INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WELKER® SAMPLE FREQUENCY CONTROLLER

MODEL

4P

DRAWING NUMBERS

EL482.1

EL820

EL862

EL867

MANUAL NUMBER

IOM-001

REVISION

Rev. G, 8/9/2024

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IMPORTANT SAFETY INFORMATION
READ ALL INSTRUCTIONS

Notes emphasize information and/or provide additional information to assist the user.

Caution messages appear before procedures that could result in damage to equipment if not observed.

Warning messages appear before procedures that could result in personal injury if not observed.

This manual is intended to be used as a basic installation and operation guide for the Welker Sample Frequency Controller, 4P. For comprehensive instructions, please refer to the IOM Manuals for each individual component. A list of relevant component IOM Manuals is provided in Appendix A of this manual.

The information in this manual has been carefully checked for accuracy and is intended to be used as a guide for the installation, operation, and maintenance of the Welker equipment described in this manual. Correct installation and operation, however, are the responsibility of the end user. Welker reserves the right to make changes to this manual and all products in order to improve performance and reliability.

BEFORE YOU BEGIN

Read these instructions completely and carefully.

IMPORTANT - Save these instructions for local inspector's use.

IMPORTANT - Observe all governing codes and ordinances.

Note to Installer - Leave these instructions with the end user.

Note to End User - Keep these instructions for future reference.

Installation of this Sample Frequency Controller is of a mechanical and electrical nature.

Proper installation is the responsibility of the installer. Product failure due to improper installation is not covered under the warranty.

If you received a damaged Sample Frequency Controller, please contact a Welker representative immediately.

Phone: 281.491.2331
Address: 13839 West Bellfort Street
Sugar Land, TX 77498

1.1 Introduction

We appreciate your business and your choice of Welker products. The installation, operation, and maintenance liability for this equipment becomes that of the purchaser at the time of receipt. Reading the applicable *Installation, Operation, and Maintenance* (IOM) *Manuals* prior to installation and operation of this equipment is required for a full understanding of its application and performance prior to use.*

If you have any questions, please call Welker at 1.281.491.2331.

**The following procedures have been written for use with standard Welker parts and equipment. Assemblies that have been modified may have additional requirements and specifications that are not listed in this manual.*

1.2 Product Description

The Welker *4P* Sample Frequency Controller is a simple, multi-function controller designed for use with sampling systems.

Once power is supplied to the 4P and solenoid, the 4P operates as a free-running timer that can be used to pulse a sample pump. By setting the sampling frequency switch, the 4P can be set to practically any time period required.

The 4P is also capable of receiving digital, voltage pulse, or analog signals and can easily interface with a variety of devices, such as transmitters, flow computers, and turbine meters. The timer board can be configured to operate based on time or proportionality to the input signal.

Welker may custom design the 4P to suit the particular application and specifications of each customer.

1.3 Power Supply to the 4P

⚠ The 4P can operate with a DC 12 or 24 V power supply. If the power supply is greater than DC 24 V, a power converter must be used to convert the power to DC 12 or 24 V.

To determine whether to supply the timer with DC 12 or 24 V, refer to *Table 1*.

Table 1: Determining Necessary Power Supply

Solenoid Power & Watt Draw	Power Supply to 4P
12 Volt, Draw ≤ 2 Watts	DC 12 V
12 Volt, Draw > 2 Watts	Install a Relay; Power Supply to 4P Dependent on Supply Needed to Supply Relay (DC 12 or 24 V)
24 Volt, Draw ≤ 10 Watts	DC 24 V
24 Volt, Draw > 10 Watts	Install a Relay; Power Supply to 4P Dependent on Supply Needed to Supply Relay (DC 12 or 24 V)

1.4 Specifications

The specifications listed in this section are generalized for this equipment. Welker can modify the equipment according to your company's needs. **Please note that the specifications may vary depending on the customization of your equipment.**

Table 2: 4P Specifications

Applications	Control of Sample Pumps Timer
Temperature Range	-40 °F to 160 °F (*-40 °C to 71 °C*)
Power	DC 7–28 V
Current	2 W @ DC 12 V* 10 W @ DC 24 V* *Solenoid Current Not Included
Analog Input	DC 1–5 V 4–20 mA
Digital Input	Open Collector or Dry Contact DC 1–5 V **Impedance:** 10 kΩ **Maximum Frequency:** 1 Hz
Digital Output	PNP Transistors Sinking 600 mA Switches Between Input and Ground
Mounting	Bracket or Dome
Feature	Adjustable Dwell Time
Options	AC/DC Converter DC 12 V Power Supply Enclosure Relay Scaler Card

1.5 Equipment Diagrams

Figure 1: Mounting Options

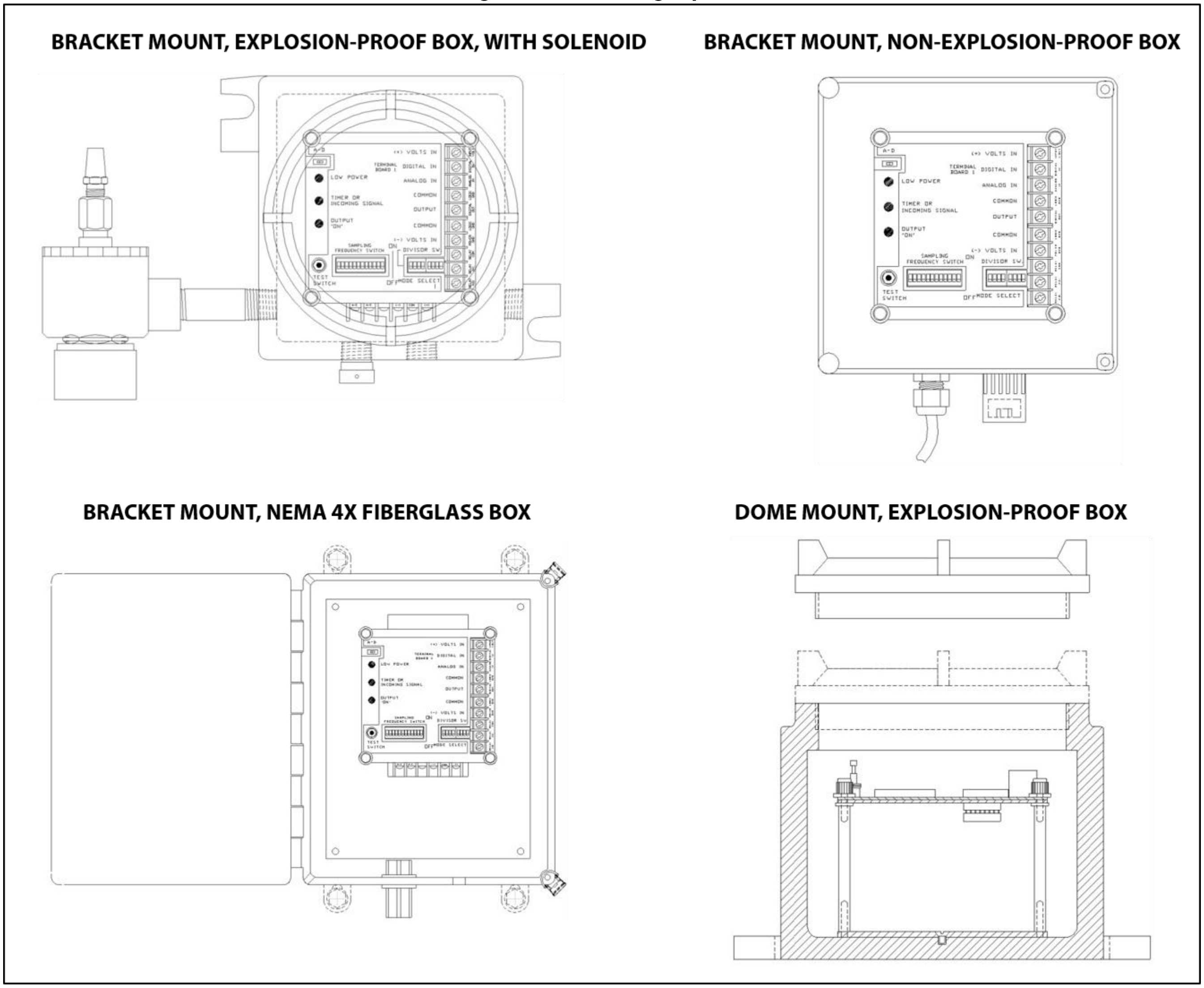
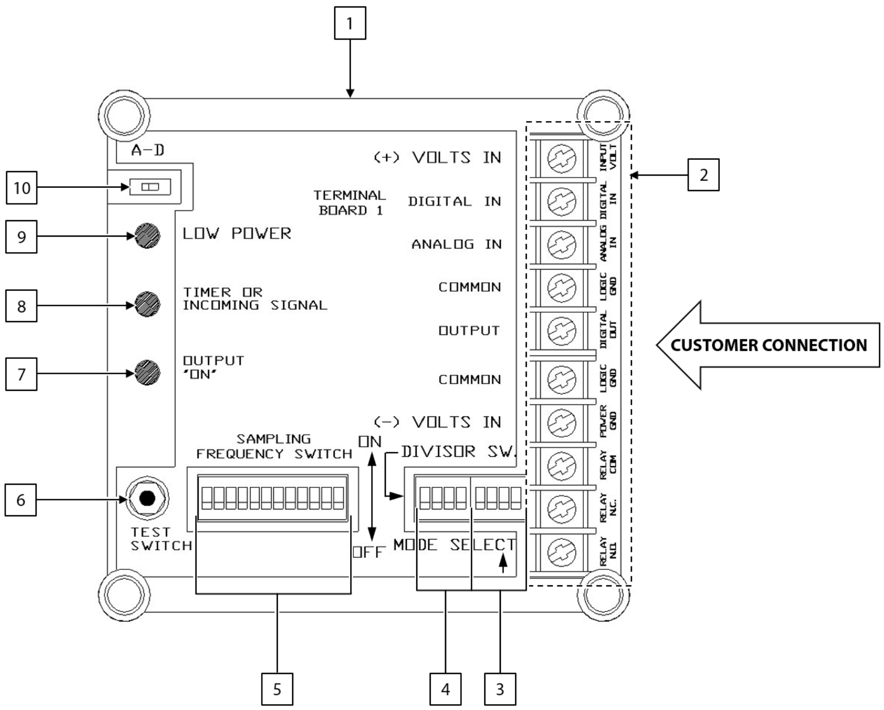


Figure 2: Timer Board Diagram



No.	Description
1	Timer Board
2	Terminal Block
3	Mode Select Switch Bank
4	Divisor Switch Bank
5	Frequency Scaling Switch Bank
6	Test Switch (Push Button)
7	Light Indicator: Output Energized
8	Light Indicator: Pulse
9	Light Indicator: Low Power
10	Analog/Digital Switch

2.1 Before You Begin

After unpacking the unit, check the equipment for compliance and any damage that may have occurred during shipment. Immediately contact a Welker representative if you received damaged equipment.

When sealing fittings with PTFE tape, refer to the proper sealing instructions for the brand used.

All electrical connections must meet local and national electric codes, and excessive weight added to the conduit run must be supported.

2.2 Installation and Initial Wiring

All terminations should be made on the terminal strip to the right of the timer board using fork terminals.

The timer board does not need to be removed from the enclosure to make terminations.

The terminations needed to power the timer are the same for all applications.

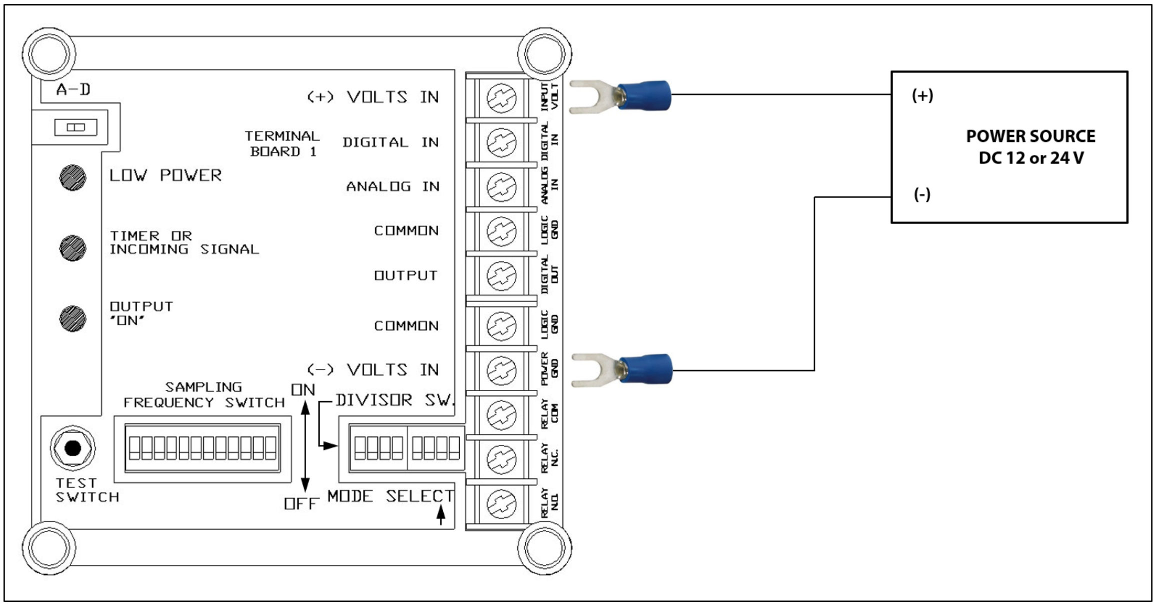
1. As necessary, mount the enclosure to the desired location. Ensure that there is sufficient clearance below the enclosure for the cables and conduit to exit.

The enclosure can be mounted directly to the pump, on a nearby wall, or to a mounting bracket.

2. Open the enclosure door.
3. Locate the wiring terminal block on the timer board (*Figure 2*).

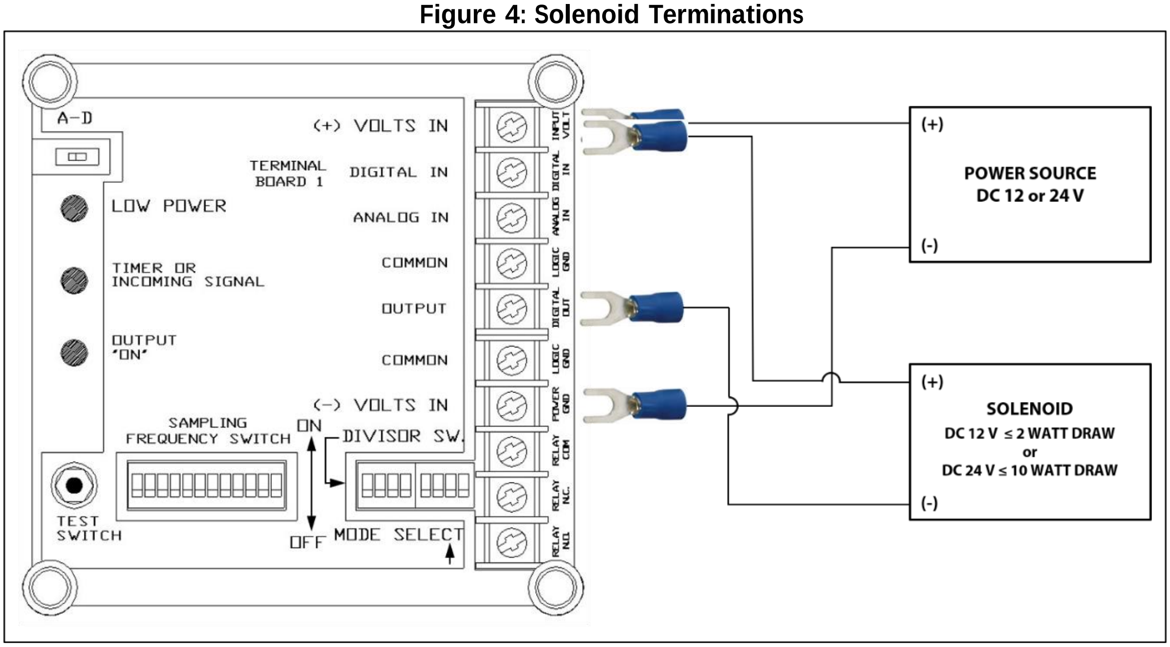
4. Make the terminations for the power supply. Connect the positive lead of the power supply to (+) VOLTS IN and the negative lead to (-) VOLTS IN (*Figure 3*).

Figure 3: Power Terminations



5. Make the terminations for the solenoid. Connect the positive lead of the solenoid to (+) VOLTS IN and the negative lead to OUTPUT (*Figure 4*).

Figure 4: Solenoid Terminations



6. If connecting the solenoid through a relay, connect the positive side of the relay to the (+) VOLTS IN terminal and the common side to the OUTPUT terminal (*Figure 5*).

Figure 5: Solenoid Terminations Through a Relay

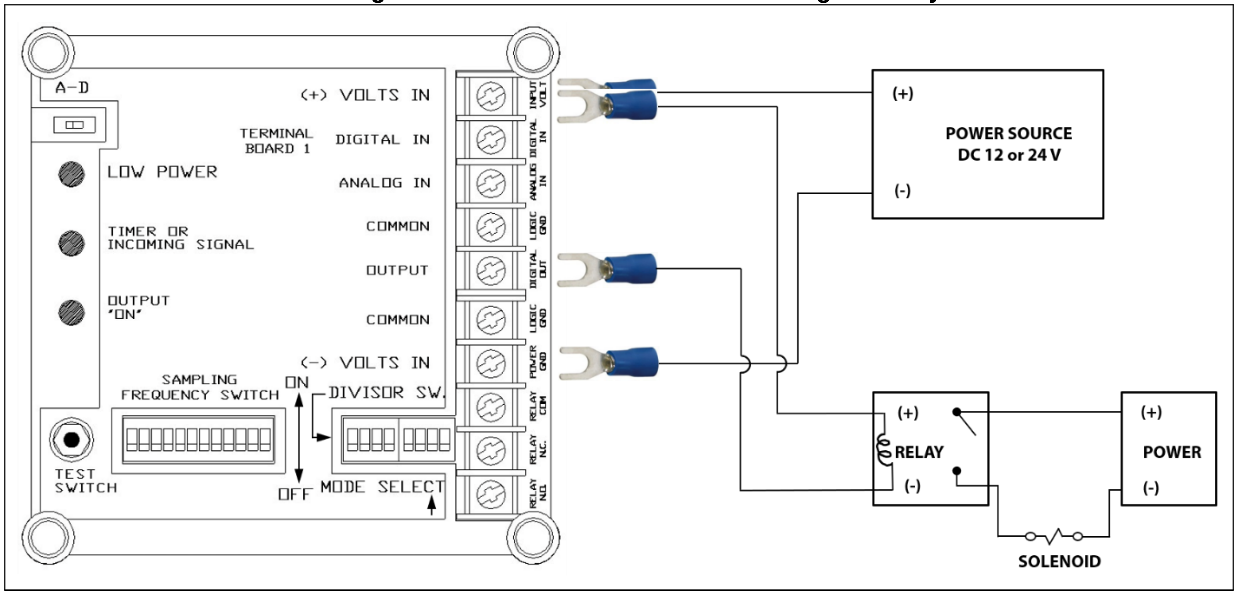
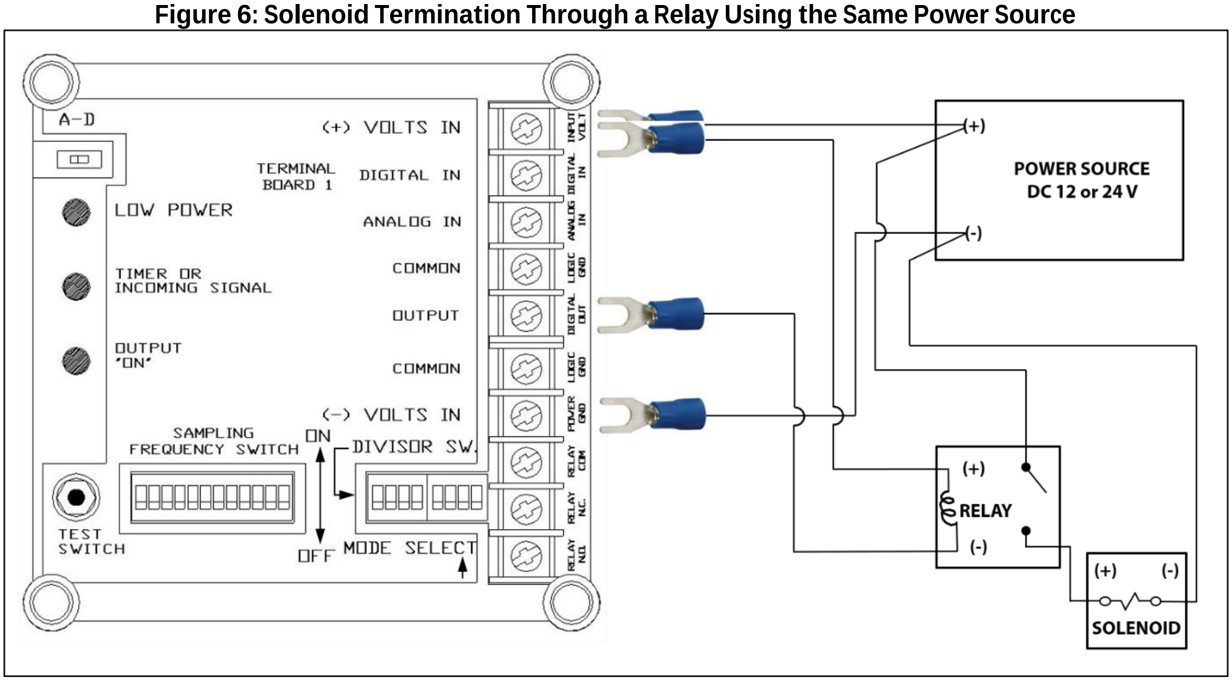


Figure 6: Solenoid Termination Through a Relay Using the Same Power Source



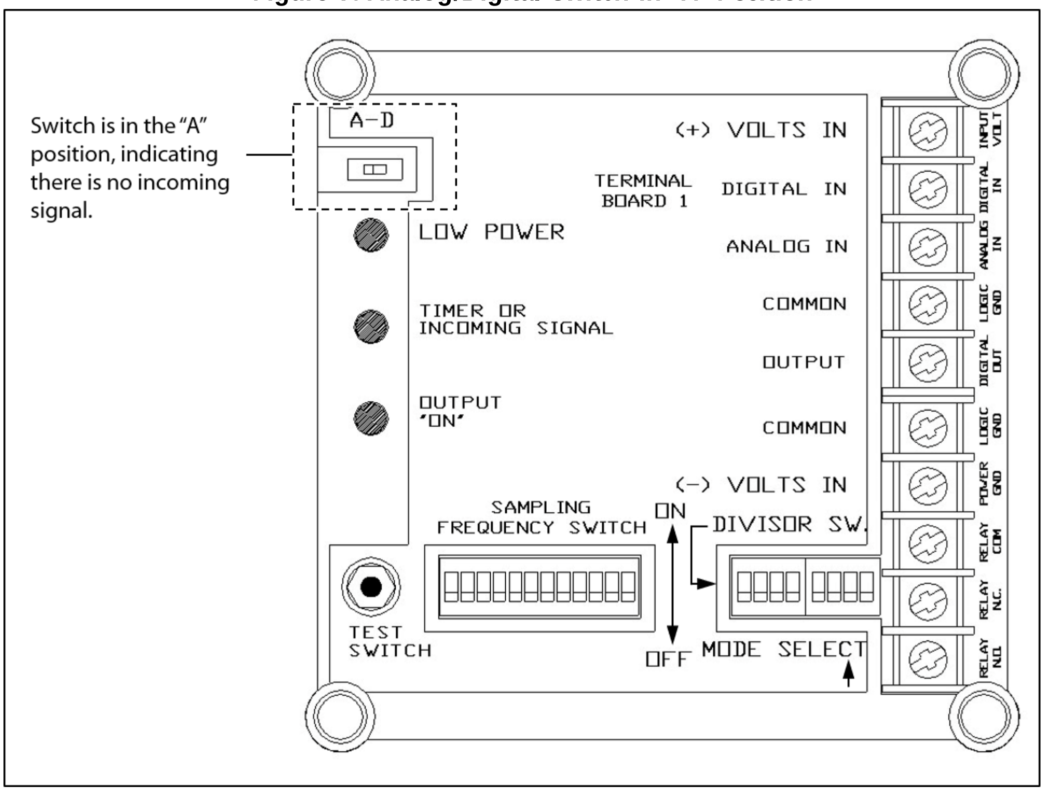
2.3 Preparing for Timed Sampling

> If there are no incoming signals and the timer board will be used for timed applications, the basic wiring configuration of the power and solenoid is sufficient for operation; no further wiring connections are required.

> A summary of settings by application is provided in *Appendix B, Settings at a Glance*.

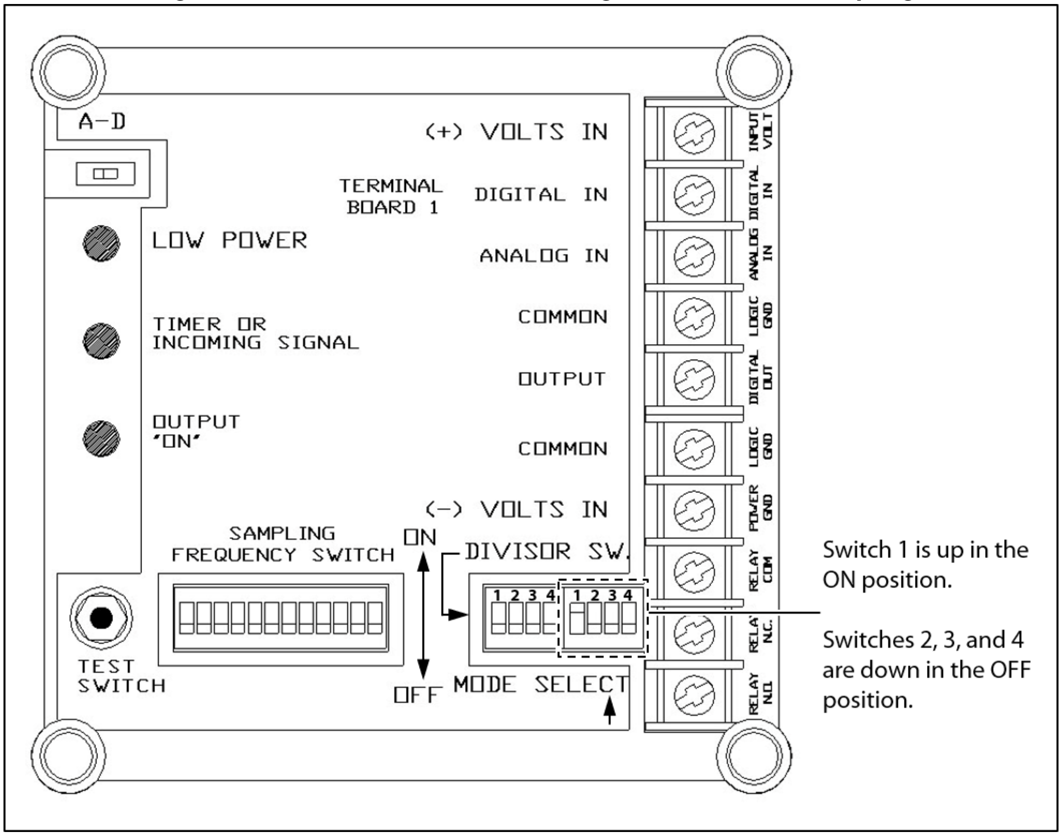
1. Slide the analog/digital switch to the left to the "A" position.

Figure 7: Analog/Digital Switch in "A" Position



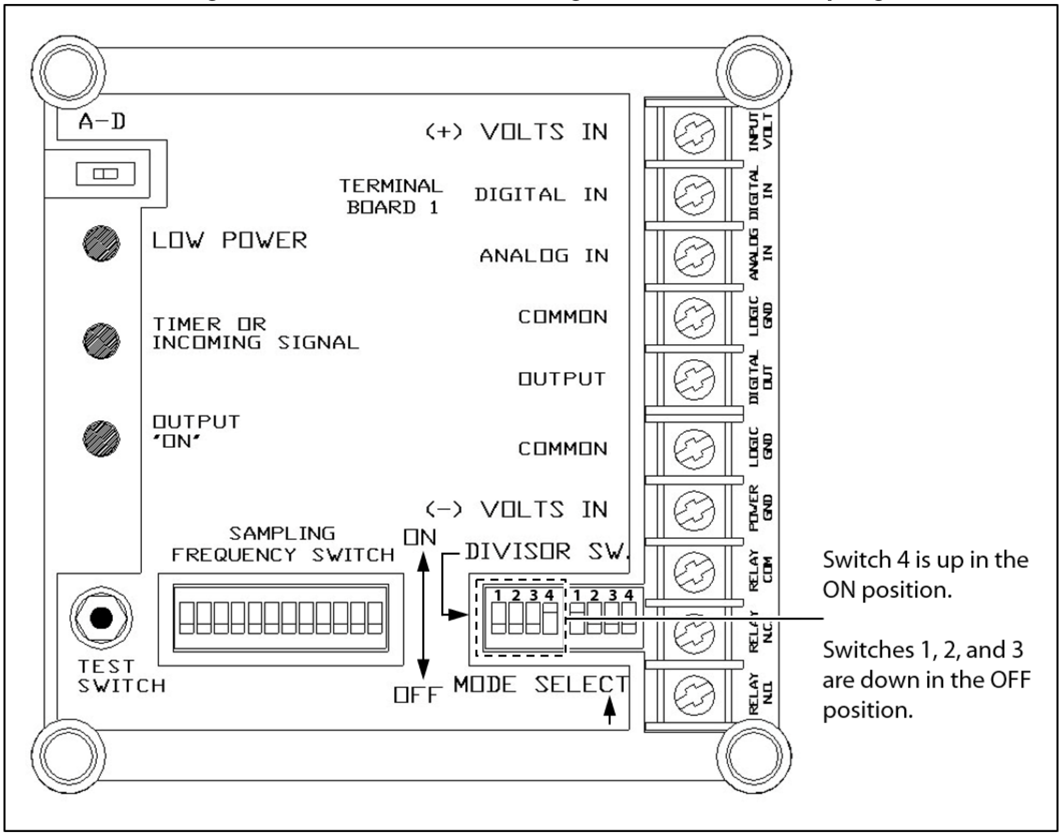
2. Slide switch 1 in the MODE SELECT switch bank up to the ON position, and then slide switches 2, 3, and 4 in the MODE SELECT switch bank down to the OFF position (*Figure 8*).

Figure 8: Mode Select Switches Configured for Timed Sampling



3. Slide switch 4 in the DIVISOR SWITCH bank up to the ON position, and then slide switches 1, 2, and 3 in the DIVISOR SWITCH switch bank down to the OFF position (*Figure 9*).

Figure 9: Divisor Switches Configured for Timed Sampling



4. Proceed to *Section 2.5*, *Setting the Sampling Frequency*.

2.4 Preparing for Proportional to Flow Sampling

> If there are incoming signals and the timer board will be used for proportional to flow applications, additional wiring connections are required.

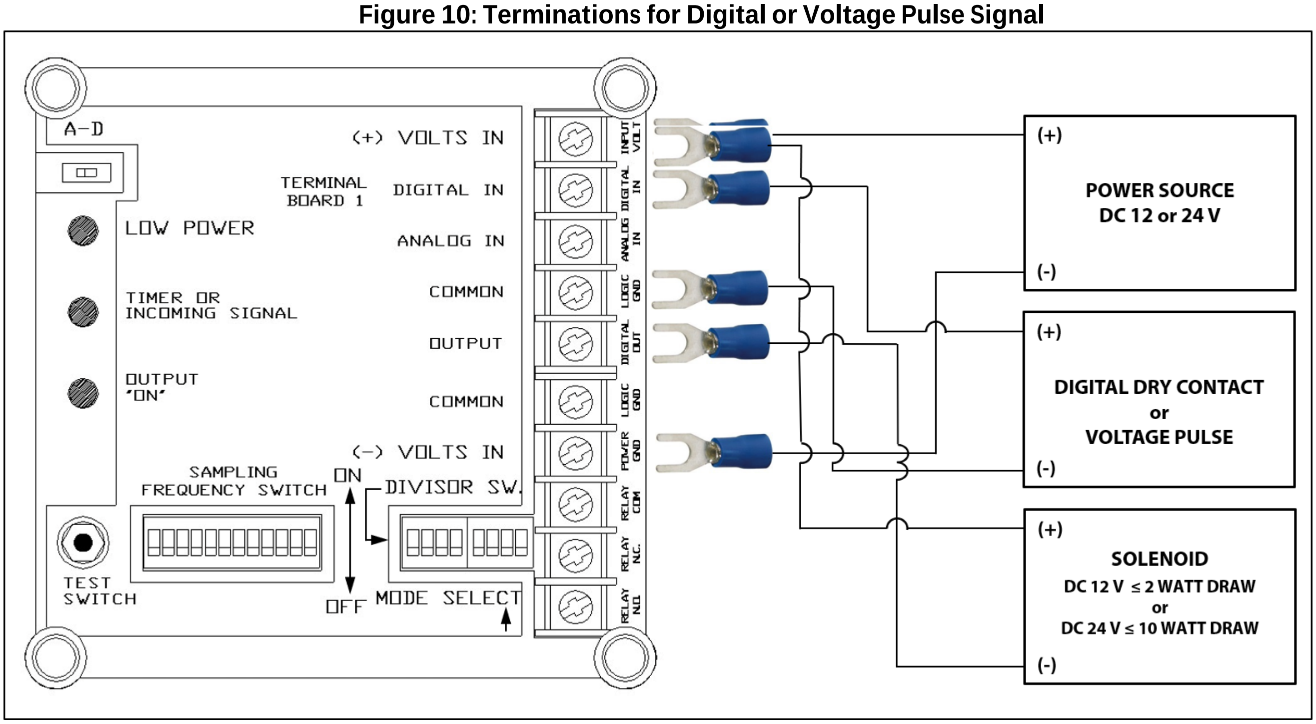
> A summary of settings by application is provided in *Appendix B, Settings at a Glance*.

> If the incoming signals are digital or voltage pulse, continue to step 1.
> If the incoming signals are analog (mA), proceed to step 6.
> If the incoming signals are analog and power needs to be supplied to the transmitter, proceed to step 11.

Digital or Voltage Pulse Signal

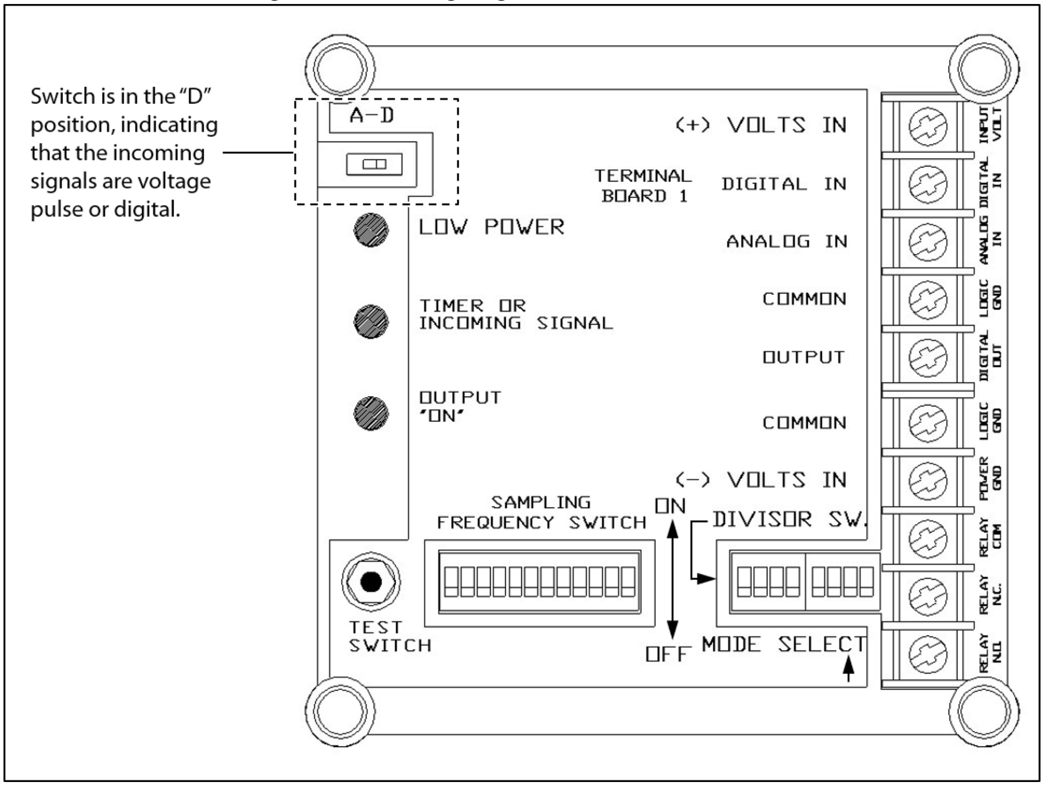
1. If the incoming signals are digital or voltage pulse, connect the positive side of the voltage pulse to the DIGITAL IN terminal and the common side to the COMMON terminal (*Figure 10*).

Figure 10: Terminations for Digital or Voltage Pulse Signal



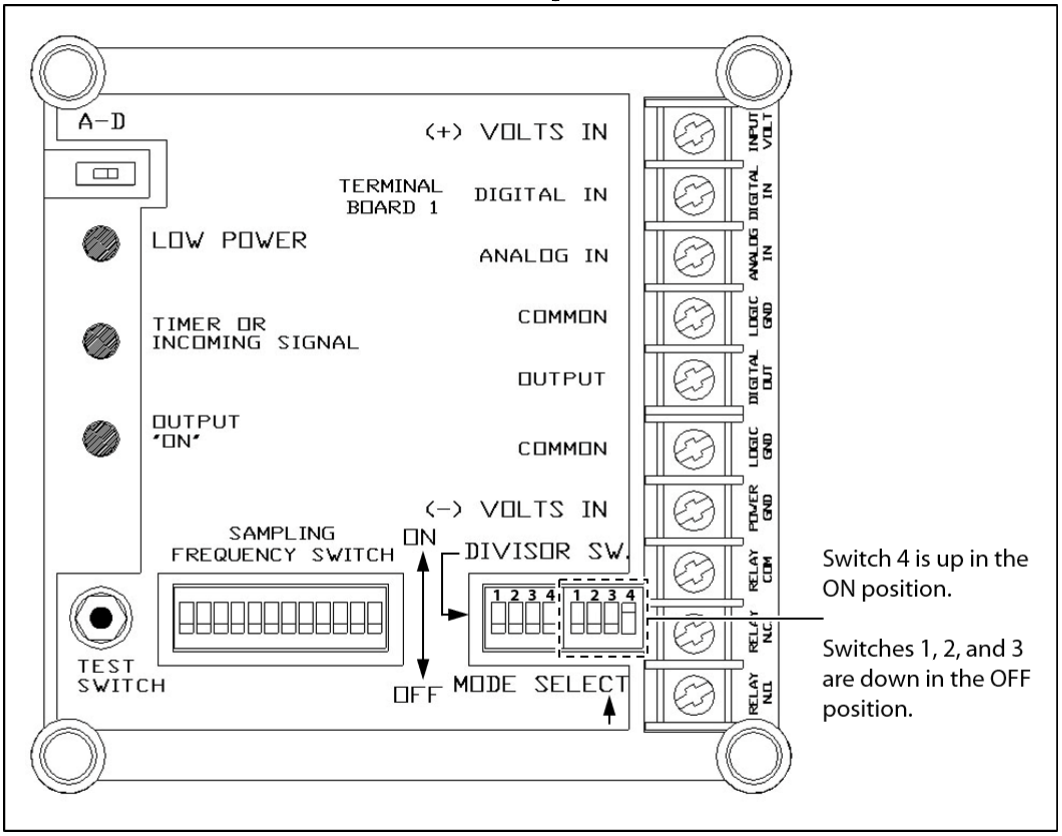
2. Slide the analog/digital switch to the right to the "D" position (*Figure 11*).

Figure 11: Analog/Digital Switch in "D" Position



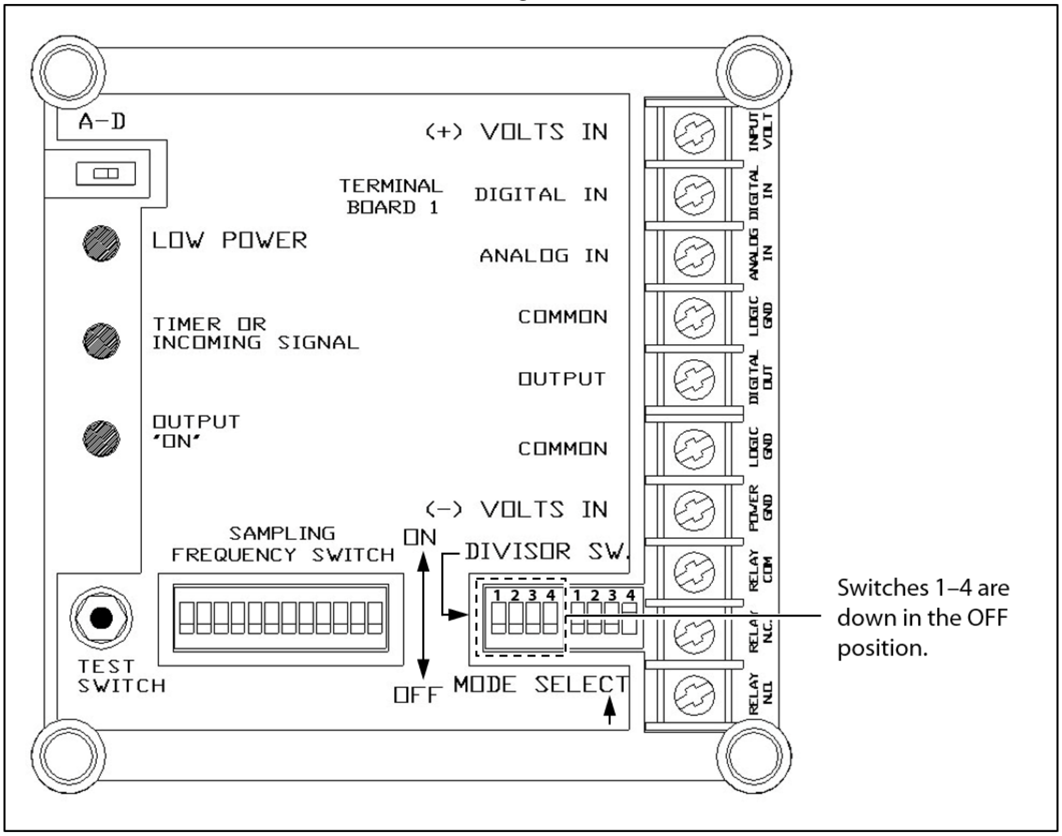
3. Slide switch 4 in the MODE SELECT switch bank up to the ON position, and then slide switches 1, 2, and 3 in the MODE SELECT switch bank down to the OFF position (*Figure 12*).

Figure 12: Mode Select Switches Configured for Proportional to Flow Sampling With Digital or Voltage Pulse Signal



4. Slide switches 1–4 in the DIVISOR SWITCH switch bank down to the OFF position (*Figure 13*).

Figure 13: Divisor Switches Configured for Proportional to Flow Sampling With Digital or Voltage Pulse Signal

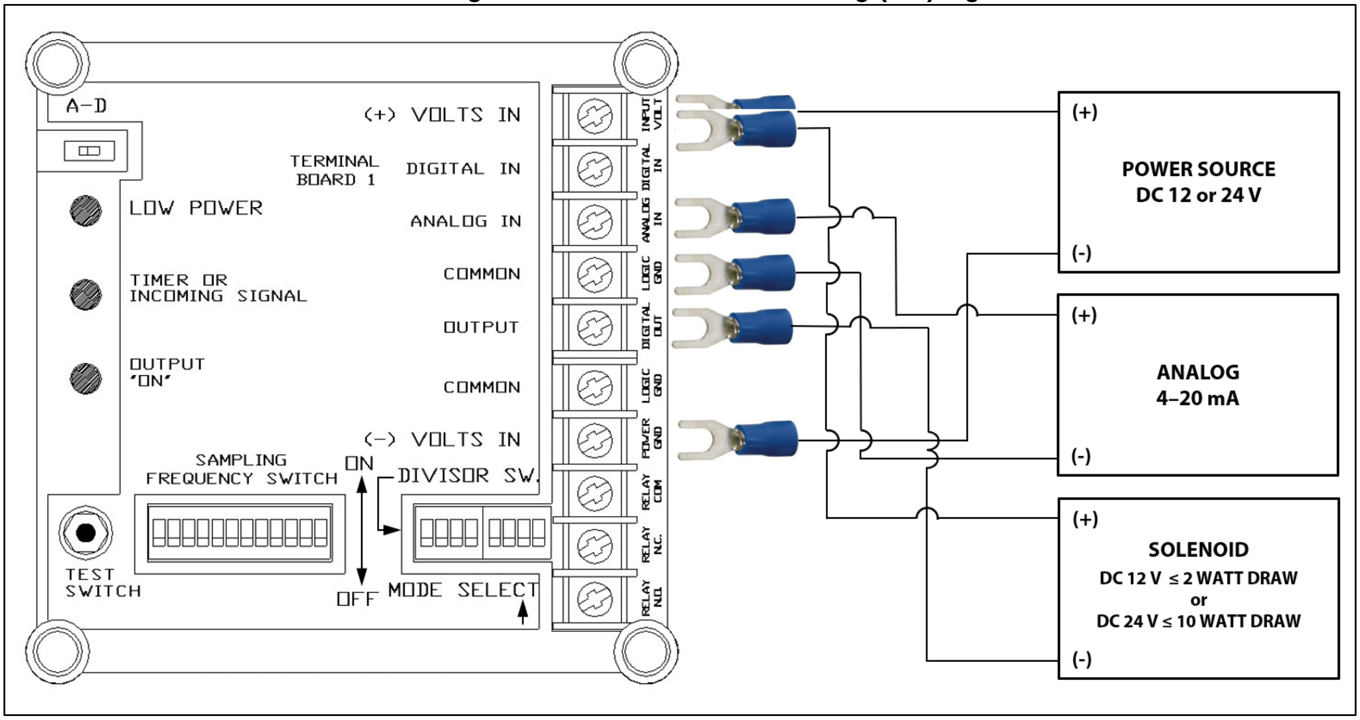


5. Proceed to *Section 2.5, Setting the Sampling Frequency*.

Analog Signal (mA)

6. If the incoming signals are analog, the power may be looped if the signal is milliamps (mA) instead of watts (W). Connect the positive side of the analog input to the ANALOG IN terminal and the negative side to the COMMON terminal (*Figure 14*).

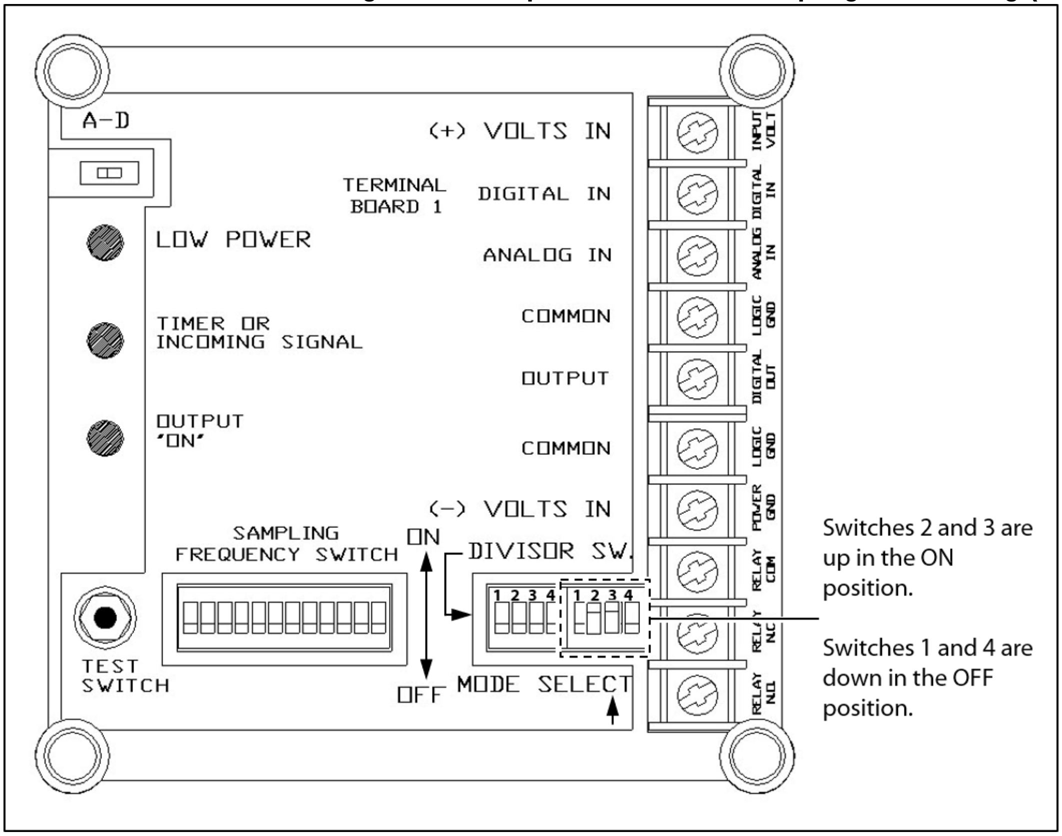
Figure 14: Terminations for Analog (mA) Signal



7. Slide the analog/digital switch to the left to the "A" position (*Figure 7*).

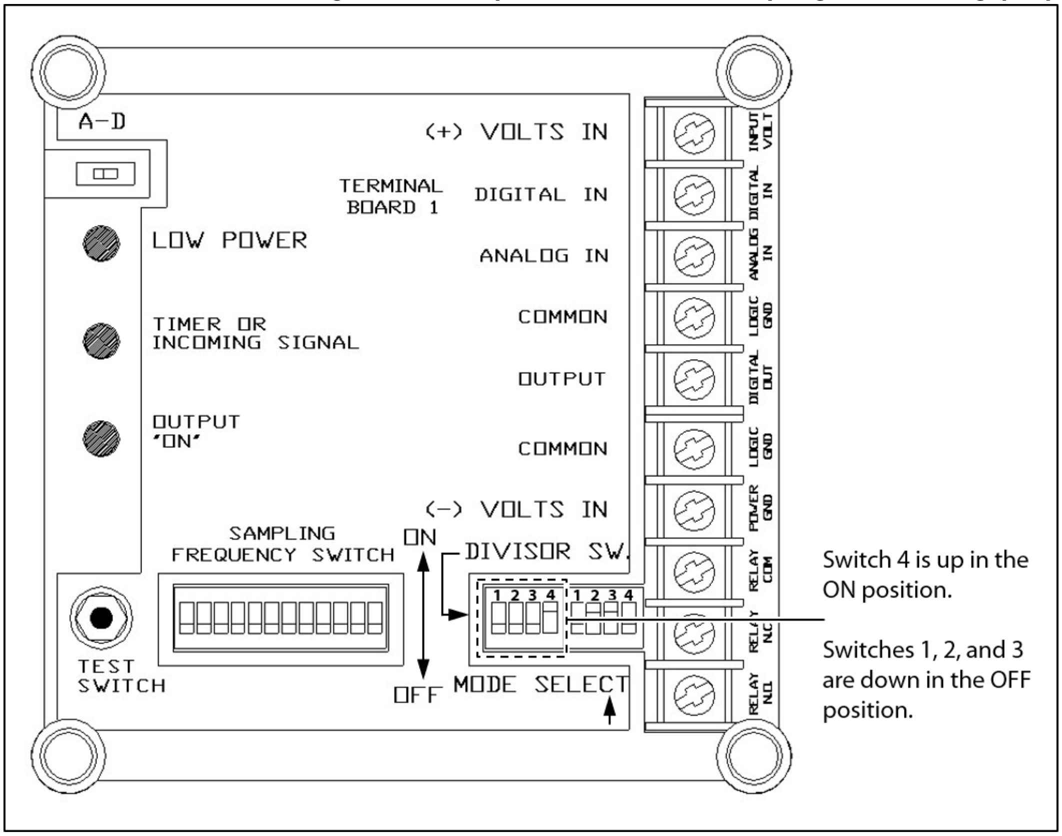
8. Slide switches 2 and 3 in the MODE SELECT switch bank up to the ON position, and then slide switches 1 and 4 in the MODE SELECT switch bank down to the OFF position (*Figure 15*).

Figure 15: Mode Select Switches Configured for Proportional to Flow Sampling With Analog (mA) Signal



9. Slide switch 4 in the DIVISOR SWITCH bank up to the ON position, and then slide switches 1, 2, and 3 in the DIVISOR SWITCH switch bank down to the OFF position (*Figure 16*).

Figure 16: Divisor Switches Configured for Proportional to Flow Sampling With Analog (mA) Signal

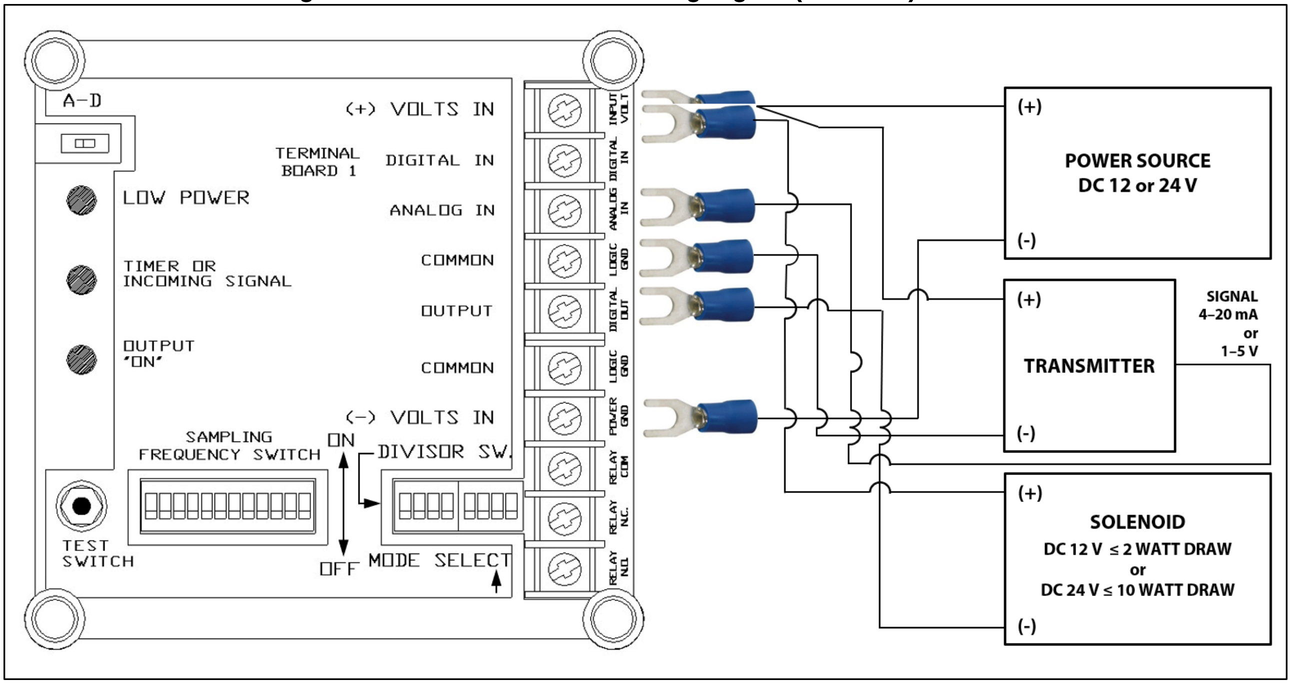


10. Proceed to *Section 2.5, Setting the Sampling Frequency*.

Analog Signal and Transmitter

11. If the incoming signals are analog and power needs to be supplied to the transmitter, connect the positive side of the transmitter to the (+) VOLTS IN terminal, the signal side to the ANALOG IN terminal, and the common side to the COMMON terminal (*Figure 17*).

Figure 17: Terminations for Analog Signal (mA or W) and Transmitter



12. Slide the analog/digital switch to the left to the "A" position (*Figure 7*).

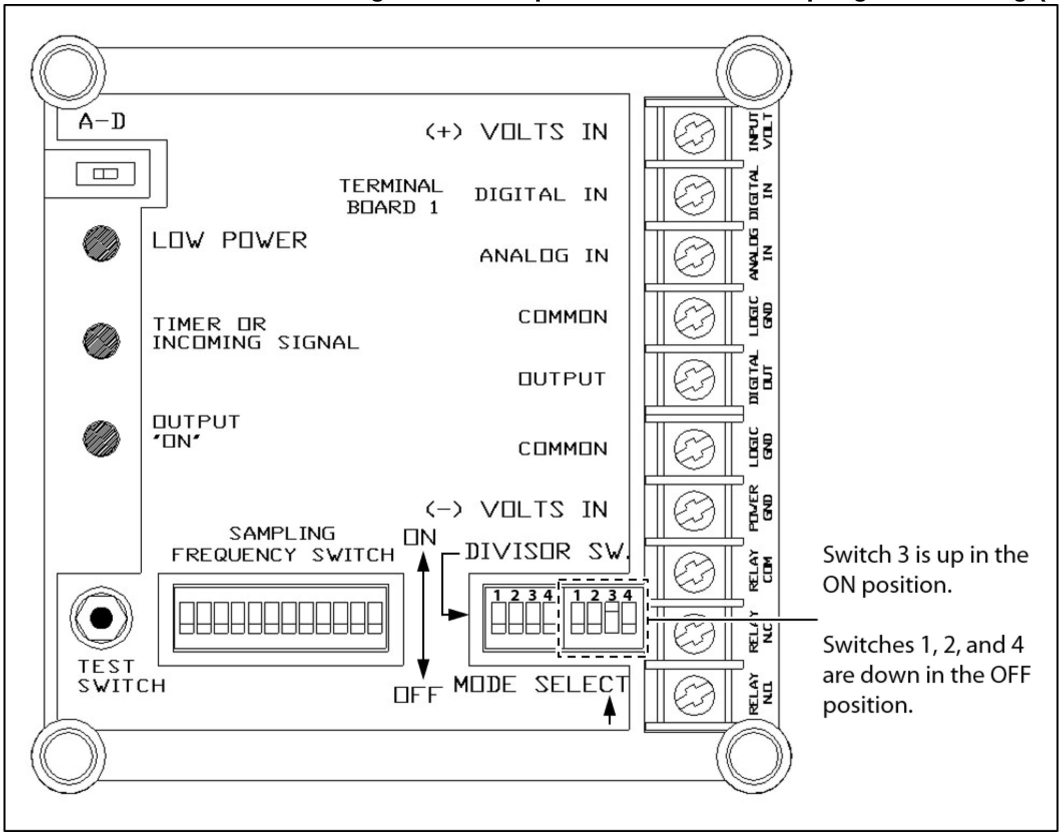
Milliamps (mA)

13. If the transmitter signal is in milliamps (mA), slide switches 2 and 3 in the MODE SELECT switch bank up to the ON position, and then slide switches 1 and 4 in the MODE SELECT switch bank down to the OFF position (*Figure 15*).
14. If the transmitter signal is in milliamps (mA), slide switch 4 in the DIVISOR SWITCH switch bank up to the ON position, and then slide switches 1, 2, and 3 in the DIVISOR SWITCH switch bank down to the OFF position (*Figure 16*).

Watts (W)

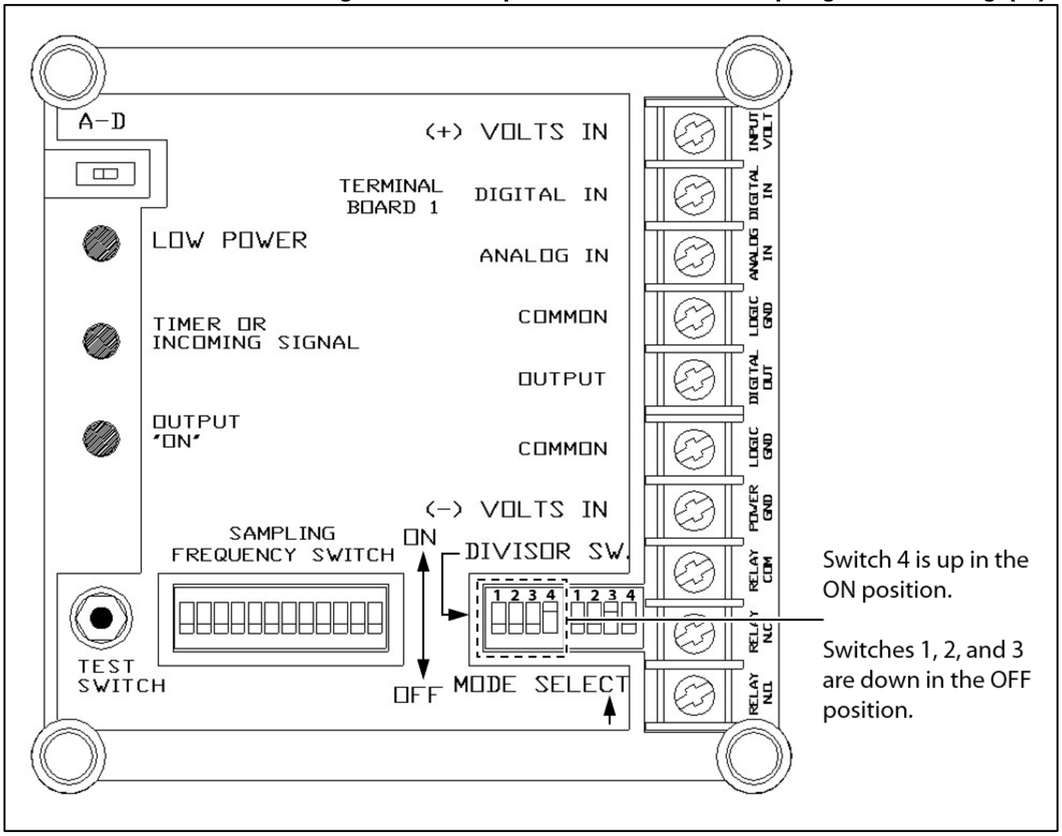
15. If the transmitter signal is in watts (W), slide switch 3 in the MODE SELECT switch bank up to the ON position, and then slide switches 1, 2, and 4 in the MODE SELECT switch bank down to the OFF position (*Figure 18*).

Figure 18: Mode Select Switches Configured for Proportional to Slow Sampling With Analog (W) Signal



16. If the transmitter signal is in watts (W), slide switch 4 in the DIVISOR SWITCH switch bank up to the ON position, and then slide switches 1, 2, and 3 in the DIVISOR SWITCH switch bank down to the OFF position (*Figure 19*).

Figure 19: Divisor Switches Configured for Proportional to Flow Sampling With Analog (W) Signal



2.5 Setting the Sampling Frequency

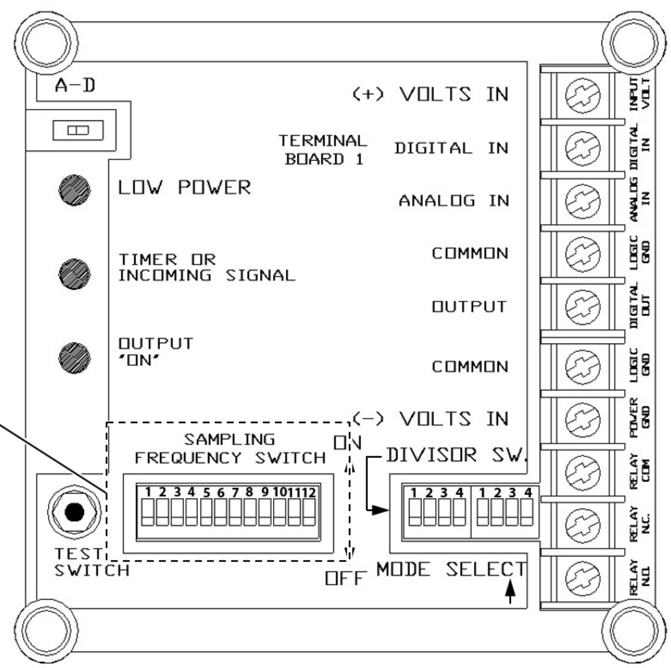
The 4P is programmed by setting the SAMPLING FREQUENCY SWITCH on the timer board. Sampling frequency equations based on the application (i.e., timed or proportional to flow) are used to calculate the switch factor, which determines the switch setting.

A summary of settings by application is provided in *Appendix B, Settings at a Glance*.

For timed collection, continue to step 1.
For proportional to flow collection (digital), proceed to step 3.
For proportional to flow collection (analog), proceed to step 5.

Figure 20: Frequency Switch Values

Frequency Switch	Binary Value
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128
9	256
10	512
11	1024
12	2048



Timed Collection

1. Calculate the desired sampling frequency using the provided equations (*Figure 21*).

Figure 21: Sampling Actuation Equations for Timed Collection

Gas or Liquid Sampling, Timed Collection

Equation 1: Number of Samples Needed

$$\textbf{Gas}: Number\ of\ Samples\ Needed = \frac{Cylinder\ Size\ (cc)}{Bite\ Size\ (cc)}$$

or

$$\textbf{Liquid}: Number\ of\ Samples\ Needed\ to\ Fill\ to\ 80\% = \frac{(Cylinder\ Size\ (cc) * 0.8)}{Bite\ Size\ (cc)}$$

Equation 2: Sample Frequency

$$Samples\ per\ Hour = \frac{Number\ of\ Samples\ Needed\ (Eq.1)}{Total\ Time\ in\ Sample\ Period\ (hr)}$$

Equation 3: Minutes per Sample

$$Minutes\ per\ Sample = \frac{60\ min}{1\ hr} \times \frac{1\ hr}{Samples\ per\ Hour\ (Eq.2)}$$

Equation 4: Seconds per Sample

$$Seconds\ per\ Sample = \frac{60\ sec}{1\ min} \times Minutes\ per\ Sample\ (Eq.3)$$

Equation 5: Counts per Sample

$$Counts\ Generated\ per\ Sample = \frac{5000\ Counts}{1\ sec} \times Seconds\ per\ Sample\ (Eq.4)$$

Equation 6: Switch Factor

$$Switch\ Factor = \frac{Counts\ Generated\ per\ Sample\ (Eq.5)}{4096}$$

2. Set the SAMPLING FREQUENCY SWITCH to the desired switch factor based on the equations (*Figure 22*).

Figure 22: Example – Timed Collection Setting, Liquid

Liquid Sampling, Timed Collection

Equation 1: Number of Samples Needed

$$800\ Samples\ Needed\ to\ Fill\ to\ 80\% = \frac{500\ cc * 0.8}{0.50\ cc}$$

Equation 2: Sample Frequency

$$1.11\ Samples\ per\ Hour = \frac{800\ Samples\ Needed\ (Eq.1)}{720\ hrs}$$

Equation 3: Minutes per Sample

$$54\ Minutes\ per\ Sample = \frac{60\ min}{1\ hr} \times \frac{1\ hr}{1.11\ Samples\ per\ Hour\ (Eq.2)}$$

Equation 4: Seconds per Sample

$$3240\ Seconds\ per\ Sample = \frac{60\ sec}{1\ min} \times 54\ Minutes\ per\ Sample\ (Eq.3)$$

Equation 5: Counts per Sample

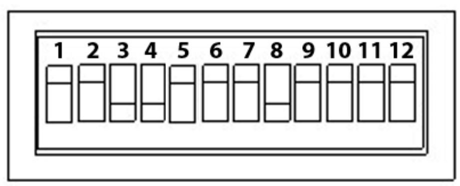
$$16{,}200{,}000\ Counts\ Generated\ per\ Sample = \frac{5000\ Counts}{1\ sec} \times 3240\ Seconds\ per\ Sample\ (Eq.4)$$

Equation 6: Switch Factor

$$3955\ Switch\ Factor = \frac{16{,}200{,}000\ Counts\ Generated\ per\ Sample\ (Eq.5)}{4096}$$

Frequency Switch	Binary Value
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128
9	256
10	512
11	1024
12	2048

SAMPLING FREQUENCY SWITCH



Switches 1, 2, 5, 6, 7, 9, 10, 11, and 12 are up in the ON position because their binary values equal 3955 (switch factor) when added together.

Proportional to Flow Collection (Digital)

3. Calculate the desired sampling frequency using the provided equation (*Figure 23*).

Figure 23: Sampling Actuation Equation for Proportional to Flow Collection (Digital)

Gas or Liquid Sampling, Proportional to Flow Collection (Digital)

$$Switch\ Factor = \frac{Number\ of\ Pulses}{Volume\ of\ Flow\ After\ Pulses} \times Volume\ of\ Flow\ Between\ Sample\ Grabs$$

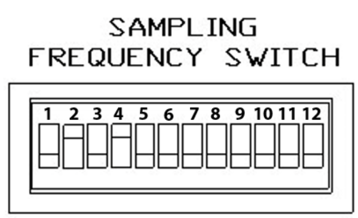
4. Set the SAMPLING FREQUENCY SWITCH to the desired switch factor based on the equation (*Figure 24* or *Figure 25*).

Figure 24: Example – Proportional to Flow Collection (Digital), Gas

Gas Sampling, Proportional to Flow Collection (Digital)

$$10\ Switch\ Factor = \frac{1\ Pulse}{1{,}000\ scf} \times Flow\ 10{,}000\ scf\ Between\ Sample\ Grabs$$

Frequency Switch	Binary Value
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128
9	256
10	512
11	1024
12	2048



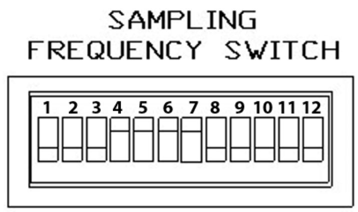
Switches 2 and 4 are up in the ON position because their binary values equal 10 (switch factor) when added together.

Figure 25: Example – Proportional to Flow Collection (Digital), Liquid

Liquid Sampling, Proportional to Flow Collection (Digital)

$$120\ Switch\ Factor = \frac{10\ Pulses}{1\ Barrel} \times Flow\ 12\ Barrels\ Between\ Sample\ Grabs$$

Frequency Switch	Binary Value
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128
9	256
10	512
11	1024
12	2048



Switches 4, 5, 6, and 7 are up in the ON position because their binary values equal 120 (switch factor) when added together.

Proportional to Flow Collection (Analog)

5. Determine the value of each incoming pulse.

> The value of each incoming pulse is determined by how the flow computer or meter is calibrated.

6. Calculate the desired sampling frequency using the provided equations (*Figure 26*).

Figure 26: Sampling Actuation Equations for Proportional to Flow Collection (Analog)

Gas or Liquid Sampling, Proportional to Flow Collection (Analog)

Equation 1: Number of Samples Needed

$$\textbf{Gas}: Number\ of\ Samples\ Needed = \frac{Cylinder\ Size\ (cc)}{Bite\ Size\ (cc)} \quad \textbf{or} \quad \textbf{Liquid}: Number\ of\ Samples\ Needed\ to\ Fill\ to\ 80\% = \frac{(Cylinder\ Size\ (cc) * 0.8)}{Bite\ Size\ (cc)}$$

Equation 2: Sample Frequency

$$Samples\ per\ Hour = \frac{Number\ of\ Samples\ Needed\ (Eq.1)}{Total\ Time\ in\ Sample\ Period\ (hr)}$$

Equation 3: Minutes per Sample

$$Minutes\ per\ Sample = \frac{60\ min}{1\ hr} \times \frac{1\ hr}{Samples\ per\ Hour\ (Eq.2)}$$

Equation 4: Seconds per Sample

$$Seconds\ per\ Sample = \frac{60\ sec}{1\ min} \times Minutes\ per\ Sample\ (Eq.3)$$

Equation 5: Counts per Sample

$$Counts\ Generated\ per\ Sample = \frac{5000\ Counts}{1\ sec} \times Seconds\ per\ Sample\ (Eq.4)$$

Equation 6: Switch Factor*

$$Switch\ Factor = \frac{Counts\ Generated\ per\ Sample\ (Eq.5)}{4096}$$

**Calculations assume the flow rate is 100%. If the flow rate is below 100%, total samples taken will equal that percentage of cylinder volume (e.g., if the flow rate is 60%, total samples taken will equal 60% of the cylinder volume).*

If the cylinder is to be filled closer to 100% and if the anticipated flow rate can be calculated, a new switch factor can be determined by multiplying the switch factor from Equation 6 *by the anticipated flow rate.*

Equation 7: New Switch Factor (Optional)

$$New\ Switch\ Factor = \frac{Flow\ Rate\ (Actual)}{Flow\ Rate\ (Maximum)} \times Switch\ Factor\ (Eq.6)$$

7. Set the SAMPLING FREQUENCY SWITCH to the desired switch factor based on the equations (*Figure 27*).

Figure 27: Example – Proportional to Flow Collection (Analog), Gas

Gas Sampling, Proportional to Flow Collection (Analog)

Equation 1: Number of Samples Needed

$$1500\ Samples\ Needed\ to\ Fill\ to\ 75\% = \frac{1000\ cc * 0.75}{0.5\ cc}$$

Equation 2: Sample Frequency

$$8.92\ Samples\ per\ Hour = \frac{1500\ Samples\ Needed\ (Eq.1)}{168\ hr}$$

Equation 3: Minutes per Sample

$$6.72\ Minutes\ per\ Sample = \frac{60\ min}{1\ hr} \times \frac{1\ hr}{8.92\ Samples\ per\ Hour\ (Eq.2)}$$

Equation 4: Seconds per Sample

$$403.2\ Seconds\ per\ Sample = \frac{60\ sec}{1\ min} \times 6.72\ Minutes\ per\ Sample\ (Eq.3)$$

Equation 5: Counts per Sample

$$2{,}016{,}000\ Counts\ Generated\ per\ Sample = \frac{5000\ Counts}{1\ sec} \times 403.2\ Seconds\ per\ Sample\ (Eq.4)$$

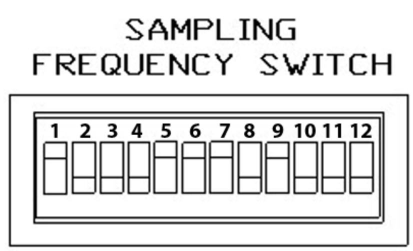
Equation 6: Switch Factor*

$$492\ Switch\ Factor = \frac{2{,}016{,}000\ Counts\ Generated\ per\ Sample\ (Eq.5)}{4096}$$

**The actual flow rate is averaging less than the maximum. A new switch factor will be determined by multiplying the switch factor from* Equation 6 *by the anticipated flow rate.*

$$369\ New\ Switch\ Factor = \frac{112.5\ MMscf\ per\ Day\ (Actual)}{150\ MMscf\ per\ Day\ (Maximum)} \times 492\ Switch\ Factor\ (Eq.6)$$

Frequency Switch	Binary Value
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128
9	256
10	512
11	1024
12	2048



Switches 1, 5, 6, 7, and 9 are up in the ON position because their binary values equal 369 (new switch factor) when added together.

SECTION 3: CALIBRATION

3.1 Before You Begin

1. As necessary, remove the thumb screws holding the timer board in the enclosure.
2. After removing the timer board from the enclosure, locate the three (3) potentiometers on the rear of the timer board. The potentiometers are labeled R31, R32, and R33.
3. Locate the eight-pin chip on the rear of the timer board. The chip is labeled U2.

3.2 Adjusting Zero and Span

> A 4–20 mA or DC 1–5 V source, frequency counter, and small blade screwdriver are needed to adjust the calibration of the 4P.

1. Connect the positive side of the frequency counter to pin 1 on U2.

> Pin 1 is the top pin on the left side of U2.

2. Connect the common side of the frequency counter to one of the COMMON terminals on the front of the timer board. The capacitor will prevent the circuit from being loaded down too low to operate.
3. Connect the 4–20 mA signal source to ANALOG IN and COMMON.
4. Adjust the signal source for a 4 mA output.
5. Observe the frequency meter. The actual frequency should be 0 Hz. If a frequency other than 0 Hz is observed, adjust R32 slightly until a reading of 0 Hz is observed.
6. Adjust the signal source for a 20 mA output.
7. Observe the frequency meter. The actual frequency should be 5000 Hz. If a frequency other than 5000 Hz is observed, adjust R33 slightly until a reading of 5000 Hz is observed.
8. As necessary, repeat steps 4–7 until the calibration has been adjusted correctly.

3.3 Adjusting Dwell Time

Dwell time is the length of time the output remains energized.

The dwell time is factory-set to approximately 2 seconds but is adjustable between 2–10 seconds.

1. With power connected to the timer board, press and release the test switch (*Figure 2*). The OUTPUT "ON" light will illuminate.
2. Measure the length of time the OUTPUT "ON" light remains illuminated. This is the set dwell time.
3. As necessary, adjust the dwell time. To increase the dwell time, adjust R31 clockwise. To decrease the dwell time, adjust R31 counterclockwise.

7.1 Troubleshooting

The most common issues for the 4P are described in *Table 3*. If an issue is encountered that is not described below, contact Welker for service options.

Table 3: 4P Troubleshooting

Issues	Possible Solutions
Nothing is happening.	Use a voltmeter to ensure that a minimum of DC 7 V and a maximum of DC 28 V is across (+) VOLTS IN and (-) VOLTS IN. Press and release the test switch and observe the OUTPUT "ON" light. If a minimum of DC 7 V and a maximum of DC 28 V is across (+) VOLTS IN and (-) VOLTS IN but the OUTPUT "ON" light does not illuminate, return the 4P to the factory for repairs.
The OUTPUT "ON" indicator light is illuminated, but the solenoid does not turn on.	Connect the solenoid leads according to the appropriate wiring diagram and observe the solenoid operation. If the solenoid does not appear to operate, return it to the factory for repairs. Connect the solenoid leads according to the appropriate wiring diagram and observe the solenoid operation. If the solenoid operates, remove the thumb screws holding the timer board in the enclosure, and then remove the timer board from the enclosure. Inspect U8 on the rear of the timer board for obvious flaws, such as cracks or burn marks. If obvious flaws are found, contact Welker for service options.
The sample container is not filling properly.	Ensure that the sampling frequency equations used were the correct equations for the application. Check the calculations to ensure that the switch factor was calculated correctly. Ensure that the switch factor was set properly using the FREQUENCY SWITCH. Check the calibration of zero and span. Adjust as necessary. If an analog signal is used as the input, ensure that the interface cable is shielded and properly grounded.

APPENDIX A: REFERENCED OR ATTACHED DOCUMENTS

Welker *Installation, Operation, and Maintenance* (IOM) *Manuals* suggested for use with this unit:

- None

Other *Installation, Operation, and Maintenance* (IOM) *Manuals* suggested for use with this unit:

- ASCO Valve, Inc. General Service Solenoid Valves Series 8345 (Welker IOM-V387)
- Parker Hannifin Corporation 3-Way Solenoid Valves Types 71313, 71315, 71335, 71385, 71395, 7131V, and 7133V (Welker IOM-V016)
- Parker Hannifin Corporation X5R71900DC1A1W 3-Way Solenoid Valve (Welker IOM-V424)
- Sola/Hevi-Duty SCP Series Power Supplies (Welker IOM-V200)
- Versa Products Company, Inc. CSG-4222-LA-XX-D012 4-Way Solenoid Valve (Welker IOM-V071)

Welker drawings and schematics suggested for use with this unit:

- Electrical Drawing: EL482.1 (Dome Mount)
- Electrical Drawing: EL820 (Explosion-proof Box With Solenoid)
- Electrical Drawing: EL862 (Non-explosion-proof Box)
- Electrical Drawing: EL867 (NEMA 4X Fiberglass Box)

B1.1 Timed Sampling

- **Analog/Digital Switch:** "A" position
- **MODE SELECT:** Switch 1 up to ON position; switches 2, 3, and 4 down to OFF position
- **DIVISOR SWITCH:** Switch 4 up to ON position; switches 1, 2, and 3 down to OFF position
- **SAMPLING FREQUENCY SWITCH:** Switches whose binary values equal the switch factor when added together up to ON position; all other switches down to OFF position (*Figure B1* and *Figure B2*)

Figure B1: Frequency Switch Values

Frequency Switch	Binary Value
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128
9	256
10	512
11	1024
12	2048

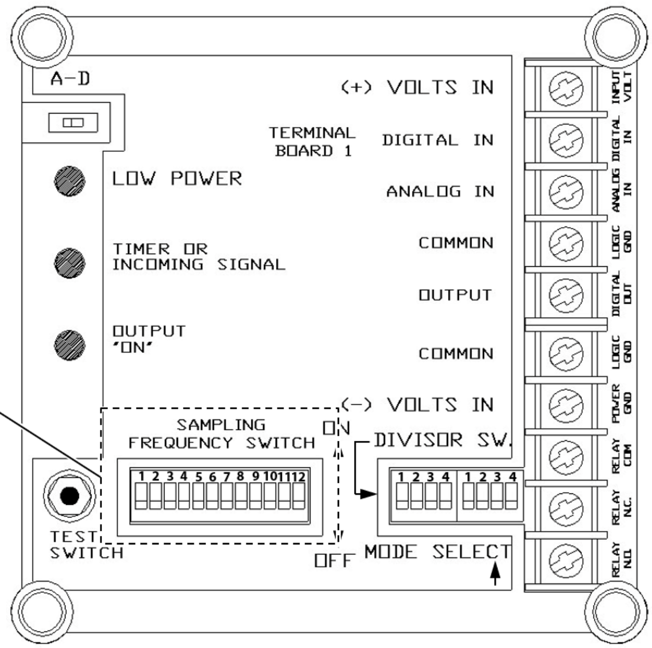


Figure B2: Sampling Actuation Equations for Timed Collection

Gas or Liquid Sampling, Timed Collection

Equation 1: Number of Samples Needed

$$\textbf{Gas}: \text{Number of Samples Needed} = \frac{\text{Cylinder Size (cc)}}{\text{Bite Size (cc)}} \quad \textbf{or} \quad \textbf{Liquid}: \text{Number of Samples Needed to Fill to 80\%} = \frac{(\text{Cylinder Size (cc)} * 0.8)}{\text{Bite Size (cc)}}$$

Equation 2: Sample Frequency

$$\text{Samples per Hour} = \frac{\text{Number of Samples Needed (Eq. 1)}}{\text{Total Time in Sample Period (hr)}}$$

Equation 3: Minutes per Sample

$$\text{Minutes per Sample} = \frac{60\ min}{1\ hr} \times \frac{1\ hr}{\text{Samples per Hour (Eq. 2)}}$$

Equation 4: Seconds per Sample

$$\text{Seconds per Sample} = \frac{60\ sec}{1\ min} \times \text{Minutes per Sample (Eq. 3)}$$

Equation 5: Counts per Sample

$$\text{Counts Generated per Sample} = \frac{5000\ Counts}{1\ sec} \times \text{Seconds per Sample (Eq. 4)}$$

Equation 6: Switch Factor

$$\text{Switch Factor} = \frac{\text{Counts Generated per Sample (Eq. 5)}}{4096}$$

B1.2 Proportional to Flow Sampling

Digital or Voltage Pulse

- **Analog/Digital Switch:** "D" position
- **MODE SELECT:** Switch 4 up to ON position; switches 1, 2, and 3 down to OFF position
- **DIVISOR SWITCH:** Switches 1–4 down to OFF position
- **SAMPLING FREQUENCY SWITCH:** Switches whose binary values equal the switch factor when added together up to ON position; all other switches down to OFF position (*Figure B1* and *Figure B3*)

Figure B3: Sampling Actuation Equations for Proportional to Flow Collection (Digital)

Gas or Liquid Sampling, Proportional to Flow Collection (Digital)
$Switch\ Factor = \frac{Number\ of\ Pulses}{Volume\ of\ Flow\ After\ Pulses} \times Volume\ of\ Flow\ Between\ Sample\ Grabs$

Analog

- **Analog/Digital Switch:** "A" position
- **MODE SELECT:** Switches 2 and 3 up to ON position; switches 1 and 4 down to OFF position
- **DIVISOR SWITCH:** Switch 4 up to ON position; switches 1, 2, and 3 down to OFF position
- **SAMPLING FREQUENCY SWITCH:** Switches whose binary values equal the switch factor when added together up to ON position; all other switches down to OFF position (*Figure B1* and *Figure B4*)

Figure B4: Sampling Actuation Equations for Proportional to Flow Collection (Analog)

Gas or Liquid Sampling, Proportional to Flow Collection (Analog)

Equation 1: Number of Samples Needed

$$\textbf{Gas}: Number\ of\ Samples\ Needed = \frac{Cylinder\ Size\ (cc)}{Bite\ Size\ (cc)} \quad \textbf{or} \quad \textbf{Liquid}: Number\ of\ Samples\ Needed\ to\ Fill\ to\ 80\% = \frac{(Cylinder\ Size\ (cc) * 0.8)}{Bite\ Size\ (cc)}$$

Equation 2: Sample Frequency

$$Samples\ per\ Hour = \frac{Number\ of\ Samples\ Needed\ (Eq.1)}{Total\ Time\ in\ Sample\ Period\ (hr)}$$

Equation 3: Minutes per Sample

$$Minutes\ per\ Sample = \frac{60\ min}{1\ hr} \times \frac{1\ hr}{Samples\ per\ Hour\ (Eq.2)}$$

Equation 4: Seconds per Sample

$$Seconds\ per\ Sample = \frac{60\ sec}{1\ min} \times Minutes\ per\ Sample\ (Eq.3)$$

Equation 5: Counts per Sample

$$Counts\ Generated\ per\ Sample = \frac{5000\ Counts}{1\ sec} \times Seconds\ per\ Sample\ (Eq.4)$$

*Equation 6: Switch Factor**

$$Switch\ Factor = \frac{Counts\ Generated\ per\ Sample\ (Eq.5)}{4096}$$

**Calculations assume the flow rate is 100%. If the flow rate is below 100%, total samples taken will equal that percentage of cylinder volume (e.g., if the flow rate is 60%, total samples taken will equal 60% of the cylinder volume).*

If the cylinder is to be filled closer to 100% and if the anticipated flow rate can be calculated, a new switch factor can be determined by multiplying the switch factor from Equation 6 *by the anticipated flow rate.*

Equation 7: New Switch Factor (Optional)

$$New\ Switch\ Factor = \frac{Flow\ Rate\ (Actual)}{Flow\ Rate\ (Maximum)} \times Switch\ Factor\ (Eq.6)$$

Analog Signal and Transmitter (mA)

- **Analog/Digital Switch:** "A" position
- **MODE SELECT:** Switches 2 and 3 up to ON position; switches 1 and 4 down to OFF position
- **DIVISOR SWITCH:** Switch 4 up to ON position; switches 1, 2, and 3 down to OFF position
- **SAMPLING FREQUENCY SWITCH:** Switches whose binary values equal the switch factor when added together up to ON position; all other switches down to OFF position (*Figure B1* and *Figure B4*)

Analog Signal and Transmitter (W)

- **Analog/Digital Switch:** "A" position
- **MODE SELECT:** Switch 3 up to ON position; switches 1, 2, and 4 down to OFF position
- **DIVISOR SWITCH:** Switch 4 up to ON position; switches 1, 2, and 3 down to OFF position
- **SAMPLING FREQUENCY SWITCH:** Switches whose binary values equal the switch factor when added together up to ON position; all other switches down to OFF position (*Figure B1* and *Figure B4*)

NOTES

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