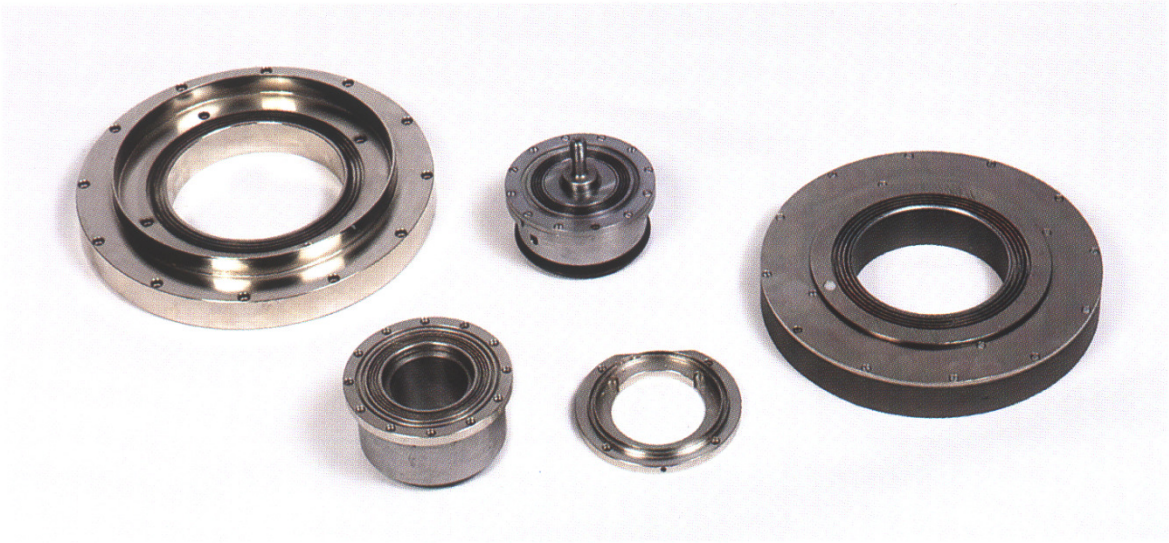
SBS Hydrokompenser
Balance System

Operation Manual

with SB-5500 Series Control

LL-5300 Rev 1.2

Productivity through Precision™



DYNAMIC BALANCE SYSTEM
A Product Line of Schmitt Industries, Inc.

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Operation and Specification Manual

for the

SBS Hydrokompenser Balance System

Covering Systems with Model 5500 series Control Unit

LL- 5300

Manual Revision # 1.2

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Benefits of SBS System with SB-5500 Control:

- Increases throughput by saving setup time
- Improves part quality by automatically balancing to 0.02 micron
- All-digital electronic design increases operating life and reliability
- Easy to install and operate
- Longer life for grinding wheels, dressing wheels and spindle bearing
- Works with existing SBS installations
- Profibus, Ethernet and USB 2.0 communication
- International adaptability: voltage, frequency, communication, and display language
- Four-channel capability reduces costs by permitting balancing of multiple machines
- Backed by world-class SBS customer service

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General Instructions

System Purpose

In order for the wheel of a grinding machine to accurately cut, produce smooth surface finishes, and generate correct part geometry, it is necessary to prevent vibration in the grinding process. A primary cause of vibration during grinding is the existence of imbalance in the grinding wheel. This is often due to the heterogeneous nature of the grinding wheel, which contains great numbers of unevenly distributed grains, causing intrinsic imbalance. This imbalance can be compounded by eccentric mounting of the wheel, varying width of the wheel, imbalance in the arbor, and coolant absorption into the wheel. Considering all these factors, even a carefully established initial balance will not last long. Furthermore, due to wear and dressing, 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 for grinding machine operators with the following objectives in mind:

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

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.

Warning: Failure to properly attach SBS Balance System components to the grinding machine spindle will result in safety hazard during machine operation.

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).

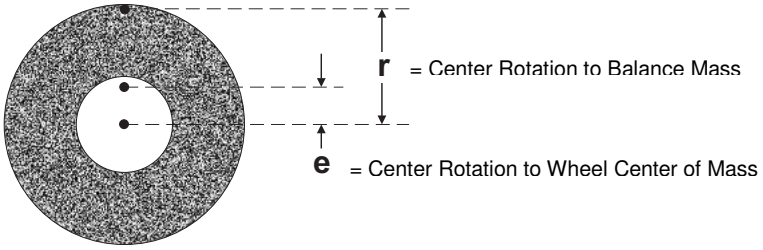
Caution: Only qualified service technicians should attempt to service the SBS Balance System. To avoid electric shock, do not remove the cover of the Control Unit, or remove cables, with power connected.

System Theory and Connection

The SBS Balance System operates on the principle of mass compensation for any given grinding wheel's imbalance. The Intrinsic Imbalance of a grinding wheel is equal to its mass multiplied by "**e**", the distance between the wheel's center of mass and the wheel's center of rotation.

Intrinsic Imbalance = e (Wheel Mass)

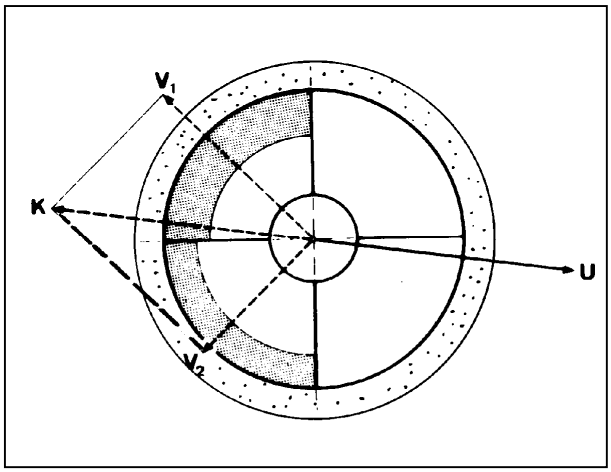
Measured Imbalance = r (Balance Weight Mass)



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 the mass of an attached balance weight, located to balance the grinding wheel, multiplied by "**r**" the distance between that weight's center of mass and the grinding wheel's center of rotation. 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.

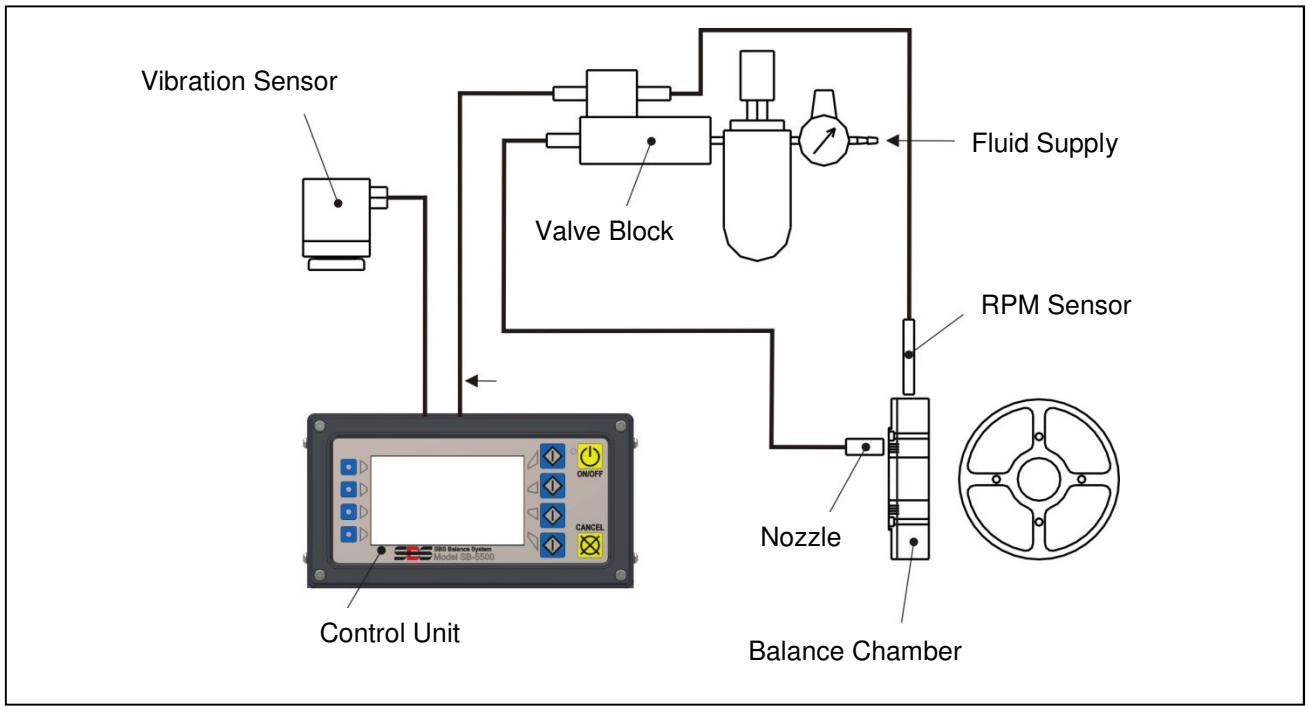
Compensation of imbalance in the Hydrokompenser system is by means of liquid (coolant or oil) which is injected into four quadrants inside the rotating balancing Chamber. The Balance Chamber is secured to the grinding wheel holder. The injected liquid is distributed and retained in each individual quadrant of the Chamber by centrifugal force.

This diagram explains the basic balance method of the Hydrokompenser system, where U is the vector of imbalance, V_1 and V_2 are the vectors produced by fluid injected into each chamber quadrant, and K is the compensation vector resulting from the sum of V_1 and V_2.



The system consists of a Balance Chamber (for addition and location of the balance fluid), a four port Nozzle (for delivery of balance fluid to each quadrant of the Chamber), a Valve Block (for filtering and control of fluid to the Nozzle), an RPM Sensor (some models of Nozzle include the RPM sensor), a Vibration Sensor, and the SBS Control Unit. Imbalance is expressed as spindle movement or vibration detected from the grinding machine by the sensor. The vibration signal from the sensor is transmitted to the control unit, which filters the signal by RPM. When an Auto-balance cycle is initiated, the control unit actuates the Valve Block to inject fluid through the Nozzle in the Chamber quadrant(s) that reduces the amplitude of the incoming vibration signal.

The vibration sensor determines the amount of unbalance, while the RPM sensor detects the position of unbalance. The required correction vector is determined by the Control unit and individual quadrant fill amounts are calculated ($V_1 + V_2$) accordingly. The individual valves in the Valve Block open as commanded by the Control unit and the liquid balance medium is allowed to pass out the corresponding port in the Nozzle under pressure. The Nozzle injects the coolant into the required quadrant(s) in the ring Chamber as a continuous stream. The Chamber grooves help collect the liquid and insure it enters the required quadrant.



Environmental Considerations

The SBS Balance System is designed to dynamically correct for the detrimental effects of grinding wheel imbalance on quality of surface finish, part geometry, as well as wheel and machine bearing life. The system cannot correct for other environmental problems. This section is intended as a discussion of some common environmental problems which may influence grinding quality.

Other sources of vibration

A most common source of vibration is adjacent machinery. Grinding machines should be properly isolation mounted if vibration-producing machinery is operating nearby. Other sources of vibration may be components mounted on the machine, such as pumps, motors, drives, etc.

The SBS Balance System may not operate efficiently under the influence of some external vibrations. The system filters the vibration signal it detects from the grinding machine at the frequency of the spindle RPM. This means that vibrations occurring at frequencies other than that of the rotating wheel will be ignored by the system. For adjacent machinery operating at the same frequency, or in phase with that frequency, the system will not distinguish between vibrations occurring from wheel imbalance and 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 help perform this test *(see: Background Vibration section),* but cannot remove these vibrations.

Machine condition

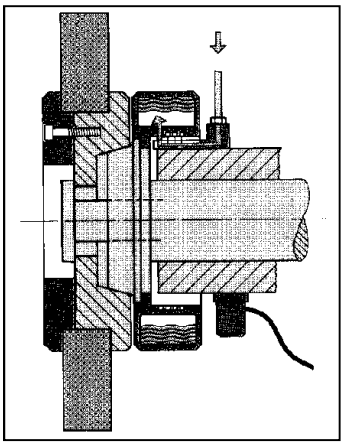
Grinding machine condition is an important factor in determining the minimum balance level that the SBS Balance System can achieve. The spindle should be balanced, as well as all components in the spindle drive train (i.e. belts, pulleys, motor, etc.). The balance system can be used to readily determine 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 cannot remove vibration resulting from machine condition problems.

System Installation

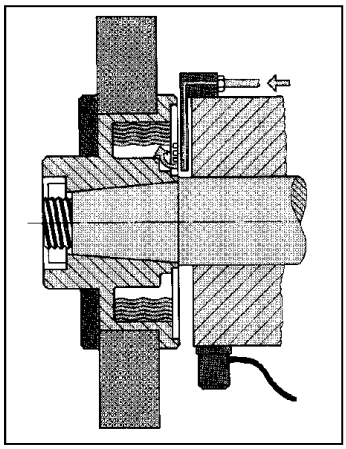
Balance Chamber

The Hydrokompenser System allows for a great variety of implementation, and supports machine operation at machine speeds up to 15,000 rpm in certain applications, which makes it the perfect solution for solving unbalance problems on machine types that mechanical balancers can't address as well. Individual Hydrokompenser Chambers are designed for specific applications, with maximum spindle rotational speeds for each design. **Caution: Exceeding the maximum spindle speed reported to Schmitt Industries, Inc. during application engineering, may result in dangerous part failure.**

A chamber can be designed for any application, and can be bolted to the grinder, or be built into the machine for OEM applications. This manual can therefore not possibly cover all methods of attachment of chambers to machines. However, they all have in common a simple installation on the grinder by several bolts and a pilot bore for precise alignment. Details will be provided in engineering drawings.



Bolted on



Built in

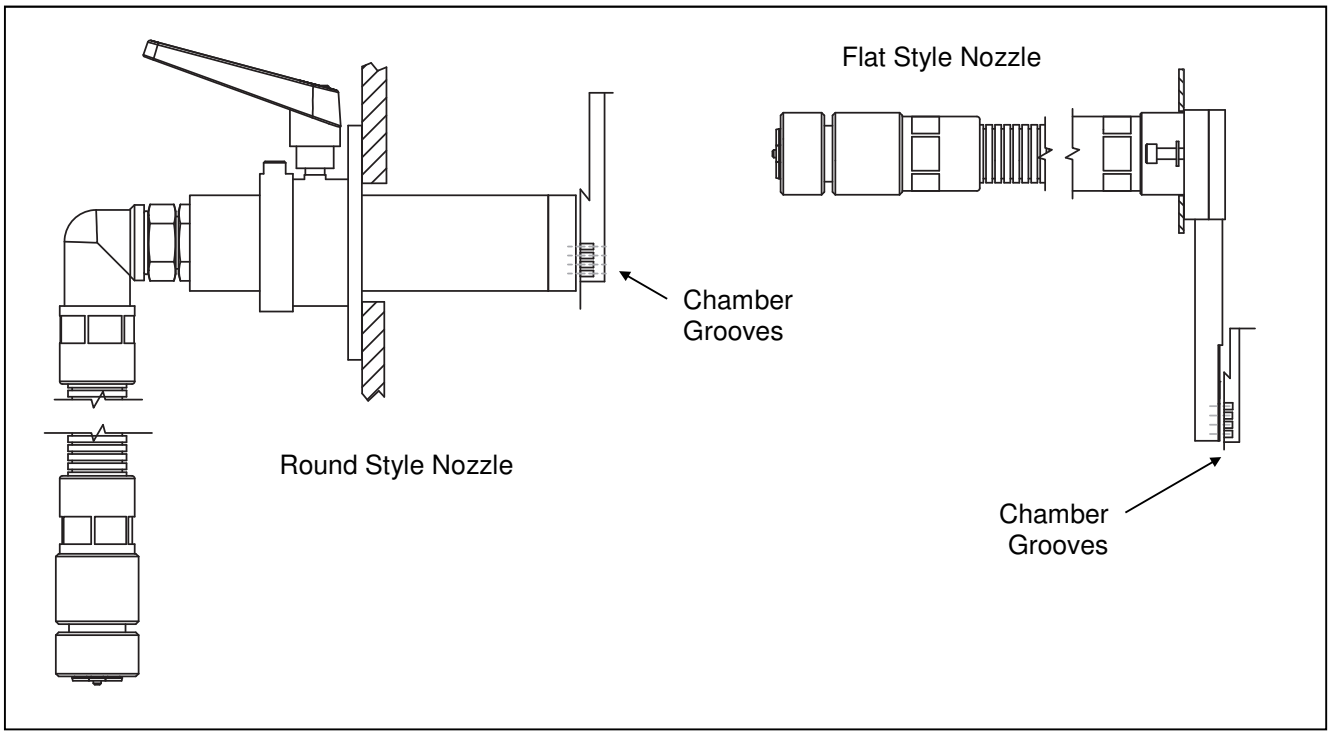
Valve Block

The Valve Block should be mounted in a clean part of the machine outside the coolant spray zone, and as close as possible to the Nozzle, typically at a distance of 2.5 meters (8 feet). This corresponds to the standard length of hose attached to the Nozzle. Special lengths are available on request. Details will be provided in engineering drawings. The Valve Block includes a fluid pressure regulator, as well as a fluid filter to remove particles from the coolant or other fluid to be used as a balance medium.

Nozzle installation and alignment

The Nozzle must be mounted on a non-rotating part of the machine so that the four nozzle ports align with and are directly facing the four fluid grooves on the Balance Chamber. Round style Nozzles come with an alignment feature to assist with finding the correct position, while the flat style (rectangular) Nozzles rely on careful measurement to achieve position. Details will be provided in engineering drawings.

The alignment of the nozzles is critical, as it determines the speed and accuracy of the balancing process. For proper operation, the nozzles must be located within a maximum distance from the Chamber face of 1-3 mm.



Attachment to the machine is best accomplished by a simple bracket of proper dimension to hold the Nozzle Block in the required position during machine operation. Where necessary, the ability to make finish adjustments in distance and alignment of the Nozzle should be provided for in the bracket design. Because the requirements for mounting are dependent on individual machine design and customer preference, the customer should provide the required hardware or bracket for attachment of the Nozzle. SBS will provide design and fabrication services for customers who so desire.

Once the nozzle block is installed and connected properly to the valve block, set the pressure using the pressure regulator on the valve block. Adjust the coolant jet exiting the nozzles in a way that it is deflected after 0.5 m (1.5 ft). If a water-based coolant is used, this should correspond to a pressure of 0.5-1.5 bars (7-21 psi), depending on the distance between valve block and nozzle block. If oil is used, this should correspond to a pressure of 1-4 bars (14-58 psi).

RPM sensor

The RPM sensor is a proximity sensor which is triggered off a rotating feature on the machine. Some Nozzles are design to incorporate the RPM sensor, and are triggered off a small hole provided in the Balance Chamber. Other applications require a separate RPM sensor, which may be located at the drive end, or the wheel end of the spindle. A small drilled hole 5mm dia. And 3mm deep is suggested for triggering the RPM sensor.

SBS Control unit

The SBS Control unit should be mounted in a location allowing observation of the display by the machine operator outside the coolant spray zone of the grinder. A variety of mounting hardware is available for installation on horizontal surfaces or for rack mounting. Cabling connections to the control unit include the Vibration Sensor, RPM Sensor, and Valve Block cables, the power cord, and the selected machine controller interface cable *(see: System Connection diagram)*.

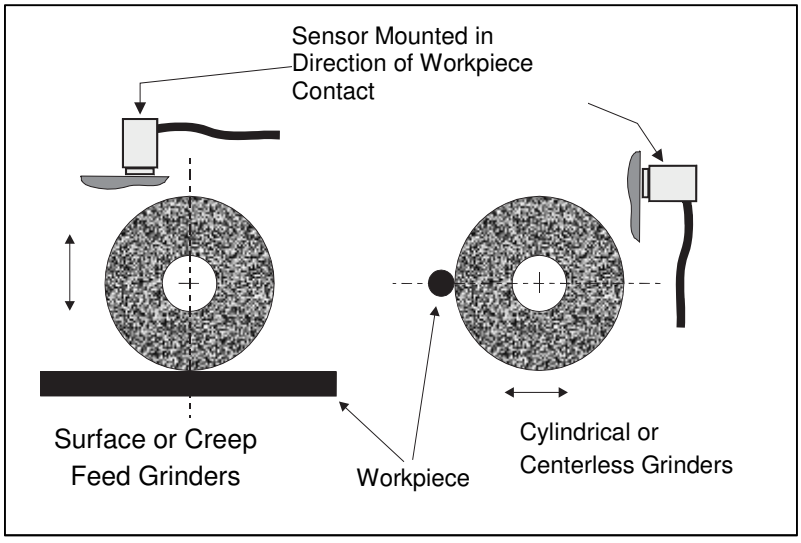
Vibration sensor location

The Vibration Sensor can be mounted on the grinding machine using the magnetic mount provided, or 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. A machined flat should be supplied at the mounting location when stud mounting the sensor.

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

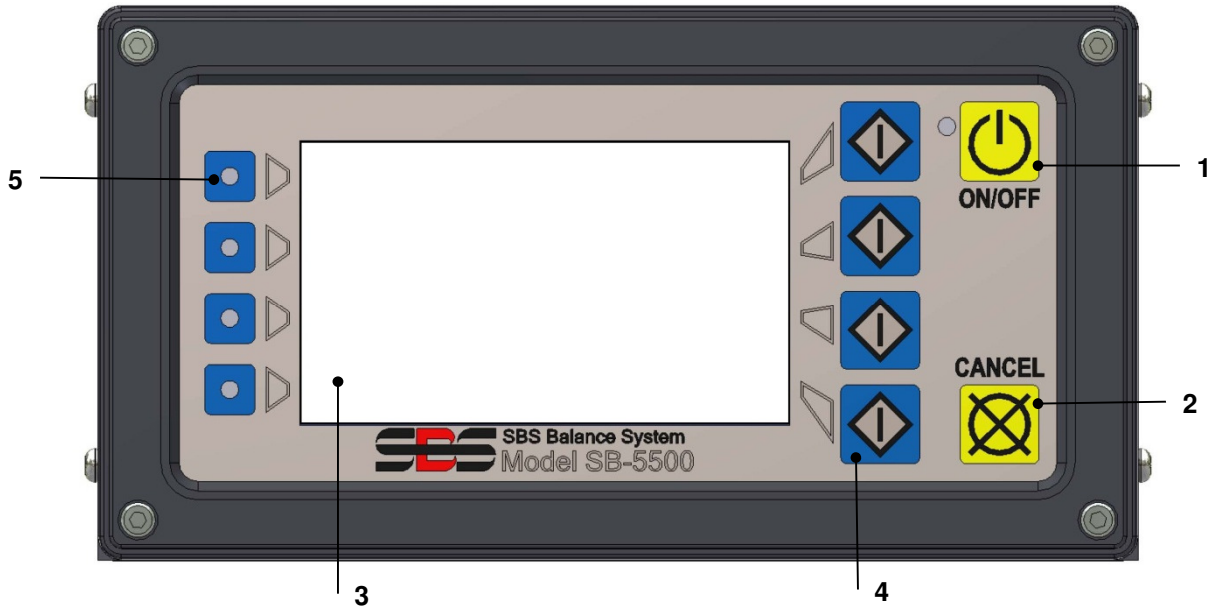
1. **Locate the Sensor in the same direction as the centerline between the grinding wheel and the workpiece**. The best place to start is a flat machined surface on the spindle housing over the bearing closest to the wheel and perpendicular to the spindle's centerline. A vertical mounting surface is 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 balance Chamber 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.

2. **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 minimizes sources of interference.



Control Unit Operating Instructions

The SBS Balance System is easily configured to the particular needs of your grinding setup. Following is an overview of the control and interface features of the SBS Balance System Control Unit.



Front panel controls

The Figure above 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. Also clears any displayed error message.

3) LCD DISPLAY. **The display is not a touch screen. Do not press on the display screen**. The screen is used to display data and assign functions to the function buttons.

4) FUNCTION BUTTONS. Operation of the Control unit is accomplished via the four function buttons to the right of the display. The menu bar area of the display, to the left of these buttons, assigns the current function to each button. Use these buttons to make all operational selections.

5) SLOT STATUS LED. A three color LED on the left side of the display shows the operational status of the balancer card or other device cards installed in each of the four corresponding card slots.

Power-on display

The Front Panel of the control can be removed and remotely mounted using a SB-43xx series cable. When switched on in either configuration the Control Unit performs self-analysis which defines its status, and the setting of operating parameters. Operator information is then shown on the LCD display following the startup sequence described below:

1) The company logo screen is displayed and lights on the front panel are illuminated to verify their operation. During this short time, the SETUP button is available. Pressing this button will enter setup mode for the control.

2) After four seconds, the unit displays information about each balancer or device card installed, indicating type of device and 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 button press will add six seconds to the display time, giving additional time to read the information.

3) After two more seconds, the unit displays the initial operational screen for the control unit. The unit will display either the SHOW ALL monitor screen, or one card slot's main operating screen, whichever was selected when the unit was last switched off.

4) Any error conditions detected by the self-analysis are displayed as "ERROR - *code*" where *code* lists the reference code of the error detected. For detailed description of error codes, see the "Displayed Error Messages" section of this manual, or additional product instruction addendum manuals.

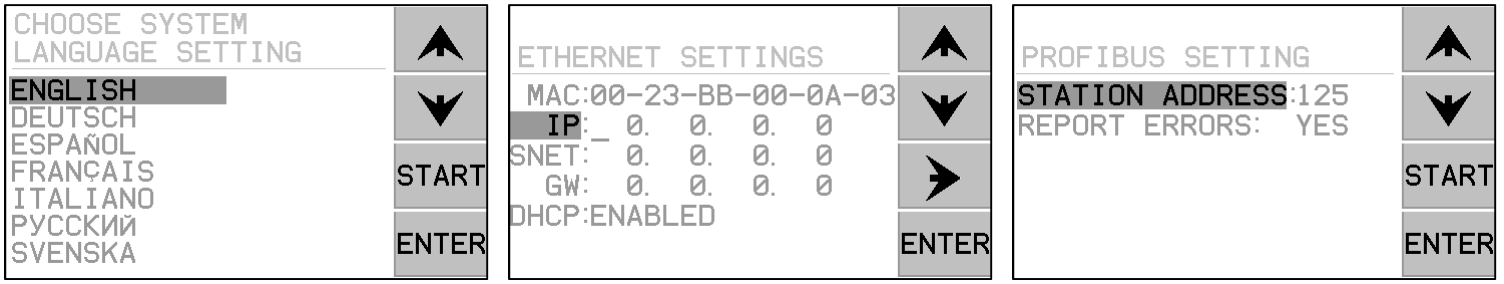
SETUP

At Power-on, press the SETUP button to enter this mode. The Setup screens allow the user to select:

1. Operational language
2. Ethernet settings
3. Profibus Station ID (if installed)

While in Setup mode:

- Press ENTER to save current settings on the screen and/or proceed to the next Setup screen
- Press CANCEL to cancel unsaved settings on the screen and/or proceed to the next screen
- Press START to cancel unsaved settings, exit Setup mode, and start operation.



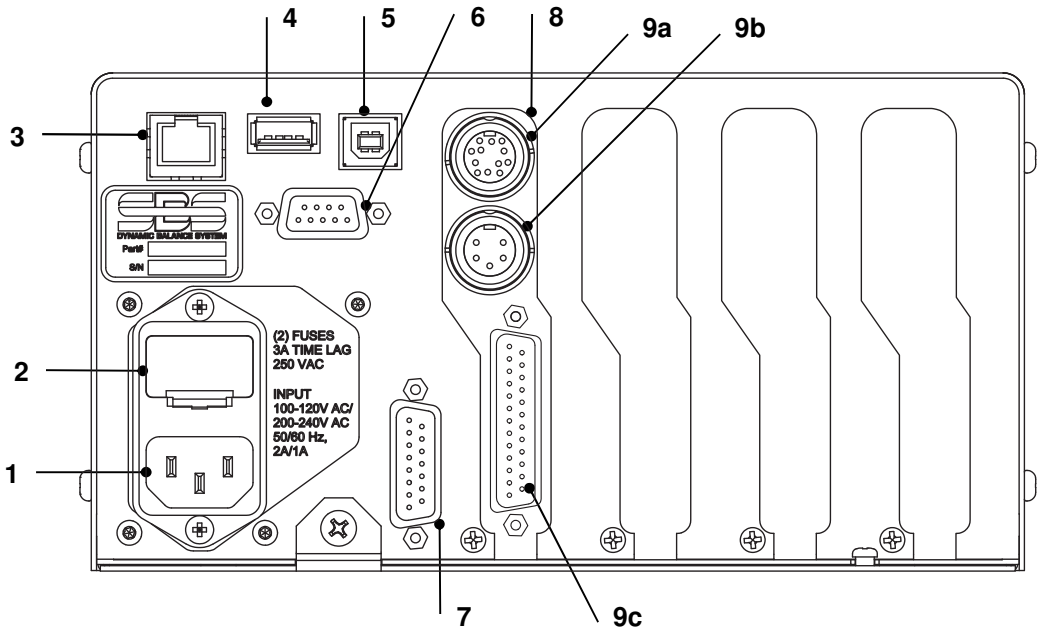
The first Setup screen selects the language used by the control. Use the arrow buttons to scroll through the available languages. The second Setup screen allows Ethernet settings. Manual settings can be made or DHCP can be enabled for automatic assignment. Use the arrow buttons to scroll through all the available Ethernet settings and use the up and down arrows to change digits. The third screen allows selection of Profibus Station ID (if installed) and the option to turn off Profibus Error reporting.

Control unit without front panel connected

The control unit can be operated without a physical keypad/display assembly attached. SBS provides a Windows software program which acts as a virtual keypad/display. The only power-on indication for the unit with no physical front panel attached is the standard Software Interface menu and command prompt. *(see: Software Interface section).*

Rear panel connections

The figure following shows the rear of the control. The following connections are located on the rear panel of the Control Unit, and are common to any cards installed in the control.



1) POWER SUPPLY. Connection for line power input (AC input model shown)
Caution: Before applying power to the Control, make sure the supply voltage is within specified range.
AC Input Models: 100-120V AC, 200-240V AC, 50-60 Hz
DC Input Models: 21 VDC to 28 VDC. 5.5A max at 21 VDC.

2) FUSE HOLDER. Contains the line fuses. AC Input Controls use (2) 5x20 3A time lag, DC Input Controls use (1) 5x20 6.3A.

3) ETHERNET. Provides TCP/IP Connection to host device, such as CNC Controller.

4) USB CONTROLLER. Allows USB flash drive to be connected for Firmware update. Latest firmware for the control and update instructions are available on the SBS website.

5) USB DEVICE. Provides connection to another USB 2.0 host, such as a CNC Control.

6) PROFIBUS. Provides connection to Profibus DP host device, such as CNC Control (option).

7) REMOTE. This DB-15 connector receptacle is a duplicate of the connector on the font side of the box, used to connect the optional cable for remote front panel installation.

8) DEVICE SLOTS. Numbered Slots are available for installation of balancer cards or other device cards supplied by SBS. Unused Slots are covered with blank panels.

Balancer card rear panel connections

The control comes standard with one card, and others can be purchased and added to the control unit as required. Each card has three connections on the rear panel of the control.

9a) BALANCE CONNECTION. Connects to the Valve Block.

9b) SENSOR CONNECTION. Connects to the Vibration Sensor.

9c) HARDWIRE INTERFACE. Standard DB-25 connector for connecting the individual balancer card in the control to a grinding machine controller. A complete description of this interface is given in the “Hardwire Interface” section.

Balancer Operation

Balancer slot status LED

The status indication for installed Balancer card is as follow:

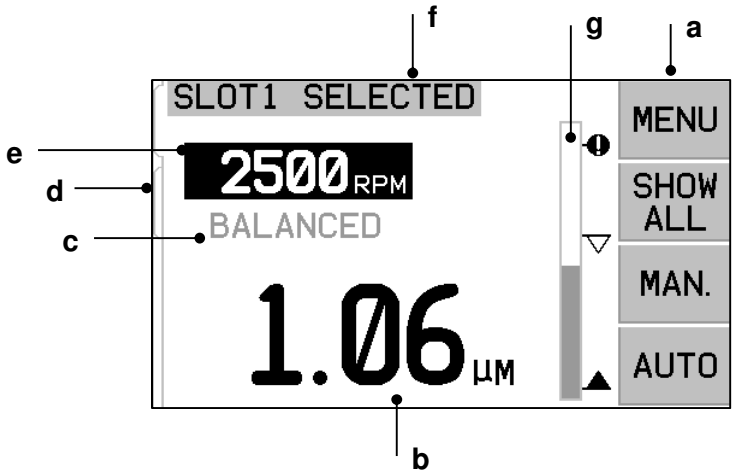
BALANCE **ABOVE CRITICAL**. The LED is lit **RED** when the measured vibration is above the user set CRITICAL limit, or if the RPM level exceeds the user set Critical Max. RPM limit. The LED will blink while the system is performing an auto-balance.

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

BALANCE **BELOW TOLERANCE**. The LED is lit **GREEN** when the measured vibration is at or below the selected TOLERANCE level. The LED will blink while the system is performing an auto-balance.

Balancer main screen elements

The following elements are displayed on the Balancer Card Main Screen.



a) MENU BAR. The right side of the display is used to assign current functions to the four corresponding Function Buttons to the right of the display. An animated hourglass appears in this display area during the balance and plotting cycles to indicate progress.

Function Buttons are defined as follows for the main screen of each balancer card. See Function Button Map for an overview.

MENU – Pressing this button displays a menu listing with selectable operating parameters and other functions for the control unit.

SHOW ALL – Displays the status of all balancer or other installed cards on one screen.

Pressing CANCEL from the SHOW ALL screen will display a "System Status" screen showing all current Ethernet settings for the control. Pressing any button from this screen will then display a "Firmware Versions" screen showing version details of all installed devices in the control unit. Pressing any button from this screen will return to the SHOW ALL screen.

MAN. – Enters Manual Balance mode allowing manual injection of fluid into each of the four Chamber quadrants (C1 through C4). Fluid is dispensed for the duration of each button press. These buttons are available only in Manual Balance mode.

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

b) VIBRATION DISPLAY. Indicates the measured vibration level of the grinding machine in either microns or mils displacement, or in millimeters/second or mils/second velocity. Displayed units are selectable from the Menu.

c) STATUS. Indicates the current status of the selected balancer card.

d) SCREEN TAB. Tabs are shown on the left side of the display for each installed device card. The open tab indicates which device card is currently selected. In the figure the card in device slot #1 is selected, and a closed tab indicates another card installed in slot#2. These tabs align with the four device card status LEDs to the left of the display.

e) RPM DISPLAY. Displays Spindle RPM measured by the balancer. The display also indicates RPM frequency during a Manual Filter vibration test.

f) IDENTIFICATION TAG. The upper edge of the display identifies the user selectable name of the device card currently selected, and the current position in the menu structure.

g) BAR GRAPH. The bar graph shows the measured vibration level compared with the LIMIT, TOLERANCE, and CRITICAL levels.

MENU Settings

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

Press the MENU button to display the menu items detailed below. The menu provides access to system settings for individual balancer cards, and to perform certain optional functions. Use the up and down arrows buttons to move through the menu items. Press ENTER to access the selected menu item. Press EXIT or CANCEL to exit the Menu and return to the Main Screen for the card.

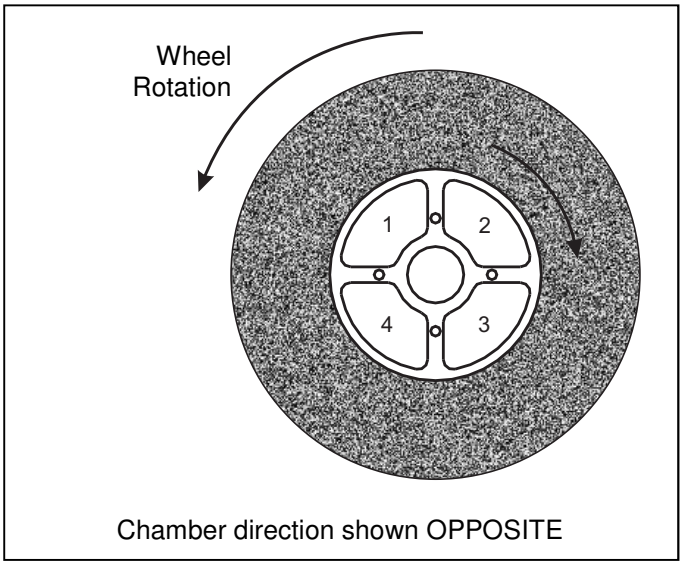
Balance settings

Use the backward arrow button to move the cursor from one digit to the next. Use the up and down arrow buttons to increase or decrease the value of the selected digit. Press the ENTER button to save any changes and move to the next balance setting. Pressing CANCEL will return to the Menu. Each of the following three balance settings are presented consecutively.

1. **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 microns higher than the background vibration level.
2. **TOLERANCE** level. This level sets the high end of the acceptable balance range. When this level is exceeded a Balance Out of Tolerance (BOT) error condition is reported. This error 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.
3. **CRITICAL** level. This level can be set at a value providing a secondary warning of 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).*
4. **WHEEL ROTATION/ CHAMBER DIRECTION** – Sets the relative direction that the chamber quadrants increase in number on the machine relative to the direction of rotation of the wheel. The Chamber quadrants are numbered from 1 to 4, with 1 being the quadrant connected to the smallest diameter chamber lid groove, and 4 the quadrant connected to the largest diameter chamber lid groove. The system must know if the direction that these quadrants increment upwards is the **same** as or **opposite**

to the direction of the wheel rotation. The system can determine this automatically, but to do so requires extra injections of fluid. Because chamber capacity is fixed and once the chamber is full it must be emptied before further balancing can be performed, automatic direction identification may not be desired in situations where this direction relationship remains constant. The following four settings are available.

- Automatic Always – With every balance operation, the direction will be determined automatically by injection into each chamber quadrant. This can be useful where the spindle swivels or otherwise changes directions.
- Automatic Once – On the first balance cycle after selecting this option, the system will automatically determine the direction by injection into each chamber quadrant, and will store the result.
- Same – This setting allows the operator to set the direction as SAME, without running the auto-determination cycle.
- Opposite – This setting allows the operator to set the direction as OPPOSITE, without running the auto-determination cycle.



Chamber direction shown OPPOSITE

Vibration units

Press the corresponding button to select from the available vibration units, available in displacement or velocity, as well as english or metric units. The currently selected units are highlighted on the screen. Once selected, the display changes allowing the up and down arrows to be used to set the resolution. Press ENTER to save the selection. Changing vibration units between metric and english will convert the numerical value set for the Limit, Tolerance, or Critical Levels. **Caution -** Changing between displacement and velocity units will not change these numerical values, as no direct conversion is possible. In this case the user must review and edit the limit settings to an appropriate number.

Balance speed

This setting will affect the time taken to perform an Auto-balance cycle. Normal is the correct setting for most applications. Factory default is Cautious, to ensure successful balance on all machines.

- CAUTIOUS – Setting 1. This setting controls the balance weights in a slower progressive balance mode. It is most useful on high speed grinders, or other machines where slight changes in the balance weight produces dramatic change in vibration level.
- AGGRESSIVE – Setting 2. This setting operates the balancer in the fastest balancing mode. It is most useful on machines with slower speeds and large wheels.
- NORMAL – Setting 3. This setting uses a combination of a fast balancing routine until the vibration level reaches 1.0 micron, then switches 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. The operation takes 10-20 seconds. It generates an on-screen graphical representation of the amplitude of vibration monitored at each RPM range in the form of a bar graph. It also produces a text listing of the top twenty vibration peaks encountered during the spectrum sweep. See the "Plot Vibration" section for operational details.

Pre-Balance

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.

Card name

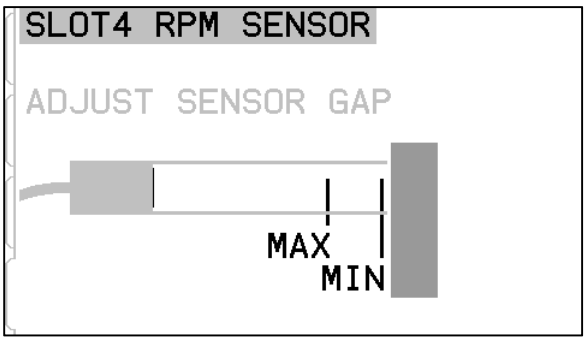
A user selectable name or label is used on screen to identify each balancer card. When no name is assigned by the user, SLOT# is default name assigned for screen display, where "#" is the number (1-4) of the slot where the card is installed.

Menu Entry

This selection enables a lock out of front panel menu access using a standard security code. Setting the protected mode denies access to the menu unless the access code is entered. This ensures that system settings will not be accidentally compromised. The screen displays "ENABLED" when Menu access is unlocked, and "PROTECTED" when menu access is controlled by 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. Access to the menu 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, select MENU ENTRY, and enter the same code to turn off protection. The display for MENU ENTRY will display ENABLED when protection has been disabled.

RPM sensor



The speed sensor must be correctly positioned opposite to and in line with a rotating trigger feature on the machine. After installation of all system components, switch on the SBS control. With the spindle stopped, loosen the mounting bolts and shift the speed sensor, so that it touches the metal of the mating face on the part that normally rotates (e.g. spindle, wheel holder, etc). Pull the speed sensor back to the specified gap of 1 to 3 mm. The system should have recognized and calibrated the speed sensor. If this is not the case, chose "RPM SENSOR" from the MENU. A graphic appears as shown depicting the gap between speed sensor and facing surface. Position the speed sensor so that the graphic shows the correct distance.

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

These two screens allow the user to set both a Max. RPM limit and a Min. RPM limit. If machine RPM rises above the Max. limit or falls below the Min. limit, the Balance Control will indicate an error condition as described below.

1) The SLOT STATUS LED will illuminate **RED** if the Max. RPM limit is exceeded.
2) Both the BOT and BOT2 outputs will be active if the Max. RPM limit is exceeded.
3) BOT2 will be active and BOT inactive if the machine RPM falls below the Min. RPM limit.
4) Main Operating Screen will indicate out of limit RPM icons, ⓘ+ or ⓘ−.

These limits are both alternate causes of the BOT2 output being active *(see Balance Critical)*. The BOT2 output can be monitored by the machine controller, and if desired can be used to set off additional warnings or interrupt the operation of the grinding machine. To set either limit, 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 either Critical RPM limit, simply reduce the limit setting 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 operational during a balance cycle, except when a Critical RPM error is detected. This behavior matches the SB-2500 and default for SB-4500 series of controls. When set to "ACTIVE (HK-5000)" both these relays are operational during a balance cycle. Each relay will be closed if the vibration level exceeds its set limits (*see CNC/ System Timing Diagram*).

Preparing to Set Operating Parameters

Ensure you fully understand the function and operation of the Control's front display panel as described in previous sections, before attempting the following operations.

Background vibration

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

Mount the Vibration Sensor in the position to be used during operation *(see: Vibration Sensor Location section)*. Install the Balancer, Control, and all cables as indicated in the installation section of the manual before powering on the Control. Leave the grinding machine off, press the MAN. Button and use the arrow buttons to manually set the vibration filter to the operational RPM of the grinding machine. Note this measured ambient vibration level without the machine running.

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. Note this background vibration level for future reference in setting the operating parameters of the system. Refer to the "Environmental Considerations" section for explanation of possible sources of background vibration.

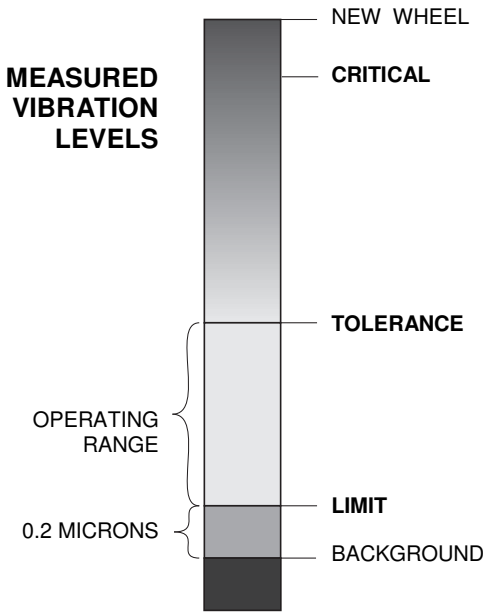
Setting Operating Parameters

This section details the menu selected operating parameters of the control. For control units with more than one balancer card installed, the user should select the desired card and then enter the MENU.

The operating parameters are independently set for each card.

Auto-Balance LIMIT

The SBS Balance System will automatically balance to a user specified low-limit of vibration, the Auto-Balance LIMIT. The Limit represents the best balance achievable in an auto-balance cycle. It is factory set at 0.4 microns displacement. A balance Limit of 1.0 micron or less is generally considered adequate for most applications. The Limit should be set **at least** 0.2 microns higher than the highest background vibration level noted in the "Preparing to Set Operating Parameters" section. **The lower the Limit is set, the longer the system will require to achieve balance.** Some experience may be necessary to determine the appropriate auto-balance Limit for a particular installation.



NO BALANCE SYSTEM IS CAPABLE OF BALANCING THE GRINDING WHEEL TO A VALUE BELOW THE BACKGROUND LEVEL. Trying to set the balance Limit below background levels will result in 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 when the system will receive the maximum floor transmitted vibration**.

To set the Limit, select BALANCE SETTINGS from the menu. The Limit is set using the arrow buttons, followed by pressing ENTER. **Note:** Velocity units may be selected for monitoring machine vibration; however the Limit setting can only be made in units of displacement.

Auto-Balance TOLERANCE

This operator defined setting establishes an upper-limit for normal process vibration for the system. When reached, this setting will cause an indication of the need to perform an auto-balance. Indications given on the front panel for balance status are shown in the following table, and additional indication is given via. both the Hardwire and Software Interfaces. The Tolerance level must be set **at least** 0.2 microns above the LIMIT setting. Typically it is set at least 1 micron above LIMIT setting.

Vibration Level	Slot Status LED	Bar Graph	Status Message
Below TOLERANCE	Green	Green	BALANCED
Above TOLERANCE	Yellow	Yellow	NEEDS BALANCE
Above CRITICAL	Red	Red	CRITICAL

Auto-Balance CRITICAL

This operator defined setting establishes an operational upper safety limit of vibration for the system. When reached, this setting will cause and indication of the critical need to perform a re-balance operation. This indication on the front panel is shown in the above table, and additional indication is given via. both the Hardwire and Software Interfaces. The Critical level 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. The Control Unit can also 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 auto-balance response between three settings. The purpose of this adjustment is to maximize the speed and accuracy of the SBS Balance System when installed on various types and sizes 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.

Automatic Balancing

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

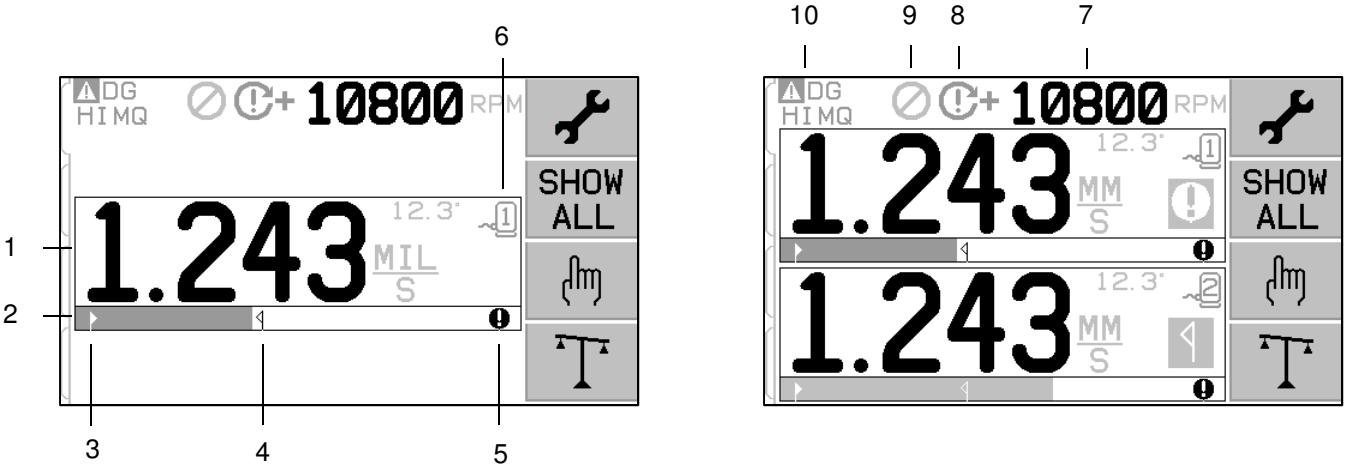
Prepare for pre-balance

Pre-balancing is used to initially balance the grinder by manually positioning balance weights on the grinding wheel. In some applications (especially for large wheels), the Balance Chamber may not have enough capacity to balance a new wheel with extreme imbalance. In such cases, the SBS Balance system can aid in positioning manual balancing weights to compensate for the majority of the wheel's imbalance. Automatic balancing can then be used to provide balance control until the next wheel change.

Before pre-balance can be performed, the machine must be fitted to allow the user to manually position balancing weights on the machine conveniently. This can be accomplished in any of the methods described under the "Balance Type" setting description. Fixed mass weights to be used should be labeled 1, 2, 3, etc. to identify them individually.

Before pre-balancing a new wheel, it is important to first minimize the Balance Chamber's effect on machine balance by ensuring it is emptied of fluid, so that only the new wheel's native imbalance will be corrected for in the pre-balance operation. Skipping this step will limit the effective balance range of the system in subsequent auto-balance cycles.

Begin the pre-balance operation by choosing "Pre-Balance" from the menu. The Pre-balance screen will be displayed, allowing the user to select the following options.



This is the Pre-balance screen. The first screen shows the display in single plane balance mode, and the second shows the display in 2-plane balance mode. The first group of screen elements shown are specific to a single balance plane, and are duplicated in the 2-plane view.

Pre-Balance screen elements for single balance plane

1. Vibration level indication. Vibration values will not display if there is a vibration sensor error (missing or shorted), or if there is no RPM value displayed. To the right of the vibration display, two Balance conditions will be indicated when they occur:
   a. ◥ - Tolerance Level exceeded (yellow color). The symbol will flash in yellow if the vibration level rises over the user selected Balance Tolerance limit.
   b. ❗ - Critical Balance exceeded (yellow color). The symbol will flash in yellow if the vibration level rises over the user selected Critical Balance level.

2. Vibration bar graph. Shows the current vibration level graphically. The scale is linear between the current settings for Balance Limit and Balance Tolerance. A different linear scale applies between the Balance Tolerance level and the Critical Balance level.
3. ▶ Balance Limit. This fixed position on the graph indicates the current level set for the Balance Limit, relative to the measured vibration level.
4. ◀ Balance Tolerance. This fixed position on the graph indicates the current level set for the Balance Tolerance, relative to the measured vibration level.
5. Critical Balance Level. This fixed position on the graph indicates the current level set for the Critical Balance, relative to the measured vibration level.
6. Slot Number. Identifies the balancer plane using the card slot number (1-4) in the SB-5500. Note: for dual plane operation slots 1 and 2 must be paired, or slots 3 and 4 must be paired. The currently selected and active slot shows the sensor symbol with slot number displayed in green color. To select an alternate balance plane (slot number), use the Show All screen.

Pre-Balance screen elements common to 2 planes

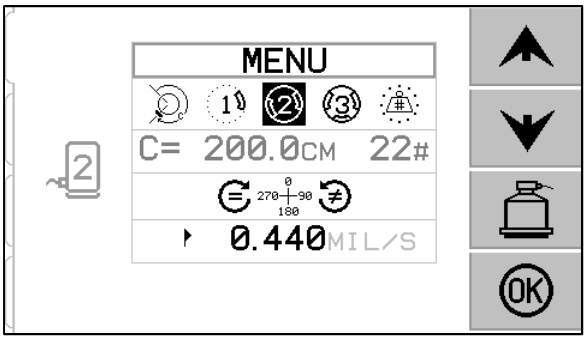
7. RPM indication. RPM values will not display if there is no incoming signal (spindle is stopped, or RPM sensor is missing or shorted). A manual RPM value can be set if needed (see Manual RPM Setup)
8. RPM Error indication. Displays one of following icons to indicate RPM error conditions:
   a. + - (red color) Critical RPM exceeded. The symbol will display and flash if the RPM level is over the Critical RPM user setting.
   b. − - (red color) RPM Minimum not met. The Symbol will display and flash if the RPM level is below the Minimum RPM user setting.
   c. - (yellow color) No RPM signal from sensor is present.
   d. - (yellow color) RPM above operation limit. The symbol will display and flash when the RPM detected is above the maximum operational limit of 30,000 RPM.
   e. - (yellow color) RPM below operation limit. The symbol will display and flash when the RPM detected is below the minimum operational limit of 300 RPM.
9. - Front Panel Inhibit (FPI) is active (see FPI under hardwire interface).
10. ⚠ - This symbol shows an existing error condition (see Error conditions), and is displayed with the letter code of the corresponding error(s).

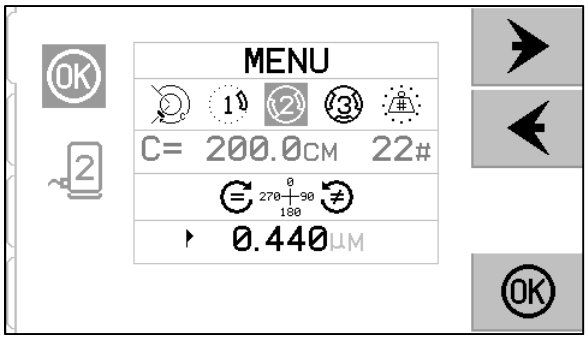
Edit and navigation conventions

The following shows the conventions in operation throughout the pre-balance menus.

- A yellow outline is used to indicate which option is currently selected. Most settings are represented by symbols that indicate the available options for that setting. Some settings require a number to be set.
- Current saved settings are shown as either a symbol highlighted with a white background, or by the displayed number for the setting.
- Use the arrow keys to move from one setting to the next. The yellow outline will indicate the current selection.
- Press the OK button to activate the selected option. Press ⊗ Cancel to exit.

When in edit mode:





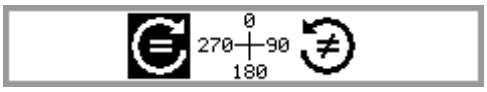
- A yellow highlighted background is used to show the current item or number being edited.
- The OK symbol will flash in yellow at the left side of the screen whenever the current selection is different than saved settings. This indicates that pressing OK is required to save the new current settings. Press OK to save changes or press Cancel to discard changes made and revert to the previous data.
- The Arrow buttons are used to make selections from available options, and also to make edit numbers. Where a number needs to be entered, the button is used to select the digit to be changed (move the underline). The buttons increment or decrement the number at the underlined digit. Holding the arrow button will start an accelerating repetition of the button press.
- Press to exit Pre-balance and return to the Auto-Balance Main Screen.

Pre-balance Setup

There are a number of user selectable operating settings for the pre-balance function, which are found under the button on the pre-balance screen. Press the button on the pre-balance screen to enter this menu. The Setup menu will time out after 1 minute of inactivity and the unit will return to the pre-balance screen without saving any changes. The hardwire interface output relays remain active during setup.

Each of the following settings is presented in order under the setup menu.

MENU	Provides access to all the MENU settings for the selected balance plane.
	Balance Type. Each type describes the method of balancing weight attachment to be used on the machine to perform balancing. Circumferential Weight – One weight of variable mass is positioned at a distance around the circumference of a rotor. Single Weight – One weight of variable mass is positioned at an angle. Two Weights – Two equal, fixed mass weights are positioned at variable angle positions. Three Weights – Three equal, fixed mass weights are positioned at variable angle positions. Fixed Positions – A specified number of mounting positions in an equally spaced fixed pattern (such as a bolt circle) are available for adding variable mass weights.

	If Fixed Position Balance Type is selected, then the right side of this selection is editable. This setting allows for editing the number of available fixed weight attachment positions (from 3 to 99). The positions are assumed to be evenly spaced in a 360 degree pattern. They must be labeled in order on the machine from 1 to the highest number available. If Circumferential Weight Balance Type is selected, then the left side of this selection is editable. This allows for editing the circumference of the rotor on the machine, around which the user will measure the distance to place a balance weight.
	Scale Direction. This is a separate setting from Chamber Direction. It sets the direction of the scale used to position the pre-balance weights relative to the wheel's direction of rotation. The weight scale direction is the direction in which the angle references (0°, 90°, 180° etc.) or the weight position location numbers (1,2,3,4, etc.) **increase**.  **Spindle rotation is in the same direction as the weight scale.**  **Spindle rotation is in the opposite direction as the weight scale.**
	Balance Limit. This is the same setting as AUTO BALANCE LIMIT. The low vibration level where the balance process is considered to be finished.

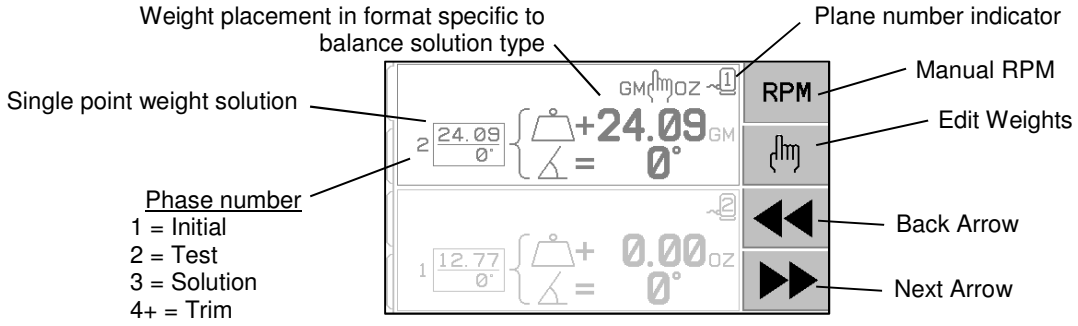
Pre-balance Process

Press T from the pre-balance screen to start a complete pre-balance operation. There are a minimum of three phases for each balance cycle:

1. **Initial Phase**. The vibration level is measured and saved.
2. **Test Phase**. A test weight placed on the machine so its effect can be measured.
3. **Solution Phase**. The balancing solution is provided. The correction weight is placed on the machine & the results are measured.

If the resulting vibration is below the Balance Limit ▸ the balance process will complete and exit to the main screen. If the resulting vibration is above the Balance Limit, a new balance solution will be provided to correct for the residual unbalance. Every subsequent balance solution is a **Trim Phase**. A Trim phase is just an iteration of the Solution Phase, performed if more adjustment is needed.

Four parts of each pre-balance phase:



a. Stop spindle. The control indicates that the spindle needs to stop.

b. Apply weights. Once stopped the operator must configure the weights as instructed.

c. Start Spindle. The spindle must be started.

d. Measure. The vibration can be measured for calculating the next phase.

This information is remembered through a power cycle. The hardwire interface output relays will remain active during the balance operation. Except where noted, the ⊠ Cancel button will stop the balance operation and return to the main screen.

Trim balance

Press the button from the pre-balance screen to start a Trim Balance operation. This skips the Initial and Test phases of the operation and starts at the Solution phase. This option is available only if the SBS System has saved results from a previously completed Initial phase and Test phase.

The first two phases of the balance cycle (Initial and Test) allow the SBS System to determine and save essential information regarding the condition of the grinder and how changes in balance weights will effect machine balance. Assuming the conditions on the machine do not change (RPM, wheel size, etc.) then subsequent balance operations can be successfully performed without re-running these two phases. If machine conditions do change, then performing balance operations based on the saved results of the Initial and Test phases will produce inaccurate results.

Trim balancing can be performed at any time that vibration levels rise above a satisfactory balance condition.

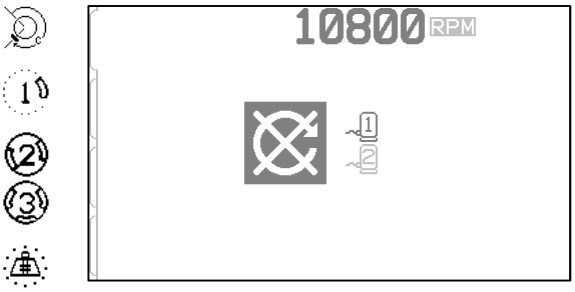
Balancing Problems - If successive Trim balance attempts are unsuccessful, this is an indication that either machine conditions have changed, or an error has occurred in weight placement (inaccurate position(s) or mass changes). In this case the operator should verify the Scale Direction setting is still accurate, then press T to start a new complete Manual Balance operation.

Important - Performing a Manual Balance will only be successful if the user is very careful in following each step of the process, and making certain that weight movements and additions are performed accurately. Both the mass of weight used and the positioning of weights used will determine the accuracy of the balance achieved.

History screens

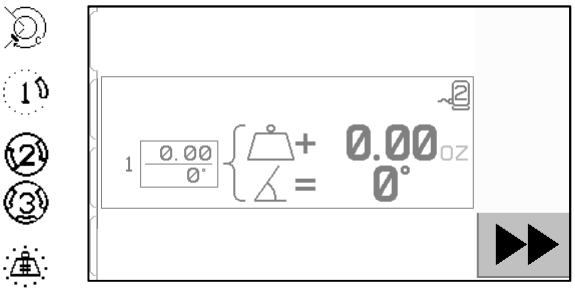
The History screens allow the user to view previously completed phases in the pre-balance process, and even to perform again one of these previous steps. Press the ◀◀ key to access the history screens. When viewing the history screens, a large "H" is displayed at the upper right. The use the ➤ and ➤ buttons to step backward or forward thru the balance phases (note the phase number display). The OK button will be displayed when it is possible to repeat the operation of a particular balance phase (any phase 3 or higher).

Pre-Balance Steps



Initial

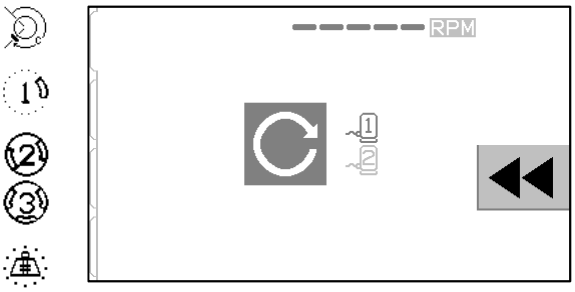
Stop Spindle - This screen requests the operator to stop the spindle. The Stop Spindle icon flashes as a reminder. This screen stays until the control detects that the spindle rotation has stopped.



Initial

Apply Weights - Once the spindle is stopped, this screen shows the operator how to place the weight. During the Initial Phase there should be no weight placed on the machine, or 2 or 3 variable angle weights should be moved to null positions as directed.

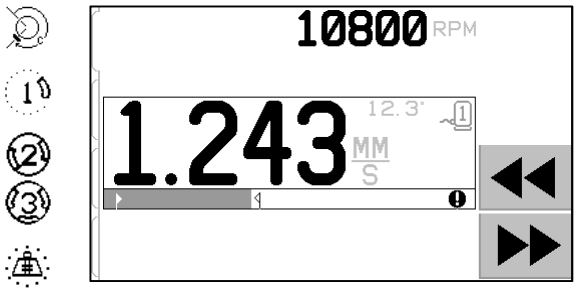
Press ▶▶ to indicate that the machine is ready.



Initial

Start Spindle - This screen prompts you to start the spindle so a vibration measurement can be taken. The icon and the "RPM" both flash as a reminder. The control stays on this screen until it senses the spindle is up to constant speed. Then the screen advances to the Measure screen.

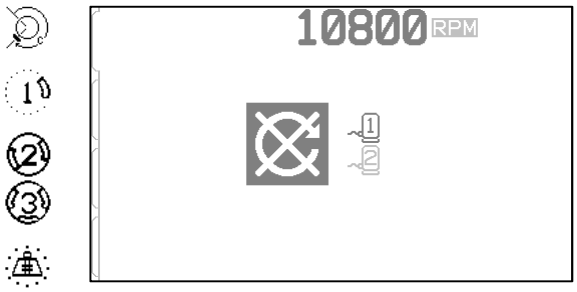
The Back arrow on the screen indicates that pressing ◀◀ will access the history screens.



Initial

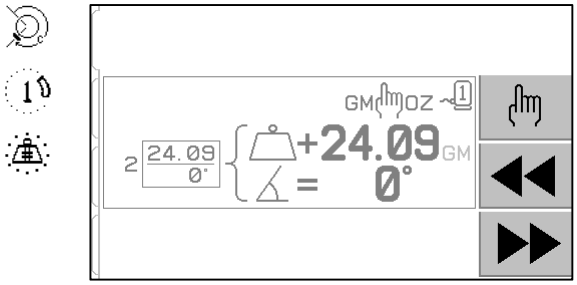
Measure Vibration - Once the rpm has stabilized, the Next arrow will appear on the screen and flash. Pressing ▶▶ will store this measurement into memory.

The Back arrow on the screen indicates that pressing ◀◀ will access the history screens.



Test

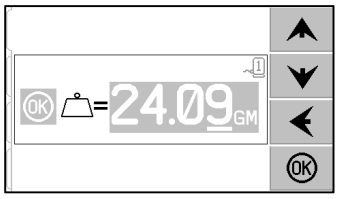
Stop Spindle - The Stop Spindle icon flashes as a reminder to stop the spindle.



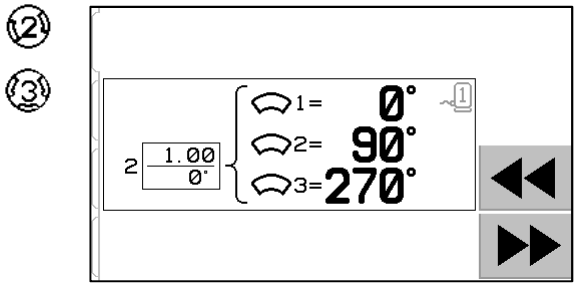
Test

Apply Weights - The test weight shown on the screen must be added at the zero position. The value of the test weight is shown.

During the Test Phase pressing the Edit Button (note GM OZ icon) will display this screen, allowing the test weight mass value to be edited. The weight units can also be selected from g, oz, lb, kg, and none.



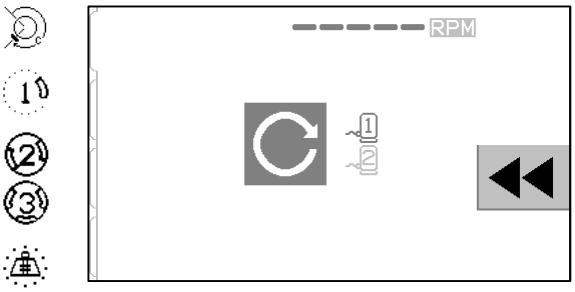
When done editing press OK to save changes and return to the Apply Weights screen.



Apply Weights - Once the spindle is stopped, this screen shows the operator where to position the weights. During this phase, one weight should be placed at the zero position **or** all weights moved to the positions shown.

Screens shown are for 3-weight balance, but the same process applies to 2-weight balance.

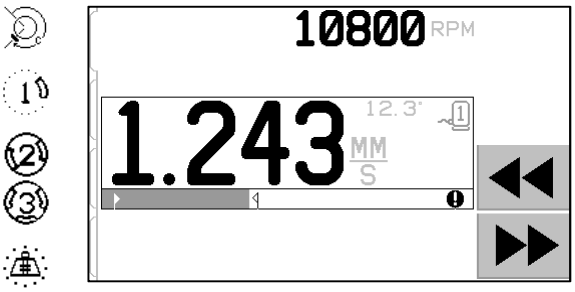
Press ▶▶ to indicate that the machine is ready.



Test

Start Spindle - The ↻ icon and the "RPM" both flash as a reminder to start the spindle again.

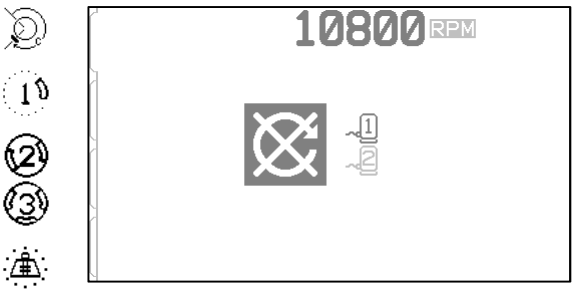
The Back arrow on the screen indicates that pressing ◀◀ will access the history screens.



Test

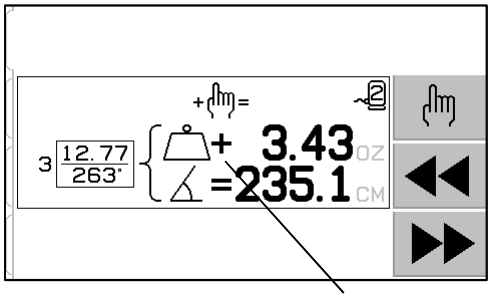
Measure Vibration - Once the rpm has stabilized, the next arrow will appear on the screen and flash. Pressing ▶▶ will store this measurement into memory.

The Back arrow on the screen indicates that pressing ◀◀ will access the history screens.

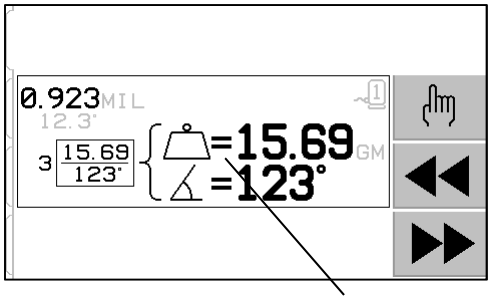


Solution

Stop Spindle - The ⊠ Stop Spindle icon flashes as a reminder to stop the spindle.



Additive Weight Solution (+)



Absolute Weight Solution (=)

Solution

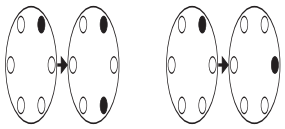
Apply Weights - The weight should be changed to the position and mass shown to bring the balance to a minimum.

Place balance weights on same radius as the test weight.

There are two ways to display the solution:

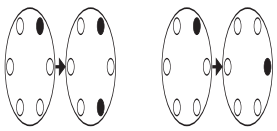
Additive Solution (+)

Leave all existing weights on the machine and only add what is shown.

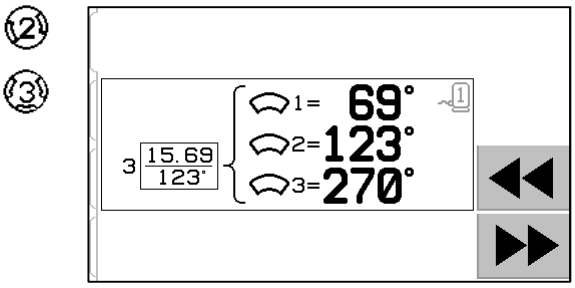
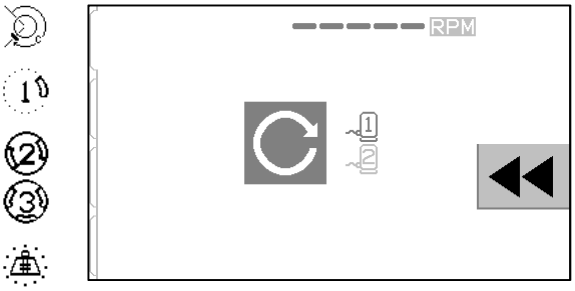
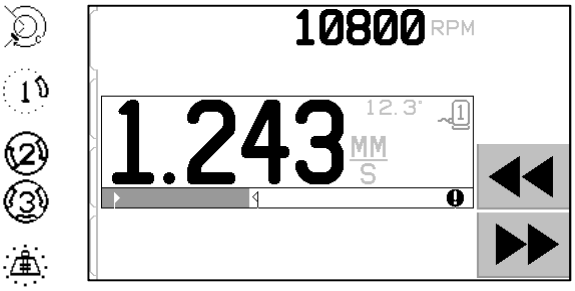


Absolute Solution (=)

Remove all test weights first then place weights as shown.

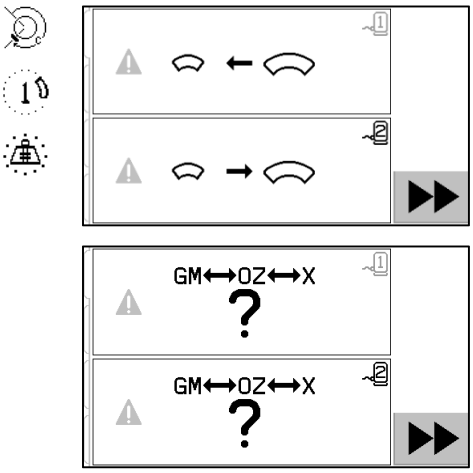
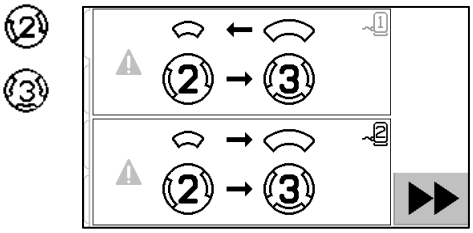


Press ✋ to Toggle between Additive and Absolute Weight Solution screens. (note +✋= icon on solution screen).

	②③ Apply Weights - The weight should be changed to the positions shown to bring the balance to a minimum. Press the next button ▶▶ to indicate that the machine is ready.
	**Solution** Start Spindle - The ↻ icon and the "RPM" both flash as a reminder to start the spindle again. The Back arrow on the screen indicates that pressing ◀◀ will access the history screens.
	**Solution** Measure Vibration. Once the rpm has stabilized, the right arrow will appear on the screen and flash. Pressing the next button ▶▶ will store this measurement into memory. The Back arrow on the screen indicates that pressing ◀◀ will access the history screens. If the resulting vibration is below the Balance Limit ▶ the balance process will complete and exit to the main screen. If the resulting vibration is above the Balance Limit, a new balance solution will be provided to correct for the residual unbalance.

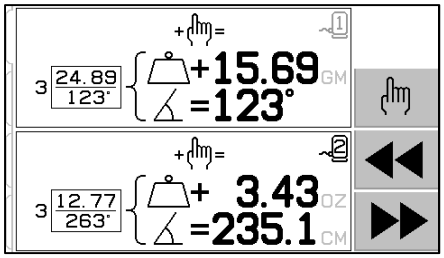
Every subsequent balance solution is a **Trim Balance**. A Trim balance is just another iteration of the Solution Phase, performed if more adjustment is needed. If changes are made, a new complete balance operation should be run by pressing T.

One of the following screens may be displayed instead of the Solution screen if the Balance Solution is difficult to achieve.

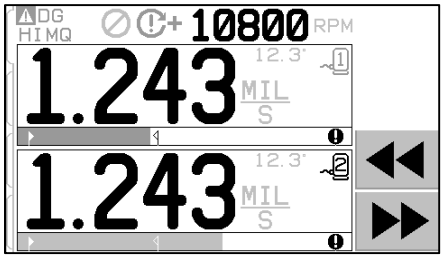
	The top screen shown indicates that either smaller or larger weights should be used. Press ◀◀ button to return to history screens for an opportunity to use a larger weight and repeat the Test phase. The bottom shown screen indicates that the compensation numbers are very large or small for accurate display and the weight units in use may need to change. Press ▶▶ button to return to the Apply Weights screen without making any changes.
	The images depict suggestions to improve results by increasing or decreasing the weight and/or changing the balance type between two and three weights. Press ▶▶ button to return to the Apply Weights screen without making any changes.

Pre-Balance Steps for Dual Plane

For simplicity, the pre-balance steps above are shown for single plane balancing. The steps for two-plane balancing are identical, but weight placement screens and measure vibration screens will show information for each of the two planes, with the top of the screen indicating one plane and the bottom of the screen indicating the second plane.

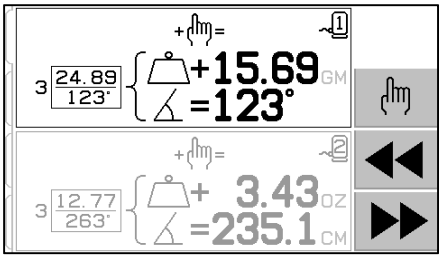


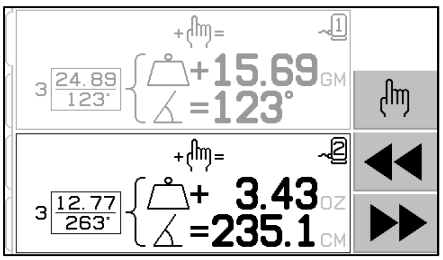
Weight placement



Measure Vibration

The test weight placement phase is broken into two separate steps, with one weight placement for each plane. The screen will show one plane as active, with the other plane shown greyed out. Complete each of the weight placements in sequence as directed.





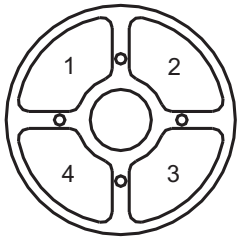
Manual Balancing

The SBS Balance System is fully automatic, but can also be operated manually. The ability to inject fluid into the Chamber manually is useful for performing diagnostic tests and allows operators to manually balance machines where desired.

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 labeled C1 through C4 and pressing a button will inject fluid in the designated quadrant of the Chamber for the duration of the button press. **Only one button may be operated at a time**.

To manually balance, inject fluid into the individual Chamber quadrants in the direction which reduces the vibration reading on the Vibration Display. This should be accomplished in three stages.

Stage 1: Perform a trial injection of the same duration into each of the four Chamber quadrants, noting which produces the largest downward change in vibration level. The balance vector needed will be produced by using this primary quadrant, in combination with one of the two adjacent quadrants. Identify which adjacent quadrant also contributes to reducing the vibration level.



Stage 2: Perform short injections into the primary quadrant and repeat as needed to achieve a minimum vibration level. Injecting into the opposite quadrant will reverse any overshoot of the minimum point.

Stage 3: Inject short bursts into the adjacent quadrant until a new minimum is reached. Injecting into the quadrant opposite will reverse any overshoot of the minimum point.

Any change in vibration level of the machine will lag behind the injection of the fluid by one or two seconds. This is due to a "settling effect" of the machine and fluid in the chamber. When the correct direction of vibration movement is not immediately clear, or the vibration level itself is small (2.0 microns or less), any injection of fluid should be performed in small increments, with a delay of two seconds between to evaluate each injection's effect.

Manual RPM filter

The system can also be used as a vibration measurement and analysis tool. The Control Unit's vibration frequency filter can be manually adjusted from 300 to 30,000 RPM in increments of one RPM. This allows the Control Unit to operate independently of the Balancer, and to measure vibration levels occurring at different frequencies.

To set the Manual Filter, detach the 12-pin Balancer Cable from the Control Unit to eliminate any incoming RPM signal. Press the MAN. button on the balancer Main Screen to enter the 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 to display vibration levels at other frequencies. A complete analysis of all frequencies of interest is also available using the Plot Vibration feature.

Plot Vibration

This function performs an automated vibration spectrum sweep at specified RPM (frequency) ranges, and displays the results graphically on screen. It can be 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. The minimum and maximum operating RPM of the grinder should be determined. The suggested evaluation range is from 0.4 x (minimum RPM) to 2.0 x (maximum RPM). This includes all frequencies which will have potential harmonic influences on the operating RPM range. Also a wide range can be used to indentify an area of interest, and then to gain more detailed information, a narrower plot performed on the RPM range of interest.

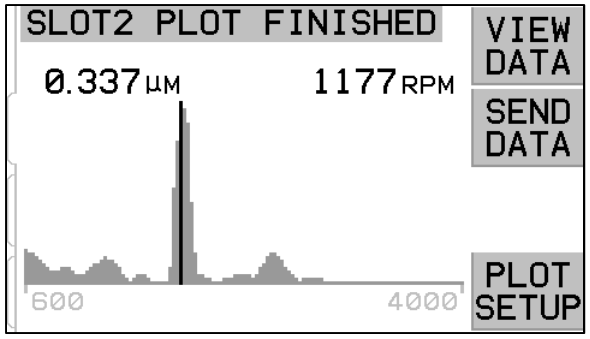
RPM RANGE – Select PLOT VIBRATION from the menu, then select RPM RANGE. The RPM Range is the frequency range that will be evaluated during the spectrum sweep. Use the arrow buttons to set the low end of the RPM range, press ENTER to store the value, and then enter the high end of the range in the same 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.

START – This begins the vibration sweep for the selected RPM Range. The rotating hour glass on the right hand side of the display indicates the Control is sweeping through the RPM range. During this process all recorded RPM, Vibration level pairs are sent out the software interface, in ASCII format. When the RPM sweep is complete, the display will show the resulting frequency plot. An un-cancelled plot will display full width on the screen. Cancelled plots will have fewer points and display in a narrower width. The vertical scale is linear, and based on the peak value, displayed at the top of the plot. The horizontal scale is logarithmic. The peak frequency will be displayed by a white line.

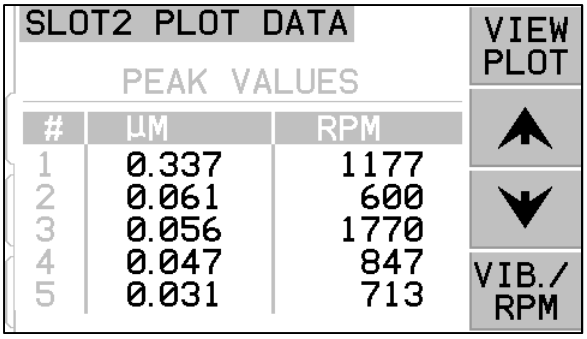
1) VIEW DATA. Press this button to change the display to a listing of peak vibration values. These are the top 20 (or less) values recorded in the selected range. The VIB./RPM button on this screen sorts the order of these values, allowing them to be ordered by vibration level or RPM. The arrow buttons are used to scroll up or down through the values. The VIEW PLOT button returns to the screen showing the last recorded graph.

2) SEND DATA. Press this button to export the recorded peak values, and corresponding RPM levels out the software interface, in ASCII format. This information can be captured and used as needed.

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.



Frequency plot



Peak values display

Hardwire Interface

Interfacing the SBS Balance System with a CNC or PLC machine controller is supported via a hardwire interface or software interface. The hardwire interface is provided via a standard DB-25 connector located on the rear panel of each Balancer Card, while the Software interface is supported via either the USB or Ethernet connections, which are 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 the grinding machine's controller must operate the SBS System. It is not possible for the SBS System to control the grinding machine.

Carefully read this entire manual 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.

Hardwire interface overview

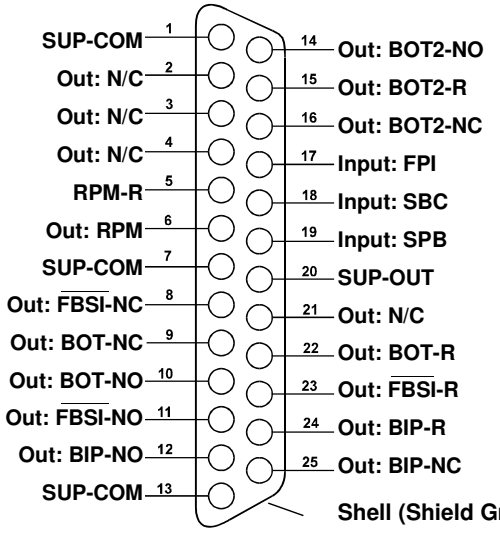
The hardwire interface consists of three sections: interface power supply, the inputs, and the outputs.

The interface power supply is provided exclusively for use with the hardwire interface inputs. It consists of three common pins and one output pin. The common pins are internally connected to chassis and earth ground. The output provides a maximum of 30 mA at approximately +15VDC. Any external power used for interface I/O must be from a SELV (Safety Extra Low Voltage) source or supply.

The three inputs provide noise immunity and robustness. The inputs are activated by being pulled high, either by connection to the SB-5500 hardwire 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-5500 hardwire 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.

SB5518 DB-25

Standard for SB-5500 balancers



The four outputs consist of optically isolated, solid state, single-pole/double-throw relays. These contacts may be used to supply an output signal by connection to a voltage source supplied by the customer. The 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 to 50VDC.

The three contacts of a single-pole/double-throw relay are 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” is used below to indicate the common contact of the relay.

Input pin names and functions

Pin#	Name	Description
18	**SBC**	Start Balance Command- Momentarily activated to initiate an automatic balance operation. The rising edge of this signal starts the operation.
19	**SPB**	Stop Balance Command- When active, this input stops an automatic balance operation in progress and inhibits the start of an automatic balance operation from either the hardwire or software interface. AUTO button is still functional on front panel.
17	**FPI**	Front Panel Inhibit- When active, key operator actions at the front panel keypad are disallowed. The MENU, MAN., 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. Access to the SHOW-ALL button and System Status screen are allowed.

Output pin names and functions

Pin#	Name	Description
22 10 9	**BOT-R,** **BOT-NO** **BOT-NC**	Balance Out of Tolerance: Return, normally open, and normally closed contacts. This output is active when 1) the measured vibration level exceeds the operator set vibration Tolerance, and remains active if the vibration exceeds the Critical Tolerance. 2) It is also active if the spindle RPM exceeds the operator defined Critical Max. RPM, but not active if spindle RPM falls below the user set Critical Min. RPM limit. Function of this relay during an automatic balance cycle is determined by the CNC BOT MODE setting.
15 14 16	**BOT2-R** **BOT2-NO** **BOT2-NC**	Balance Out of Tolerance Two: Return, normally open, and normally closed contacts. This output is active 1) when the measured vibration level exceeds the operator defined Critical Tolerance, 2) when the spindle RPM exceeds the operator defined Critical Max. RPM, or 3) if spindle RPM falls below the Critical Min. RPM limit set. Function of this relay during an automatic balance cycle is determined by the CNC BOT MODE setting.
24 12 25	**BIP-R** **BIP-NO** **BIP-NC**	Balance In Progress: Return, Normally Open, and Normally Closed contacts. This output is active while an automatic balance operation is in progress.
23 11 8	**FBSI-R** **FBSI-NO** **FBSI-NC**	Failed Balance/ System Inoperative: Return, normally open, and normally closed contacts. This output is active when the system is in normal operation mode, with the power on, and after a successful Power On Self-Test. It is de-energized if the control is in a power off or power standby mode, or if an error or fault condition arises.
6 5	**RPM** **RPM-R**	This solid state relay closes once per revolution. This is a buffered output of the RPM signal generated by the balancer. It is not available if the RPM has been entered manually.

Software Interface

The SBS Balance System provides a software interface via either Ethernet TCP/IP or USB. The software interface allows the same control capability as the hardwire interface plus system status monitoring, setting the Auto-Balance Limit, and vibration spectrum analysis. The following description applies to all SB-5500 models.

Interfacing

The software interface provides a serial interface emulation which connects the Control to a Windows computer over either Ethernet TCP/IP or USB. For TCP/IP, use Telnet at the Windows command prompt pointed to the IP address of the Control, or use HyperTerminal or similar serial communications software pointed to port 23 with any baud rate setting. When connecting via USB, Windows will assign a COM port to the control. If the SB-5500 is not automatically assigned a COM port, a driver for Windows installation of USB-Serial communication is available on the SBS website at www.grindingcontrol.com. COM port assignment is controlled by Windows, and a unique COM port will be assigned for each detected SB-5500 control. The port assigned can be determined by viewing Windows Device Manager. Use HyperTerminal or other serial communications software to interact with the Control over USB connection.

Software commands and responses

When the Control unit is first powered up, the following message is transmitted via the software interface.

/SB-5500, Copyright (c) 2009, Schmitt Industries, Inc.<CR>
V0.02<CR>

Commands - A message preceded with the digit '1' through '4' is a command or response referring to Slot Cards 1 to 4, respectively. A message starting with any other character refers to the System Control. Examples following use "1" as the card slot number.

The following commands from the Software Interface 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>**

Slot 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.zzVn.nn [sss]/text	Slot response. z.zz indicates Slot Card type: 1.02 is Mechanical Balancer; 1.03 is N/C Balancer; 2.02 is Hydro Balancer; 3.00 is AEMS card; 5.00 is Manual Balancer. n.nn is balancer firmware revision. sss is the user specified name for this card. The slash precedes a text comment that explains the card type. **1X1.02V0.15[NAME]/MECHANICAL BALANCER<CR>** **1X1.03V0.15[NAME]/NON-CONTACT BALANCER<CR>** **1X2.02V0.15[NAME]/HYDROKOMPENSER<CR>** **1X3.00V0.03[NAME]/GAP / CRASH<CR>** **1X5.00V0.15[NAME]/MANUAL 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. 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>**
	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>**

Slot Card Commands (Cards are Individually Controlled)		
Command	Response	Meaning/ **Example**:
		<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	**1P1<CR>** Current Balance Speed setting is cautious. **<Esc>1P2<CR>** Set Slot 1 Balance Speed setting aggressive. **1P2<CR>** Current Balance Speed setting is aggressive.
R[rrr]		Set critical RPM level. rrr is new Critical RPM level. Values of 301-30100 are used as Critical RPM value. All other values are interpreted as 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. Response of rrr=300 means no limit is set, Critical RPM is OFF. **1R300<CR>**
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>**

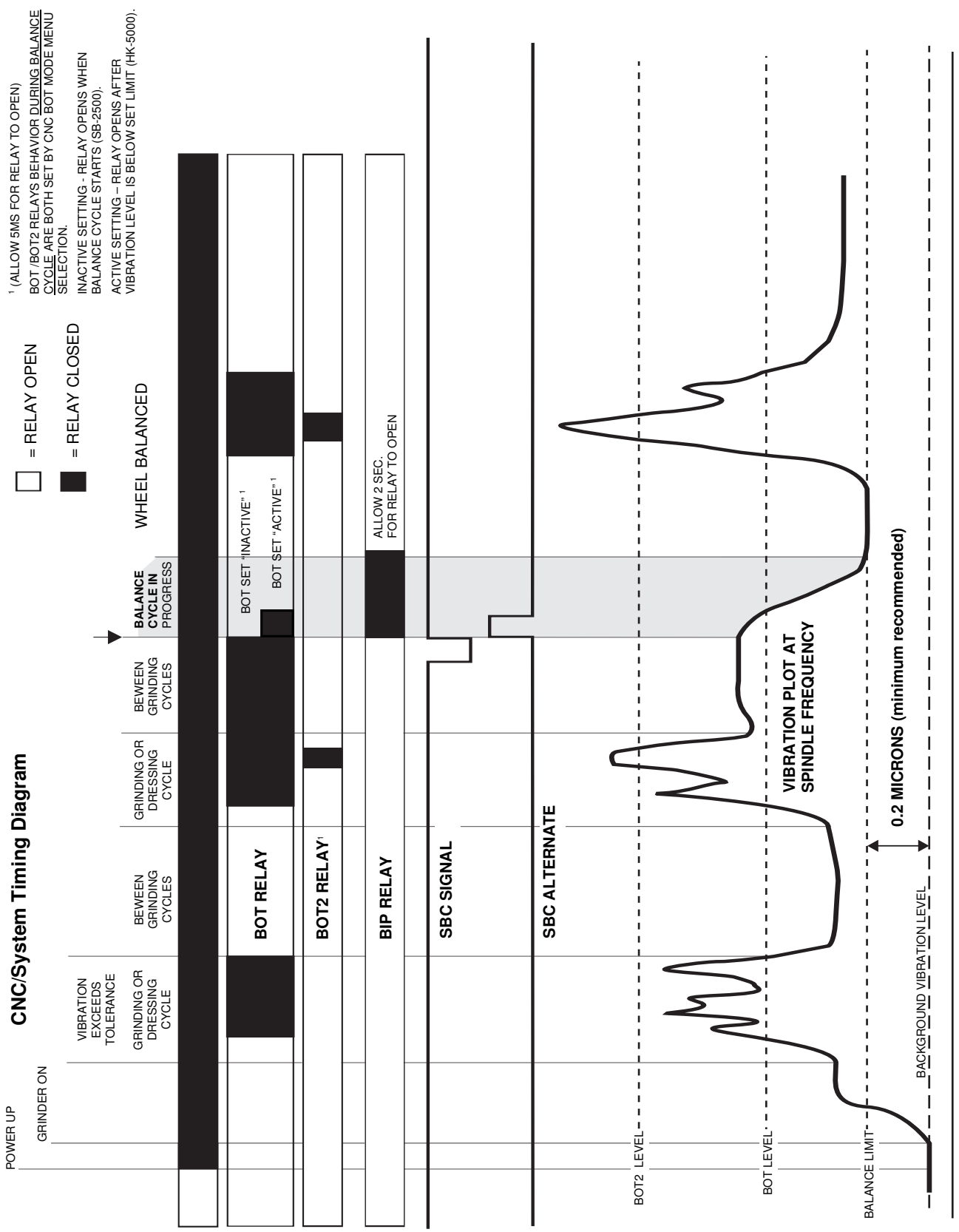
Software operation summary

The Software interface capability of the SBS Balance System allows for fully automated balancing and testing of a grinding machine. For example, if the vibration spectrum of a new machine is recorded, it may be kept for future reference to gauge relative bearing condition, spindle balance and 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. This data may be used to indicate when a grinding wheel needs to be changed or other maintenance performed.

Profibus DP Interface

A Profibus Implementation document, along with the required Profibus GSD file, can be downloaded from the SBS website at www.sbs.schmitt-ind.com/support/software-firmware/.

CNC/System Timing Diagram

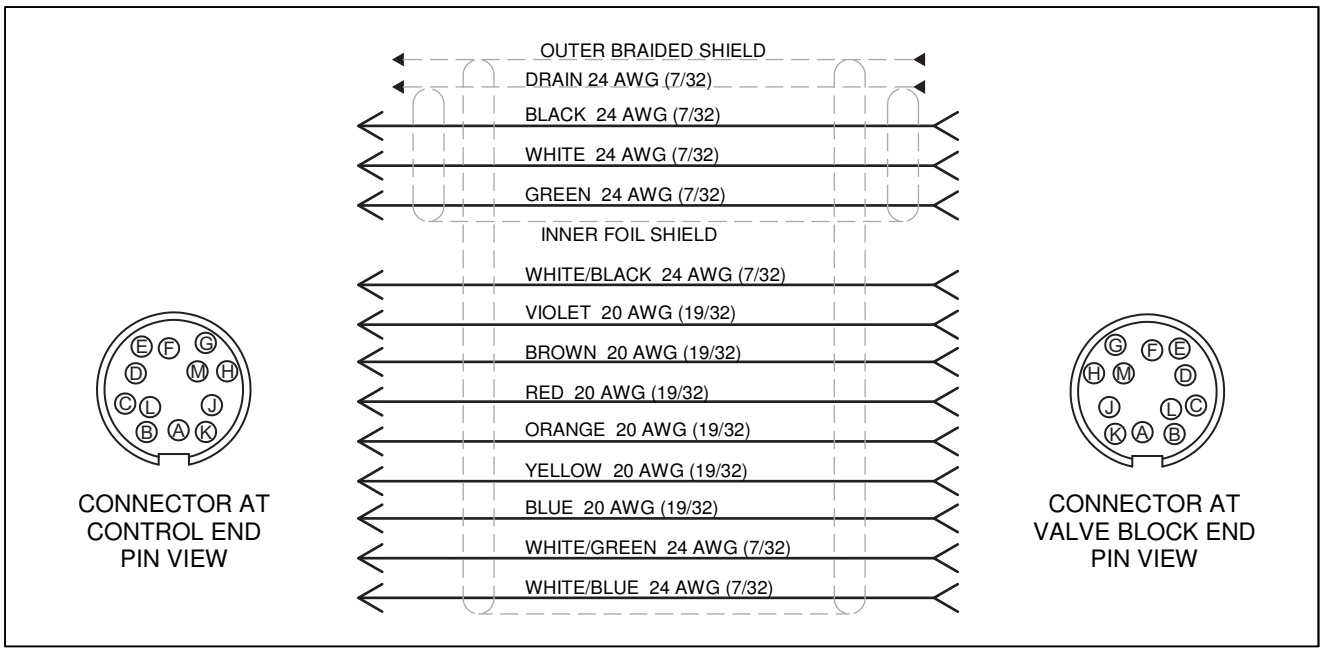


System Maintenance

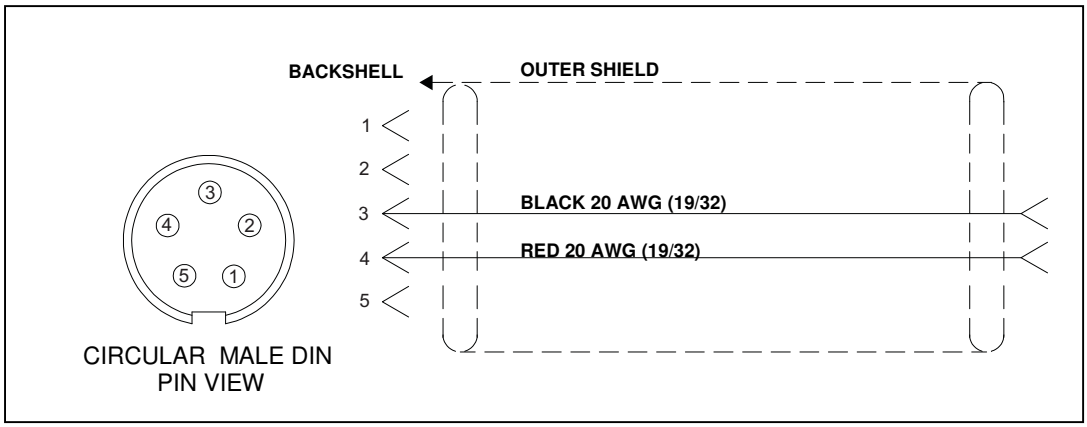
Maintenance

Operator maintenance of the SBS Control is restricted to replacement of the line fuse. Cable schematics follow in order to assist with minor repair or wiring connection work. Regular Maintenance on the Hydrokompenser system should include periodic cleaning and removal of swarf or other buildup inside the Balance Chamber. After removing the chamber lid or whenever a leak in the chamber is found, it is necessary to completely clean the mating faces of the Chamber Body and Chamber lid, then reseal the perimeter of each quadrant of the chamber using a hardening engine gasket sealant. SBS recommends Loctite 518. Periodic cleaning or replacement of the coolant filter when it becomes clogged, and periodic cleaning and flushing of the Valve Block and Nozzle to remove buildup are also necessary. If a solenoid valve fails, replacements can be ordered from the factory and installed by the customer. If further service is required, contact your SBS Manual Balancer source, or Schmitt Industries Inc.

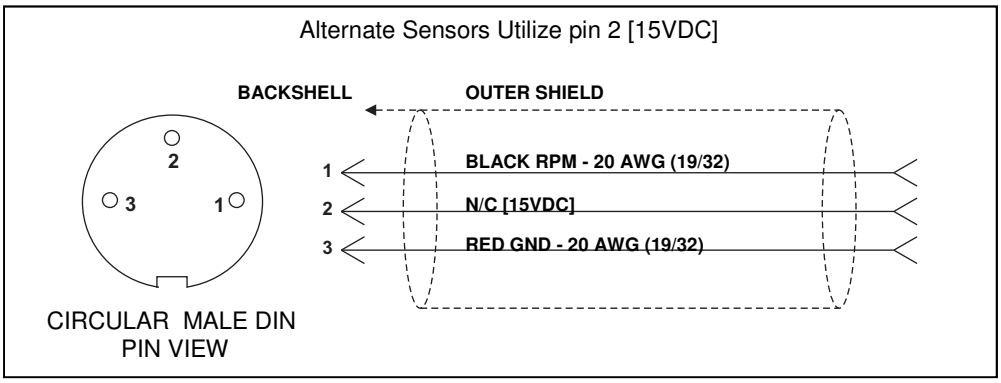
Valve Block cable schematic – SB-46xx



Vibration sensor schematic – SB-14xx



RPM sensor schematic - SH-1778



Trouble Shooting Guide

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 by overnight delivery at our facility. 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 returning 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.

This guide is designed to help you if you experience problems with your SBS Balance System.

Step 1 If the Control Unit displays any error messages, refer to the Displayed Error Messages section of the manual for explanation of the message. Contact Schmitt Industries for assistance as required. **When reporting a service issue, please indicate the Error Code (letter) of all displayed Errors.**

Step 2 Verify that the unit is receiving an RPM signal from the RPM sensor. If no RPM signal is shown with the spindle rotating, adjust the position of the RPM sensor (see manual section: *RPM Sensor Installation*). If position adjustment of the RPM sensor does not produce an RPM signal, the RPM Sensor and Control Unit should both be returned for repair.

Step 3 If the Control Unit displays an RPM signal, but no vibration signal, check the Vibration Sensor. Verify that the Sensor is firmly seated on the machine, its magnet is 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)*.

If you continue to receive no reading from the Vibration Sensor, the Vibration Sensor and Control Unit should both be returned for repair.

Step 4 If the Vibration and RPM sensors are working correctly, then perform an integrity check of the rest of the system. This test should be performed with the machine running, but not during a grind or dress cycle. Press the MAN. button to enter the manual mode, and simply press each of the four manual buttons, one at a time, for a period of about 5 seconds. With each injection of fluid, the system should register a change in the displayed vibration level on the Control Unit. Next inject fluid into chamber quadrant 1 for 10 seconds, observe the vibration change, and then inject into quadrant 3 for the same amount of time. Injection

into these two quadrants should produce an equal and opposite change in vibration level. Perform this same test with quadrants 2 and 4. If you do not get normal response from these tests, there is a service problem with the system which the below chart may help with.

Step 5 If the control unit's self check shows no service problem with the SBS System, then investigate environmental/application issues. The background vibration level on the machine should be checked, and the Balance Limit setting verified as appropriate with this level. *(see: Environmental Considerations section) (see: Setting Operating Parameters section).*

Issue	Cause	Remedy
Unbalance increases constantly in short time	Balance Chamber leaks	Seal Chamber Lid
No or little change of unbalance while injecting	Balance Chamber leaks, poor injection	Adjust valve block
	Hydraulic circuit does not operate properly	Check hydraulic as follows: • Select Manual Mode • Change unbalance display by about 1 pm by injecting coolant for example into valve 1 (chamber 1) • This procedure takes about 10-20 seconds. When operating valve 3 (chamber 3) the amount of vibration display has to be brought back to the basic initial value in the same time. • The same procedure has to be repeated with valves 2 and 4 (chambers 2 and 4). If this cannot be done, the following measures have to be taken: • Check or - if necessary - change connections of valves 1, 2, 3, 4 • Adjust valve block correctly • Place chamber no. 1 opposite to injection valve 1. The liquid jet will not be reflected if positioning is correct. • Adjust coolant pressure in a way that the liquid jets of all valves are deflected after approx. 1 ½ ft (0.5 m).
System cannot be balanced to within tolerance	Interfering vibrations	Balance vibrating assemblies (e.g. drive motor) Change speed of possible second spindle Change position of vibration transducer at same level
	Coolant pressure	Adjust so that stream from Nozzle is deflected after 0.5m (1.5 ft) Water: 7 - 21 psi (0.5-1.5 bars) Oil: 14 – 58 psi (1-4 bars)
	Hydraulic circuit does not operate properly	See above
	Vibration transducer is placed at a bad spot	Fit vibration transducer in another position of machine
	Tolerance limit too low	Increase tolerance limit

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

Display test option

The display can be tested for functionality during control power-up by pressing one of the function buttons above "SETUP", 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 once more will return 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

Self-diagnostic software has been incorporated into all SB-5500 Balance Control Units. If a problem ever occurs with an SBS system, It is reported on the front panel display as an error code. Below is a listing of these error codes, a description of when the Control Unit automatically runs each test, how each code is cleared, the definition of each error message, and prescribed action to be taken by the user.

Press CLEAR or CANCEL to manually clear a displayed error message. Once an error is cleared, it will be displayed again when the error condition is next detected. To further isolate defective components a series of test operations accompany some of the error codes.

Please indicate the Error Code (letter) of any displayed Errors when returning equipment for repair. Also please provide as much detail as possible regarding the conditions when problems were encountered, and the symptoms experienced.

Error Code	Message	Definition	Action
A	RPM OUT OF RANGE OPERATION RANGE IS 300-30000 CHECK RPM SENSOR	Checked continuously. Displayed if the RPM signal coming from the Balancer is below 300 RPM or exceeds 30,000 RPM.	Clears automatically. 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	VIB SENSOR DEFECT OPEN – CHECK CABLE AND CONNECTORS - SEE MANUAL	Checked continuously. Vibration Sensor presence not detected. This could be caused by a defective sensor or by no sensor being connected.	Clears automatically when sensor detected. Check sensor connections and try Power-On again. Continued error messages indicate the need for repairs to the Sensor.
C	VIB SENSOR DEFECT SHORT – CHECK CABLE AND CONNECTORS – SEE MANUAL	Checked continuously. Vibration sensor short circuit detected.	Clears automatically. 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	VALVE DRIVER FAULT SHORT – CHECK CABLE AND CONNECTORS – SEE MANUAL	Checked at the end of a valve pulse. Valve short circuit detected.	Cleared manually. Determine which component is defective by swapping parts 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 the MAN. Button to enter manual control mode. Press and hold down the first of the four manual valve buttons for 15 seconds. Repeat with each of the manual buttons, one at a time. If error E is displayed, clear this error it is expected. If no other error occurs during this test, then the problem is with the Valve Block. If error D or F is displayed, then continue on with this test. Disconnect the cable from the Control Unit, and repeat the above test, using all four manual motor buttons, one at a time. If error E is displayed, clear this error it is expected. If no other error occurs during this test, then the problem is with the Valve Block Cable. If error D or F is displayed, the problem is with the Control Unit.

Error Code	Message	Definition	Action
E	VALVE DRIVER FAULT OPEN – CHECK CABLE AND CONNECTORS – SEE MANUAL	Checked at the end of a valve pulse. Valve open circuit detected.	Cleared manually. Determine which component is defective by swapping with another system. Return defective component for repairs. If in doubt, return all items.
F	VALVE DRIVER FAULT EXCESS CURRENT - PERFORM MANUAL FUNCTION TEST	Checked at the end of a valve pulse. Valve – excessive current detected (short or stall).	Cleared manually or by pressing Auto button. Verify that both ends of the Valve Block Cable are properly attached. If connector pins are contaminated, clean with electrical contact cleaner. If the problem persists, determine if the Valve Block Cable is the defective component by swapping with another system, or by using a voltmeter and consulting the enclosed schematic. This error can be caused by motor/gear train failure inside the balancer. Return the defective cable or Valve Block for repairs. If in doubt, return both items.
G	AUX POWER DEFECT SHORT – CHECK CABLE AND CONNECTORS - SEE MANUAL	Checked continuously. 24V Auxiliary Supply low – fuse open.	Cleared automatically. Determine which component is defective 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. Unplugging one cable at a time from the control can help isolate the problem component. If the error persists return Control Unit and cables for repair.
H	RPM/CNC POWER DEFECT SHORT – CHECK CABLE AND CONNECTORS - SEE MANUAL	Checked continuously. 15V Auxiliary supply low – fuse open.	Cleared automatically or by pressing Auto button. Check for shorts in RPM Sensor and machine controller interface cables and connectors and re-initiate system check. Unplugging one cable at a time from the control can help isolate the problem component. 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. If the error persists return Control Unit and cables for repair.
I	AUTO-BALANCE FAILED LIMIT NOT REACHABLE BEST BALANCE ACHIEVED AT	Checked during Auto Balance cycle. Auto Balance Failed – unable to reach limit.	Cleared manually or by pressing Auto button. 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.

Error Code	Message	Definition	Action
J	NO RPM SIGNAL CHECK CABLES CHECK SPINDLE	Checked continuously. No incoming RPM signal, possible open in RPM sensor circuit.	Cleared automatically or by pressing Auto button. Ensure that the spindle is running, with balancer cable attached at both balancer and control ends. Determine which component is defective by swapping with another system. Return defective component for repairs. If in doubt, return all items.
K	ABNORMAL CONDITION BAL CYCLE COMPLETED AFTER ERROR DETECTED SEE MANUAL	Checked when Auto Balance Cycle Complete. Balance cycle completed with errors (after error detected and cleared)	Cleared manually. No action required other than clearing error.
L	CIRCUIT FAILURE UNABLE TO MEASURE VIBRATION SEE MANUAL	Checked continuously. Signal acquisition circuit failed.	Cleared automatically. No action required other than clearing error. If the problem persists, the Control Unit should be returned for repair.
M	FILTER CONTAC OPEN COOLANT FILTER CLOGGED - CLEAN OR REPLACE COOLANT FILTER	Checked during Auto Balance cycle. Coolant filter indicator indicates clogged filter.	Cleared automatically. Stop Machine, clean or replace filter and restart balancing.
N	CHAMBER FULL EMPTY CHAMBER AND RESTART BALANCING CHECK INITIAL UNBALANCE	Checked when Auto Balance Cycle Complete. Balancing chambers might be full.	Cleared automatically. Stop Machine Spindle, empty chambers and restart balancing. If problem persists, either chambers are clogged with dirt and capacity is reduced, or unbalance is too big for installed chambers.
O	RPM UNSTABLE CHECK SPINDLE CHECK MACHINE	Checked during Auto Balance cycle. Unstable reading from RPM sensor.	Cleared automatically. Stop Machine, check setting of speed sensor. Check speed sensor operation, replace if necessary
P	CHECK DIRECTION SETTING	Checked during Auto Balance cycle. Incorrect direction setting.	
	INTERNAL VOLTAGE ERROR	Checked continuously. A Fault with one of the internal power supplies of the Control	Note conditions when the error occurred and return the Control for repair.

Appendix A: Specifications

Physical Features

Multiple Device Control
Four (4) available slots accept these control cards:

SB-5512	Mechanical balancers with cable connection
SB-5518	Hydro Balancers
SB-5522	Acoustic Emissions Monitoring System (AEMS)
SB-5532	Mechanical balancers with non-contact connection
SB-5543	Manual balance control

SB-4500 Compatible
Operates with existing balancers/cables, sensors, CNC/PCL Hardwire Interface

Display
Type: Color TFT LCD
Active area: 480H x 272V pixel
3.74 inch [95mm] x 2.12 inch [53.86mm]

Multi-language Capability

Communication Interfaces
Ethernet TCP/IP, USB 2.0, Profibus DP, CNC/PLC Hardwire Interface (opto-isolated outputs)

DC or AC Power Options

DC Supply: Input 21 VDC to 28 VDC. 5.5A max at 21 VDC. Reverse voltage protected.

Connector: Molex 50-84-1030 or equiv.
Contacts: Molex 02-08-1002 or equiv.

AC Supply: 100-120 VAC, 50/60 Hz, 2A max; 200-240 VAC, 50/60 Hz, 1A max. Main supply voltage fluctuations not to exceed +/-10% of nominal supply voltage.

Performance

RPM Reporting
300 to 30,000 RPM

Sub-micron Vibration Range
50 µg to 1.25g

Vibration Display Resolution
Three user selectable options
1) 0.1 µm 0.01 mil 0.01 mm/s 1 mil/s
2) 0.01 µm 0.001 mil 0.001 mm/s 0.1 mil/s
3) 0.001 µm 0.001 mil 0.001 mm/s 0.01 mil/s

Vibration Display Repeatability
6,000 RPM ±1% @ 5.0 µm
300 – 30,000 RPM ±2% @ 50:1 signal to noise

Vibration Display Accuracy
6,000 RPM ±2% @ 5.0 µm
300 – 30,000 RPM ±4% @ 50:1 signal to noise

Auto-Balance Resolution
0.02 microns displacement at 6,000 RPM

Vibration Filter
Custom digital filter has bandwidth +/- 3% of measurement RPM

Certifications
ETL and CE certified

Environmental and Installation

Pollution degree 2
Installation category II
IP54, NEMA 12
Environmental temperature range: 5°C to +55°C

Vibration Sensor

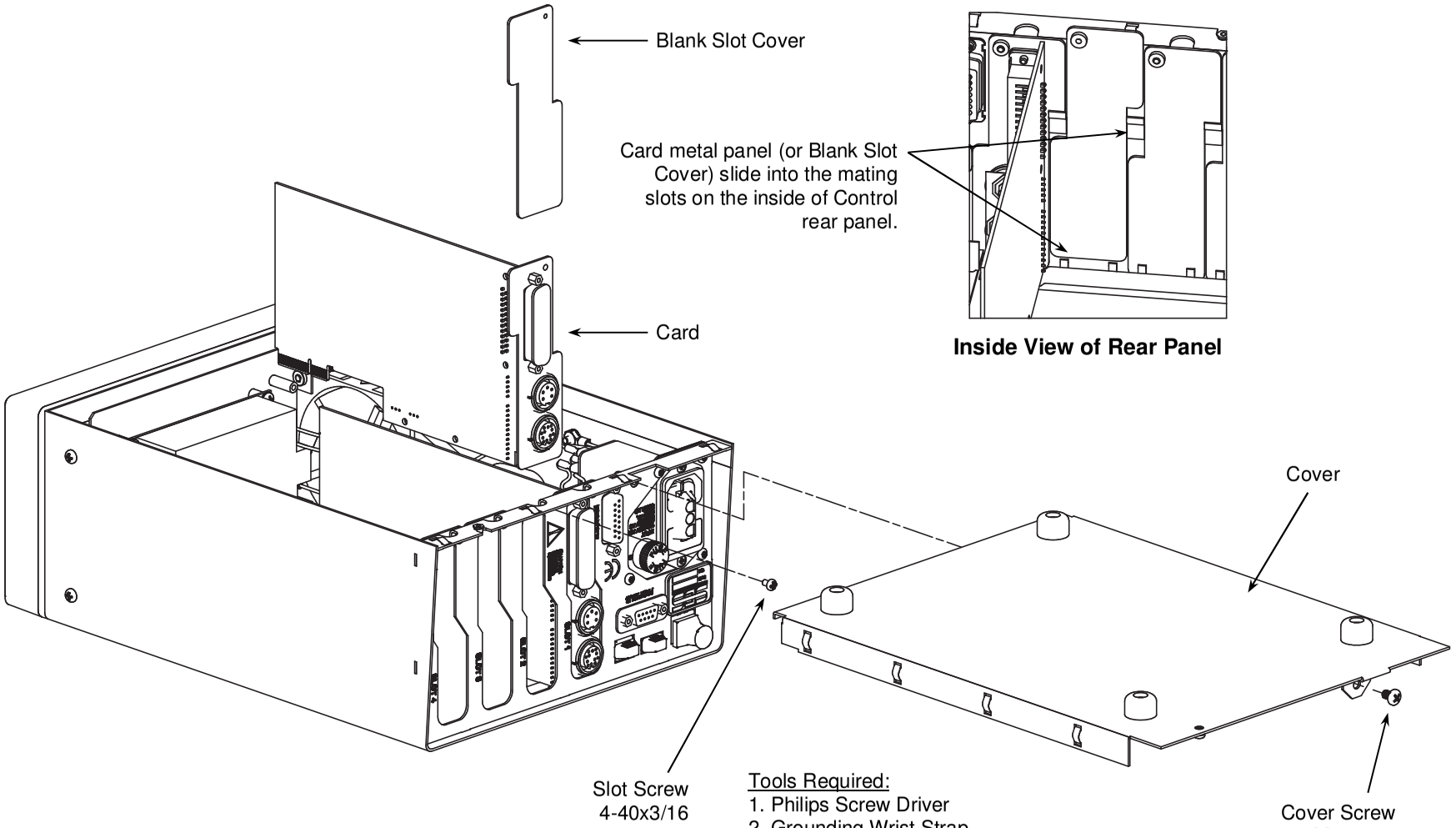
Sensitivity Range	+ /- 25g
Sensitivity Resolution	0.0001g
Voltage Sensitivity	100 mV/g
Excitation Current	2 to 8 mA
Frequency Response	0.5 to 5000 Hz
Operating Temperature	0 to +70 C

Appendix B: Replacement Parts List

Part#	Description
Valve Block cables	
SB-46xx	Valve Block Cable /Extension Cable for SH-4000
SB-46xx-W	Valve Block Cable for old model SH-1942
CA-0121	12-pin Male DIN (control end for 46xx series cables)
CA-0122	12-pin Female DIN (Valve Block end for 46xx series cables)
Controls/ options	
SB-24xx-L	Hardwire Interface cable (standard lengths)
SB-43xx	Remote Keypad Cable for SB-5500
SB-5500	CONTROL UNIT (Expandable to 4 Card slots)
SB-5512	Additional Mechanical Balancer Card
SB-5518	Additional Hydrokompenser (water balancer) Card
SB-5522	AEMS Gap/Crash Monitoring System Card
EC-5605	A/C Control Fuse, 3 amp time lag 5x20 (2 required)
EC-5614	D/C Control Fuse, 6.3 amp time lag 5x20
CA-0009	Power Cord
CA-0009-G	Power Cord (Germany)
CA-0009-B	Power Cord (British)
Vibration sensors	
SB-14xx	Sensor Cable (standard lengths)
SB-16xx	Sensor Ext. Cable (standard lengths)
CA-0112	5-pin Male DIN
Control mounting hardware options	
SK-5000	Rack Panel: SB-5500, Full Wide w/ 1/2 Blank, 3U
SK-5001	Rack Panel: SB-5500, Partial Wide 3U w/ Handles
SK-5002	Rack Panel: SB-5500, 1/2 Rack 3U Bracket
SK-5003	Control Mount: SB-5500, Bottom Flange
SK-5004	Control Mount: SB-5500, 90 Deg. Bracket, Cabinet
SK-5005	Keypad Mount: Flush Panel Frame Kit
Other parts	
CH-0078	Relay Assembly: CH-0080 Filter Indicator
CH-0080-E	Replacement Filter Element/Screen
CH-0080-V	Complete Filter Assembly with Indicator and Fittings
CH-4001	Solenoid Valve: >SH-4000
CH-4013	Pressure Gage: 0-4 BAR/ 60 PSI, 63mm (1.5")
CH-4013-A	Pressure Gage: 0-10 BAR/ 150 PSI, 63mm (1.5")
SH-1778	RPM Sensor with 3m cable
SH-1779	RPM Sensor Extension Cable, 10m
CH-2440	Replacement Proximity Switch: Round 8.0mm Dia. -Round Nozzles
CH-2441	Replacement Proximity Switch: M8 Thread -SH-1778
CH-2443	Replacement Proximity Switch: Rectangular. -Flat Nozzles

xx in P/N = cable length in feet
Standard options 11 [3.5m], 20 [6.0m], or 40 [12.0m], e.g. SB-4811 = 11ft [3.5m]

Appendix C: Balancer Card Installation



Unit is shown upside down with the cover removed.

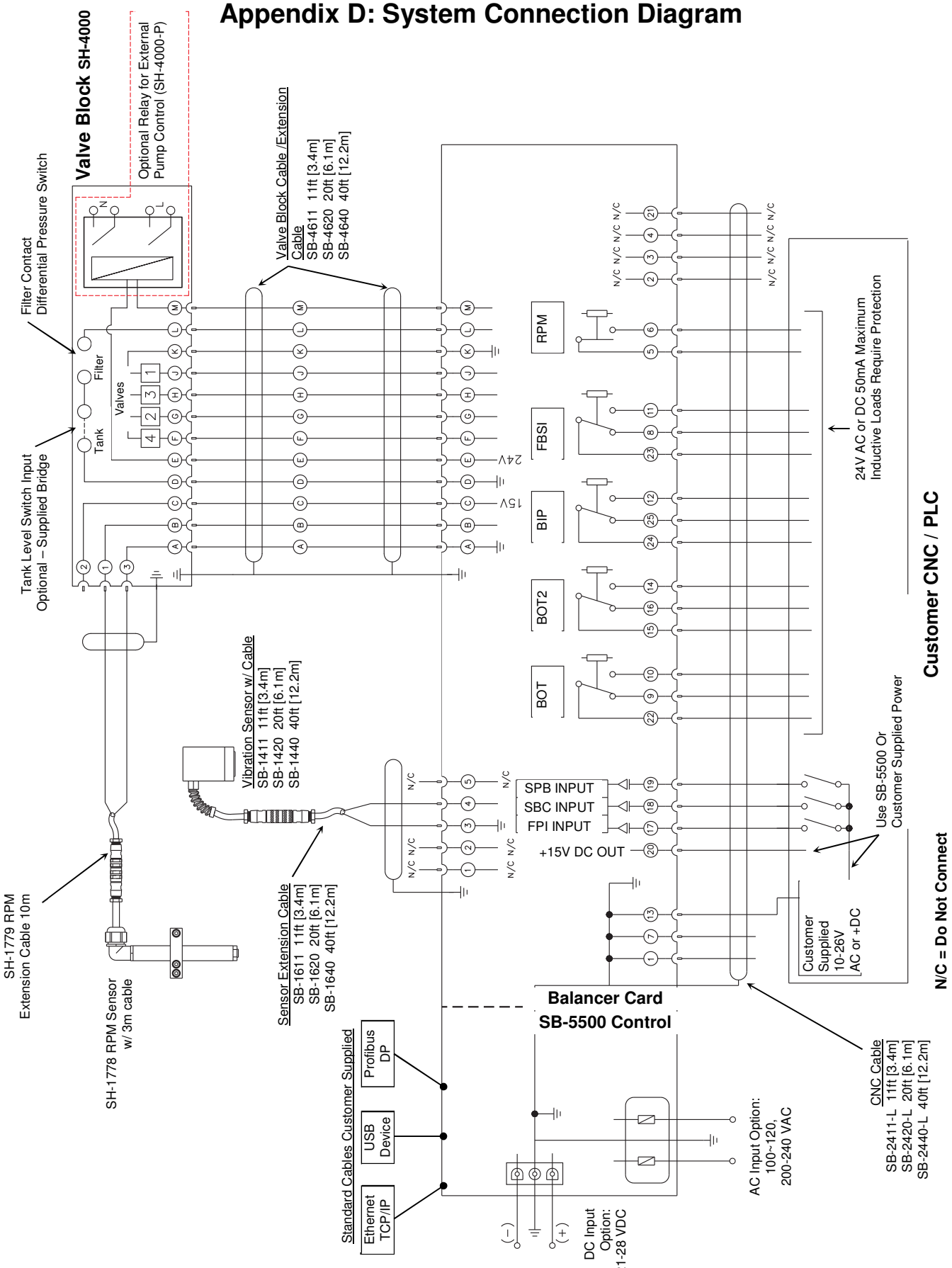
Safe handling requires that technician have the unit open or cards out of ESD bags only on an ESD-safe work surface, and only when the technician is properly grounded

Note: All Service (including card installation) should be performed by a qualified technician, or the unit returned to Schmitt Industries Inc. for service.

Tools Required:
1. Philips Screw Driver
2. Grounding Wrist Strap

Procedure:
1. Unplug Unit, invert, and lay on a ESD Safe Surface.
2. Remove Cover Screw at Back Panel of Control.
3. Remove Slot Screw and Blank Slot Cover.
4. Plug Card into Main Circuit Board while sliding Card metal plate into mating slots on inside of Rear Panel.
5. Install Slot Screw to secure Card.
6. Install Cover And Tighten Cover Screw.

Appendix D: System Connection Diagram



Ordering the SBS Balance System

The SBS Balance System is sold as a set and 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 and matched to your exact needs. The system comes with complete operating instructions, making operator training and system use simple, and helping to bring immediate returns on your investment.