



THE ARTHUR RUSSELL CO., INC.

VibroBlock® Feeder Systems

VBC 2000-C Digital Vibration Control

Installation And Operation Manual



***“PROVEN AUTOMATION SOLUTIONS SINCE 1945”***

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# VBC 2000-C DIGITAL VIBRATION CONTROL INSTALLATION AND OPERATION MANUAL

## DESCRIPTION:

The **VBC 2000-C** Controller from Arthur G. Russell is a closed loop vibration controller intended for feeder bowls, and other equipment powered by the Arthur G. Russell **VibroBlock®**. A solid-state transducer monitors vibration, so that the **VBC 2000-C** can vary power output to precisely control vibration. Advanced diagnostics allow feeder bowl maintenance to be scheduled, thus eliminating down time. Vibration amplitude can be remotely changed by simple pulses generated by a PLC or other controller. Settings can be saved to non-volatile memory by a push button on the controller.

## SAFETY:

When properly installed, the **VBC 2000-C** is intended to comply with all applicable safety standards. Safety features include: Finger safe wiring terminals, enclosed high voltage components and insulated DIN rail mounting hardware. Filtering is provided internally to comply with European CE EMC requirements.

## INDICATOR LAMPS:

The green **RUNNING** lamp is lit whenever the device (feeder, track, bin, etc.) is vibrating enough for the transducer to receive adequate signal. The **TUNE** lamp is lit whenever the resonant frequency of the device drops below line frequency (50Hz, 60Hz). The tune lamp only indicates that maintenance may be required and is not cause to shut down the system. The tune lamp is not valid and will remain lit on 100 Hz and 120 Hz equipment. Flickering during start-up should be ignored. The **LOAD CURRENT** display indicates actual current in DC amperes flowing to the **VibroBlock®s**. Load current is used for **TUNING**.

## CONNECTIONS:

Connect as shown on the diagram on page 7. For safety the **VBC 2000-C** controller and all connected loads, must be connected to earth ground. Earth ground terminals are provided and are internally connected.

## CONTROLLER INSTALLATION:

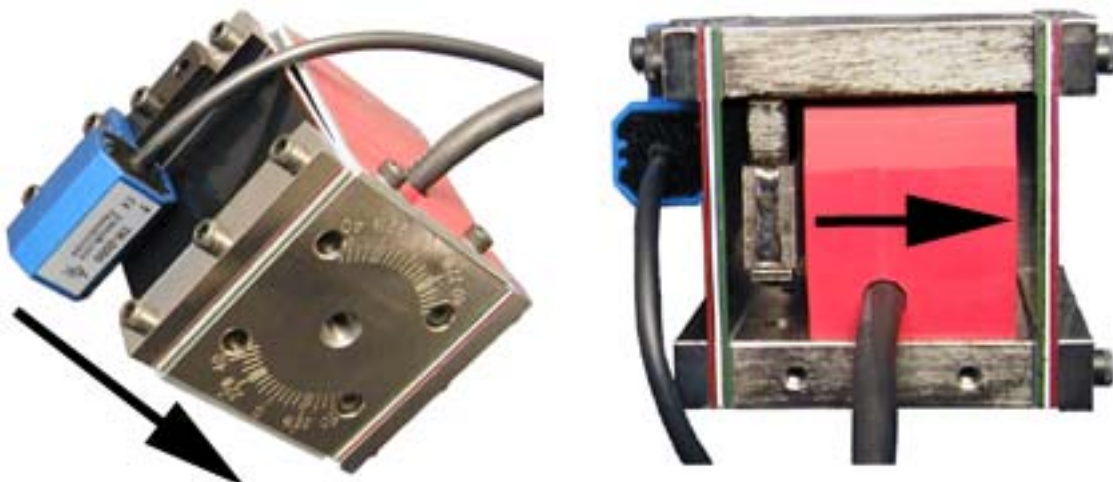
The **VBC 2000-C** must be installed in an enclosure approved for the location. Mount the **VBC 2000-C** on DIN rail as far as possible from sources of electrical noise. Make sure that the controller as well as all connected loads are properly grounded as shown in the diagram on page 7, and in compliance with any local codes. Such sources of electrical noise may include both AC and DC motor controls, switching power supplies and any high current carrying conductors. While EMI and RFI usually will not harm the controller, erratic operation such as pulsation or poor performance can result. The most important and critical aspect of the **VBC 2000-C** installation is the wiring and routing of the **TR 2000** transducer cable. The shield must be properly connected and terminated as shown in the wiring diagram on page 7. Even though the cable is shielded, it must be routed away from significant sources of EMI and RFI. If the cable is run in a raceway or conduit, avoid running it with any other cables or wires carrying high levels of EMI or RFI.

This is important even if all cables are shielded. Mount the **VBC 2000-C** controller as close as possible to the connected load. If the **VBC 2000-C** must be located at distances greater than 15 feet from the connected load, extreme care must be exercised when routing the transducer cable to be sure that it is away from any sources of EMI and RFI. Electrical noise problems are usually indicated if the red tune indicator on the front panel flickers during normal operation. If flickering occurs but performance is satisfactory there is no need for concern however. Never connect anything else to the transducer terminals except the transducer. Avoid terminating the transducer wires anywhere but on the **VBC 2000-C** controller. If a termination or disconnecting means is required, expose as little unshielded transducer wire as possible. When connecting a transducer cable to the controller, strip only as much cable as is necessary. Increasing the wire size of the **VibroBlock®** wiring at longer distances may also be required. Following these guidelines will result in smooth and stable operation of the **VBC 2000-C** system.

### **TRANSDUCER INSTALLATION:**

Mount the **TR 2000** transducer as shown in the drawing on page 11. Mounting the **TR 2000** in this manner on the **VibroBlock®** will ensure that it maintains the proper axis of vibration no matter what angle the **VibroBlock®** is adjusted to. Proper phasing of the transducer is essential for proper operation. As a general rule, this can be accomplished by ensuring that both the **VibroBlock®** and **TR 2000** cords exit from the same side. If an alternative mounting is required, proceed as follows: locate the small arrow on the label of the **TR 2000** transducer. **The arrow must point in the direction of the face of the **VibroBlock®** coil assembly as is shown by the arrows below. Removing the red nameplate from the **VibroBlock®** will expose the location of the coil assembly and armature.** Improper orientation of the **TR 2000** will result in a continuously lit tune indicator.

This indication only applies to systems tuned at 50 hertz or 60 hertz. The tune indicator is invalid on 100 hertz or 120 hertz systems and will remain lit constantly during operation. Because the tuning indicator cannot be used to verify proper installation of the transducer on 100 hertz and 120 hertz systems, extra care to verify correct mounting is necessary. Another important aspect of mounting the **TR 2000** transducer is ensuring that the transducer is mounted on the vibrating side of the **VibroBlock®**. If the transducer is mounted on the side of the **VibroBlock®** that is bolted to the driver base or mass bar poor performance will result. This problem is usually indicated when a small number of presses of the increment button or pulses from a PLC will bring the system from off to full amplitude.



## **START UP:**

Always apply power to the **VBC 2000-C** controller at least 10 seconds before vibration is required. The **VBC 2000-C** generally will take 5 to 10 seconds to boot up when power is applied. This is typical of most motor drives, servo amplifiers and other electronic equipment. Interrupting power to stop vibration for high levels or other machine stoppages is not recommended. Also, never interrupt output from the controller on terminals H1 H2 to stop vibration. Damage to the controller could result. Always use PLC control to pulse the vibration up and down or short C1 and C2 with an isolated relay to stop vibration. **Note:** Sometimes it is desirable that vibration must start instantly. In this instance use C1 and C2 and an isolated relay for start/stop function.

## **ADJUSTING VIBRATION AMPLITUDE:**

To increase vibration, pulse the left-hand button. When a satisfactory level is attained, press "save". Unless saved, vibration will return to the original setting when controller is shut down.

To decrease vibration, press and hold the center button and pulse the left-hand button until a satisfactory level is attained, then press "save".

## **PULSES:**

Pulses can be defined as alternate ON/OFF pressing of the left pushbutton on the front panel of the **VBC 2000-C**, when operated in manual mode. When connected to a PLC, pulses should be 5 milliseconds or greater **ON** time with at least 5 milliseconds **OFF** time between pulses.

## **OPTIONAL PLC CONTROL OF AMPLITUDE:**

Terminal block **J1** contains the PLC connections. Terminals **1** and **2** function the same as the Up-Down arrow button and center button on the front panel respectively. These functions are designed for 24VDC 10ma signals from a PLC or other controller. They can be source or sink, depending on the connection of terminal **3-COM**. This allows soft start and stop of the feeder and multiple, programmable speeds. A recommended program is shown on page 8.

## **REMOTE (TUNING FAULT) SENSING:**

Terminal Block **J1** Terminals **5-FLT+** and **6-FLT-** are an isolated 10ma 24vdc max. transistor output signal. This signal is on when the **TUNE** lamp is lit. Terminal **4-SHIELD** is provided for **J1** signals, and should be used in electrically noisy environments.

## **UNDERSTANDING PULSE CONTROL:**

The **VBC 2000-C** uses a digital system to control vibration amplitude. This digital system has a maximum range of 0 to 100 pulses. This could be explained as 0 to 100 percent output of the controller. In reality however, the number of pulses required to achieve maximum amplitude varies for each application. The reason for this is best explained with an understanding of how the controller and transducer interact. When you pulse the left-hand button or issue pulses from a PLC to increase amplitude, the controller tries to output maximum amplitude. As vibration actually increases, the transducer signal cancels out the effect of the pulses that were issued until a balance is reached. This is the desired amplitude of vibration. Therefore, generally any problems with the transducer such as improper mounting, improper connection or damage will generally cause amplitude to increase. There are two reasons why the number of pulses required to reach full amplitude varies by application. The transducer measures acceleration and acceleration increases with frequency. A 120 hertz application will produce four times the signal from the transducer as a 60 hertz application will produce at the same vibration amplitude. Since transducer signal counteracts pulses to reach a balance, far more pulses are required for a 120 hertz application than for a 60 hertz application for the same amount of vibration. A transducer mounted on a **VibroBlock®** vibrator in a feeder bowl application actually vibrates far less than the amplitude at the rim of the bowl. The radius from the transducer to the rim of the bowl determines this. Therefore, fewer pulses are required to achieve the same amplitude on a feeder bowl than on a linear application such as a track or bin. There is also a slight difference between 50 hertz and 60 hertz applications. The only time 100 pulses or 100 percent would actually be used would be on a 120 hertz linear track running at an extremely high amplitude. Care must be taken not to issue pulses to increase amplitude beyond the point that the actual amplitude stops increasing. These dead pulses above maximum can be very confusing and can make the controller appear not to be able to be turned down in amplitude. In this case issuing as many as 100 down pulses may be required to bring the controller back to zero. This is a common complaint when someone tries to increase amplitude on an out of tuned or damaged system, and then saves this setting. After repairing the damage or re-tuning, the vibration appears to go wild and will not turn down. If enough down pulses are issued, this problem will automatically correct. Starting from zero, there is an approximate dead band of six pulses before any vibration can be detected. This dead band allows for the maximum component and temperature tolerance of the controller and ensures that the controller can always be pulsed down to zero vibration. It is important when using PLC control to always make sure that the controller always has a setting of zero vibration minus six pulses saved. Any number of pulses greater than minus 6 is perfectly acceptable and will produce the same result. This procedure eliminates any unwanted amplitude offsets that may appear when the controller is powered up.

## TUNING AND LOAD CURRENT:

Proper tuning is essential to all **VibroBlock®** equipment. Tuning and other maintenance to **VibroBlock®** equipment should only be attempted by qualified personnel. Special equipment such as torque wrenches, bowl balancer and **VibroTuner** are sometimes necessary to perform tuning operations. A video instruction manual for VibroBlock vibrators is available on request. As a general rule **VibroBlock®** systems should be tuned at 1 1/2 cycles above line frequency, 61.5 hertz or 51.5 hertz. Although the **VBC 2000-C** can operate in a wider frequency range, these settings are usually optimal. These are usually the settings for a **VibroBlock®** system when it left our factory. Since the **VibroBlock®** system may lose cycles over time, a warning is provided on the **VBC 2000-C** in the form of the tune indicator, which also operates the fault output. This is only a warning that tuning or some other maintenance may soon be required, but is generally no reason to shut down the system. Improper tuning or other maintenance problems can cause the **VibroBlock®s** to draw excessive current. The load current meter on the front of the control can provide valuable information. The maximum current allowed for each **VibroBlock®** is indicated on a nameplate of the block. **VB 12** equals .5A, **VB 16** equals 1A and **VB 32** equals 2A. These are maximum ratings and must not be exceeded. Proper load current for a **VibroBlock®** system that is properly tuned, will generally fall in the range of 50 percent to 80 percent of full load current of all the blocks. As amplitude is increased on a properly tuned system, load current will gradually increase, and at a fairly high amplitude will begin to decrease as amplitude continues to rise. This is because tuning decreases with amplitude and the system becomes more efficient at high amplitudes, requiring less power. The load current meter provides no indication of amplitude of vibration

## LOGIC POWER

The **VBC 2000-C** is identical to **VBC 2000-B** except for an additional feature called **Logic Power**. Terminals **1** and **2** on **K-6** are provided for the optional connection of a remote source of 24 V DC. The **Logic Power** terminals can be used if there is a need to interrupt line power to the controller for brief periods. Maintaining 24VDC at the **Logic Power** terminals will allow the controller to instantly restart if there is an interruption of line power. The 24VDC supply current required for logic power is less than 200 milliamps when line power is interrupted, and generally less than 20 milliamps when line power is on. The 24VDC common must be grounded to the same potential as the controller ground.

## TROUBLE SHOOTONG GUIDE:

Before proceeding with the troubleshooting checklist please verify the following: Turn off power and check all electrical connections. Verify tightness of all terminals on the **VBC 2000-C**. Check that both the transducer and **VibroBlock®** plugs are securely connected. Restore power. Verify 120 volts is present at terminals **L** and **N**.

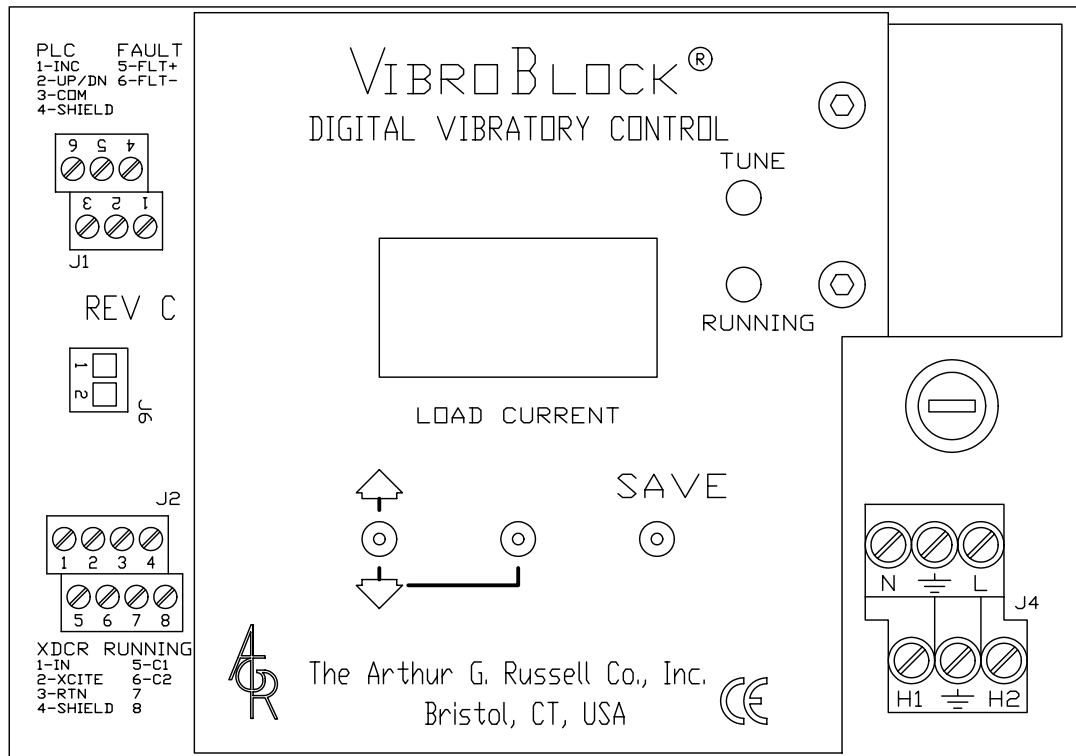
## TROUBLE SHOOTING CHECKLIST

Problem	Solution
Load current display blank (No Vibration)	Check the <b>VBC 2000</b> fuse and replace if necessary
No vibration non (PLC mode)	Are <b>C1</b> and <b>C2</b> shorted by an external relay? Are pushbutton settings properly set and saved?
No vibration (PLC mode)	Verify 24 volt signals at the increment and up down terminal strip on the VBC 2000 Force and increment manually from the PLC
Erratic vibration and or TUNE light flickering	Check transducer connections Isolate sources of EMI and RFI Tighten any loose parts that may be vibrating. Check all bolts for tightness Replace TR 2000 transducer
TUNE light on steady on 50 hertz or 60 hertz system (System vibrating)	Remove tuning weights one at a time Check all screws for tightness Check VibroBlock®s for broken springs Re-tune system
Both TUNE light and RUNNING light on (System vibrating)	Is system tuned for 120 hertz or 100 hertz? Isolate sources of EMI and RFI Check tuning Replace TR 2000 transducer
Both TUNE light and RUNNING light off (System vibrating)	Remove tuning weights one at a time Check all screws for tightness Check VibroBlock®s for broken springs Re-tune system
Vibration starts at high amplitude (PLC mode)	Transducer disconnected or faulty Pulses were manually added by pushbutton, this condition should self correct on shut down (if not previously saved)

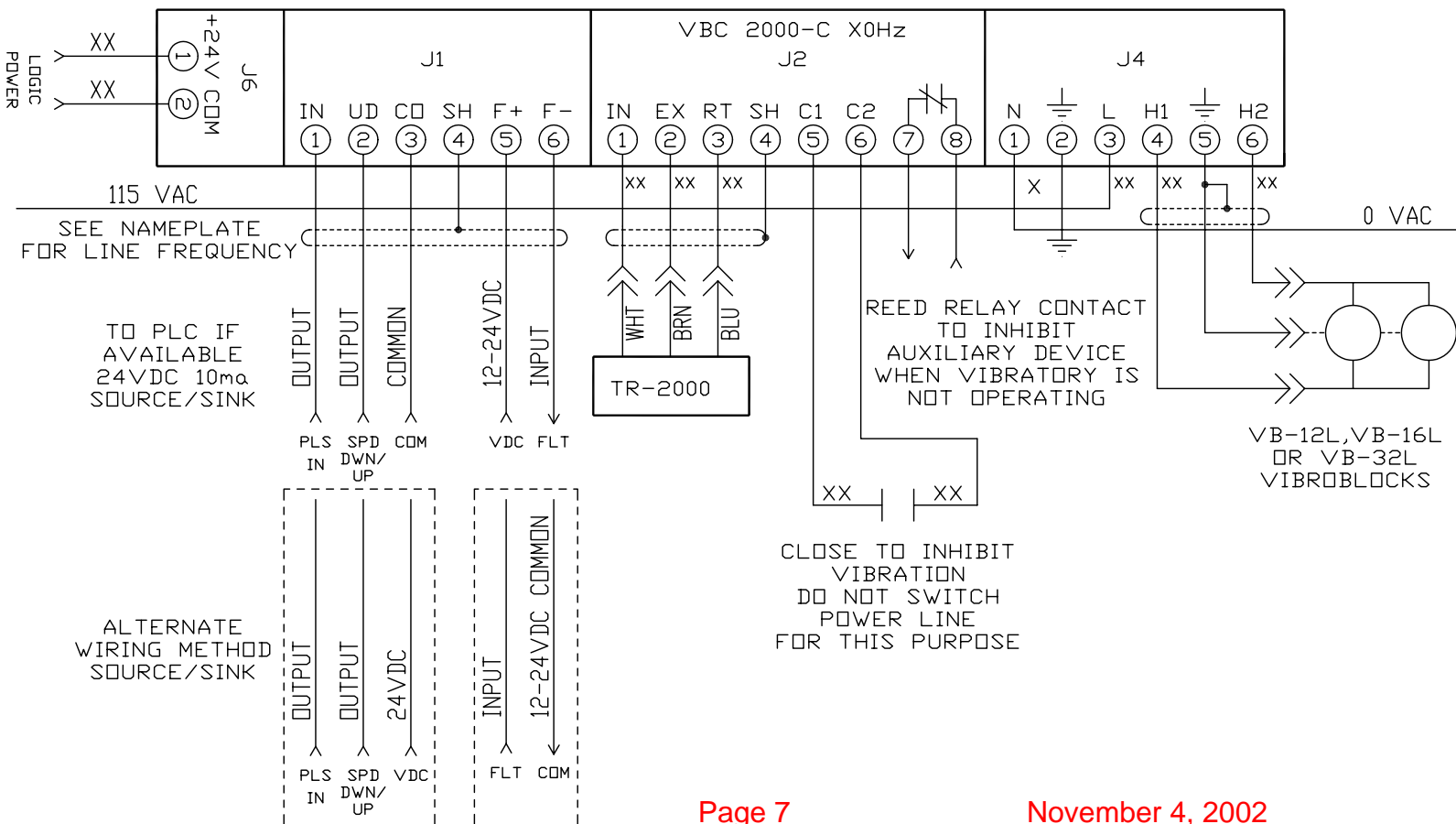
The latest version of this document, **vbc2000.pdf** is available at **[www.arthurgrussell.com](http://www.arthurgrussell.com)**

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**External Connections to Feeder, Bin or Track and PLC**



As many speeds as desired can be added. The addresss shown are examples only.

This logic can also be used with the PA-1 Pulse To Analog Converter

Your addresses could be the same or different. All addresses that are labeled as

REPLACE WITH must be replaced with your own I.O. addresses.

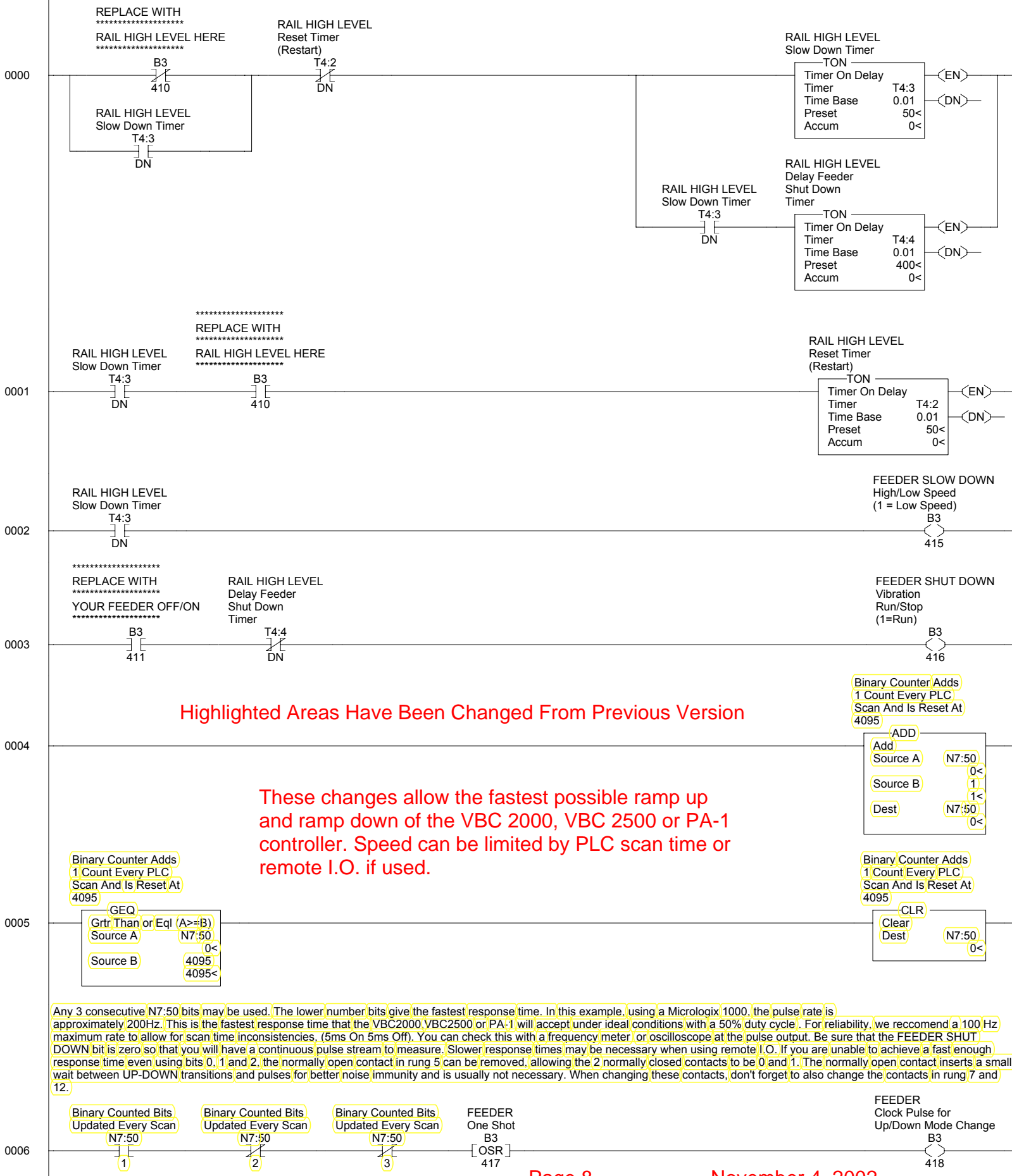
B3/410=RAIL HIGH LEVEL INPUT

B3/411=FEEDER OFF/ON INPUT

B3/412=FEEDER UP/DOWN SPEED SELECT OUTPUT

B3/413=FEEDER PULSE IN OUTPUT

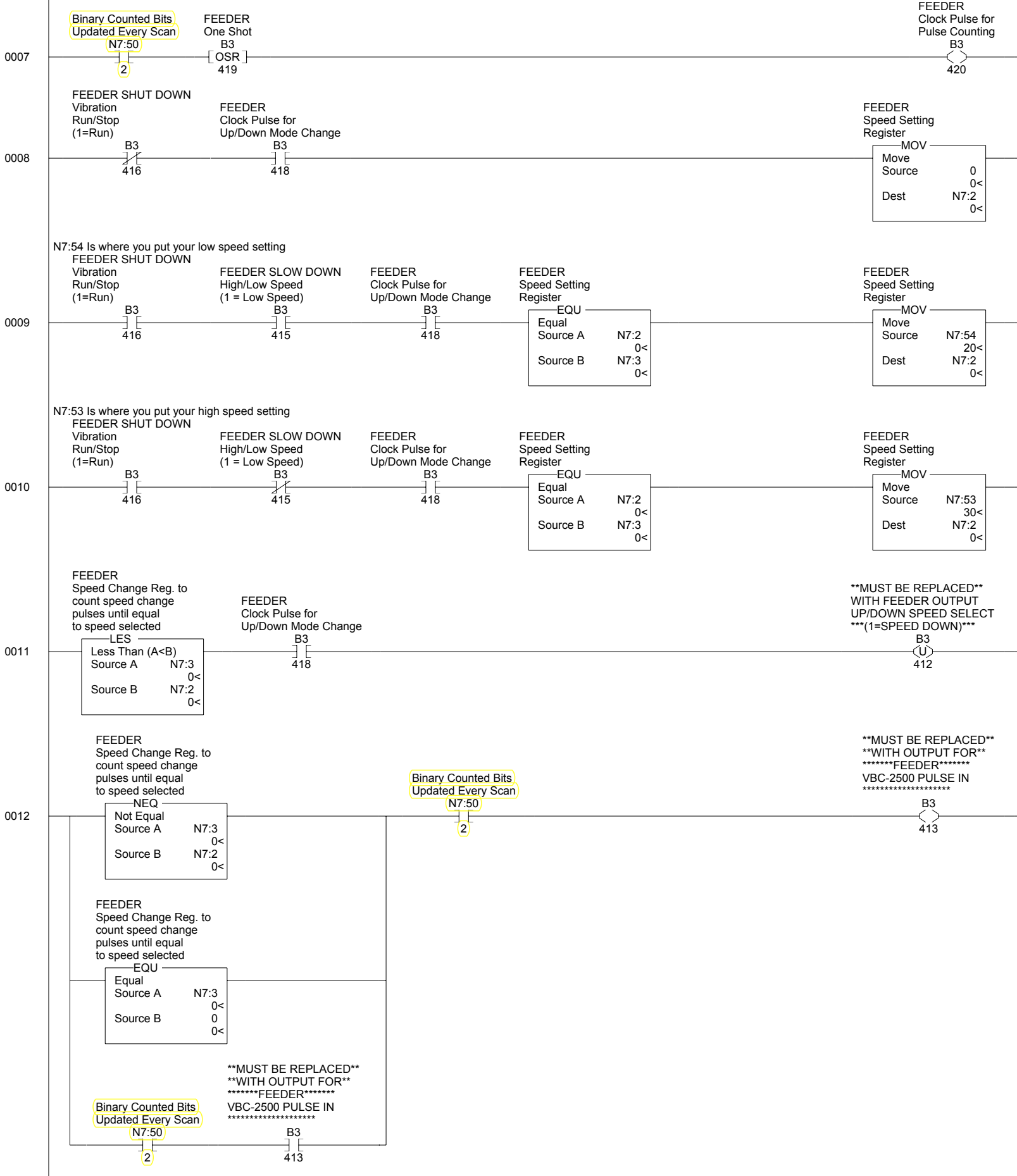
B3/414=FEEDER OUT OF TUNE INPUT

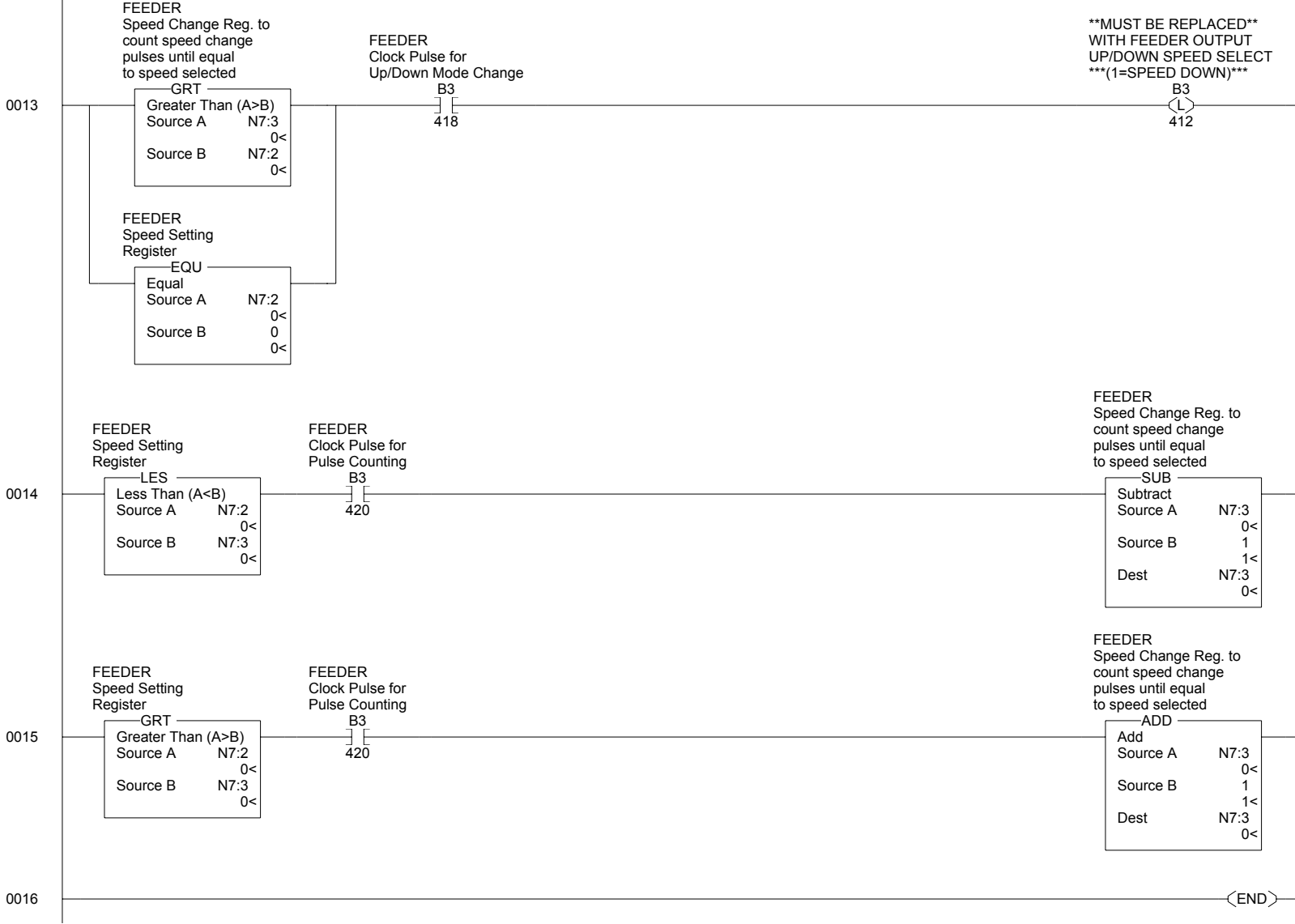


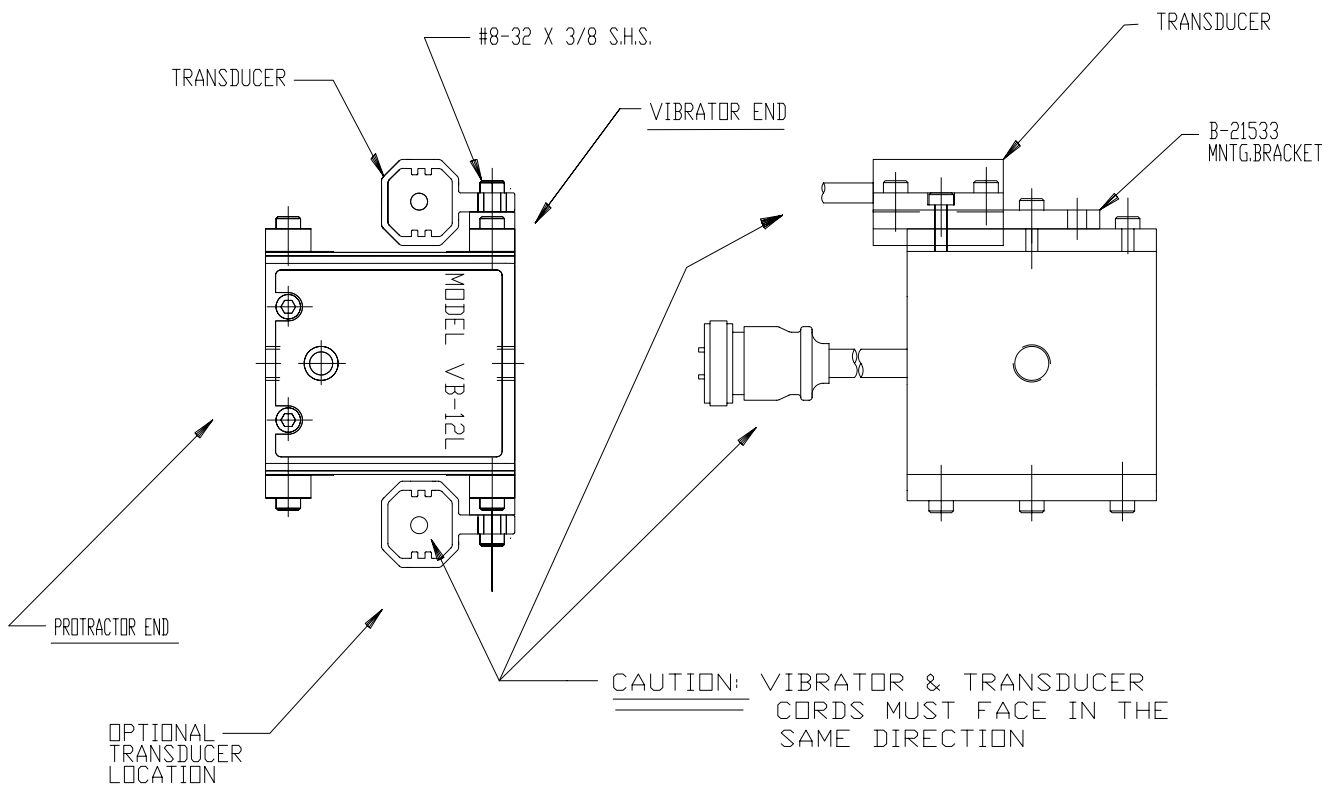
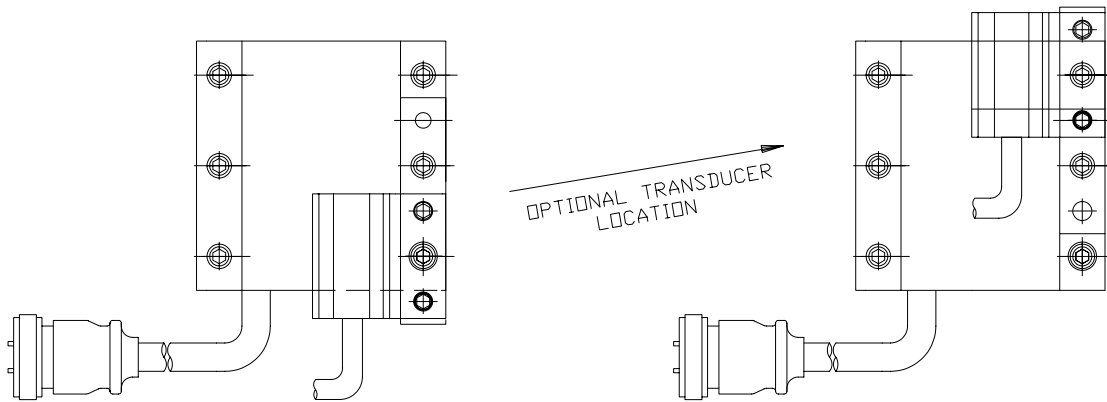
Highlighted Areas Have Been Changed From Previous Version

These changes allow the fastest possible ramp up and ramp down of the VBC 2000, VBC 2500 or PA-1 controller. Speed can be limited by PLC scan time or remote I.O. if used.

Any 3 consecutive N7:50 bits may be used. The lower number bits give the fastest response time. In this example, using a Micrologix 1000, the pulse rate is approximately 200Hz. This is the fastest response time that the VBC2000, VBC2500 or PA-1 will accept under ideal conditions with a 50% duty cycle. For reliability, we recommend a 100 Hz maximum rate to allow for scan time inconsistencies. (5ms On 5ms Off). You can check this with a frequency meter or oscilloscope at the pulse output. Be sure that the FEEDER SHUT DOWN bit is zero so that you will have a continuous pulse stream to measure. Slower response times may be necessary when using remote I.O. If you are unable to achieve a fast enough response time even using bits 0, 1 and 2, the normally open contact in rung 5 can be removed, allowing the 2 normally closed contacts to be 0 and 1. The normally open contact inserts a small wait between UP-DOWN transitions and pulses for better noise immunity and is usually not necessary. When changing these contacts, don't forget to also change the contacts in rung 7 and 12.







TR2000 TRANSDUCER MOUNTING ON  
 VB-12L, VB-16L & VB-32L VIBRATORS