

## Safety

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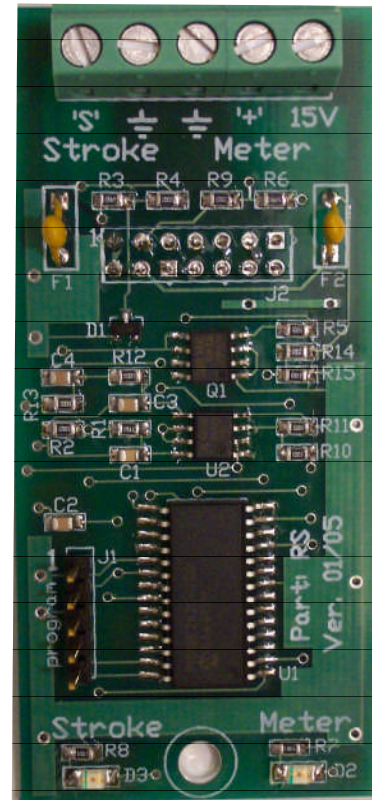
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#### Safety

30 VDC maximum on field wiring terminals.  
24 VDC maximum on internal card surfaces.

## RS Driver Card



## 1. Application

Solenoid drive chemical pumps are commonly controlled by turning the pump's power AC power ON & OFF. This control method has some limitations when precision feed rate, high turn-down ratio and/or fast response is required.

Most solenoid drive pumps may also be stroke controlled by plugging in the pump and using a stroke control signal to pace the pump. The **RS Driver** card provides a pump stroke control.

The **RS Driver** measures flow rate using a turbine or paddlewheel water meter and may be configured to control the stroke rate of a solenoid drive chemical feed pump based on the measured flow rate.

The **RS Driver** eliminates the delay between measuring a changing flow rate and modifying the feed rate by executing the control calculations in the **RS Driver** card.

Control delays may cause over or under treatment for in-line feed applications where a flow rate meter is pacing a feed pump.

### Controls:

1. Proportionately controls the pump based on the measured flow rate. As flow rate increases, pump feed rate strokes/minute increases. This is GPM to SPM; rate-to-volume control typically used for in-line feed applications where there is no downstream storage to limit the effect of over & underfeeds

2. Any analog sensor input A..N or manual input may be used to control the pump Strokes/minute. This is proportional control, replacing a 4-20mA controlled pump with a stroke controlled Pump

### Flexibility:

The STROKE output may interlocked by any of the controller's digital inputs, turning OFF the pump when the interlock contact set opens.

The STROKE control may be configured to reduce pump output as flow rate or an analog sensor increases in value, reversing the logical sense of the control.

The STROKE output may be used without using the RATE input, allowing you to control the STROKE using a sensor or manual input and to log the total strokes for inventory control.

The flow RATE input may be used independently to measure rate and log volume without using the STROKE output. This function is comparable to RATE-to-VOLUME, but does not require a 4-20mA output water meter & may be used to monitor & log discharge rates.

A user set maximum pump rate scales the STROKE control to fit pumps with maximum rates from 50 to 400 strokes/minute.

## 2. Installation

### 2.1 RS Services

#### Control Source:

Users may set any of the controllers enabled sensor's A..N or the value of the control equation on Relays 1..10 to control the pump Stroke rate including the **RS Driver** meter rate input

#### Setpoints:

Users set the **MAXIMUM** & **OFF** setpoints.

At **MAXIMUM** the pump is at the **Pump Maximum** stroke rate. At **OFF** the stroke rate is zero & the pump is off. Example A: **MAX** = 150 GPM, **OFF** = 0 GPM, . Example B: **MAX** = 8.22pH, **OFF** = 7.85pH

#### Pump Maximum

User set mechanical maximum varies with pump type and manufacturer from 50 to 400 strokes/minute.

#### Interlock

User set from one to four dry contact inputs 'AND'ed or 'OR'ed. Open contact sets stop chemical feed, setting stroke rate to zero.

#### Auto-Manual

User switched between modes. Manual mode sets %ON from 0..100%.

Retains setpoints and interlocks on return to Auto mode.

#### Stroke Logging & Display

Strokes may be logged to a user selected water meter input O..Z. The O..Z meter may be calibrated in mL or fractional gallons/stroke for usage tracking and alarms.

Current stroke rate is displayed by the controller as a percentage of the pump maximum.

On-card visual indicator of each stroke.

#### Meter Rate Logging & Display

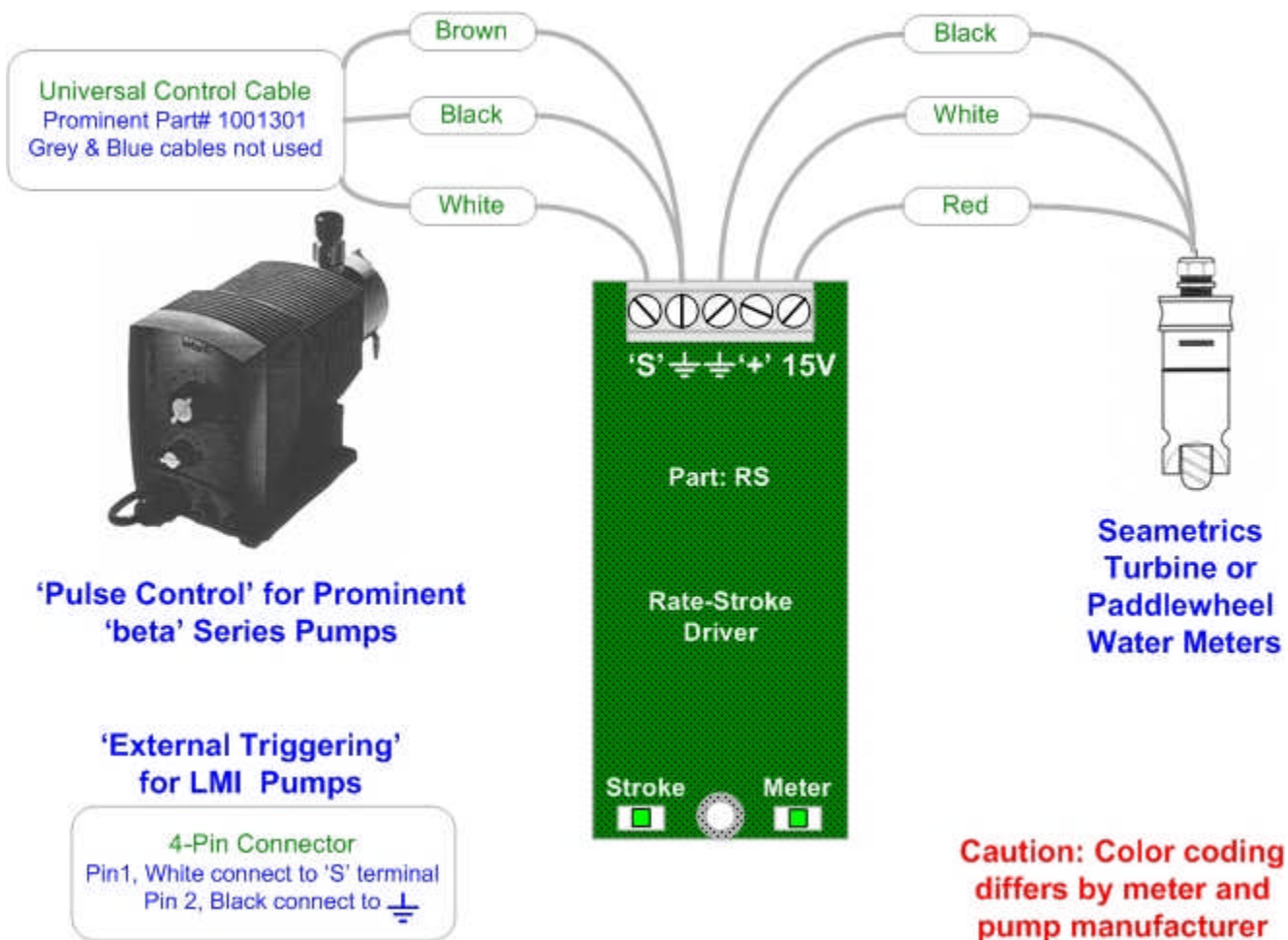
The measured rate is logged by the controller and can be converted to a volume and logged to a water meter O..Z. On-card visual indicator of each meter pulse.

#### Alarms:

1. Alarms on **Pump Disconnected**. Detects both an unplugged pump and disconnected STROKE control wiring. Pumps that are controlled by switching the power ON/OFF cannot detect an unplugged pump.
2. The power to three wire meters is thermally fused. If a meter wiring short or miswiring trips the fuse, the controller would alarm, informing the user of the wiring fault. The alarm clears automatically when the wiring fault is corrected.
3. Stroke rate = 0, pump off if controller- RS card communications interrupted for more than 6 seconds.

## 2.2 Driver Card Installation

1. Unplug or turn OFF the controller AC power.
2. RS Drivers may be installed in any of the M7 or M14 dual driver card slots. Do not install the RS driver in the 'G' slot of an M7 controller.
3. Turn ON the controller after installing the RS Driver and the controller will auto-configure, displaying both the assigned RATE Input A..N and STROKE Output C1 to C8, on the LCD display and browser.
4. Cable the chemical feed pump and water meter. **Caution: Do not install meter or pump cables in the same conduit as AC power wiring. Disconnect a non-functioning turbine or paddlewheel. Damage to the water meter may occur if mis-wired.**



### Technical Notes:

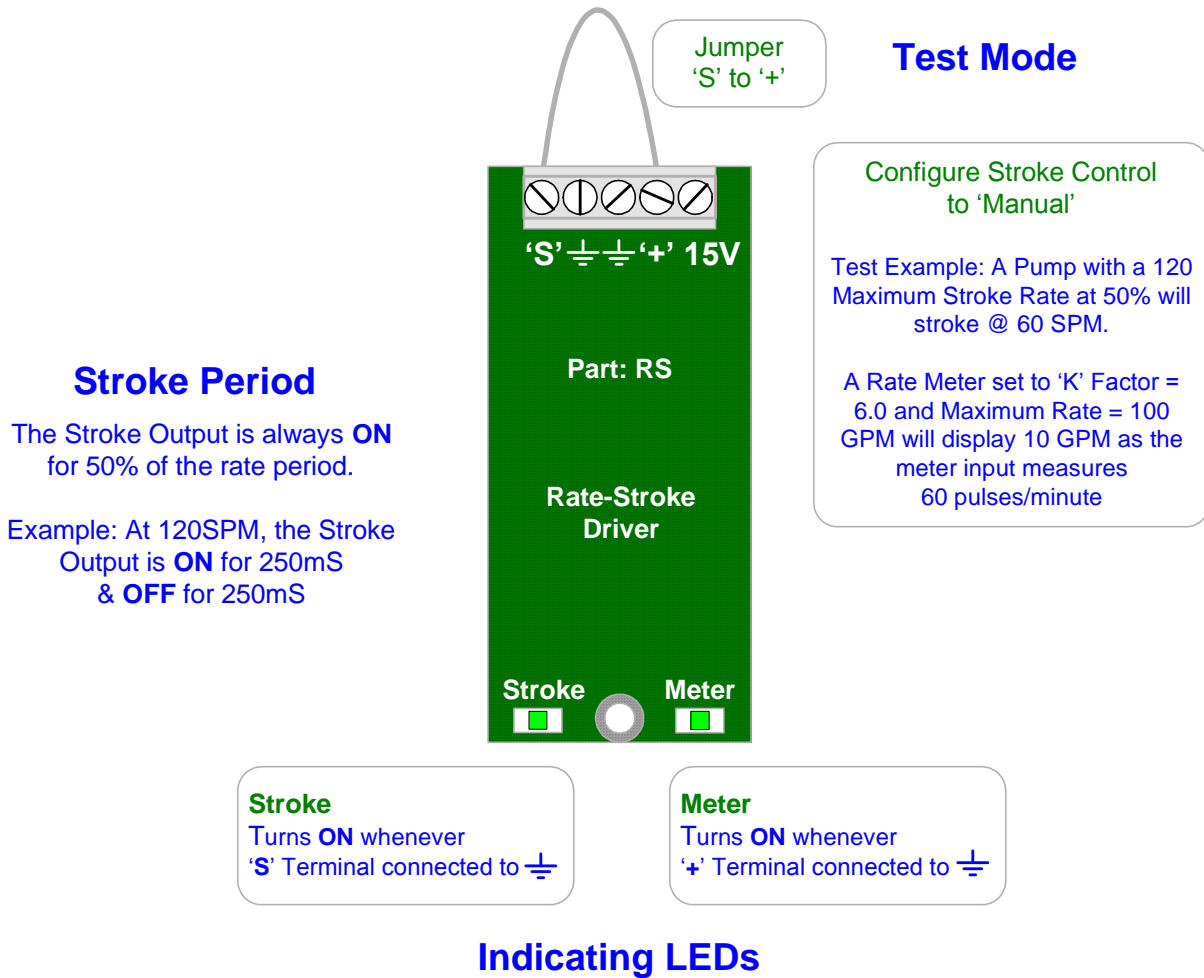
1. The meter '+' terminal is pulled up to 5VDC by 10K, limiting the meter signal current to 0.5mA.
2. The pump 'S' terminal is an open drain FET, thermally fused at 50mA, identical in operation to an open collector transistor.
3. The 15V supply is unregulated & provides from 15 to 20VDC, thermally fused at 50mA.
4. The ground terminals are connected to controller common and electrical ground via the controller's AC power cord.

### 3. Configuration - Operation

#### 3.1 Hardware View – Self Test

Rate-Stroke cards can be used to self-verify by connecting the stroke output into the water meter input. Placing the Stroke control into MANUAL mode allows you to set the Strokes/Minute and the Maximum pump strokes/minute. The Rate meter input converts the stroke rate into gallons or liters per minute.

Every time the **STROKE** LED turns ON, the **METER** LED turns ON indicating a measured pulse.



#### Meter LED Note:

Meter pulse rates over 25 pulses/sec or 1500 pulses/minute cannot be followed on the Meter LED. Above 25 pps the eye cannot follow the LED ON/OFF switching and the LED appears dim, typically at 50% of the brightness of the Stroke LED.

### 3.2 New Card Browser View

Rate-Stroke cards have a stroke control output (**C1** in this example) and a Rate water meter input (**B** in this example)

The browser view and LCD display will automatically reconfigure to show both stroke output and meter input.

Stroke outputs are assigned to any available output C1 through C1, sharing this space with 4-20mA outputs cards.

**06:47:36 2005-04-06** Alarm User No.1 Refresh

**Sensors & Controlled Outputs**

O: Feedwater	0	gal	
1: Chemical Pump	OFF	0.0	minutes

**Monitoring Sensors**

A: Sensor Input A	0.00		
B: Rate meter	3	gpm	
C: Condensate Cond.	26.5	uS	
D: Steam Production	18500	Lb	
	0	gpm	
	0	gal	
T: Operate Interlock	OFF	0.0	minutes

**Unused, Uncontrolled Outputs**

	OFF	0.0	minutes
	OFF	0.0	
	OFF	0.0	
5: Relay output 5	OFF	0.0	minutes
C1: Stroke Output C1	96.0	spm	
C2: 4-20mA Output C2	8.0	mA	

### 3.3 Rate Water Meter Configuration - Diagnostic

The Rate meter input may be used to control the Stroke rate, unused and/or used to control another pump or relay.

The flow rate measured by the meter may be converted to volume using **Rate-to-Volume** compensation and logged by one of the controller's water meter inputs.

**Configure**

B: Rate meter

Must be Turbine or Paddlewheel type

Description	Rate meter	
'K' Factor	5.00	'K' Factor is pulses/gallon OR pulses/liter
Max. rate	200.00	Set to 110% to 125% of expected maximum measured flow rate
Displayed units	gpm	
Digits after decimal	2	
Compensation	None	
Disable Input	<input type="radio"/> YES <input checked="" type="radio"/> NO	Rate water meter measurement input
Input card type	Rate-to-Stroke	
Log Period	60	minutes

Use the Diagnostic page to monitor a varying flow rate in real time.

The RS Driver uses the meter **'K' factor** to convert the measured meter pulse to a flow rate in GPM or LPM.

The RS Driver provides a voltage proportional to meter flow rate scaled to the user set **Max. Rate.**

**Diagnostic**

B: Rate meter

Sensor Location	B	Current value of water meter at input 'B'
Input card type	Rate-to-Stroke	
Current State	Operational	
Displayed Value	24.30	gpm
Period Maximum	48.49	gpm
Period Minimum	-0.00	gpm
Period Average	3.36	gpm
Sample size	773	
Current Period	57	minutes
Log Period	60	minutes
Compensation	None	
Measured Level	297.8	mV
'K' Factor	5.00	
Max. rate	200.00	gpm
Input card ID	50	mV

110% to 125% of maximum expected flow rate

Card ID level 50mV +/-10mV

### 3.4 Stroke Control Configuration

#### 3.3.1 Manual Mode

Stroke controls default when first installed to manual control at zero spm with a Maximum Pump rate of 60 spm.

Set the Maximum Pump spm correctly for your pump type before connecting the pump stroke control cable.

'Inventory Location' logs the number of pump strokes. If you calibrate the logging meter for the volume/stroke or the number of strokes/gallon, the meter will log the pumped volume.

Meter volume occurs in both Manual & Auto modes.

**Configure**

C1: Stroke Output C1

Control by: No control

Interlocked by: none

Return to Auto:  YES  NO

Manual Level: 80 %

Inventory location: none

Maximum Pump: 120 spm

Now @ 80% of 120spm = 96 spm

Pumps from 50 to 400 Strokes/Minute supported

Stroke outputs are assigned to any available output C1 through C1, sharing this space with 4-20mA output cards.

The **Diagnostic** page shows both the current manual setting and the resulting pump stroke rate.

**Diagnostic**

C1: Stroke Output C1

Current State: Set to Manual 80.0%

No control: 96 spm

OFF: 0.000 spm

MAX: 0.000 spm

Output card @: A

Maximum Pump: 120 spm

Current Rate: 80.0 %

Now @ 80% of 120spm = 96 spm

RS Driver card installed in Slot 'A'



3.3.2 Stroke Control using a Controller Sensor

And single sensor analog sensor or the control value of any relay may be used to control the pump stroke rate.

Use of the Rate meter to control the stroke rate is detailed in section 3.3.4.

Stroke control may be interlocked with from one to four of the controller’s dry contact inputs. When the contact set opens, the pump spm is set to zero, turning the pump OFF

The **Diagnostic** page provides the information required to confirm stroke control.

The RS Driver card sends the actual pump strokes to the controller where they may be converted to volume and logged on one of the controller meter inputs as the pumped volume.

If you calibrate the volume logging meter as a Turbine meter with the 'K Factor equal to Strokes/Gallon OR Strokes/Liter, the meter will then log Gallons or Liters

Field	Value	Unit
Volume today	1850	gal
Current Rate	1850	spm
Maximum Pump	120	spm
Output card @	A	
MAX	20000	FBH
OFF	0	FBH
Control by: D	18200	FBH
Current State	Set to Auto	

3.3.2 Stroke Control using a Controller Sensor continued

The browser view automatically reflects the pump stroke control by a controller sensor.

In this example the Rate water meter part of the RS Driver card is not used for pump stroke control

The screenshot shows a control interface with a green background. At the top, it displays the time '06:49:48', date '2005-04-06', an 'Alarm' button, 'User No. 1', and a 'Refresh' button. Below this are two main sections:

- Sensors & Controlled Outputs:**
  - D: Steam Production 18500 LBH
  - C1: Stroke Output C1 111.0 spm
  - O: Feedwater 0 gal
  - 1: Chemical Pump OFF 0.0 minutes
- Monitoring Sensors:**
  - A: Sensor Input A 0.00 ---
  - B: Rate meter 3 gpm
  - C: Condensate Cond. 26.5 uS
  - F: Rate meter 0 gpm

Two callout boxes provide additional context:
 

- One points to the 'C1: Stroke Output C1' row, stating: 'View automatically changes to show status of sensor and pump stroke control'.
- Another points to the 'B: Rate meter' row, stating: 'Rate meter not used for control'.

3.3.3 Configuration Reference

Maximum Stroke Rate

The maximum stroke rate varies with pump manufacturer and model. The controller scales stroke rates from zero SPM to the user set Maximum SPM. **Example:** A Maximum Stroke Rate of 200 SPM and a manual control setting of 40%, controls the pump at 80 spm.

Maximum Stroke Rate Range

The maximum stroke rate must be as least 50 SPM and cannot exceed 400 SPM. An 'Out of Range' error message occurs if you enter a value outside the 50..400 SPM range.

Operator Errors

If you set the Maximum Stroke Rate less than the actual rate for your pump, then you will not be able to deliver the pump's rated output.

If you set the Maximum Stroke Rate greater than the pump rating, pump operation will vary with pump vendor. The pump may stall, delivering no chemical OR is may be limited by the pump firmware to a maximum rate. In either case, you will not have linear control across the full feed range of the pump.

**Do not set the Maximum Stroke Rate higher than the maximum SPM for your pump!**

## 3.3.3 Configuration Reference continued

### OFF Setpoint

The controller sets to pump to 0 SPM at the OFF Setpoint.

#### OFF Setpoint Range

If you are using the Rate, Water meter input of the RS Driver card, the controller forces the control range to be between 0 & 1000GPM or 1000LPM. An 'Out of Range' error message occurs if you enter a value outside the 0..1000 range.

There are no limits on the OFF Setpoint range if you are using any other analog sensor for control of SPM.

#### OFF Setpoint less than Maximum Setpoint

You would typically set OFF setpoint less than the Maximum setpoint.

**Example:** Control using a Rate water meter on the RS driver. OFF = 0GPM, Maximum = 100GPM.

At zero GPM, pumps at 0 SPM

At flow rates of 100 GPM & higher, pumps @ Maximum SPM.

Between 0 & 100 GPM, pump SPM is proportional to rate, increasing as the flow rate increases.

#### OFF Setpoint greater than Maximum Setpoint

You can set the OFF setpoint greater than the Maximum setpoint.

**Example:** Control using a temperature sensor. OFF = 100F, Maximum = 50F

At temperatures of 100F & higher, pumps at 0 SPM

At temperatures of 50F & lower, pumps @ Maximum SPM.

Between 100F & 50F, pump SPM is proportional to temperature, increasing as the temperature falls.

### Maximum Setpoint

The controller sets to pump to Maximum Stroke Rate SPM at the Maximum Setpoint.

#### Maximum Setpoint Range

If you are using the Rate, Water meter input of the RS Driver card, the controller forces the control range to be between 0 & 1000GPM or 1000LPM. An 'Out of Range' error message occurs if you enter a value outside the 0..1000 range.

There are no limits on the Maximum Setpoint range if you are using any other analog sensor for control of SPM.

#### Maximum Setpoint greater than OFF Setpoint

You would typically set Maximum setpoint greater than the OFF setpoint.

**Example:** Control acid feed using an pH sensor. OFF = 7.50pH, Maximum = 7.55.

At 7.50pH, pumps at 0 SPM

At pH's of 7.55 & higher, pumps @ Maximum SPM.

Between 7.50pH & 7.55pH, pump SPM is proportional to pH, increasing as the pH increases.

#### OFF Setpoint greater than Maximum Setpoint

You can set the OFF setpoint greater than the Maximum setpoint.

**Example:** Control oxidant using an ORP sensor. OFF = 250mV, Maximum = 240mV.

At ORP's of 250mV & higher, pumps at 0 SPM

At ORP's of 240mV & lower, pumps @ Maximum SPM.

Between 250mV & 240mV, pump SPM is proportional to ORP, increasing as the ORP decreases.

## 3.3.3 Configuration Reference continued

### Interlock

The controller sets the pump SPM to zero when the interlocking contact set is closed.

Up to 4 contact sets may be AND'ed or OR'ed.

**Example:** The re-circulating flowswitch contacts connected to controller input 'U' must be closed for the pump to control feed rate.

**'AND' Example:** The pH sensor sample line flowswitch connected to input 'T' **AND** the 'Mixer Pump ON' contact switch connected to input 'Z' must both be closed for the pump to control. Both contact sets must be closed for the pump to operate.

**'OR' Example:** The building automation system contact set for Chiller No.1 connected to input 'U' **OR** Chiller No.2 connected to input 'X' must be closed for the pump to control. Either set of contacts may be closed & the pump will operate.

### RS Driver Card Location

The RS driver card is installed in one of the controller slots used for analog sensors and 4-20mA outputs.

If you require stroke control based on the rate water meter connected to the RS Driver card, set the Control Equation to the letter used for the rate water meter.

**Example:** The RS Driver is installed in slot 'C' Setting the control equation to 'D', controls the pump SPM based on the rate measured by the meter connected to input 'D'

If you have more than one RS Driver card in your controller, the Card Location helps you to identify each Rate-Stroke driver prior to you assigning them specific names.

### Alarms

The controller alarms when the RS Driver does not detect a pump connected to the stroke control.

Alarms also occur when the water meter +15V thermal power fuses, indicating a wiring short to the rate meter.

Stroke control does not detect a pump

Active Alarms		
Clear All Alarms		
<input type="radio"/> YES <input checked="" type="radio"/> NO		
4-20mA Output C2	4-20mA loop open	2005-04-06 06:41:51
Stroke Output C4	Pump disconnected	2005-04-06 06:48:52
Relay 1-5 Fuse	Fuse opens	2005-04-06 06:41:51

Loss of communication between the RS Driver card and the controller also causes an alarm. Turn the controller OFF and verify that the RS Driver card is firmly and completely seated on the connection header.

3.3.4 Stroke Control using the Rate Meter

When the Rate Meter part of the RS Driver card is used to control pump stroke rate, stroke rate is calculated on the RS Driver card.

The user set OFF & MAX setpoints are used to change the stroke rate as soon as the measured meter rate changes.

**Configure**

C1: Stroke Output C1

Controlling sensor letter 'A'..'N': B

Sensor 'B' value @ zero spm, pump OFF → Control by: OFF

Sensor 'B' value @ maximum spm, pump full ON → Control by: MAX

Interlocked by: none

Set to Manual:  YES  NO

Inventory location: P:Pumped Volume

Maximum Pump: 120 spm

Pump type sets the maximum strokes/minute

Optional location for logging pumped volume

Control by:	B	
OFF	0.00	gpm
MAX	100.00	gpm
Interlocked by:	none	
Set to Manual	<input checked="" type="radio"/> YES <input type="radio"/> NO	
Inventory location	P:Pumped Volume	
Maximum Pump	120	spm

Whenever the RS Driver card is controlling using the on-board rate meter, the last line of the **Diagnostic** page alerts the user that the measured Rate issuer for Pump Control

**Diagnostic**

C1: Stroke Output C1

Controlling water meter & its current flow rate

Current State: Set to Auto

Control by: B

Current Setpoints → OFF: 0.00 gpm

→ MAX: 100.00 gpm

Output card @: A

Maximum Pump: 120 spm

Current Rate: 24.0 %

Volume today: 104.2 gal

SPM control by: Rate meter

100% x (24.33/100.00) = 24% or 29 spm

Displays only when Rate meter control Stroke on the same card

Displays only when Volume logging meter selected

Current State	Set to Auto	
Control by: B	24.33	gpm
OFF	0.00	gpm
MAX	100.00	gpm
Output card @	A	
Maximum Pump	120	spm
Current Rate	24.0	%
Volume today	104.2	gal
SPM control by	Rate meter	

### 3.4 Combining Stroke & Current Loop Controls

The Rate Meter part of the RS Driver may be used independently in any way that any other controller sensor is used.

In this example the Rate Meter is used to control a 4-20mA current loop output.

**Configure**

C2: 4-20mA Output C2

Control by:

4 mA Level:  gpm

20 mA Level:  gpm

Interlocked by:

Set to Manual:  YES  NO

Rate meters may also be used to control current loops

The current loop settings are independent of any controller stroke control settings.

**Diagnostic**

C2: 4-20mA Output C2

Current State	Set to Auto	
Control by: B	7.9	mA
4 mA Level	0.00	gpm
20 mA Level	100.00	gpm
Output card @	C	

Current loop controls & setpoints are independent of stroke controls

In this example, the Rate Meter is used to control a pump stroke control and a 4-20mA current.

The browser view automatically changes to reflect the use of the rate meter to control both outputs.

07:09:50 2005-04-06 Alarm User No.1

**Sensors & Controlled Outputs**

B: Rate meter	24.30	gpm	
C1: Stroke Output C1	28.8	spm	
C2: 4-20mA Output C2	7.9	mA	
O: Feedwater	0	gal	
1: Chemical Pump	OFF	0.0	minutes

Stroke & Current Loop Controls may share a sensor

## 3.6 Keypad Services

Rate-Stroke controls involve the interaction of a controlling sensor and a pump stroke control. Monitoring and configuring this type of control typically uses the browser interface. A subset of the monitoring and configuration services is available through the keypad.

### 3.6.1 Rate Meter

**Diagnostic:** Duplicates information available using the browser with the exception of data logging parameters.

**Alarms:** Duplicates information and controls available using the browser.

**Calibration:** Unused. Re-directs the user to Configure for setting the 'K' Factor & Maximum flow rate.

**Configure:** The meter 'K' Factor is limited to be  $\geq 0.1$  and  $\leq 1000$ . If you enter a value outside of this range, the 'K' Factor is unchanged. No error message is provided.

The meter Maximum Rate is limited to be  $\geq 1$  and  $\leq 1000$ . If you enter a value outside of this range, the Maximum Rate is unchanged. No error message is provided.

Rate-to-Volume compensation is supported for keypad users

### 3.6.2 Stroke Control

**Diagnostics:** Displays  
Current State: Manual / Auto / Interlocked  
Output card @: Slot location for RS driver card.  
Control by: Controlling Sensor and current pump stroke rate  
OFF & MAXIMUM setpoints: units set to controlling sensor

**Configure:** Provides the following controls:  
Manual-Auto Switch: Switching back to Auto from Manual, restores the previous setpoints.  
Control Equation view & edit: Control equation limited to a single sensor or Relay control value  
OFF & MAX setpoint view & edit: Stroke control by the rate meter is limited to 0 to 1000 GPM or LPM. Setpoints outside of the 0 to 1000 range are ignored, leaving the setpoint unchanged  
Interlock view & edit: Interlocked stroke controls are set to zero spm.

Place the stroke control into **Manual** mode to edit the following

**Max Rate:** The mechanical maximum stroke rate of the pump. Limited to be greater or equal to 50spm and not more than 400spm.  
Defaults to 60spm on driver card installation.

**Trim Stroke Rate:** Calibrates the RS driver card clock. Nominally 30000. User adjustable +/-5%  
This value sets the strokes/minute accuracy. Typically set by the manufacturer and never modified.

## 4.0 Specifications

<b>Stroke Output</b>	Open drain thermally fused @ 50mA	Examples
	400 Strokes/Minute Maximum	50% duty cycle, 75mS minimum stroke width @ 400 spm.
	10,000 : 1 turn down	A 300spm rated pump strokes at a minimum rate of 1 stroke every 33.33 minutes.
	Maximum pump stroke rate from 50spm to 400spm, defaults to 60spm	Matches control to pump type.
	Interlock turns OFF pump on open contact set.	Zero spm on interlock
	Alarms on Disconnected Pump	Less than 4.5VDC pull-up by stroke controlled pump; alarms.
	Control OFF during updating	Zero spm while new setpoints, pump or meter parameters are loaded
<b>Rate Meter Input</b>	Maximum 24VDC on unregulated 15VDC, thermally fused at 50mA	Power for three wire turbine & paddlewheel meters.
	400Hz. Maximum meter pulse rate	Limited to Seametrics IP80 type maximum frequency. <b>Example:</b> A Seametrics 4" IP80 meter installed in a weldolet has a nominal 29 'K' Factor. 250GPM is 121 pulses/second or 121Hz.
	Meter input pulled up to +5VDC by the RS Driver Card.	
	'K' factor limited to 0.1 to 1000	Range limited by Browser & Keypad
	Max Meter Rate limited from 1 to 1000	Range limited by Browser & Keypad
<b>Delay on Power ON</b>	15 seconds from controller power ON to stroke control and rate measurement.	RS Driver card is programmed by the controller with user settings on each power ON.