ACCRETECH | SBS
PRECISION PROCESS CONTROL

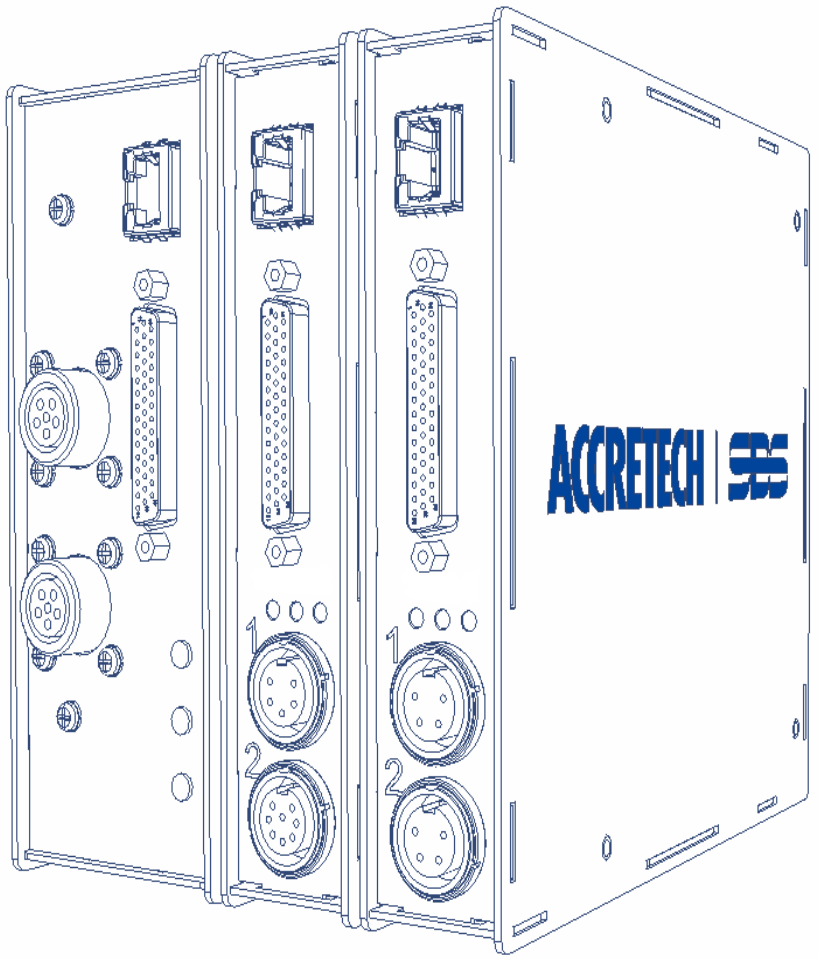
OPERATIONS MANUAL

SB-6560
SB-6560-8

SB 6500

ExactControl™ System

Engineering Confidence for Precision Grinding



ENGINEERING CONFIDENCE.
BUILT WORLDWIDE.

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PRECISION PROCESS CONTROL

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User's Guide and Specification

For the

SBS ExactControl™ System

Covering Operation of SB-6560 and SB-6560-8

of Model 6500 series Control Units

LL-6600

Manual Revision # 1.2

Covers operation with product firmware rev 1.21.2

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Benefits of SBS ExactControl™ System with SB-6500 Control:

- Increases throughput by saving setup time
- Improves part quality by providing grind and dress quality monitoring
- Gap Elimination - Increases throughput by reducing unproductive grind infeed.
- Crash Protection - Quick detection of extreme wheel contact to allow feed shutdown and prevent dangerous wheel crashes.
- 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
- Profinet and OPC UA communication
- International adaptability: voltage, frequency, communication, and display language
- Backed by world-class SBS customer service

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1 System Installation

1.1 System Purpose

The SBS ExactControl™ Card has been developed to monitor grinding and dressing processes. Work-piece contact detection, collision detection and monitoring the allowance in grinding and dressing are made possible, with the following objectives in mind:

- **Maximum flexibility of process control**
- **Maximum efficiency of process control**
- **User-friendly operation of the system**
- **Maximum grinding efficiency**
- **Minimal requirements for installing**
- **Simple and clear parameter settings**
- **Clear display of process data**
- **Uniform user interface between all 6500-series modules**

1.2 Operator Safety Summary

This summary contains safety information necessary for operation of the SBS ExactControl™ 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 ExactControl™ System, it is necessary to read and understand the entirety of this manual. After reading the Operation Manual, contact Accretech SBS, 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 AEMS 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.

1.3 Process Control Overview

The ExactControl™ system consists of an independently mountable electronic control module with DIN clip attachment capability. The base process is this: an 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 can ensure that either a maximum or minimum degree of wheel contact is maintained throughout a dress or grind cycle. Monitoring results are then reported via hardwire and/or software interfaces. They can also be monitored on a remote PC or on the Machine Control's display. Machine CNC/PLC 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 a dressing or grinding process.

1.4 Signal Inputs for Process Monitoring

To control a process, the device needs some kind of input to monitor. Typical examples include acoustic signals in a grinding operation, spindle RPM, spindle power, and temperature. The device has dedicated inputs for acoustic sensors. It also has general purpose analog voltage inputs. Any of these can be used as a process measurement signal.

1.5 Strategies, Instances, and Jobs

A **Strategy** is a pre-defined formula or algorithm for evaluating or processing a process measurement signal.

An **Instance** is a Strategy combined with assigned selections and settings, which include the specific process measurement signal, customizing parameters, and a specific switching output (status). If reference data is required for a Strategy, then the data acquired during a Teach cycle will be stored as part of each instance.

A **Job** is a collection of one to four Instances which will be combined to monitor a particular process or operation (e.g. a particular workpiece on a grinding machine).

1.6 Channels

A **Channel** is a signal interface through which a specific Job (process monitoring cycle) may be operated. Each channel has digital inputs for Job Start, Job Select, and Teach. It also has digital outputs for reporting the process status.

Seven channels are available in three groups: Software Interfaces (Profinet/OPC UA) provide four channels; Digital IO provides one or two channels; and there is one Manual channel. The device can run up to seven jobs at the same time, one on each channel. Any channel may start a job at any time. The resulting output signal of each monitoring channel will normally be reported back on the same channel. The Manual channel has no output signals.

1.7 Channel Signals

Job Select: A number of the channel input signals are used, via preset codes, to select a particular job. Normally these are set to the desired code before the process cycle is started.

Teach: This dedicated input is set prior to the start of a process cycle. It is active to indicate that the cycle is used to teach the nominal behavior of the signal inputs for the selected Job. If the currently selected strategy does not support teaching, this input is ignored.

Job Start: This input signal is made active to start and run the cycle, whether it is for processing or teaching. The signal is made inactive to stop the cycle.

Infeed Enable: This output signal is active to indicate that the Job cycle is running. Its design purpose is to enable machine operation as needed for the process (e.g. enable infeed of a grinding wheel towards a workpiece).

Switching Output: This optional output is used to provide a signal that indicates the evaluation result of a process. Several different outputs may be used depending on the combination of strategies grouped in the Job. The Manual channel does not activate any switching outputs. The digital channels can only activate Digital IO outputs. A Software channel can specify its switching outputs as one of the Digital IO outputs, or as software outputs which will be output in that specific channel's software output.

1.8 Connections

The front and bottom of the SB-6560 ExactControl™ module is shown below. The two circular connectors allow for the attachment of AE sensors. In the SB-6560-8 version, there are eight connector inputs for expanded sensor use.

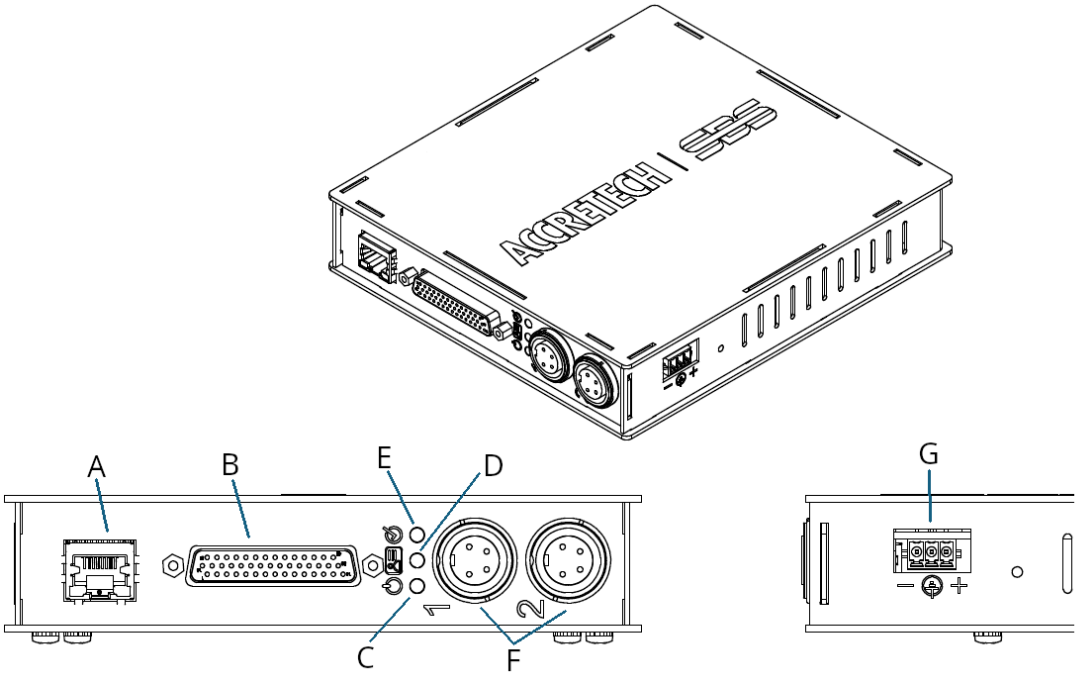


Figure 1: A

A) Ethernet. Provides TCP/IP and UDP connection to host devices, such as SB-6500 software or OPC UA server.

B) Hardwire I/O. DB-44 connector.

C) LED-Red. On when device is supplied power.

D) LED-Yellow. Device ID. Normally off. Flashes as directed by operator.

E) LED-Green. On when module is fully operational. Flashes in on/off pattern when device is in "recovery mode". Flashes in triple-blink pattern when device is updating.

F) AE Sensor connection. Sensor number marked as shown.

G) Power supply, DC input. 22 VDC to 26 VDC. 0.9A max at 22 VDC

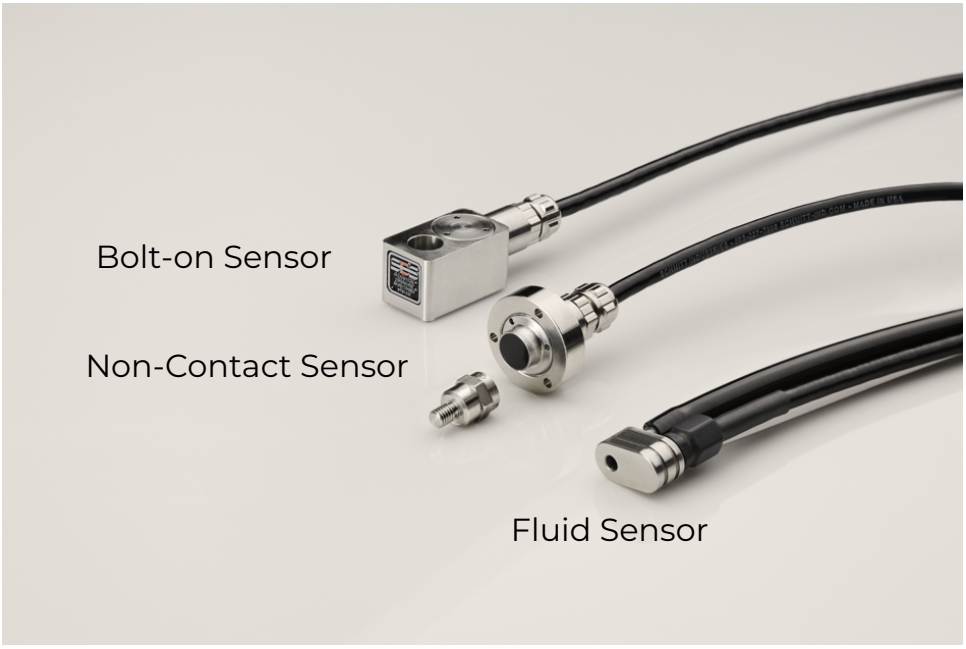
1.9 Acoustic Sensor Location

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 reasonably 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 located 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 unit, 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 a Bolt-on sensor, it is recommended 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 one AE 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 one sensor on the dresser structure for dressing monitoring, and another sensor on the tailstock, or other rigid portion of the part holding structure of the machine, for grinding monitoring. Two AE sensors can be connected and in use at any time by the ExactControl™ system.



1.10 AE Sensor Types

A variety of Sensor configurations are available for 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 a screw directly to the machine structure, nearest as possible to 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 work spindle 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 and pressure regulated machine coolant) is directed to flow onto the target area. The AE signal transmitted up the fluid stream and is detected by the sensor.

Balancer mounted Sensor – The sensor is integrated into non-contact mechanical external or internal SBS balancers.

2 Basic Software Usage

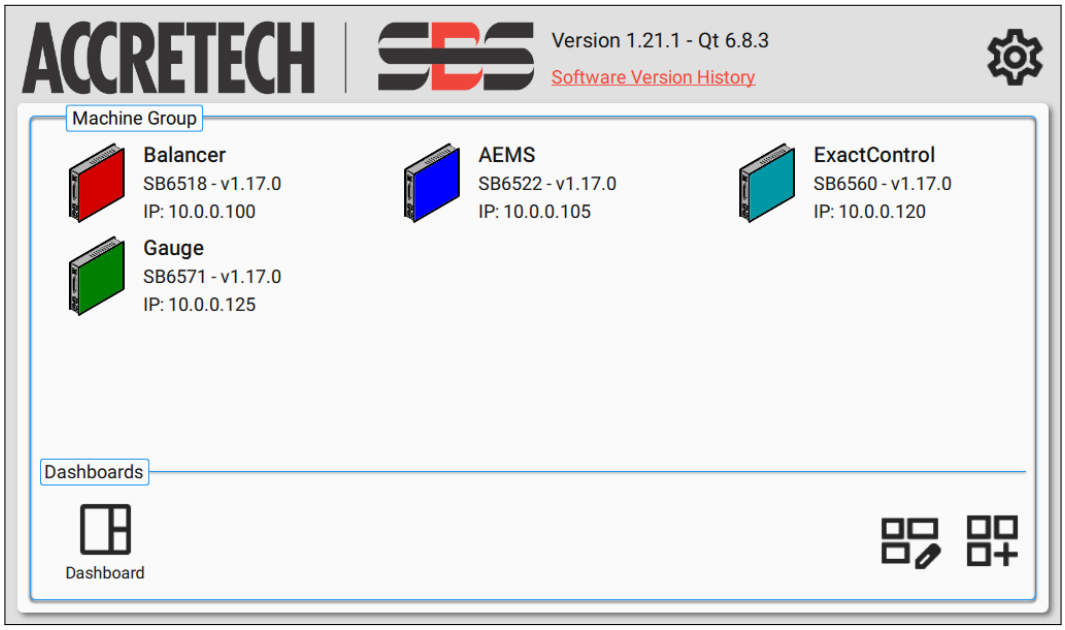
When the software starts up it will load the last connected machine group. If no machine group exists, you will be prompted to create one.

The home page is the primary form of program navigation. Clicking on any module or dashboard graphic will go to its specific visualization. It also provides navigation to the settings page and Module Management interface.

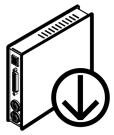


SBS Home Button

Clicking on the SBS Home button from the module main screen returns you to this home screen.



SB6500-Software Home Screen



Module Management



Software Settings



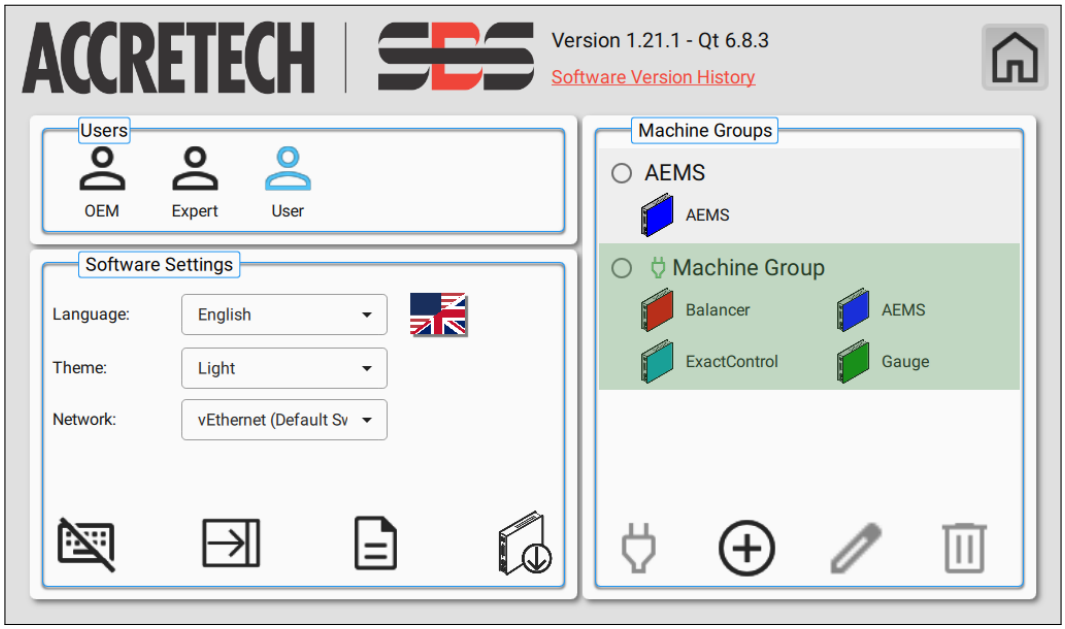
Create New Dashboard



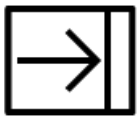
Edit Dashboard

2.1 Software Settings

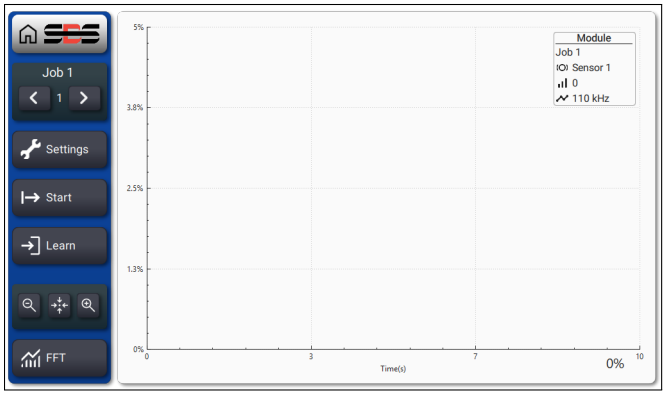
This section allows changes to the overall user experience, including language, color theme, and active network adapter. Custom color themes can be created, using Light or Dark mode as a starting point. Saving a custom theme is currently not supported.



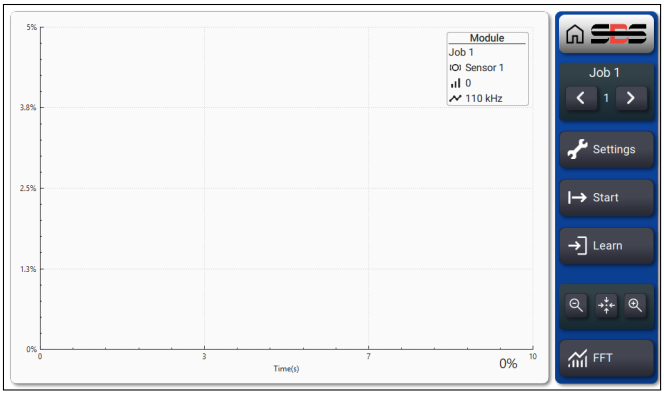
SB6500-Software Settings Page



The placement of the module control bar can be controlled by the operator by toggling the control bar position button.

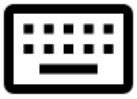


Left Module Control Bar

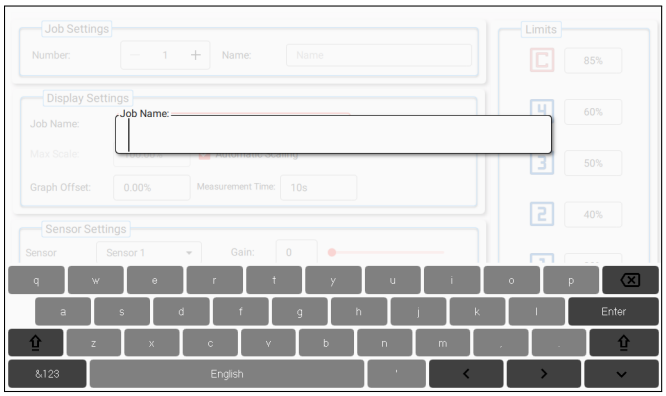


Right Module Control Bar

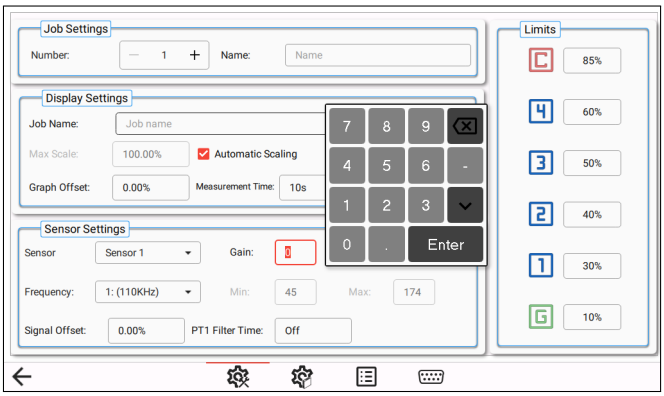
2.1.1 On-Screen Keyboard



The keyboard button enables the onscreen keyboard to appear when contextually necessary. If editing a value that uses alphanumeric characters, the full-sized keyboard will appear. In the case that you are editing a value that only accepts numeric values, a number pad keyboard will appear next to the control.



Full-sized keyboard



Number pad keyboard

2.1.2 Software Event log

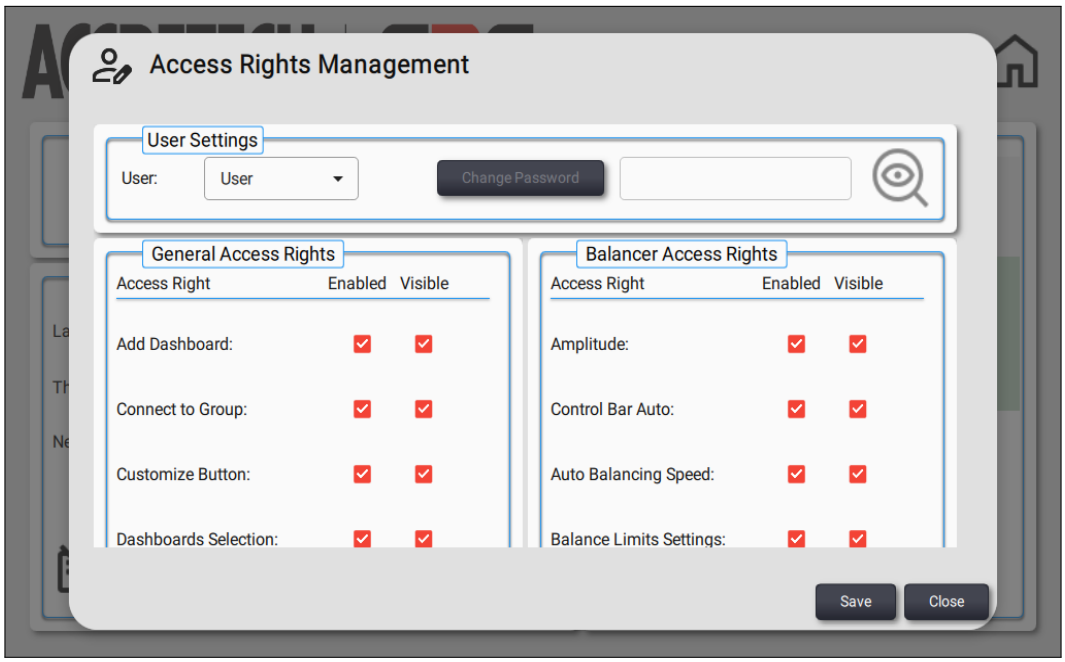


The software event log button shows the events that occur on a global software level. See Event Log for module-specific information.

2.1.3 Network

Select the network adapter to use for connecting to modules. If there are any issues finding modules for machine group creation or connection, it is important to try changing the network adapter to the one that is connected to the network the modules are on.

2.1.4 Access Rights



Access Rights Settings as OEM

Under the user's card are the three available user profiles for the software. Each one is intended to have different access levels to the software but must be configured by the OEM before use. The system remembers the last logged in user and will re-login to that user level on next boot without prompting for a password. The three different levels have these inherent abilities that cannot be changed:

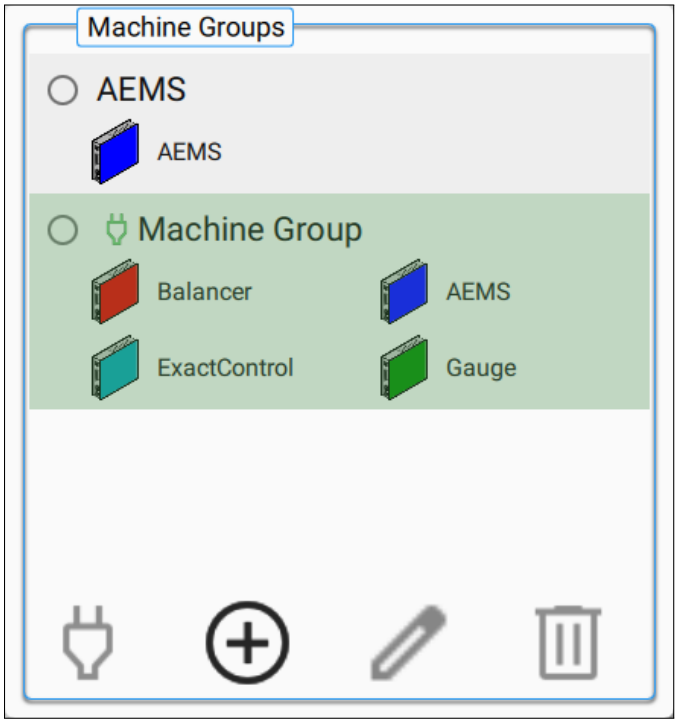
1. OEM
    a. Can edit the access rights of the other two users.
    b. Cannot change access rights for the OEM user. OEMs always have full access to all features.
    c. Can change the password for the OEM, or Expert.
2. Expert
    a. Can have a password assigned by the OEM.
    b. Can have access rights assigned by the OEM.
3. User
    a. Cannot have a password assigned.
    b. Can have access rights assigned by the OEM.

Warning: Losing or forgetting the OEM password can only be fixed by an SBS service provider. If you have been locked out of the system, please contact support for assistance.

2.2 Machine Groups



A Machine Group is a selection of control modules that the operator wishes to display and interact with. To interact with an SBS control module of any type, it must be a member of a Machine Group. Modules may be members of multiple machine groups. The Machine Group currently active is marked with the plug icon.



Machine Group Manager



Connect to selected Machine Group



Create Machine Group



Edit Machine Group.

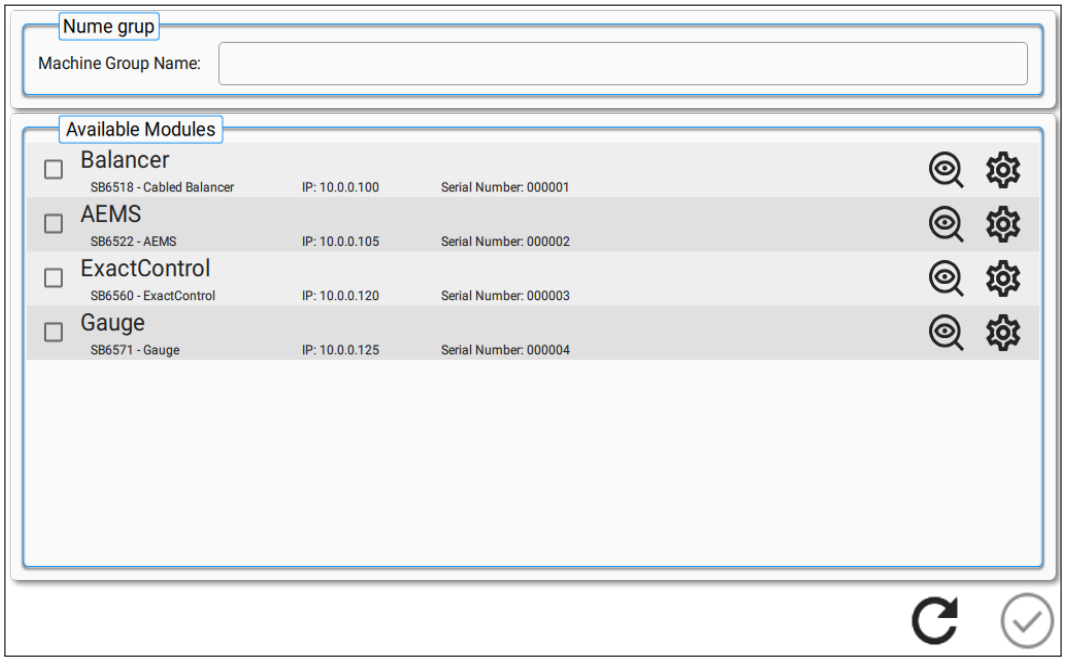


Delete Machine Group.

2.2.1 Create Machine Group

Clicking the "Create Machine Group" (+) button initiates a search on the connected network for all SBS control modules. Devices found will be displayed in the Available Modules list. If the module you are looking for does not show on the list, wait 30 seconds, then refresh the list. Mark any modules you wish to add, name the Machine Group, then click "Create".

Some modules may be listed in red text with their IP as "Not on Network". This means that the module is not on the same subnet as the computer's network adapter. The SB-6500 Software cannot connect to the module in this state; however the module's IP can be changed by editing its Network Settings via the "Edit Network Settings" button. By default modules use the "Auto-set IP" setting. This means modules use DHCP for IP assignment, and when DHCP is not available, a link-local address is assigned (169.254.x.x).



Machine Group Creation



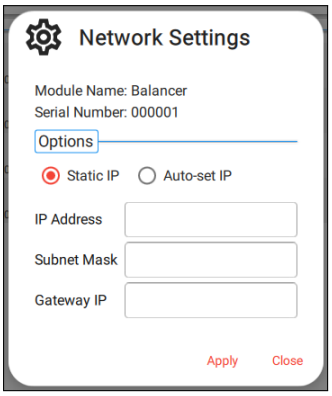
Identify Module: Will flash yellow LED on module three times.



Refresh Module List.



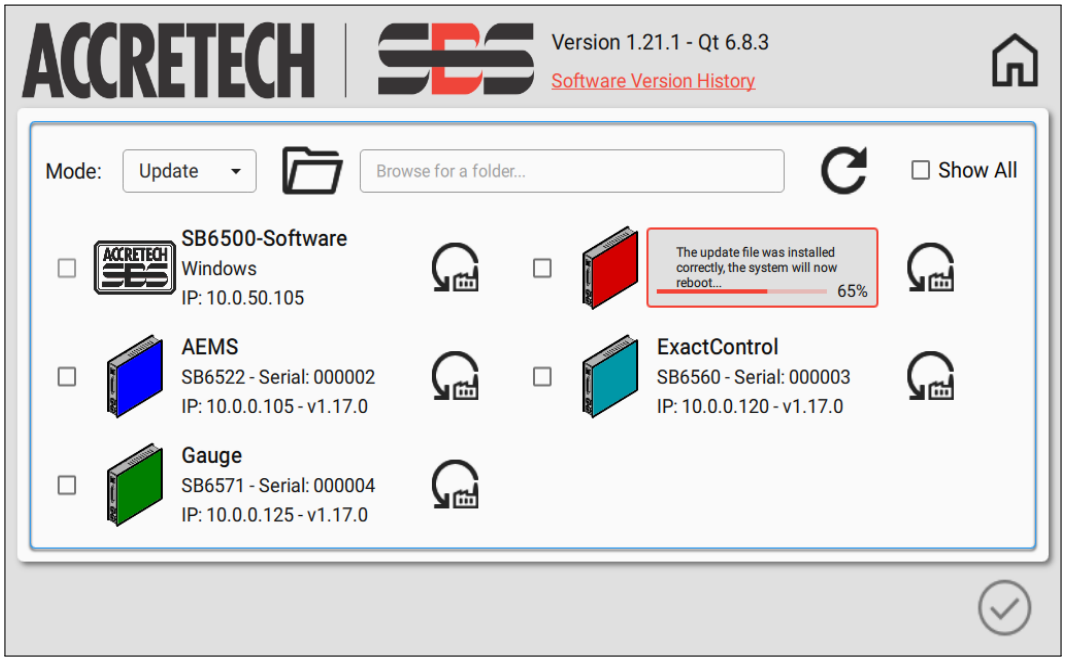
Edit Network Settings.



Network Settings Screen

2.2.2 Software Update

To update the software on the SBS control module, browse to the folder containing the update file. The list of modules displayed will be populated from the active Machine Group. Check the Show All box to show all modules on the network. Select the modules you wish to update, then press the "Start Updating" button.



Module Manager



Go to Module Manager



Select Update Folder



Start Updating

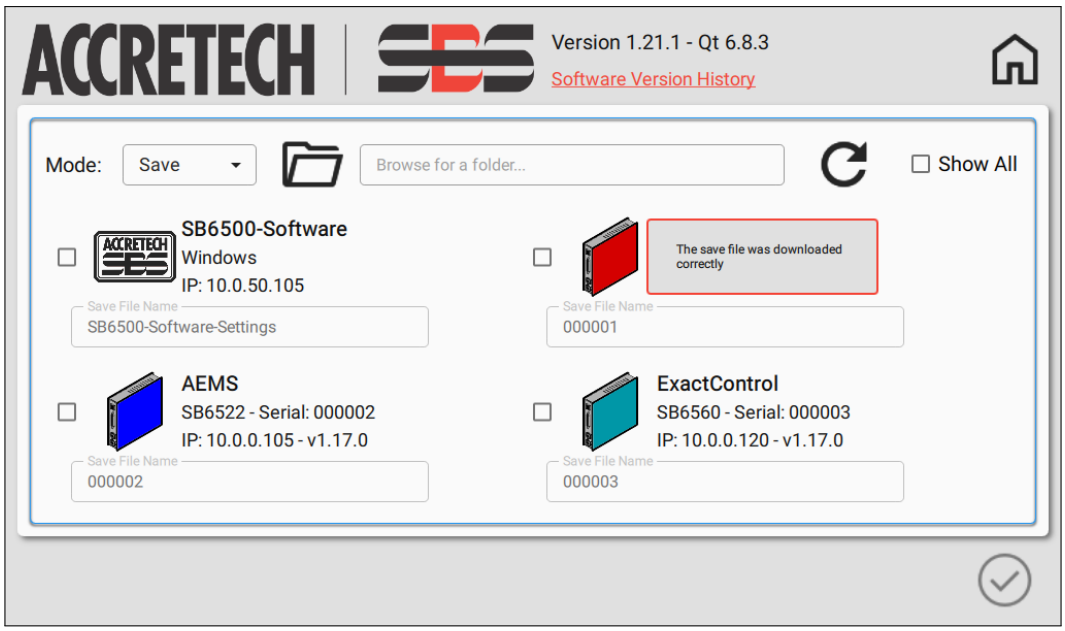


Factory Reset: Resets all module parameters back to default values. Includes network settings.

2.2.3 SB6550 Update

If running on an SB6550 display, the updating screen will include the Display as an option. The display update file should be in the same folder as the module update file.

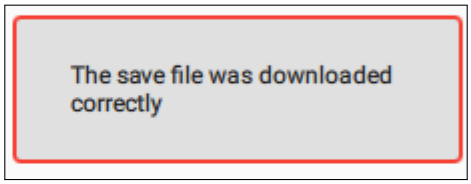
2.2.4 Save / Restore



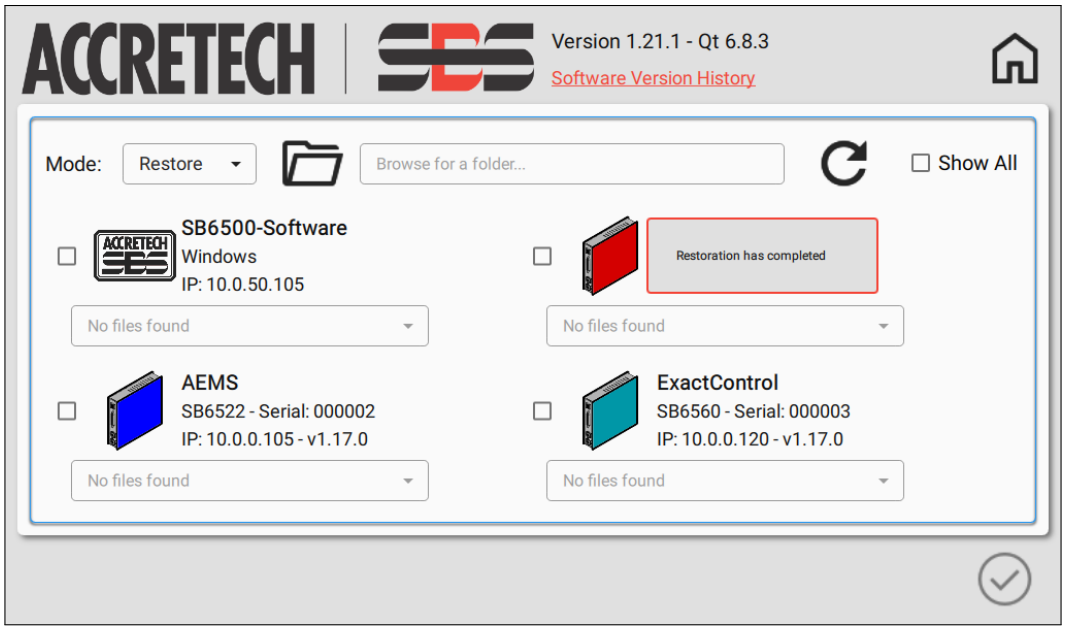
Save Menu

By changing the mode to Save in the module manager, you can save the current settings of any module to a file. That file can then be used to restore those settings to any module of the same type. This Save/Restore function allows you to backup the settings at any time for retrieval later or to copy to a new installation.

On an SB6550 display the save file will automatically be placed on a USB drive inserted into the front USB C port. Do not remove the USB drive until all modules show the saving process as complete.



File saved successfully

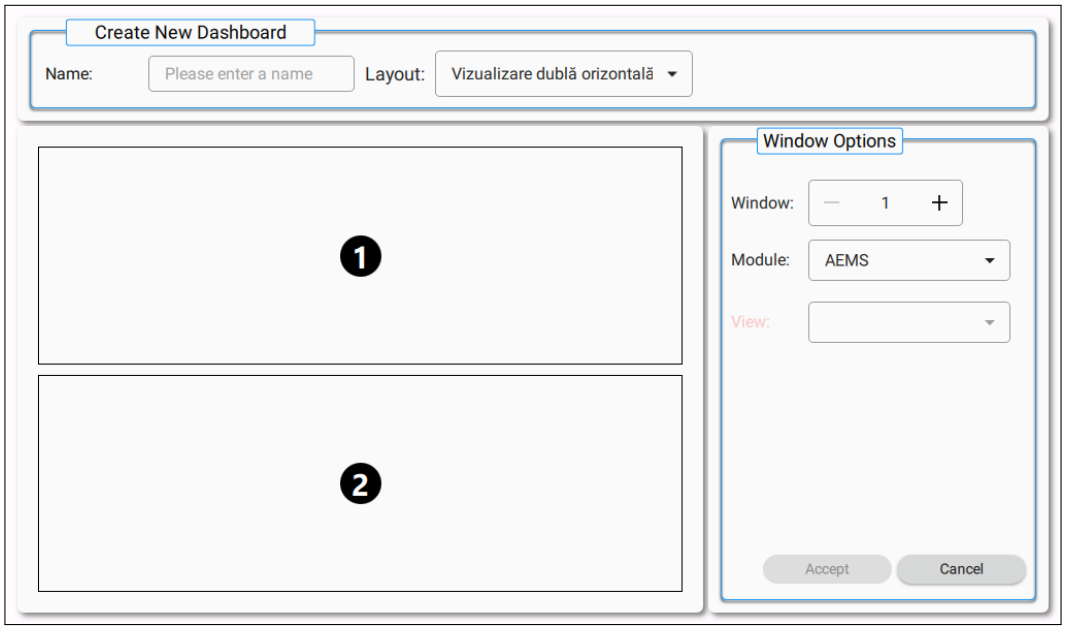


Restore Menu

Changing the mode to Restore brings up the restore interface. Select the modules that should be restored from the file in the target folder. If there is only 1 file for that module type in the target folder it will be selected automatically. Otherwise, you must select which file to use for that module using the drop down. Click the Accept button to begin the restore process. This will completely overwrite the module's current settings with the settings in the restore file. Note that there is no way to undo this process.

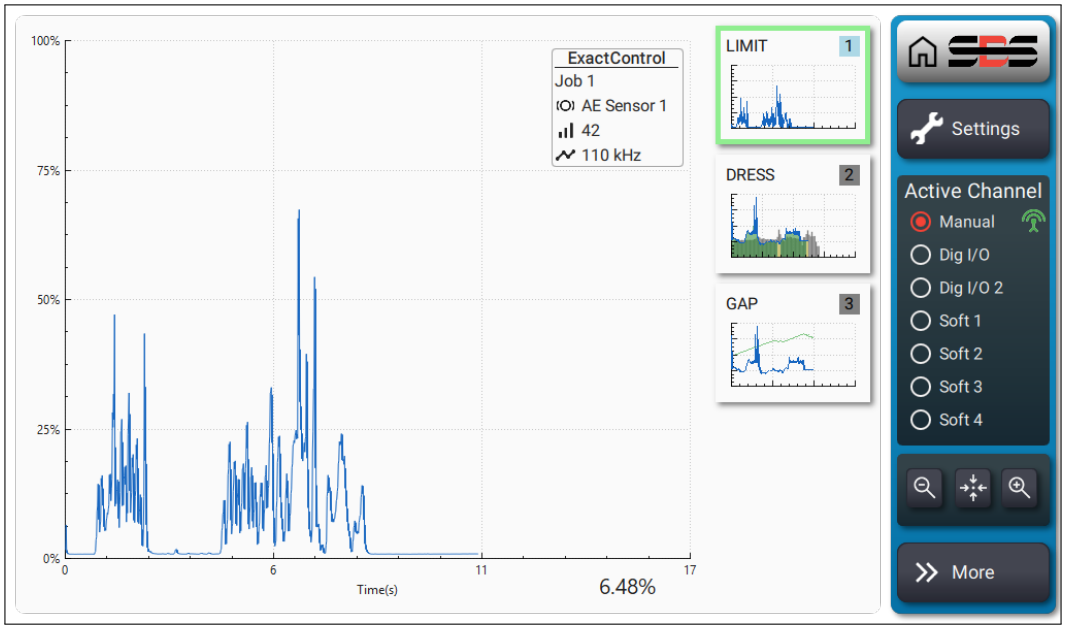
2.3 Dashboards

Operators may create customized user layouts for monitoring several SBS modules on one screen. From the navigation bar, click Create New Dashboard from the Dashboards option. Select the preferred layout from the list. Assign a module to each numbered window in the Window Options box. Depending on the size and shape of the window and the module assigned, further options may be available for you to choose from. When complete, press Accept to launch the dashboard. This dashboard will be added to the pulldown list when Dashboards is selected on the Navigation bar.



Dashboard Customizer

3 Exact Control Operation



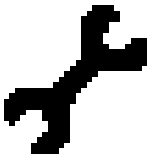
ExactControl™ Main View

This is the main screen of the ExactControl™ system. A scrolling, linear scale graph of the input signal is displayed, along with the Control Bar. This graph will change based on the current running strategy.

The current signal level is shown as a percentage of the full input range at the bottom right.

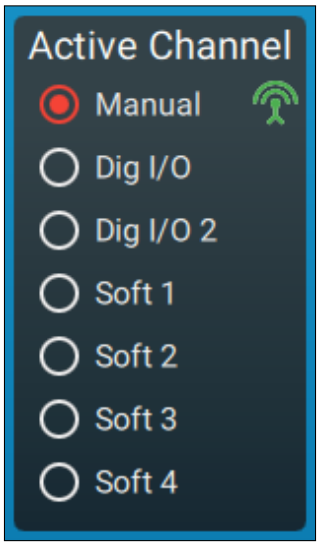
The Control bar for ExactControl™ shows the following features:

3.1 Settings



Pressing this button allows you to modify any of the parameters in ExactControl™, access the event log, and the I/O diagnostics screen. See the Settings Menu section for more information.

3.2 Active Channel



Shows which channel is currently being displayed in the main ExactControl™ graphing window.

Running channels are indicated using the icon, placed after the channel name. If a channel is started, the Active Channel selection will automatically switch to that channel.

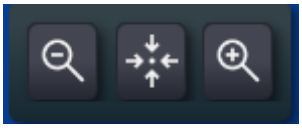
3.3 Start/Stop

The START/STOP toggle button controls the starting and stopping of the manual channel. It is possible to stop or freeze the display, so that target levels can be adjusted against recent signal levels or for review of an event by the operator, however this will also stop the currently running manual channel entirely.

3.4 Teach

Teach is a process to assist with setup for proper operation. Initiating the Teach allows operating parameters to be determined and set for each monitored work process (Job). Only ExactDress and ExactIntegral strategies require a teach – all other strategies do not utilize teach mode.

3.5 Graph Controls



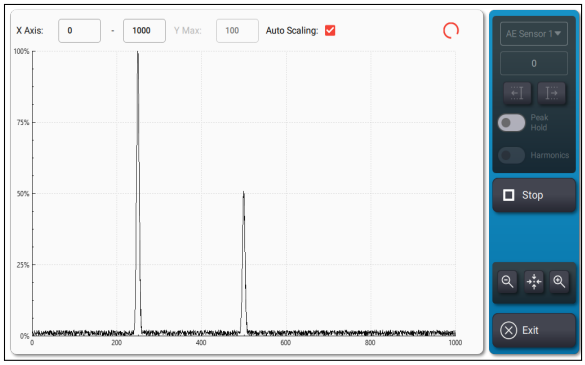
This interface allows you to increase, decrease, or reset the graph scale.

3.6 FFT

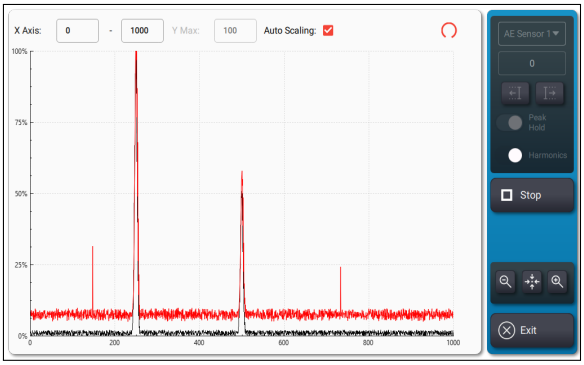
This activates the FFT interface of ExactControl™. A job must be running before an FFT can be started. The graph shows the signal output of the currently active sensor up to 1Mhz. The gain applied to the signal is based on the gain of the active job. Changing the sensor Gain value can affect the amplitude of the data presented.

A graph control interface is available, as well as an option to define the maximum graph scale. Activating the Auto Scaling function will rescale the FFT to ensure all data is shown on screen. If the currently running job uses more than one sensor the "Sensor" dropdown may be used to select the sensor used for the FFT. The minimum and maximum frequency shown on the graph can be set via the X Axis fields in the upper-left corner of the screen.

Press Start to activate graphing. Starting the FFT with the Peak Hold option activated will keep the highest peak for any frequency and display it in red. This can make it easier to capture transient events.

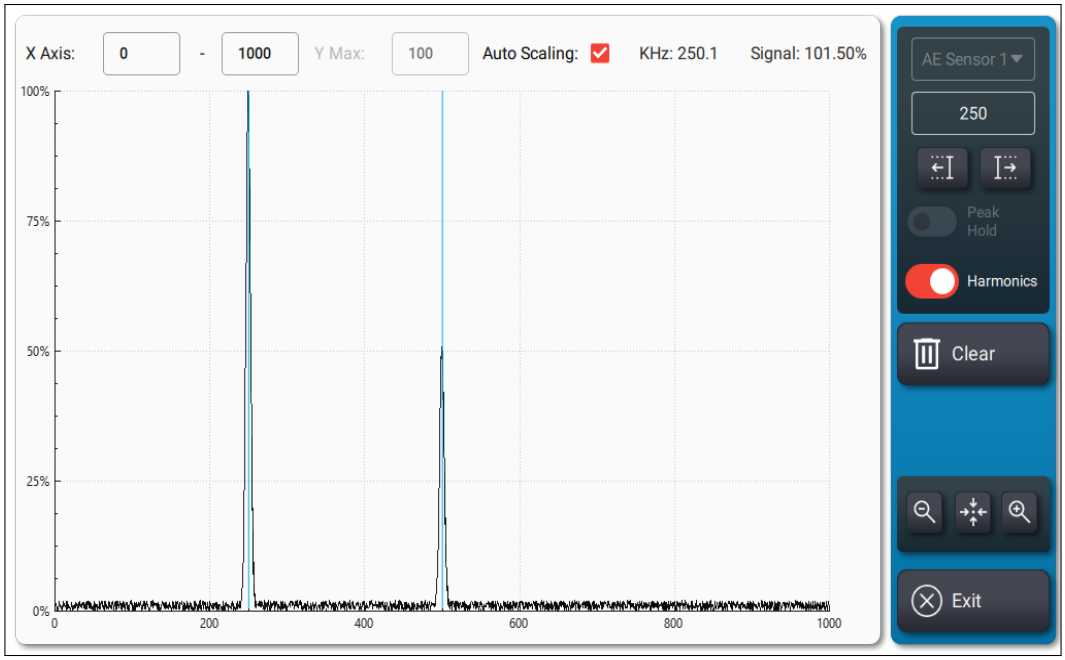


FFT example with Record inactive



FFT example with Record active

Stopping the FFT activates the on-screen cursor. Use the buttons, mouse or touch interface to move the cursor on the screen. The frequency and signal amplitude are displayed at the top. Activating the harmonic cursor option displays the cursor as well as multiples of the selected frequency on the graph.



FFT Graph with Harmonic Cursor Active

4 Settings Menu

Upon pressing the settings button, the user is taken to the settings menu where they may configure their ExactControl™ system.

4.1 Navigation Bar

This contains the user-selectable operation settings for the ExactControl™ system as well as troubleshooting and setup tools for the hardwire interface. Pressing ← at the top left of the menu bar returns to Main Operation.





Job Settings



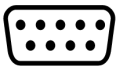
Module Settings



PCT Viewer



Event Log



I/O Diagnostics

4.2 Job Settings

This screen is used to set up and edit all the process control jobs stored on the module.

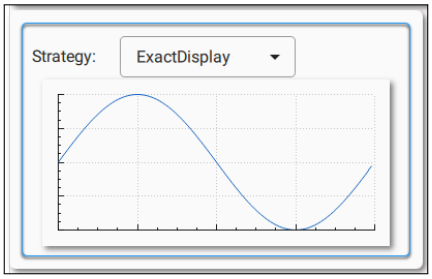
The current job which is being edited and the changeable name of that job are shown in the General Parameters pane.

All the instances for a given job will be shown in the “Instances” property of the General Parameters section.



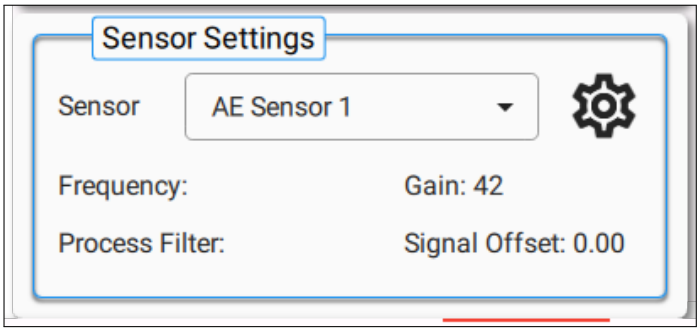
Clicking the button will create a new instance for the current job. Clicking the button will delete the currently selected instance.

The currently selected strategy type will be shown in the “Strategy” window.



And the settings of this strategy will be shown in the “Strategy Settings” section. Note that each strategy type has unique settings. The strategy types are further explained in the “Strategies” section of this manual.

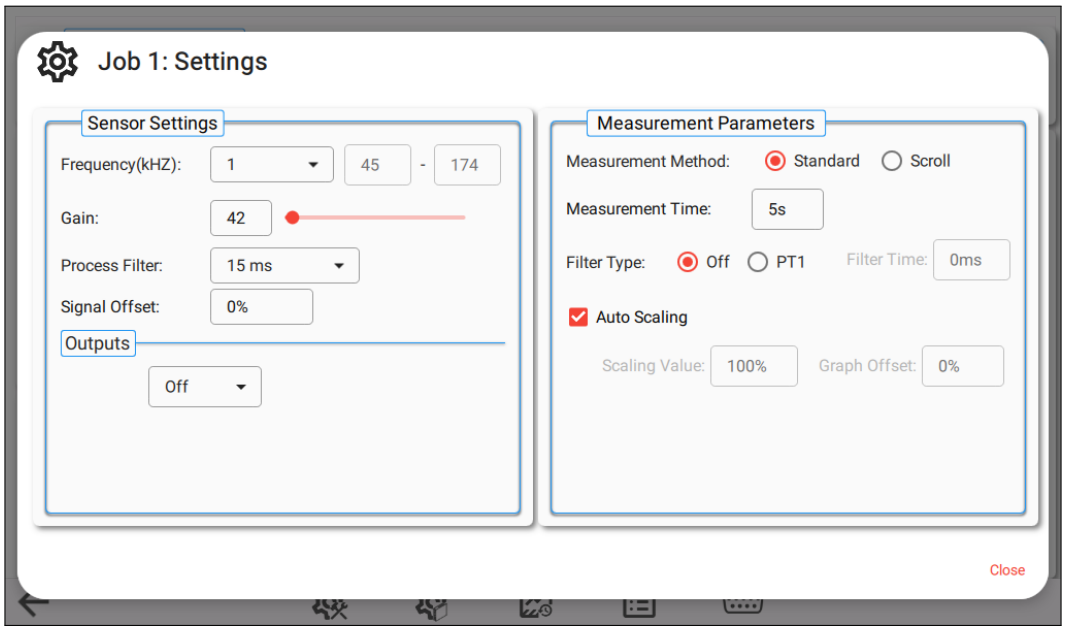
The Sensor Settings section allows the user to select which sensor they would like their current job to use. The ExactControl™ can use either an SBS AE sensor, or the voltage applied to one of the CNC Hardwire interface’s Analog Input pins as a sensor input.



The button will take the user to the expanded job settings screen for the current job.

4.2.1 Expanded Job Settings

This screen shows general settings for the currently selected instance.



Expanded Job Settings

4.2.2 Sensor Settings

The sensor settings affect how the input signal is processed from the AE sensor. If using an Analog sensor, Frequency, Gain, and Process Filter will be disabled.

Frequency – The frequency band which will be used for sensing the AE signal for the current job.

Gain – Controls the amplification of the AE signal.

Process Filter – A hardware-level filter which is applied to the AE signal.

Signal Offset - Subtracts the value from the signal level. Default value is 0.0%. Signal Offset is applied to the incoming signal before strategy calculations are performed. This can be useful to ensure that small increases in background noise do not unintentionally trigger a switching output, instead of performing a Learn Cycle.

4.2.3 Outputs

The pin assignments of the switching outputs for a given strategy are seen here. The first pin assignment may be set here. Upon setting it, the rest of the switching outputs will auto-fill sequentially. “Dig” outputs refer to the CNC’s “Dig Out” pins. “Profi” outputs refer to ‘output’ bits which can be triggered over the Profinet interface.

If multiple instances within the same job are assigned to the same Dig or Profi output (for example, both instances are assigned to Digital Output 1), that output will behave as a logical OR of the instances' switching triggers.

4.2.4 Measurement Parameters

These parameters affect how the measurement signal is displayed and manipulated prior to being processed through the running strategy’s algorithm.

Measurement Method – Controls how the graph expands in the x-axis. Each graph will start with a visible x-axis width of “**Measurement Time**” size. Once the graphed signal exceeds this time, a **Standard** graph will automatically increase the width of its x-axis. A **Scroll** graph will scroll such that the x-axis width stays the same as new points are graphed.

Filter Type – Controls the adjustable software filter which is applied to the incoming signal. PT1 is a first-order low pass filter which takes “**Filter Time**” milliseconds to settle. Hardware compares will not be used if any "Filter Type" is selected.

Auto Offset – Only available for ExactDisplay, ExactGap, ExactLimit, and ExactTime. If selected, after a job is started, for a period of “**Offset Time**” milliseconds the signal will be monitored. During this time infeed enable will be off and no strategy calculations will take place. The lowest value seen from the signal will be offset to zero, and the “**Signal Offset**” parameter will be accordingly set. Then, the infeed enable output will trigger and the strategy algorithm will start.

Auto Scaling – Allows the y-axis of the graph to automatically fit the signal. If not enabled the max y-value shown will be “**Scaling Value**” and the minimum y-value shown will be “**Graph Offset**”.

4.2.5 AE Learn Cycle

Upon pressing the “AE Learn” button in the top-right corner of the Job Settings page, a Learn Cycle will begin. Note that at least one instance in the currently selected job must use an AE sensor for a Learn Cycle to start. A Learn Cycle is only for AE sensor input, not analog inputs. If two different AE sensors are used in different instances, then the Learn Cycle will be performed for both simultaneously.

The Learn Cycle is a process to assist with setup for proper operation. Initiating the Learn Cycle allows operating parameters to be determined and set for each monitored work process (Job). A Learn Cycle is only needed for jobs which use an AE sensor. Jobs using a custom analog sensor as their only input do not need a learn cycle to be performed.

During the learn cycle the background AE signal levels for each of the eight frequency bands will be compared with the signal levels that occur during normal dressing or grinding contact, and the frequency band with the best Work/Air signal ratio will be suggested as the frequency to be monitored.

The following parameters will be adjusted at the completion of the Learn Cycle:

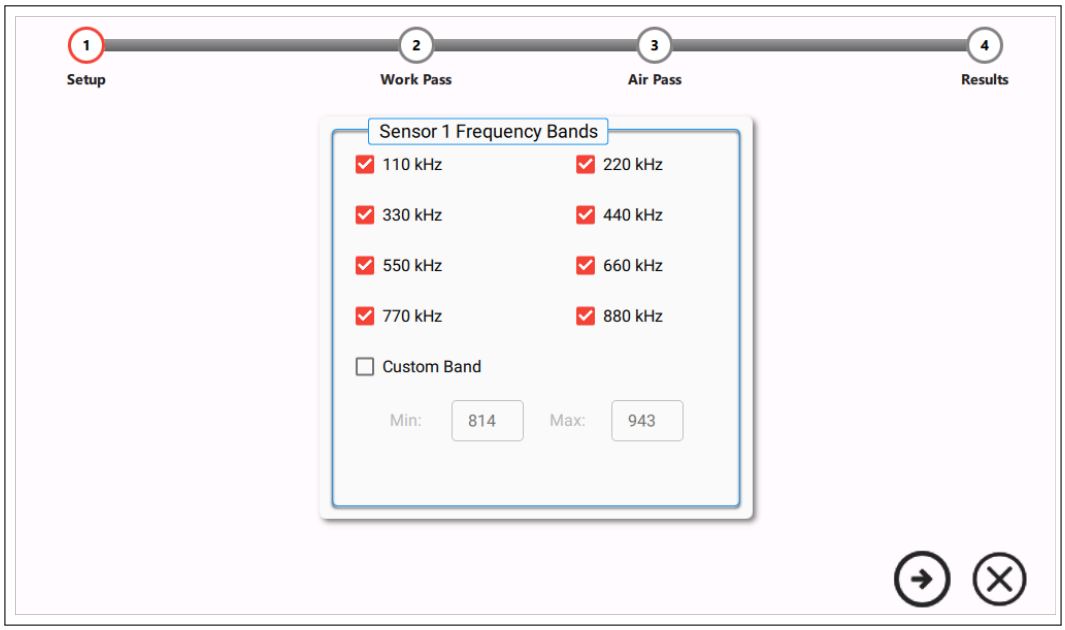
- Frequency band
- Gain
- Any active Gap, Crash, or Limit (1-4)

Any limit whose sensitivity was set to OFF (value set to 0) will not be adjusted during the learn cycle and will remain off. The Signal Offset value will be reset to 0%.

Important - If the results of the Learn process produce Work/Air ratios that are 1.2 or below, 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 or installation.

A separate Learn Cycle must be run for each Job.

Learn Cycle: Setup



Review the frequency band. Deactivated bands will not be evaluated during the Learn cycle.

For ExactControl™, a Learn Cycle may be run with one or two sensors simultaneously depending on the job settings.

A custom band can be defined here by checking the Custom Band check box. Note that this will disable all other standard bands for the learn cycle.

Sensitivity multipliers will determine the signal value the limit is set to. This is only relevant for running a Learn Cycle on a job containing an ExactGap or ExactLimit strategy instance.

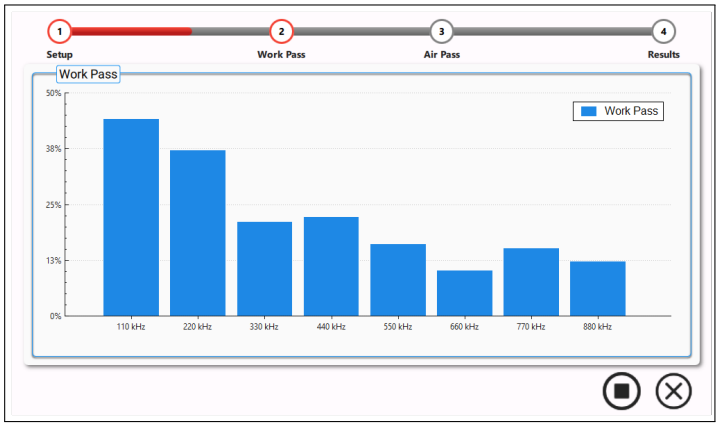
*Gap Limit = Air *(Sensitivity)*

Crash Limit = Work(Sensitivity)*

Limit values are a percentage of the range between Gap and Crash. 1.5 would be 50% of the value between the Gap and Crash values.

The operator should now initiate normal wheel contact with the dresser or part and complete one or more cycles until the bar graph is stable. Once it is stable, press the STOP Button.

Learn Work



The second step in performing a Learn Cycle is to learn the background or AIR signal level. The machine should be operational with all systems running but **without** wheel contact with the part or dresser.

Once the graph has settled, press START ▶ to begin learning. Press Stop when complete.

Learn Air

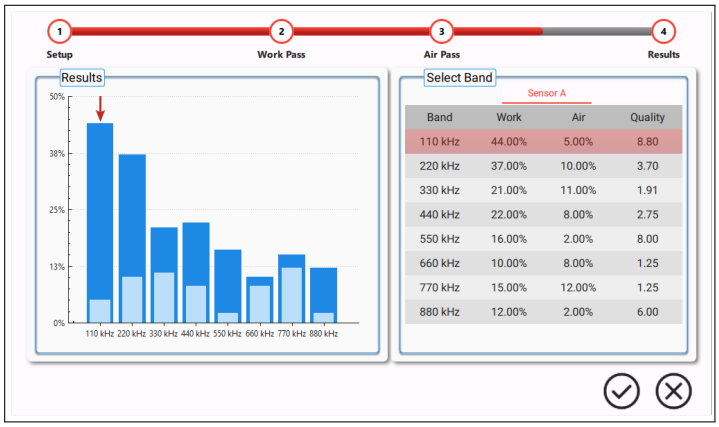


The Results screen will show the AE signal WORK and AIR levels recorded for all eight frequency bands. The resulting ratio between WORK level and the background AIR level (W/A) is displayed.

The frequency band selected by the control unit for optimal monitoring is highlighted. This selection is based on the highest W/A ratio.

Press ENTER to accept this choice or override the ExactControl™ system selection by choosing another frequency band with good results, and then press ENTER.

Results



4.3 Module Settings

The Module Settings contains the user-selectable operation settings for the ExactControl™ system. It is segmented into two sections: General Settings and Jobs.

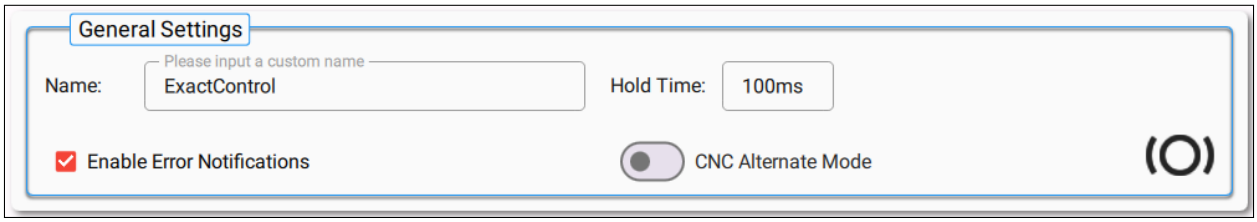
4.3.1 General Settings

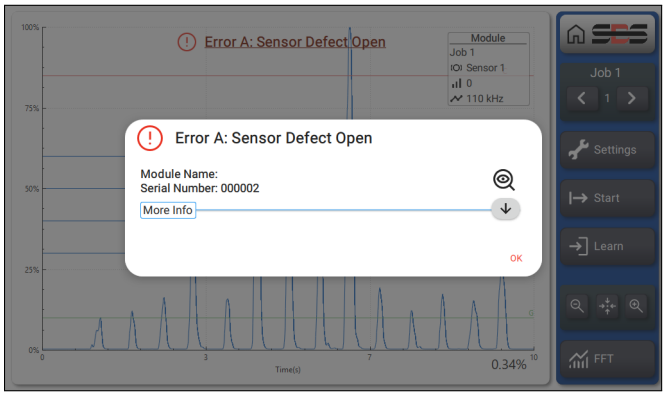
The display name of the control unit and sensors can be assigned, as well as deciding to enable or disable notifications to better control the user experience. The CNC Alternate Mode setting is explained in this manual's CNC Function Modes section.

The "**Hold Time**" setting dictates the minimum amount of time which a switching output will be held active after it is triggered. If it is set to 0 the switching output will always deactivate as soon as its switching trigger is no longer being triggered.

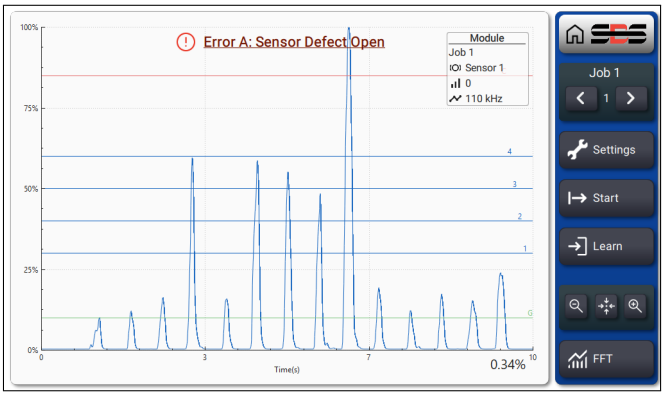


Opens Sensor Names page.



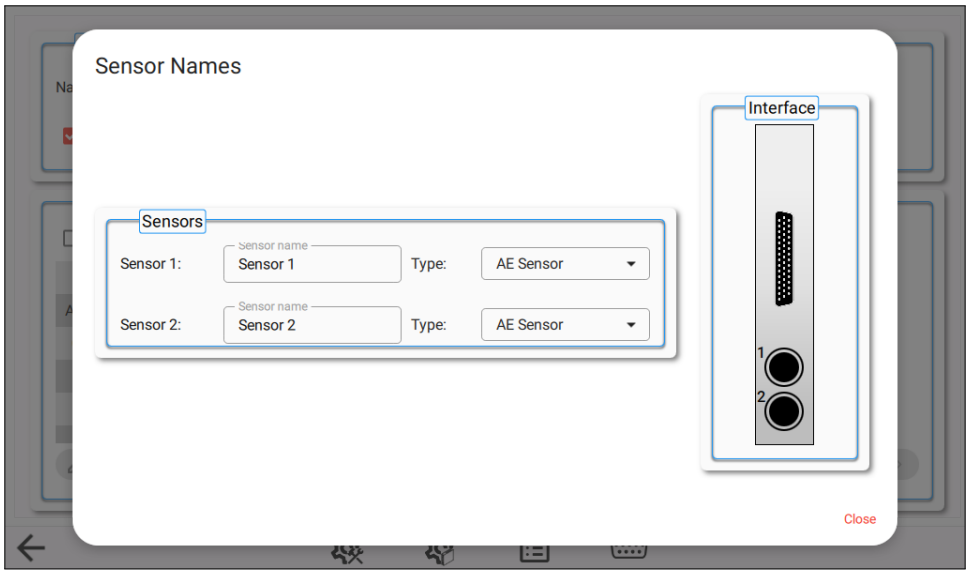


Example with Notifications Enabled



Example with Notifications Disabled

4.3.2 Sensors



If desired, you may assign a sensor name to AE sensors connected to the ExactControl™ module.

Sensors marked as Fluid will activate the Fluid Sensor Active output whenever the ExactControl™ system is monitoring through that sensor. See Hardwire section for more detail.

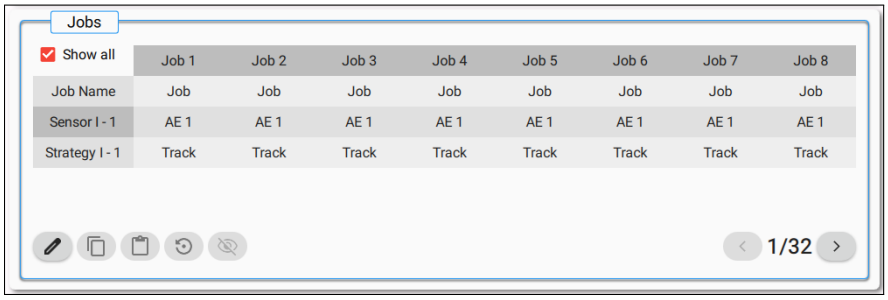
4.3.3 Jobs

Each distinct process monitored on the machine is referred to as a Job. Up to 256 Jobs can be stored on the ExactControl™ module for use as needed.

A work process is distinct if there is any variation in the contributing factors that would influence the AE signal intensity generated from wheel contact. This would include a change in any of the following: AE sensor location, grinding wheel size or type, dressing unit, work piece, feed rates, wheel RPM, and coolant type or flow. Setup parameters are all stored separately for each parameter set.

Jobs are shown in a table to provide a convenient overview of all parameters. Selecting < or > loads the next group of Jobs onto the screen. The job currently running is highlighted in red with the word **Active** above it.

The blue highlighted job can be manipulated by the five function buttons at the bottom left of the screen.



Jobs Table



Edit parameters of the job.



Copy Job parameters.



Paste Job parameters.



Reset Job parameters back to factory default.



Hide Job

4.3.4 Edit Job Parameters

Use this button to go to the Job Settings page for the selected Job.

4.3.5 Copy/Paste Job

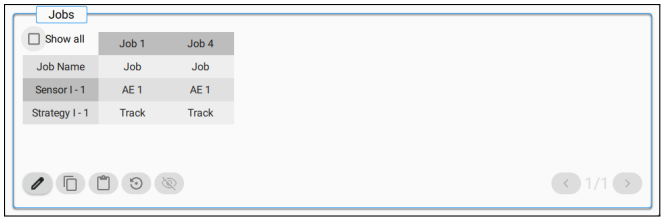
Select the source Job, then press Copy. Select the destination Job and press Paste. This enables quick population of common parameters used in the operation of ExactControl™. It is recommended that each Job perform a Learn Cycle to calibrate its AE sensor(s) properly.

4.3.6 Reset Parameters

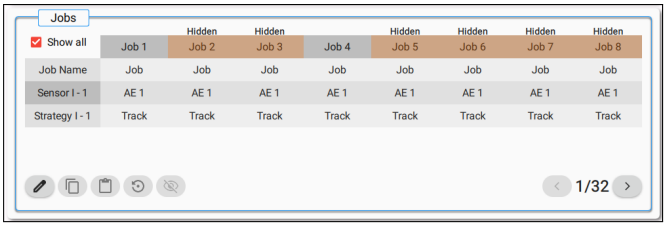
This will change all Job parameters for the selected Job back to the factory settings.

4.3.7 Hiding Jobs

Hiding unnecessary Job numbers can make it easier to find the Jobs needed for operation. Activating the Show All checkbox allows the hidden Jobs to be seen.



Jobs Hidden

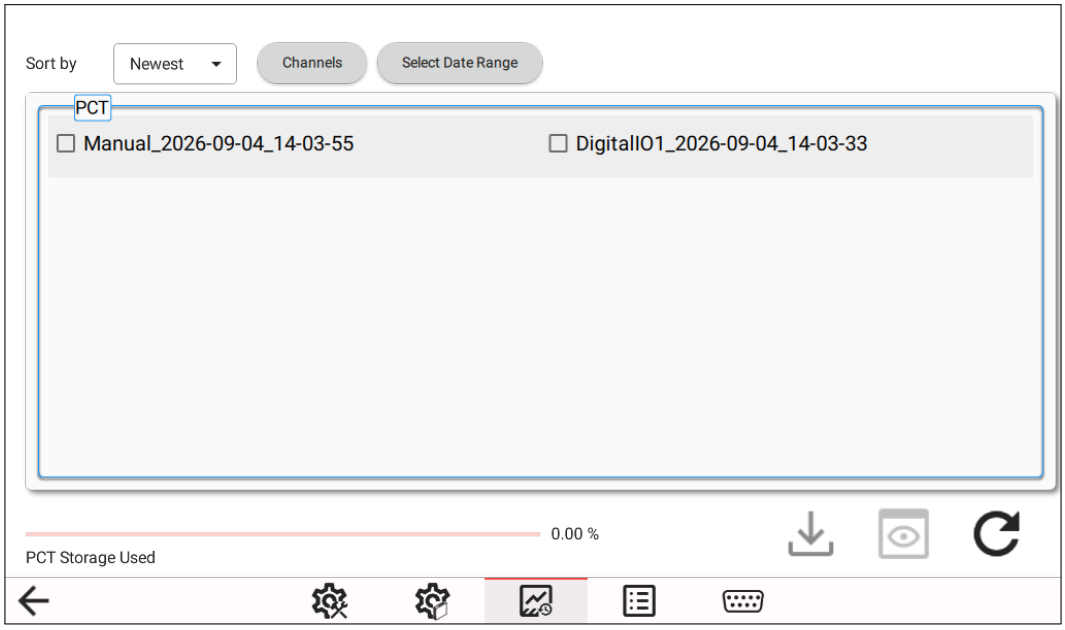


Show All active

4.4 PCT Viewer

PCT is a custom SBS file format which allows users to view all data from their previously ran ExactControl™ jobs. All ExactControl™ jobs are automatically recorded upon starting and saved upon stopping. From the PCT Viewer selection page, a set of PCTs may be selected for viewing or exporting. PCT files are named using this convention:

`<CHANNELNAME>_<YEAR>-<MONTH>-<DAY>_<HOUR>-<MINUTE>-<SECOND>`



PCT Viewer



Refresh view of PCT files

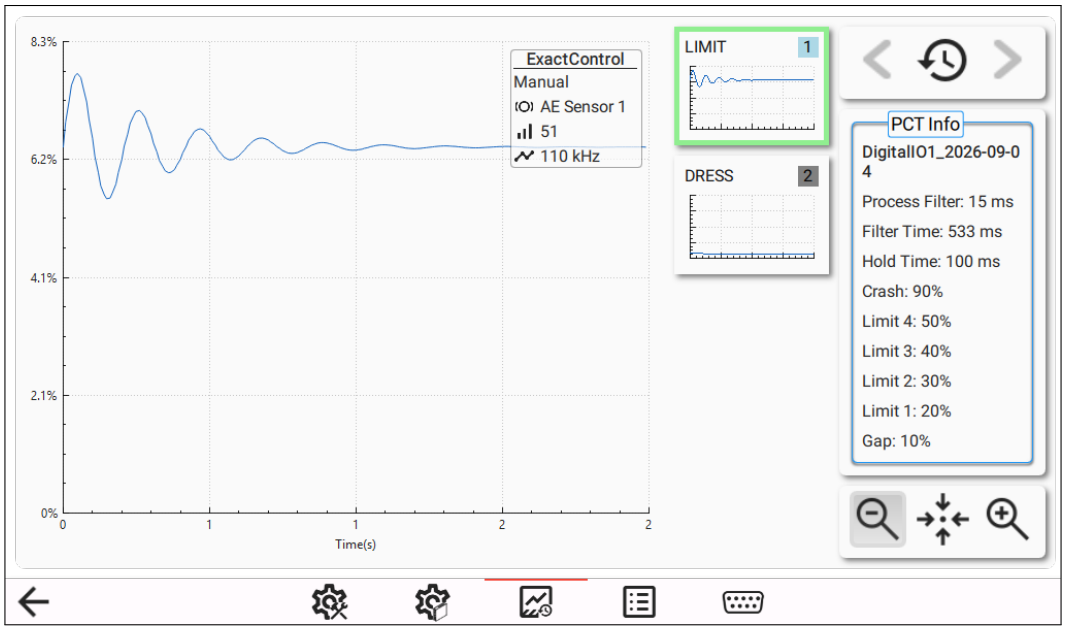


View selected PCT files



Export selected PCT files

Viewing a PCT file will show its settings and process data.

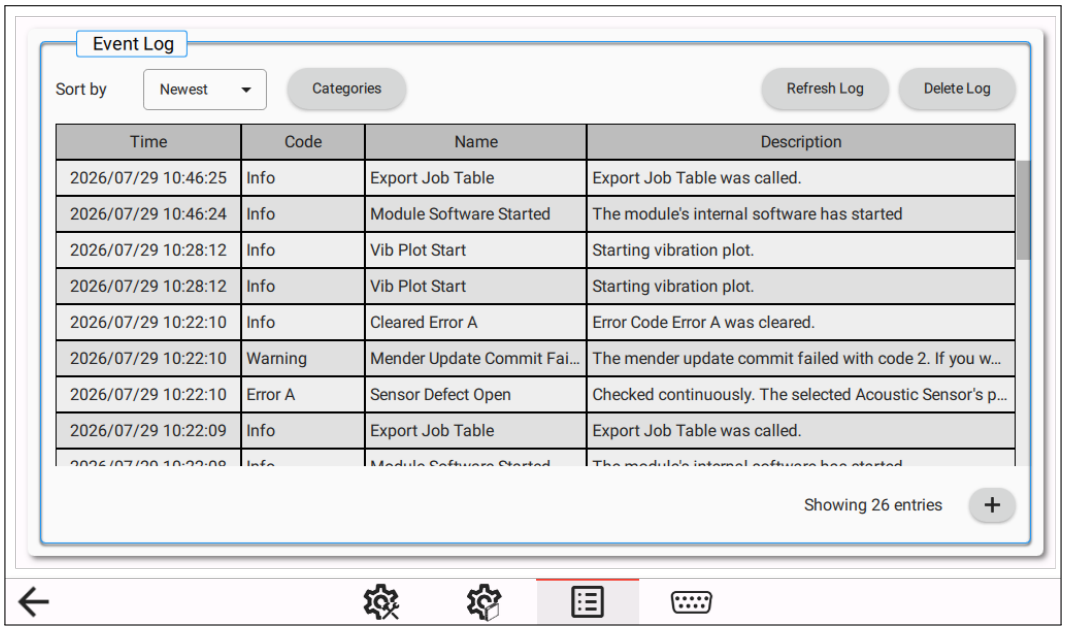


PCT Graph

Exporting a PCT file will download a .pct2 file and a .csv file to the user's computer. The .pct2 file is designed to be used with SBS products. The .csv file contains basic data from the instance which the user may analyze independently.

4.5 Event Log

Shows historical data stored on the module. Last 100 entries provided. Additional entries can be viewed by pressing the + button in the lower right corner of the screen. Entries are sortable and can be filtered by their code type. Codes include Info, Warning, Error, and Debug. Clicking on any line will show more information.

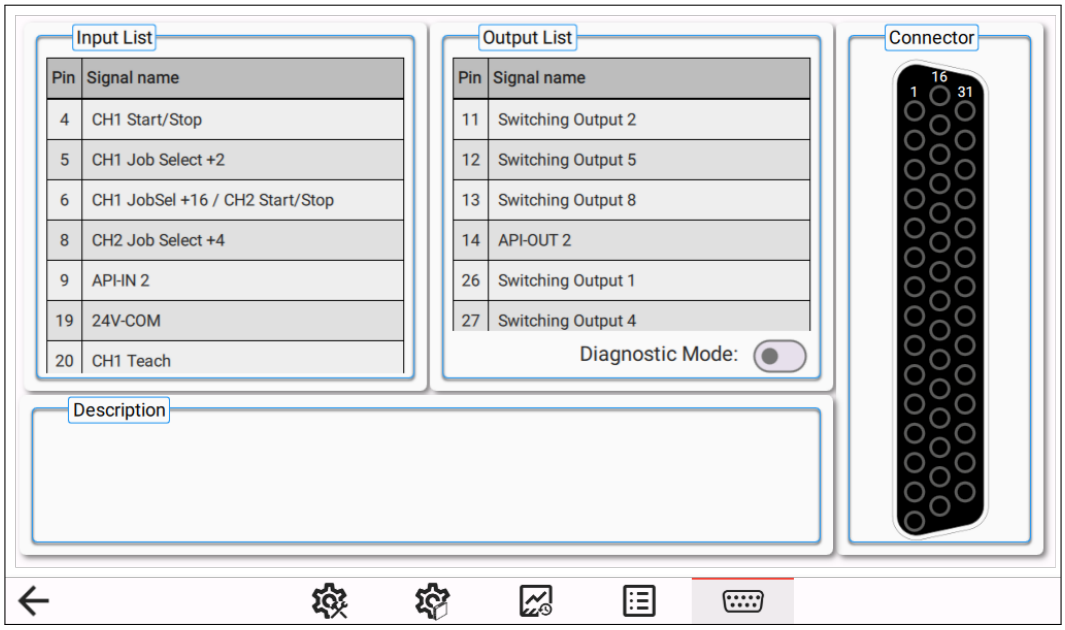


Event Log

4.6 I/O Diagnostics

Shows a list of all inputs and outputs on the ExactControl™ Hardwire I/O interface. A filled green circle indicates the input is being activated, or the output is in an activated state. Entering Diagnostic Mode through the switch at the bottom of the Outputs group allows the operator to manually force a given output pin into an active state for testing connection function with the grinding machine.

Selecting any input/output provides more information in the description box and highlights that pin on the Connector image for visual identification.



I/O Diagnostics

5 Strategies

ExactControl™ allows the user to select a “strategy” which will be used for a given instance. A strategy is a unique algorithm which can be used to trigger switching outputs on the ExactControl™ module by processing the **Measurement Signal**.

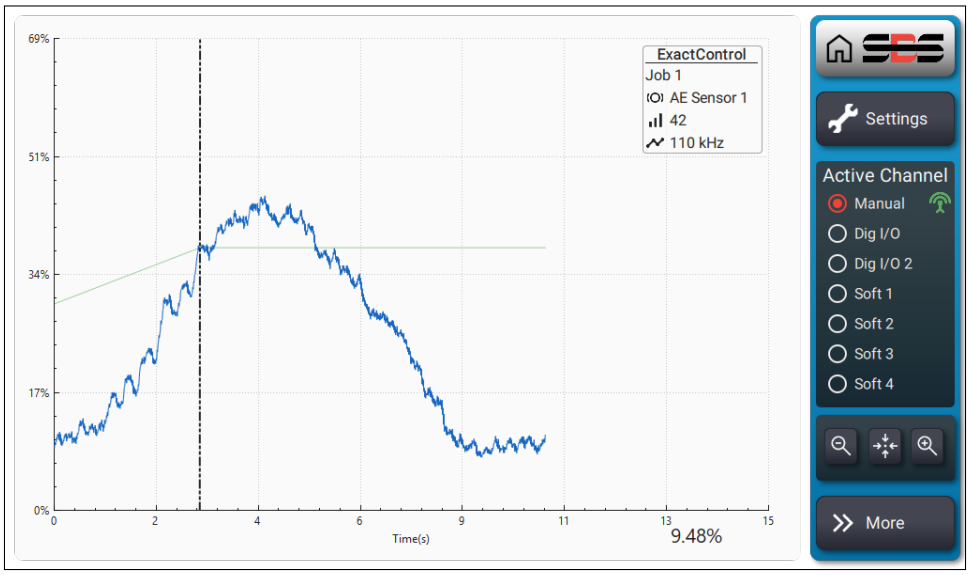
5.1 ExactDisplay Strategy

ExactDisplay shows data on the screen without any special processing while it records data to on-module memory. It has no unique parameters and has no switch point at which the switching output will activate. The Teach cycle has no function.

5.2 ExactGapStrategy

Purpose and Application

- Reliable work-piece contact detection even under coolant flow.
- Automatic idle tracking to improve sensor sensitivity and reliability.
- Automatic setting of the threshold for touch-recognition based on a Learn Cycle.



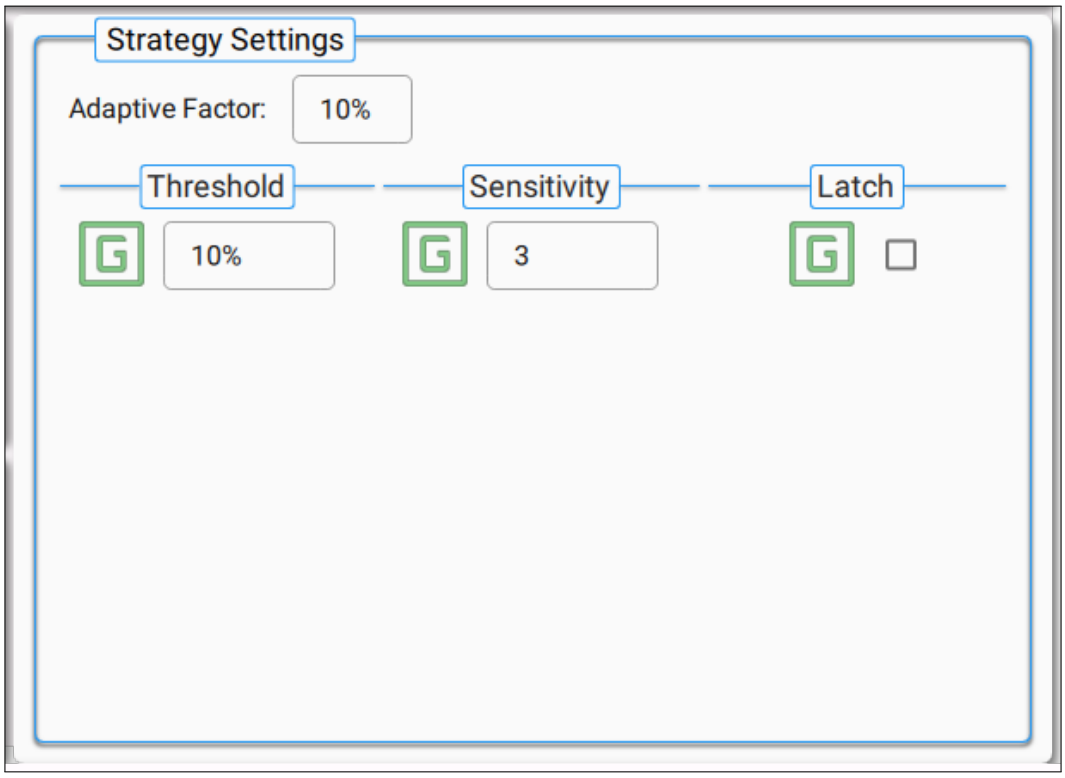
Operation

The purpose of ExactGap is sensitive and reliable detection of contact between the grinding wheel and the workpiece. For example, a fast, roughing infeed rate is used for the wheel's approach to the workpiece. When the wheel contacts the workpiece, the **Measurement Signal** increases. When the **Measurement Signal** exceeds a threshold, ExactGap triggers the switching output. The machine's CNC/PLC should immediately respond with a slower infeed rate appropriate for grinding. For ExactGap to have an operational effect, its infeed enable output signal must be wired to the machine's CNC/PLC infeed enable input. Note that the **Threshold** can be calculated during a Learn Cycle or set manually. It is also either fixed (a constant) or adaptive (automatically adjusted according to changes in the measurement signal). When the **Measurement Signal** exceeds the **Threshold** value, workpiece contact is detected, and the selected switching output switches off. The time of the work-piece contact is marked with a vertical dashed line (switching point). The Teach Cycle has no function.

Switching Outputs

1. *Gap Exceeded* – Indicates that the current **Measurement Signal** value exceeds the ExactGap **Threshold** or previously exceeded the ExactGap **Threshold** if latching is enabled.

Parameters



Auto-Offset: Note that the Auto Offset parameter of the **Measurement Signal** should be set to **"on"**. This is important for the proper functioning of ExactGap. The parameters unique to ExactGap are Sensitivity, Threshold, and the Adaptation factor.

Sensitivity – Set the sensitivity to the work-piece contact detection

This parameter sets the **Sensitivity** of the calculation for the work-piece contact detection **Threshold**. For a Sensitivity of 0.0 the automatic calculation is turned off. In this case the value entered in the **Threshold** parameter field is used for the **Threshold**.

For a value greater than 0.0 it is used to calculate the **Threshold**. A **Sensitivity** of 0.1 sets the lowest **Threshold** (highest touch sensitivity) and 39.9 sets the highest **Threshold** (lowest touch sensitivity). The calculation uses **Sensitivity** combined with the peak air value measured during the Learn Cycle's air pass.

Threshold = PeakAirValue * Sensitivity

For example, if Sensitivity = 3.0 and PeakValue = 1.0%: Threshold = 1.0% * 3.0 = 3%. Note that the Threshold by calculation has a limit of 80%. The Sensitivity parameter is applied at the end of each Learn Cycle by calculating the Threshold from the peak air value. A change of Sensitivity will result in a changed Threshold. Peak air value only changes with a Learn Cycle.

Threshold – Set a fixed Threshold

Immediately following a Learn Cycle this parameter will display the Threshold that was computed at the end of that Learn Cycle. Otherwise, the threshold can be freely set by the user.

Latch – Set latching behavior

If latch is turned on then the Switching Output for gap will "latch", meaning that once that output is activated, it will stay on for the entire duration of the Job, regardless of the value of the **Measurement Signal**.

Adaptive Factor – Set the adaptive tracking rate

Adaptive tracking is a function which can substantially improve the reliability of the work-piece contact detection. It allows a limited automatic adjustment of the Running Threshold (green line) during the process. This allows the **Measurement Signal** to change slowly without causing a switching output activation and remain sensitive to a faster changing signal consistent with contact detection. The Threshold value, described in the Threshold and Sensitivity sections above, is used as the starting Threshold of every ExactGap cycle. The Threshold at the start of the cycle only changes from an adjustment of the Threshold parameter. After the process starts, the threshold continually adapts its level as shown in the figure. The threshold seeks to be higher than the current Measurement Input (blue) by the amount of the starting Threshold.

TargetThreshold = CurrentSignal + StartThreshold

The Adaptive factor sets the maximum rate at which the threshold can change during the process cycle. This rate is calculated as a percentage of the starting Threshold per second.

RateOfChange = StartThreshold * AdaptiveFactor / second

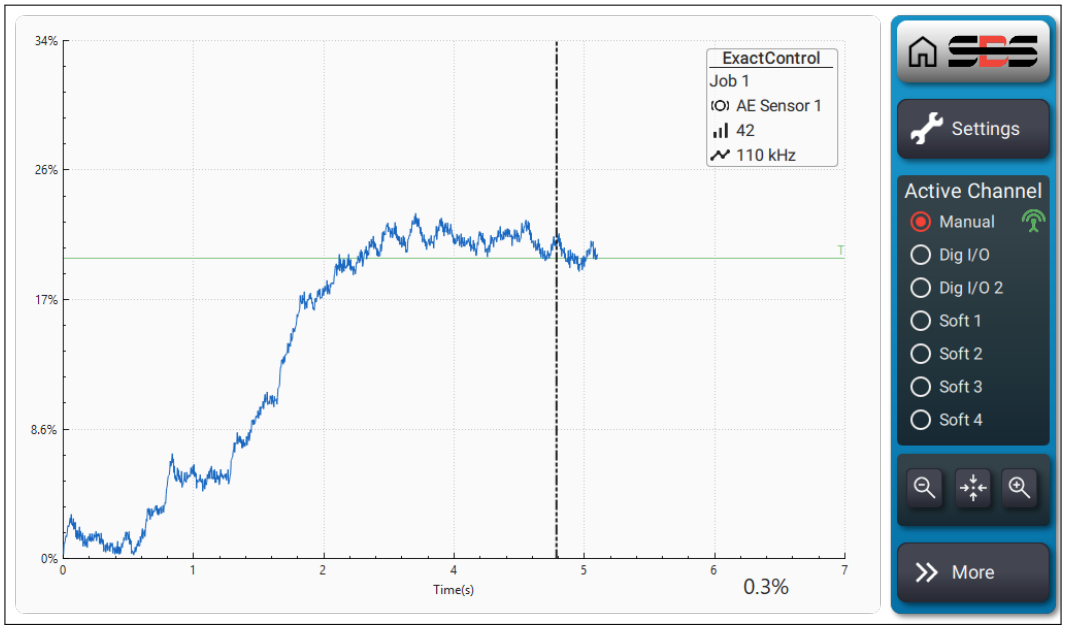
For example, if Adaptive factor = 0% then the rate is 0% per second (adaptive function is off – threshold is a horizontal line). If the starting Threshold is 8% and the Adaptive factor is 50% then the rate is 4% per second. If the starting Threshold is 0.5% and the Adaptive factor is 150% then the rate is 0.75% per second.

Note: The Adaptive factor should be set as small as possible. Otherwise, the threshold may move above the Measurement signal as the wheel contacts the workpiece, resulting in a failed detection of the contact.

5.3 ExactTime Strategy

Purpose and Application

- Evaluating the time interval of measurement values that are above a threshold.
- Monitoring a minimum or maximum processing time.
- Monitoring of the maximum allowable spindle load (overload, collision).



Operation

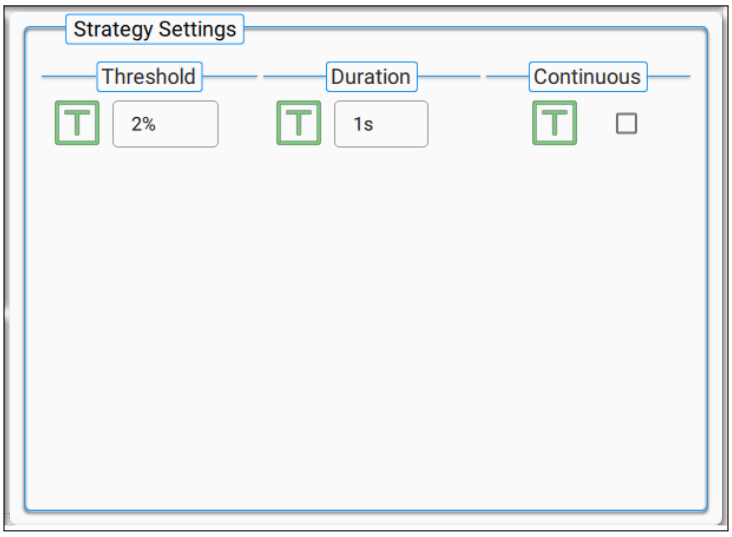
ExactTime monitors the interval of time that the **Measurement Signal** exceeds a preset **Duration**. When the process starts, the accumulated time is set to zero. After that, Time is not accumulated while the **Measurement Signal** is below the **Threshold** and it is accumulated while above. When the accumulated time reaches the value of the **Duration** parameter, the switching output is triggered. This strategy will respond quickly to a small **Duration**. In extreme cases (set at 0.00 sec.) the switching output will trigger the instant the **Measurement Signal** exceeds the **Threshold**. This is suitable, for example, to monitor the maximum permissible spindle load. The **Continuous** parameter can force the strategy to reset the accumulated time when the Measurement signal falls below the Threshold. In this case the strategy only triggers the Switching output if the Measurement signal remains above the Threshold continuously for the full interval of the Duration. This strategy does support teaching.

Switching Outputs

1. *Timer Elapsed* – Indicates that the current **Measurement Signal** has exceeded the ExactTime **Threshold** for **Duration** seconds.

Parameters

The parameters unique to ExactTime are Threshold, Duration, and Continuous.



Threshold – Set the fixed signal threshold

This parameter sets the **Threshold** level. Time is accumulated only while the **Measurement Signal** is above this value.

Duration – Set the desired accumulated time value

Sets the amount of time that the **Measurement Signal** is required to be above the **Threshold** before the switching output is triggered. If set to 0.00 then it will trigger the instant the **Measurement Signal** exceeds the **Threshold**.

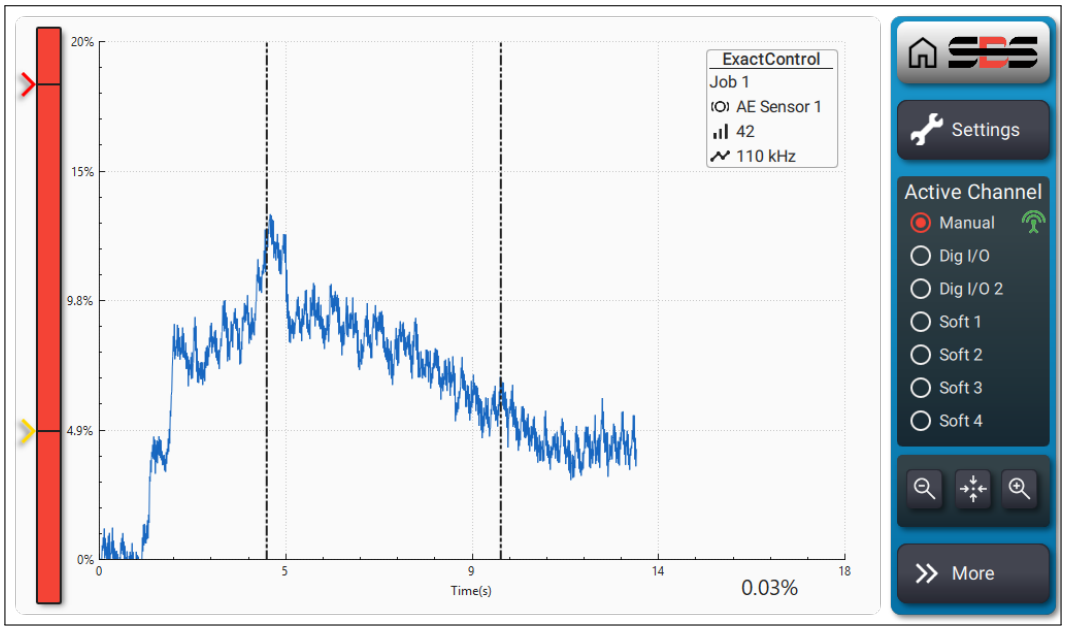
Continuous – Specify whether the accumulated time must be continuous

- No: Time increasingly accumulates whenever the **Measurement Signal** is above the **Threshold**. It stops accumulating when the **Measurement Signal** falls below the **Threshold** but continues accumulating when it rises above. The switching output triggers when the total time above the **Threshold** matches the **Duration**.
- Yes: Time accumulates while the **Measurement Signal** is above the **Threshold**, but the time accumulator is reset to zero whenever the **Measurement Signal** is below the **Threshold**. The switching output will trigger only after the **Measurement Signal** remains above the **Threshold** for the whole interval of the **Duration**.

5.4 ExactIntegral Strategy

Purpose and Application

- Monitoring the minimum and/or maximum measurement based on the area under the curve.
- Teach cycle for determining the area of a good part.



Operation

The ExactIntegral process calculates and monitors the area (integral) under the **Measurement Signal** curve. One switching output triggers when the area reaches a minimum integral value. A second switching output triggers when the area reaches a maximum integral value. For example, the area may represent the amount of oversize stock material being removed from a workpiece, integrating the grinding power over time. The minimum and maximum integral switching points are based on a previous Teach cycle performed with a nominal reference part. If a subsequent workpiece is evaluated as having too little or too much stock removal, this status is reported with the appropriate switching output(s).

Switching Outputs

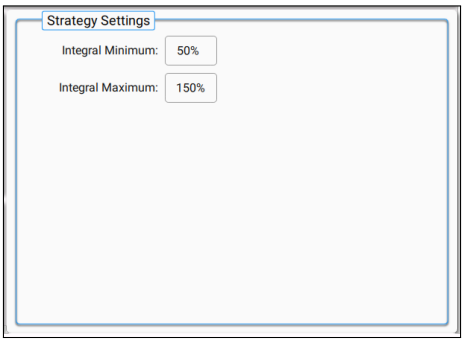
1. *Lower Limit Met* – Indicates that the current integral value is greater than or equal to the **Minimum Integral** % of the taught integral value.
2. *Upper Limit Met* – Indicates that the current integral value is less than or equal to the **Maximum Integral** % of the taught integral value.

Teach Cycle

The ExactIntegral Teach Cycle should operate with a good reference workpiece that has a nominal overstock allowance. At the end of the Teach Cycle the integral of this part's **Measurement Signal** is saved as the Teach value, which is the 100% reference for the integral parameter settings. The switching outputs are disabled during the Teach cycle.

Parameters

The parameters unique to ExactIntegral are Minimum Integral and Maximum Integral.



Minimum Integral – Set the switch point for the minimum integral

This parameter specifies the minimum allowance that must be ground from a workpiece. The value specifies the integral as a percentage of the Teach value that was computed during the Teach cycle using a nominal part. Using 60% specifies that at least 60% of the machining effort must be performed before the minimum requirement is met and the minimum integral switching output becomes active, signaling a good process start. If this parameter is set to 0.0%, then the switching output for the minimum integral is disabled and the switching output will always remain on.

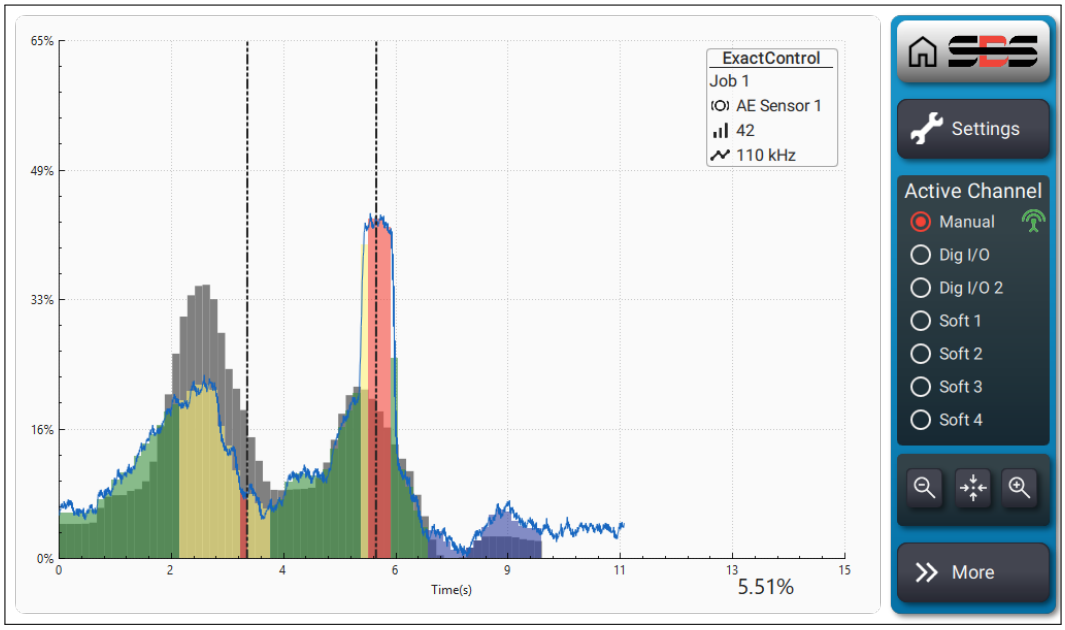
Maximum Integral – Set the switch point for the maximum integral

This parameter specifies the maximum allowance that may be ground from a workpiece. The value specifies the integral as a percentage of the Teach value that was computed during the Teach cycle using a nominal part. Using 140% specifies that up to 140% of the machining effort can be performed before the maximum limit is met and the maximum integral switching output becomes inactive, signaling a failed process. If this parameter is set to 0.0%, then the switching output for the maximum integral is disabled and the Switching output will always remain on. It is recommended that this parameter not be set between 0.0 and 100.0%, which always limits the maximum integral below the Teach value and may produce undesirable results.

5.5 ExactDress Strategy

Purpose and Application

- Recognition of small defects in the dressed form.
- Monitoring of the grinding wheel contour to ensure the accuracy of shape.
- Maximum load monitoring during dressing.
- Effective filtering of disturbances in the Measurement signal.



Operation

The ExactDress process compares the **Measurement Signal** curve to a reference Teach Cycle curve that was acquired during a Teach Cycle. The entire process is divided into small equal-time intervals called zones. The signal is filtered in each zone by capturing the average value of all the **Measurement Signal** samples recorded during its time interval. Therefore, the ExactDress process operates by evaluating the **Measurement Signal** zones compared with the corresponding Teach Cycle zones. Two comparisons are made and each affects its own switching output signal. The measurement signal is drawn on the graph as a blue line. Zones that strongly pass the evaluation are drawn in green, zones that marginally pass are drawn in yellow, and zones that fail are drawn in red. Zones which are entirely ignored are drawn in blue.

The first Switching output, the **Segment Min** output, is used for the dressing profile. The Segment Min switching output triggers on the first failed zone in which the **Measurement Signal** is below the minimum allowable threshold for that zone. If it didn't trigger during a process, then there were no failed (red) zones during the entire process due to the minimum zone threshold. This means that every zone of the **Measurement Signal** had an adequate amplitude compared to its corresponding Teach zone. I.e. the dressing cycle process is good. The **Segment Min** parameter sets the comparison levels for each zone. Zones that are ignored for evaluation are drawn in light blue. Ignored zones have a Teach value below the setting of the Ignore level parameter. The Teach Zones are drawn as gray bars.

The second Switching output, the **Segment Max** output, is used to detect an overload. The **Segment Max** parameter sets the zone overload level. A switch point line will be drawn at the trigger time.

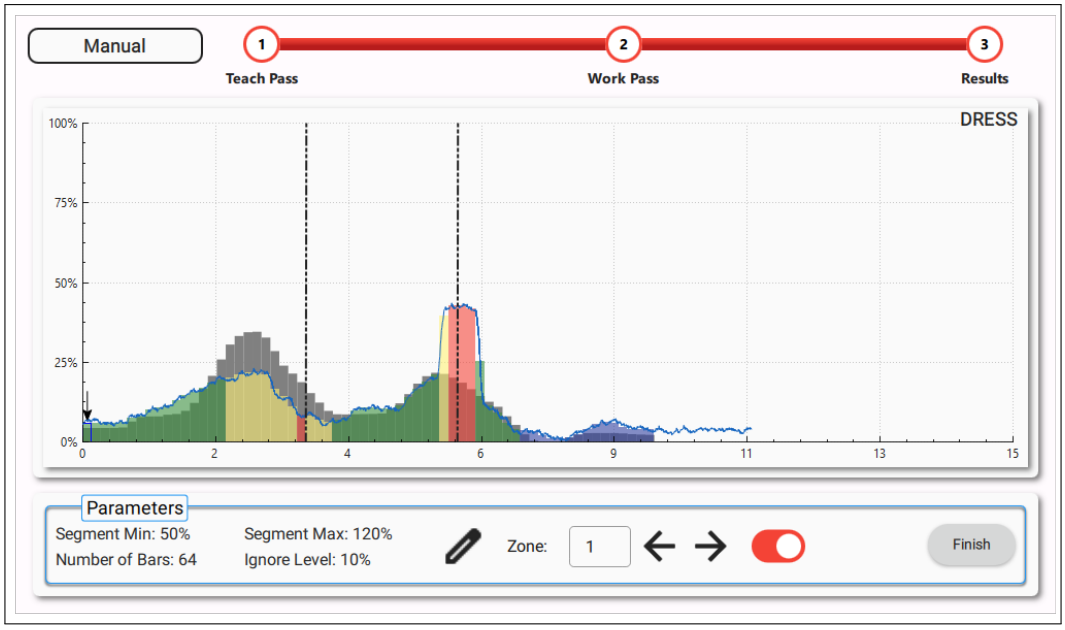
Switching Outputs

1. *Below Tolerance* – Indicates that any of the measured bins are below the tolerance threshold set per-bin based off the **Segment Min** parameter.
2. *Above Tolerance* – Indicates that any of the measured bins are above the tolerance threshold set per-bin based off the **Segment Max** and **Segment Max Method** parameter.

Teach Cycle

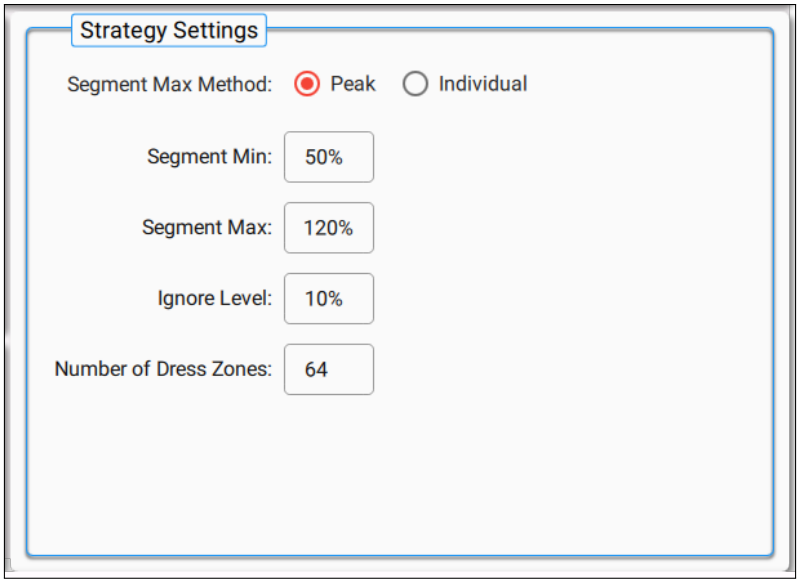
The ExactDress Teach Cycle often uses a single dressing pass to make sure the grinding wheel dresses the entire contour of the wheel with normal contact (no form error). The Teach cycle should be operated until an acceptable set of Teach cycle zones is displayed. The switching outputs are disabled during the Teach cycle.

For ExactDress, a Teach screen will pop up when a Teach Cycle is started. First, the Teach cycle should be run. Next, a normal work cycle should be run to verify the results of the Teach cycle. Now, the results page will appear. In this page, all the base ExactDress parameters may be changed and their effect on the results of the test work pass will be shown. Individual zones may be disabled such that they are ignored for the running ExactDress strategy.



Parameters

The parameters unique to ExactDress are Segment Min, Segment Max, Segment Max Method, Ignore Level, Number of Dress Zones, and Disabled Dress Zones.



Segment Min – Set the minimum required percentage per zone

This parameter sets the minimum threshold level required for a zone value to be acceptable. Each process zone is evaluated with this setting applied to the corresponding Teach cycle zone. If this parameter is set to 50%, for example, each process zone value must reach 50% of each corresponding Teach cycle zone for the zone to pass.

- The zone color is based on this comparison.
  - Green (good) is reported for a signal above 33% of the distance between the threshold and the Teach value.
  - Yellow (marginal) is reported for a process zone value above the threshold but below 33% of the distance between the threshold and the Teach zone value.
  - Red (fail) is reported a process zone value below the threshold, for which the Min Switching Output is turned off. Once off, the Min Switching Output stays off until Job Stop.

Segment Max – Set the maximum overall percentage

This parameter sets the maximum threshold level allowed in a zone. It is a percentage of the zones' selected max method. When the **Segment Max Method** is set to Peak Zone, if Segment Max is set to 150% then all process zones must remain below 150% of the max in each zone throughout the entire cycle or an error condition exists.

- The Max Switching Output is turned off the first time the level is tested above the threshold.
- The Max Switching Output stays off until Job Stop.

Segment Max Method – Set how Max Segment is calculated and used

- Peak Zone:
  - The threshold is **Segment Max** percentage of the largest of all Teach Zone values.
  - The threshold is tested in every zone that is not ignored.
- Individual Zone:
  - The threshold is **Segment Max** percentage of each individual Teach Zone value.
  - The zone color is Red if the level exceeds the max for the zone.
  - The zone color is Yellow if the level gets to within 33% of the threshold above the zone value.
  - The zone color is Green if the level is below 33% of the threshold above the zone value.
  - The threshold is not tested in disabled zones.

Ignore Level – Set the percentage to ignore

Many Teach zones have values too small for use in evaluation of the **Measurement Signal**. These zones typically represent time intervals when the grinding wheel is not in full contact with a workpiece or dresser. The **Ignore Level** parameter specifies which of those Teach zones should not be used. The level is the entered percentage applied to the largest of all Teach zone values (tallest zone). The **Measurement Signal** is not evaluated in any zone where its corresponding Teach zone is below this **Ignore Level**. For example, if this parameter is set to 10% then all **Measurement Zones** are ignored for which the corresponding Teach Zones are less than 10% of the largest of all Teach Zone values (tallest zone). Note that Segment Min and Segment Max are both ignored in a zone that is not evaluated.

Number of Dress Zones – Set how many bars will be used for dress comparisons

This parameter allows the user to control how many dress bars are used for the ExactDress strategy. The total sum of the width of the dress bars remains the same, meaning that individual bars will either grow or shrink in width to meet this requirement.

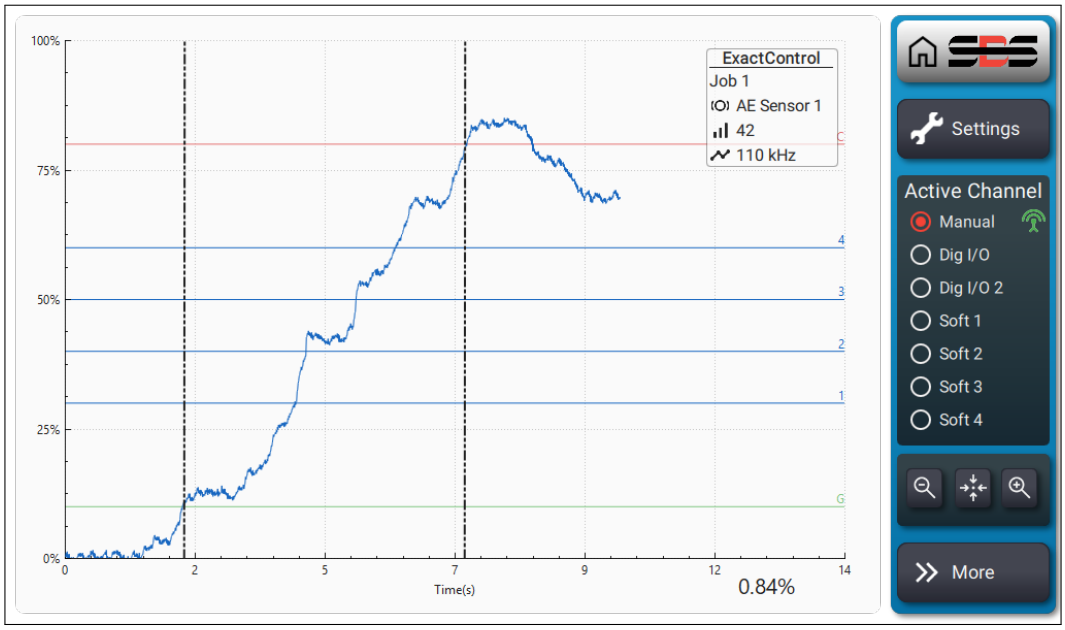
Disabled Dress Zones – Select specific Dress Zones which are ignored

This parameter may not be changed from the settings screen – it must be changed from the ExactDress teach screen. Zones which are disabled will be ignored (see Ignore Level) while running the ExactDress strategy.

5.6 ExactLimit Strategy

Purpose and Application

- SBS AEMS card emulation on the ExactControl™ card.
- Up to four simultaneous thresholds for signal level detection.
- Reliable work-piece contact detection (GAP) even under coolant flow.
- Reliable work-piece (CRASH) detection even under coolant flow.
- Real-time GAP and CRASH detection in hardware for faster response of AE sensor inputs.



Operation

The ExactLimit process compares the **Measurement Signal** curve to each of up to six fixed thresholds. The thresholds can be manually adjusted, or with an AE sensor as an input they can automatically be set through the learning process. The six switching output signals activate independently when the **Measurement Signal** exceeds the corresponding threshold.

Switching Outputs

1. *Gap Triggered* – Indicates that the current **Measurement Signal** value exceeds the ExactGap **Threshold** or previously exceeded the ExactGap **Threshold** if latching is enabled.
2. *Limit 1 Triggered* – Same as Gap Triggered, except using Limit 1's **Threshold**.
3. *Limit 2 Triggered* – Same as Gap Triggered, except using Limit 2's **Threshold**.
4. *Limit 3 Triggered* – Same as Gap Triggered, except using Limit 3's **Threshold**.
5. *Limit 4 Triggered* – Same as Gap Triggered, except using Limit 4's **Threshold**.
6. *Crash Triggered* – Same as Gap Triggered, except using Crash's **Threshold**.

Teach Cycle

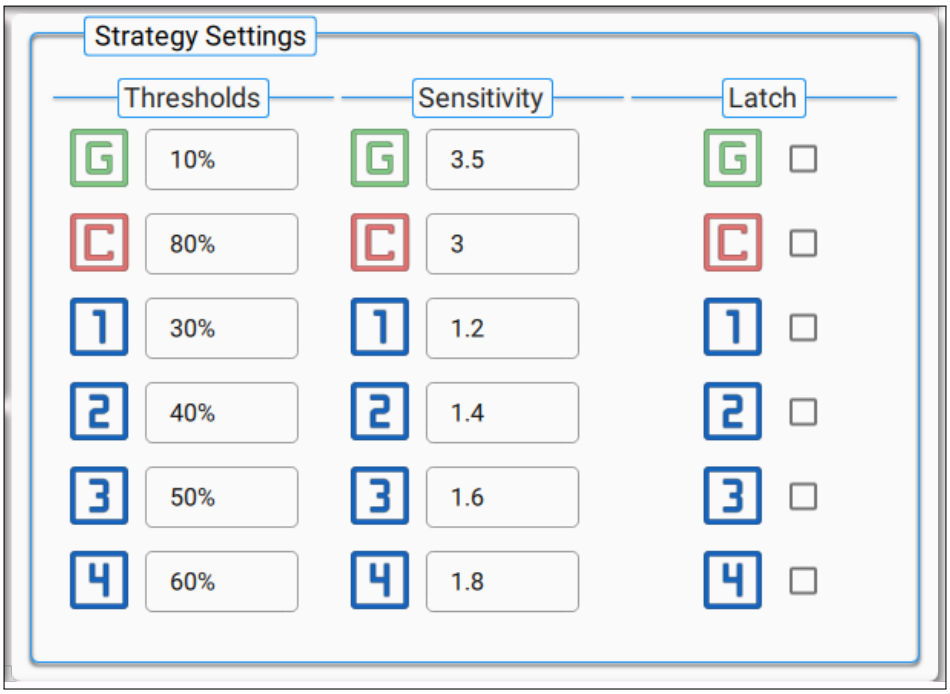
ExactLimit does not have a Teach Cycle as all its thresholds are assigned during the job's Learn Cycle.

Measurement Signal Parameters

To best emulate the SBS AEMS card operation it is recommended that the AE sensor setup has an Inverted Measurement setting of **no**, a Filter type setting of **off**, and Process Filter settings of **15 ms**.

Parameters

Each limit has a **Threshold**, **Sensitivity**, and **Latching** enable.



Sensitivity – Set the sensitivity based on the signal acquired during the Teach Cycle

View the Learn Cycle section of this document for further information on how **Threshold** is calculated at the end of a Learn Cycle using **Sensitivity**.

Threshold – Set a fixed Threshold

This parameter specifies the value which, upon the Measurement Signal surpassing this value, causes the Switching Output for the threshold's associated limit to activate. If **threshold** is set to 0 for a given limit, that limit is turned off and will not be used by the ExactLimit strategy.

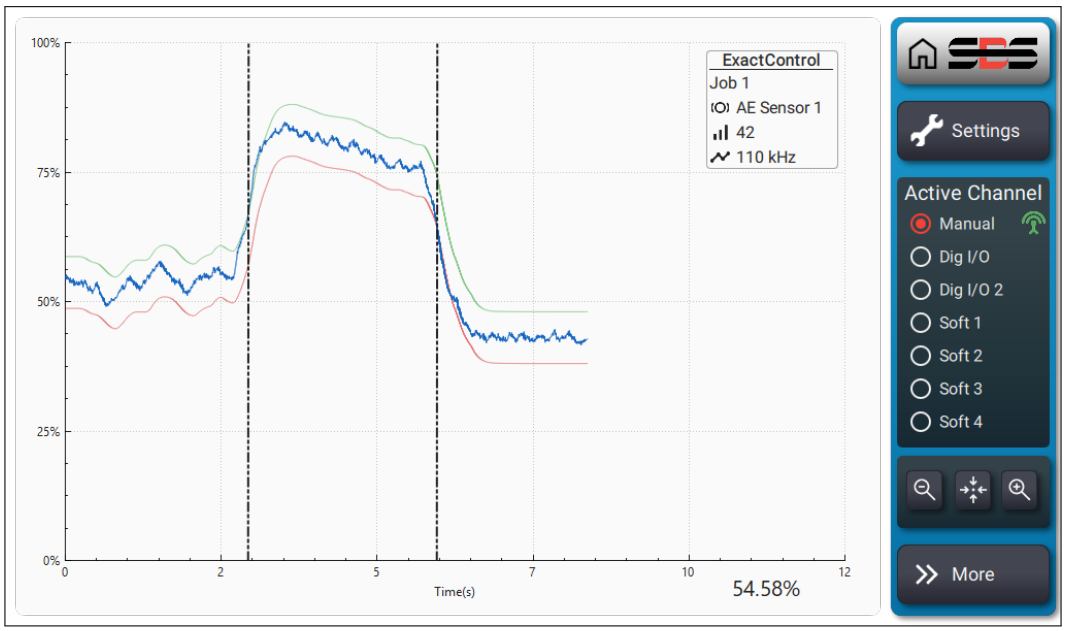
Latch – Set latching behavior

For each limit, if latch is turned on then the Switching Output for that limit will "latch", meaning that once that output is activated, it will stay on for the entire duration of the Job, regardless of the value of the **Measurement Signal**.

5.7 ExactTrack Strategy

Purpose and Application

- Detection of a sudden change in the input signal.



Operation

The ExactTrack process compares the **Measurement Signal** curve to each of two tracking thresholds. The threshold parameters are manually set. The Upper Switching Output signal activates when the **Measurement Signal** exceeds the **Upper Threshold** (green line). The Lower Switching Output signal activates when the **Measurement Signal** goes below the **Lower Threshold** (red line). The Teach cycle has no function.

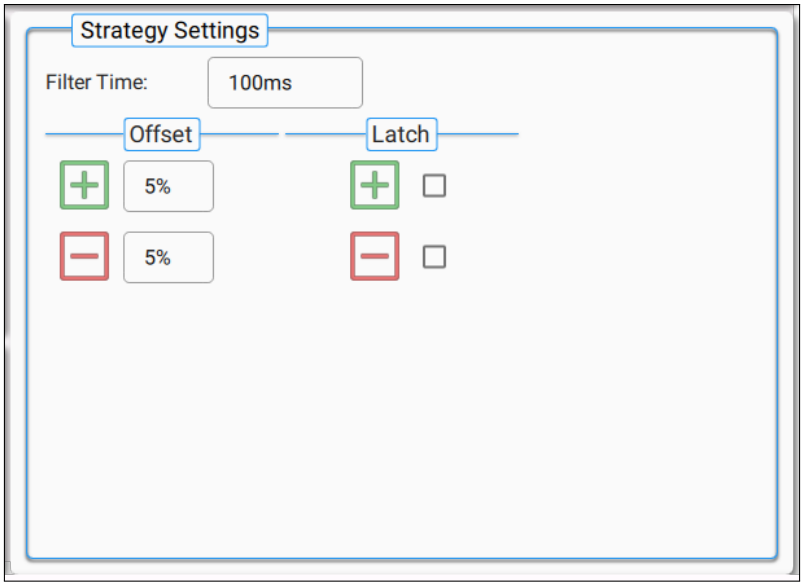
Switching Outputs

2. *Upper Limit Triggered* – Indicates that the current **Measurement Signal** value exceeds the upper limit's **Offset** threshold or previously exceeded the upper limit's **Offset** threshold if latching is enabled.

1. *Lower Limit Triggered* – Indicates that the current **Measurement Signal** value is below the lower limit's **Offset** threshold or previously was below the lower limit's **Offset** threshold if latching is enabled.

Parameters

The limits (Upper and Lower) each have two parameter settings, **Offset** and **Latch**. There is also a common **Filter Time** setting which is applied to both limits.



Offset – Set the tracking Thresholds

This parameter sets the offset, in percent of full signal, from the **Measurement Signa**l to its threshold.

Upper Compare Offset is the offset above the **Measurement Signa**l for the Upper switching output.

Lower Compare Offset is the offset below the **Measurement Signa**l for the Lower switching output.

Filter Time – Set the time constant tracking signal filter

This parameter sets the time constant, in ms, of the filter that generates the tracking signal from the input signal. It controls how fast the thresholds change as a function of the input signal.

Latch – Set latching behavior

For each compare offset, if latch is turned on then the Switching Output for that compare offset will “latch”, meaning that once that output is activated, it will stay on for the entire duration of the Job, regardless of the value of the **Measurement Signal**.

6 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-44 connector. It is left to the operator to supply the necessary interface hardware.

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.

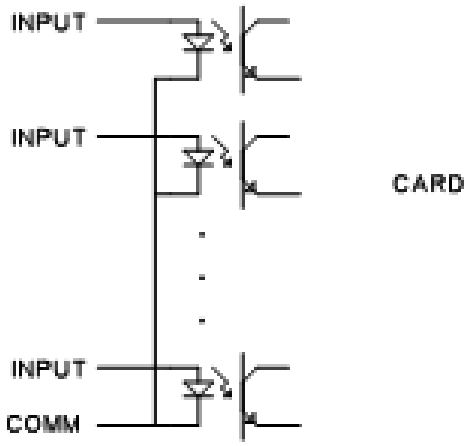
Carefully read this entire manual before attempting to interface the SBS System with any machine controller.

6.1 Digital Supply

⚠ An external 24 Volt supply must be connected between I/O common negative (Pin 19) and positive terminals (Pin 30) for the Digital outputs to operate.

30	24V-SUPPLY	20-28 VDC supply for operation of CNC I/O
19	24V-COM	Reference ground for pin 30.

The Digital IO inputs consist of sixteen transistors with 500 V optical isolation from the system. Each is activated during the application of +24 VDC on its pin relative to the external common pin. Activating the inputs requires 5 mA at a voltage between +18 VDC and +28 VDC. The switching time is less than 1ms. TTL or other logic level conversion of input signals will require an external circuit powered by an external logic power supply. Unidentified pins are reserved for future use.

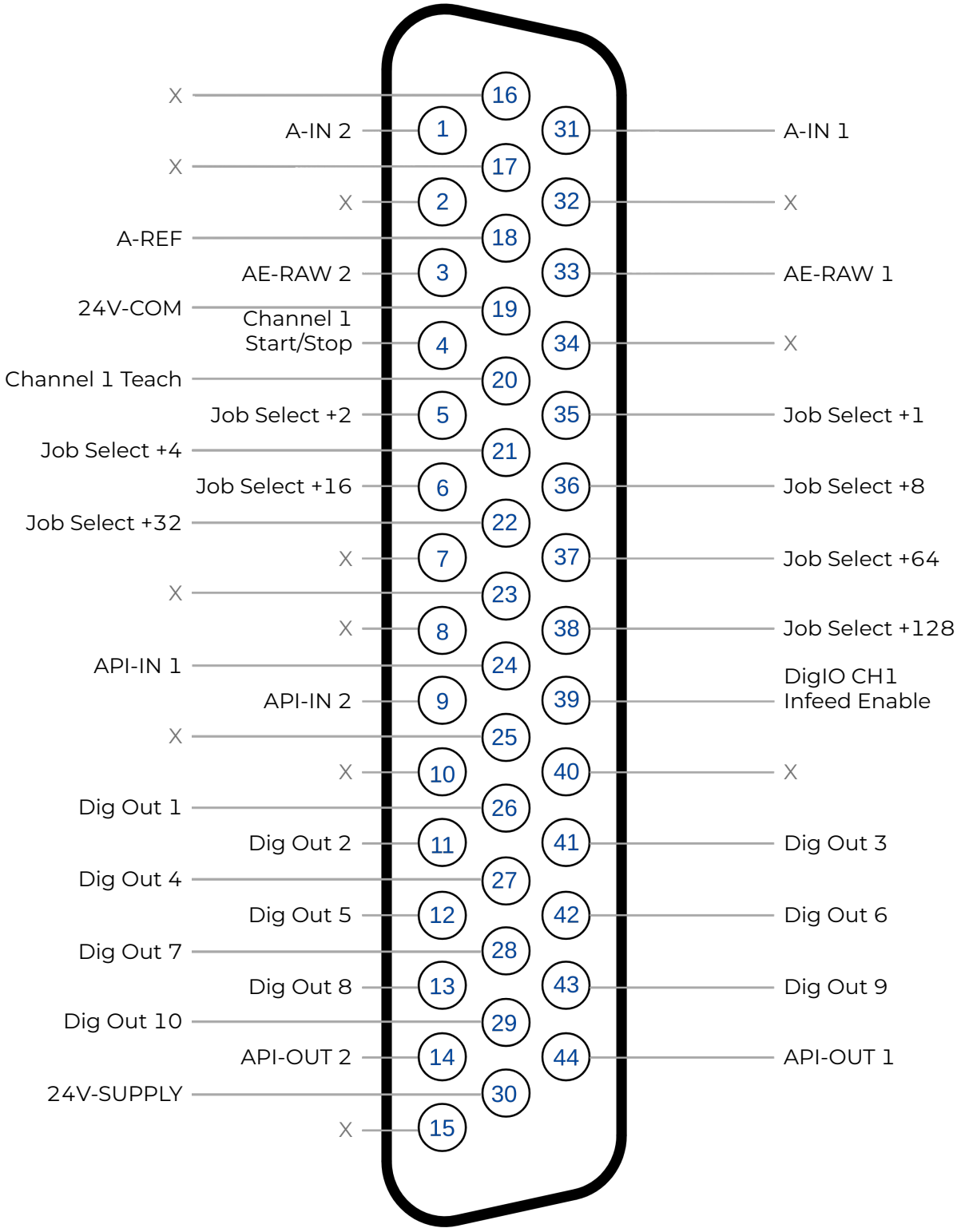


6.2 CNC Function Modes

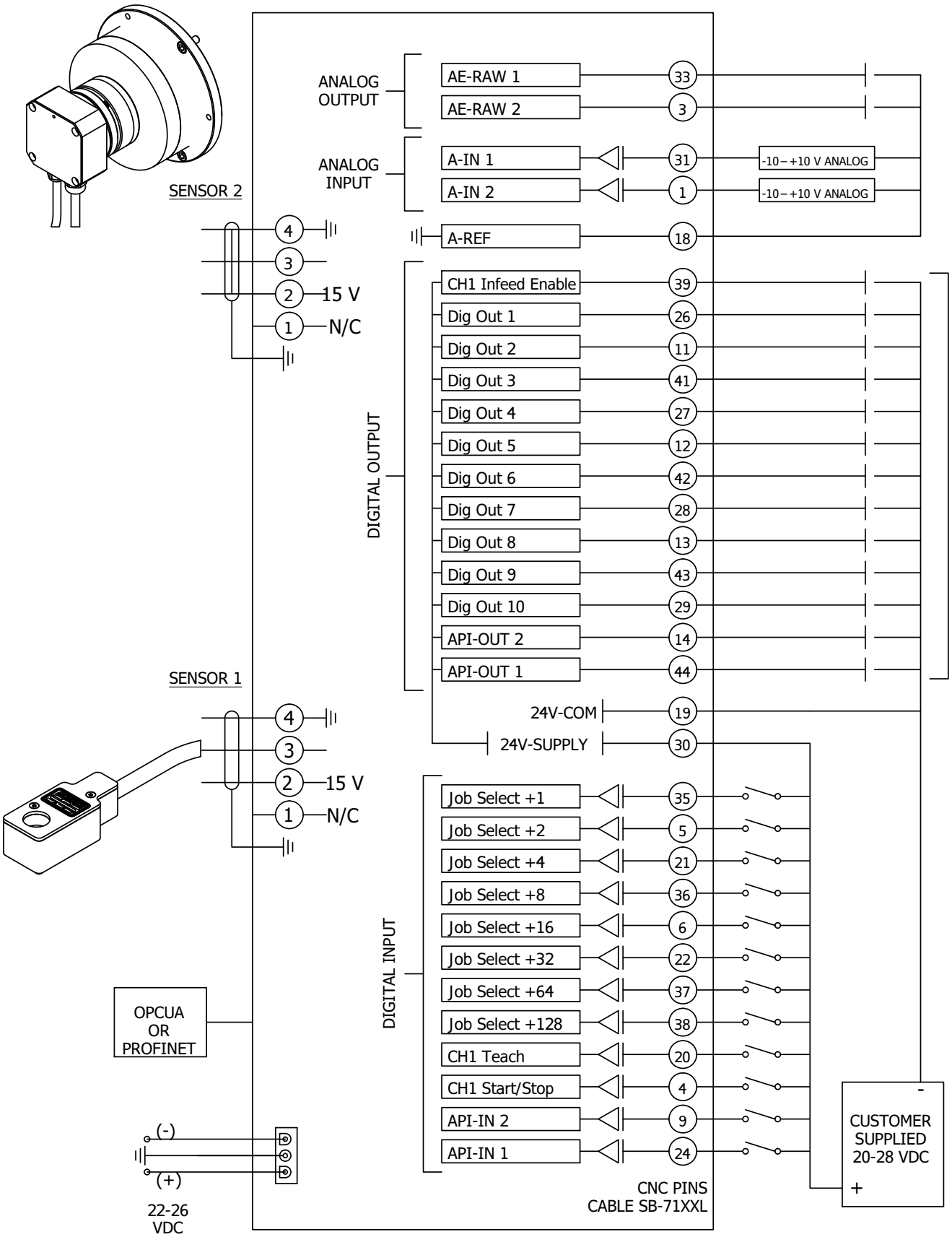
The ExactControl™ module supports two different modes of CNC functionality: One Digital Channel Mode and alternate Two Digital Channel Mode.

6.3 One Digital Channel Configuration

Standard Function Mode supports running any of the ExactControl™ Module's 256 jobs.



X = Reserved for future use


ANALOG OUTPUT
AE-RAW 1
AE-RAW 2
33
3
ANALOG INPUT
A-IN 1
A-IN 2
31
1
-10 – +10 V ANALOG
-10 – +10 V ANALOG
A-REF
18
SENSOR 2
4
3
2
15 V
1
N/C
DIGITAL OUTPUT
CH1 Infeed Enable
Dig Out 1
Dig Out 2
Dig Out 3
Dig Out 4
Dig Out 5
Dig Out 6
Dig Out 7
Dig Out 8
Dig Out 9
Dig Out 10
API-OUT 2
API-OUT 1
39
26
11
41
27
12
42
28
13
43
29
14
44
SENSOR 1
24V-COM
19
24V-SUPPLY
30
DIGITAL INPUT
Job Select +1
Job Select +2
Job Select +4
Job Select +8
Job Select +16
Job Select +32
Job Select +64
Job Select +128
CH1 Teach
CH1 Start/Stop
API-IN 2
API-IN 1
35
5
21
36
6
22
37
38
20
4
9
24
OPCUA OR PROFINET
(-)
(+)
22-26 VDC
CNC PINS CABLE SB-71XXL
CUSTOMER SUPPLIED 20-28 VDC
-
+

6.3.1 Input Pin Names and Functions (1 Channel Mode)

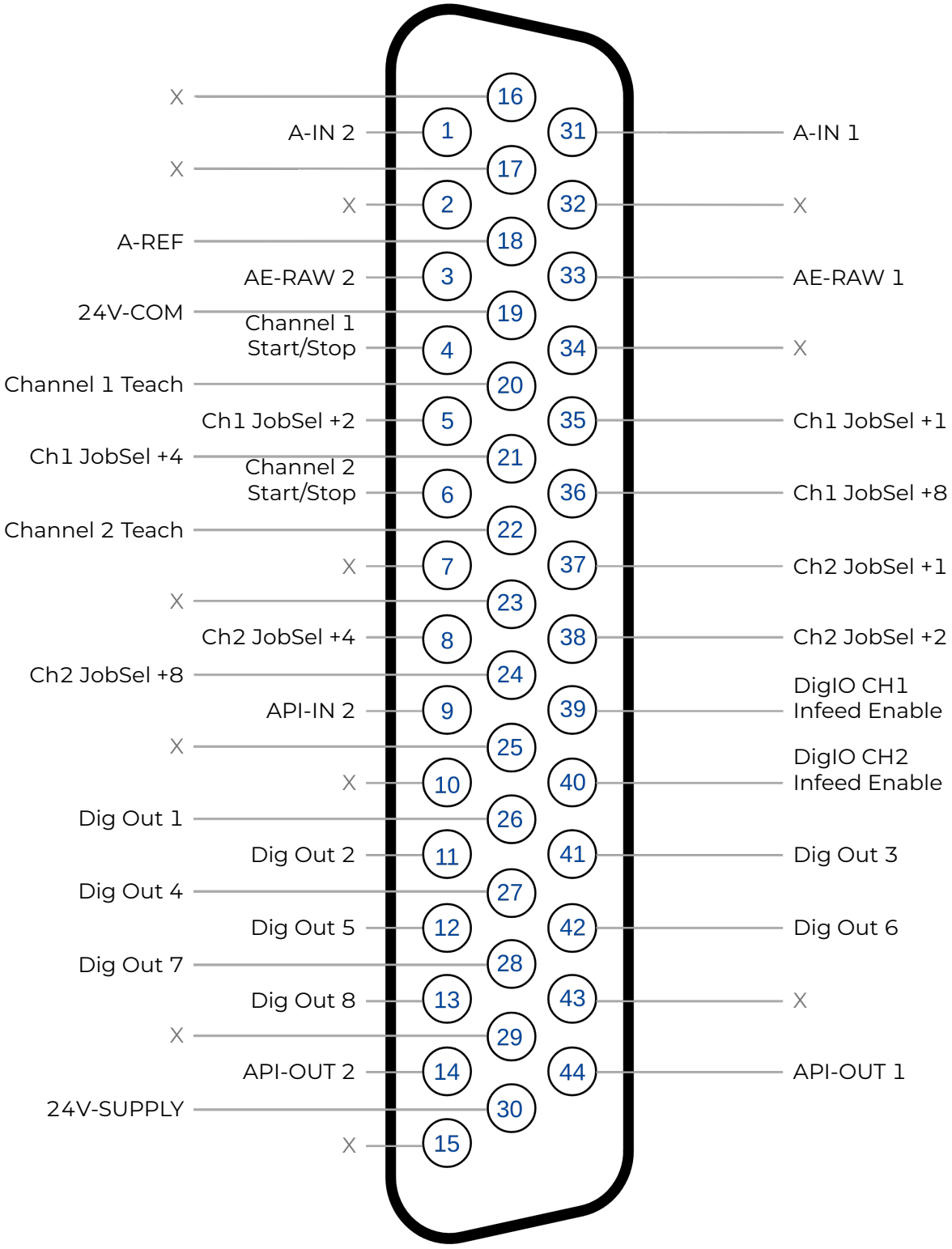
<table>
<tr><th>Pin#</th><th>Name</th><th>ACTIVE</th><th>Description</th></tr>
<tr><td>24</td><td>API-IN 1</td><td>HIGH</td><td>Reserved for future use.</td></tr>
<tr><td>9</td><td>API-IN 2</td><td>HIGH</td><td>Reserved for future use.</td></tr>
<tr><td>4</td><td>Channel 1 Start/Stop</td><td>HIGH</td><td>Sets the active job to match the sum of the Job Set Inputs and starts Digital IO Channel 1 on the rising edge of the input. If Job Set Inputs equal 0, then the last job opened in the settings screen will run. Deactivating the input stops the job running on Digital IO Channel 1.
<table>
<tr><th colspan="9">JOB SELECT INPUTS</th></tr>
<tr><th>+128</th><th>+64</th><th>+32</th><th>+16</th><th>+8</th><th>+4</th><th>+2</th><th>+1</th><th>Job Value</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>Settings Job</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>3</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>17</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>255</td></tr>
</table></td></tr>
<tr><td>20</td><td>Channel 1 Teach</td><td>HIGH</td><td>This dedicated input is set prior to the start of a process cycle. It is active to indicate that the cycle is used to teach the nominal behavior of the signal inputs for the selected Job. If this signal is active when the Digital IO Channel 1 is started, then that channel will be in a teach mode until it is stopped.</td></tr>
<tr><td>38</td><td>Job Select +128</td><td>HIGH</td><td rowspan="9">The Job number is the sum of the values of the active Job Select bits plus one. e.g. Activate Job Select bits +4 and +2 to start Job 7 and activate Job Select bits (+1) and (+8) to start Job 10. If the job number is set to 0 the current job selected in the settings screen will run.
Jobs 1-256 may be activated through this interface.</td></tr>
<tr><td>37</td><td>Job Select +64</td><td>HIGH</td></tr>
<tr><td>22</td><td>Job Select +32</td><td>HIGH</td></tr>
<tr><td>6</td><td>Job Select +16</td><td>HIGH</td></tr>
<tr><td>36</td><td>Job Select +8</td><td>HIGH</td></tr>
<tr><td>21</td><td>Job Select +4</td><td>HIGH</td></tr>
<tr><td>5</td><td>Job Select +2</td><td>HIGH</td></tr>
<tr><td>35</td><td>Job Select +1</td><td>HIGH</td></tr>
<tr><td>31</td><td>A-IN 1</td><td>OTHER</td><td>Analog In 1. Reads in a 0% to 100% signal for a user-supplied 0 to +10 VDC. Can be selected as signal input for instances through the SB6500 Software.</td></tr>
<tr><td>1</td><td>A-IN 2</td><td>OTHER</td><td>Analog In 2. Reads in a 0% to 100% signal for a user-supplied 0 to +10 VDC. Can be selected as signal input for instances through the SB6500 Software.</td></tr>
</table>

6.3.2 Output Pin Names and Functions (1 Channel Mode)

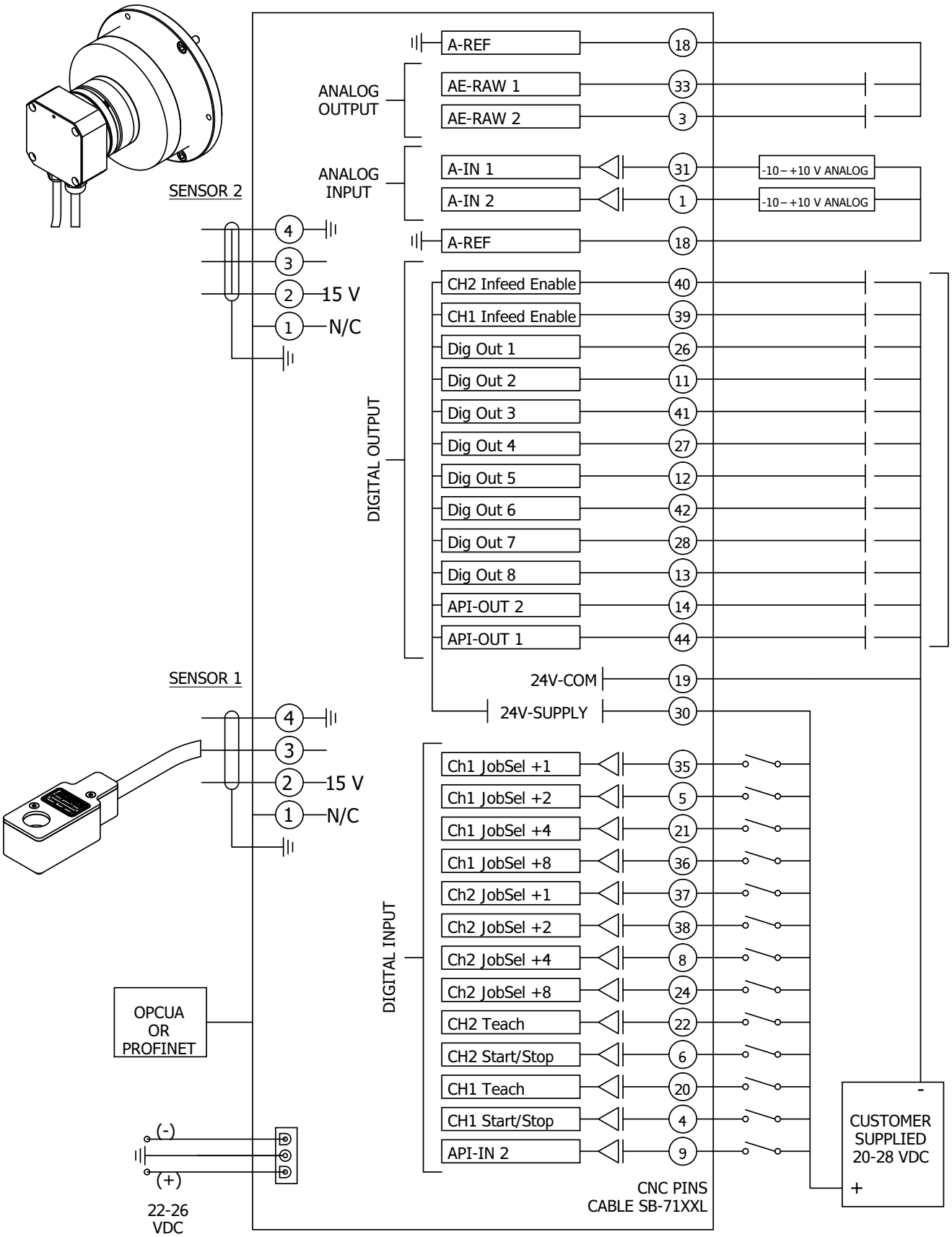
Pin#	Name	ACTIVE	Description
44	API-OUT 1	HIGH	Reserved for future use.
14	API-OUT 2	HIGH	Reserved for future use.
29	Dig Out 10	LOW	These optional outputs are used to provide a signal that indicates the evaluation result of a process. Several different outputs may be used depending on the combination of strategies grouped in the running Job. These outputs must be assigned via the SB6500 Software during job setup.
43	Dig Out 9	LOW	
13	Dig Out 8	LOW	
28	Dig Out 7	LOW	
42	Dig Out 6	LOW	
12	Dig Out 5	LOW	
27	Dig Out 4	LOW	
41	Dig Out 3	LOW	
11	Dig Out 2	LOW	
26	Dig Out 1	LOW	
39	DigIO CH1 Infeed Enable	HIGH	This output signal is active to indicate that the Job cycle is running. Its design purpose is to enable machine operation as needed for the process (e.g. enable infeed of a grinding wheel towards a workpiece).
18	A-REF	OTHER	Non-Isolated Ground Reference for use with Analog Outputs.
33	AE-RAW 1	OTHER	Unfiltered signal from the first AE sensor in use. Referenced against pin 18, A-REF.
3	AE-RAW 2	OTHER	Unfiltered signal from the first AE sensor in use. Referenced against pin 18, A-REF.

6.4 Two Digital Channel Configuration

Alternate Function Mode supports running two channels on any of the ExactControl™ Module's first 16 jobs.



X = Reserved for future use


A-REF
18
ANALOG OUTPUT
AE-RAW 1
33
AE-RAW 2
3
ANALOG INPUT
A-IN 1
31
-10 – +10 V ANALOG
A-IN 2
1
-10 – +10 V ANALOG
A-REF
18
SENSOR 2
4
3
2
15 V
1
N/C
CH2 Infeed Enable
40
CH1 Infeed Enable
39
Dig Out 1
26
Dig Out 2
11
Dig Out 3
41
Dig Out 4
27
Dig Out 5
12
Dig Out 6
42
Dig Out 7
28
Dig Out 8
13
API-OUT 2
14
API-OUT 1
44
DIGITAL OUTPUT
24V-COM
19
24V-SUPPLY
30
SENSOR 1
4
3
2
15 V
1
N/C
Ch1 JobSel +1
35
Ch1 JobSel +2
5
Ch1 JobSel +4
21
Ch1 JobSel +8
36
Ch2 JobSel +1
37
Ch2 JobSel +2
38
Ch2 JobSel +4
8
Ch2 JobSel +8
24
CH2 Teach
22
CH2 Start/Stop
6
CH1 Teach
20
CH1 Start/Stop
4
API-IN 2
9
DIGITAL INPUT
OPCUA OR PROFINET
(-)
(+)
22-26 VDC
CNC PINS
CABLE SB-71XXL
-
CUSTOMER SUPPLIED 20-28 VDC
+

6.4.1 Input Pin Names and Functions (2 Channel Mode)

<table>
<tr><th>Pin#</th><th>Name</th><th>ACTIVE</th><th>Description</th></tr>
<tr><td>9</td><td>API-IN 2</td><td>HIGH</td><td>Reserved for future use.</td></tr>
<tr><td>4</td><td>Channel 1 Start/Stop</td><td>HIGH</td><td>Sets the active job to match the sum of the Job Set Inputs and starts Digital IO Channel 1 on the rising edge of the input. If Job Set Inputs equal 0, then the last job opened in the settings screen will run. Deactivating the input stops the job running on Digital IO Channel 1
<table>
<tr><th colspan="5">JOB SELECT INPUTS</th></tr>
<tr><th>+8</th><th>+4</th><th>+2</th><th>+1</th><th>Job Value</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>Settings Job</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>3</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>11</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>15</td></tr>
</table></td></tr>
<tr><td>20</td><td>Channel 1 Teach</td><td>HIGH</td><td>This dedicated input is set prior to the start of a process cycle. It is active to indicate that the cycle is used to teach the nominal behavior of the signal inputs for the selected Job. If this signal is active when Digital IO Channel 1 is started, then that channel will be in a teach mode until it is stopped.</td></tr>
<tr><td>6</td><td>Channel 2 Start/Stop</td><td>HIGH</td><td>Sets the active job to match the sum of the Job Set Inputs and starts Digital IO Channel 2 on the rising edge of the input. If Job Set Inputs equal 0, then the last job opened in the settings screen will run. Deactivating the input stops the job running on Digital IO Channel 2
<table>
<tr><th colspan="5">JOB SELECT INPUTS</th></tr>
<tr><th>+8</th><th>+4</th><th>+2</th><th>+1</th><th>Job Value</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>Settings Job</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>3</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>11</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>15</td></tr>
</table></td></tr>
<tr><td>22</td><td>Channel 2 Teach</td><td>HIGH</td><td>This dedicated input is set prior to the start of a process cycle. It is active to indicate that the cycle is used to teach the nominal behavior of the signal inputs for the selected Job. If this signal is active when the Digital IO Channel 2 is started, then that channel will be in a teach mode until it is stopped.</td></tr>
</table>

Pin#	Name	ACTIVE	Description
24	Ch2 JobSel +8	HIGH	The Job number for DigIO Ch2 is the sum of the values of the active Job Select bits plus one. e.g. Activate Job Select bits +4 and +2 to start Job 7 and activate Job Select bits (+1) and (+8) to start Job 10. Jobs 1-16 may be activated through this interface.
8	Ch2 JobSel +4	HIGH	
38	Ch2 JobSel +2	HIGH	
37	Ch2 JobSel +1	HIGH	
36	Ch1 JobSel +8	HIGH	The Job number for DigIO Ch1 is the sum of the values of the active Job Select bits plus one. e.g. Activate Job Select bits +4 and +2 to start Job 7 and activate Job Select bits (+1) and (+8) to start Job 10. Jobs 1-16 may be activated through this interface.
21	Ch1 JobSel +4	HIGH	
5	Ch1 JobSel +2	HIGH	
35	Ch1 JobSel +1	HIGH	
31	A-IN 1	OTHER	Analog In 1. Reads in a 0% to 100% signal for a user-supplied 0 to +10 VDC. Can be selected as signal input for instances through the SB6500 Software.
1	A-IN 2	OTHER	Analog In 2. Reads in a 0% to 100% signal for a user-supplied 0 to +10 VDC. Can be selected as signal input for instances through the SB6500 Software.

6.4.2 Output Pin Names and Functions (2 Channel Mode)

Pin#	Name	ACTIVE	Description
44	API-OUT 1	HIGH	Reserved for future use.
14	API-OUT 2	HIGH	Reserved for future use.
13	Dig Out 8	LOW	These optional outputs are used to provide a signal that indicates the evaluation result of a process. Several different outputs may be used depending on the combination of strategies grouped in the running Job. These outputs must be assigned via the SB6500 Software during job setup
28	Dig Out 7	LOW	
42	Dig Out 6	LOW	
12	Dig Out 5	LOW	
27	Dig Out 4	LOW	
41	Dig Out 3	LOW	
11	Dig Out 2	LOW	
26	Dig Out 1	LOW	
39	DigIO CH1 Infeed Enable	HIGH	This output signal is active to indicate that the Job cycle is running on DigIO Ch1. Its design purpose is to enable machine operation as needed for the process (e.g. enable infeed of a grinding wheel towards a workpiece).
40	DigIO CH2 Infeed Enable	HIGH	This output signal is active to indicate that the Job cycle is running on DigIO Ch2. Its design purpose is to enable machine operation as needed for the process (e.g. enable infeed of a grinding wheel towards a workpiece).
18	A-REF	OTHER	Non-Isolated Ground Reference for use with Analog Outputs.
33	AE-RAW 1	OTHER	Unfiltered signal from the first AE sensor in use. Referenced against pin 18, A-REF.
3	AE-RAW 2	OTHER	Unfiltered signal from the first AE sensor in use. Referenced against pin 18, A-REF.

7 OPC UA Interface

In addition to the hardwire interface, each SBS control module provides an OPC UA server over its Ethernet connection. A machine controller, PLC, or other OPC UA client can use this server to communicate with the module directly, without the SB6500-Software. The module always operates as the OPC UA server; the customer's system connects to it as the OPC UA client. For example, UaExpert from Unified Automation is a free, general-purpose OPC UA client that can be used to browse the module's data and test the connection.

The main OPC UA server always listens on port 4845. The module also runs an OPC UA discovery server on port 4840. To connect, point the OPC UA client to the module's IP address on port 4845:

```
opc.tcp://<module IP address>:4845
```

By default, the module obtains its IP address through DHCP. If no DHCP server is available, it falls back to a link-local IP address (169.254.x.x). A static IP address may be set instead if desired. The module's IP address can be viewed and changed from the Network Settings screen (see Create Machine Group).

Discovery and connection range: Module discovery in the SB6500-Software (used when creating or editing a Machine Group) only works on a single local link. Modules on the other side of a router or on a different subnet will not appear in the Available Modules list. OPC UA connections do not have this restriction. An OPC UA client can connect to a module from any network that can reach the module's IP address, provided that port 4845 is not blocked by a firewall.

8 Troubleshooting Guide

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

8.1 Displayed Error Messages

Self-diagnostic software has been incorporated into all SB-6500 Series Control Modules. 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 (SENSOR 2 DEFECT) OPEN – CHECK CABLE AND CONNECTORS – SEE MANUAL	Checked continuously while job using this sensor is running. Acoustic Sensor 1 (2) presence not detected. This could be caused by a defective sensor or by no sensor being connected.	Clears automatically when sensor detected and can be manually cleared. Check sensor connections and try Power-On again. Continued error messages indicate the need to repair or replace the Sensor or connecting cable.
B	SENSOR 1 DEFECT (SENSOR 2 DEFECT) SHORT – CHECK CABLE AND CONNECTORS – SEE MANUAL	Checked continuously while job using this sensor is running. Acoustic Sensor 1 (2) short circuit detected.	Clears automatically when sensor detected and can be manually cleared. Disconnect the Control Unit from 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.

8.2 Updating the SB6550 Display Module without the SB6500-Software

To update without using the user interface, place the update file for the display in the root directory on a FAT32-formatted USB drive and change the file extension from ".disp" to ".mender" (i.e. "updateFileName.mender"). While the display is powered, insert the USB drive into the front USB-C port of the display. The display will update. Do not remove the USB drive until after completion.

9 Support

For support, contact the machine builder or SBS at:

Accretech SBS, Inc.
2261 NW 28th Avenue
Portland, Oregon 97210 USA

Tel.: +1 503.595.4270
Fax: +1 503.595.4271
CustomerService@accretechSBS.com
https://accretechsbs.com/

10 Appendices

10.1 Appendix A: Specifications

Physical Features
Battery life (clock): 10 years
Service life – 10 years
SB-5500 Compatible
Operates with existing cables and sensors.
Interface adapter required to use SB-5500 hardwire cable.

Communication Interfaces
Ethernet TCP/IP (OPC UA), Profinet DP, CNC/PLC Hardwire Interface (opto-isolated outputs)

Power Supply
Input 22 VDC to 26 VDC. 0.9A max at 22 VDC. Reverse voltage protected.
Connector: Phoenix Contact 1952034 or Eq.

44 Pin DSUB Connector Interface
CNC Digital Inputs and Outputs:
opto-isolated from system signals to at least 500V.
Requires common external 24VDC supply.
Outputs:
active: drive up to 50 mA per output
inactive: high impedance down to -30 V referenced to the common.
Require flyback protection when driving coil.
Inputs:
-3VDC to 30VDC absolute max range.
Inputs are active with +18V to 30V DC applied relative to common
active inputs draw 5ma @ 24V (4.8mA to 5.2mA).
Inputs are inactive with -3VDC to +5VDC applied relative to common.

Environmental and Installation
SB-6560/6560-8
Pollution degree 2
Installation category I
IP30
Environmental temperature range:
5°C to +55°C

SB-6500 Minimum Networking Requirements
Ethernet CAT6 shielded cable.
100Mbit/s unmanaged switch.

SB-6500 Software Minimum Computer System Requirements

- Processor (CPU): 2.8 GHz
- Memory: 8GB RAM
- Storage: 200MB
- Operating System: Windows 11 (x64), Windows 10 (x64) version 22H2, or Windows 10 Enterprise 2018 (x64) or newer.
- OS must be 64 bit.
- Graphics: 4GB Video Memory with 128MB VRAM

SB-6500 Software Features
Multi-language Capability
English, Japanese, Chinese Simplified, Chinese Traditional, Slovak, Czech, German, Polish, Turkish, French

10.2 Appendix B: Replacement Parts List

PN	Description
AE Sensors and Cables	
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

Replacement sensors and cables can be identified by product tags on the product. Contact SBS for further information.

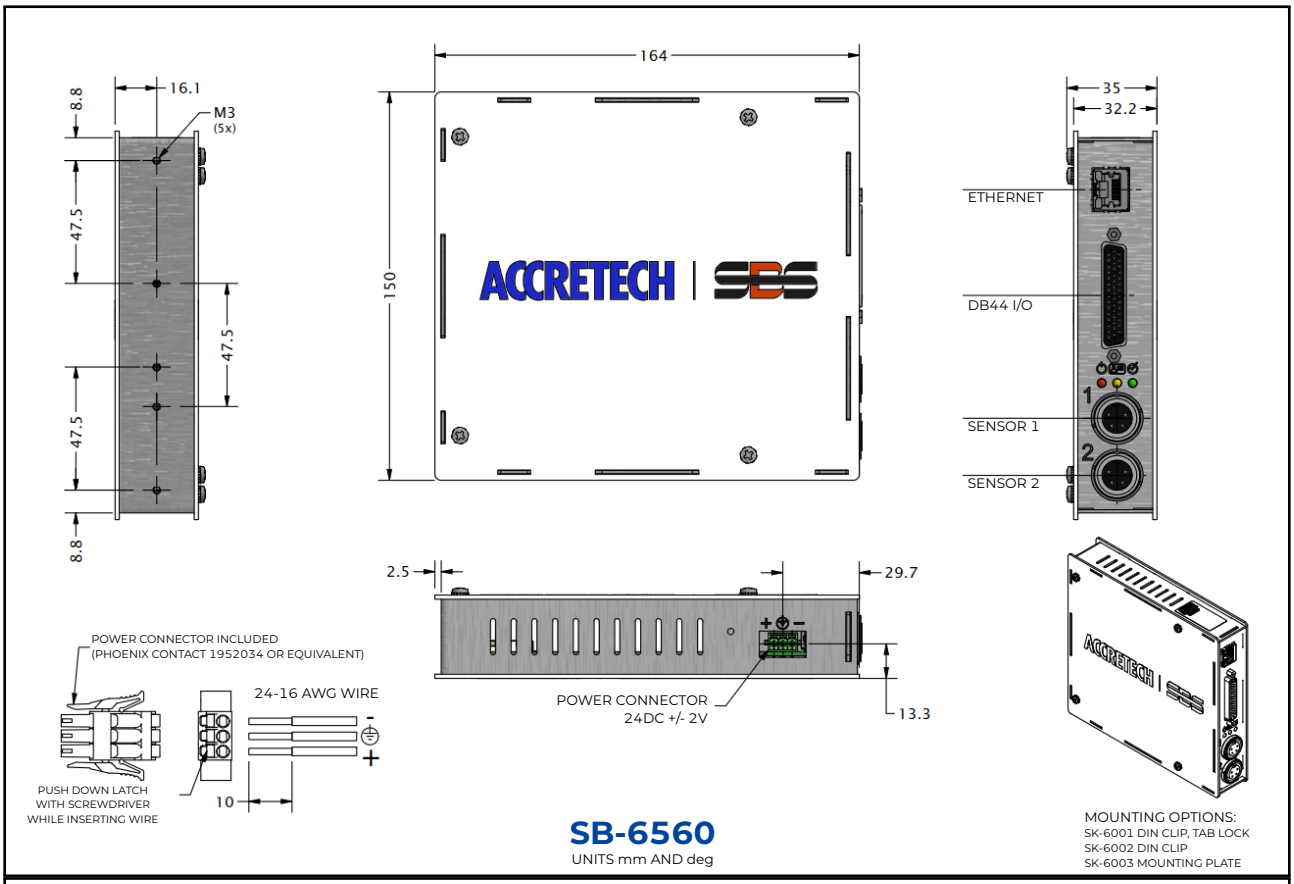
Control Mounting Options	
SK-6001	DIN rail mount clip: pull tab release
SK-6002	DIN rail mount clip: pivot release
SK-6003	Control Module mounting plate kit

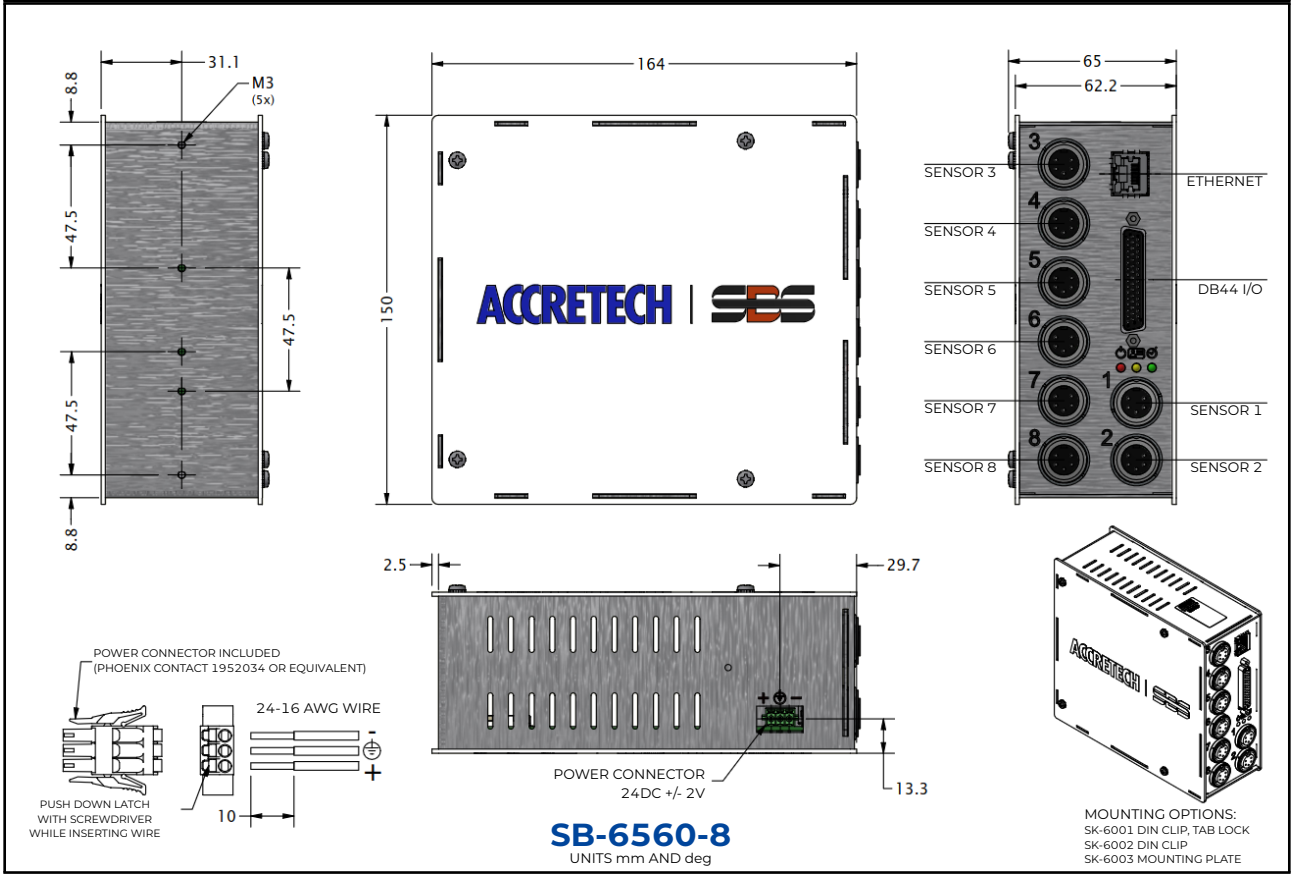
Other Parts	
ED-0218	Power Supply Connector
ED-0154	Replacement Battery CR2032

xx in P/N = cable length in feet

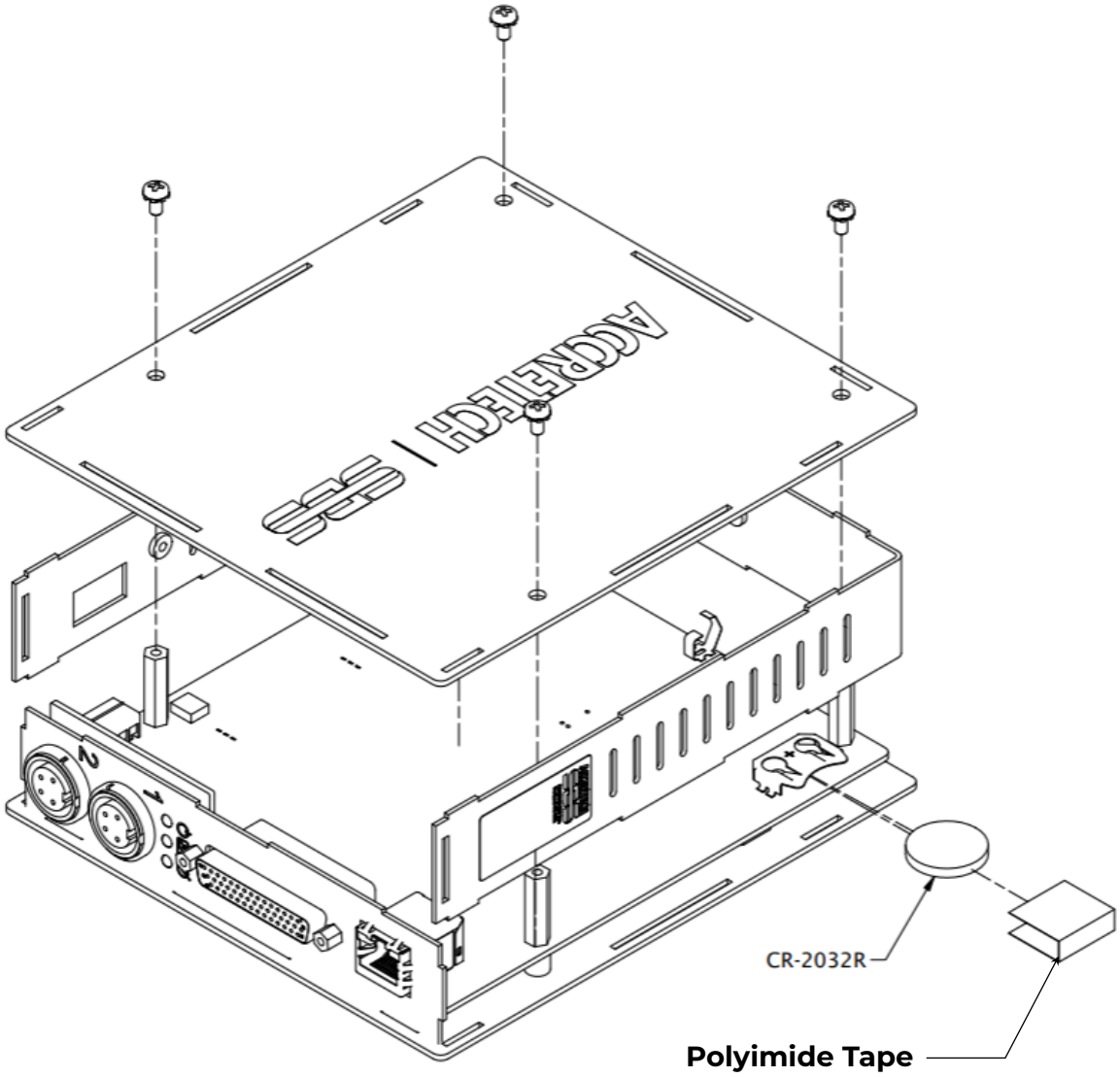
Standard options 11 [3.5m], 20 [6m], or 40 [12m], e.g. SB-4211 = 11ft [3.5m]

10.3 Appendix C: Mechanical Drawings





10.4 Appendix D: Battery Replacement

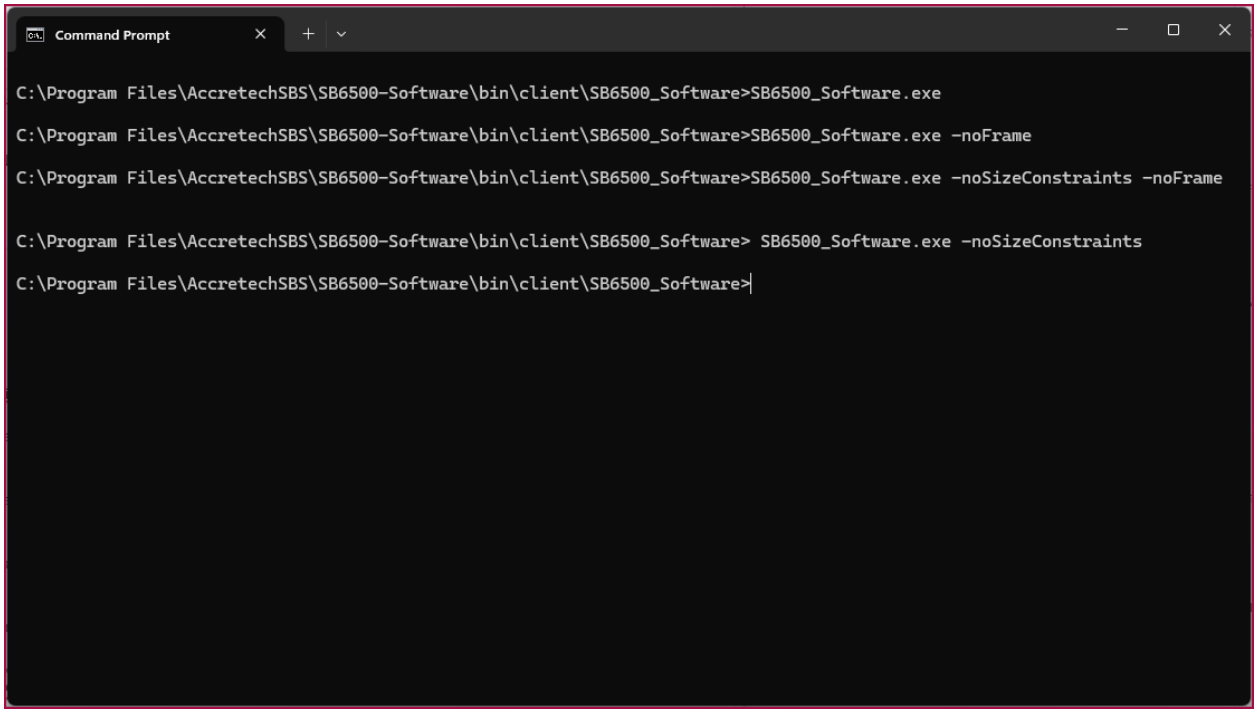


10.5 Appendix E: Command Line Options

If launching the SB-6500 Software from Command Prompt, the following options are available:

-noFrame	Removes the window frame
-alwaysOnTop	Sets the SB-6500 Software to always stay on top of other applications
-ipc	Activates -noFrame, -noAutoPos, -noAutoSize, and -noSizeConstraints
-noAutoPos	Disables the SB-6500 Software using the settings or passed in arguments to automatically position the window. This positioning code occurs after program launch, and this would be needed to manually set a position through other means.
-noAutoSize	Disables the SB-6500 Software using the settings or passed in arguments to automatically size the window. This sizing code occurs after program launch, and this would be needed to manually set a size through other means.
-noSizeConstraints	Removes the SB-6500 Software's size constraints, allowing its window to be resized by clicking and dragging or by setting a width and height through other means.
-fullscreen	Sets the SB-6500 Software to run in full screen. This disables the window frame as well and runs the SB-6500 Software taking up the entire space.
-pos	Followed immediately by 2 values, this sets the SB-6500 Software's position to the values passed directly after this. Example: -pos 400 500 would put the SB-6500 Software's upper-left corner at the coordinates x=400, y=500. Does not work if -noAutoPos is on.
-width	Followed immediately by a value, this sets the SB-6500 Software's width to the passed value in pixels. Note: Requires -noSizeConstraints to work. Does not work if -noAutoSize is on.
-height	Followed immediately by a value, this sets the SB-6500 Software's height to the passed value in pixels. Note: Requires -noSizeConstraints to work. Does not work if -noAutoSize is on.

Example:



ACCRETECH | SBS
PRECISION PROCESS CONTROL

Engineering confidence for **precision grinding.**

Accretech SBS is committed to delivering products that meet or exceed customer expectations, providing outstanding after-sales service and support, and continually strengthening the effectiveness of our quality management system.

HEADQUARTERS

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SALES & SERVICE

Tel: +1 503.595.4270
sales@accretechSBS.com
Worldwide network

MODELS COVERED IN THIS MANUAL

SB-6560 | SB-6560-8

ENGINEERING CONFIDENCE.
BUILT WORLDWIDE.

Document LL-6600 · Revision 1.2
Software version 1.21.2 · November 2026

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SCAN FOR SUPPORT

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