

OPERATIONS MANUAL

SB-4500 Series Control



The World's
Best Automatic
Balancer ...
Just got better.

L-4100-4

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Operation and Specification Manual
for the
SBS Dynamic Balance System

Covering Systems with The Following

- Model 4500 series Control Unit
- Model 4400 series Control Unit
- Model 4475 series Control Unit

L- 4100-4

Manual Revision # 4.0

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General Instructions

System Purpose

A grinding wheel is the cutting tool of a grinding machine. In order for the grinding wheel to accurately cut, produce smooth surface finishes, and generate correct part geometry, it is necessary to prevent vibration in the grinding process. One of the primary causes of vibration in an operating grinding machine, is the existence of imbalance in the grinding wheel.

Imbalance is often due to the heterogeneous nature of grinding wheel construction. A wheel contains great numbers of unevenly distributed grains, which cause an intrinsic imbalance. This imbalance will be compounded by eccentric mounting of the wheel, varying width of the wheel, imbalance in the arbor, and coolant absorption into the wheel. Even a carefully established wheel balance, considering all these factors, will not last long. Due to wear and frequent dressing of the wheel periphery, the rotational dynamics of a grinding wheel are always changing. For these reasons, dynamic balancing of grinding wheels has long been recognized as an important step in the production process.

The SBS Balance System has been developed to provide dynamic balancing to grinding machine operators with the following objectives in mind:

- **Attractive Purchase Price**
- **Ease and Usefulness of Operation**
- **Maximum Grinding Machine Efficiency**
- **Minimal Installation Requirements**
- **Minimal Maintenance Requirements**

Operator Safety Summary

This summary contains safety information necessary for operation of the SBS Balance System for grinding machines. Specific warnings and cautions are found throughout the Operation Manual where they apply, but may not appear in this summary. Before installing and operating the SBS Balance System, it is necessary to read and understand the entirety of this manual. After reading the Operation Manual, contact Schmitt Industries Inc. for any additional technical assistance required.

Warning: Observe all safety precautions for operation of your grinding machinery. Do not operate your equipment beyond safe balance limits.

Caution: To avoid equipment damage, do not drop or mistreat.

Warning: Failure to properly attach SBS Balance System components to the grinding machine spindle, including the proper use of provided adaptor lock screws, will result in safety hazard during machine operation.

Caution: Only qualified service technicians should attempt to perform service on the SBS Balance System. To avoid electric shock, do not remove the cover of the Control Unit, or remove cables, with power connected.

Warning: Never operate a grinding machine without all proper safety guarding in place.

Caution: To avoid equipment damage, make sure the line voltage is within the range specified for the system (see specification section).

System Theory and Connection

The SBS Balance System operates on a principle of mass compensation for a given grinding wheel imbalance. The Intrinsic Imbalance of a grinding wheel is equal to the product of the wheel's mass multiplied by the distance between the wheel's center of mass and the wheel's center of rotation (*figure 1*).

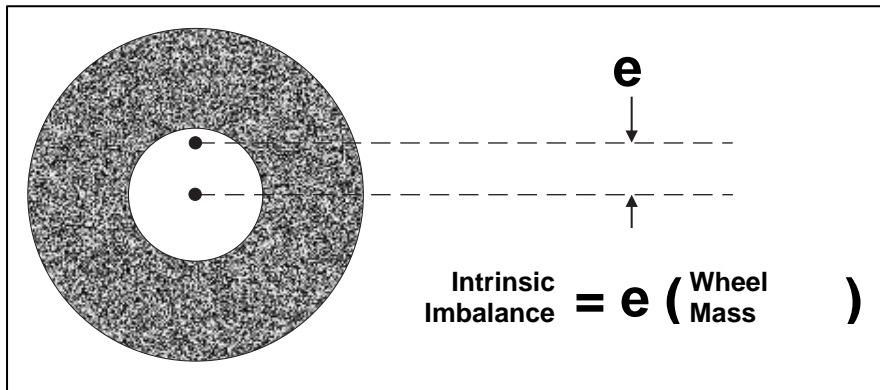


Figure 1

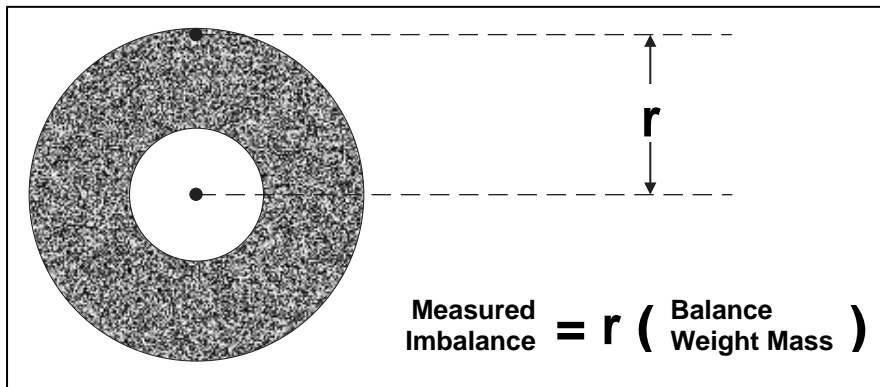


Figure 2

The imbalance of a grinding wheel is determined in practice by use of the Measured Imbalance of the wheel. The Measured Imbalance is equal to the product of a mass, affixed to the grinding wheel to balance it, multiplied by the distance between that mass's center and the center of rotation of the grinding wheel (*figure 2*). In both cases, the imbalance is given in terms of a mass multiplied by a distance, with (grams)(centimeters) being the units used for reference by the system.

In order to correct for various and changing imbalances which occur on a user's grinding machine, the SBS Balance System uses two movable weighted masses, which can be independently positioned so that their resulting compensation will counter any imbalance which is within the specifications of the system. These weights are located in the Balancer, and are driven by high torque electrical motors through a precision gear train.

Figure 3 is a simplified block diagram of the SBS Balance System. The system consists of the Balancer, a Balancer Cable, a Vibration Sensor, and the SBS microprocessor based Control Unit. Imbalance is expressed as spindle movement or vibration and is detected from the grinding machine by the sensor in peak to peak units of measure. The vibration signal from the sensor is transmitted to the control unit, which filters the signal by RPM. The control unit then drives the two balancer masses in the direction that reduces the amplitude of the incoming vibration signal.

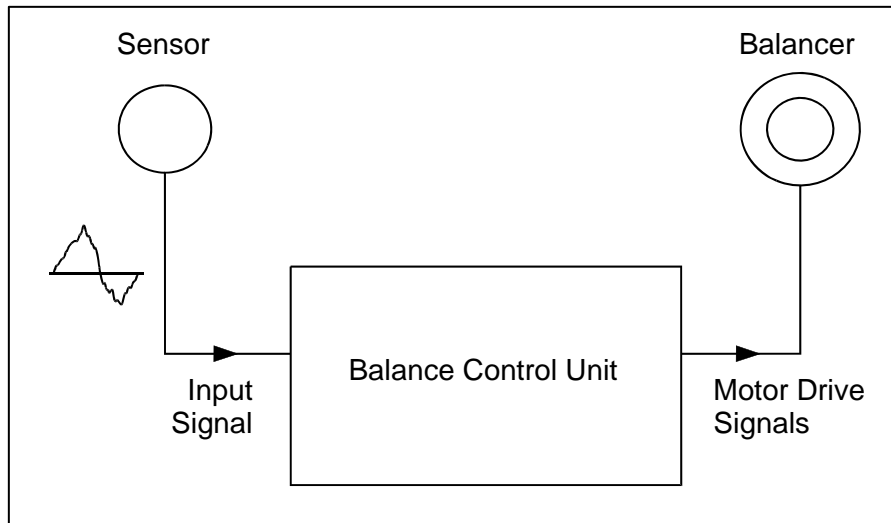


Figure 3

When the balance weights are positioned so that minimum vibration is achieved, the balance cycle is complete. Figure 4a shows a rotating grinding wheel that is unbalanced, with an SBS Balance System installed. The imbalance is represented by the white dot located on the circumference of the wheel. The other two black dots represent the masses located in the balancer. By incrementally repositioning the weights, a triangulation is achieved which cancels out the imbalance, as shown in Figure 4b.

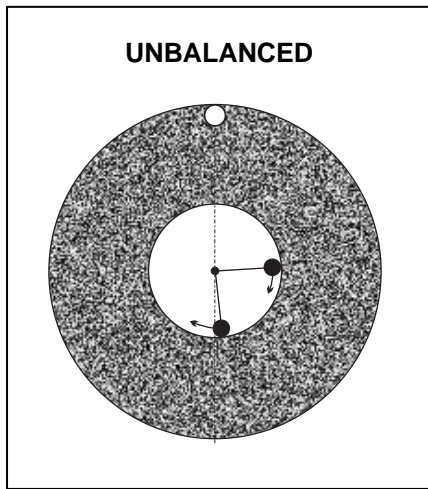


Figure 4a

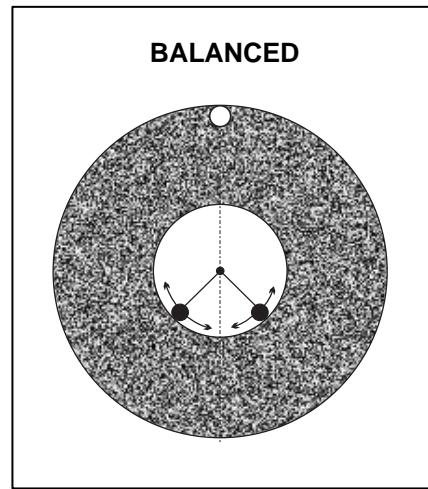


Figure 4b

Environmental Considerations

The SBS Balance System is designed to dynamically correct for grinding wheel imbalance, with its detrimental effects on quality of surface finish, accuracy of shape production, wheel life, and machine bearing life. The system cannot correct for other environmental problems, which may also impact these areas. This section is intended as a discussion of some common environmental problems, which may influence grinding quality and the ability of the SBS Balance System to fully demonstrate its benefits.

Other Sources of Vibration

A most common source of vibration is adjacent machinery. It is therefore important that a grinding machine be properly shock mounted or otherwise isolated if vibration-producing machinery is operating

nearby. Another source of vibration may be components mounted on the machine, such as pumps, motors, drives, etc.

The SBS Balance System may not operate as well under the influence of certain external vibrations. The system filters the vibration signal it detects from the grinding machine by the frequency of the spindle RPM. This means that vibrations occurring at other frequencies than that of the rotating wheel will be ignored by the system. In the case of adjacent machinery operating at the same frequency, or in beat with that frequency, the system will be unable to distinguish vibrations occurring from wheel imbalance with those originating in the adjacent machine.

An excellent test for environmental vibration is to monitor the vibration level on the grinding machine while the spindle is not turning. The vibration level should be checked in various locations on the grinding machine, but in particular at the location the vibration sensor is to be mounted. All surrounding equipment, including any auxiliary pumps or attachments on the grinding machine should be operating during this test. The SBS Balance System can quickly let you accomplish this test (*see: Background Vibration section*). The SBS Balance System can not remove these vibrations.

Machine Condition

The grinding machine's condition is important in determining the balance level, that the SBS Balance System can achieve. The spindle itself should be balanced, as well as all components in the drive train of the spindle (i.e. belts, pulleys, motor, etc.). The balance system can readily determine if any significant imbalance exists in the machine itself. Simply use the same method as described above for checking environmental vibration, except test with the spindle running and with no wheel mounted. The SBS Balance System does not remove these vibrations.

Balance System Installation

The SBS Balance System is easily installed in a short period of time. This section provides instructions for mounting of the system hardware on the grinding machine. Included are sections pertaining to installing the balancer, making system connections, installing the vibration sensor, and selecting the proper line voltage setting.

External Balancer/ Adaptors

The Balancer is mounted with the provided adaptor to the machine spindle (*figure 5a*). The mounting adaptor is specifically designed to accommodate the particular machine's spindle configuration, and will vary in design. In general, the adaptor will consist of two parts. The **Adaptor Nut** mounts on the Grinding machine, usually replacing the spindle nut of the machine, either on the wheel or pulley end of the spindle. The **Adaptor Flange** will bolt to the Balancer, and then thread onto the installed Adaptor Nut. Appropriate wrenches are supplied for both parts. Use of a lubricating compound between the Balancer and Mounting Adapter is recommended, to ensure ease of future disassembly.

Lock Screws are a feature of many adaptor designs, where required by high machine speeds or machine spindle braking. These lock screws will consist of M6 socket set screws in the face of the Adaptor Nut, and M5 socket set screws in the outer diameter of the Adaptor Flange (*figure 5a*). **Warning** - All lock screws must be properly secured each time the Adaptor Nut or Adaptor Flange is installed in place, in order to prevent the assembly from coming loose during operation of the grinder.

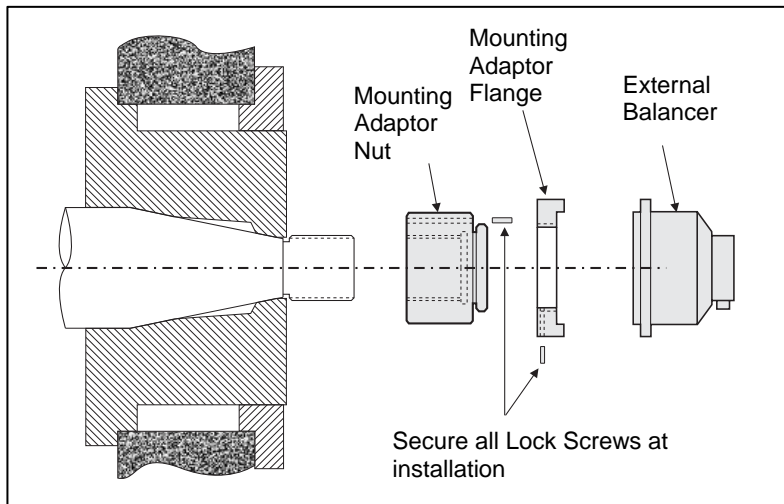


Figure 5a

Follow this assembly procedure to ensure proper mounting of Adaptor Nuts and Flanges were lock screws are part of the adaptor design:

1. Loosen all lock screws before assembly. The engagement end of these screws should be below flush with the face of the adaptor part where they exit.
2. Screw the Adaptor nut onto the machine wrench tight, using the supplied wrench. Use of hammers or wrench extension bars are not advised.
3. Tighten all the lock screws in the Adaptor Nut, wrench tight.
4. Thread the Balancer/ adaptor flange assembly onto the mating threads on the Adaptor Nut.
5. Tighten the lock screws in the Adaptor Flange, wrench tight
6. All lock screws must be fully loosened before attempting removal of these parts from the machine.

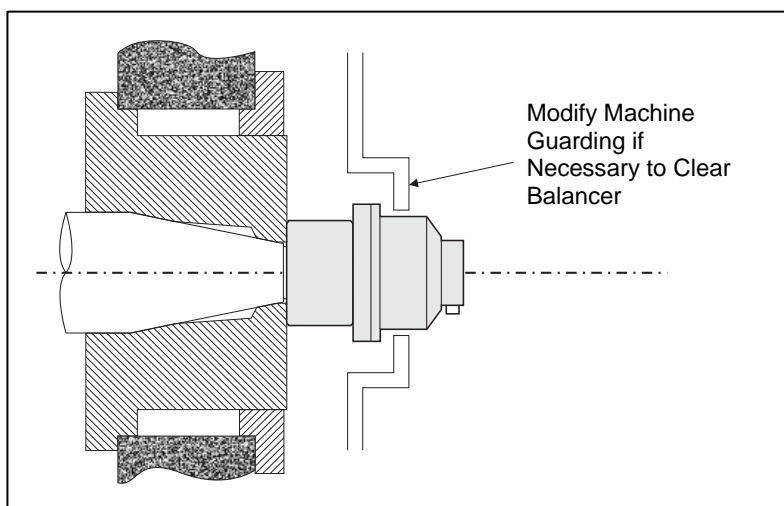


Figure 5b

The Balancer must be checked for machine clearances upon installation. Make sure there is no interference between the Balancer or adaptor and any part of the machine (workhead, tailstock, etc.), especially with the wheel worn to it's smallest diameter (*figure 5b*). Modify the machine guarding if needed to provide clearance from the Balancer.

The Balancer Cable should be restrained to prevent the cable from being caught up in the rotating machine (*figure 5c*), but should allow for the cable's removal as necessary during wheel changes. These components are designed for the harshest environments and the most aggressive coolants. However, common sense dictates that where possible, machine guarding should be modified to allow the rotary junction and cable to extend outside the guard. Optimally, the cable should be secured so that the connector on the Balancer points down, as shown in the diagram. This position will minimize the chance of fluid or swarf entering the connector when the connector is opened during wheel changes. While the connection is opened, if contamination of the cable connector pins occurs, the pin area must be cleaned prior to re-assembly. If heavy wheels are being changed, remove the Balancer from the area during wheel changes. Most adapters for larger machines are of a two piece design, which simplifies this process.

These installation drawings show the standard balancer version, with the SBS slip ring collector (rotary electric junction) design. Another balancer option is available which includes the SBS non-contact collector. When this balancer version is used, the installation is similar, except that the balancer comes in two parts, with the separate collector piece being mounted across an air gap from the balancer, on a stationary part of the machine. Additional mounting instructions will be provided with this version of balancer describing in detail how this is to be accomplished.

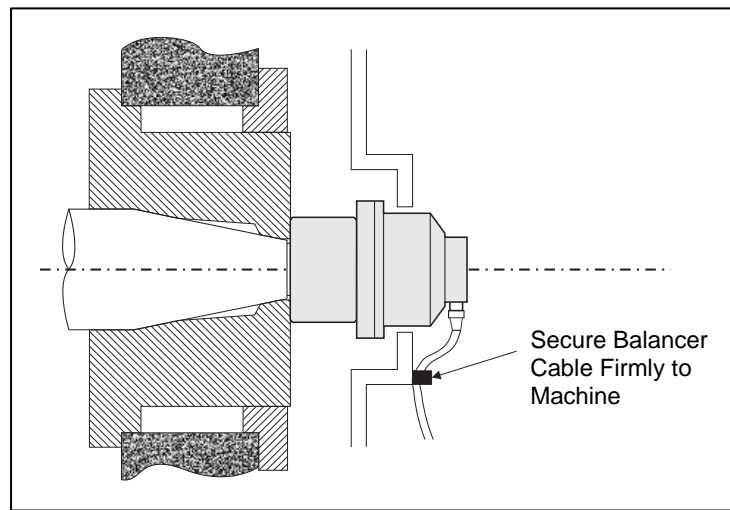


Figure 5c

Internal Balancer

Internal Balancers are designed for mounting inside or internal to the machine spindle. The machine manufacturer must provide a precision-machined mounting bore as part of the design of the grinder's spindle in order to accept an internal balancer. The method of attachment is the essential difference between an internal balancer and an external balancer. Once installed, the operation of the two designs is identical and they are discussed interchangeably throughout this manual. The mounting diagram (*figure 6*) shows how the internal balancer is mounted in the wheel end of the machine spindle. The flange style mounting shown is typical, although a taper lock mounting option is available which eliminates the flange mount and allows the whole internal balancer to fit within the diameter of the mounting bore.

The internal balancer shown is cabled to the SBS collector, which is mounted separately at the rear end of the spindle. With other versions of the balancer, the collector can also be mounted at the wheel end of the spindle, directly attached to the balancer, eliminating the need for the cable bore down the center of the spindle. Both the standard SBS slip ring collector, and the SBS non-contact collector, are available options with the internal balancer.

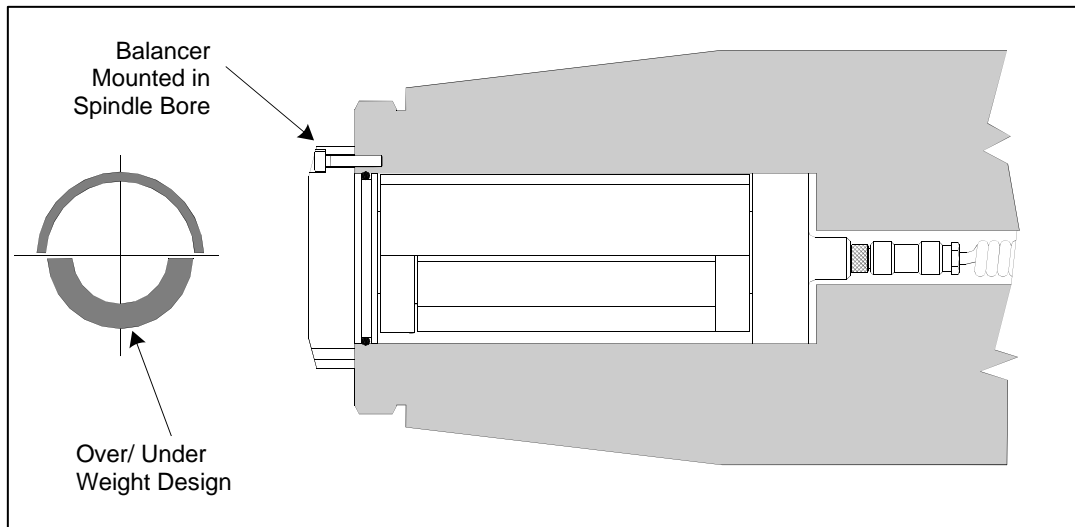


Figure 6

SBS Control Unit

The SBS Control Unit should be mounted in a location that allows observation of the display by the machine operator. Mounting hardware is available for installation on horizontal surfaces or for rack mounting in standard 19" racks. Cabling connections to the control unit include the Vibration Sensor Cable, the Balancer Cable, the power cord, and machine controller interface cable if applicable (*see: System Connection diagram*). All connections are clearly labeled on the rear of the control unit. Be sure that the proper fuses (Two 3 Amp Time Lag) are installed. (*see: Rear Panel Controls section*).

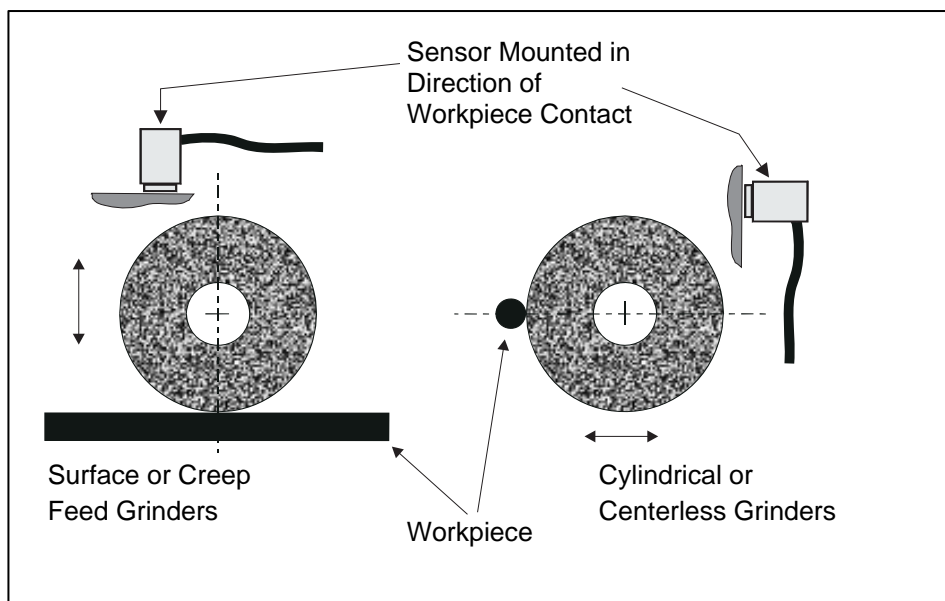


Figure 7a

Vibration Sensor Location

The Vibration Sensor can be mounted on the grinding machine either by use of the magnetic mount provided, or by permanent stud mount. The magnetic mount should be used during initial system start up, until a good permanent location is found on the grinding machine for the sensor. The sensor can then be permanently stud mounted at that location. When stud mounting the sensor, a machined flat should be supplied at the mounting location on the machine.

The location and installation of the sensor are crucial to successful operation of the SBS Balance System. Because of differing machine characteristics, Vibration Sensor location is specific to machine model. There are some general principles that should assist in finding a proper sensor location for your grinding machine.

1. The first general principle is to **locate the Sensor in the same direction as the centerline between the grinding wheel and the workpiece**. The best place to start is a flat machined surface on the spindle housing over the bearing closest to the wheel, and perpendicular to the spindle's centerline (*figure 7a*). A vertical mounting surface is preferable on most cylindrical grinding machines because the sensor is in line with the grinding wheel and the workpiece. For this same reason, on surface grinders and creep feed grinders, a horizontal mounting surface is generally best. Although the balancer itself may be mounted either on the wheel or pulley end of the machine, the Sensor should always be aligned at the wheel end of the machine (*figure 7b*).

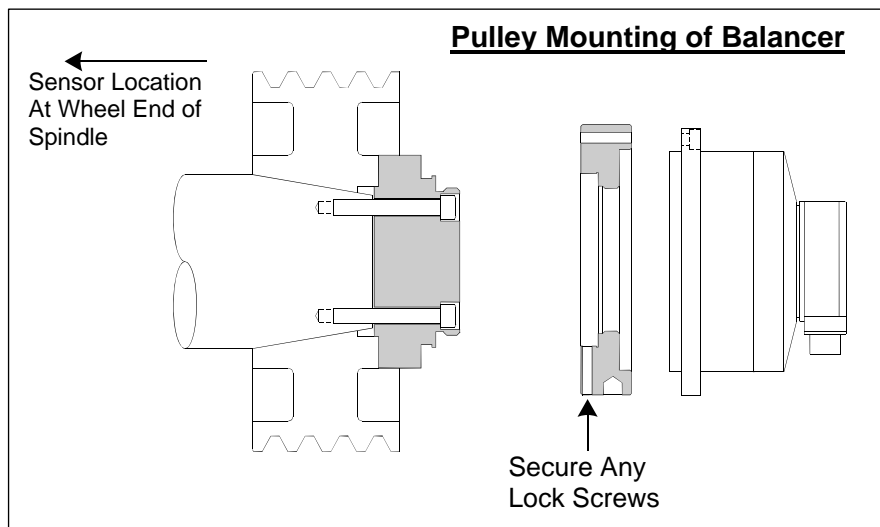


Figure 7b

2. The second general principle is to **locate the sensor on a rigid part of the machine structure, where vibration from the spindle will be accurately transmitted**. On some machines, the wheel guard can be a good location to mount the sensor, if it is heavy enough and rigidly attached to the spindle housing. The balance system relies on vibration signals received from the Vibration Sensor to accurately display the current vibration level, in peak to peak units, and to balance the grinding wheel. The system employs narrow bandwidth filters that prevent vibration at non-spindle frequencies from being detected. However, in applications where the motor or other machine components are running at the same speed or frequency as the spindle, interfering vibrations may result. Careful experimentation with the sensor's location goes a long way in minimizing sources of interference.

Control Unit Operating Instructions

The SBS Balance System, once installed, is easily configured to the particular needs of your grinding setup. The following section includes an overview of the control and interface features of the SBS Balance System Control Unit. In the second section of this manual, "External and Internal Balancer Operation" detailed description is given of the function and operation of the various features of the system which will allow the user to perform auto-balancing, manual balancing, and vibration analysis, as well as machine controller interface to the system.

Sections cover the SB-4400 (expandable to two channels), and the SB-4500 (expandable to four channels). Both units are capable of being controlled by a CNC or PLC machine controller.

Model SB-4500 Front Panel Controls

Figure 8 illustrates the controls and indicators on the front panel of the Balance Control Unit. The following is a description of these features:

- 1) **ON/OFF.** This button turns on the operating power for the system. When the system is turned on, the unit initiates a Power-On Display, and the green LED to the left of the button will be illuminated. When turned OFF, the unit is in the stand-by mode, and the green LED is blinking. This indicates power is connected to the unit, but the control is inactive.
- 2) **CANCEL BUTTON.** Pressing this button will cancel the operation in progress, or the last selection or entry made.
- 3) **LUMINESCENT DISPLAY.** This display is not a touch screen. Do not attempt to operate the control unit by pressing on the display.
- 4) **FUNCTION BUTTONS.** The display is not a touch screen. Operation of the Control unit is primarily accomplished via these four multi-function buttons. The Menu Bar area of the display, to the left of these buttons, assigns the current function to each button.
- 5) **SLOT STATUS LED.** An LED indicator of three colors on the left side of the keypad display the operational status of the balancer card or other device installed in that card slot.

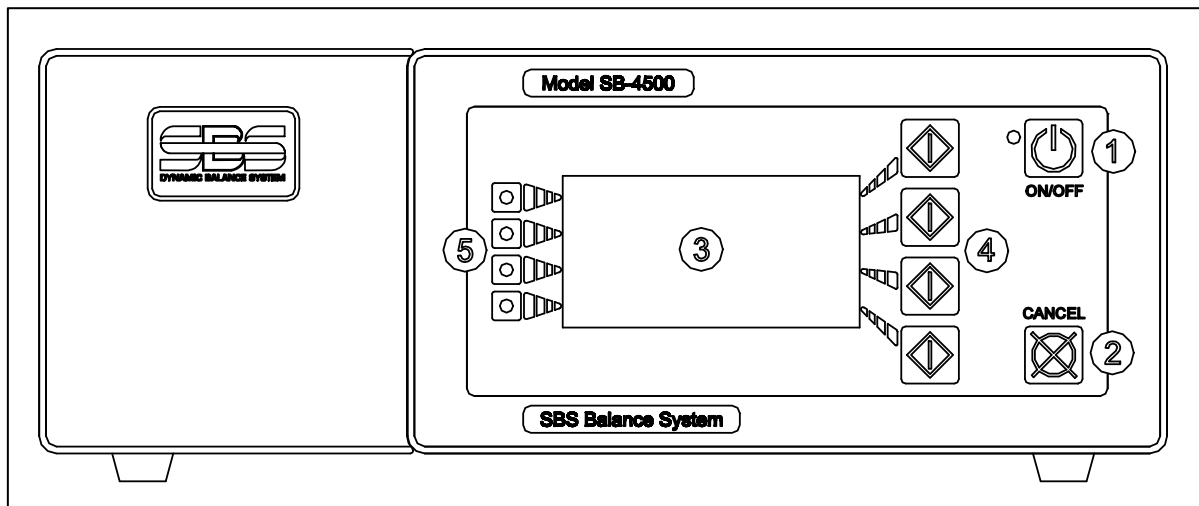


Figure 8

Power-On Display for Control Models with Attached front Panel

When the ON/OFF button is pressed on the front panel of the Control Unit, and power is applied to the unit, the Control Unit performs a series of self-checks, which define its status, and the setting of various operating parameters. Operator information regarding these parameters is displayed using the Control Unit's graphic display. The sequence follows this order:

- 1) The company logo screen will be displayed and lights on the front panel are illuminated to verify their operation. During this time, a SETUP function button is available. Pressing this button will allow language selection, and RS-232 Baud Rate selection. These settings are common to all installed card slots.

-
- 2) After a few seconds, the company identification screen will clear and the unit will display information related to each slot or slots where card devices are installed, indicating each type of device, and relevant identifying information. To extend the time that this information is displayed, press any one of the function buttons while the slot information is on the screen. Each press will add six seconds to the display time, providing additional time to read the information.
 - 3) After a few more seconds, the slot information screen will clear, and the unit will display the initial operational screen for the control unit. Where one balancer channel is installed, this first screen will be the main balancer screen. Where more than one device is installed, the unit will display either the SHOW ALL monitor screen, or one channel's main balancer screen, whichever was selected when the unit was last turned off.
 - 4) Any error conditions detected by the self-checks are displayed as "ERROR - *code*" where *code* lists the reference code of the error detected. For detailed description of error codes, see Displayed Error Messages section of this manual, or other additional product instruction addendum manuals.

SETUP Option

This option allows the user to select the language used by the control unit for display, and the RS-232 baud rate used by the control for RS-232 communication. During Power-up, while the company logo screen is displayed, press the SETUP button to change the screen. The next screen displayed allows the selection of the language used by the control for display. Use the arrow buttons to scroll through the available languages and press the ENTER button to switch the control unit to the desired language. After pressing the ENTER button, a screen for changing the baud rate for the RS-232 port is displayed. Use the arrow buttons to scroll through the available baud rates and press the ENTER button to make the selection. Pressing the START button at any time during this process will bypass remaining SETUP options and resume normal operation.

Power-On Indication for Control Models with no Display

The only power-on display for this type of unit is the standard RS-232 menu and command prompt. (*see: RS-232 Commands and Responses section*)

Model SB-4400 Front Panel Controls

This dedicated remote control model of the Control Unit does not have a front panel, and can be activated only via the two interface ports on the Control Unit, or by use of an optional remote front panel. Operation of the unit via the remote front panel is identical to that described above for the SB-4500 unit.

Model SB-4500 Rear Panel Connections

Figure 9 illustrates the rear of the control. The following four connections are located on the rear panel of the Balance Control Unit, and are common to any cards installed in the control.

- 1) **POWER SUPPLY.** Connection for line power input. **Caution - before applying power to the Control Unit, make sure the voltage is within specified voltages for the balancer (100-120V AC, 200-240V AC, 50-60 Hz).**
- 2) **FUSE HOLDER.** Contains the line fuses. To replace fuses, remove the line plug from receptacle and use a small screwdriver to draw out fuse holder from the plug body. An equivalent of the two supplied 3 Amp Time Lag 5x20 fuses should be used.

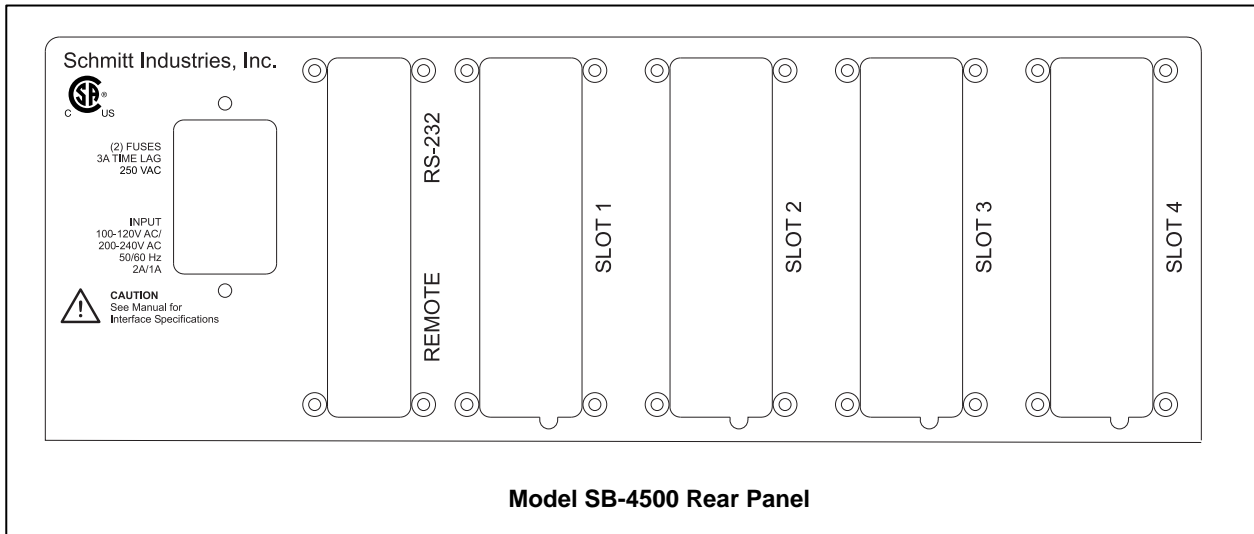


Figure 9

- 3) **RS-232 PORT.** A DB-9 connector receptacle is used to provide external communication for serial transfer of data.
- 4) **DEVICE SLOTS.** These numbered Slots are available for installation of balancer channel cards or other devices supplied by Schmitt Industries. Factory configuration of the control unit will include a balancer channel card installed in Slot 1, with unused Slots being sealed with blank cover panels.

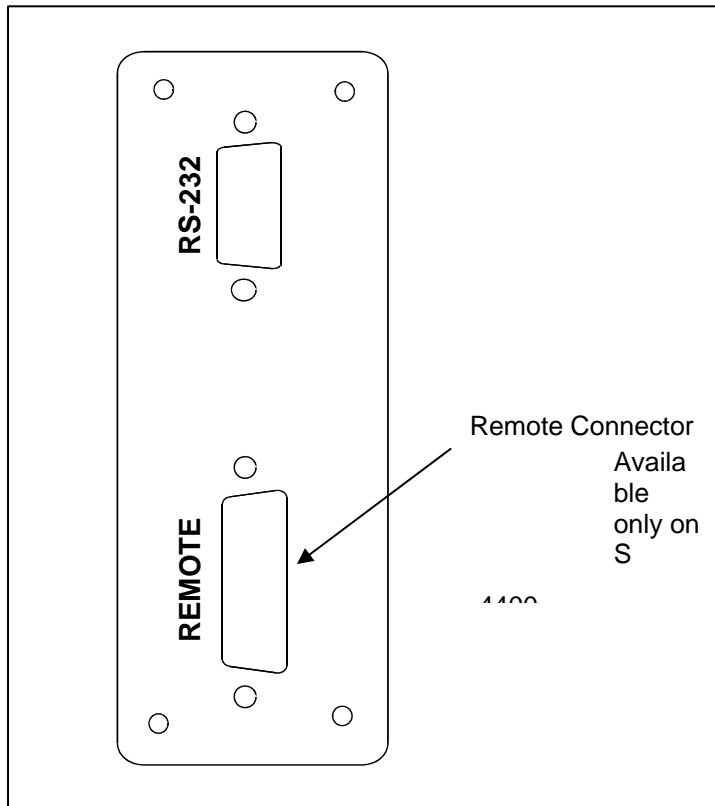


Figure 10

Additional capabilities can be added to the system by installation of separately sold add-in card products supplied by SBS. One such product is the SBS AEMS Gap and Crash monitoring system card. This product allows automatic acoustic monitoring of the machine for grinding Gap elimination, and wheel Crash protection. See your SBS representative for details.

Model SB-4400 Rear Panel Connections

The SB-4400 is a dedicated machine controller or remote controlled version of the SBS Control Unit. Rear panel control and connections for this unit are identical to those on the standard SB-4500 channel unit, except for the addition of the REMOTE plug, located directly below the RS-232 port (*see: figure 10*). This DB-15 connector receptacle is used to connect the optional remote front panel unit (SB-4450) to the control, where remote panel mounting is desired.

External/ Internal Balancer Operation

Balancer Slot Status LED

The status indication for installed Balancer channels is as follow:

BALANCE ABOVE CRITICAL. The LED is lit **RED** when the measured vibration level is above the CRITICAL level selected by the user. While the system is performing an auto-balance, the LED will blink.

BALANCE OUT OF TOLERANCE. The LED is lit **YELLOW** when the measured vibration level is above the TOLERANCE level selected by the user. While the system is performing an auto-balance, the LED will blink.

BALANCE BELOW LIMIT. The LED is lit **GREEN** when the vibration level of the grinding machine is at or below the selected TOLERANCE limit. While the system is performing an auto-balance, the LED will blink.

Balancer Main Screen Elements

The following items are elements displayed on the Balancer Card Main Screen (*figure 11*).

- a) **MENU BAR.** The right side of the display is used to assign current function to the four corresponding Function Buttons to the right of the display. This includes menu selections and direction arrows. An animated hourglass appears here during the balance and plotting cycles, indicating progress.

These Function Buttons are defined as follows for the main screen of each Balancer Channel. See Function Button Map (*figure 12*) for an overview of the balancer functions available.

MENU. When this button is pressed, the display shows a menu listing with selectable operating parameters and other functions for the control unit. The displayed arrow selection buttons are used to move the highlighted selection bar up and down the listing. Press the ENTER button once the menu item has been highlighted.

SHOW ALL. This selection will only be displayed on the Menu Bar when more than one balancer card is installed in the control unit. Pressing the corresponding button will display the monitored status of all balancer channels, or other devices.

MAN. Manual Balance Menu selection allows movement each of the two weighted masses in the Balancer, (M1 or M2). Each mass can be moved in both directions using the function buttons corresponding to the forward and reverse arrows on the display. These arrow buttons are available only during a Manual Balance operation.

AUTO. Initiates an auto-balance cycle. Pressing the CANCEL button will halt the auto-balance cycle. (*see: Automatic Balancing section*).

- b) **IDENTIFICATION TAG.** The upper edge of the display is used to identify the name of the channel currently selected, and the current position in the menu structure.
- c) **VIBRATION DISPLAY.** Indicates the measured vibration level of the grinding machine in either microns or mils of displacement, or in millimeters/second or mils/second of velocity. The displayed units are selectable from the Menu.
- d) **RPM DISPLAY.** Displays Spindle RPM measured by the balancer. Display also indicates RPM frequency during a Manual Filter vibration test.

- e) BAR GRAPH. The bar graph reflects the monitored vibration level compared to the LIMIT, TOLERANCE, and CRITICAL levels. A bar graph during plot shows the progress of the plot cycle.
- f) STATUS. This text label is used to indicate the current status of the selected balancer channel.

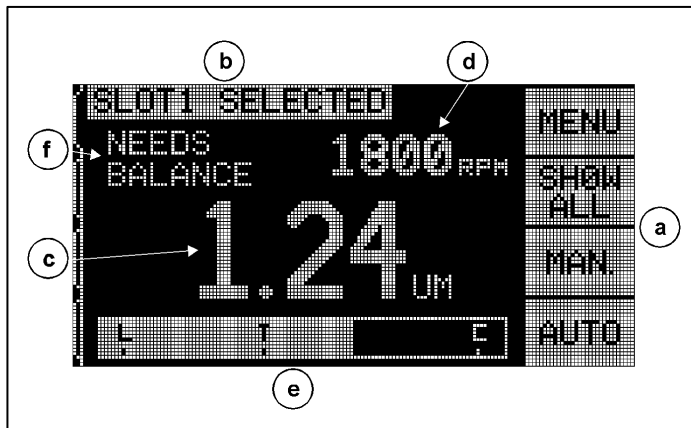


Figure 11

MENU Settings and Selections

Note: All menu items are set independently for each installed balancer card, or other device.

Pressing the MENU button listed on the display will produce a listing of menu items. This menu provides a means of specifying system settings for individual balancer channels, and for performing certain optional functions. Use the buttons corresponding to the up and down arrows to move through the menu items. Press the ENTER button to select an individual menu item for edit or operation. Pressing the EXIT or CANCEL buttons will exit the Menu screen, and return to the Main Screen for the channel. Description of each MENU listing follows:

Balance Settings

Use the button corresponding to the backward arrow to move the cursor from one digit to the next. Use the buttons corresponding to the up and down arrows to increase or decrease the value of the selected digit. When finished press the ENTER button to store any change in value, and move to the next balance setting. Each of the following three balance settings are presented consecutively. Pressing CANCEL will return to the Menu.

- **LIMIT** target level - This is the lower limit that the balancer will try to achieve during an Auto-balance cycle (This value should be set 0.2 micros higher than the background vibration level).
- **TOLERANCE** level - This level sets the high end of the acceptable operating balance range. When this level is exceeded a Balance Out of Tolerance (BOT) error condition is reported. This signals the operator or machine controller to re-balance the machine. This level needs to be determined by process considerations. It should rarely be less than 1 micron above the Limit.
- **CRITICAL** level - This level can be set at a value that provides a secondary warning of an extreme out of balance condition that may be damaging to the grinding machine or process. When this level is exceeded a Critical Balance out of Tolerance (BOT2) error is reported. This signals the operator or machine controller to shut down the machine. This same error can also be triggered by excessive RPM (*see: Critical RPM section*).

Vibration Units

Press the corresponding button to select from the available vibration units that may be displayed (UM, MIL, MM/S, or MIL/S). The currently selected units are highlighted on the screen. When the unit button has been pressed, the display will change, giving the opportunity to select the desired display resolution for that choice. The buttons corresponding to the up and down arrows are used to set the resolution, and pressing the ENTER button stores the selection.

Balance Speed

This setting will affect the time taken to perform an Auto-balance cycle. Normal is the correct setting for most applications.

- CAUTIOUS balancing – Setting 1. This selection will control the balance weights in a slower progressive balance mode. This setting is most useful on high speed grinders, or other machines where slight movement of the balance weights produces dramatic change in vibration level.
- AGGRESSIVE balancing – Setting 2. The aggressive selection operates the balancer in the fastest balancing mode. This setting is most useful on machines with slow speeds and large wheels.
- NORMAL balancing – Setting 3. This selection uses a combination of a fast balancing routine until the vibration level reaches 1.0 micron, then switching automatically to a slower routine for accurate balancing.

Plot Vibration

This function allows the user to perform a vibration spectrum sweep in a selected RPM range. This operation will take several minutes. It will generate an on-screen graphical representation of the amplitude of vibration monitored at each RPM range in the form of a bar graph. It will also produce a text listing of the top twenty vibration peaks encountered during the spectrum sweep. See the Plot Vibration section for operational details.

Pre-Balance

Allows the user access to the pre-balance function of the control unit. The pre-balance function provides a step by step process which assists the machine operator in placing manual balancing weights on the grinding machine in correct position to achieve a rough balance. This feature can be useful upon installation of new wheels, or whenever the wheel imbalance exceeds the balance capacity of the automatic balancer. By pre-balancing, the majority of the wheel imbalance is removed, allowing the balance system to perform final trim balancing, and to maintain balance as the wheel wears. See the Pre-Balance section for operational details.

Channel Name

Select a name or label to identify the balancer channel. This name is used on the various screens to identify which channel is currently selected. SLOT1 is the factory default name assigned to all channels, until the user selects a unique name.

Menu Entry

This selection on the menu list provides for use of a standard access code for menu protection. Setting the channel to the protected mode denies access to the menu list unless the access code is entered. This setting ensures that system settings will not be accidentally compromised. The screen displays ENABLED when Menu access is available, and PROTECTED when menu access is controlled by the access code.

Function buttons are assigned the numbers 1, 2, 3, and ENTER, which are used to input the access code. The standard access code is **232123**. Once the code has been entered and the ENTER button has been pressed the MENU selection is protected. Re-entry to the menu list will now require entry of this code. The message MENU ACCESS PROTECTED will be displayed notifying the user that the menu is password protected, and the user will be given the opportunity to enter the code. Entering a code other than the correct number will produce a message INCORRECT CODE ENTERED TRY AGAIN/ CANCEL.

To disable menu protection, enter the correct code to access the menu, select the MENU ENTRY item from the menu, and enter the code again to turn off the protection. The display for MENU ENTRY will display ENABLED when protection has been disabled.

Factory Settings

Returns user selectable parameters under the BALANCE SETTINGS menu to the default factory defaults, changes BALANCE SPEED to CAUTIOUS, and sets CRITICAL RPM back to 0.

Critical RPM

This setting allows the user to select a maximum RPM level, which when exceeded will cause the Balance Control to indicate an error condition. Toggle the selection cursor with the up and down arrow buttons to highlight the CRITICAL RPM selection, and press the ENTER button. The screen now displays the CRITICAL RPM entry screen. Any RPM level set using this screen will act as a maximum limit, and if this limit is exceeded, the Control will indicate an error in two ways. The SLOT STATUS LED will illuminate **RED**. In addition, both the BOT and BOT2 Relay contacts will be tripped. This is an alternate cause of these error conditions. The BOT2 relay can be monitored by the machine controller, and if desired can be used to set off additional warning systems or interrupt the operation of the grinding machine. To set the desired RPM for the Critical level, use the left arrow button to select digits, and the up and down arrow buttons to change the selected digit. Press ENTER to save the setting and return to other screens. To disable the Critical RPM feature, simply reduce the CRITICAL RPM level to zero.

CNC BOT MODE

This selection controls the behavior of both the BOT (Balance out of Tolerance) and BOT2 (Critical Tolerance) relays **during Auto balance Cycles**. When set to “INACTIVE (SB-2500)” both these relays are open and not active during a balance cycle, except when a Critical RPM error is detected. This inactive behavior matches the SB-2500/SB-3500 series of controls. When set to “ACTIVE (HK-5000)” both these relays are active during a balance cycle. Each relay will be closed if the vibration level exceeds its set limits (*see CNC/ System Timing Diagram*).

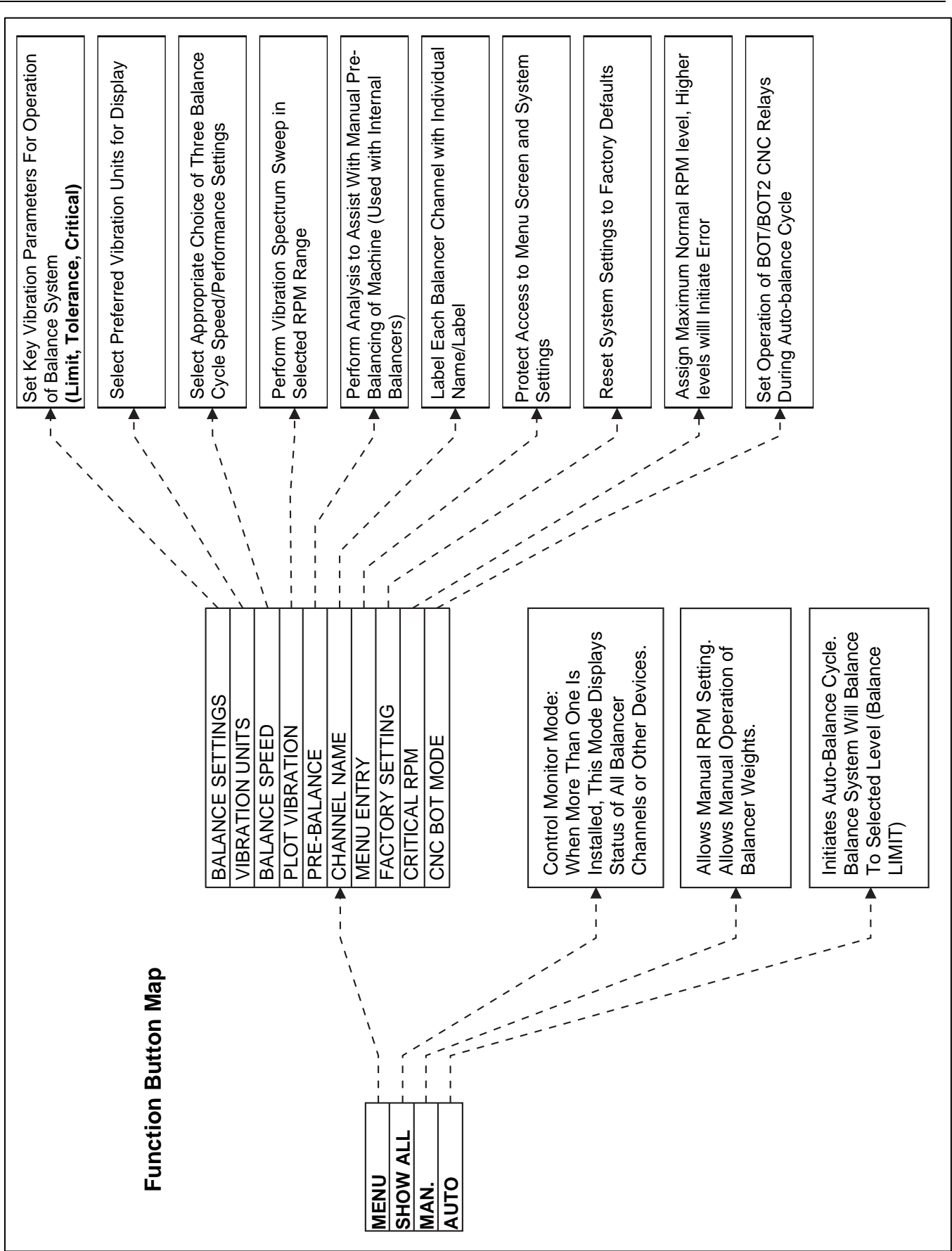


Figure 12

Balancer Rear Panel Connections

Figure 13 illustrates the rear of the individual balancer card for control of external and internal balancers (part SB-4512) installed in the control. The control unit comes standard with one such card, and others can be purchased and added to the control unit as required. The following three connections are located on the rear panel of the Balance Control Unit, and are common to any balancer cards installed in the control.

- 1) **SENSOR CONNECTION.** The receptacle through which the Vibration Sensor cable makes connection to the Control Unit.
- 2) **BALANCER CONNECTION.** The receptacle with which the Balancer Cable makes connection to the Control Unit.
- 3) **HARDWIRE INTERFACE.** Standard DB-25 connector receptacle for use in making connection between the Control Unit and any grinding machine controller. A complete description of this interface protocol is given in the Machine Control Hardwire Interface section of this manual.

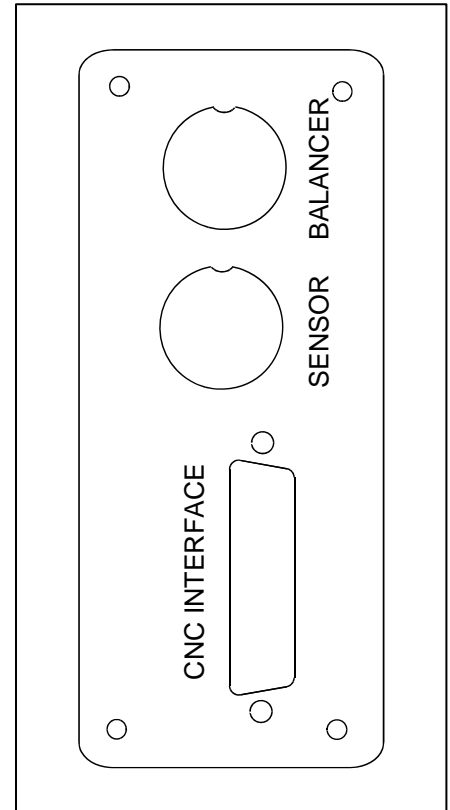


Figure 13

Preparing to Set Operating Parameters

An understanding of the function and operation of the Control Unit's front panel controls is assumed in the following section. The following numbered steps provide a quick outline for system set-up.

Background Vibration

A check of the background vibration level must be performed, to correctly set up the system.

- 1) Mount the Vibration Sensor in the position to be used during operation (*see: Vibration Sensor Location section*). Install the Balancer, Control Unit, and all cables as indicated in the installation section of the manual before turning on the Control Unit power. Leaving the grinding machine off, press the MAN. Button and use the arrow buttons to manually set the controls vibration filter to the operational RPM of the machine. Note this measured ambient vibration level with the machine not running.
- 2) Turn on all secondary machine systems (such as hydraulics, and motors), but leave the machine spindle turned off. The vibration level displayed without the spindle running is the background vibration level for the machine. Make note of this background vibration level for future reference in setting the operating parameters of the system. Refer to the Environmental Vibration section for explanation of possible sources of background vibration.

Verifying Balancer Sizing

- Using the manual motor buttons, the left and right arrow buttons marked M1 and M2. Rotate the masses in the Balancer, while the machine is operating at speed. By running each of the two weights in opposite directions, the operator should be able to introduce more than three microns of vibration in the grinding machine, but not more than thirty microns. If results do not fall in this range, it may be a sign that the Balancer needs to be re-sized for your application. Contact your SBS Balance System provider for consultation. In the interim, do not allow the grinder to operate for extended periods with high vibration levels.

Setting Operating Parameters

The following section details the menu-selectable operating parameters of the Control Unit, in the order that they appear. For control units where more than one balancer card is installed, the user should select the desired channel, and then enter the MENU list. **The menu settings are independently set for each channel.**

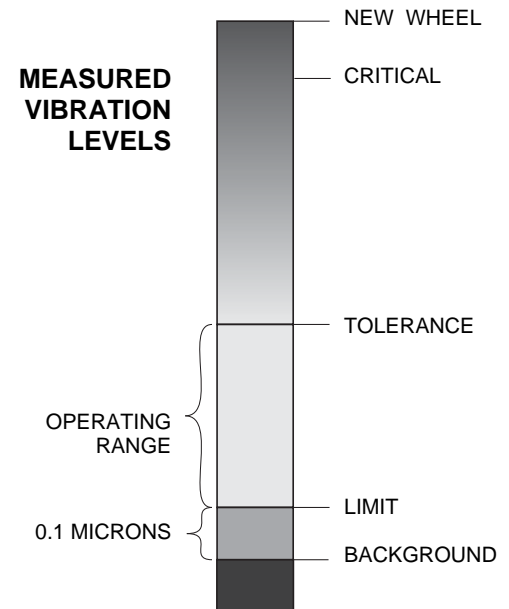
When the MENU button is pressed, a listing will display up and down arrows, an EXIT, and ENTER selection. Use the up and down arrows to make a selection from the menu list and press ENTER to enter the menu item selected. When all desired changes are made, press the EXIT button to leave the menu mode.

Auto-Balance LIMIT

The SBS Balance System is designed to balance quickly and automatically to a level of vibration specified by the user, with the use of Auto-Balance LIMIT. The Auto-Balance Limit is factory set at 0.4 microns of displacement. A balance level of 1 micron or less is generally considered adequate for most applications. If the user wishes, this limit can be set anywhere from 0.02 microns and up. **The lower the Auto-Balance Limit is set, the more time the system will typically require to achieve balance.** Some experience may be necessary to determine the appropriate Auto-Balance Limit for a particular installation.

- To set the Auto-Balance Limit, the MENU button is pressed, and BALANCE SETTINGS is selected from the menu. The Auto-Balance Limit is set using the arrow buttons, followed by pressing the ENTER button. Typically you should set the LIMIT at a level that is 0.2 micron higher than the highest background vibration level you noted in step #2 above. Press the ENTER button to enter the selected level. **Note:** While Velocity display modes may be selected for monitoring machine vibration, the LIMIT setting can only be made in units of displacement.

NO BALANCE SYSTEM IS CAPABLE OF BALANCING THE GRINDING WHEEL TO A VALUE BELOW THE AMBIENT OR BACKGROUND LEVEL. The results of trying to set the balance limit below ambient levels will be long or failed balance cycles. Since the background vibration level is often a product of floor transmitted vibrations, these levels may change as adjacent machines are put into or out of service. **Set the balance limit during periods which reflect the maximum floor transmitted vibration the system will receive.**



Auto-Balance TOLERANCE

- 5) Related to the Auto-Balance Limit, is the Auto-Balance Tolerance setting. This operator defined setting establishes the vibration level, which acts as an “upper limit” for the system. When reached, this setting will indicate the need to perform a re-balance operation. This indication is given both by the **yellow** color of the SLOT STATUS LED on the front panel, as well as via the hardwire interface. The Tolerance level is selectable in the same manner as the Auto-Balance Limit. It must be set **at least** 0.2 microns above the LIMIT setting. Typically it is set at least 1 micron above LIMIT setting.

Auto-Balance CRITICAL

Related to the Auto-Balance Tolerance, is the Auto-Balance Critical setting. This operator defined setting establishes the vibration level, which acts as an indicator of the operational upper safety limit for the system. When reached, this setting will indicate the critical need to perform a re-balance operation. This indication is given both by the **red** color of the SLOT STATUS LED on the front panel, as well as via the hardwire interface. The Critical level is selectable in the same manner as the Tolerance setting. It must be set **at least** 2.0 microns above the TOLERANCE setting.

Vibration Display

The units used by the Control Unit to display machine vibration levels are selectable between metric or English units. Also, the Control Unit can display vibration in terms of velocity or displacement. The factory setting of displacement most directly reflects the movement of the grinding wheel, and therefore impact of vibration on the work piece. Use the VIBRATION UNITS Menu item to select the desired option.

Balance Speed Selection

This Menu setting toggles the Control Unit’s response between three automatic ranges. The purpose of this adjustment is to maximize the speed and accuracy of the SBS Balance System when installed on various sizes and types of grinders.

To determine the correct setting for balance speed, it is necessary to observe the operation of the system on its first few balances. With the system installed on the grinding machine, and the machine running, initiate an Auto-Balance cycle. Check to see that the system makes steady and timely progress to a balance point. Unbalance the system two or three times, using the buttons located on the Manual screen (MAN.). Each time initiate an Auto-Balance and check the results. Then select each of the other speed settings and run two or three more tests. An error message “Error I” displayed during this test indicates that the PULSE setting should be reset to a slower setting” (*see: Displayed Error Messages section*). This quick check will give a clear indication of the proper setting. Your SBS Balance System is now “tuned” to your grinding machine.

Model SB-4400 Control Unit

LIMIT, TOLERANCE, CRITICAL, and BALANCE SPEED operating parameters are settable through the RS-232 port. Other operating parameters can be changed only with the use of the optional Remote Keypad supplied by Schmitt Industries, Inc.

Automatic Balancing

Once all operating parameters are set, the SBS Control Unit can perform automatic balance cycles, which are initiated by pressing the AUTO button, or by a Start Balance command via the hardwire interface. It is important to understand that Auto-Balance is an automatic cycle, which is initiated by the user, which performs according to the operating parameters set, and then ends. **Between balance cycles, the system will report vibration levels, and RPM, but will not self-initiate an Auto-Balance cycle.**

The operator (or machine controller) needs to understand when it is appropriate to initiate an Auto-Balance cycle. Auto-Balance should be performed with the machine running, and coolant flowing. **Auto-Balance should not be performed while the wheel is in contact with the workpiece or dresser.** The process of grinding a part, dressing the wheel, moving the wheelhead, etc. can introduce vibrations into the machine which are unrelated to wheel balance. Attempting to balance during such processes will not work, and will have detrimental effect on the grinding or dressing results. (see: *CNC/ System Timing Diagram*)

Pre-Balancing

Pre-balancing is used to manually position balance weights on the grinder to achieve an initial rough balance level. In some applications (especially with internal balancers), an automatic balancer may not have enough capacity to balance a new wheel with extreme imbalance. In such cases, the SBS Balance system can aid the user in positioning manual balancing weights to quickly compensate for the major portion of the wheel's imbalance. Automatic balancing can then be used to provide fine balance control until the next wheel change.

Begin the pre-balance operation by choosing the "Pre-Balance" option from the MENU. The opening pre-balance screen will be displayed. This screen shows the current pre-balance parameters, and allows the user to:

- EXIT the pre-balance operation.
- SETUP pre-balance operation parameters
- Go to the NEXT step in the pre-balance process.

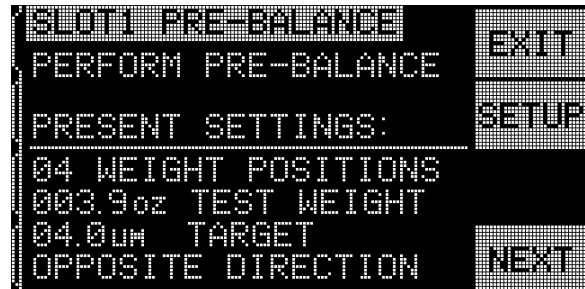


Figure 14

Prepare for Pre-balance

Before pre-balancing, it is important to first minimize the Balancer's effect on machine balance, so that during the pre-balance operation only the new wheel's native imbalance will be correctly analyzed and corrected for. It is suggested that once the old wheel is removed from the machine, and before the new wheel is installed, that the grinder be re-started, and a balance cycle be run. This balance cycle has the purpose of moving the balance weights inside the balancer to a null balance position, essentially 180 degrees opposite one another. Once the cycle is complete, stop the machine and install the new wheel, then proceed with pre-balance. Skipping this step will limit the effective balance range of the system in subsequent auto-balance cycles.

0-BAL (Zero Balance Weights)

This option is only available on special Non-contact Internal Balancers which have the “Zero Weights” option installed. Instead of running a balance cycle prior to installing a new wheel, the user may select this option to automatically move the balance weights inside the Balancer 180 degrees opposite one another, to achieve a null balance effect. When this option is initiated, the first screen displayed looks like figure 16a. The “Stop Spindle” text will flash, and the “START” button will not be displayed until the grinding spindle is stopped. After pressing START, the screen in figure 16b is displayed while the rotors are being positioned. Once complete, the unit will again display the initial Perform Pre-Balance screen.

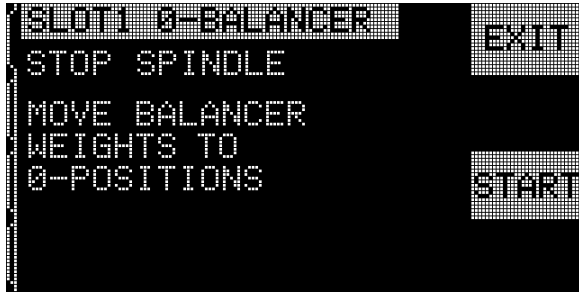


Figure 16a

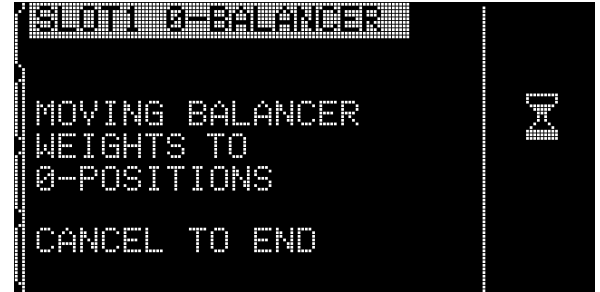


Figure 16b

Setup

After pressing SETUP, the user is presented with a sequential menu of operational parameters or settings. The first selection is BALANCE TYPE, which describes which of the three available methods of pre-balance will be used. Upon entering each screen, the current setting is always highlighted. Use the Arrow buttons to make changes to the settings as needed, and the ENTER button to save each selection made. You can abort the sequence of Menus any time by pressing EXIT or CANCEL.

Balance Type

1. 2 Spread Weights – Supports pre-balance using two (2) equal fixed mass weights, which can be positioned at any specific angle on the wheel holder. An angle scale must be provided for location of the weights relative to some zero point. (0-360 degrees).
2. 3 Spread Weights – Supports pre-balance using three (3) equal fixed mass weights, which can be positioned at any specific angle on the wheel holder. An angle scale must be provided for location of the weights relative to some zero point. (0-360 degrees).
3. Variable Weights Fixed Angles – Supports pre-balance using addition of variable weights at known numbered positions. Following this choice, the user also sets the number of equally spaced locations (e.g. 6 locations spaced at 60°) where weight can be added to the machine. These locations can be drilled and tapped screw locations or similar attachment points. This number of locations can be set from 3 to 99. Each location should be marked with a reference number, starting with zero (e.g. 0-5 for six locations).

Weight Units

The user selects units of weight desired to describe the balance weights to be added. The settings include Grams, Ounces, or None. The NONE setting can be used to describe any fixed arbitrary unit of weight. The user can then manipulate weights based on this new “unit”. Such a unit can be used to indicate the number of any identical objects, such as screws or washers of the same size, or other identical balance weights of unknown mass.

Balance Weights

Enter the number of Weight Units assigned to each balance weight. This can be the measured weight in grams or ounces, or any convenient number of arbitrary units to be assigned to each balance weight.

Target Level

Enter the Vibration Level the user wants to achieve. The user can run iterative pre-balance cycles to achieve lower and lower vibration levels, and may quit the pre-balance process at any vibration level. When this reference Target Level is achieved, the unit will display BELOW TARGET to indicate the pre-balance has been successful.

Scale Direction and Wheel Rotation

Sets the direction of the weight scale on the machine, used to position the balance weights. This is a relative direction **in relation to the rotation direction of the wheel**. The weight scale direction is the direction (clockwise or counterclockwise while facing the scale) in which the angle references (0°, 90°, 180° etc.) or the weight position location numbers (1,2,3,4, etc.) increase. The system must know if this direction is the same or opposite the direction of the wheel's rotation. The system can determine this automatically, but to do so requires one extra trial-run cycle at the beginning of the pre-balance cycle, which may not be desired in situations where this direction relationship remains constant. The following four settings are available.

1. Automatic Always – Every pre-balance operation, the direction will be determined automatically by having the operator run the extra trial-run cycles. This can be useful where the spindle swivels or otherwise changes directions.
2. Automatic Once – On the first pre-balance cycle ran after selecting this option, the system will automatically determine the direction by having the operator run the extra trial-run cycles, but will then store the result, and not run the auto-determination cycle again.
3. Same – This setting allows the operator to manually input the direction as SAME, without running the auto-determination cycle.
4. Opposite – This setting allows the operator to manually input the direction as OPPOSITE, without running the auto-determination cycle.

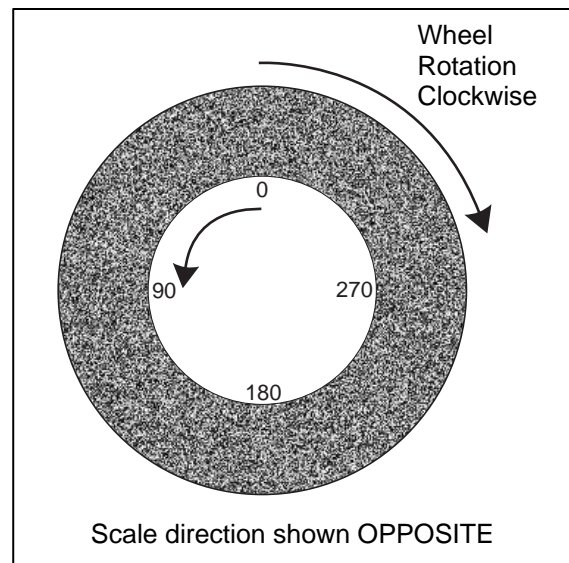
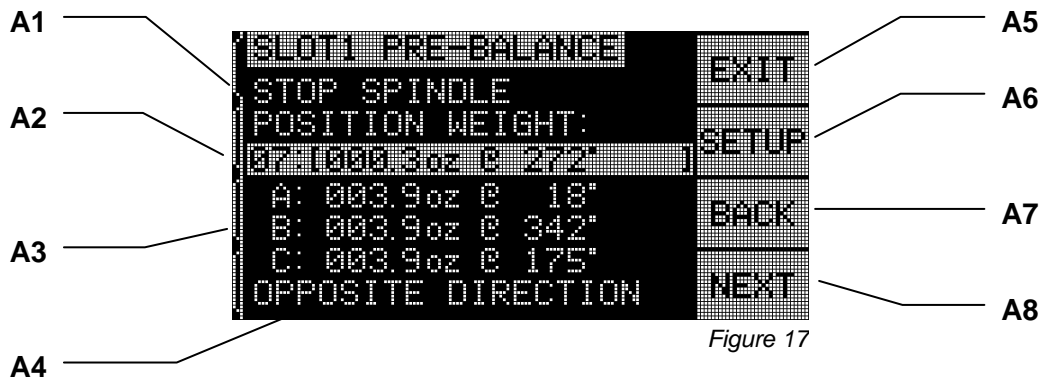


Figure 15

Beginning The Pre-Balance Operation

The user must provide for the following before attempting to pre-balance. The machine must be fitted to allow the user to manually position balancing weights on the machine conveniently, without machine disassembly. This can be accomplished in any of the method described under the Balance Type setting description. Fixed mass weights to be used should be labeled A, B, or C, to identify them individually. On the opening pre-balance screen, press the NEXT button to initiate the pre-balance operation, using the currently selected parameters. The pre-balance operation is an iterative or repetitive process of manually positioning balance weight(s) according to the system's directions, and then checking the vibration level results of each move.

Position Weight Screen



The first screen in this progression, the “Position Weight” screen, will look something like figure 16, with some variation, depending on the type of pre-balance operation being performed. The elements of the screen are described below.

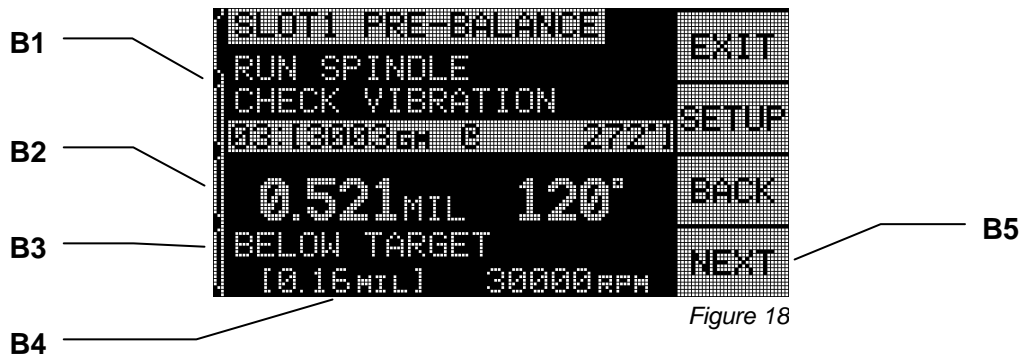
- A1) Instruction Section – This part of the screen tells the user what to do next. The “STOP SPINDLE” text will flash until the unit detects no incoming RPM signal. The NEXT button will also not be available until this condition is met. **The user is instructed to stop the machine spindle, position balance weights as shown in the location detail, then press the NEXT button.**
- A2) Run Identification Bar – The highlighted bar shows the run reference number, followed by a descriptive label for the run. A list of typical labels follows:
 - 01: REMOVE WEIGHTS – On the first run the user must remove all balance weights
 - 02: TRIAL RUN – On the Second run, the user will add a balance weight at the zero position.
 - 03: DIRECTION RUN – This run is optional and only occurs when the control is set to auto-determine the Scale Direction setting.
 - 04: (Balance Vector) – A Balance Run. This and any subsequent cycles are called balance runs, and attempt to balance the machine. Each of the balance runs will be identified by its balance vector (see screen example). This vector always shows the calculated additional amount and location of weight needed to achieve balance, assuming any installed weights on the machine were left as is. The user can choose to place a single weight of this mass at this location, to achieve balance if this method is desired.
- A3) Location Detail – For two or three spread weight balancing, this area will look like the screen above, with each weight (A, B, etc.) listed, along with the mass of the weight expected, and the location each weight should be positioned at. For any balance runs beyond the initial one, a plus (+) or minus (-) will indicate relative angle movements from the current position.

For variable weight fixed angle balancing, a list will be shown of the amount of weight to be added at specific location numbers. Angles are also referenced for each location number. For any balance runs beyond the initial one, a plus (+) or minus (-) will indicate relative changes in weight placement from the current positions.
- A4) Direction Setting – This area will show the current Scale direction setting, or “AUTOMATIC DIRECTION” if the unit is in the process of automatically determining the direction.
- A5) EXIT – will always exit the pre-balance process, back to the Main Menu. The CANCEL button will accomplish the same.

- A6) SETUP – Pressing setup from one of these screens allows the user to change balance settings mid-course, and then continue from that point forward with the pre-balance process.
- A7) BACK – Pressing this button will display a history screen, which allows the user to use arrow buttons to scroll back through each of the balance runs conducted, and even allows the user to choose one of these earlier reference points as their current start point to continue the pre-balance process from. This allows the User to “go back” to an earlier point in the pre-balance process, if desired, without having to start from the beginning again. All references to weight amount and location shown are absolute references, in this mode.
- A8) NEXT – This button will only be available when the spindle has stopped. Pressing this button will display the Check Vibration screen, so the unit may determine the balance level achieved.

Check Vibration Screen

Figure 18 shows the elements of the second pre-balance screen, the “Check Vibration” screen. This screen will be displayed after each Position Weight screen, and has the purpose of showing the balance or vibration level which has resulted from the prior placement of weights. Many of the screen elements are the same as on the Position Weight screen, with the critical differences described below.



- B1) Instruction Section – This part of the screen tells the user what to do next. The “RUN SPINDLE” text will flash until the unit detects a stable incoming RPM signal. The NEXT button will also not be available until this condition is met. **The user is instructed to start the machine spindle, check the vibration level to determine if the balance level is adequate, then press the NEXT button to continue with the next step in the process.**
- B2) Below the run identification bar, the screen now shows the measured vibration level, in the units selected by the user. To the right of the vibration level, the measured phase angle is also displayed to interested users.
- B3) BELOW TARGET – This text is displayed whenever the measured vibration level is at or below the Pre-Balance Target Level set by the user in the Setup section. Once this Level is reached, the pre-balance is considered complete by the system, so the NEXT button will no longer be available.
- B4) Reference – The bottom line of the screen displays the current Target Level set, and to the right of the Target level, the current measured RPM level.
- B5) NEXT – This button will only be available when the spindle is running, and the Target level has not been achieved. Pressing this button will display the next Position Weight screen, so the user may make further weight adjustments.

Manual Balancing

The SBS Balance System is fully automatic, but also provides the capability for manual operation. The ability to move the weighted balance masses in the Balancer by hand can be utilized in various situations. Purposefully unbalancing the system to a given vibration level can be useful for performing diagnostic tests of the grinding machine. Occasionally operator preference may dictate that the balancing procedure be performed manually.

Manual Balance buttons are accessed by pressing the MAN. button. A manual RPM can be specified when no RPM signal is being received from the balancer, by using the arrow buttons to set the level and pressing the ENTER button. The buttons are divided into two groups, each controlling one of the two masses in the balancer (M1 and M2). Each mass can be moved in either the forward or backward direction, with reference to the rotation of the grinding wheel. **Only one button may be operated at a time.** To manually balance, the operator must move the two masses in the direction which reduces the vibration reading on the Vibration Display. This should be accomplished in three stages.

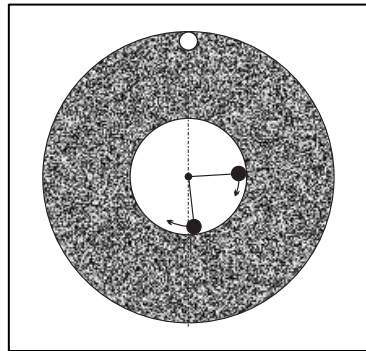


Figure 19a

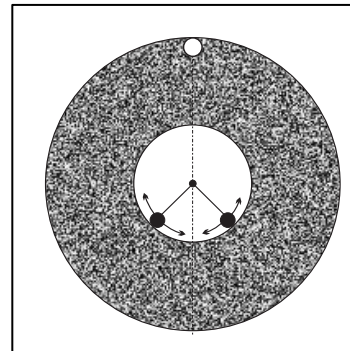


Figure 19b

First move each of the two masses equally in the same direction, either forward or backward. If moving them forward increases the vibration, then choose the opposite direction. Continue this way until the vibration level can no longer be reduced. This movement has the purpose of positioning the two masses equally about the line through the center of the wheel and the center of the imbalance (*figure 19a*).

The next stage is to find the correct angle for position of the masses in relation to the “center line” (*figure 19b*). Do this by moving the masses equally in different directions (one forward and one backward). Again, if the vibration level is increased, the opposite movement should be tried. This stage is complete when the vibration level can no longer be reduced. Finally the balance level can be fine-tuned by moving the masses individually in small increments, in order to minimize the vibration reading.

It should be realized that any change in vibration level of the machine would lag behind the movements of the masses by one or two seconds. This is due to a “settling effect” of the machine. For this reason, when the correct direction of movement is not yet clear, or the vibration level itself is small (2.0 microns or less), any movement of the masses should be performed in small increments, with a delay of two seconds between movements to evaluate the movement’s effect.

Manual RPM Filter

The system has application as a vibration measurement and analysis tool, aside from its purpose as a dynamic balancing system. To facilitate this function, the Control Unit has the capability of manual adjustment of the vibration frequency filter. Any filter RPM from 300 to 30,000, incremented in units of one

RPM, can be manually implemented. This function allows the Control Unit to operate independently of the Balancer, and to measure vibration levels occurring at different frequencies.

To set the Manual Filter, the 12-pin Balancer Cable can be detached from the Control Unit to eliminate an incoming RPM signal. The MAN. Button on the balancer Main Screen should be pressed to enter manual mode. Set the desired RPM frequency for the manual filter, using the left arrow button to select digits, and the up and down arrow buttons to change the selected digit. Press ENTER to view the vibration level at this selected RPM. If desired, the Manual Filter level can be adjusted again to display the vibration levels at another frequency. In this way many different frequencies of vibration can be analyzed. A complete analysis of all frequencies from 300 to 30,000 RPM is also available using the RS-232 Interface port (see: command "G" under RS-232 Interface section).

Plotting Vibration

This function will perform an automated vibration sweep of a specified RPM (frequency) range, and display the results as a graph on screen. This function can be very useful in diagnosing machine condition induced vibration or discovering environmental problems, which may have adverse effects on the grinding process. The RPM range to be evaluated will vary by machine and process. On constant surface speed machines, the minimum and maximum RPM should be determined. The suggested range to evaluate is from 0.4 x (minimum RPM) up to 2.0 x (maximum RPM). This range is important because it includes all the likely frequencies, which will have harmonic influence on the operating RPM range.

RPM RANGE – After selecting the PLOT VIBRATION menu item, the first screen displayed allows the user to press this button to select the RPM range. The RPM Range is the frequency range that will be evaluated during the spectrum sweep for vibration amplitudes. Once this selection is made, use the arrow buttons to first set the low end of the RPM range, press ENTER to store the value, and then select the high end of the range in the same manner. When setting the RPM range, use the up and down arrow buttons to increase or decrease values, and the left arrow button to move the cursor to the desired digit. While the RPM RANGE screens are shown, the number preceded by T= indicates the amount of time in seconds estimated to perform the sweep, given the current RPM settings.

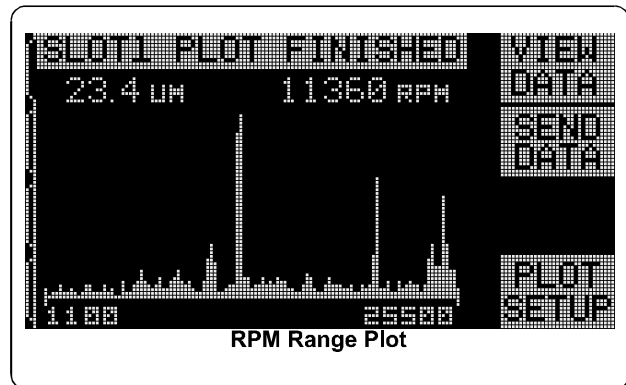


Figure 20

START – This button begins a vibration sweep for the selected RPM Range. The rotating hour glass figure on the right hand side of the display signifies that the Control is sweeping through the RPM range and recording the maximum value in each monitored RPM range. During this process, all recorded RPM, Vibration level pairs are sent out the serial RS-232 port, in ASCII format..

When the RPM sweep is complete, the display will change to the screen shown (figure 20). The area necessary to display the incremented RPM range is dependent on the RPM range selected, divided by the

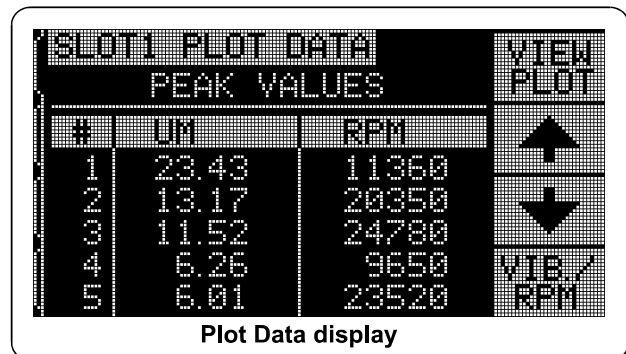


Figure 21

number of available pixels across the horizontal axis. The vertical scale is based on the peak value, displayed at the top of the plot. The vertical scale is logarithmic.

- 1) **VIEW DATA.** Pressing this button will change the display to a listing of peak vibration values (*figure 21*). These are the top 20, or less, values recorded in the selected range. The VIB./RPM button on this screen switches the order of these values, allowing them to be ordered either by vibration level or RPM. The arrow buttons are used to scroll up or down through the peak values. The VIEW PLOT button returns to the screen showing the last recorded graph.
- 2) **SEND DATA.** Pressing this button will export the vibration peak values, and corresponding RPM levels out the serial RS-232 port, in ASCII format. This information can then be captured and used as needed by the user.
- 3) **PLOT SETUP.** This button returns the user to the setup screen for performing a vibration plot, where alternate RPM settings can be input for plotting, or the plot process can be exited, by pressing the EXIT button.

Machine Control Hardware Interface

There are two different options available for interfacing the SBS Balance System Card with a CNC or PLC machine controller. Either a hardware interface or software interface is supported. The hardware interface is supported via a standard DB-25 connector located on the rear panel of the Balancer Card, while the Software interface is supported via the DB-9 connector located on the rear panel of the SBS Control Unit's Main Card, which is common to the whole control unit. Because of the many possible variations and configurations of cabling required for such an interface, it is left to the operator to supply the necessary cable. **When designing an interface for the SBS System, it is important to understand that it is intended that the grinding machine's controller operate the SBS System.** It is not possible, or advisable, for the SBS System to control the grinding machine. The following interface is provided as a means to connecting with the SBS control, using information provided by the system, to maintain the desired balance parameters. The whole of this manual should be read before attempting to interface the SBS System with any machine controller. Sections covering the interface of other SBS products installable in the SBS Control, are covered separately in the manual addendum for such products.

Hardware Control Interface Overview

The hardware interface consists of three sections: interface power supply, the inputs, and the outputs.

The interface power supply is provided exclusively for use with the inputs of the hardware interface. It consists of three common pins and an output pin. The common pins are internally connected to chassis and earth ground, while the output is intended to provide a maximum of 30 mA at approximately +15VDC. Any external power used for interface I/O must be from a SELV source or supply.

The three inputs provide optical isolation between input signals and the rest of the Control circuitry. The inputs are activated by being pulled high, either by connection to the SB-4500/4400 hardware interface power supply output or by connection to a customer supplied signal. Activating the inputs requires at least 8 mA at a voltage between 10 and 26 volts, AC or +DC, referenced to the SB-4500/4400 hardware interface power supply common. The common pins are internally connected to chassis and earth ground. The inputs are deactivated by removing the connection to the power or signal source.

The four primary outputs consist of optically isolated, solid state, single-pole/double-throw relays. These relays may be used to supply an output signal by connection to a voltage source supplied by the customer. The relay contacts are electrically isolated from all other circuits and are rated for 24 Volts DC or AC, 50 mA maximum. Inductive loads must be protected against flyback.

The three contacts of a single-pole/double-throw relay are often referred to as “normally open”, “normally closed” and “common”. The term “common” in this sense does not imply connection to power supply commons. The term “return” will be used below to indicate the common contact of the relay.

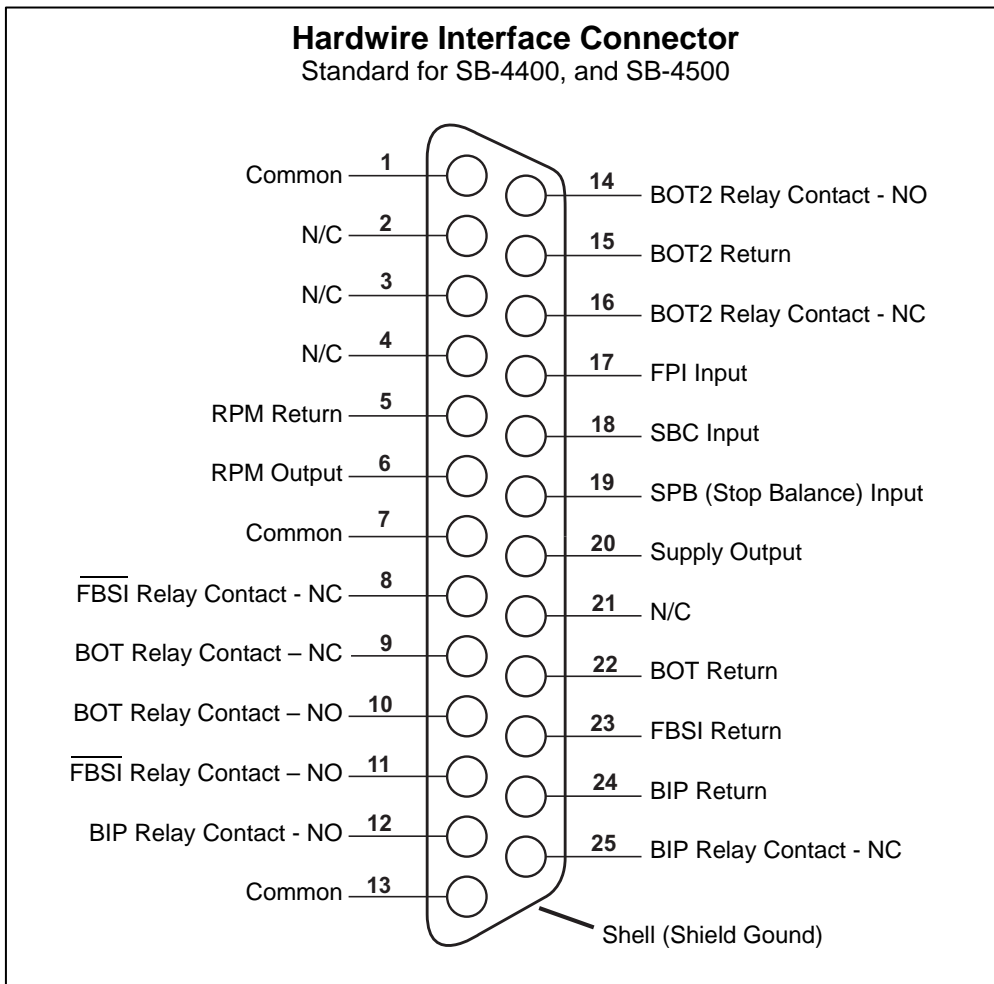


Figure 22

Input Pin Names and Functions

<u>Pin#</u>	<u>Name</u>	<u>Description</u>
-------------	-------------	--------------------

- | | | |
|-----------|------------|--|
| 18 | SBC | Start Balance Command- This input is momentarily activated to initiate an automatic balance operation. The rising edge of this signal starts the operation. |
| 19 | SPB | Stop Balance Command- While active, this input stops an automatic balance operation in progress and inhibits the start of an automatic balance operation. |
| 17 | FPI | Front Panel Inhibit- While this input is active, most operator actions at the front panel keypad are disallowed. Specifically, the Menu button, the Manual button, and the Auto Button are disabled. Still enabled are the Power button and the Cancel button, which can be used to stop an automatic balance operation. |

Output Pin Names and Functions

<u>Pin#</u>	<u>Name</u>	<u>Description</u>
22	BOT-R,	Balance Out of Tolerance: Return, Normally Open, and Normally Closed contacts.
10	BOT-NO	This relay is energized when the sensed vibration level exceeds the operator defined
9	BOT-NC	Tolerance. Function of this relay during an automatic balance cycle is determined by the CNC BOT MODE setting.
15	BOT2-R	Balance Out of Tolerance Two: Return, Normally Open, and Normally Closed
14	BOT2-NO	contacts. This relay is energized when the sensed vibration level exceeds the operator
16	BOT2-NC	defined Critical Tolerance, or when the spindle RPM exceeds the operator defined Critical RPM. Function of this relay during an automatic balance cycle is determined by the CNC BOT MODE setting.
24	BIPR	Balance In Progress: Return, Normally Open, and Normally Closed contacts. This
12	BIP-NO	relay is energized while an automatic balance operation is in progress.
25	BIP-NC	
23	/FBSI-R	Failed Balance/ System Inoperative: Return, Normally Open, and Normally Closed
11	/FBSI-NO	contacts. This relay is energized after a successful Power On Self Test. It is de-
8	/FBSI-NC	energized if a fault condition arises.
6	RPM	This relay closes once per revolution. This is a buffered output of the RPM signal
5	RPM-R	generated by the balancer. It is not available if the RPM has been entered manually.

Software (RS-232) Interface

The SBS Balance System provides an alternate interface using the RS-232 signal lines on the DB-9 connector. The RS-232 interface allows the same control capability as the hardware interface with the additional capability of monitoring the system status, setting of the Auto-Balance Limit, and performing a vibration spectrum analysis. The following description applies to all models of SBS Control Units. The interface is identical for the SB-4500 and SB-4400 units.

Interfacing

The RS-232 interface is a subset of the complete RS-232 specification, and uses only three wires for communication. When connecting to this interface, some systems will require additional jumper wires on the control unit end of the cable for successful operation with this three-wire interface. The following pins on the DB-25 connector are used for the RS-232 interface.

<u>Pin #</u>	<u>Pin Name</u>	<u>Description</u>
5	COM	Signal/Common
2	TXD	Transmitted Data RS-232-C
3	RXD	Received Data RS-232-C

Setting Baud Rate

The baud rate of the RS-232 interface is set at unit power-up, by selecting the **SETUP** option. The factory setting for baud rate is 9600 baud, which should be adequate for most applications. To change the baud rate, turn the Control on by pressing the button marked **ON/OFF** in the upper right corner of the membrane keypad, and immediately after the unit is powered up, press the **SETUP** button. When the language setting screen appears press the **ENTER** button again to change to the Baud Rate screen. To select the Baud rate, use the up and down arrow buttons, to select from the displayed list. Once the correct baud rate is highlighted press the **ENTER** button, to choose the new setting. The baud rate can be set from 300 to 19200 baud. Use of the optional Remote Keypad is necessary to change the baud setting for a SB-4400 Control Unit.

RS-232 Commands and Responses

When the Control unit is first powered up, the following messages are transmitted out the RS232 Port. The first two lines are from the System Control, the first is identifying text and the second is the firmware version. The remaining lines identify the functions plugged into the Slot Card positions and the firmware revision associated with each. The last five messages may be transmitted in any order:

```
/SB-4500, Copyright (c) 1998, Schmitt Industries, Inc.<CR>  
V0.02<CR>  
2X1.00V0.09[GR1]/Standard Balancer<CR>  
1X0/No Card<CR>  
3X0/No Card<CR>  
4X0/No Card<CR>
```

Commands - A message preceded with the digit '1' through '4' will be a command or response referring to Slot Cards 1 through 4, respectively. A message starting with any other character refers to the System Control.

The following commands from the RS232 Port are available:

Control Unit Commands		
Command	Response	Meaning/ Example:
C		Control Panel Status Inquiry. <Esc>C<CR>
	CI	Control Panel is Inhibited CI<CR>
	CE	Control Panel is Enabled CE<CR>
	CX	Control Panel is not installed CX<CR>
CE		Control Panel Enable. <Esc>CE<CR>
	K	Command Acknowledged K<CR>

	CX	Control Panel is not installed CX<CR>
CI		Control Panel Inhibit. <Esc>CI<CR>
	K	Command Acknowledged K<CR>
	Q	Command Not Accepted (Panel in use?) Q<CR>
	CX	Control Panel is not installed
V		Version Request (main board firmware). <Esc>V<CR>
	Vn.nn	Firmware Version V1.00<CR>

Balancer Card Commands (Cards are Individually Controlled)		
Command	Response	Meaning/ Example:
X		Type (of slot card) Request. < Esc >1X<CR> Start Slot 1 Info Request.
	Xz.xxVv.vv [sss]/text	Slot info response. z indicates Slot Card type: 1 is Mechanical Balancer; 2 is Hydro Balancer. 4 is EM Ring Balancer. xx is specific hardware or balancer category. v.vv is balancer firmware revision. sss is the user specified name for this card. The slash delineates a text comment that briefly explains the card type. 1X1.00V1.00[GR1]/Std Balancer<CR>
	X0/No Card	No card is installed in the slot. 1X0/No Card<CR>
	XX/Not Responding	A card is installed in the slot, but is not responding to the system. 1XX/Not Responding<CR>
BA		Balancer Abort Command. <Esc>2BA<CR> Abort Slot 2 Balance Cycle.
	BT	Balance cycle terminated (if running) 2BT<CR>
BS		Balance Start Command. This command will start the auto balance cycle if the system resources can be acquired. Once it starts, the front panel Cancel button will stop the cycle. <Esc>1BS<CR> Start Slot 1 Balance Cycle.
	BS	Balance Cycle started 1BS<CR>
	BT	Balance Cycle terminated 1BT<CR>
G[sss][,][eee]		Graph Vibration Spectrum. This takes vibration readings as a function of the rpm of the vibration. Optionally specify sss as starting rpm and eee as ending rpm. <Esc>1G500,2000<CR> Start Slot 1 Vibration Spectrum Program. Scan from 500 to 2000 RPM.
	U=units	Spectrum program started (units given) 1U=UM<CR>
	Grrr,vv.vvv	Graphic Vibration Point. One line is generated for each RPM measured. rrr is the current rpm. vv.vvv is the measured vibration at the specified RPM. 1G500,0.04<CR> 1G550,0.05<CR>

Balancer Card Commands (Cards are Individually Controlled)		
Command	Response	Meaning/ Example:
	GE	Graphic Spectrum End. The graphics vibration spectrum routine is finished. 1GE<CR>
GX		Cancel Vibration Spectrum. <Esc>1GX<CR> Stop Slot 1 Vibration Spectrum Program.
	GE	Graphic Spectrum End
L[x.xx[, [y.yy][, [z.zz]]]]		Limits Command. x.xx is Limit, y.yy is Tolerance, z.zz is Critical Vibration level, all in microns. If x.xx is not present then the Limit level will not be changed. If y.yy is not present then the Tolerance level will not be changed. If z.zz is not present then the Critical Vibration level will not be changed. <Esc>1L<CR> Get Slot 1 Balance Limits.
	Lx.xx,y.yy, z.zz	Balance limit response (new values). x.xx is Limit, y.yy is Tolerance, z.zz is Critical Vibration level, all in microns. 1L0.40,1.20,20.00<CR> <Esc>1L0.08,,15<CR> Set Slot 1 Limit to .08, Critical level to 15.00, don't change Tolerance. 1L0.08,1.20,15.00<CR>
P[1 2 3]		Balance Speed setting. 1 sets cautious balance. 2 sets aggressive balance. 3 sets normal balance. <Esc>1P<CR> Get Slot 1 Balance Speed setting.
	P1	Current Balance Speed setting is cautious. 1P1<CR> <Esc>1P2<CR> Set Slot 1 Balance Speed setting aggressive. 1P2<CR>
R[rrr]		Set critical RPM level. rrr is new Critical RPM level 300 to 30000. Use 0 (zero) for rrr to turn Critical RPM Off. <Esc>1R3500<CR> Set Slot 1 Critical RPM to 3500 RPM. <Esc>1R0<CR> Turn Slot 1 Critical RPM check Off. <Esc>1R<CR> Get Slot 1 Critical RPM
	Rrrr	1R3500<CR> Slot 1 Critical RPM is 3500 RPM.
S[C]		Status Request command. If 'C' present then previously reported errors condition will be cleared before the status is reported. <Esc>1S<CR> Report Slot 1 Status.
	S rrr,v.vv, [FBSI,] [BIP,][FPI,] ERR=eee	Status response. rrr is RPM, v.vv is vibration level in microns, FBSI indicates balance failed/system inoperative, BIP indicates balance in progress, FPI indicates front panel is inhibited. eee represent individual error letters representing error conditions. If the first letter is '@' then an error condition requires clearing (use SC command or press clear on front panel). 1S 1590,0.23,ERR=@GI<CR> <Esc>1SC<CR> Report Slot 1 Status. 1S 1590,0.24,ERR=G<CR>

RS-232 Operation Summary

The RS-232 capability of the SBS Balance System, when used in conjunction with a capable host computer can provide a completely automated testing and balancing capability for a grinding machine. If the vibration spectrum is recorded at a point in time (perhaps when the machine is new), that record can then become a reference for gauging bearing condition, spindle balance, and overall machine condition. The RPM and vibration level readouts from the status line can be used to provide a remote indication of the machine operating speed, and characteristics. On some machines this data may be interpreted to indicate when a grinding wheel needs to be changed or other maintenance performed.

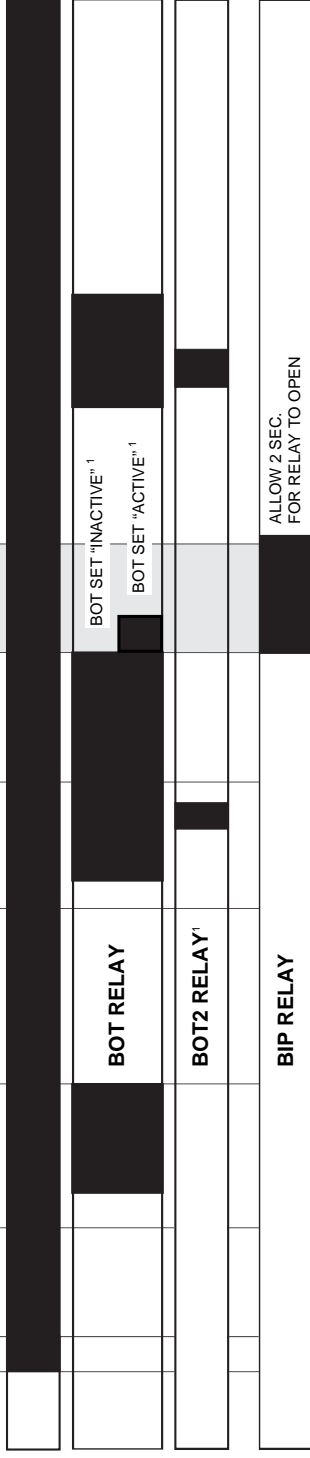
CNC/ System Timing Diagram

¹ (ALLOW 5MS FOR RELAY TO OPEN)
 BOT /BOT2 RELAYS BEHAVIOR DURING BALANCE CYCLE ARE BOTH SET BY CNC BOT MODE MENU SELECTION.
 INACTIVE SETTING - RELAY OPENS WHEN BALANCE CYCLE STARTS (SB-2500).
 ACTIVE SETTING - RELAY OPENS AFTER VIBRATION LEVEL IS BELOW SET LIMIT (HK-5000).

☐ = RELAY OPEN
 ■ = RELAY CLOSED

START BALANCE COMMAND ISSUED
 WHEEL BALANCED
 BALANCE CYCLE IN PROGRESS

POWER UP GRINDER ON
 VIBRATION EXCEEDS TOLERANCE GRINDING OR DRESSING CYCLE
 BETWEEN GRINDING CYCLES
 GRINDING OR DRESSING CYCLE
 BETWEEN GRINDING CYCLES
 BETWEEN GRINDING CYCLES



ALLOW 2 SEC. FOR RELAY TO OPEN

SBC SIGNAL
 SBC ALTERNATE

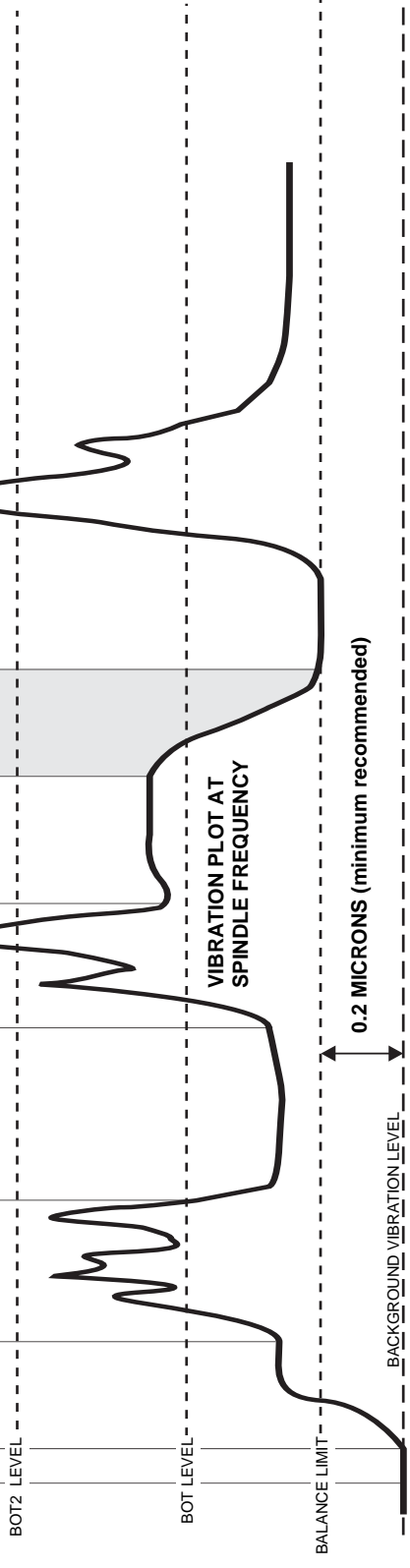


Figure 23

System Maintenance

Collector Maintenance

Operator maintenance of the SBS Balance System consists of replacement of the line fuse in the Control Unit, and replacement of Balancer slip ring assembly as necessary. Instructions are available with the replacement parts below. Cable schematics for the Balancer Cable and Sensor Cable follow (*see: figure 25 and 26*), in order to assist with minor repair or wiring connection work. If further service is required, contact your SBS Balance System source, or Schmitt Industries Inc.

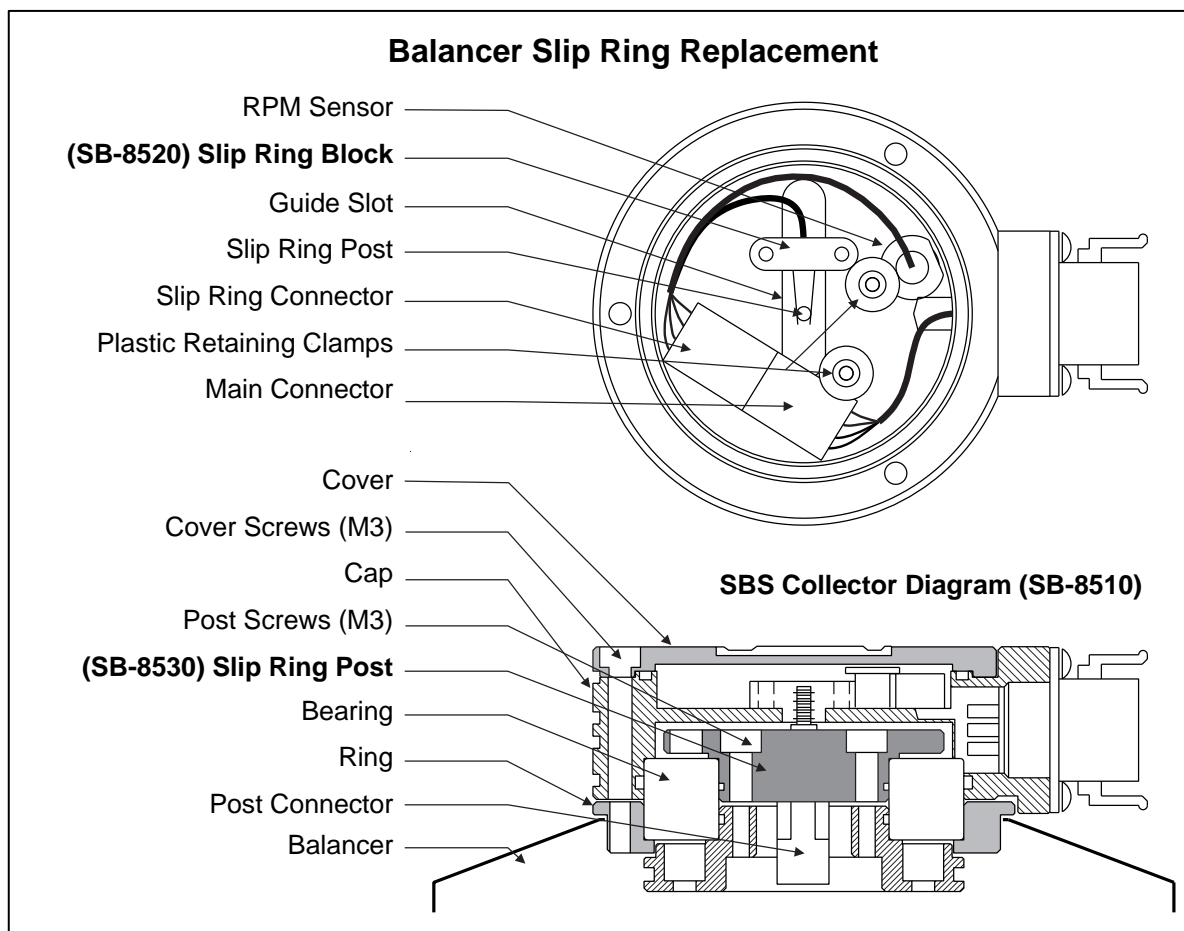


Figure 24

An optional non-contact version of the SBS collector is shipped with some balancers. This version is recognizable in that the collector with cable attachment point is a separate part from the balancer, and is mounted independently on the grinder. The non-contact version contains no serviceable parts.

SBS Return/Repair Policy

Schmitt Industries' policy is to give highest priority to the service needs of our customers. We recognize the cost of machine downtime, and strive to deliver same day repair of items arriving at our facility, whenever possible. Because of the complication and delays involved with international shipments, customers outside the continental U.S. should contact their local SBS source for service support. Before return of any equipment for repair, it is necessary for you to contact Schmitt Industries, Inc. for a Return Materials Authorization (RMA) number. Without this tracking number, Schmitt Industries can not ensure prompt and accurate completion of your repair needs. Failure to obtain an RMA number may result in substantial delay.

Balancer Cable Schematic

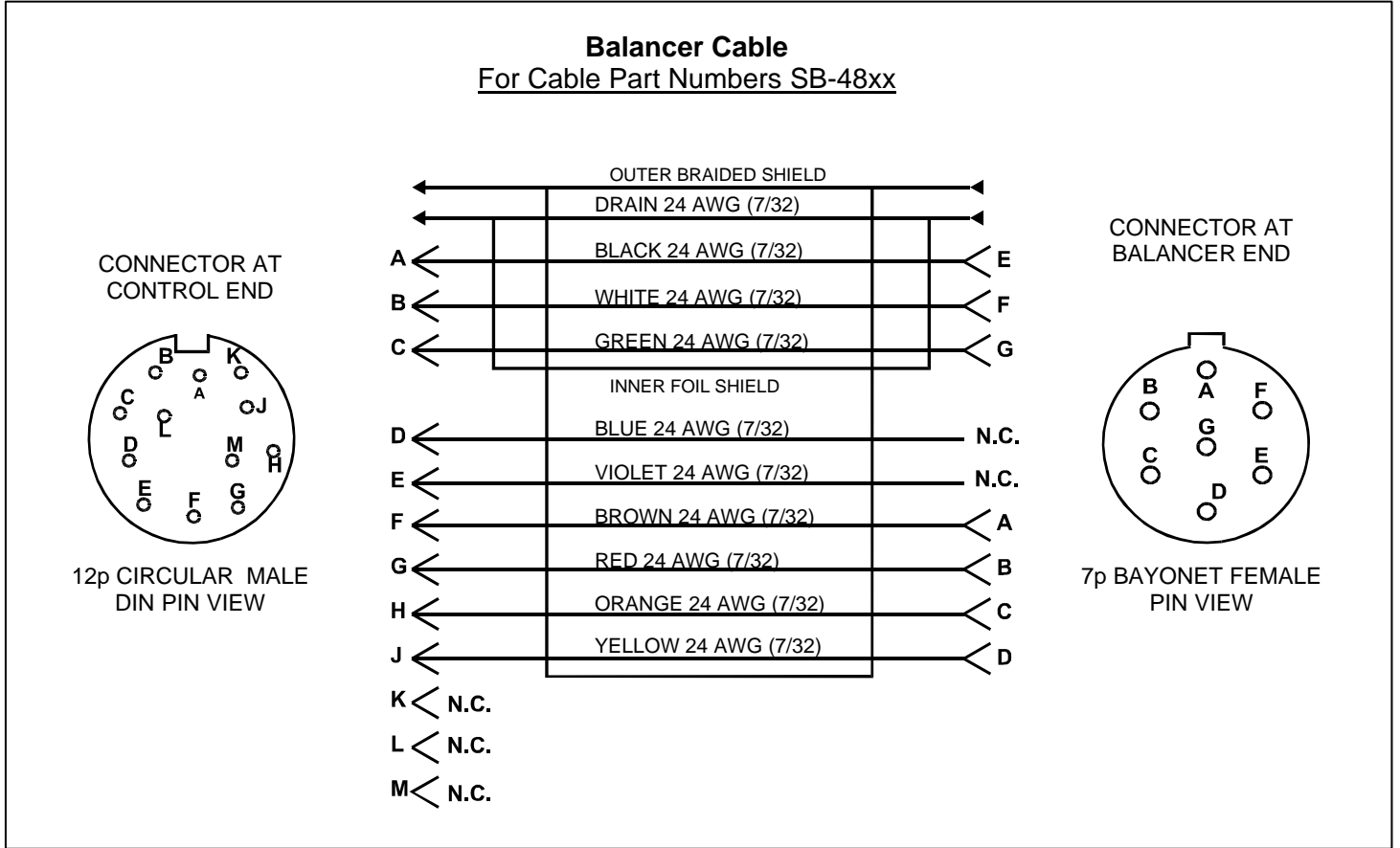


Figure 25

Sensor Cable Schematic

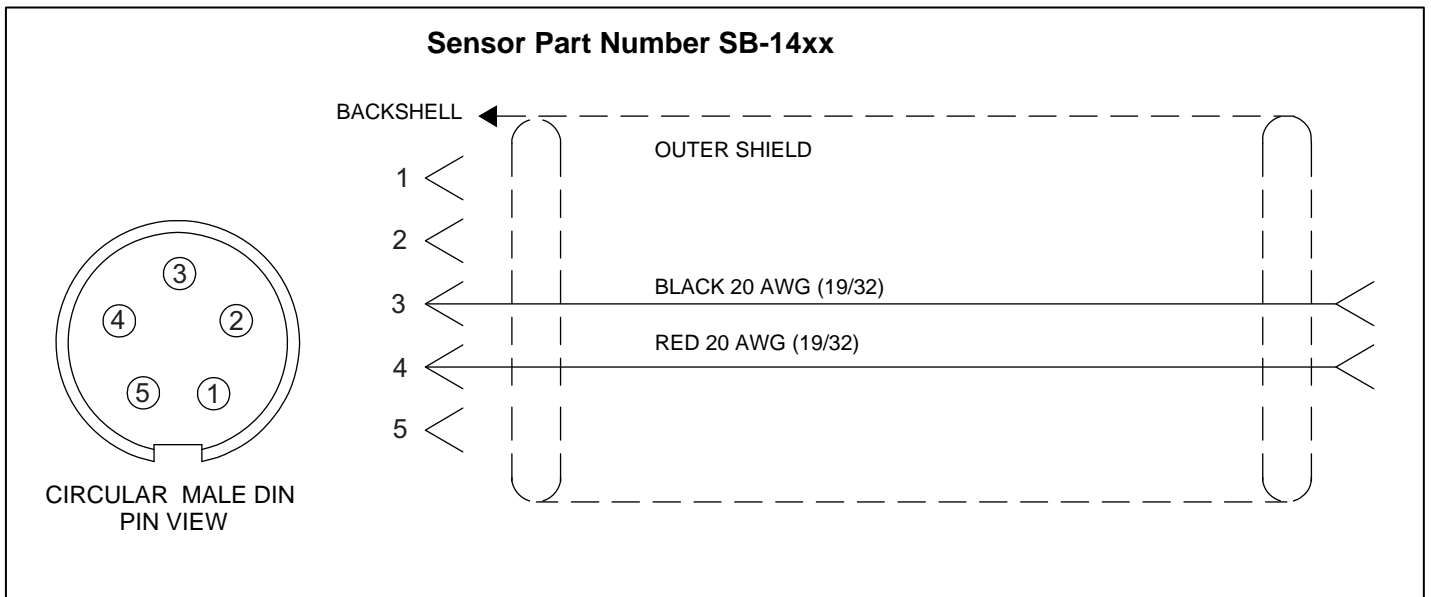


Figure 26

Trouble Shooting Guide

If you experience trouble with the operation of the SBS Balance System, the following guide is designed to help in determining the source of the problem.

Step 1 If the balance Control Unit is displaying any error messages, refer to the Displayed Error Messages section of this manual for explanation of the message(s) displayed. Contact Schmitt Industries for assistance as required.

Step 2 If you are experiencing problems, with no displayed error messages, then check the Vibration Sensor, and verify that the Sensor is firmly seated on the machine, its magnet firmly tightened in place, and it is properly connected to the Control Unit. Also check that the Sensor's position on the grinding machine accurately reflects machine balance (*see: Vibration Sensor Location section*).

As a final check, set the RPM manually on the Control Unit to the operating speed of the grinder, and verify that there is an incoming vibration signal. If you receive a zero reading from the Sensor during this test, the Vibration Sensor and Control Unit should be returned for repair. Contact Schmitt Industries for a return materials authorization (RMA) number.

Step 3 Once the Vibration Sensor's function is verified, the next step is to perform an integrity check of the rest of the system. This test should be performed with the machine running, but not in a grinding or dressing cycle. Press the MAN. button to enter the manual control mode, and simply press each of the four manual buttons, one at a time, for a period of about 5 seconds. With each movement of the Balancer weights, the system should register a change in the displayed vibration level on the Control Unit. If this does not happen for any of the four buttons, there is a service problem with the system. The Balancer, Control Unit, Vibration Sensor, and Balancer Cable should all be returned as a unit. Contact Schmitt Industries for a return materials authorization (RMA) number.

Step 4 If the integrity check shows no service problem with the SBS System, then the final area to investigate is environmental/application issues. The background vibration level on the machine should be monitored under operation, and the Balance Limit setting checked against this level. (*see: Environmental Considerations section*) (*see: Setting Operating Parameters section*) Also, the sizing of the Balancer to the application should be checked. (*see: Verifying Balancer Sizing section*)

If you continue to have problems after following these four steps, contact Schmitt Industries, or your SBS Balance System source for assistance.

Display Test Option

During control power-up, while the company logo screen is displayed, a functional test of the display can be initiated by pressing one of the function buttons above the SETUP button followed by the SETUP button. The screen will display a DISPLAY TEST message and list buttons for TEST, START, and SETUP. Pressing TEST will reverse the light and dark text areas. Pressing TEST again will display a full screen with all pixels lit. Pressing again will turn all screen pixels off. Pressing again returns the screen to DISPLAY TEST. Also displayed are the revision reference numbers for the system main board and display board. The LED status indicators on the left side of the display will sequence through the three colors to check operation. Press the START button to bypass SETUP and resume normal operation. Press the SETUP button to continue to system setup.

Displayed Error Messages

New self-diagnostic software has been incorporated into all SBS Balance Control Units. If a problem ever occurs with an SBS system, It is quickly reported on the front panel display in the form of an error code. Below is a listing of these codes, a description of when the Control Unit automatically runs each test, how each code is cleared, the definition of each error message, as well as the prescribed action to be taken by the user of the system. To further isolate defective components a series of test operations accompany some of the error codes.

A— Checked continuously

message: **RPM OUT OF RANGE**
OPERATION RANGE IS
300-30000
CHECK RPM SENSOR

Clears automatically.

definition: Displayed if the RPM signal coming from the Balancer is below 300 RPM or exceeds 30,000 RPM and the RPM number cannot be displayed.

action: Verify operating speed of the grinding machine. If the machine is running above 30,000 RPM, contact your SBS Balance System source for application consultation. If the machine is running within the operating speed limits, and this error message persists, this indicates a failure of the RPM sensor in the Balancer. The Balancer should be returned for service.

B— Checked Continuously

message: **VIB SENSOR DEFECT**
SHORT – CHECK CABLE
AND CONNECTORS -
SEE MANUAL

Clears automatically.

definition: Vibration Sensor presence not detected. This could be caused by a defective sensor or by no sensor being connected.

action: Check sensor connections and try Power-On again. Continued error messages indicate the need for repairs to the Sensor.

C— Checked Continuously

message: **VIB SENSOR DEFECT**
SHORT – CHECK CABLE
AND CONNECTORS –
SEE MANUAL

Clears automatically.

definition: Vibration sensor short circuit detected.

action: Disconnect the balancer from AC power before checking cables and connectors, and sensor for shorts. If the problem can not be isolated, the sensor, cable, and/or Control Unit should be returned for repair.

D— Checked at the end of a motor pulse.....

message: **MOTOR DRIVER FAULT**
SHORT – CHECK CABLE
AND CONNECTORS –
SEE MANUAL

Cleared manually.

definition: Motor – short circuit detected.

action: Determine which is the defective component by swapping with another system, or by using the following diagnostic test. Return defective component for repairs. If in doubt, return all items.

test: Shut off the grinding spindle, and disconnect the Balancer Cable from the Balancer, but not from the Control Unit. Press MAN. Button on control to enter manual control mode. Press and hold down the first of the four manual motor buttons for 15 seconds. Repeat with each of the manual motor buttons (only one button can be actuated at a time).

If error E is displayed, clear this error, as it is expected. If no other error occurs during this test, then the problem is with the Balancer. If error D or F is displayed, then continue on and perform part two of this test.

Disconnect the cable from the Control Unit, and repeat the above test, using all four manual motor buttons. If error E is displayed, clear this error, as it is expected. If no other error occurs during this test, then the problem is with the Balancer Cable. If error D or F is displayed, the problem is with the Control Unit.

E— Checked at the end of a motor pulse.....

message: **MOTOR DRIVER FAULT**
OPEN – CHECK CABLE
AND CONNECTORS –
SEE MANUAL

Cleared manually.

definition: Motor – open circuit detected.

action: Determine which is the defective component by swapping with another system. Return defective component for repairs. If in doubt, return all items.

F— Checked at the end of a motor pulse.....

message: **MOTOR DRIVER FAULT**
EXCESS CURRENT -
PERFORM MANUAL
FUNCTION TEST

Cleared manually.

Cleared by pressing Auto button.

definition: Motor – excessive current detected (short or stall).

action: Verify that both ends of the Balancer Cable are properly attached. If connector pins are contaminated, clean with electrical contact cleaner. If problem persists, determine if the Balancer Cable is the defective component by swapping with another system, or by using a voltmeter, and the enclosed Balancer Cable Schematic. Return the defective cable or Balancer for repairs. If in doubt, return both items.

G— Checked continuously

message: **AUX POWER DEFECT**
SHORT – CHECK CABLE
AND CONNECTORS -
SEE MANUAL

Clears automatically.

definition: 24V Auxiliary Supply low – fuse open.

action: Determine which is the defective component by swapping with another system, or by using the following diagnostic test. Return defective component for repairs. If in doubt, return all items.

test: Check for shorts in cables and connectors and re-initiate system check. If the error persists return Control Unit and cables for repair.

H— Checked Continuously

message: **RPM/CNC POWER DEFECT**
SHORT – CHECK CABLE
AND CONNECTORS -
SEE MANUAL

Clears automatically.

Cleared by pressing Auto button.

definition: 15V Auxiliary supply low – fuse open.

action: Check for shorts in Balancer and machine controller interface cables and connectors and re-initiate system check. If the error persists return Control Unit and cables for repair. If you have the SBS system cabled to your machine controller, verify that the interface cable is free of electrical shorts. The interface cable is not supplied with the SBS system, and repair is the responsibility of the user.

I— Checked during Auto Balance cycle

message: **AUTO-BALANCE FAILED**
LIMIT NOT REACHABLE
BEST BALANCE
ACHIEVED AT

Cleared manually.

Cleared by pressing Auto button.

definition: Auto Balance Failed – unable to reach limit.

action: Reset the PULSE setting to “CAUTIOUS”, and verify system integrity as OK (*see: Trouble shooting Guide section*). If this error continues, there are two possible causes of this error.

- 1) LIMIT set too Low - The LIMIT must be set 0.2 higher than the Measured background vibration (*see: Other Sources of Vibration section*).
- 2) It is a signal that the Balancer supplied is sized incorrectly for the application. Conduct the test described in the Verifying Balancer Size section. If test results are outside suggested levels, contact your SBS Balance System source to discuss replacement.

J— Checked Continuously.....

message: **NO RPM SIGNAL**
CHECK CABLES
CHECK SPINDLE

Cleared automatically.

Cleared by pressing Auto button.

definition: No incoming RPM signal, possible open in RPM sensor circuit.

action: Ensure that spindle is running, with balancer cable attached at both balancer and control ends. Determine which is the defective component by swapping with another system. Return defective component for repairs. If in doubt, return all items.

K— Checked when Auto Balance Cycle Completed.....

message: **ABNORMAL CONDITION**
BAL CYCLE COMPLETED
AFTER ERROR DETECTED
SEE MANUAL

Checked when Auto Balance Cycle Completed.

definition: Balance cycle completed after error detected and cancelled, clears automatically.

action: No action required other than clearing manually from the Balancing screen.

L— Checked Continuously.....

message: **CIRCUIT FAILURE**
UNABLE TO MEASURE
VIBRATION
SEE MANUAL

definition: Signal acquisition circuit failed.

action: Clears automatically, no action required other than clearing manually from the Balancing screen. If the problem persists, the Control Unit should be returned for repair.

Appendix A: Electronic Specifications

Control Unit

Installation: Pollution degree 2, Installation category II

RPM Reporting: 300 to 30,000 RPM

Vibration Range: 120 μ G to 25 G

Vibration Display Resolution:

One of three options are selectable by the user over the operational range	0.1 μ m	0.01 mil	0.01 mm/s	1 mil/s
	0.01 μ m	0.001 mil	0.001 mm/s	0.1 mil/s
	0.001 μ m	0.001 mil	0.001 mm/s	0.01 mil/s

Vibration Display Repeatability:

6,000 RPM

$\pm 1\%$ @ 5.0 μ m

300 – 30,000 RPM

$\pm 2\%$ @ 50:1 signal to noise

Vibration Display Accuracy:

6000 RPM

$\pm 2\%$ @ 5.0 μ m

300 – 30,000 RPM

$\pm 4\%$ @ 50:1 signal to noise

Vibration Filter

3% width

60 dB per decade drop-off

modified Butterworth (SBS proprietary)

Auto-Balance accuracy

+/- 0.1 microns displacement.

Power Requirements:

Supply: 100-120 VAC, 50/60 Hz, 2A max; 200-240 VAC, 50/60 Hz, 1A max

Mains supply voltage fluctuations not to exceed +/- 10% of nominal supply voltage.

Environmental Conditions:

Intended for indoor use only.

Temperature: 5°C to + 55°C

Humidity: 0 to 95% relative humidity (non-condensing) throughout temperature range.

Altitude: \leq 2000 m

Cleaning Instructions:

Wipe unit off with clean cloth. May use mild detergent or water. Do not spray or immerse unit.

Vibration Sensor

Sensitivity Range + /- 25g

Sensitivity Resolution 0.0001g

Voltage Sensitivity 100 mv/g

Excitation Current 2 to 8 ma

Frequency Response 0.5 to 5000 Hz

Operating Temperature 0 to +70 C

Appendix B: Replacement Parts List

Part# Description

Balancer Cables¹

SB-48xx	Balancer Cable /SB-4500 series
SB-48xx-V	Balancer Cable /SB-4500 series – Heavy Duty
SB-46xx	Balancer Extension Cable /SB-4500 series

Controls/ Options

SB-43xx	Remote Keypad Cable for SB-4400
SB-24xx-L	Hardwire Interface cable (standard lengths)
SB-4500	CONTROL UNIT (Expandable to 4 Channels)
SB-4400	CONTROL UNIT (Expandable to 2 Channels)
SB-4450	Remote Keypad (option for SB-4400)
SB-43xx	Remote Keypad connection cable (option for SB-4400)
SB-4475	CONTROL UNIT (w/ optional installed front panel)(Expandable to 2 Channels)
SB-4512	Additional Mechanical Balancer Channel Card
SB-4518	Additional Hydrokompenser (water balancer) Channel Card
SB-4522	AEMS Gap/Crash Monitoring System Card

Vibration Sensors¹

SB-14xx	Sensor Cable (standard lengths)
SB-16xx	Sensor Ext. Cable (standard lengths)

Control Mounting Hardware Options

SB-0451	Rack Mount Panel: SB-4500 – 19”
SB-0441	Rack Mount Panel: SB-4400 ½ Rack DIN 3U
MC-0400	Control Mount Bracket: SB-4500
SB-0442	Control Mount Bracket: SB-4400

Other Parts

EC-5605	Control Unit Fuse, 3 amp time lag 5x20 (2 required)
CA-0009	Power Cordset
CA-0009-G	Power Cordset (Germany)
CA-0009-B	Power Cordset (British)
SB-8510	Complete SBS Balancer Low Profile Collector replacement
SB-8520	Collector Slip Ring Block Replacement—L/P
SB-8530	Collector Slip Ring Post Replacement—L/P
MC-8516	Collector RPM Sensor Replacement—L/P
MC-8515	Collector 7-Pin Connector w/ Wire Harness
CA-0114	7-Pin Male DIN (control end plug of Balancer Cable for 25xx series cables)
CA-0121	12-pin Male DIN (control end plug of Balancer Cable for 48xx series cables)
CA-0125	Standard 7-Pin Female Bayonet Connector (Balancer end of Balancer Cable)
CA-0105	Heavy-Duty 7-Pin Female Bayonet Connector (Balancer end of Balancer Cable)
SB-0020	1" Hex Wrench (Large Adapter Nuts)
SB-1300	Adjustable Hook Pin Spanner (Adapter Flanges)
SB-1311	Adjustable Face Pin Spanner 1/4" pins (Small Adapter Nuts)
SB-1321	Adjustable Face Pin Spanner 3/8" pins (Large Adapter Nuts)

1) xx = cable length in feet - standard options 11, 20, or 40 at standard price

Appendix C: Balancer Card Installation

Note: All Service (including card installation) should be performed by a qualified technician, or the unit returned to Schmitt Industries Inc. for service.
(Unit is shown upside down with the cover removed.)

Tools Required:

1. 1/16" Allen Wrench
2. Grounding Wrist Strap

Procedure:

1. Unplug Unit, Invert, and Lay on a Non-Marring Surface.
2. Remove Back Cover Screws (1).
3. Loosen Front Cover Screws (2) A Few Turns.
4. Remove Bottom Cover (3) and Attach Grounding Wrist Strap (4) To Rear Lip Of Panel
5. Remove Slot Cover Screws (5) And Slot Cover (6).
6. Plug Balancer Card (7) Into Back Plane Board (8).
7. Install Slot Cover Screws (5) Into Balancer Card (7).
8. Remove Grounding Wrist Strap (4)
9. Install Cover (3) And Tighten Cover Screws (1 & 2).

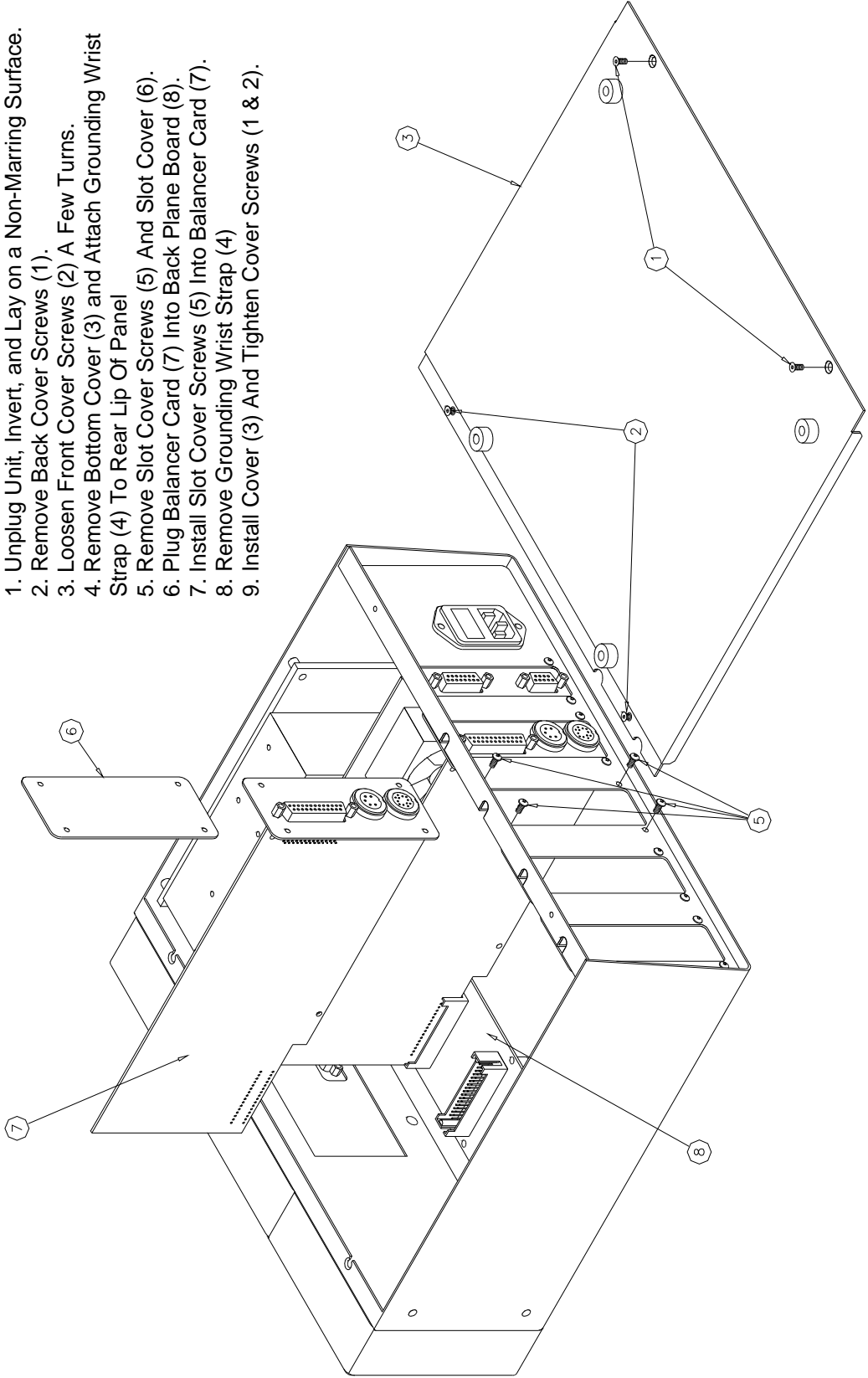


Figure 27

Appendix D: System Connection Diagram

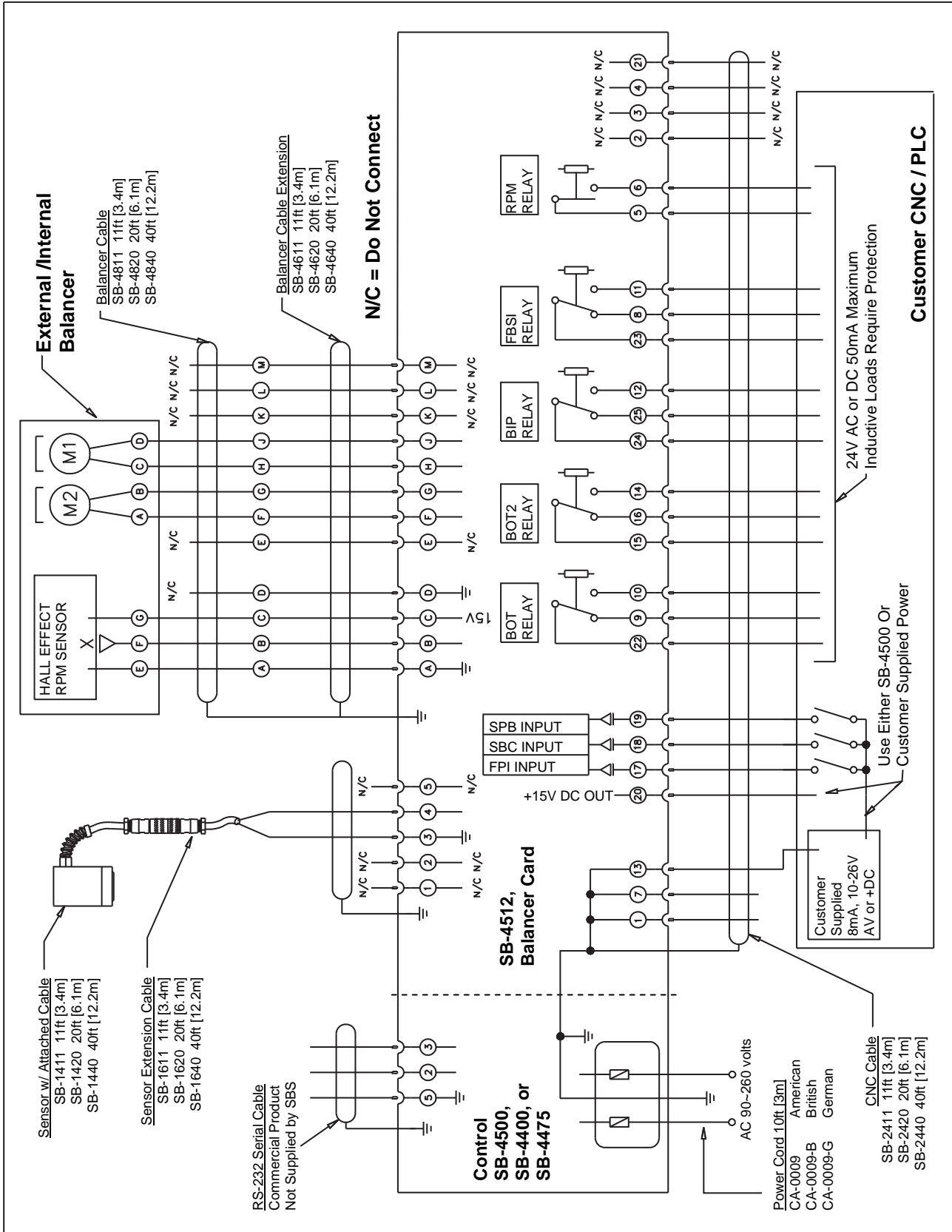


Figure 27

Ordering The SBS Balance System

The SBS Balance System is sold as a set, matched to the requirements of the users grinding machine. The system includes a Balancer, a microprocessor based Balance Control Unit, a Balancer Cable, a Vibration Sensor, and all necessary attachments and tools for installation on the grinding machine.

Selection of your balance system requires only a few moments of your time:

- 1) Complete the Application Questionnaire provided by your SBS Balance System dealer.
- 2) Based upon response to the questionnaire, your dealer selects the appropriate mounting adapter and determines the mass compensation required by your application.
- 3) Your SBS Balance System is delivered, matched to your exact needs. The system comes with complete operating instructions, which makes operator training and system use simple, and helps bring immediate return to your investment.