SBS ExactDress™ System
Operation Manual
with SB-5500 Series Control

LL-5400, Rev. 2.4

Productivity through Precision™

SBS®
DYNAMIC BALANCE SYSTEM

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Operation and Specification Manual

for the

SBS ExactDress™ System

with Model 5500 series Control Unit

LL- 5400

Manual Revision # 2.4
Covers operation with rev. 0.20 firmware

Benefits of SBS ExactDress™ System with SB-5500 Control:

- Increases throughput by saving setup time

- Improves part quality by providing dress quality monitoring

- Gap Elimination - Increases throughput by reducing unproductive dress infeed.

- Crash Protection - Quick detection of extreme wheel contact to allow feed shutdown and prevent dangerous wheel crashes.

- Four-channel capability reduces costs by permitting both balancing and process monitoring of multiple machines

- Longer life for grinding wheels, dressing wheels and spindle bearings

- Enhanced digital electronic design with increased operating life and reliability

- Easy to install and operate

- Works with existing SBS installations

- Profibus, Ethernet and USB 2.0 communication

- International adaptability: voltage, frequency, communication, and display language

- Backed by world-class SBS customer service

ExactDress Firmware Revision History:

Rev.	Description
0.20	The VIEW button is enabled during a process such that using this button no longer corrupts data. After adjusting the Gap level for a Job the Gap Sensitivity is saved, and after a sensor Learn the sensitivity value is applied to the Air value to generate the Gap level. The graph time on Run view has been clarified by adding the "s" symbol to the value. It is now easier to edit the last process zone, which was difficult under some circumstances. The Teach process was revised to remove the last zone, which may have poor quality due to small variations in the process time. Both Run and Process views now show relay status for Teach and Start/Stop Inputs, as well as MAX and MIN outputs. Default MAX level now set at 120%. The CNC Error output is active (showing no monitoring) when in Process Teach, Sensor Learn, MIN editing, MAX editing, IGN level editing, zone editing, access of any setup menu, and any error condition. When the CNC Error is activated, existing status output for the most recent process (MIN and MAX) will clear and indication on screen will also clear.
0.19	The 'VIEW' button is disabled during a process to prevent data corruption. Zone indicators at the end of a process are now shown in red if the process cycle was too short to fill those zones with data. This gives a visual indicator of the reason the Min relay is active in this condition. Fixed bug where the CNC Job select input was not always working correctly. Added the display of peak signal values on the Run screen as it scrolls.
0.18	Text (IDLE, NORMAL, etc.) on the Run view screen was replaced with 'G' and 'C' relay indicators and the display plot time. The Run view now shows data filtered like the SB-5522 AEMS card rather than showing the noisier data of previous revs (only applies to product with FPGA rev 02 or later).
0.17	The Gap level is now adjustable graphically from the Run view, replacing the Gap Sensitivity screen. This Gap level is now remembered for this Job until it is edited again.
0.16	A line graph is available in the Run view in addition to the bar graph, selectable through 'Graph Type', now in the Display Settings menu.
0.15	Changed word 'display' to 'screen' under display settings. Minimum value for MIN level was lowered from 10% to 5%.
0.14	The menus were reorganized for more logical access. The number of Jobs was changed to 32. A menu is provided to assign the current Job to the desired CNC input position (A, B, or none). During a learn cycle, the user selects which AEMS sensor is used by each job. Each Job's assigned sensor and CNC input position is visible while selecting the current Job. A parameter was added to the software Cycle command that assigns a Job to the desired CNC input position.
0.13	The Run and Process view button label 'MODE' was change to 'VIEW'. The CNC start event no longer changes the display to the Process view. Job 1 and Job 2 now have separate learns. Job 2 will use sensor 2 if it is present during learn.
0.12	The process display now colors zones blue that have a teach value below the ignore level. While editing the process parameters, the screen is displayed in Full view rather than Clip view so all zones are visible.

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General Instructions

System Purpose

The SBS ExactDress™ System has been developed to provide process control enhancement to grinding machine operators. "Gap" elimination, Crash Monitoring, and Process Monitoring of the quality and consistency of wheel contact in the Dressing process are all provided, with the following objectives in mind:

- **Ease and Usefulness of Operation**
- **Maximum Grinding Machine Efficiency**
- **Minimal Installation Requirements**
- **Close Integration with SBS Balance Systems**
- **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 or ExactDress™ sensor components to the grinding machine spindle, including the proper use of provided adaptor lock screws, 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 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 ExactDress™ system consists of an electronic control, and an acoustic emission (AE) sensor. This electronic control is packaged as a separate device card installed and operated in the SB-5500 series Control unit. The AE sensor is mounted on the grinding machine and located to detect high frequency acoustic emissions generated in the machine structure resulting from wheel contact in the dressing process. The level of this signal is monitored and referenced against known background levels at the same frequency, allowing key events to be automatically and quickly detected on the grinding machine as they occur. These events include: Initial contact of the dresser to the grinding wheel (gap control), or abnormal or severe contact between the wheel and dresser (crash protection).

Process monitoring is provided that assures that either a maximum or minimum degree of wheel contact is maintained throughout a dress or grind cycle. Monitoring results are then reported via the hardwire and software interfaces, and the Control's front panel display. Machine CNC controls can be programmed to use this information to minimize Gap time, protect against damage resulting from wheel crash, and especially to monitor the quality and consistency of the dressing process.

System Installation

System Connections

The Back panel of the SB-5523 ExactDress™ card is shown installed in slot #1 of the SB-5500 control below. The device can be identified by the two four (4) pin circular connectors, for connecting the acoustic sensor(s). The first sensor position (SENSOR 1 -①) is used to connect an SBS AEMS sensor for process monitoring. The lower connector (SENSOR 2 -②) can be used to connect a different AEMS sensor when a separate sensor position or sensor type is installed for monitoring distinct processes.
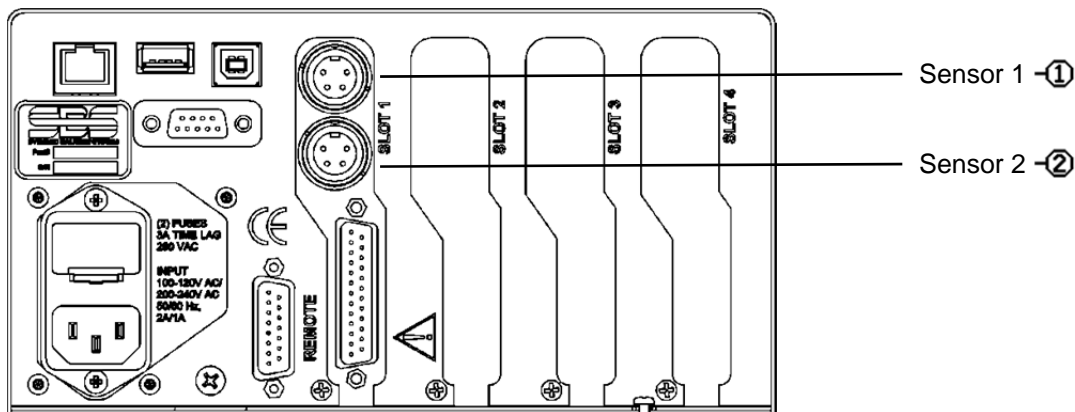
Acoustic Sensor Location

Choose an appropriate sensor location on the grinder for testing. The Sensor must be mounted to the machine casting or some other rigid machine structure. Do not mount acoustic sensors on thin or loosely attached machine components such as wheel guards. The mounting spot should be reasonable flat, and must be free of foreign matter such as swarf. Paint removal is advisable but not required.

The critical issue to be considered in placing the sensor is acoustic transmission quality. The sensor should be location on a rigid part of the grinder so that the high frequency noise resulting from contact between the wheel and work part, or between the wheel and dresser, will travel to the sensor with minimal loss of signal. Signal loss will occur both with distance traveled through the machine structure, and especially with each part to part mating junction in the machine. What is desired is a short path of travel for the acoustic signal,

through as few parts of the machine as possible, with all parts of this travel path being rigid, solid, and closely coupled and firmly mated portions of the machine structure.

For Bolt-on sensor, it is advisable to use superglue (Loctite 401 or equiv.) to try some different mounting locations, until the best location is found.

It may be possible to mount the ExactDress™ sensor on the spindle housing, near where the balancer sensor would be located, and use this location for monitoring both Dressing and Grinding. If this does not work on a particular machine structure, the alternative is to mount the sensor on the dresser structure for dressing monitoring. One sensor can be used by the ExactDress™ system.

AE Sensor Types

A variety of Sensor configurations are available to fit your installation requirements. The Main types of sensors are pictured below. Each sensor type is available in various models and the user should consult the SBS Product catalog for details on all available models.

Bolt-On Sensor – The sensor is attached by use of a M6 or ¼" screw directly to the machine structure, near the contact point between the grinding wheel and the work piece or the wheel dresser.

Non-Contact Sensor – The sensor comes in two parts to allow mounting directly to the rotating wheel or dresser spindle. A rotating part is mounted to the spindle to pick up the AE signal from wheel contact. A non-rotating part is mounted directly opposite the rotating part, where the AE signal is detected and transferred to the AE monitor.

Fluid sensor – The sensor allows detection of AE signal direct from the work piece or the wheel. A fluid stream (usually the filtered machine coolant) is directed to flow onto the target area. The AE signal transmitted up the fluid stream is detected by the sensor.

Balancer mounted Sensor – The sensor can be integrated into Non-Contact mechanical SBS balancers (external or internal).

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.
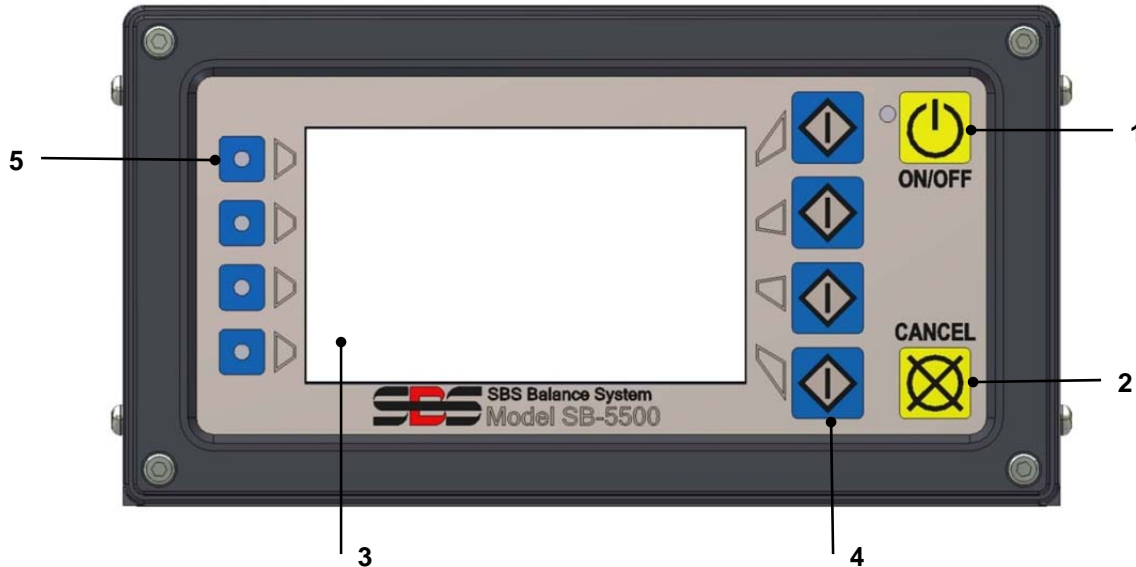
Front Panel Controls

Figure 9 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 power stand-by, 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 installed device card in each of the four corresponding card slots. The front panel slot status LED for any installed ExactDress™ Card has the following assignments: **GREEN** indicates the AE signal is below the CRASH limit, and **RED** indicates the AE signal is above the CRASH limit.

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 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 control setup. The Setup screens allow the user to select:

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

While in Setup:

- 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, 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 Setup screen allows selection of Profibus Station ID, if installed.

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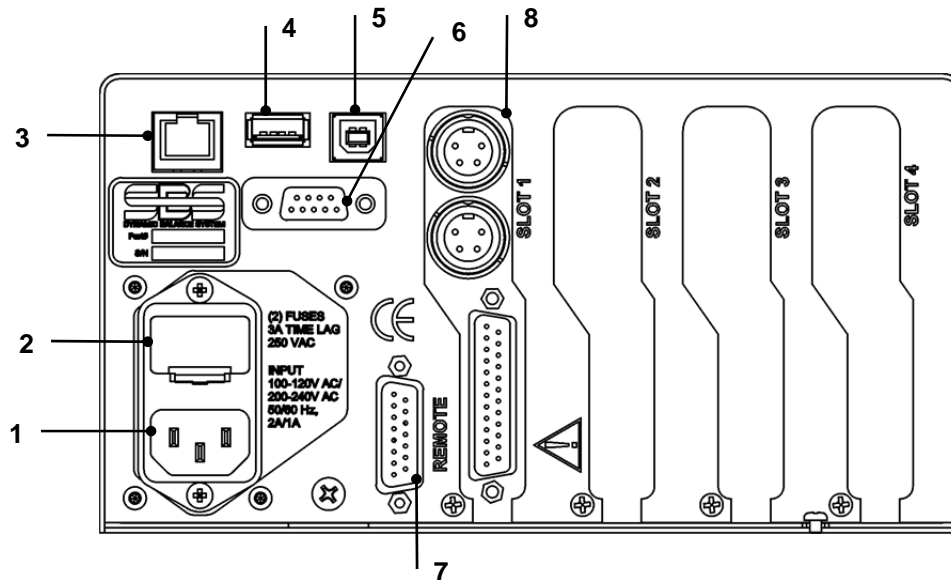
1) POWER SUPPLY. Connection for line power input (AC input model shown)
   Caution: Before applying power to the Control, make sure the supply voltage is within specified range.
   AC Input Models: 100-120V AC, 200-240V AC, 50-60 Hz
   DC Input Models: 21 VDC to 28 VDC. 5.5A max at 21 VDC.

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 www.grindingcontrol.com.

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 ExactDress™ cards or other device card products supplied by SBS. Unused Slots are covered with blank panels.

ExactDress™ Operation

The SHOW ALL button on any control card main screen displays the system-wide status screen, showing a summary status view of all control card channels installed in the SBS control unit. From the SHOW ALL display, select the ExactDress™ control card to view the main screen with detailed interface.

Main Screen

In the upper left of the main screen, the user assigned channel name for the ExactDress™ card is displayed. Following the channel name is the number of the currently selected job (01 to 32), followed by the AE sensor number assigned to the current job (-① or -②).

The main screen can display two distinct operation modes. The first screen shown is the **Run view.** The second screen shown is the **Process view**, which shows the current results of process monitoring.

The displayed view is changed by using the VIEW toggle button, third from the top. If no Process Reference has been established using the Teach mode, then the Process view is not available.

Error H

This error message is displayed when the VIEW button is pressed when no existing Process Reference exists, indicating the need to perform a Process Teach before the Process View can be used.

Run View

A scrolling graph of the AE signal is displayed, with the current AE signal level shown as a numerical value at bottom left. The current graph time (number of seconds of data represented by the AE graph) is shown at bottom right. The GAP limit shown in green is adjusted using the LIMIT edit menu. The CRASH limit shown in red defines the top of this screen, and is adjusted using the CRASH Sensitivity setting under the Sensor Parameters menu. When either of these limits is exceeded, the corresponding "G" or "C" symbol is displayed to the right of the current AE signal level. The bottom of this graph represents an AE signal value of 80% of the learned Air value (see Sensor Learn).
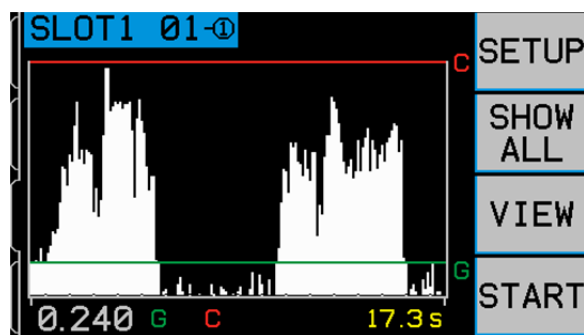
Run View

The START/STOP toggle button on the **Run view** screen starts and stops the display from scrolling the real-time acoustic signal. It is possible to stop the display, so that recent signal levels can be reviewed by the operator. When the screen is stopped, all monitoring functions are still enabled, and real-time results are still provided via the CNC Interfaces.

Process View

The **Process view** screen shows the results of the evaluation of the most recent process run, compared against the current saved job. Each bar on the screen represents a zone of the process, and the color of each bar indicates its status. Each zone of the process is also represented by the status bar at the bottom of the screen. The bottom of this graph always represents an AE signal value of 0, so the noise floor is included in the display.
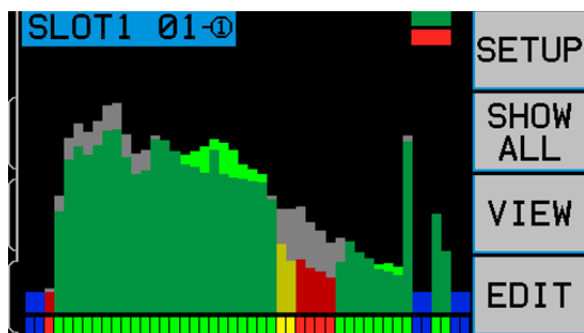
Process View

EDIT button

The Edit button on the Process View screen accesses editing of the key Process Parameters. The Process Parameters determine the evaluation criteria used to compare a current run of a process against the saved Process Reference. The EDIT button is only available onscreen when data exists for both the Process Reference (see Teach Mode), and for a current run of the process.

Process Parameters

All Process parameters are set using a percentage scale where 0% represents the bottom of the screen (0 signal level), and 100% represents the height of a zone or zones on the Process Reference (shown in grey).

Maximum Limit (MAX)

Sets a linear limit on the AE Signal value for the entire process, regardless of zone, and is shown as a red line on this screen. This limit is set as a percent of the current Process Reference peak value (100% represents the highest zone in the Process Reference). This limit is shown as a red line on this screen. If this value is exceeded for any zone during the process, then an error is indicated at process completion. Default = 120%, Range = 0-320%

Zone Minimum (MIN)

Sets the low acceptable limit for AE signal for each separate process zone. The limit is set as a percent of each separate zone's value in the current Process Reference, and each zone of the current process run is compared separately to the corresponding zone in the Process Reference (100% represents the height of each individual Process Reference zone). As this limit is adjusted the color showing the error condition of individual zones will be updated onscreen. An error is indicated at process completion if any active zone fails this evaluation. Default = 50%, Range = 0-100%

Ignore Level (IGN LEVEL)

Sets the noise floor for monitoring the process, as a percent of the Process Reference peak value (100% represents the value of the highest zone in the Process Reference). This limit is shown as a blue line on this screen. While editing this limit, zones where the Reference level is below the IGN Limit will be displayed in BLUE, and zones where the current Process level is below the IGN Limit will be displayed in RED, both with a height equal to the IGN Limit. This same display behavior is exhibited during the run of any Process while in monitor mode. While the current process is monitored, any zones in the current process with a value below this limit are ignored in evaluation of the process. Default = 10%, Range = 5-80%
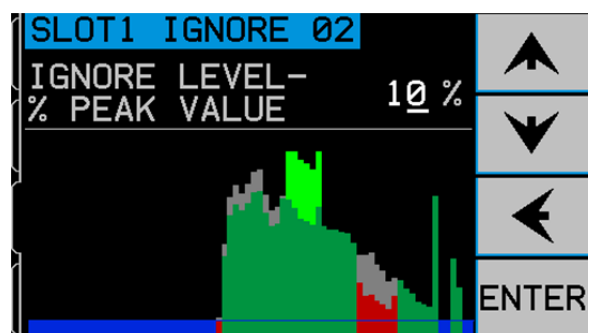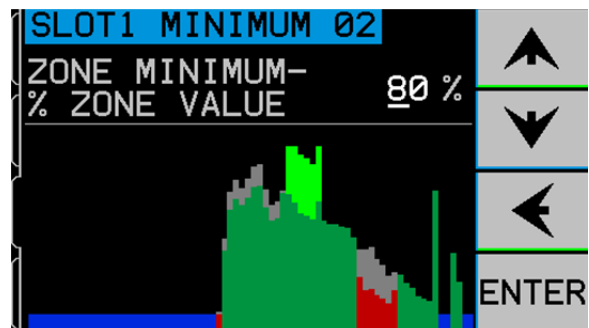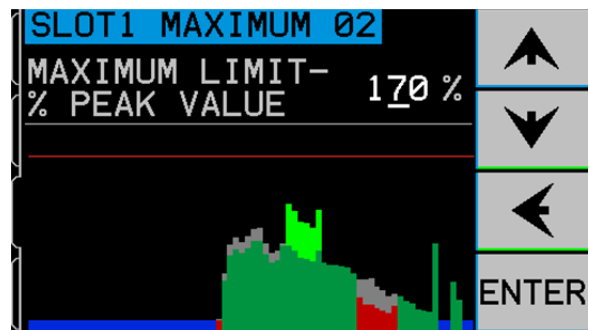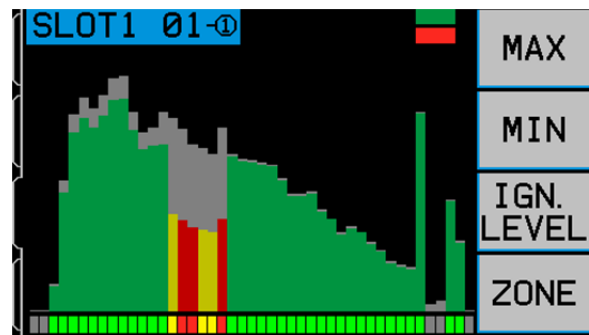
Zone Edit (ZONE)

The Zone edit menu allows individual zones to be turned off for purposes of all process evaluation.

- Press ALL OFF to turn off evaluation for all zones which are currently marked in red in the graph. If zones are shown in grey at the end of the graph (Reference value only), but with the status bar in red for those zones, this indicates these zones did not receive data during the most recent process run because the process time was shorter than the expected time set in the Teach process. Zones in this condition are not turned OFF by this button.

- Press ALL ON to turn back on evaluation of all zones which had been previously turned off.

- Press EDIT ZONE to bring up another screen which allows the user to select individual zones by scrolling a cursor on the bar at the bottom of screen, and then turn on/off evaluation for the selected zone. Any zones in Ignore condition (Blue) which are outside the block of active zones (to left or right of all active zones) cannot be edited using this menu.

Only zones which have been turned off using the Edit menu can be turned back on under this menu. Zones in the Ignore condition because of the current Ignore Level setting are editable, but results will not be shown until the IGN level is revised.
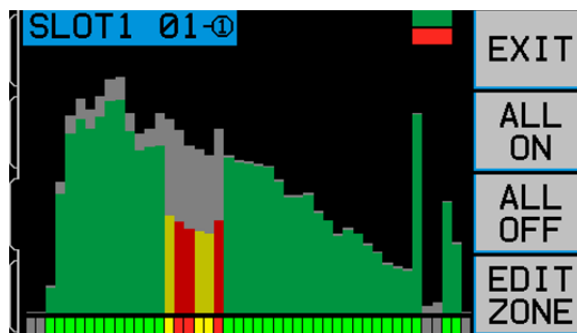
Setup

The SETUP button on the main screen displays the Setup screen. From this screen the user can access either the Menu or the Limit screen.

Limit Screen

The LIMIT button on this screen displays the Limit screen. From this screen you first select the limit you want to edit, either G (Gap) or C (Crash). Selecting C only displays the current signal level associated with the C limit on screen, but the C limit cannot be moved. Changes to the C limit must be made using the Crash Sensitivity adjustment under the Sensor Parameters menu. Selecting the G limit for editing allows the G limit to be repositioned on the screen.
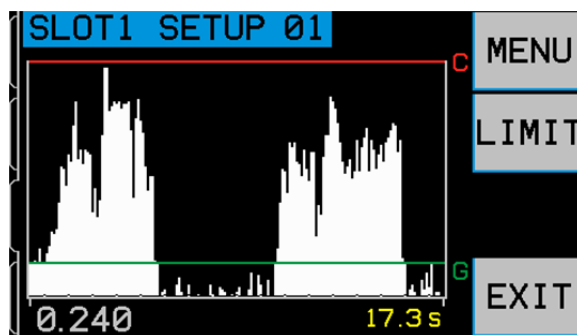
G Limit Edit

This screen allows the G (Gap) limit to be repositioned relative to the displayed AE signal level. The G limit is displayed in yellow and flashes. The corresponding signal level of the current G limit position is shown in yellow at bottom right. Also shown at bottom middle of the screen is the corresponding G limit Sensitivity setting A(x.xx). This number represents the G limit position as a multiple of the AIR level recorded during the last sensor Learn cycle. Sensitivity is the saved value for the G limit, so if a new Learn cycle is performed and the system gain is changed, the limit will still be positioned at the same sensitivity level. The G limit can be positioned anywhere onscreen. The bottom of the screen represents A(0.80).
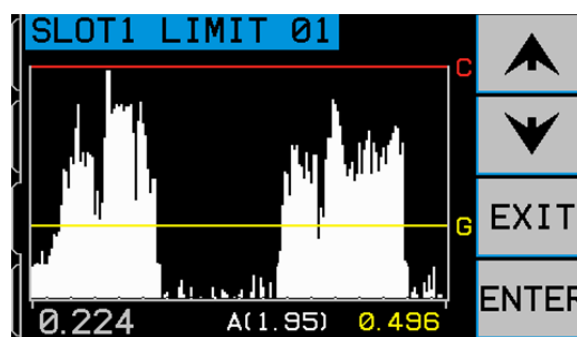
G Limit Sensitivity

Limit Signal Level

Menu

The MENU button on the Setup screen displays the Menu. This Menu contains user selectable operation settings for the system.

```
┌──────────────────────────┐ ┌─────┐
│SLOT1 MENU 01             │ │  ▲  │
│SELECT MENU ITEM          │ ├─────┤
│┌────────────────────────┐│ │  ▼  │
││1. JOB #                ││ ├─────┤
││2. SENSOR PARAMETERS    ││ │     │
││3. DISPLAY SETTINGS     ││ │EXIT │
││4. CNC SIGNAL TIME      ││ ├─────┤
││5. CHANNEL NAME         ││ │     │
││6. MENU ENTRY           ││ │ENTER│
││7. FACTORY SETTINGS     ││ │     │
│└────────────────────────┘│ └─────┘
└──────────────────────────┘
```

Job Defined

Each job includes a **Process Reference**, and its related parameters listed below. The job is used to evaluate current iterations of the same process in order to determine if the process falls within expected normal tolerances. Thirty-two distinct jobs can be saved for use in evaluation of distinct processes (see Process Defined).

- **Process Reference** - The saved AE signature of the process which has been determined by the operator to represent a known good process

- **Process Parameters** (set under the EDIT menu from the Process view screen)

- **Sensor Parameters** (set under Setup menu/Sensor Parameters)

- **Display Settings** (set under Setup menu/Display Settings)

Job#

This menu allows the operator to select the current active job which will be used for process control, from the available positions (01 to 32). Use the up and down arrows to select the job#. The -① or -② indicated next to the job number shows if an AE sensor number is currently assigned to the job, indicating that settings exist for that job#. Where no settings have been saved under a job#, there is no sensor number assignment shown.

```
┌──────────────────────────┐ ┌─────┐
│SLOT1 JOB 01              │ │  ▲  │
│SELECT SAVED JOB          │ ├─────┤
│                          │ │  ▼  │
│                          │ ├─────┤
│         ╔═╗ ╔═╗ -①      │ │     │
│         ║ ║ ║ ║  A       │ │EXIT │
│         ╚═╝ ╚═╝          │ ├─────┤
│          (1-32)          │ │ENTER│
│                          │ │     │
└──────────────────────────┘ └─────┘
```

On this screen the operator can also see and select which jobs have been assigned to CNC input positions A and B. Job select input positions A and B are the two available hardwire inputs to the ExactDress™ card which allow selection of the active job. A job can be assigned to either input position A or input position B. Current job# selection and Job Select input position assignment can also be accomplished via the software interface.

```
┌──────────────────────────┐ ┌─────┐
│SLOT1 01-①               │ │  ▲  │
│CNC JOB SELECT            │ ├─────┤
│SELECT MENU ITEM          │ │  ▼  │
│┌────────────────────────┐│ ├─────┤
││1. ASSIGN POSITION A    ││ │     │
││2. ASSIGN POSITION B    ││ │EXIT │
││3. DO NOT SET           ││ ├─────┤
│└────────────────────────┘│ │     │
│                          │ │ENTER│
└──────────────────────────┘ └─────┘
```

Press ENTER to set the currently selected job# as active. Press EXIT to discard any changes. When a job# is selected using this menu, the following screen allows the operator to assign Job Select position A or B to the current job#, or to make no changes in the input assignment.
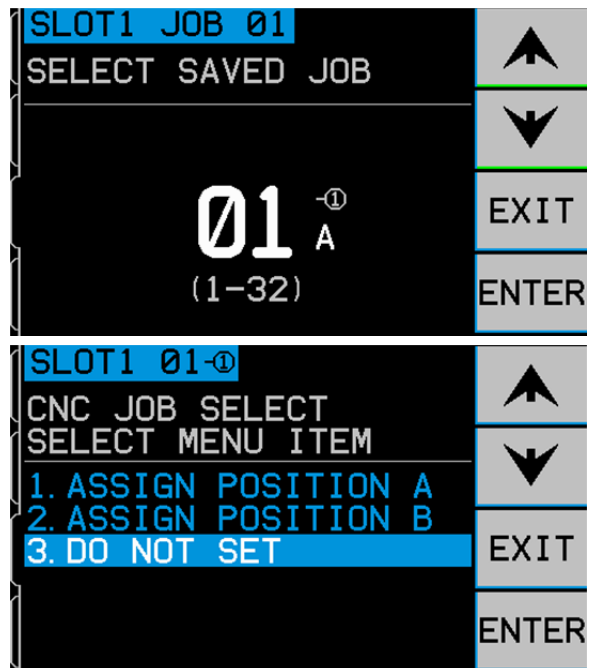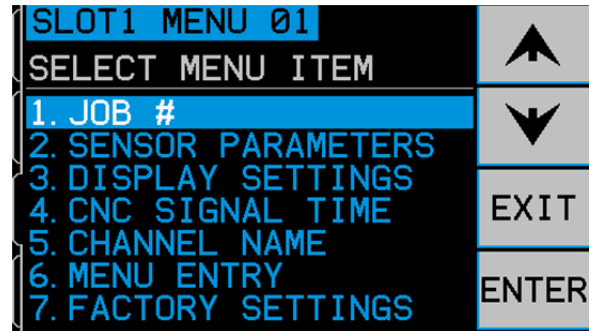
Sensor Parameters

Settings found under the Sensor Parameters menu allow a Learn cycle to be run. A Learn cycle will assign a sensor# to the job, set the correct gain for measuring AE signals for that job, as well as setting the most responsive frequency range for AE monitoring. This section also provides for adjusting Gap sensitivity and Crash sensitivity. New settings are saved at the completion of each menu section.

Sensor Learn Cycle

The system needs to be setup for proper operation by initiating a learn cycle for each job. Each job setup should represent a distinct process to be monitored (see Process Defined). Running the learn cycle will first assign a sensor number (-① or -②). The Sensor Select screen is displayed, showing which sensor positions are currently connected to the ExactDress™ card. Select which sensor should be assigned from the options presented.

The learn cycle will next set the system gain and overall measurement scale, as well as help determine which of the eight frequency bands should be selected for best operation results. During the learn cycle the background acoustic emission signal levels for each of the eight frequency bands will be compared with the signal levels that occur during normal dressing or grinding for the same frequencies, and the frequency with the best Work/Air signal ratio will be suggested as the frequency to be monitored. If the results of the Learn process produce Work/Air ratios that are 1.2 or below, then the system has been unable to see any significant difference between the AE signal during wheel contact and prior to wheel contact. This is usually a result of either an improperly performed Learn cycle, or a poor AE sensor location.

The next screen of the learn cycle is titled AIR PASS, and will show eight bar graphs, representing the real time signal levels occurring in each of the separate frequency bands covered by the unit. The bar graphs will rise and fall as signal levels change. The VIEW DATA button allows the user to view the results of the most recently completed learn cycle, and choose an alternate frequency band based on those results. To perform a new learn cycle, the first step is to learn the background or AIR signal level. To do this the grinder should be operational, with all systems running, but **without** wheel contact with the part or dresser. Once the graph has settled after machine startup, press START to begin learning. Move the wheel though a mock grind or dress movement, but **without** wheel contact (the bar graphs may rise a little during this process due to axis motion). When finished, press the ►► button to store the maximum background/AIR levels recorded in each frequency band, and to move to the next learn cycle step.

The screen should now be reversed in color from the previous screen, and titled NORMAL WORK PASS. The operator should initiate wheel contact with the dresser or part, and complete one or more cycles, until the bar graph is stable. This process records the
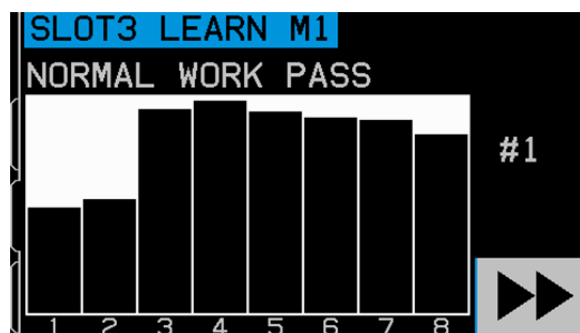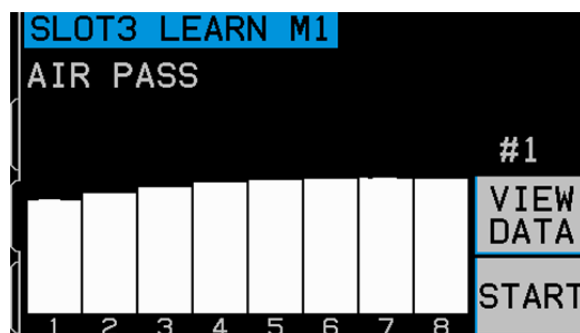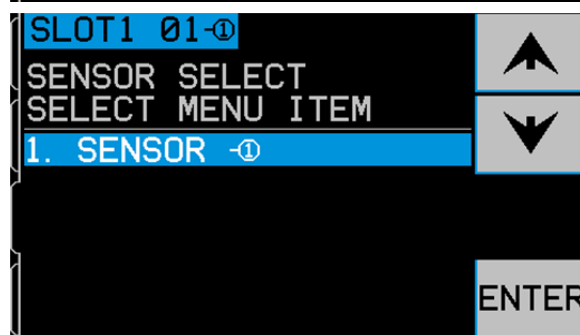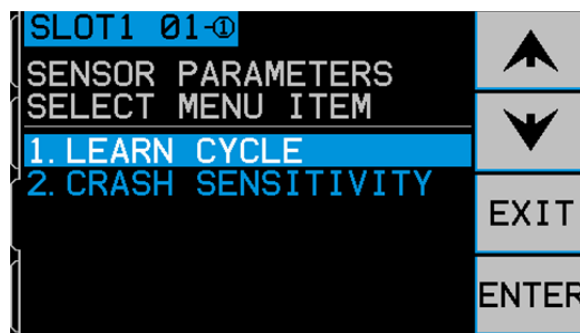
maximum signal levels during normal grinding or dressing. The bar graphs will show the highest levels recorded during this current learning cycle. Once the bar graph has stabilized, press the ►► button to store this information and display the resulting data screen.

The data screen will show the current active filter band at the top of this screen. Acoustic levels recorded for all eight filter bands during the most recent Air and Work passes are shown as a table. The resulting ratio between Work and Air levels is displayed, and also the filter band suggested by the control system as most responsive is highlighted, which is the band with the largest W/A ratio. Press ENTER to accept this choice, or override the ExactDress™ system selection by choosing another filter band, and then pressing ENTER, or press Cancel to exit the screen leaving the currently active filter band selected. The maximum W/A ratio is suggested as the best starting point in determining the most responsive filter for an application, however the installer may find another filter to be more effective. Very low signal levels can produce a good W/A ratio but with little effective difference between Work and Air values. In such a case it is may be best to look at the largest difference between Work and Air levels and select that band as being more responsive. Once the most responsive filter has been selected for an application, this selection should not change. It is based on the machine structure, sensor location relative to the wheel contact point, and type of wheel contact. All these things should remain relatively constant for a given application. If Air noise levels rise significantly, or Work signal level falls significantly, SBS suggests troubleshooting to determine the cause of these changes.

Press EXIT twice to exit the setup menu, and return to the Main Screen.

Crash Sensitivity

This setting determines the C (Crash) limit, based on a fixed multiple of the maximum work level recorded during the last learning cycle. A higher Sensitivity setting means the Crash limit will be set nearer the work level (more sensitive), while a lower Sensitivity setting will move the Crash limit further above the work level (less sensitive). Use the up/down arrow buttons to achieve the proper sensitivity for your job requirements.

Sensitivity and Gain Control

Changing the sensitivity setting will change the effective signal gain of the unit. To ensure ease of setup, the signal gain is set automatically, based on the current results of the last learning cycle, and the current sensitivity setting. By increasing the sensitivity setting, the Crash Limit will be assigned a lower value, and screen scale will be recalculated to compensate, producing higher displayed signal levels. By lowering the sensitivity setting, the Limit will be assigned a higher value, and the new screen scale will then produce lower displayed signal levels. Note - the screen scale of the ExactDress™ system is logarithmic, not linear. This allows fairly large changes in signal level to be displayed on screen, without overrunning the screen limits.

Display Settings

Graph Time

Graph Time adjusts the time scale the ExactDress™ system uses to display data on the screen in **Run view**. The Graph time set represents the number of seconds taken to scroll across the display screen, so the width of the screen reflects the data taken in this same time period. The default time is 11.4 seconds and can be set up to 365 seconds. A longer Graph Time will display data over a longer period of time, but at a lower resolution.
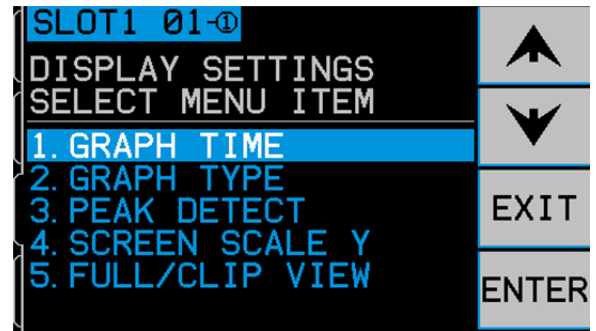
Graph Type

This setting allows the Run View (scrolling real-time acoustical signal levels) to be displayed as either a line graph or a filled bar graph.

Peak Detect

With this setting turned on, peak AE signal levels are displayed on the Run View screen. Peak values are defined as the highest signal value seen during the period of time that the signal rises above the G limit, and then falls again below the G limit and remains below that limit for a minimum of 10 effective screen pixels of display. The effective screen pixel size (each discrete displayed signal level) will vary in size based on the screen graph time.

Screen Scale Y

Sets the vertical scale of the Process View screen as a percent of the current job's peak zone value. This screen updates as the value is changed.

Full/Clip View

This setting determines if the full process time (from Process Start to Stop) is displayed on the Process View. When in Clip mode, any continuous block of leading or trailing zones which fall below the Ignore Level are clipped from the display.

CNC Signal Time

Sets the minimum hold time, in milliseconds (msec.), that relay contacts are opened or closed to indicate an event signal. **Important – The purpose is to make an event's signal last long enough to assure signal detection by the machine control used.** The factory default settings are 1 msec, but PLCs or similar devices typically will often monitor at timed intervals of about 5 msec. In such cases the signal time must be set to exceed the polling cycle time. Affects PROCESS MIN., PROCESS MAX., GAP, and CRASH (if not latched) signals of the CNC interface.

To change settings, select SETUP from the Main screen. From the Setup screen, select MENU with the corresponding button, then select CNC SIGNAL TIME from the menu. The two screens that follow control the ON and OFF contact hold times. Times can be set from 1 to 250 msec.

To set the desired time for the N.O. contact closed time, use the left arrow button to select digits, and the up and down arrow buttons to change the selected digit. Press ENTER to accept the entry and proceed to the OFF-TIME screen. In the same manner, set the time that the N.C. contact will be closed and press ENTER.

CNC Crash Latch

This menu option sets how the CRASH output signals will react to crash conditions. Use the up and down arrow buttons to toggle the cursor between the OFF or ON selections. Press ENTER to have the entry accepted.

OFF Crash not latched, subject to ON/OFF times like GAP, PROCESS MIN., PROCESS MAX.

ON Crash condition closes the CRASH N.O. contact until it is reset by: (1) RESET CNC input (2) HOST error clear (3) CLEAR button when Crash error screen is displayed.
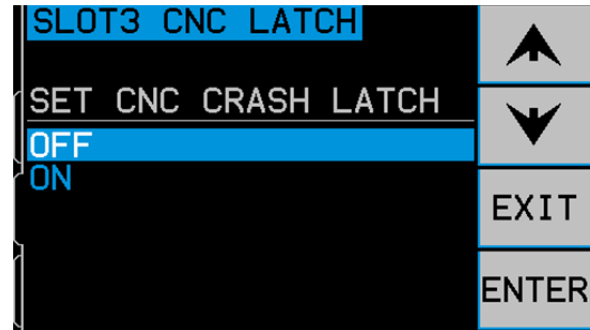
Channel Name

Selecting the CHANNEL NAME menu item will display an entry screen. Use the right arrow button to select cursor position, and the up and down arrow buttons to toggle through the alphanumeric list to label the ExactDress™ card device. Distinct names can be used to identify each card device installed in the SBS control unit with this feature. Up to Five characters can be used to name the ExactDress™ card. Press ENTER to accept the entry.

Menu Entry

This selection on the menu list provides for use of a standard access code for menu protection. Setting the channel to "protected" denies access to the menu list unless the access code is entered. This setting ensures that system settings will not be accidentally compromised. The screen displays ENABLED when Menu access is available, and PROTECTED when menu access is controlled by the access code. Function buttons are assigned the numbers 1, 2, 3, and ENTER, which are used to input the access code. The standard access code is **232123.** Once the code has been entered and the ENTER button has been pressed the MENU selection is protected. Re-entry to the menu list will now require entry of this code. The message MENU ACCESS PROTECTED will be displayed notifying the user that the menu is password protected, and the user will be given the opportunity to enter the code. Entering a code other than the correct number will produce a message INCORRECT CODE ENTERED TRY AGAIN/ CANCEL.

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

Verify Normal Operation

The **Run view** main screen can be stopped or started by toggling the lower right hand button. When running, the screen will display real time acoustic level information, as it occurs. When stopped, the screen shows the last time period recorded. When the wheel is not making contact, the screen should show signal levels below the G (Gap) limit line. **If the signal level is above the G limit with no wheel contact, you should repeat the learning cycle to achieve proper results.** The C (Crash) limit level is set automatically during the learning cycle and vary according to the results of the learning process and the sensitivity setting selected by

the operator (Crash sensitivity is described in the following section). The Gap level can be adjusted onscreen by using the LIMIT edit on the Setup screen.

Initiate wheel contact with the dresser or work-piece, and observe the running display. You should see the acoustic levels falling mid-screen during full wheel contact, and dropping off below the G level between passes. If results are not as described, then one of the following should be tried.

a) Try adjusting the G level.

b) Adjust the scale of the screen by adjusting the Crash Sensitivity setting. Running the Learn process again is not required. Note that higher sensitivity selections are more sensitive to noise as well as signal.

c) Try an alternate Sensor location, and perform a new Sensor LEARN cycle. Try moving the sensor closer on the machine structure to the point of wheel contact, as described in the Acoustic Sensor Location section.

Process Monitoring

Before the system can be used for Process Monitoring, it must first be setup with the proper system gain and sensitivity, using the Learn Cycle and other settings under the Sensor Parameters menu.

Process Defined (Start/Stop)

The ExactDress^{TM} allows the AE signal signature of a known good dress or grind process to be saved as a Process Reference, along with the desired evaluation settings. The resulting job can then be used to evaluate subsequent runs of the same process. A process is likely distinct when anything is changed on the machine or process which will vary the AE signature of the process. Key variables which will create a distinct process include:

- Wheel type, size, speed or position
- Dresser or work piece speed, type or position
- AE sensor type or position
- job settings (Process Parameters, Sensor Parameters, Display settings)

The process is a time window of interest for evaluation in a repeating dress or grind cycle. The timing of the process is defined as what occurs between the process START and the process STOP. The START/STOP input on ExactDress^{TM} is used to establish the timing of these events. The input is held active at the process START, and deactivated to indicate the process STOP. This input on the ExactDress^{TM} card is intended to be set using a programed output from the machine PLC/CNC. While the START/STOP input is active, it is indicated on screen by the ▶ symbol.

The START/STOP input should be programed to capture the whole of the dress or grind process to be evaluated, usually based on the cycle start, or a subsequent point, where the machine slide or stage movement will begin from a known and repeatable position. The START/STOP input indicates timing of the start and stop of the process. For best results it is essential that the timing of this input be as consistent as possible in relation to the timing of actual wheel position in the process. If the timing of the process START is not consistent, then each zone of the current process may not line up with the corresponding zone of the saved job, leading to ineffective evaluation. For this reason **the output should be programed in such a way as to minimize or eliminate any loop time or other cycle timing variations on the CNC**.

Process Zones

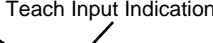For evaluation purposes the entire process is broken into equal time slices called zones. Each zone represents the average AE signal level for that time slice of the process. It is essential that the timing of the START/STOP input be very consistent, so that AE signal levels are not time shifted from one run of the process to the next. Each zone will represent a certain number of process time milliseconds, depending on the overall length of the process. You can refer to the chart shown and lookup your process time to see how much process time is devoted to each zone (x). Also you can determine how many zones are created for your process by calculating $(P \bullet 1024)/x$.

P=Process time sec.	x=ms/zone	zones
0 <= P < 0.5	16	1-32
0.5 <= P < 1	32	16-32
1 <= P < 2	32	32-64
2 <= P < 4	64	32-64
4 <= P < 5	128	32-40
5 <= P < 8	64	80-128
8 <= P < 16	128	64-128
16 <= P < 32	256	64-128
32 <= P < 64	512	64-128
64 <= P < 128	1024	64-128

Process Teach Mode

Once the process timing is established by the Start/Stop input to the ExactDress™, the Process Reference can be captured. The dress or grind process should be run repeatedly until the desired degree of wheel contact is made consistently throughout the defined process cycle. Once the process has been validated, then it should be taught to the ExactDress™.

TEACH: This relay input is held active to put the unit into teach mode. The first completed cycle of the process while in Teach mode defines the process time for the saved Process Reference (the saved signal levels for each zone of the process). Any time at the end of the process run which

Start/Stop Input Indication

Teach Input Indication

is not sufficient to complete a full zone is discarded, so only fully complete zones are retained. While the Teach input is held active, it is indicated on screen by the ⏸ symbol. The Teach process can be repeated as many times as desired, using the START/STOP input to start and stop each cycle while keeping the Teach input active. The grey bars displayed on the screen show the saved Process Reference for the currently selected job. While the system remains in teach mode and this job remains selected, the last three complete iterations of the process are averaged and saved into the current Process Reference. The orange line is displayed to indicate the most current iteration of the process. This display allows the user to see how much change is occurring from one iteration of the process to the next, and to gauge how stable the process is.
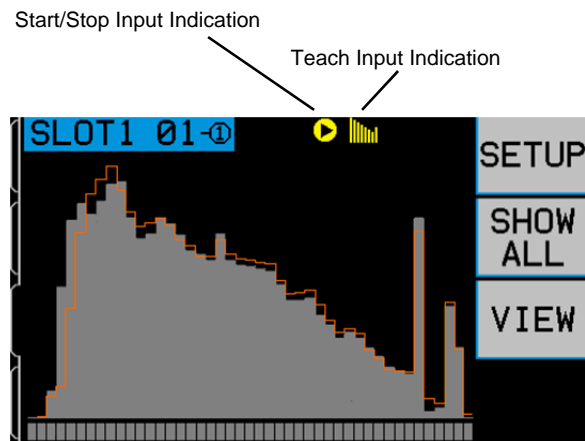
If teach mode is interrupted before the completion of any process run, the remaining zones in that process run will receive a data value of zero, and therefore this will affect the saved average for those zones in the process reference.

Changing the job will interrupt the teach mode. If the unit remains in teach mode, a new average will then be started for the newly selected job. Resetting the teach input to inactive and then to active again will also interrupt teach mode, and start a new average for the currently selected job.

This averaging feature can be used to help ensure that the saved Process Reference is a good representation of the process, and will be useful as the master against which future cycles of the process are evaluated.

Monitor Mode - Process Evaluation

When ExactDress^{TM} is not in teach mode, it is in Monitor mode. In this mode, each zone of the currently run process is compared to the corresponding zone in the Process Reference of the current job. The process results are displayed as follows.

Blue – Zones in Ignore condition, where the current Process Reference is below the Ignore limit. In the case where a zone's reference level is above the Ignore limit, but the signal level in a process run falls below the Ignore level, that zone will fail process evaluation, and the zone will be shown in red with a height equal to the Ignore limit to indicate why it failed.

PROCESS-MAX Output Indication

PROCESS-MIN Output Indication

Grey – The grey bars indicate the Process Reference of the saved job. If zone evaluation is manually turned off using the Edit menu, the zone will show only the grey bar and no other color. The status bar at the bottom of screen will also show the zone in grey. If a process run time falls short of the Process Reference time (START/STOP is deactivated early), then the final zone(s) in the process may not have any data to evaluate. Such unprocessed zones are also shown as only the grey reference bar for the zone(s), but the status bar at the bottom of the screen will show that zone(s) status as red.

Green – Zones where the current process is above the Zone Minimum limit.

Yellow – Zones where the current process is marginally above the Zone Minimum limit. If the zone's signal level is above the ZONE MINIMUM, but falls within the first 1/3 of values between the ZONE MINIMUM setting and 100%, then the screen bar is displayed in yellow, indicating the zone is in tolerance but is near the limit.

Red – Zones where the current process is below the Zone Minimum limit. If the current process signal level is lower than the ZONE MINIMUM limit, then that zone is out of tolerance and the screen bar is colored red.

For example if the ZONE MINIMUM is set to 70%, then any zones falling below 70% of that zone's job value are red. Any zones with values from 70% up to 80% are yellow, and zones with values of 80% or higher are green. If any zones are evaluated as out of tolerance, then the process is considered out of tolerance, and the PROCESS-MIN relay is activated.

The current process is displayed in color on top of the grey bars of the Process Reference. Where the current process signal level rises above the grey job bars, then the green color is displayed in a brighter shade of green, showing where the signal has risen above the job level.

PROCESS-MIN: This relay indicates if all the zones active for evaluation in the current process are above the minimum threshold set for the most recently completed process. The ZONE MINIMUM limit defines the minimum acceptable value for each zone to be considered in tolerance, which is set as a percentage of the value seen in the corresponding zone of the Process Reference. This current relay status is indicated on screen next to the SETUP button by the lower bar turning red when the relay is active.

PROCESS-MAX: This relay indicates if the current process has exceeded the maximum threshold set for the most recently completed process. The maximum limit for the process is not based on evaluation of individual zones, but is a simple linear limit for the entire process. The limit is defined by the MAXIMUM LIMIT setting. If at any time during the process an AE signal is measured above this limit, then the process
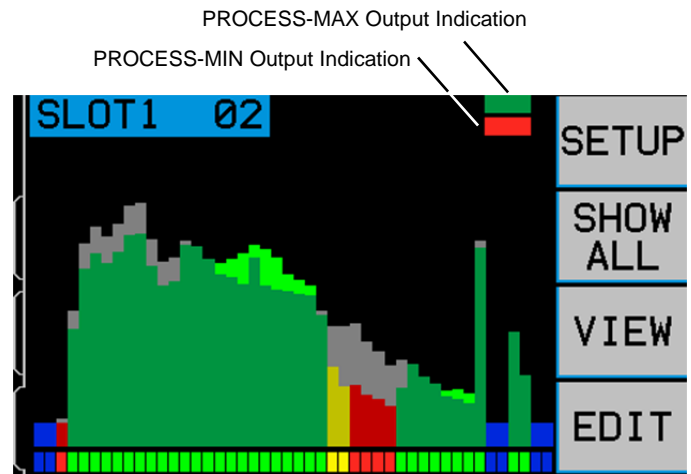
is considered out of tolerance and the PROCESS-MAX relay is activated. This current relay status is indicated on screen next to the SETUP button by the upper bar turning red when the relay is active.

Zones Ignored in Evaluation

Zones are ignored in evaluation of the process for two reasons:

Ignore Level. A zone will be ignored in process monitoring if the signal level for that zone in the current process reference is below the user set IGNORE LEVEL. This setting is based on a percentage of the peak zone signal value saved in the current job. Zones in the condition are not considered part of the process to be reviewed. For instance, this allows the period of time before and after wheel contact normally occurs in the process to be ignored.

Zone Edit. The EDIT menu can be used to edit the saved job to turn off evaluation of the PROCESS-MIN status for any zone(s) within the process. This can allow any zone(s) that represent a portion of the process that does not require process control to be ignored in this determination of process status. This can have benefits where a portion of the process does not produce consistent AE signal levels and where this portion of the process is outside the area of concern for monitoring.

Hardwire Interface

Interfacing the SBS 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 individually on the rear panel of the ExactDress™ 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.

SB5523 DB-25
For ExactDress™ card in SB-5500

Pin	Left		Pin	Right
1	SUP-COM		14	Out: PROCESS MAX-NO
2	Analog-OUT		15	Out: PROCESS MAX-R
3	Out: N/C		16	Out: PROCESS MAX-NC
4	Out: N/C		17	Input: JOB SELECT
5	Out: ERROR-R		18	Input: CRASH RESET
6	Out: ERROR-NO		19	Input: START/STOP
7	SUP-COM		20	SUP-OUT
8	Out: CRASH-NC		21	Input: TEACH
9	Out: PROCESS MIN-NC		22	Out: PROCESS MIN-R
10	Out: PROCESS MIN-NO		23	Out: CRASH-R
11	Out: CRASH-NO		24	Out: GAP-R
12	Out: GAP-NO		25	Out: GAP-NC
13	SUP-COM			Shell (Shield Ground)

Carefully read this entire manual before attempting to interface the SBS System with any machine controller. Sections covering the interface of other SBS device card products installable in the SBS Control are covered separately in the manual for each product.

Hardwire Control Interface – ExactDress™ Card

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.
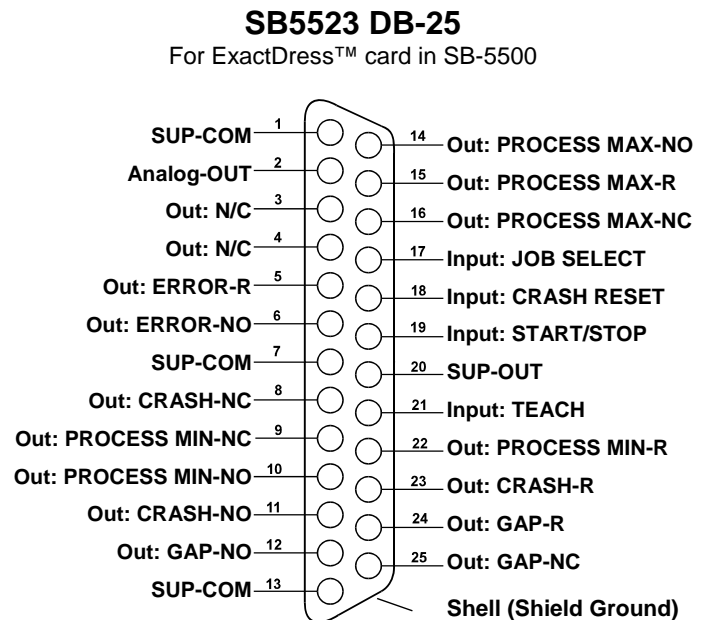
The inputs provide noise immunity and robustness. The inputs are activated by being pulled high, either by connection to the SB-5500 hardwire interface power supply output or by connection to a customer supplied signal. Activating the inputs requires at least 8 mA at a voltage between 10 and 26 volts +DC, referenced to the SB-5500 hardwire interface power supply common. The inputs are deactivated by removing the connection to the power or signal source.

The 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
17	JOB SELECT	Use this input to select which of the two jobs assigned to relay positions A and B is active (for process monitoring or teach mode). Inactive = job# assigned to position A, active = job# assigned to position B). Switching jobs will erase current analyzed data from memory.
18	CRASH RESET	Crash Reset. The crash status latch will be reset following the rising edge of a voltage applied to this input. A crash that occurs while voltage is applied will not be reset. The voltage must be removed and reapplied. This input is ignored if the CNC Crash latch is set to OFF.
19	START/ STOP	Activate this Input to set the start of the process time window to be monitored. Deactivate the input to indicate the end of the process. It is critical that the timing of the START/STOP signal be very consistent relative to the dress/process cycle being monitored. See Process Defined section.
21	TEACH	Activate this Input to enable Process Teach mode. While in Teach mode, the currently selected job is taught a Process Reference signal.

Output Pin Names and Functions

Pin#	Name	Description
2	Analog- OUT	Analog signal output (0-10V, 2mA max.) referenced to SUP-COM. See following section for further details.
6	ERROR- NO	Output is system error flag. Open indicates error condition, Closed indicates system is in normal monitoring condition. If control is OFF or in any condition not able to monitor, this relay is open to indicate that the monitoring function if offline. This output is open when in Process Teach, Sensor Learn, MIN editing, MAX editing, IGN level editing, zone editing, during front panel access of any setup menu, and during any error condition. When the CNC Error is opened, existing status output for the most recent process (MIN and MAX) will clear and indication on screen will also clear.
5	ERROR-R	Common return connection for the ERROR contact.
11	CRASH-NO	Closed to indicate a crash condition. Latches if the CNC crash latch is on.
8	CRASH-NC	Closed whenever CRASH-NO is open (no error condition detected). It is also closed when power is off and during standby, initialization, self-test, and LEARN modes.
23	CRASH-R	Common return connection for the CRASH contacts.
12	GAP-NO	Closed whenever the AE signal is at least at the GAP setting (wheel contact detected).

25	GAP-NC	Closed whenever GAP-NO is open indicating that the AE signal is below the GAP setting. Also closed when power is off, during standby, initialization, self-test, and LEARN modes.
24	GAP-R	Common return connection for the GAP contacts.
10	PROCESS MIN.-NO	Closed at the completion of a process run when the results of the process run fall below the zone minimum limit set. Indicates that some process zones in the most recently completed process run have produced lower than expected AE signal. This output is open during the process run and when in Teach mode.
9	PROCESS MIN.-NC	Closed whenever the PROCESS MIN.-NO relay is open.
22	PROCESS MIN.-R	Common return connection for the PROCESS MIN. contacts.
14	PROCESS MAX.-NO	Closed at the completion of a process run when any of the zones in the most recent process run have exceeded the AE signal level set for the Process Maximum Limit (excessive AE signal). This output is open during the process run and when in Teach mode.
16	PROCESS MAX.-NC	Closed whenever the PROCESS MAX.-NO is open.
15	PROCESS MAX.-R	Common return connection for the PROCESS MAX. contacts.
20	SUP-OUT	A protected supply referenced to the Supply Common connection. It will be adequate to operate any combination of the CNC inputs on the CNC connector.
1,7,13	SUP-COM	Common reference connection for the CNC input pins on all channels, connected to earth and chassis ground. This connection is for the common of the external supply, when one is used to activate the CNC input signals.
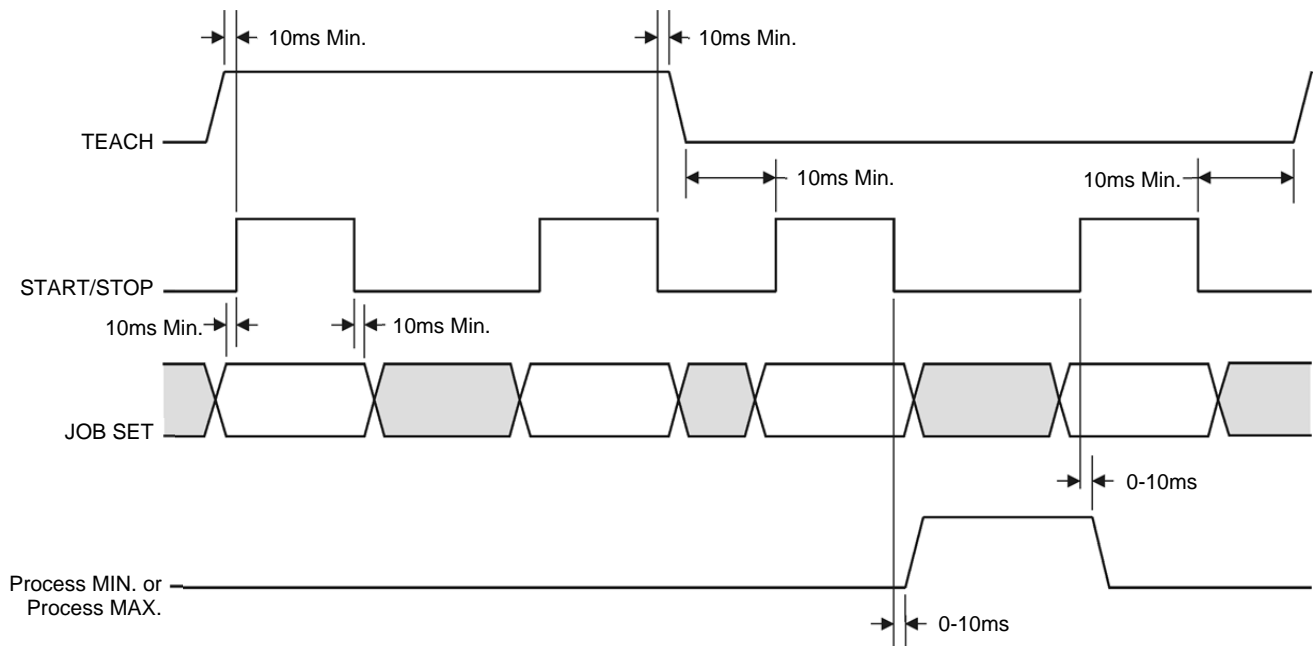
ExactDress™ Analog Output

The analog output voltage is presented at pin 2 of the 25 pin CNC connector of the SB-5523 card. Pin 1 is the ground reference for this voltage. The analog output on the ExactDress™ system is not calibrated to a fixed level. The gain of the system is auto scaling, so that the analog signal output always falls in the 0-10 VDC range. This auto scaling gain is needed to accommodate the huge variation in signal level, which can be measured on various types of grinders with different applications and sensor placements. This auto scaling gain corresponds to the gain used for the display of AE level on the front panel. This scale will change every time a learning cycle is run or when the Crash sensitivity setting is changed.

Following is an explanation of the process that sets this voltage and the effects of that process on other event threshold settings in the system. During the LEARN process, the WORK value is measured. This WORK value, along with the CRASH SENSITIVITY setting, is then used to compute the system's Crash Event level. The CRASH SENSITIVITY (CS) selects a multiplier for the measured WORK level that yields the Crash Event level (CRASH).

$$(CRASH) = (WORK)(CS)$$

The internal amplifier gain is set such that a Crash Event would generate a voltage of about 9.7 volts at the analog output. The values selectable for CRASH SENSITIVITY (CS) produce multipliers ranging from 3.55 to 1.05 (with LOW=3.0 and HIGH=1.5). This multiplier is applied to the WORK level to set the amplifier gains.

$$(V_{CRASH}) = 9.7 \; VDC = (V_{WORK})(CS)$$

In an example where sensitivity is set higher (e.g. CS = HIGH), the incoming AE signal needs only to rise to 50% higher than the normal WORK level to trigger a crash event. With the system set to a lower sensitivity setting (e.g. CS = LOW), a signal increase of 200% is needed to generate the event.

Assuming that normal work processes can have a minimum AE level of approximately 1/2 of the learned work level, the analog output voltage representing WORK can be approximated using the following table:

Crash Sensitivity	Low	Medium	High
Min. WORK Voltage	1.50	2.25	3.00
Max. WORK Voltage	3.00	4.50	6.00

The voltage levels representing AIR and GAP levels are much lower than the WORK level. On the same voltage scale, the WORK voltage will be W/A (from the LEARN screen) times the AIR voltage. The GAP voltage will be AIR voltage times the GAP SENSITIVITY (GS) level selected. The range of GS settings correspond to multipliers from 3.55 to 1.05 (with LOW=2.5 and HIGH =1.5).

$$(V_{WORK}) = (W/A)(V_{AIR}) \qquad (V_{GAP}) = (V_{AIR})(GS)$$

Software (USB or Ethernet) Interface

The SBS 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. 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:

Command	Response	Meaning/ **Example**:
...		

Control Unit Commands (Cards are Individually Controlled)		
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>**

ExactDress™ Card Commands (Cards are Individually Controlled)		
Command	Response	Meaning/ **Example**:
X		Type (of slot card) Request. **< Esc >1X<CR>** Start Slot 1 Info Request.

ExactDress™ Card Commands (Cards are Individually Controlled)		
Command	Response	Meaning/ **Example**:
	X6.xxVv.vv [sss]/text	Slot info response. 6 is ExactDress type. xx is specific model type. v.vv is gap firmware revision. sss is the user specified name for this card. Text briefly explains the card type. **1X3.00V1.00[GAP1]/EXACTDRESS<CR>**
S[C]		Status Request command. If 'C' present then previously reported errors conditions will be cleared before the status is reported. **<Esc>1S<CR>** Report Slot 1 Status.
	Snn,aaaa [,CIP][,AIP] [,FPI] [,GAP] [,MIN] [,MAX] [,CRASH][,A][, B], ERR=eee	Status response. nn indicates active job# (01 to 32), aaaa is AE level (dynes). CIP is Cycle In Progress. AIP is Process mode active. FPI is Front Panel Inhibit. GAP, PROCESS MIN., PROCESS MAX., and CRASH the corresponding relay output is closed, A and B indicate that that the job# nn is also selectable by the CNC job select input, eee represent individual error letters representing error conditions. If the first character is '@' then an error condition requires clearing (use SC command or press clear on front panel). **1S1,2.905,CRASH,ERR=@AB<CR>** **<ESC>1SC<CR>** Report Slot 1 Status. **1SD2.912,ERR=B<CR>**
C[S|A|nn[,A |B]]		Cycle Command: If nn will change to corresponding job# (nn range 01 to 32). If S or A then will Start or Abort the measurement process, correspondingly. No response to A or nn. If an A follows the job number nn, the job nn will be assigned to the CNC job select input position A. If an B follows the job number nn, the job nn will be assigned to the CNC job select input position B. **<ESC>1C2<CR>** Set dataset to 2. **<ESC>1CS<CR>** Start Cycle.
	n<sp>dddd	Cycle data. n is slot#. dddd is AE level in dynes. These will be sent whenever a cycle is running. There will be no response if the command is not allowed. **1 0.023<CR>** slot 1<sp>dyne level. **1 0.120<CR>** slot 1<sp>dyne level. **2 0.134<CR>** slot 2<sp>dyne level. **<ESC>1CA<CR>** Abort Cycle. (no response)
L		Level request: **<ESC>1L<CR>** Request Current AE Levels.
	Lnn,gggg,cccc	Level response. nn indicates active job# (nn range 01 to 32). Levels (dynes) are gggg for Gap and cccc for Crash. **1L1,0.023,3.112<CR>** dataset 1 mode levels.
P[O|F]		Request current display peak dynes enable status. If O present then enable the onscreen display of each peak AE signal value. If F present then disable this display. No response to O or F. **<ESC>1P<CR>** Request current status of peak dyne display mode. **<ESC>1PO<CR>** Enable display of peak dynes. **<ESC>1PF<CR>** Disable display of peak dynes.
	P{O|F}	Display Peak AE signal value mode response. O indicates display mode is on, F indicates display mode is off. **1PO<CR>** Displaying of peak dynes is enabled **1PF<CR>** Displaying of peak dynes is disabled

Displayed Error Messages

Self-diagnostic software has been incorporated into all SB-5500 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	SENSOR 1 DEFECT OPEN – CHECK CABLE AND CONNECTORS SEE MANUAL	Checked continuously. Acoustic Sensor 1 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.
B	SENSOR 1 DEFECT SHORT – CHECK CABLE AND CONNECTORS - SEE MANUAL	Checked continuously. Acoustic Sensor 1 short circuit detected.	Clears automatically. Disconnect the Control Unit from AC power before checking cables and connectors, and sensor for shorts. If the problem cannot be isolated, the sensor, cable, and/or Control Unit should be returned for repair.
E	+15V POWER DEFECT SHORT – CHECK CABLE AND CONNECTORS – SEE MANUAL	Checked continuously. 15V Auxiliary supply low – fuse open	Check for shorts in Sensor and CNC cables and connectors and re-initialize the system. If the error persists return Control Unit and cables for repair. If you have the SBS system cabled to your CNC controller, verify that the CNC cable is free of electrical shorts. The CNC cable is not supplied with the SBS system, and repair is the responsibility of the user.
F	CRASH CONDITION	Checked continuously. Unit has measured acoustic levels exceeding the Crash limit set.	Cleared manually by pressing "Clear" button or by CNC RESET. Check for part crash. Reset Error.
G	CIRCUIT FAILURE UNABLE TO MEASURE AE SIGNAL SEE MANUAL	Checked continuously. Signal acquisition circuit failed.	Clears automatically. No action required other than clearing manually from the screen. If the problem persists, the Control Unit should be returned for repair.
H	NO TEACHED DATA AVAILABLE PERFORM TEACHING CYCLE	Checked with each process START. No saved TEACH data is available for process.	Cleared manually by pressing "Clear" button or by CNC RESET. Perform TEACH process to establish a Process Reference.
I	DISPLAY FIRMWARE NEEDS TO BE UPGRADED TO SUPPORT SB5523	Checked at power-up. Firmware for display PCB is not current for support of SB5523.	Cleared manually by pressing "Clear" button or by CNC RESET. Perform Firmware upgrade for Control Unit.

Appendix A: Specifications

SB-5500 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 (ExactDress™)
SB-5532   Mechanical balancers with non-contact connection
SB-5543   Manual balance control

SB-4500 Compatible
Operates with existing cables and sensors.

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

Multi-language Capability
English, Chinese, French, German, Italian, Polish, Russian, Spanish, Swedish

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.

Environmental and Installation

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

CNC Hardwire Interface

Input requirements: 10-26V AC/DC, 8mA min.
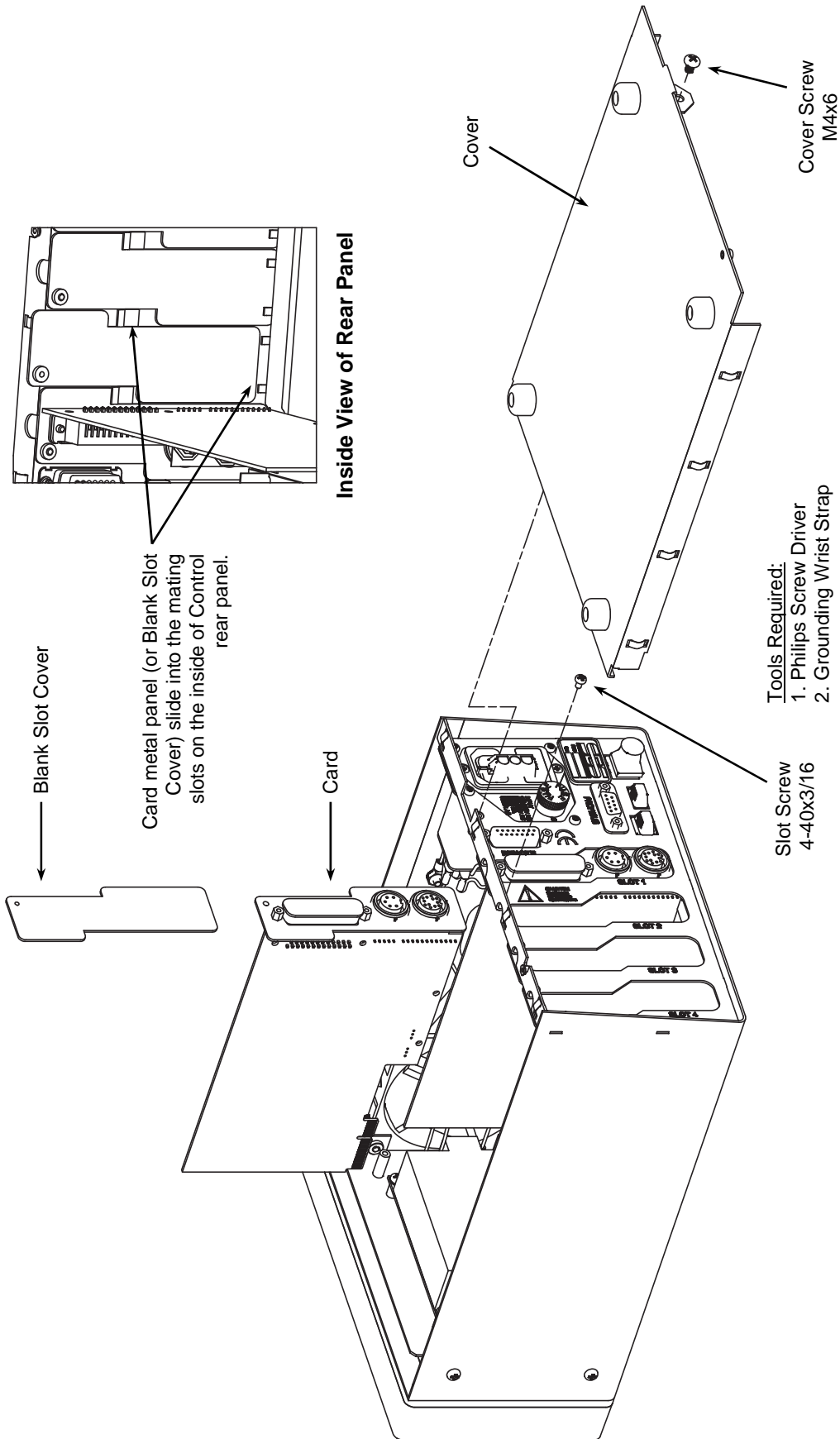Output +15VDC, 30mA max.

Appendix B: Replacement Parts List

Part#	Description

ExactDress™ Control

SB-5500-E	Control: ExactDress, AC Input
SB-5501-E	Control: ExactDress, AC Input, No Profibus
SB-5510-E	Control: ExactDress, AC Input, No Front Panel
SB-5511-E	Control: ExactDress, AC Input, No Front Panel, No Profibus
SB-5520-E	Control: ExactDress, 24 VDC Input
SB-5521-E	Control: ExactDress, 24 VDC Input, No Profibus
SB-5530-E	Control: ExactDress, 24 VDC Input, No Front Panel
SB-5531-E	Control: ExactDress, 24 VDC Input, No Front Panel, No Profibus
SB-5523	Control Card: ExactDress

ExactDress™ Sensors
Built in to Non-contact Balancers

SB-42xx	Bolt-on Sensor
SB-41xx	AE-Extension Cable
SB-3208	AE Sensor: Non-contact spindle mounted Mini-Stud Mount – M6x1.0 LH
SB-3209	AE Sensor: Non-contact spindle mounted Mini-Stud Mount – M6x1.0 RH
SB-3225	AE Sensor/ Sender Package: Non-Contact In-Spindle
SB-3210	AE Sensor: Non-Contact In-Spindle w/ slide tube connection

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

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 Cordset
CA-0009-G	Power Cordset (Germany)
CA-0009-B	Power Cordset (British)

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: ExactDress™ Card Installation

Inside View of Rear Panel

Card metal panel (or Blank Slot Cover) slide into the mating slots on the inside of Control rear panel.

Blank Slot Cover

Card

Cover

Cover Screw M4x6

Slot Screw 4-40x3/16

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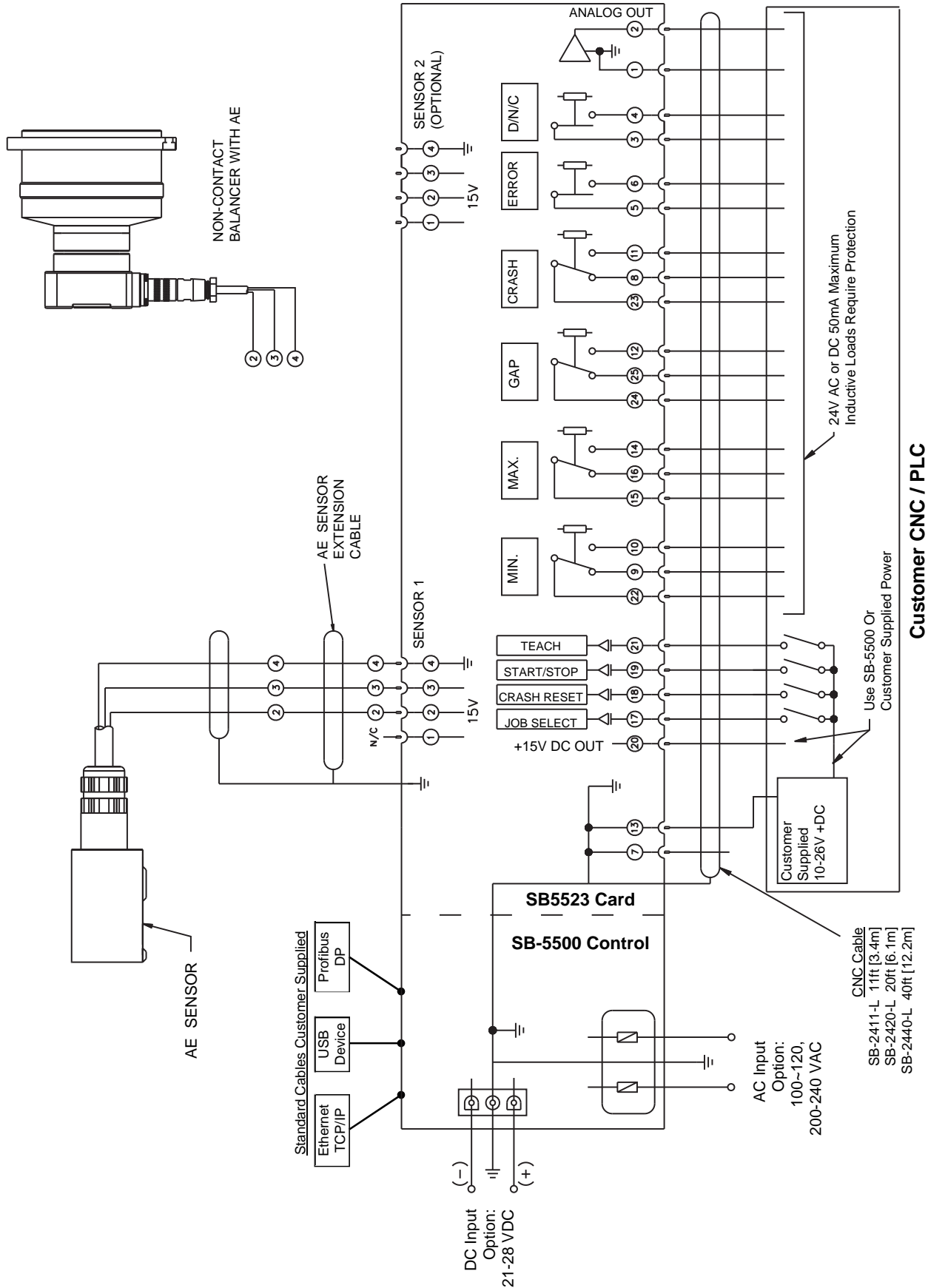2. Grounding Wrist Strap

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.

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.

Appendix D: ExactDress™ System Connection Diagram