of Chain

Delay
Preset: 0 Elapsed: 0

OR Chain First Out: 0 Chain Trip Status: False

Action Output

Trip Logic: True if Block True

Instance Trip Status: False

Type: No Action

Figure 6 - Plunger Arrival Action Block

Point Number : 2 - Lifting

Logic |

PM SURFACE CONTROLS: ACTION BLOCKS

Block Logic Operation

Block Tag: Lifting

Enable

Value #1
Input Pt Def: 180, 0, 213
Input Value: 0.0

Operator: LT (<)

Value #2
Set Pt Def: 0, 0, 0
Set Pt Value: 5.0

Delay
Preset: 0 Seconds
Elapsed: 0 Seconds

Result
DeadBand EU: 0.0
Block Trip Status (Before Bypass): **True**

Bypasses

Types Currently Active

Local Latched Class B
 Remote Latched Class C
 Class B/C

Local Bypass
 Demand Bypass (Latched)

Remote Bypasses

1. Use Action Block
Undefined 0 Latched

2. Use Action Block
Undefined 0 Latched

3. Use Action Block
Undefined 0 Latched

Class B Timer Seconds
Preset: 300 Elapsed: 0

Class C Deadband / Arm Delay
DeadBand EU: 0.0
Preset: 5 Elapsed: 0

Block Trip Status (After Bypass): **True**

Chain

To: 1 - Arrival 1 Block Status

Type: AND Is End of Chain

Delay
Preset: 0 Elapsed: 0

Chain Trip Status: **False**

Action Output

Trip Logic: True if Chain True

Instance Trip Status: **False**

Type: No Action

Figure 7 - Lifting Action Block

Point Number : 3 - Afterflow

Logic |

PM SURFACE CONTROLS: ACTION BLOCKS

Block Logic Operation

Block Tag: Afterflow

Enable

Value #1
Input Pt Def: 178, 0, 18
Input Value: 1.0

Operator: EQ (==)

Value #2
Set Pt Def: 0, 0, 0
Set Pt Value: 3.0

Delay
Preset: 0 Seconds
Elapsed: 0 Seconds

Result
DeadBand EU: 0.0
Block Trip Status (Before Bypass): **False**

Bypasses

Types Currently Active

Local Latched Class B
 Remote Latched Class C
 Class B/C

Local Bypass
 Demand Bypass (Latched)

Remote Bypasses

1. Use Action Block
Undefined 0 Latched

2. Use Action Block
Undefined 0 Latched

3. Use Action Block
Undefined 0 Latched

Class B Timer Seconds
Preset: 300 Elapsed: 0

Class C Deadband / Arm Delay
DeadBand EU: 0.0
Preset: 5 Elapsed: 0

Block Trip Status (After Bypass): **False**

Chain

To: 2 - Lifting 2 Inst Status

Type: AND Is End of Chain

Delay
Preset: 0 Elapsed: 0

Chain Trip Status: **False**

Alarm Logging

Log Inst Trips
 Log Inst Clear

First Out
Inst FO Tag R

Action Output

Trip Logic: True if Chain True

Instance Trip Status: **False**

Type: VAL (to Result Reg)

Action Item
Pt Def: 98, 0, 23

Figure 8 – Move Plunger Velocity Action Block

Point Number: **4 - Move 821**

Logic

PM SURFACE CONTROLS: ACTION BLOCKS

Block Logic Operation

Block Tag: Move 821

Enable

Value #1
Input Pt Def: 28, 2, 16
Input Value: 0.0

Operator: EQ (==)

Value #2
Set Pt Def: 0, 0, 0
Set Pt Value: 1.0

Delay
Preset: 0 Seconds
Elapsed: 0 Seconds

Result
DeadBand EU: 0.0
Block Trip Status (Before Bypass): **False**

Bypasses

Types Currently Active

Local Latched Class B
 Remote Latched Class C
 Class B/C

Local Bypass
 Demand Bypass (Latched)

Remote Bypasses

1. Use Action Block
Undefined 0 Latched

2. Use Action Block
Undefined 0 Latched

3. Use Action Block
Undefined 0 Latched

Class B Timer Seconds
Preset: 300 Elapsed: 0

Class C Deadband / Arm Delay
DeadBand EU: 0.0
Preset: 5 Elapsed: 0

Block Trip Status (After Bypass): **False**

Chain

To: Undefined 0 Inst Status

Type: OR Is End of Chain

Delay
Preset: 0 Elapsed: 0

OR Chain First Out: 0 Chain Trip Status: **False**

Action Output

Trip Logic: True if Block True

Instance Trip Status: **False**

Type: SAV (from Result Reg)

Action Item
Pt Def: 98, 0, 1

Alarm Logging

Log Inst Trips
 Log Inst Clear

First Out

Inst FO Tag R

Figure 9 – Store Plunger Velocity Action Block

Point Number: **5 - Afterflow**

Logic

PM SURFACE CONTROLS: ACTION BLOCKS

Block Logic Operation

Block Tag: Afterflow

Enable

Value #1
Input Pt Def: 178, 0, 18
Input Value: 1.0

Operator: EQ (==)

Value #2
Set Pt Def: 0, 0, 0
Set Pt Value: 3.0

Delay
Preset: 0 Seconds
Elapsed: 0 Seconds

Result
DeadBand EU: 0.0
Block Trip Status (Before Bypass): **False**

Bypasses

Types Currently Active

Local Latched Class B
 Remote Latched Class C
 Class B/C

Local Bypass
 Demand Bypass (Latched)

Remote Bypasses

1. Use Action Block
Undefined 0 Latched

2. Use Action Block
Undefined 0 Latched

3. Use Action Block
Undefined 0 Latched

Class B Timer Seconds
Preset: 300 Elapsed: 0

Class C Deadband / Arm Delay
DeadBand EU: 0.0
Preset: 5 Elapsed: 0

Block Trip Status (After Bypass): **False**

Chain

To: 2 - Lifting 2 Inst Status

Type: AND Is End of Chain

Delay
Preset: 0 Elapsed: 0

Chain Trip Status: **False**

Action Output

Trip Logic: True if Chain True

Instance Trip Status: **False**

Type: VAL (to Result Reg)

Action Item
Pt Def: 98, 0, 24

Alarm Logging

Log Inst Trips
 Log Inst Clear

First Out

Inst FO Tag R

Figure 10 - Move Velocity Confidence Code Action Block

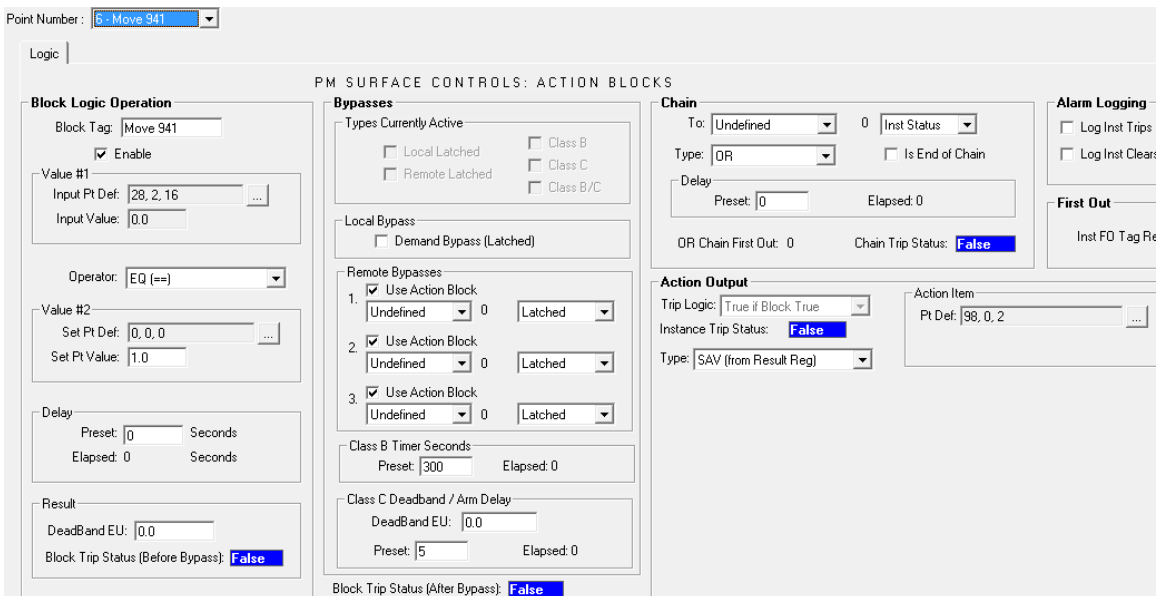


Figure 11 - Store Velocity Confidence Code Action Block

3.2 Adding Surface Velocity to Cycle Logs (PMWO version 4.03 and newer)

From PMWO version 4.03 and onwards users can store custom values in the Cycle Log. For those on older versions of PMWO the surface velocity can be stored to history instead. Refer to section 0.

Cycle Settings are in the PMWO Config display #80, under the General tab.

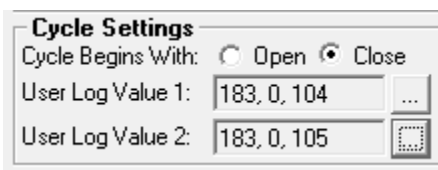


Figure 12 - Add User Values To Cycle Logs

User logged values are in the PMWO Units display #79, under the Cycle Logs tab.

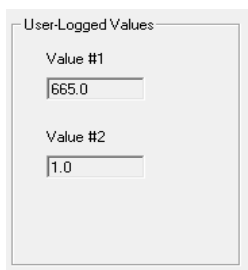


Figure 13 - User Logged Values

3.3 Adding Surface Velocity to History (PMWO version pre 4.03)

To write the surface velocity and velocity calculation code to history add the following two points.

| Point | Archive Type | Archive Point |
|-------|---------------|---------------|
| 1 | Current Value | 183, 0, 104 |
| 2 | Current Value | 183, 0, 105 |
| 3 | Undefined | 0, 0, 0 |
| 4 | Undefined | 0, 0, 0 |
| 5 | Undefined | 0, 0, 0 |

Figure 14 - Archive Surface Velocity