



469D Seismic Simulation Control System

469D Panel Reference for Shimizu

This page intentionally left blank.

Topics

<i>469D Controller Settings</i>	5
<i>469D Digital Seismic Table Controller</i>	5
<i>AC/DC Conditioners</i>	17
<i>A/D Converters</i>	22
<i>Adaptive Harmonic Cancellers</i>	24
<i>Adaptive Inverse Controller</i>	28
<i>Amplitude/Phase Controllers</i>	34
<i>User Analog Inputs</i>	37
<i>Analog Readouts</i>	39
<i>D/A Converters</i>	42
<i>Data Player</i>	44
<i>Data Recorder</i>	46
<i>Digital Meters</i>	48
<i>4-Channel Digital Oscilloscope</i>	51
<i>Digital Readouts</i>	59
<i>Force Balance</i>	60
<i>Frequency Response Function (FRF) Plotter</i>	62
<i>Function Generators</i>	65
<i>Impulse Response Function Plotter</i>	72
<i>Limit Detectors</i>	75
<i>Message Log</i>	78
<i>Observers</i>	79
<i>Online Iteration</i>	82
<i>Origin Offset</i>	84
<i>Ramp Rates</i>	85
<i>Resonance Compensators</i>	87
<i>Spectrum Analyzer</i>	88
<i>Three-Variable Controllers</i>	90
<i>Units</i>	94
<i>Valve Drivers</i>	95

This page intentionally left blank.

469D Controller Settings



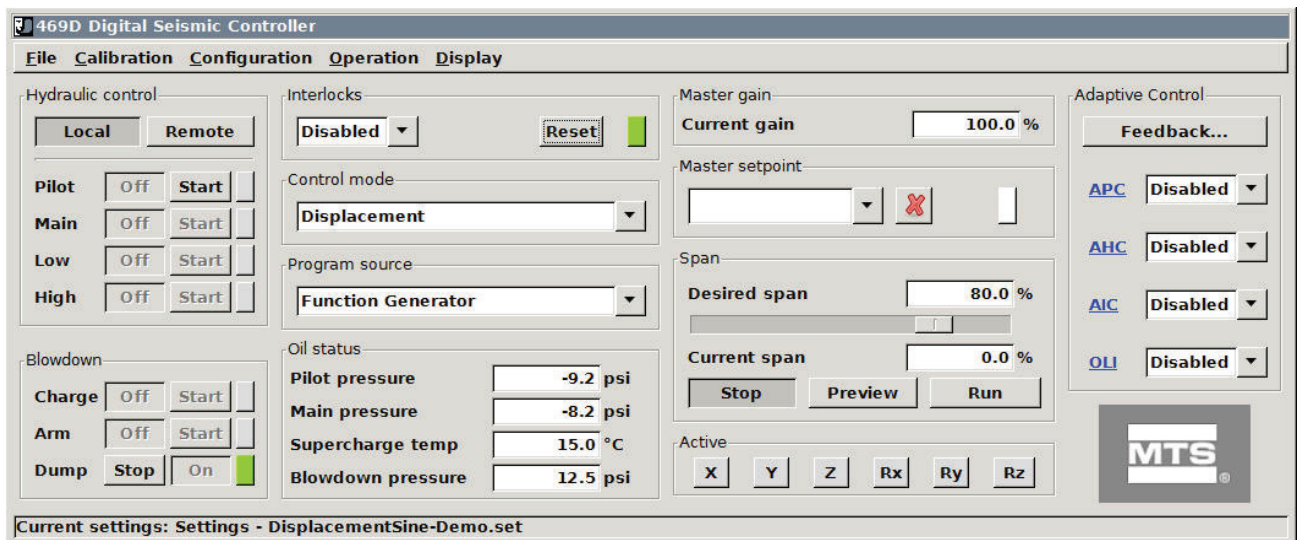
Warning:

When a panel opens it will display the current settings as it applies to the system.

If you change a setting without understanding the effect of the change, unexpected motion can occur in the system. Unexpected system motion can cause personal injury or damage to equipment.

Do not change a setting without knowing what effect the change will have on the system.

469D Digital Seismic Table Controller



Access

The main controller panel opens when you start the application.

When to use the panel

Use this panel to access all other panels in the application, define system controls, and run the table control system.

Panel description

The main controller panel allows access to all other parts of the application. It includes both menus and system controls.

System controls on the main controller panel allow you to perform the following tasks:

- Enable and monitor hydraulics
- Panel 469D Reference
- Monitor system fluid pressure and temperature.
- Enable or disable limits.

- Reset limit/interlock conditions.
- Monitor the program control mode.
- Monitor the program source.
- Display the master gain and select the park/normal table positions.
- Set the desired span and monitor current span.
- Stop, run or preview a program.
- Enable/disable adaptive control.
- Monitor other system states.

Control labels that are underlined

A control label that is the color blue and is underlined on the main panel, such as APC, identifies that the control is a shortcut to a menu option.

Application menus

The following menus are provided:

- File — allows you to change passwords for access privileges, restore or save settings, convert files from binary to text format or visa versa, and quit the application.
- Calibration — allows you to calibrate converters, conditioners, and valve drivers, and save or restore the calibration values.
- Configuration — allows you to configure defaults for some panels.
- Operation — allows you to setup operations for control of the system.
- Display — allows you to set up readout displays.

For More Information

Function Generators Reference (p. 114)

469D Digital Seismic Table Controller Reference

Hydraulic Controls

Control	Descriptions
Local/Remote	In Local Mode, the hydraulics are controlled from the 469D Controller. In Remote Mode, the hydraulics are controlled from the Hydraulic Power Controller Main Panel. Note:  You must clear and reset all interlocks (including emergency stop buttons) before the HPS pump can be turned on.
Pilot Off/Start	Start/Stop the Supercharge and Pilot pumps. Enabled only in Local Mode. The Pilot Indicator to the right of the Start button shows the status of the Pilot pump. Gray = Off, Blinking Yellow = Starting, Green = On.
Main Off/Start	Start/Stop all of the Main pumps that are selected. Enabled only in Local Mode. The Main Indicator to the right of the Start button shows the status of the Main pumps selected. Gray = Off, Blinking Yellow = Starting, Green = On.
Low Off/Start	Start/Stop the table Low Main pressure. Enabled only in Local Mode. The Low Indicator to the right of the Start button shows the status of all the table Low Main pressure. Gray = Off, Blinking Yellow = Starting, Green = On.
High Off/Start	Start/Stop the table High Main pressure. Enabled only in Local Mode. The High Indicator to the right of the Start Button shows the status of the table in High Main pressure. Gray = Off, Blinking Yellow = Starting, Green = On.

Blowdown Controls

Control	Descriptions
Charge Off/Start	Start/Stop the Blowdown Charging mode. Enabled only in Local Mode. The Pilot pump pressure goes to Blowdown Charge pressure. Pilot pressure is supplied by a check valve to Main pressure. Blowdown control valves are clamped shut. The Charge Indicator to the right of the Start button shows the status of the Blowdown Charge. Gray = Off, Blinking Yellow = Charging, Green = Charge Full.

Control	Descriptions
Arm Off/Start	Start/Stop the Blowdown Charging mode. Enabled only in Local Mode. The Pilot pump pressure returns to Normal pressure. Blowdown control valves are armed and ready to flow oil if needed. High pressure is changes to 3500 psi. This pressure will stay high until Blowdown is disarmed or 5 minutes have elapsed. The Arm Indicator to the right of the Start button shows the status of the Blowdown Arm. Gray = Off, Blinking Blue =Arming, Green = Armed.
Dump Off/Start	Start/Stop all of the Main pumps that are selected. Enabled only in Local Mode. The Main Indicator to the right of the Start button shows the status of the Main pumps selected. Gray = Off, Blinking Yellow = Starting, Green = On.

Interlock Controls

Control	Descriptions
Disabled/Enabled	Enables or disables the software and hardware limit detectors. The hardware limit detectors are only enabled if the hardware limits Disable control on the associated AC/DC Conditioner panel is not checked.
Reset button and indicator	Clears the hardware and software limit status indicators located on the AC/DC Conditioners and Limit Detector panels and the system E-STOP chain. The indicator turns green when all over limit conditions are clear.

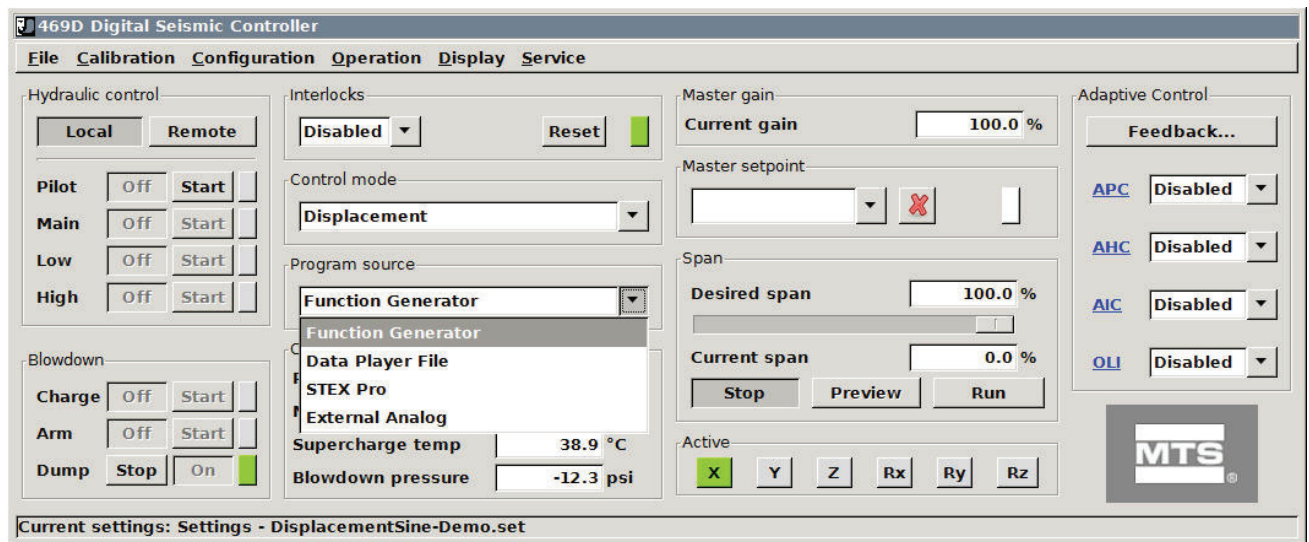
Control Modes

Options	Description
Displacement, Velocity, or Acceleration	Select the desired control mode (displacement, velocity, or acceleration).

Program Sources

Options	Description
469D Function Generator 469D Data Player STEX ProPC command or External Analog signal	Select the desired program source from the pull-down list.

In the following example, Function Generator is selected as the program source:



Oil Status Information

System Hydraulic Sensors	Description
Pilot pressure (psi)	Hydraulic pressure supplied to operate servo valves and bearings.
Main pressure (psi)	Hydraulic pressure available to the actuators.
Supercharge temp (°C)	Displays the Supercharger output oil temperature.
Blowdown pressure (psi)	Hydraulic pressure in the blowdown accumulators.

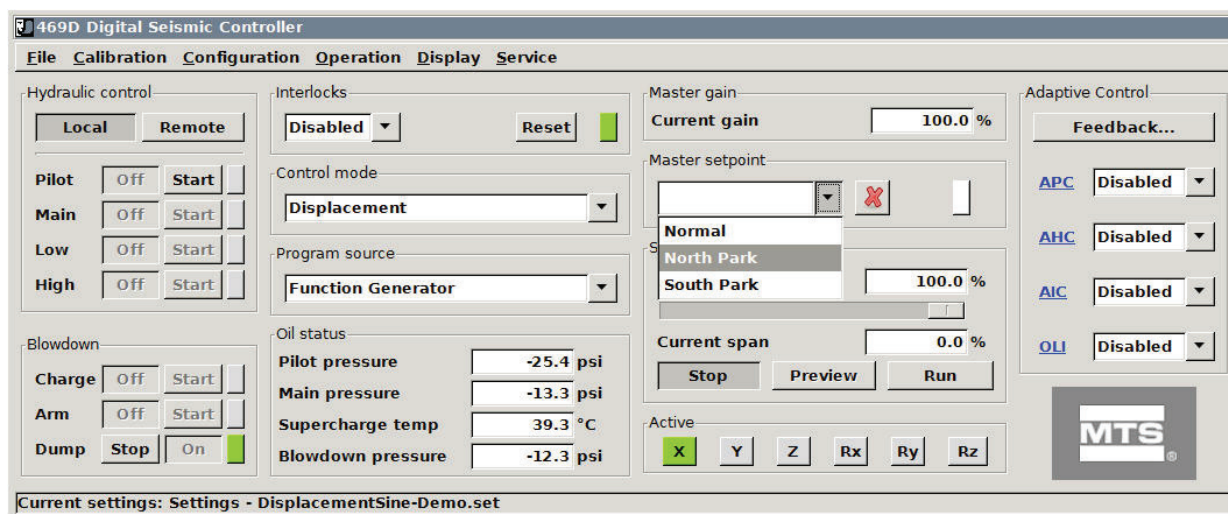
Master Gain Setting

Control	Description
Current gain	Shows the Master gain for all channels. Set by Master Gain Throttle box.

Master Setpoint Options

Options	Description
Normal North Park South Park	Normal and parking positions are determined and defined at the time the system is put into commission. Selecting Normal with hydraulics on will move the table to its normal test start position. Selecting North Park with hydraulics on will move the table to its North park position, or selecting South Park will move the table to its South Park position. Both positions were determined and defined as a stable position with the lowest amount of stored energy. The Master Setpoint Indicator to the right of the control indicates the present status of the Master Setpoint: Clear = Table is not at Normal or either Park position. Blinking Yellow = Table in motion towards Normal or one of the Park positions. Green = Table is at Normal or one of the Park positions. Clicking the X button will stop the table if it is in motion to normal or parking positions.

In the following example, North Park is selected:



Span Controls

Control	Description
Desired Span	Use the slide bar to adjust the desired amplitude of the command signal. The value is multiplied by the commanded value established for the selected program source.
Current Span	Shows the current value of the span. The master span may take time to ramp up to its set value. This shows the actual value, at any moment.
Stop button	Stops the test program. Span will ramp to zero. System returns to the setpoint levels by Master Gain Throttle box.
Preview button	Allows user to evaluate (preview) command time history while hydraulic power is on. The program runs without commands being sent to the servo controller. Active only in velocity or acceleration control modes. Use Preview to verify that the program will not exceed the mechanical limits.
Run button	Enables and runs the program.

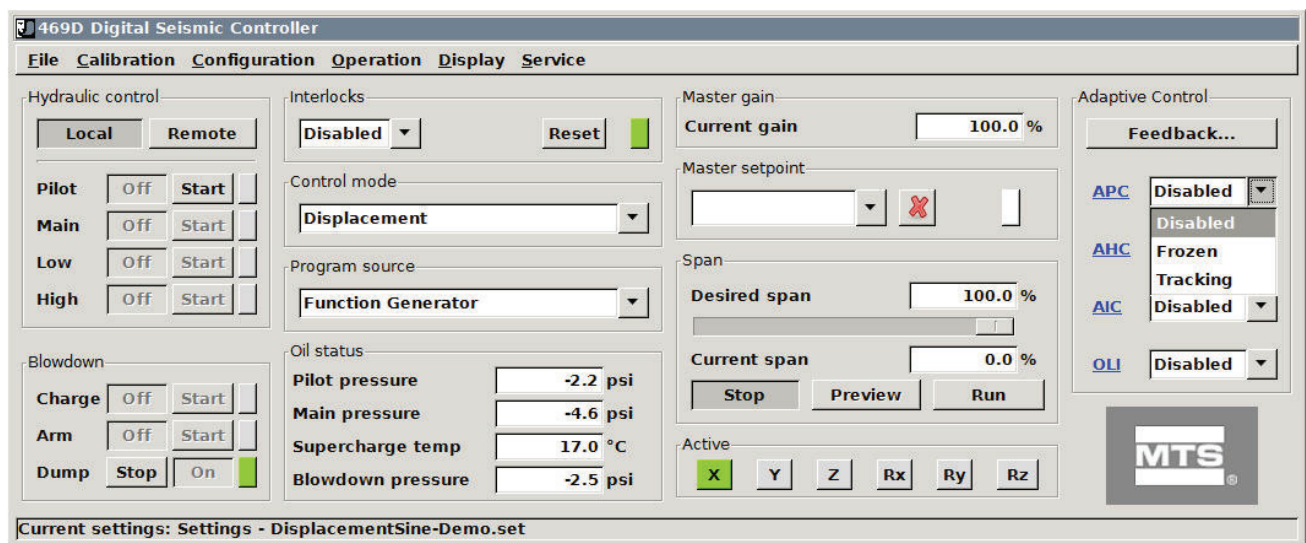
Degree of Freedom Table Motion Indicators

Indicators	Description
	When an indicator is green, the degree of freedom is active:
X	Longitudinal
Y	Lateral
Z	Vertical
Rx	Roll
Ry	Pitch
Rz	Yaw

Adaptive Control: Amplitude and Phase Control (APC)

Control	Description
<u>APC</u> Disabled	APC is off.
<u>APC</u> Frozen	APC is on and controlling, but coefficients are unchanging. This mode is not recommended for normal operation. If you freeze the coefficients and then change the command frequency, the amplitude correction corresponding to the frozen coefficients may be inappropriately large at the new frequency, resulting in damage to your specimen and test system.
<u>APC</u> Tracking	APC is on and controlling, and coefficients are changing. This is the mode recommended for normal operation.

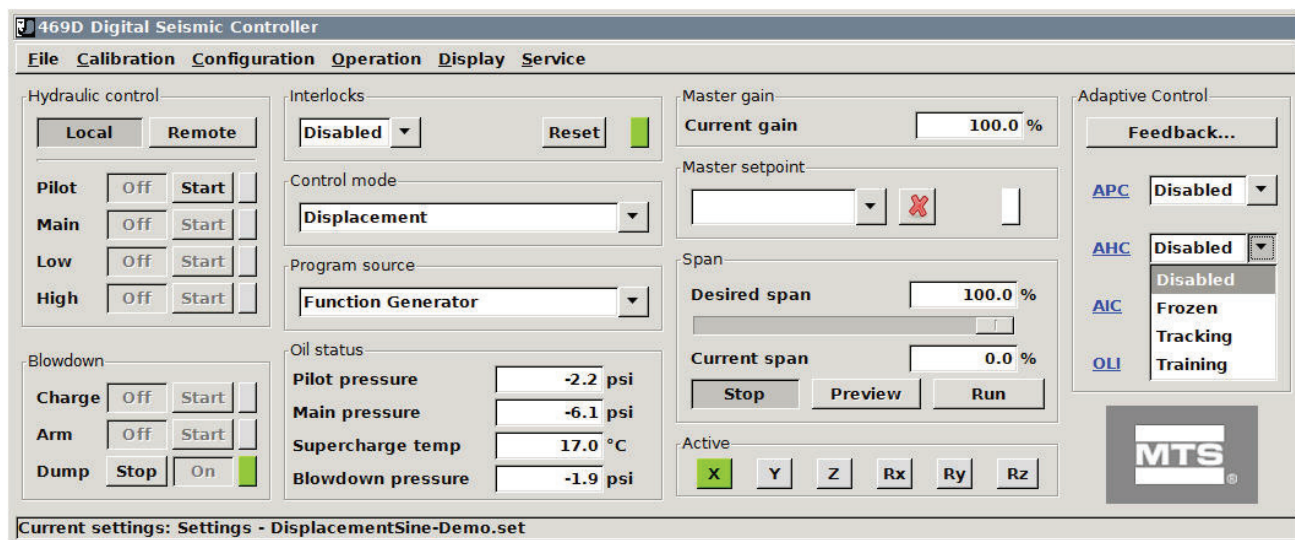
In the following example, APC Disabled is selected:



Adaptive Control: Automatic Harmonic Canceller (AHC)

Control	Description
<u>AHC</u> Disabled	AHC is off.
<u>AHC</u> Frozen	AHC is on and canceling, but canceler coefficients are unchanging. This mode is not recommended for normal operation. If you freeze the coefficients and then change the command frequency, the harmonic amplitude corresponding to the frozen coefficients may be inappropriately large at the new frequency, resulting in damage to or destruction of your specimen and test system.
<u>AHC</u> Tracking	AHC is on and canceling, and canceler coefficients are changing. This is the mode recommended for normal operation.
<u>AHC</u> Training	AHC is on but not canceling. Plant input and output are passively monitored while model coefficients are updated. This mode is used to determine model coefficient values prior to running Frozen or Tracking modes.

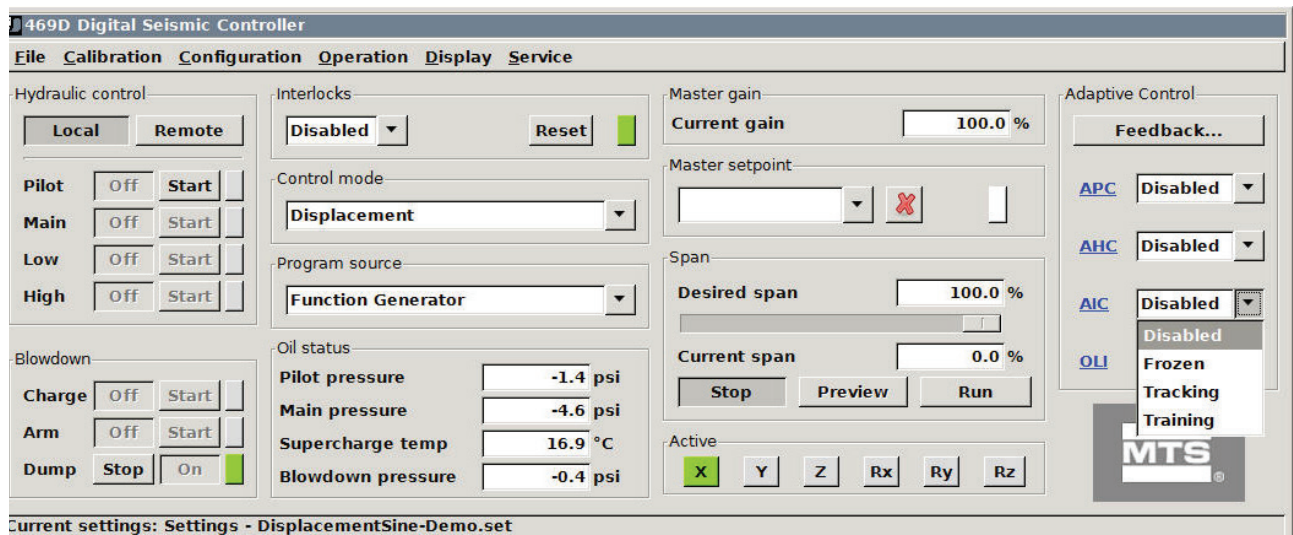
In the following example, AHC Disabled is selected:



Adaptive Control: Automatic Inverse Control (AIC)

Control	Description
<u>AIC</u> Disabled	AIC is off.
<u>AIC</u> Frozen	AIC is on and controlling, but coefficients are unchanging. This is the mode recommended for running most tests.
<u>AIC</u> Tracking	AIC is on and controlling, and coefficients are changing. This mode is used to refine coefficients during training, as well as adapting to changing plant dynamics during a test.
<u>AIC</u> Training	AIC is on but not controlling. Plant input and output are passively monitored while coefficients are updated. This mode is used to determine initial values of transfer function coefficients prior to running Frozen or Tracking modes.

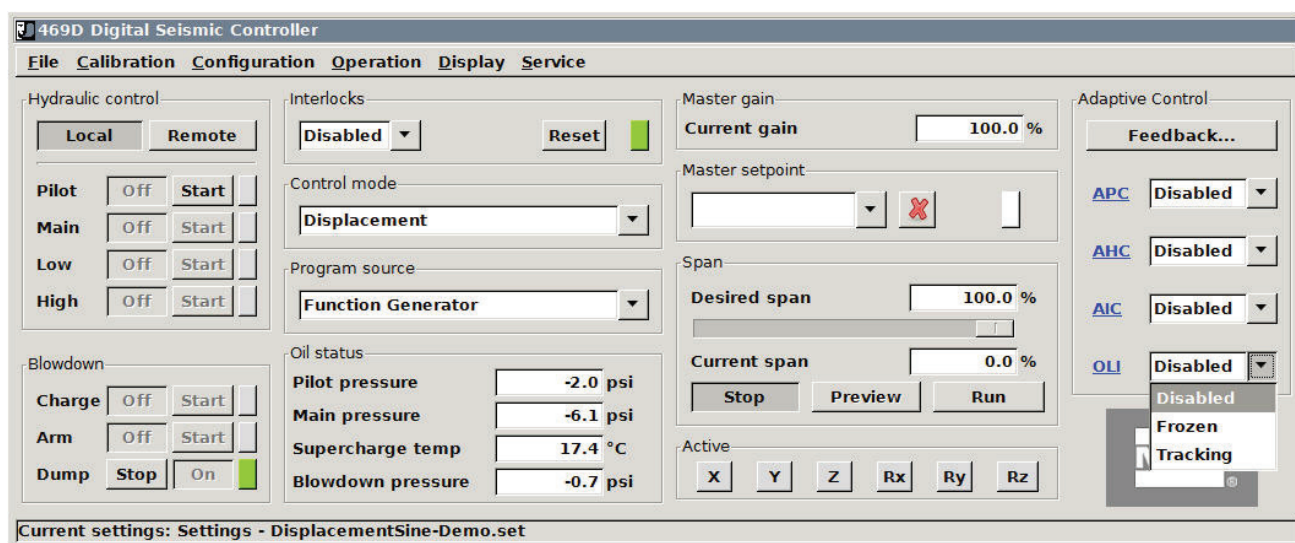
In the following example, AIC Disabled is selected:



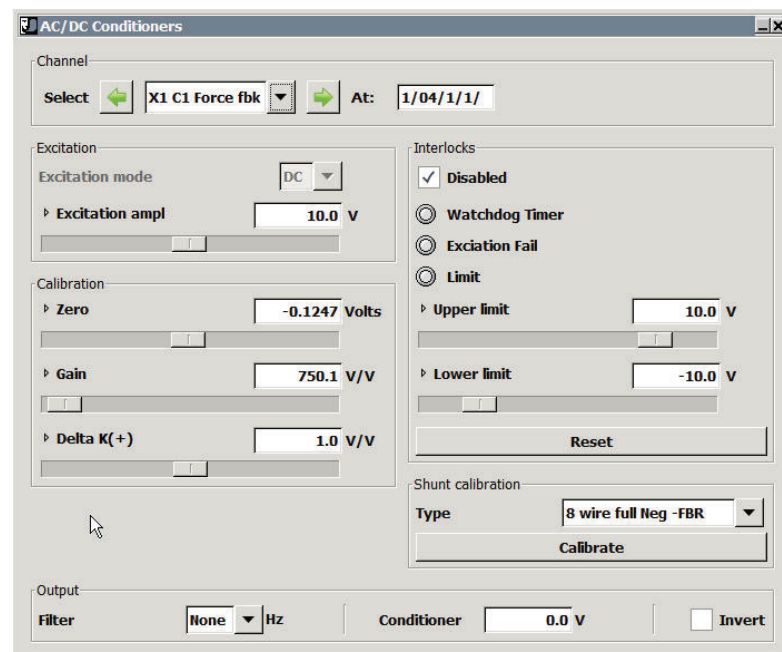
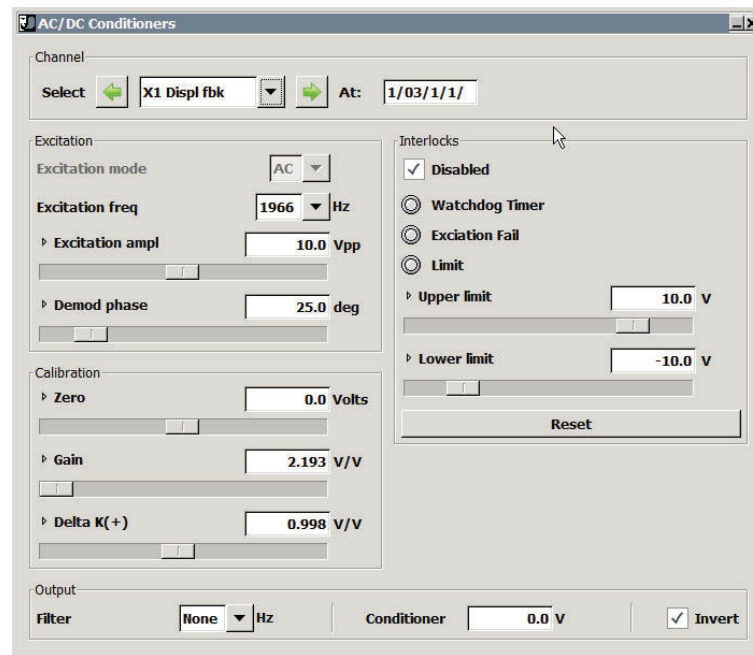
Adaptive Control: Online Iteration (OLI)

Control	Description
<u>OLI</u> Disabled	OLI is off.
<u>OLI</u> Frozen	OLI is on, but advancing to the next drive file at the end of the current iteration is inhibited. Use this mode if you want to OLI to monitor error statistics when playing out a final drive file.
<u>OLI</u> Tracking	OLI is on, and advancing to the next drive file at the end of the current iteration is enabled. Use this mode to develop a final drive file. When you turn on OLI to Frozen or Tracking, AIC is automatically turned on in Frozen mode for you. When you turn off OLI, AIC is automatically turned off. You can change AIC to Tracking mode if you want AIC's inverse transfer function to update during iteration. In certain strongly nonlinear systems where the inverse transfer function varies significantly with signal level, this feature may help the iteration process to converge. However, because most systems converge nicely without this feature, and because the potential for AIC divergence in Tracking mode, we recommend that you leave AIC in Frozen mode.

In the following example, OLI Disabled is selected:



AC/DC Conditioners



Access

Main controller panel **Calibration** menu > **AC/DC Conditioners**

When to use the panel

Use the Conditioners panel to calibrate a conditioner with its associated transducer and to identify and reset hardware interlocks. Whenever a transducer is replaced or moved, the associated conditioner should be calibrated. Hardware limits should be checked and reset before starting a test. In addition, MTS recommends verifying calibration values periodically.

Panel description

The Conditioners panel allows you to perform the following tasks:

- Select a specific conditioner
- Calibrate the conditioner to its associated transducer
- Select polarity of output
- Select filtering option
- Set hardware limits for the conditioner output (feedback)
- Identify whether an interlock has occurred
- Disable and/or reset interlocks

For More Information

AC Conditioner Calibration (p. 197)

DC Conditioner Delta-P Calibration (p. 198)

DC Conditioner Accelerometer Calibration (p. 200)

AC/DC Conditioners Reference

Channel Selection Controls

Control	Descriptions
Channel Select Down Arrow	Select a channel from the drop-down list.
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

AC or DC Conditioner Controls

Control	Descriptions
Excitation Mode	Displays the type of conditioner as a result of selecting a channel; AC or DC.
Excitation Amplitude	Sets the level of the excitation signal sent to the transducer. You can use the slider bar to set a value or you can enter it in the text box. Click on the small arrow at the upper left of the slider bar to view or change the Min and Max currently in effect. For example:  To return to the slider bar view, click on the arrow or anywhere on the slider bar and the original slider bar view will redisplay. For example: 
Zero slide bar and text box	Sets the analog DC offset of the conditioner hardware. You can use the slide bar to set a value or you can enter it in the text box.
Gain slide bar and text box	Sets the total gain of the conditioner. You can use the slide bar to set a value or you can enter it in the text box.
Delta K (+) slide bar and text box	Sets the delta K(+) value for the conditioner. You can use the slide bar to set a value or you can enter it in the text box.

Control	Descriptions
Output Filter cutoff pop-up	Click the down arrow button to display a list of available cutoff frequencies. Select the desired frequency and click the check mark button to accept the selection and close the list, or click the X button to decline the selection and close the list. To select no cutoff frequency, select None from the list and close the list as described. The predefined cutoff frequencies shown in the list (50 Hz, 100 Hz, 300 Hz, 500 Hz, and 1000 Hz) correlate to the filter selections on the DUC circuit board. The Software cutoff frequency choice bypasses the filter on the DUC circuit board, and allows you to specify any cutoff frequency and specify either a one pole or two pole filter.
Invert Polarity check box	Boxed checked will invert the conditioner signal polarity. Box not checked will not invert the conditioner signal polarity.
Conditioner output text box	Shows the current value of the signal output by the selected conditioner. Not editable.

AC Conditioner Specific Controls

Control	Descriptions
Excitation freq	Select a channel from the drop-down list.
Demod. phase slide bar and text box	Sets the demodulator phase of the AC conditioner output. You can use the slide bar to set a value or you can enter it in the text box.

DC Conditioner Specific Controls

Control	Descriptions
Shunt Cal button	Closes the shunt calibration relay to complete a shunt calibration of the conditioner and displays the value in the Conditioner output display

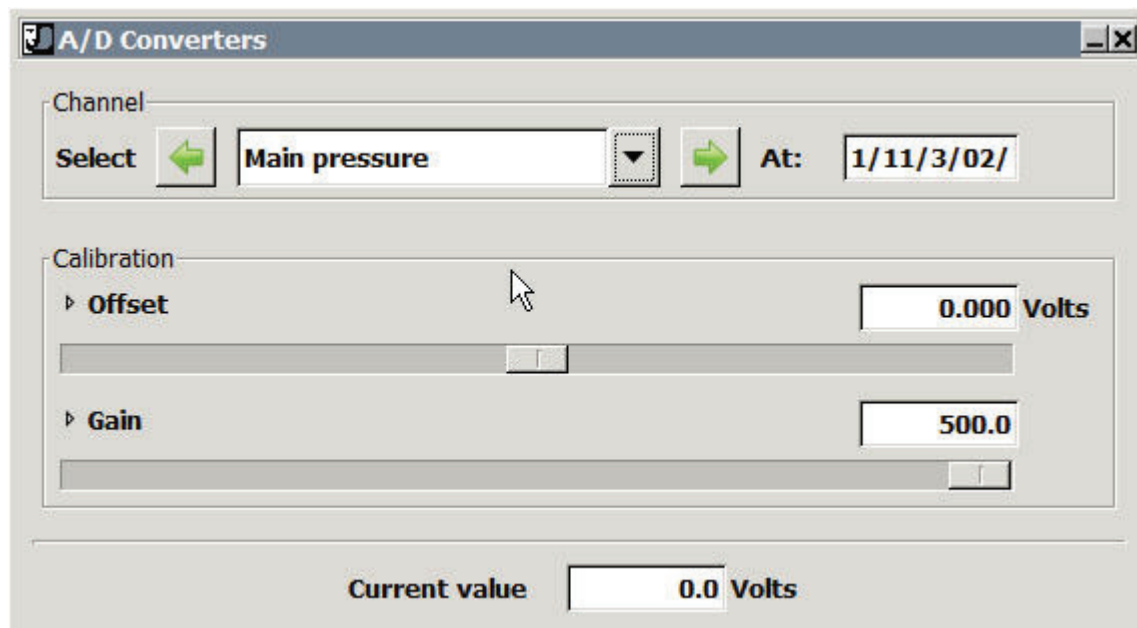
Interlock Controls

Control	Descriptions
Disabled check box	When checked, disables hardware interlocks for the selected channel.
Reset button	When pressed, resets the hardware interlocks for the selected channel.
Watchdog Timer indicator	Indicates the status of the watchdog timer.
Excitation fail indicator	Shows whether excitation has failed. This detector is always enabled, both in hardware and software. Excitation failure causes a system interlock because it may indicate a broken, defective or missing cable.

Interlock Limit Controls

Control	Descriptions
Limit indicator	Indicates whether the output has gone outside of the limits shown in the Upper or Lower limit text boxes.
Upper Limit slide bar and text box	Sets the upper limit of the output. You can use the slide bar to set a value or you can enter it in the text box. If the output exceeds this level, the Limit indicator lights red.
Lower Limit slide bar and text box	Sets the lower limit of the output. You can use the slide bar to set a value or you can enter it in the text box. If the output falls below this level, the Limit indicator lights red.

A/D Converters



Access

Main controller panel **Calibration** menu > **A/D Converters**.

When to use the panel

Use this panel during test setup to periodically calibrate the converters in the system to ensure that the input and output voltages are balanced.

Panel description

The A/D Converters panel allows you to adjust the offset and gain for a selected A/D converter.

For More Information

A/D Converter Calibration (p. 196)

A/D Converters Reference

Channel Selection Controls

Control	Descriptions
Channel Select Down Arrow	Displays the name of the selected channel. Select a channel from the drop-down list.
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

Signal Adjustment Controls

Control	Descriptions
Offset slide bar and text box	Adjusts the offset of the signal output by the converter. Enter an offset for a Current value of 0.00 V. You can use the slide bar to set a value or you can enter it in the text box. Offset is saved in the Calibration file.
Gain slide bar and text box	Adjusts the gain of the signal output by the converter. Use the Gain adjustment to set the full-scale range of the converter. You can use the slide bar to set a value or you can enter it in the text box. Gain is saved in the Calibration file.

Current Values

Control	Descriptions
Current value display	Displays the current raw (unconverted) and final (converted) values of the selected signal.

Adaptive Harmonic Cancellers

Adaptive Harmonic Cancellers

Channel
 Select Long

Training
 Reset ☐ Training
 ▶ Convergence rate
 ▶ Maximum freq

Tracking
 Reset ☐ Tracking
☒ Reset on run
 ▶ Convergence rate

Harmonics

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32

Authority
 ▶ Max authority

Access

Main controller panel **Operation** menu > **Controllers** > **Adaptive Harmonic**.

When to use the panel

The panel allows you to setup adaptive harmonic canceller to reduce or cancel spurious harmonics in the feedback when programming sine waves. This approach will inject input harmonics into the controller command waveform with just the right phase and amplitude to cancel the desired feedback harmonics.

Panel description

Adaptive Harmonic Cancellation (AHC) greatly reduces harmonic distortion of the response of a control system driven by a sinusoidal command. It measures the harmonic distortion directly and adapts in real time the cancelling waveform that it applies to the control system input.

Adaptive Harmonic Cancellers Reference

Background Information

Because cancellation occurs at the system output by means of a signal at the system input, the phase response of the system must be known. The “control system model”, an adaptive finite-impulse-response (FIR) filter, provides this information. Before cancellation is turned on, it must learn the system phase response by commanding the system with a random signal over the frequency range of operation.

During training, excite the system with a low level random signal using the Function Generator panel. The maximum frequency of the random signal should be entered into the Maximum Freq text box on the Adaptive Harmonic Cancellers panel.

Channel Selection Controls

Control	Descriptions
Channel Select Down Arrow	Displays the name of the selected channel. Select a channel from the drop-down list.
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

Model Setup Controls

Control	Descriptions
Reset button	This button is active when AHC is set to Training on main controller panel. Click the button to reset the coefficients to their initial state. Unless you are changing the test setup significantly, you do not need to reset coefficients.
Tracking indicator	Indicates green when the model coefficient adaptation process is tracking. Indicates white when the model coefficient adaptation process is not tracking. The conditions for tracking are: - AHC is set to Training on main controller panel. - On the Adaptive Harmonics Cancellers panel, the Model Convergence rate is nonzero. - The command waveform on the Function Generators panel is not constant at zero or any other level.
Maximum freq slide bar and text box	Set the maximum frequency up to which AHC will cancel harmonics. This value should be set to the maximum frequency used to train the model. AHC cannot cancel harmonics outside the range of frequencies in which it has been trained. If the command waveform is a sine sweep, when a harmonic exceeds the maximum frequency, cancellation of that harmonic is automatically disabled. Once the harmonic frequency is within range again, cancellation of that harmonic is automatically enabled.

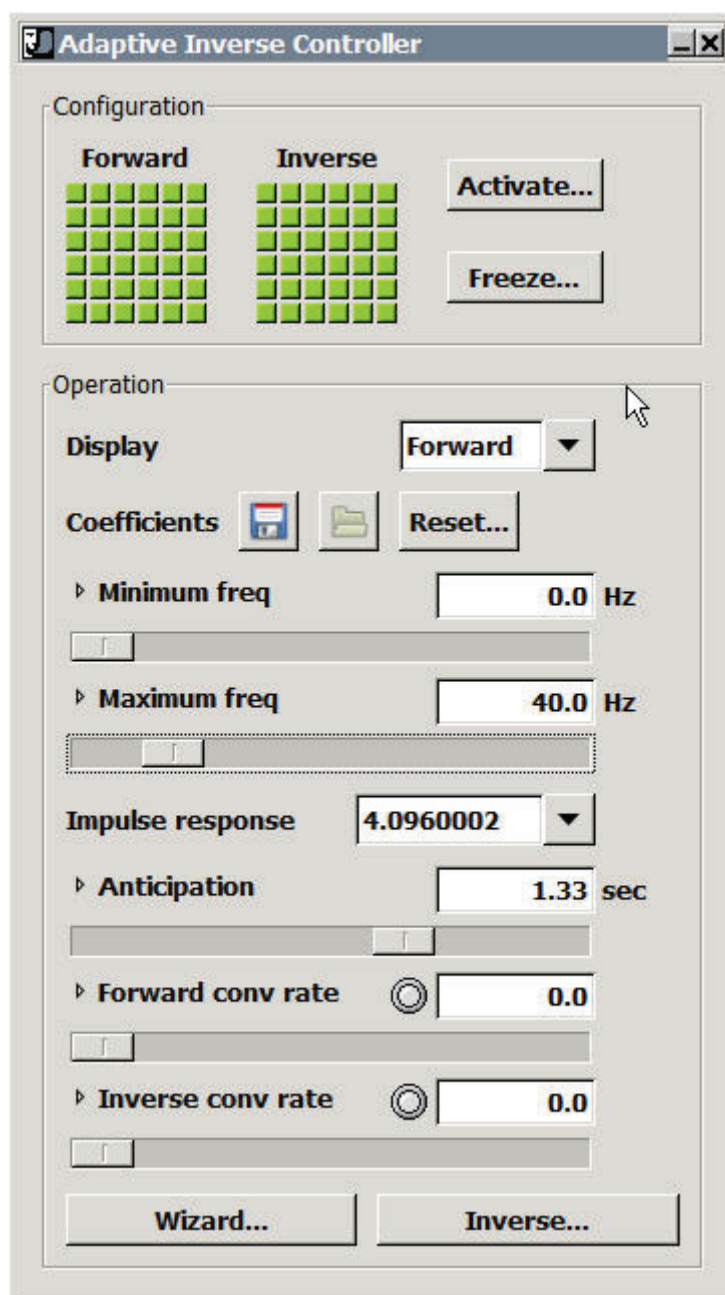
Control	Descriptions
Convergence rate slide bar and text box	Set the convergence rate of the model coefficient adaptation process. A value of zero means no adaptation. Higher values increase the speed of the adaptation process at a cost of decreased model accuracy. Too high of a value will cause the adaptation process to diverge, driving the coefficients to infinity. A convergence rate of less than one is usually (but not necessarily) safe.  Warning: Setting the convergence rate too high will cause system instability. Instability can result in uncontrolled actuator movement that can cause both equipment and vehicle damage. If instability occurs, immediately lower the convergence rate to 1.0 or less.

Canceller Setup Controls

Control	Descriptions
Reset button	This button is active when AHC is set to Disabled, Frozen, or Tracking on main controller panel. Click the button to reset the coefficients to their initial state. Unless you are changing the test setup significantly, you do not need to reset coefficients..
Tracking indicator	Displays the current state of the canceller coefficient adaptation process. The tracking indicator is green if coefficients are adapting, white if not. The conditions for tracking are: - AHC is set to Disabled, Frozen, or Tracking on main controller panel. - On the Adaptive Harmonics Cancellers panel, the Canceller - Convergence rate is nonzero. - The command waveform on the Function Generators panel is not constant at zero or any other level.
Reset on run Check Box	Check this box to reset adjustments to zero on Program Run.

Control	Descriptions
Convergence rate slide bar and text box	Set the convergence rate of the model coefficient adaptation process. A value of zero means no adaptation. Higher values increase the speed of the adaptation process at a cost of decreased model accuracy. Too high of a value will cause the adaptation process to diverge, driving the coefficients to infinity. A convergence rate of less than one is usually (but not necessarily) safe.  Warning: Setting the convergence rate too high will cause system instability. Instability can result in uncontrolled actuator movement that can cause both equipment and vehicle damage. If instability occurs, immediately lower the convergence rate to 1.0 or less.
Harmonics selection boxes	Select the harmonics to be canceled. Selected harmonics boxes are shown as dark gray. Do not use the first harmonic unless you are canceling cross-coupling disturbance on another channel.
Authority display	Displays the maximum amplitude of any canceling signal that AHC has added to the command. Not all of the signals will have this amplitude, only the largest one.
Max Authority text box	Set an upper limit of the amplitude of any canceling signal that AHC adds to the command. This is a safety feature designed to limit the amplitude of motion should AHC's adaptation process become unstable.

Adaptive Inverse Controller



Access

Main controller panel **Operation** menu > **Controllers** > **Adaptive Inverse**.

When to use the panel

Although adjustments are described in this section, in normal use you will need to make few adjustments.

Panel description

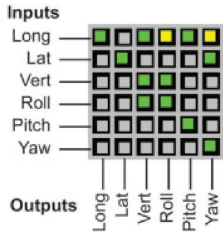
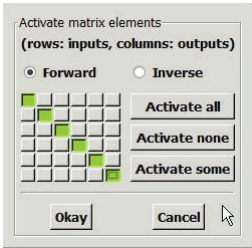
The Multichannel AIC panel allows you to set up an adaptive inverse controller.

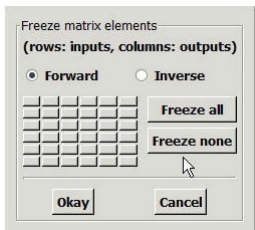
Adaptive Inverse Reference

Background Information

Adaptive Inverse Control (AIC) is a control compensation technique that augments a fixed-gain controller to correct for closed-loop gain and phase irregularities in order to improve control fidelity. In addition, in multichannel control systems with cross-coupled dynamics, it greatly reduces cross-coupling disturbances between control channels. It measures control system dynamics directly and modifies the control compensation accordingly in real time, making it possible to adapt to changing system dynamics.

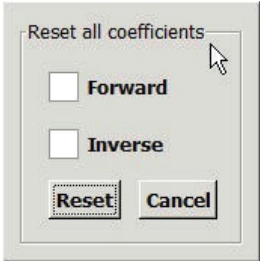
AIC Configuration Controls

Control	Descriptions
Activation Status Grids 	Displays the Forward and Inverse activation status of a transfer function matrix element by color: Green – The element is active and its coefficients are adapting. Yellow – The element is active but its coefficients are frozen (not adapting). Gray – The element is inactive (pruned out of the matrix). The location of an element within the grid is a function of the physical interaction that the element represents. System inputs are represented by rows and system outputs by columns. For example, the element in the sixth column of the second row is the element that represents the effect that Lat has on Yaw. This row-column interpretation applies to all grid indicators in this and other panels.
Left Arrow	Click Activate to open the appropriate Matrix Elements panel.  From the panel you can select specific elements that you want to activate or freeze. Use the Forward/Inverse radio buttons to toggle between the Forward or Inverse matrix. Click a specific location in the grid to select or de-select an individual element. You must click Okay for changes to the grid to be set. If you change between the Forward and Inverse matrix displays before you click Okay, changes to the current display are not kept.

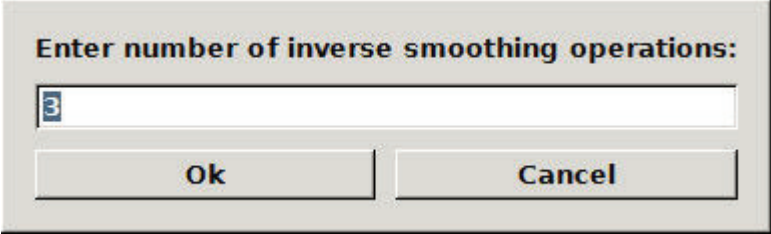
Control	Descriptions
Freeze	Click Freeze to open the appropriate Matrix Elements panel.  From the panel you can select specific elements that you want to activate or freeze. Use the Forward/Inverse radio buttons to toggle between the Forward or Inverse matrix. Click a specific location in the grid to select or de-select an individual element. You must click Okay for changes to the grid to be set. If you change between the Forward and Inverse matrix displays before you click Okay, changes to the current display are not kept.

AIC Operation Controls

Control	Descriptions
Display	Specify which transfer function matrix (Forward, Inverse, or Combined) is the focus of the Element Status list, the Element Status grid, the FRF Plotter grid, and the IRF Plotter grid.
Coefficients Save icon (Disk Icon)	Displays the current state of the canceller coefficient adaptation process. Saves the current values of the filter coefficients to a text file. Temporarily save coefficients obtained during the training process. This saves vales to a temporary file. The final settings should be saved in the settings file by clicking File menu > Save Settings.
Coefficients Open icon (Folder Icon)	Opens and restores the temporary file saved above. This is useful for backing up intermediate training results in case something goes wrong.

Control	Descriptions
Coefficients Reset (right side of window)	Resets the coefficients to zero for all elements in the transfer function matrix. The dialog box shown below appears in order to allow you to specify whether coefficients in the forward or inverse or both transfer function matrices are reset. 
Minimum freq and Maximum freq slide bars and text boxes	Set the frequency range in which AIC concentrates its effort. Signal energy outside this frequency range is discounted as noise. This is done by filtering the signals input to AIC with bandpass filters whose cut-in and cutoff frequencies are the minimum and maximum frequencies, respectively. The minimum frequency should be set equal to or greater than the cut-in frequency.
Impulse response text box and down arrow button	Set the impulse response length of all AIC filter elements. Click the down arrow button to display a list of response choices. Select the desired response and click the check mark button to accept the selection and close the list, or click the X button to decline the selection and close the list. Make sure the impulse response length is long enough for training the model. If necessary, the impulse response can be shortened later, after the forward model has been trained.
Anticipation slide bar and text box	Set the anticipation delay that allows AIC to create a causal compensator.
Forward conv rate and Inverse conv rate slide bars and text boxes	Set the convergence rate of the coefficient adaptation process. A value of zero means no adaptation, Higher values increase the speed of the adaptation process at a cost of decreased transfer function accuracy. Too high of a value will cause the adaptation process to diverge, driving the coefficients to infinity. A convergence rate of less than one is usually (but not necessarily) safe.  Warning: Setting the convergence rate too high will cause system instability. Instability can result in uncontrolled actuator movement that can cause both equipment and vehicle damage. If instability occurs, immediately lower the convergence rate to 1.0 or less.

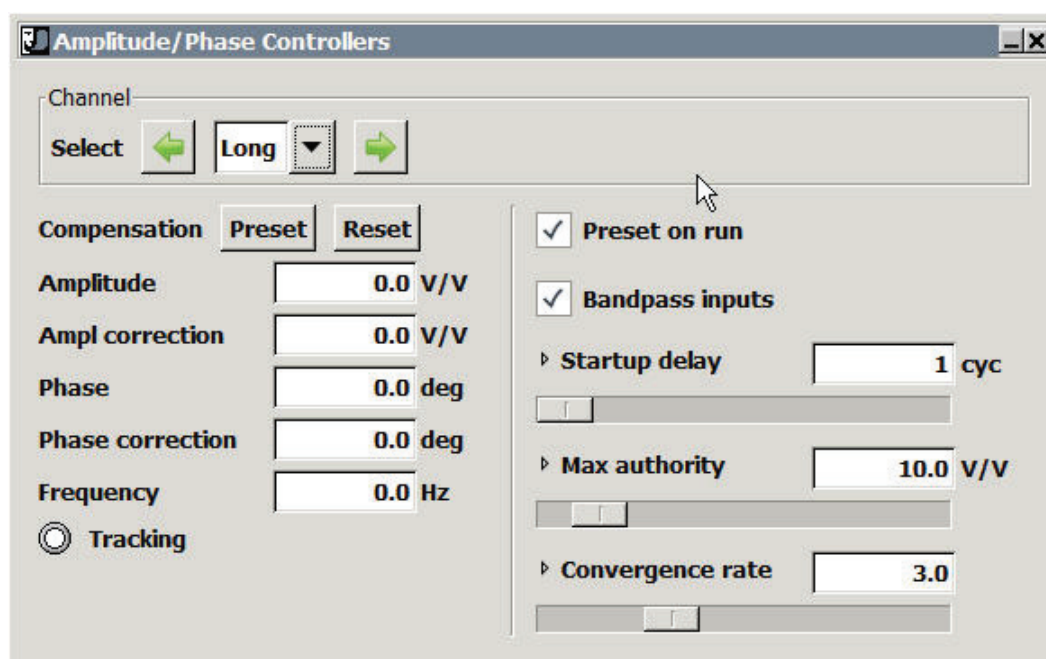
Control	Descriptions
Forward conv rate and Inverse conv rate indicators	Displays the current state of the coefficient adaptation process. The tracking indicator is green if any active transfer function element is adapting. If no transfer function elements are adapting, the indicator is white. The conditions for tracking are: • AIC is set to Training or Tracking on the main controller panel. • The convergence rate is nonzero. • The master span is nonzero (that is, the Run button on the main controller panel has been selected yet). The state of the Run button on the Function Generator panel has no effect on tracking. • The feedback signal level is above the noise threshold level.
Wizard button	 The training wizard will exercise each table axis using user-specified parameters. As a result of the training exercise, the training wizard will calculate coefficients for the forward model.

Control	Descriptions
Inverse button	Calculate the inverse transfer function matrix instantly rather than adapting incrementally over time. When you select the Inverse button the following dialog window is displayed:  Type a value for the number of times the smoothing window will be applied to the system inverse. Smoothing reduces Gibbs oscillation in the inverse. Gibbs oscillation occurs when frequency bins are zeroed per the frequency range specified by the minimum and maximum frequency slider bars. A value of zero corresponds to no smoothing.

The conditions for adaptation (tracking) to occur are:

- AIC mode is set to Training or Tracking.
- The convergence rate is nonzero.
- The master span is nonzero (Run button on the main controller panel has been pressed). The local span (Run button on Function Generator panel) has no effect on tracking.
- The feedback signal level is above the noise threshold level, which is determined by pressing Noise Level Set button.

Amplitude/Phase Controllers



Access

Main controller panel **Operation** menu > **Controllers** > **Amplitude/Phase**.

When to use the panel

Use this panel only when the program (or command) signal is a sine wave. This controller minimizes the differences in amplitude and phase between the command and feedback.

Panel description

This panel allows you set up an amplitude/phase controller to correct feedback amplitude and phase errors when programming sine waveforms.

Amplitude/Phase Controllers Reference

Background Information

Amplitude/Phase Control (APC) is a control compensation technique that augments a fixed-gain controller to correct for closed-loop amplitude and phase irregularities in order to improve control fidelity. It measures control system dynamics directly and modifies the control compensation accordingly in real time, making it possible to adapt to changing system dynamics.

Channel Selection Controls

Control	Descriptions
text box	Displays the name of the selected channel.
Down Arrow	Use the down arrow to select a channel from the drop-down list
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

APC Setup Controls

Control	Descriptions
Compensation Preset button	Presets the Ampl correction to 1 and the Phase correction to 0.
Compensation Reset button	Sets both the Ampl correction and the Phase correction to zero.
Amplitude text box	Displays the current amplitude.
Ampl correction text box	Displays the current amplitude correction being applied to the command. Also allows values to be entered so that APC can be set to correction values other than that provided by the Compensation Preset and Reset buttons.
Phase text box	Displays the current phase
Phase correction text box	Displays the current phase correction being applied to the command. Also allows values to be entered so that APC can be set to correction values other than that provided by the Compensation Preset and Reset buttons.
Frequency text box	Displays the current frequency of the command.

Control	Descriptions
Tracking indicator	Displays the current state of the coefficient adaptation process. The tracking indicator is green if coefficients are adapting, white if not. The conditions for tracking are: • APC is set to Tracking on the main controller panel. • The Convergence rate on the Amplitude/Phase Controllers panel is nonzero. • The command waveform on the Function Generators panel is not constant at zero or any other level. • The number of sine cycles since the start of the command waveform is greater than the number of cycles of startup delay.
Preset on run check box	Check to perform a Preset upon Program Run
Bandpass inputs check box	Specify that APC's input signals are to be bandpass filtered to remove harmonic noise. This is a desirable thing except in certain rarely encountered situations that require the maximum possible adaptation speed, making the slight slowdown due to the delay of the filters unacceptable. It is recommended that you leave this checked.
Startup delay slide bar and text box	Set the number of sine cycles after the start of the command that must elapse before adaptation can begin. This prevents adaptation during the transition from a stopped to a running state until transients have died out somewhat.
Max authority slide bar and text box	Set the maximum amplitude correction that APC is allowed to apply to the command. This is a safety feature designed to limit the amplitude of motion should APC's adaptation process become unstable.
Convergence rate slide bar and text box	A value of zero means no adaptation. Higher values increase the speed of the adaptation process at a cost of increased susceptibility to noise. The convergence rate should be no more than unity otherwise the potential for instability exists.  Warning: Setting the convergence rate too high will cause system instability. Instability can result in uncontrolled actuator movement that can cause both equipment and vehicle damage. If instability occurs, immediately lower the convergence rate to 1.0 or less.

User Analog Inputs

The screenshot shows the 'User Analog Inputs' panel with the following sections:

- Channel:** A 'Select' button with a left arrow, a dropdown menu showing 'User A/D #1', a right arrow button, and an 'At:' label with a value of '01/'.
- Calibration:**
 - Offset:** A slider bar and a text box showing '0.0 Volts'.
 - Gain:** A slider bar and a text box showing '1.0 V/V'.
- Engineering Units:**
 - Units name:** A text box showing 'Volts'.
 - Mapping:** '-10 volts =' followed by a text box showing '-10.0 Volts', and '+10 volts =' followed by a text box showing '10.0 Volts'.
- Current value:**
 - Raw:** A text box showing '0.0 Volts'.
 - Engineering:** A text box showing '0.0 Volts'.

Access

Main controller panel **Configuration** menu > **User Analog Inputs**.

When to use the panel

Use the Analog Inputs panel to select a device connected to one of the analog inputs of the console and calibrate the selected device to the control electronics and assign engineering units to the signal.

Panel description

The Analog Inputs panel allows you to select a user supplied device and calibrate it to the control electronics.

Analog Inputs Reference

Channel Selection Controls

Control	Descriptions
text box	Displays the name of the selected channel.
Down Arrow	Use the down arrow to select a channel from the drop-down list
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

Signal Adjustment Controls

Control	Descriptions
Calibration Offset slide bar and text box	Adjusts the offset of the signal output by the converter. Enter an offset for a Current value of 0.00 V. Use the slide bar to set a value or enter it in the text box. Offset is saved in the Calibration file.
Calibration Gain slide bar and text box	Adjusts the gain of the signal output by the converter. Use the Gain adjustment to set the full-scale range of the converter. You can use the slide bar to set a value or you can enter it in the text box. Gain is saved in the Calibration file.
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

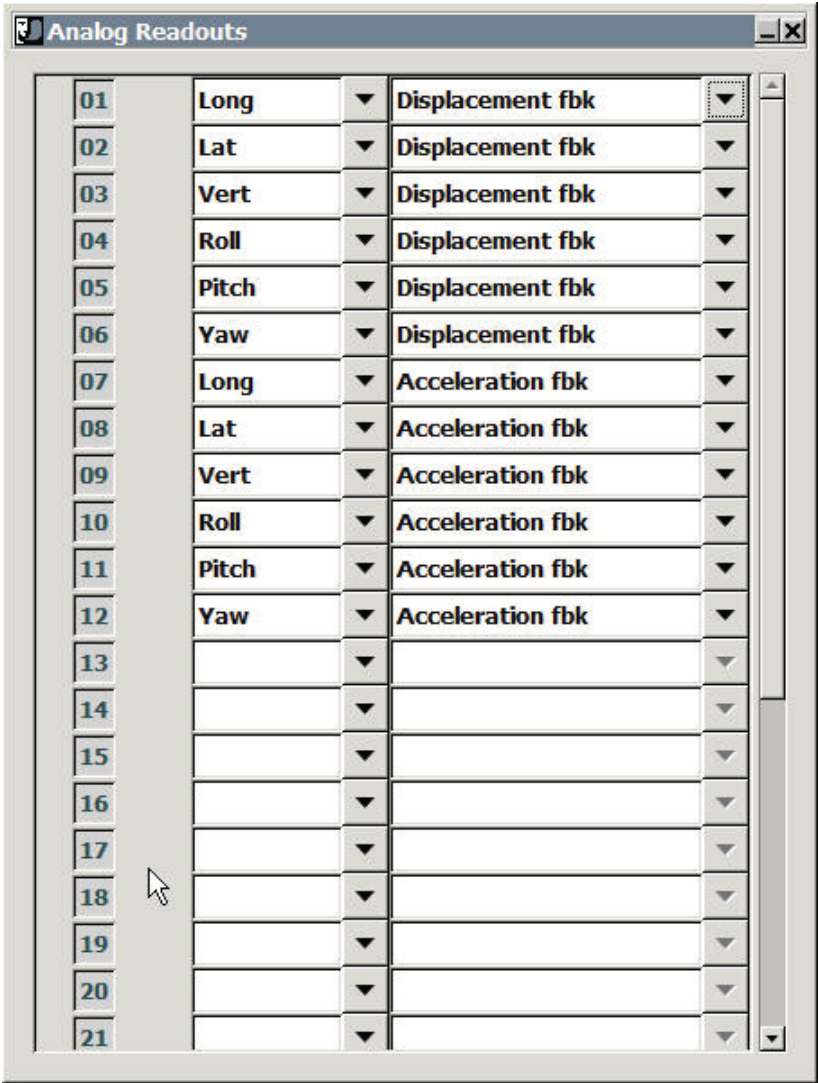
Engineering Units Controls

Control	Descriptions
Units name text box	Sets/Displays the engineering units name.
+/- 10 Volts text box	Correlates the full scale $\pm$ volts to full scale values for the respective engineering units. You can specify the value and the units.

Current Values

Control	Descriptions
Raw	Displays the current raw (unconverted) value of the selected signal.
Engineering	Displays the final (converted) value of the selected signal.

Analog Readouts



Access

Main controller panel **Display** menu > **Analog Readouts**.

When to use the panel

Use this panel when you need to set up an analog readout device (D/A Converter).

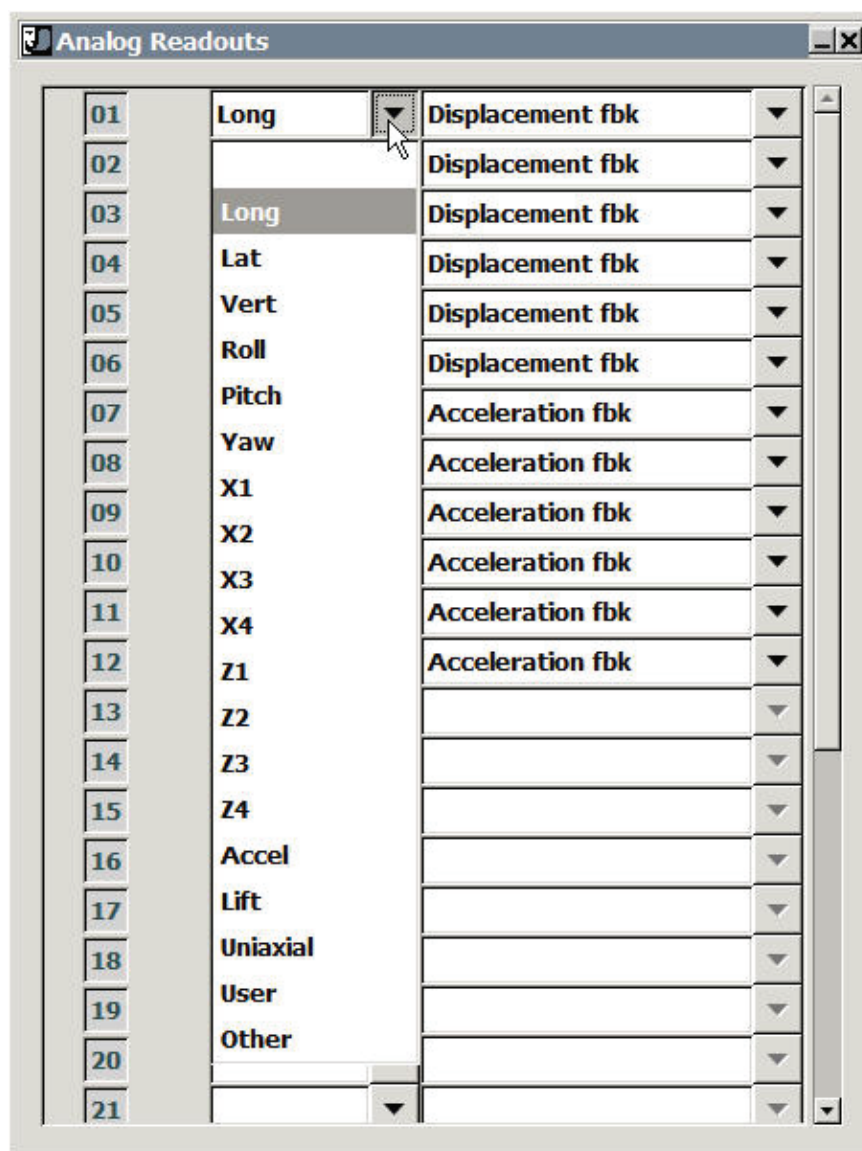
Panel description

The Analog Readouts panel allows you to select signals to be output to an analog readout device.

469D Two-Tier Signal Selection - Group Selection

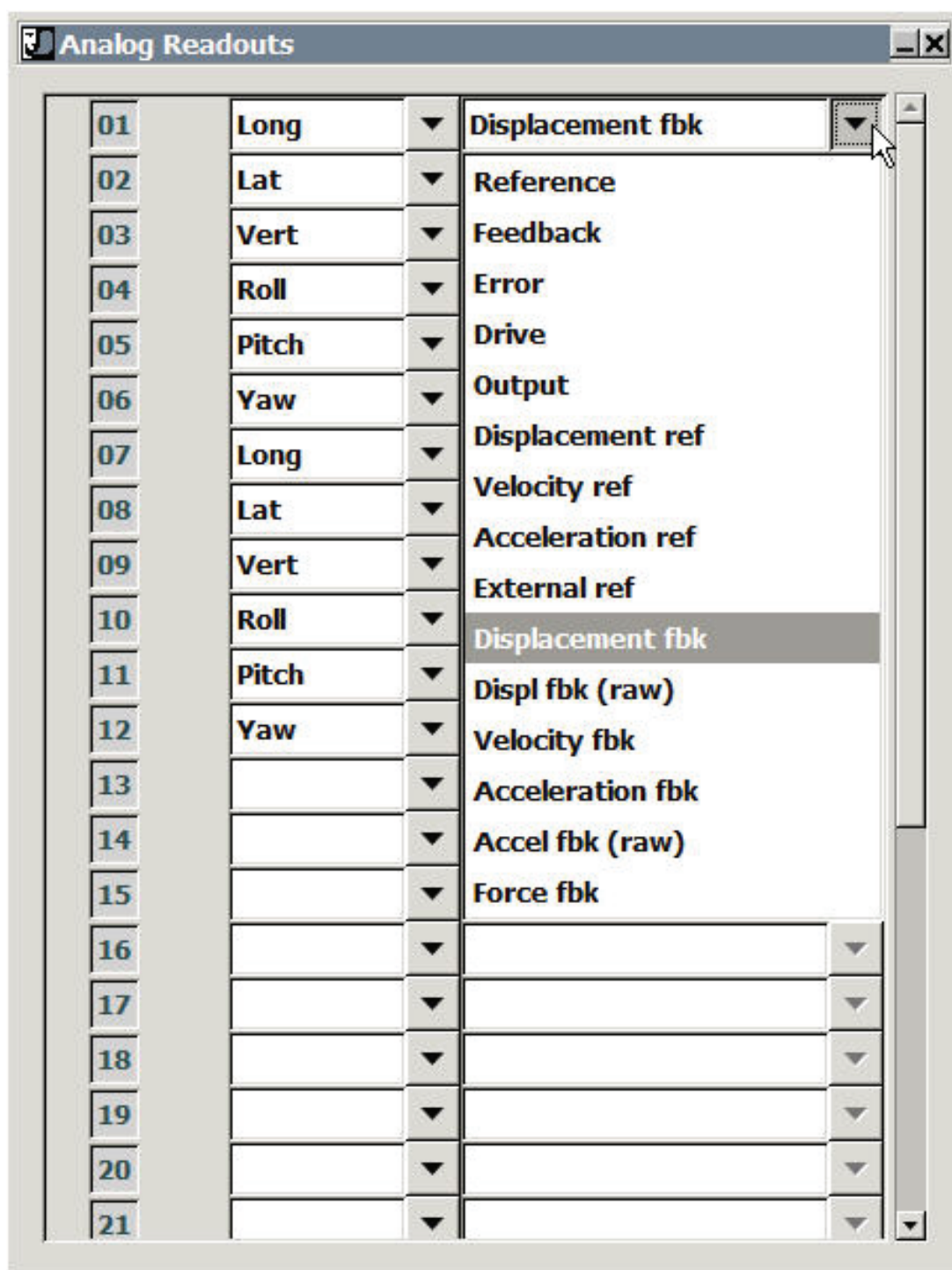
The 469D now uses a two-tier signal selection system to shorten the very long display menus that used to be associated with all the available channels. Now, the left selection is for the general group of signals that are desired to select. This menu has Degrees-of-Freedom, Actuators, Accelerometers, and a few special groups.

Next to any Analog Readout channel on the left, click on the left text box or the down arrow for the left text box. Then you will see the menu shown below. Select the desired group for the desired Analog Output signal. Next, click on the right text box or the down arrow for the right text box to select the actual channel from the group you previously selected.

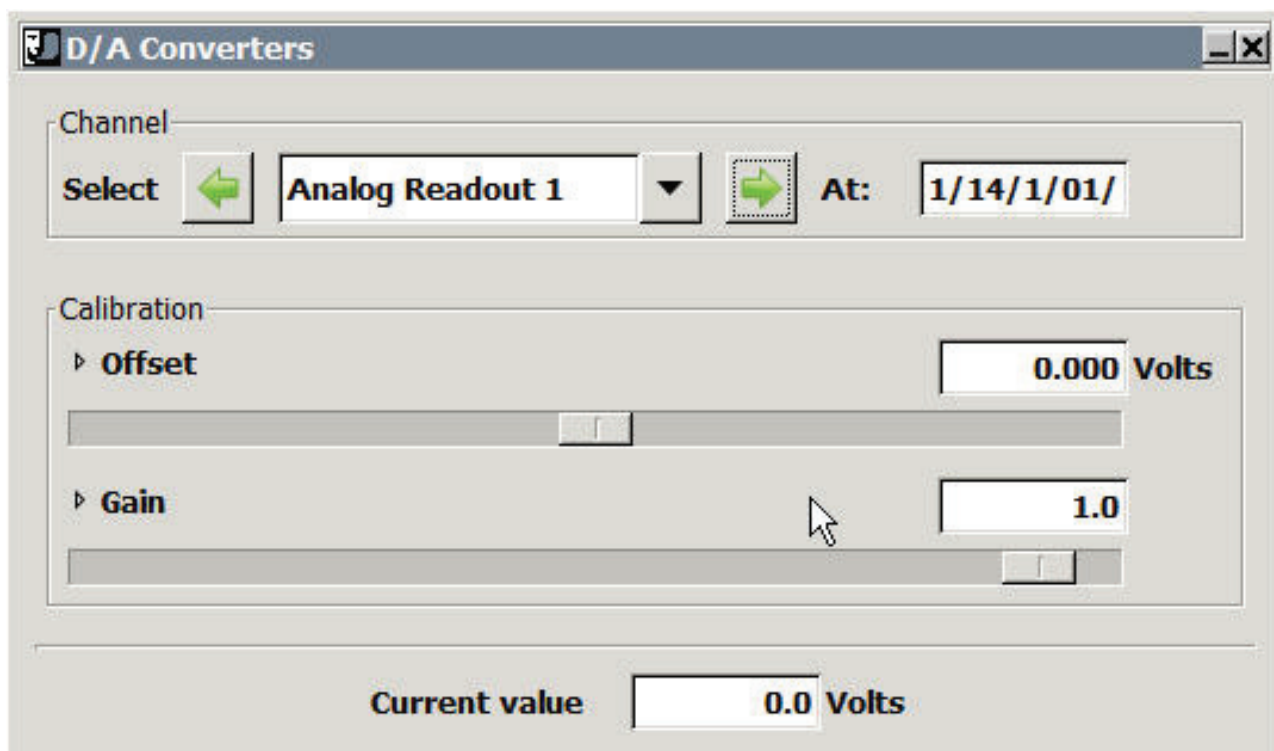


469D Two-Tier Signal Selection - Channel from Group Selection

Once the Group has been selected as shown above, then clicking the right text box or the down arrow for the right text box will display the channels available in the selected group. The actual desired channel can then be selected to be output on the referenced Analog Output channel.



D/A Converters



Access

Main controller panel **Calibration** menu > **D/A Converters**.

When to use the panel

Use this panel to periodically calibrate the converters in the system to ensure that the input and output voltages are balanced.

Panel description

The D/A Converters panel allows you to adjust the offset and gain for a selected D/A converter.

For More Information

D/A Converter Calibration (p. 196)

D/A Converters Reference

Channel Selection Controls

Control	Descriptions
text box	Displays the name of the selected channel.
Down Arrow	Use the down arrow to select a channel from the drop-down list
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

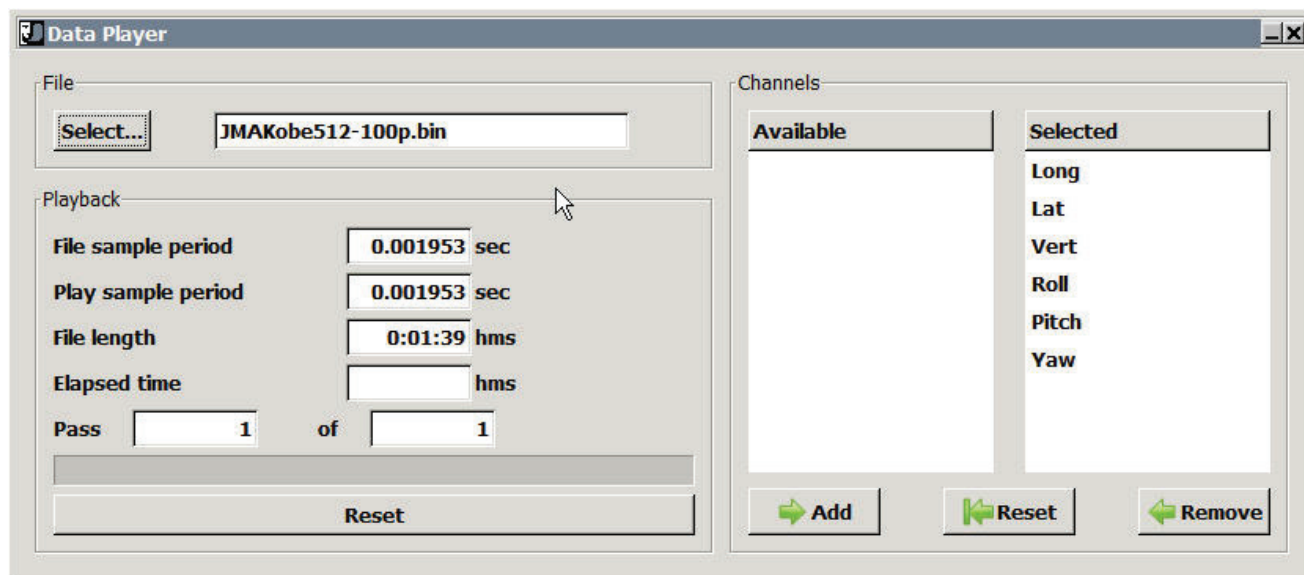
Signal Adjustment Controls

Control	Descriptions
Calibration Offset slide bar and text box	Adjusts the offset of the signal output by the converter. Enter an offset for a Current value of 0.00 V. You can use the slide bar to set a value or you can enter it in the text box. Offset is saved in the Calibration file.
Calibration Gain slide bar and text box	Adjusts the gain of the signal output by the converter. Use the Gain adjustment to set the full-scale range of the converter. You can use the slide bar to set a value or you can enter it in the text box. Gain is saved in the Calibration file.

Current Value

Control	Descriptions
Current value display box	Displays the current value of the selected signal.

Data Player



Access

Main controller panel **Operation** menu > **Data Player**.

When to use the panel

Use the Data Player panel to list the data channels and choose a file to be played out as the program source when the Data Player selection is enabled as the program source on the main controller panel.

Panel description

The Data Player panel allows you to list the data channels and select a time history file for the program source.

First choose the desired channels and then select the file. It is very important that the number of channels and order of channels selected match the number and order in the selected file.



Important:

Always keep the natural order of channels as they are listed by the software in the Available list.

Playout file information

When using a file for the playout source, the file must be in MTS binary format. The Translate text to binary option under the File menu on the main controller panel will translate an ASCII text file to MTS binary format.

The text file to be translated must be in the following format:

The first value in the text file must be the time period between samples, followed by the data in engineering units arranged in a single column.

The translator will prompt you for the ASCII text file. The converted file will be given the same name as the text filename but will have a .bin extension.

When a file is played out, the system does not automatically ramp up at the beginning of the file. It is assumed the file will contain this ramping data if it is required. The span will jump to 100% at the beginning of the file. The only exception to this is in the middle of the file, if the program is put into Stop mode, then the system will ramp down to 0% and ramp back up to 100% when it starts up again (Run mode enabled).

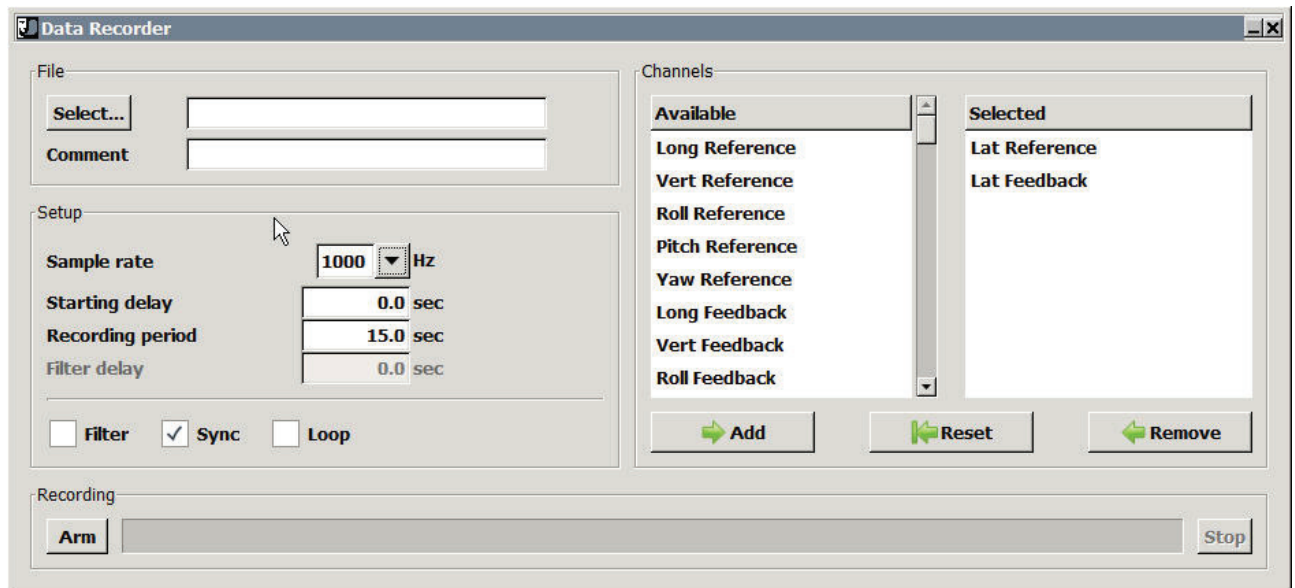
You can scale the playout file by playing it out at a different sample rate than the recorded rate. The Play Sample Period input allows the user to input a playout sample period different from the recorded sample period.

Data Player Reference

Data Player Controls

Control	Descriptions
File Select button and text box	Selects the file which contains the playout data. The file must be in MTS binary format. The Translate text to binary option under the File menu on the main panel can be used to convert an ascii text file to MTS Binary format.
File sample period text box	Displays the sample period of the recorded file.
Play Sample Period text box	Input the desired sample period for playing out the recorded file. This value defaults to the File sample period value.
File Length text box	Displays the playout file length.
Elapsed Time text box	Displays the amount of time that the file has been played out.
Pass _ of _ text boxes	Input the number of times to play the selected file in the second text box. The current pass is the number in the first text box.
File Reset button	When selected, resets Elapsed time counter to zero, the Pass counter to one, and the playout file to the beginning.
Channels list of Available and Selected	Select the channels to be played out. The Available box shows the available channels. The Selected box shows the selected channels. Use the Add and Remove buttons to move the channels between the list of available channels and the list of selected channels. . Make sure the number of channels selected and the order of these selected channels matches the number and order in the selected playout file.
Channels Reset button	Select the Reset button to reset the playout file to the beginning.

Data Recorder



Access

Main controller panel **Operation** menu > **Data Recorder**.

When to use the panel

Use the Data Recorder panel to record data from selected channels and store the data in a file. The data in the file will be in MTS binary format. This data file can be converted to an ascii text format file by choosing the **Translate binary to text** option under the **File** menu option.

Panel description

The Data Recorder panel allows you to:

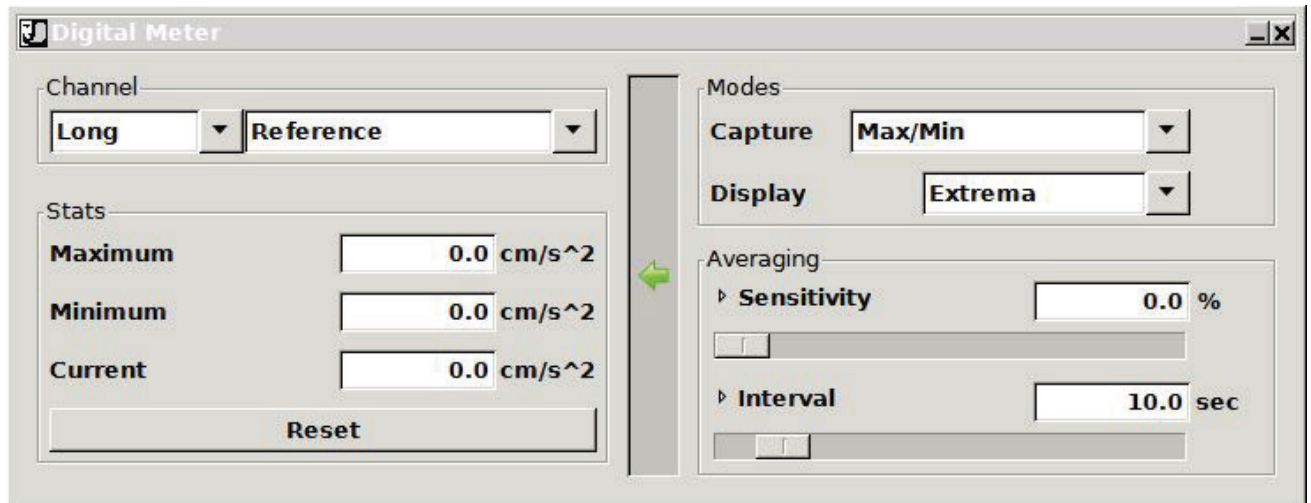
- Record data from selected channels and store in a user selected file.
- Set the sample rate, starting delay, and recording period.
- Choose whether to start recording data when you click the Start button, or to synchronize the data recording with the Run button on the main panel.

Data Recorder Reference

Data Recorder Controls

Control	Descriptions
File Select... button and text box	Input the filename where the recorded data is to be stored.
File Comment text box	Use this text box to input a comment to be stored with the data. This comment box can be used to input information to identify the particular acquisition such as a Serial ID number, etc.
Sample Rate pull down menu	Click the down button to display a list of sample rates. Select the desired sample rate and click the check mark button to accept the selection and close the list, or click the X button to decline the selection and close the list.
Starting delay text box	Input the time delay between when the Start (or Run) button is pressed and data recording begins.
Recording period text box	Input the period of time that the data recorder should run.
Filter delay and Filter check box	When the Filter check box is checked, a digital anti-aliasing filter is added to each selected signal. The software will select an appropriate filter type dependent on the sample rate. The frequency response of this AA filter can be viewed using the FRF panel. The AA filter will add a delay which displays in the Filter delay text box. You may need to adjust the starting delay and/or extend the recording period, accordingly.
Sync check box	If checked, data recorder will start when the Run button on the main panel is pressed (the Start button on the Data Recorder panel must also be on). If not checked, the data recorder will start as soon as you click the Start button.
Loop check box	When checked, will record over and over again.
Channels list of Available and Selected	Select the signals to be recorded. The Available box shows the available signals. The Selected box shows the selected signals. Use the Add and Remove buttons to move the channels between the list of available channels and the list of selected channels. . Make sure the number of channels selected and the order of these selected channels matches the number and order in the selected playout file.
Channels Reset button	Select the Reset button to clear the Selected box of all signals.
Start/ Arm button	Starts data recording. If acquisition is synchronized, the Arm button grays out after you click on it. Acquisition is then queued to start with the Main Panel Run button.
Progress bar	After data acquisition starts, the progress bar grows from left to right, showing how much data has been recorded (0 to 100%).
Stop button	Stops data recording.

Digital Meters



Access

Main controller panel **Display** menu > **Digital Meters**.

When to use the panel

Use these panels to read the current value of the selected signal.

Panel description

A Digital Meter panel allows you to monitor a signal.

Background information

The digital meters provide the following signal monitoring modes:

- Max/min

Monitors the maximum and minimum signal values since the display session began or the reset button was last selected. Signal values are displayed in the Maximum and Minimum text boxes.

- Peak/valley (banded)

Similar to Max/min mode, except the Reset button is automatically pressed after the signal reverses by an amount determined by the sensitivity adjustment. Thus changes in signal peaks and valleys can be continuously monitored. This selection can be used for cyclic and non-cyclic waveforms.

- Peak/valley (timed)

Similar to Max/min mode, except the Reset button is automatically pressed after the signal reverses a quarter of a cycle as determined by the signal's current frequency. Thus changes in signal peaks and valleys can be continuously monitored. This selection can be used only for cyclic waveforms.

- RMS/mean

Monitors the RMS and mean of a signal since the display session began or the Reset button was last selected. The amount of signal averaging can be adjusted using the Averaging Interval slide bar or text box. This selection can be used for cyclic and non-cyclic waveforms.

Digital Meters Reference

Signal Selection Controls

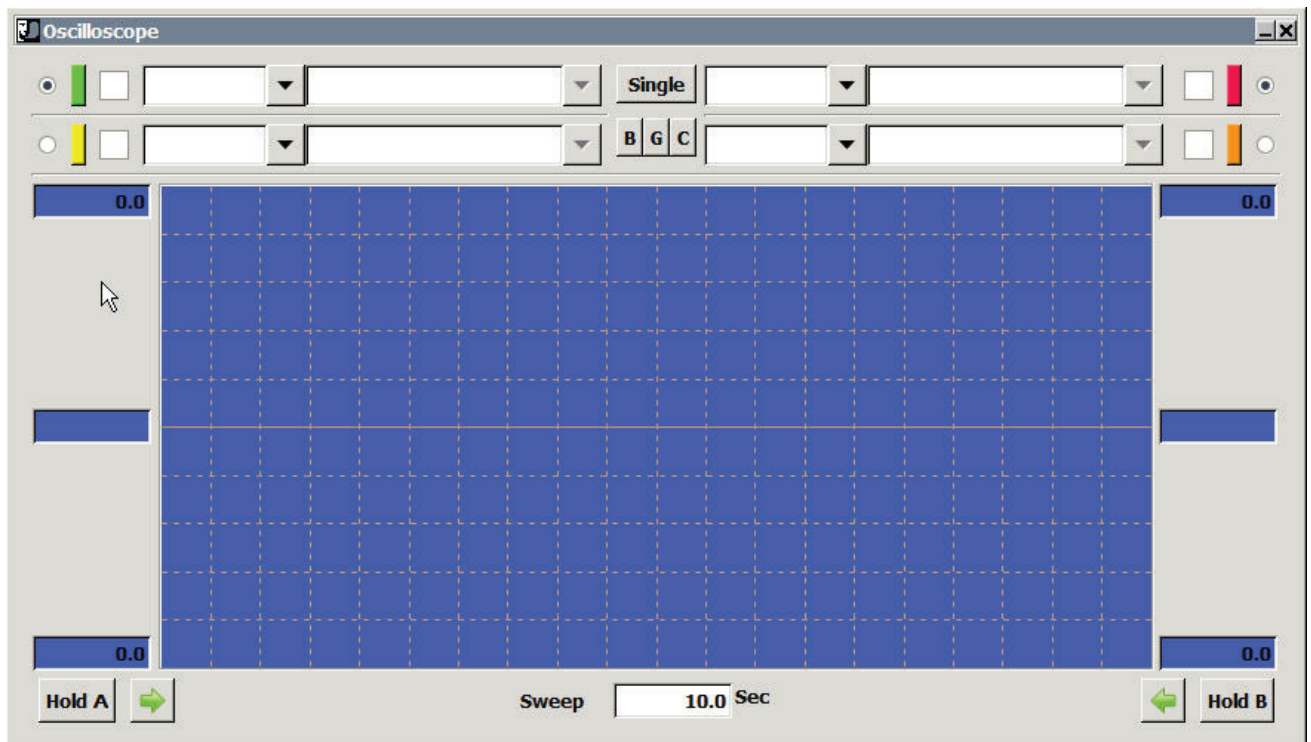
Control	Descriptions
Channel selection text boxes	Displays the group and channel names of the selected signal. Select the signal group from the down list of the left text box. The group menu is displayed and the group can then be selected. After group selection, select the channel from the drop-down list in the right text box.

Meter Setup Controls

Control	Descriptions
Maximum or Peak or RMS or Amplitude text box	Displays the Maximum value for the signal when Capture Mode is Max/Min and Display Mode is Extrema. Displays the Peak value for the signal when Capture Mode is Peak/valley and Display Mode is Extrema. Displays the RMS value for the signal when Capture Mode is RMS/Mean (Display Mode is grayed out). Displays the Amplitude of the signal when Capture Mode is Max/Min or Peak/valley and Display Mode is Amplitude/Base.
Minimum or Valley or Mean or Base text box	Displays the Minimum value for the signal when Capture Mode is Max/Min and Display Mode is Extrema. Displays the Valley value for the signal when Capture Mode is Peak/valley and Display Mode is Extrema. Displays the Mean value for the signal when Capture Mode is RMS/Mean. (Display Mode is grayed out). Displays the Base value of the signal when Capture Mode is Max/Minor Peak/valley and Display Mode is Amplitude/Base.
Current text box	Displays the current value of the selected signal.
Reset button	Clears the Minimum and Maximum text boxes.
Arrow button	Click to open/close the right side of the display panel, which contains the more options.

Control	Descriptions
Capture Mode drop-down list	Use the down-arrow to select a monitoring mode. The choices are: Max/min: displays the maximum and minimum values of the signal in the Maximum and Minimum boxes. Peak/valley (banded): displays the peak and valley values of a signal determined by reversal outside a specified sensitivity band. Peak/valley (timed): displays the peak and valley values of a signal determined by reversal within an amount of time determined by the signal frequency. RMS/Mean: displays the RMS and mean values of a signal averaged over a specified sliding time interval.
Display mode drop-down list	Use the down-arrow to select a display mode. The choices are: Extrema: displays min/max or peak/valley values. See Capture mode above. Amplitude/Base: is an alternative form of displaying extrema, where: $\text{Amplitude} = \text{max} - \text{min} / 2$ and $\text{Base} = \text{max} + \text{min} / 2$.  Note: Not available in RMS/mean capture mode
Averaging Sensitivity slide bar and text box	For peak/valley detection, sets the sensitivity of detection to a percentage of full-scale band. You can use the slide bar to set a value or you can enter it in the text box.
Averaging Interval slide bar and text box	For RMS/Mean capture mode, sets the averaging interval. You can use the slide bar to set a value or you can enter it in the text box.

4-Channel Digital Oscilloscope



Access

Main controller panel **Display** menu > **4-Channel Scope** or **Oscilloscope**.

When to use the panel

Use this panel at any time to monitor system signals.

Panel description

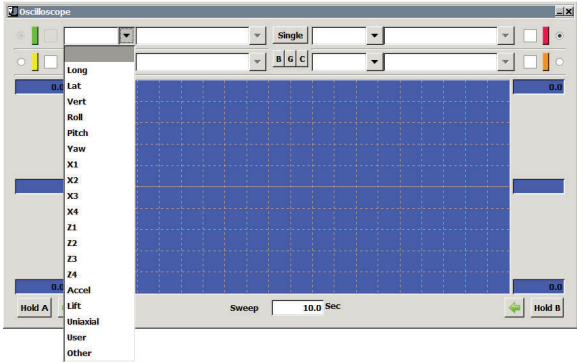
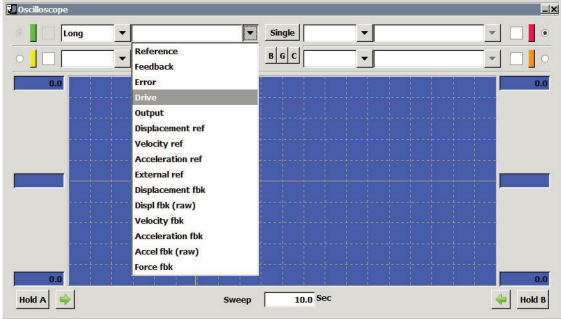
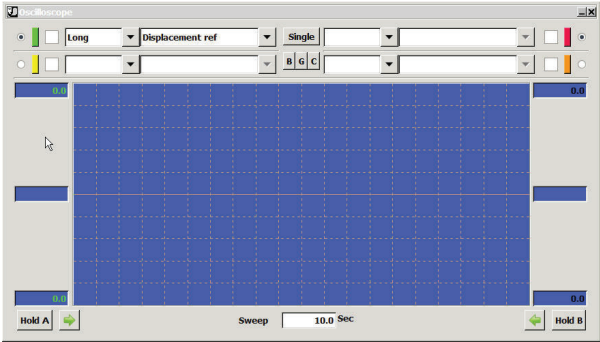
The Oscilloscope panel shows oscilloscope traces for one to four signals. This panel allows you to perform the following tasks:

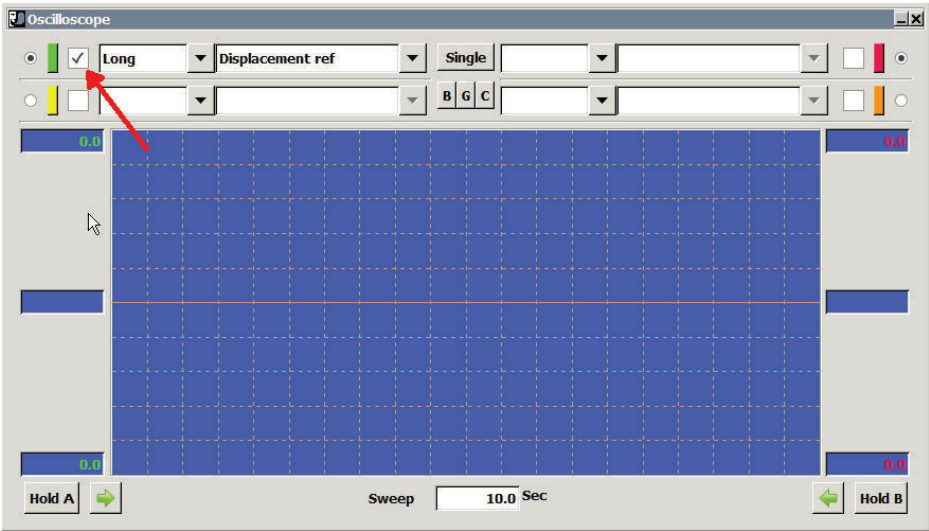
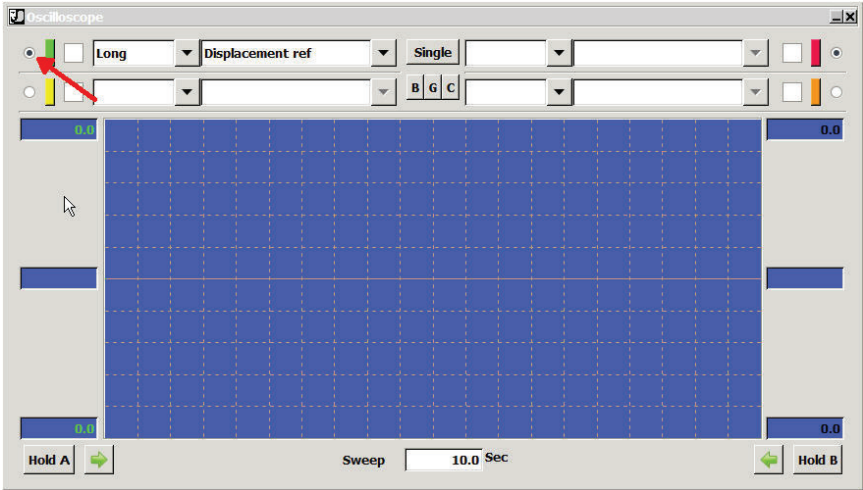
- Select one to four signals to be monitored.
- Set the sweep period for the display of the selected signals.
- Select the scaling parameters of the selected signals.
- Select the colors for the signals and display for the monitor.
- Use the cursor to measure signal values at a specific time or specified interval time on the monitor.

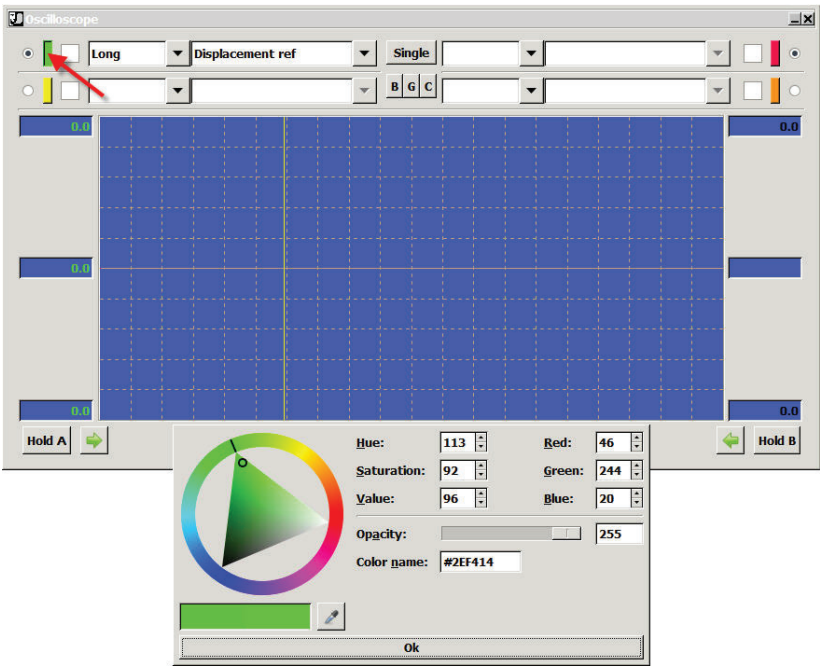
The Oscilloscope panel can be re-sized by dragging the sides or corners to a new size.

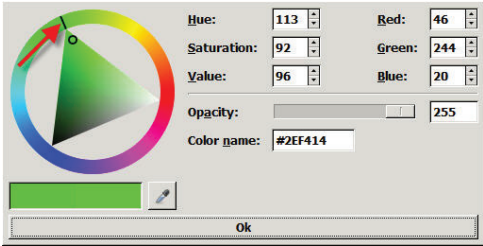
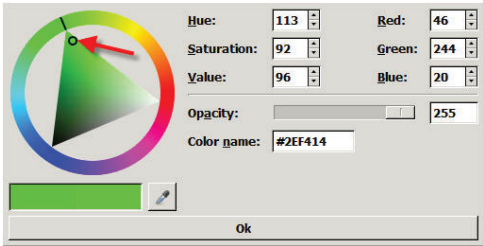
4-Channel Digital Oscilloscope Reference

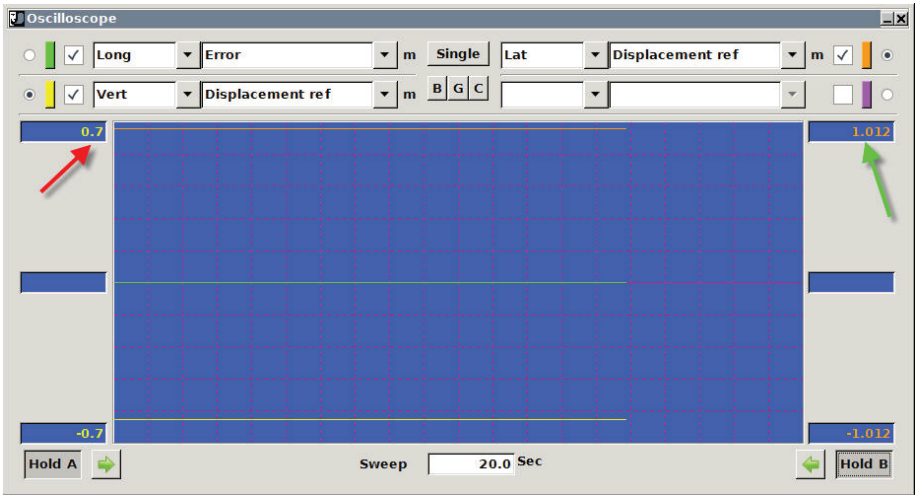
Signal Selection Controls

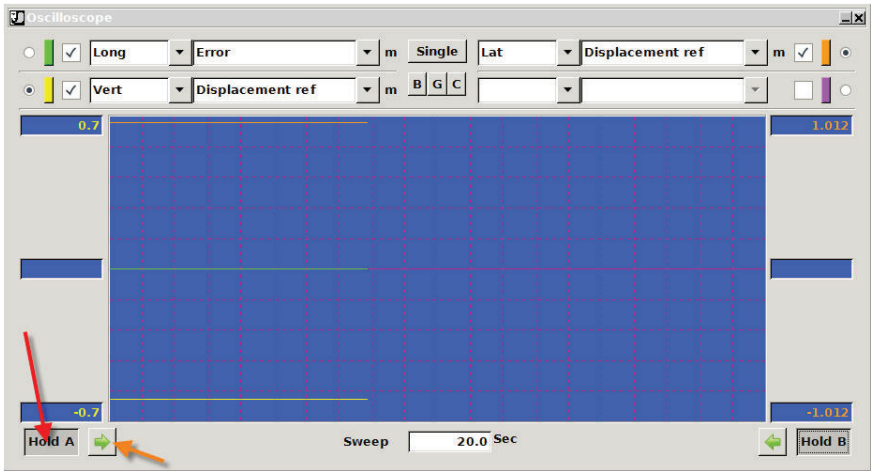
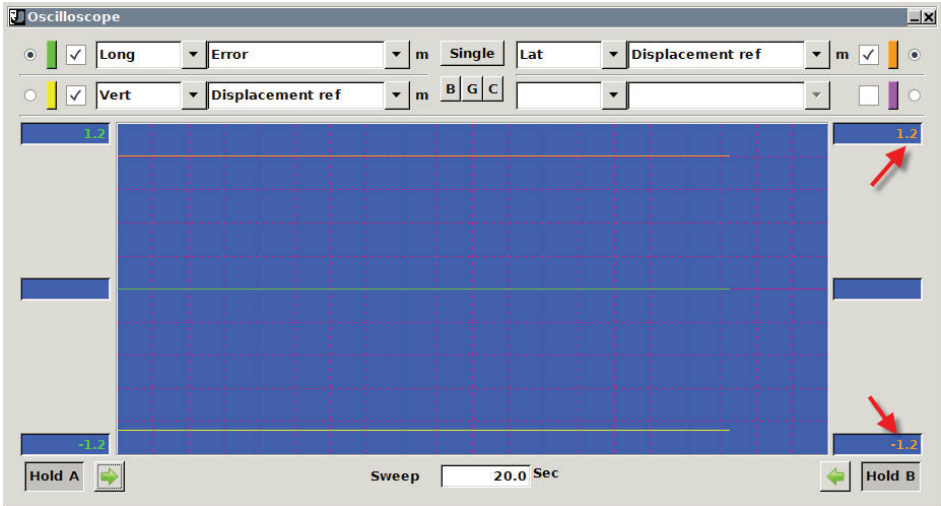
Control	Descriptions
Group and channel text boxes	Displays the group and channel names of the selected signal. Select a signal from a 2-tiered set of signals. First, select the signal group by clicking the left text box or the down arrow on the left text box. For example:  The group menu is displayed and the group can then be selected. After group selection, clicking on the right text box or the down arrow on the right text box will show the actual channel menu where the channel selection can finally be made. For example:  The desired channel displays on the 4-Channel Oscilloscope. For example: 

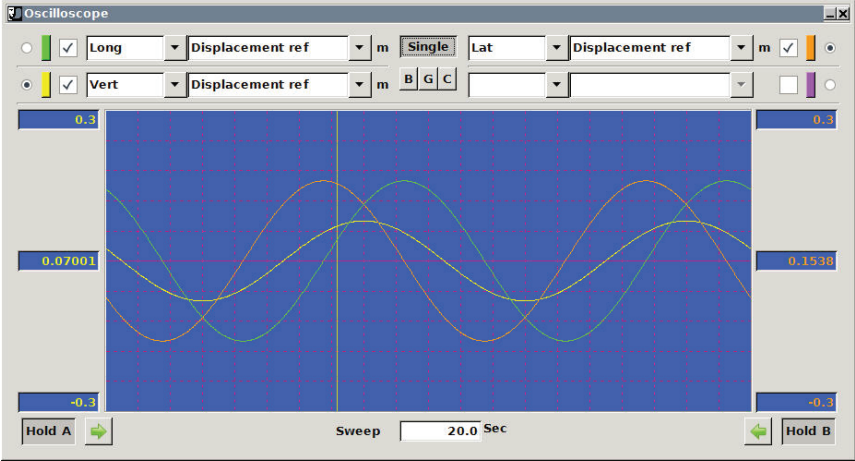
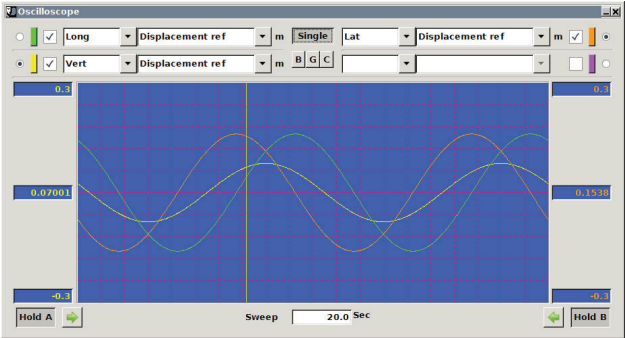
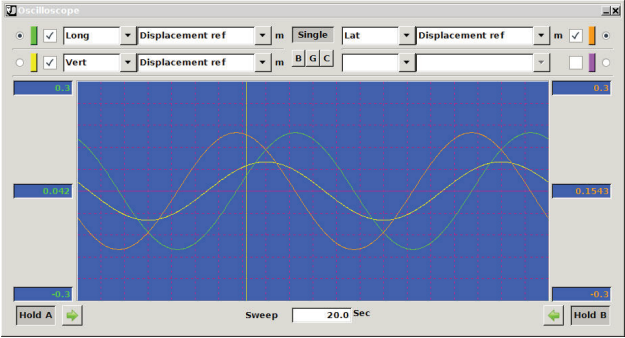
Control	Descriptions
Channel Active text box	 Checking this box shall display this channel. Not all of the channels that have names need to be displayed. Only those channels with the Display Active box checked are actually displayed on the Oscilloscope.
Scale Active radio button	 Selecting the Scale Active radio button associated with a channel activates the scope to display the upper and lower scale numbers in the scope display area text boxes in the corresponding color chosen for the channel.

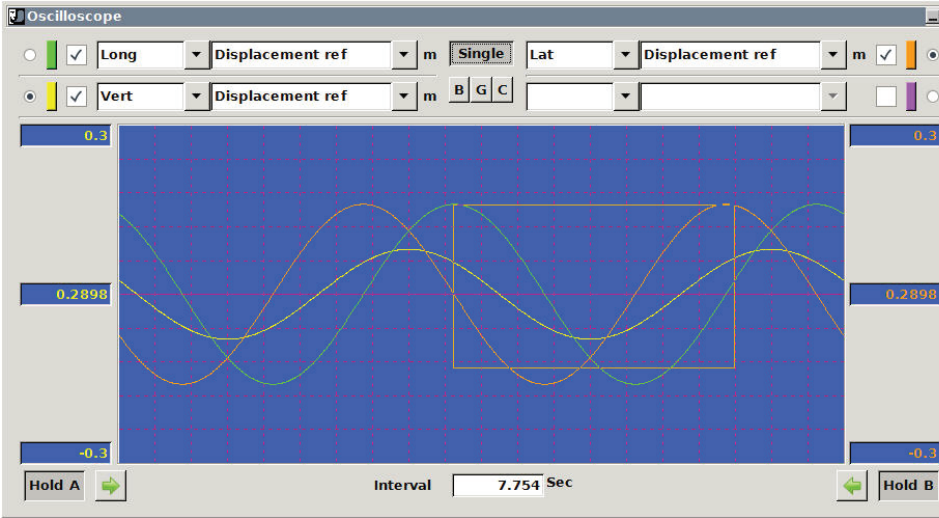
Control	Descriptions
Channel Color button	 Selecting the channel color button displays the color selection panel for the associated channel. The color selection panel contains a color wheel and text boxes, either of which can be used to change the color of the display channel trace.

Control	Descriptions
Color Wheel Controls	 The outer ring black mark controls the main color selection.  The small circle can be moved inside the triangle to adjust hue and saturation
Color text boxes	Values can be directly entered into any of the color select text boxes. Any text box change also automatically changes the color wheel.
Scope display area text boxes	For each channel that is scale active, the top and bottom scope display area text boxes show the maximum and minimum scale values for the selected channel. The values are shown in the same color as the trace of the channel they represent. For example



Control	Descriptions
Hold A and Hold B buttons	The Hold A and Hold B buttons correlate to the channel selected (via the Scale Active radio button) in the top area of the panel. If the Hold A or B button is pushed, then these scales are static. If Hold button is off, then the corresponding trace auto-scales. The static scales can be edited. Entering the top scale automatically enters the bottom scale = negative of top scale. 
Arrow buttons	Selecting the Arrow button located next to the Hold A button copies the scale from the left side to the right side. Selecting the Arrow button located next to the Hold B button copies the scale from the right side to the left side. In the following example, the arrow button on the left was used to overwrite the scales on the right with the values from the left: 

Control	Descriptions
Sweep rate text box	 The Sweep Rate text box displays the current display sweep time. The sweep rate can be changed by text entry into the text box.
Display Cursor	Click the mouse in the display area, and the cursor will appear. Where the cursor intersects the traces will be sampled and shown in the middle scale text boxes on the left and right sides. In the following example, 0.07001 is the value of the yellow trace where the cursor intersects it. 0.1538 is the value of the orange trace at the cursor intersection.  To view the other trace value at the SAME cursor position, click the radio button for the green trace and the scales and the 0.042 cursor value will appear as shown. 

Control	Descriptions
Interval Box Cursor	 The Interval Box Cursor has two functions. It can be used to just measure a time interval on the display or it can be used to select an area of the display to magnify to full display size. Click and hold down the mouse in the display area and a cursor box will appear. Drag the vertical right side of the box to the point where the interval measurement should be done. The vertical height of the box does not matter in this case. Click inside the box and the Interval in time shall be shown at the bottom of the screen where the Sweep rate box used to be. To return to the original display, click once outside the box on the display. To define an area to magnify, click and hold the mouse down and drag the mouse to surround the desired area with a cursor box. Then, click inside the interval box and that portion of the display will then fill the entire display. Double-click twice to get back to the original display.
Single button	Select the Single button to display one single sweep. To resume viewing the active display, select the Sweep button again.
B button (Background)	Select the B button to access the color selection panel and change the background color of the oscilloscope display.
G button (Grid)	Select the G button to access the color selection panel and change the color of the oscilloscope display grid.
C button (Cursor)	Select the C button to access the color selection panel and change the color of the oscilloscope cursor.

Digital Readouts

Signal Group	Channel	Value	Signal Group	Channel	Value	Signal Group	Channel	Value
Long	Reference	0.0 cm/s ²	Long	Feedback	0.0 cm/s ²	Long	Output	0.0 cm/s
Lat	Reference	0.0 cm/s ²	Lat	Feedback	0.0 cm/s ²	Lat	Output	-1.334e-06 cm/s
Vert	Reference	0.0 cm/s ²	Vert	Feedback	-3.397e-05 cm/s ²	Vert	Output	-0.35 cm/s
Roll	Reference	0.0 deg/s ²	Roll	Feedback	0.0 deg/s ²	Roll	Output	0.0 deg/s
Pitch	Reference	0.0 deg/s ²	Pitch	Feedback	0.0 deg/s ²	Pitch	Output	0.0 deg/s
Yaw	Reference	0.0 deg/s ²	Yaw	Feedback	0.0 deg/s ²	Yaw	Output	0.0 deg/s
Lat	Displacement fbk	4.768e-07 cm	Vert	Displacement fbk	0.05 cm	Long	Displacement fbk	0.0 cm
X1	Displ fbk	0.0 cm	X1	Valve cmd	-0.0005204 Volts	X1	Force fbk	0.0 kN
X2	Displ fbk	0.0 cm	X2	Valve cmd	-0.0005203 Volts	X2	Force fbk	0.0 kN
X3	Displ fbk	0.0 cm	X3	Valve cmd	-0.0005204 Volts	X3	Force fbk	0.0 kN
X4	Displ fbk	0.0 cm	X4	Valve cmd	-0.0005203 Volts	X4	Force fbk	0.0 kN
Z1	Displ fbk	0.0 cm	Z1	Valve cmd	-0.025 Volts	Z1	Force fbk	0.0 kN
Z2	Displ fbk	0.0 cm	Z2	Valve cmd	-0.025 Volts	Z2	Force fbk	0.0 kN
Z3	Displ fbk	0.0 cm	Z3	Valve cmd	-0.025 Volts	Z3	Force fbk	0.0 kN
Z4	Displ fbk	0.0 cm	Z4	Valve cmd	-0.025 Volts	Z4	Force fbk	0.0 kN

Access

Main controller panel **Display** menu > **Digital Readouts**.

When to use the panel

Use this panel to read the present value of a selected signals.

Panel description

The Digital Readouts panel allows you to monitor up to 32 signals.

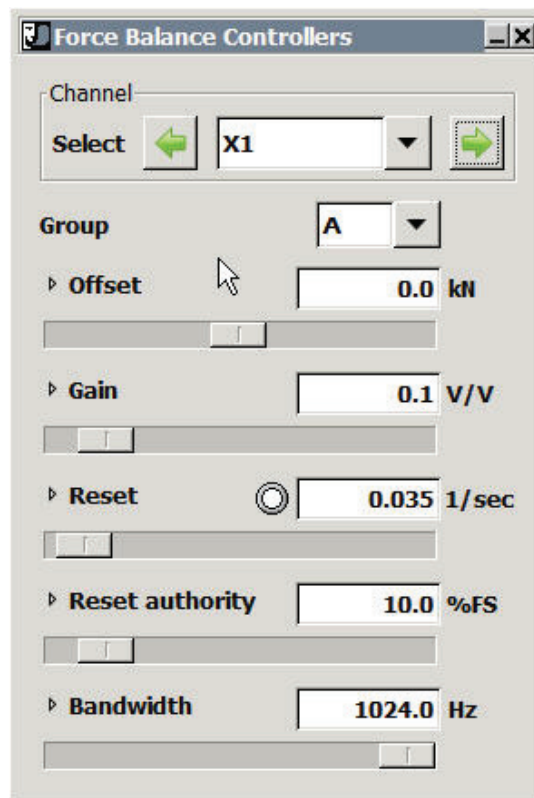
2-Tier Channel selection

Select a signal from a 2-tiered set of signals. First, select the signal group by clicking the left text box or the down arrow on the left text box. The group menu is displayed and the group can then be selected. After group selection, clicking on the right text box or the down arrow on the right text box will show the actual channel menu where the channel selection can finally be made.

To remove a channel from the panel:

1. Click on the name of the channel you want to remove.
2. From the left side group list, scroll to the top of the list and select NONE.
3. Click OK. The channel name in the right text box will also disappear.

Force Balance



Access

Main controller panel **Operation** menu > **Controllers** > **Force Balance**

When to use the panel

Use the Force Balance Controllers panel to set up and adjust parameters for the Warp PID controllers.

Panel description

The Force Balance Controllers panel allows you to setup and tune the force balance servo control loops by individual channel or by group. All current and reference gains are included in the parameters that are saved to a settings file.

Force Balance Reference

Background Information

Each of the controls on the Force Balance Controllers panel affects the system in a distinct way. It is important to understand these effects before attempting to tune the circuits.

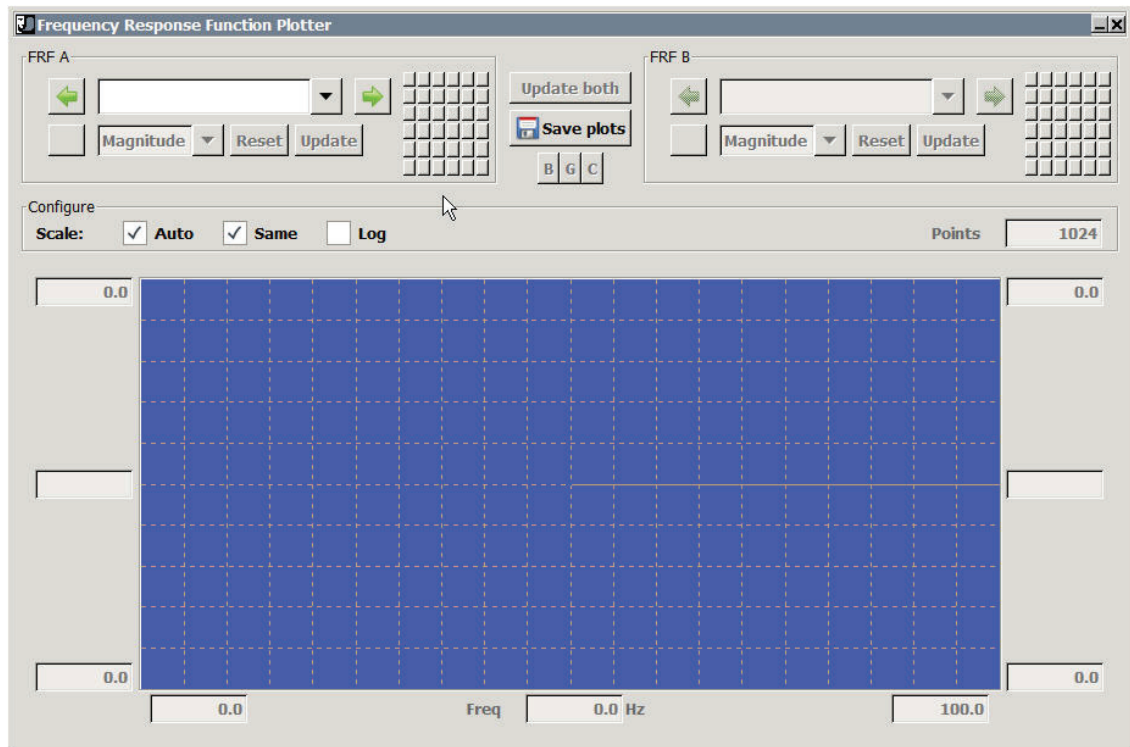
Signal Selection Controls

Control	Descriptions
text box	Displays the name of the selected channel.
Down Arrow	Use the down arrow to select a channel from the drop-down list
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

Force Balance Controls

Control	Descriptions
Group text box	The Group text box displays the group to which the current conditioner selection is assigned. If the conditioner is not assigned to a group, then the Group text box displays none. If the current conditioner selection is assigned to a group, any adjustment to the selected conditioner's settings will also be assigned to the remaining conditioners in that group. If the selected conditioner's assigned group is none, then any adjustment to the selected conditioner's settings will be independent of the remaining conditioner selections, even if there are others that are assigned to none. Use the down arrow to select a group from the drop-down list (none, A, B, C, D, and E).
Offset slide bar and text box	Adjusts the offset force that is applied at the actuator in kilo newtons.
Gain text box and slide bar	Adjusts the proportional gain for the selected channel.
Reset indicator , text box and slide bar	Adjusts the reset (integral) gain for the selected channel. The Reset indicator shows the current state of the reset integrator. • White – not integrating • Green – integrating • Red – has integrated up to maximum integral authority. You should review whether to increase the integral authority.
Reset Authority text box and slide bar	Adjusts the limit for the reset integrator. Enter the value in percent of full scale output.
Bandwidth slide bar and text box	Adjusts the bandwidth of the low pass filter.

Frequency Response Function (FRF) Plotter



Access

Main controller panel **Display** menu > **FRF Plotter**

When to use the panel

Use this panel to display the frequency response for one or two channels. It allows you to identify cross coupling between channels. Before using this panel, use the Function Generator panel to set a random drive signal for the channel(s).

Panel description

The FRF (frequency response function) Plotter panel is used with adaptive inverse control and adaptive harmonic control. It allows you to display the frequency response characteristics of the selected channels. This panel is also used to display the forward FRF determined by the spectrum analyzer. The display plots magnitude or phase vs. frequency. The FRF Plotter panel can be re-sized by dragging the sides or corners to a new size.

Background Information

A FRF is a mathematical model that accounts for the effects of a system on a signal.

It provides a linear approximation of the changes in phase and amplitude that occur in the frequencies making up a signal as that signal passes through a system.

The system that the signal is played through contains the electronic and hydro-mechanical parts of the testing equipment, the transducers, and the test specimen. The response collected shows all the changes in phase and amplitude that the system produces in the signal. These changes are calculated and used to compensate for the effects of the system on the signal.

If any system component is significantly changed (for example, if a test specimen accelerometer is replaced) a new FRF should be measured for the system.

A FRF is measured by exciting the test system with a shaped random drive signal (whose frequency content is similar to the desired drive signal) and collecting responses to the excitation.

Frequency Response Function Plotter Reference

Signal Selection Controls

Control	Descriptions
text box	Displays the name of the selected channel.
Down Arrow	Use the down arrow to select a channel from the drop-down list
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

Reset and Update Controls

Control	Descriptions
Reset button	The Reset button when activated is used with the spectrum analyzer. It resets the spectrum analyzer averaging to zero count and starts averaging again.
Update and Update both buttons	The Update button for each signal updates the display of adaptive control for that signal. The Update both button updates the display of adaptive control for both.

Cross Coupling Configuration Matrix Diagram

Control	Descriptions
	This diagram shows how each command signal is coupled to a feedback signal for adaptive control. The rows correspond to command signals, and the columns correspond to feedback signals.
	Callout in graphic: 1 — Feedback 2 — Command In the first example shown here, the first command (Long) is coupled to the first feedback (Long). The adaptive controller is said to be “on-diagonal,” coupling a command channel with its corresponding feedback channel. Each adaptive controller couples one command to one feedback, but these need not be associated with the same degree of freedom. In the second example shown here, the first command channel (Long) coupled to the third feedback channel (Pitch). In this configuration, the adaptive controller is said to be “off-diagonal,” coupling an actuator with a different transducer.

FRF Plotter Scale Controls

Control	Descriptions
Auto check box	Selects independent auto scaling. In this mode, the two signals are scaled to fill the entire display area, regardless of their relation to each other. Even if Auto scale is selected, you can change the frequency range of interest using the text boxes on the X axis.
Same check box	If this box is checked, the same scaling is applied to both signals.
Log check box	If checked, plots on a logarithmic scale. Unchecked, plots on a linear scale.
Points text box	Selects and shows the number of points displayed at the selected scale. You can enter a number of points in this box (range 32 to 384).

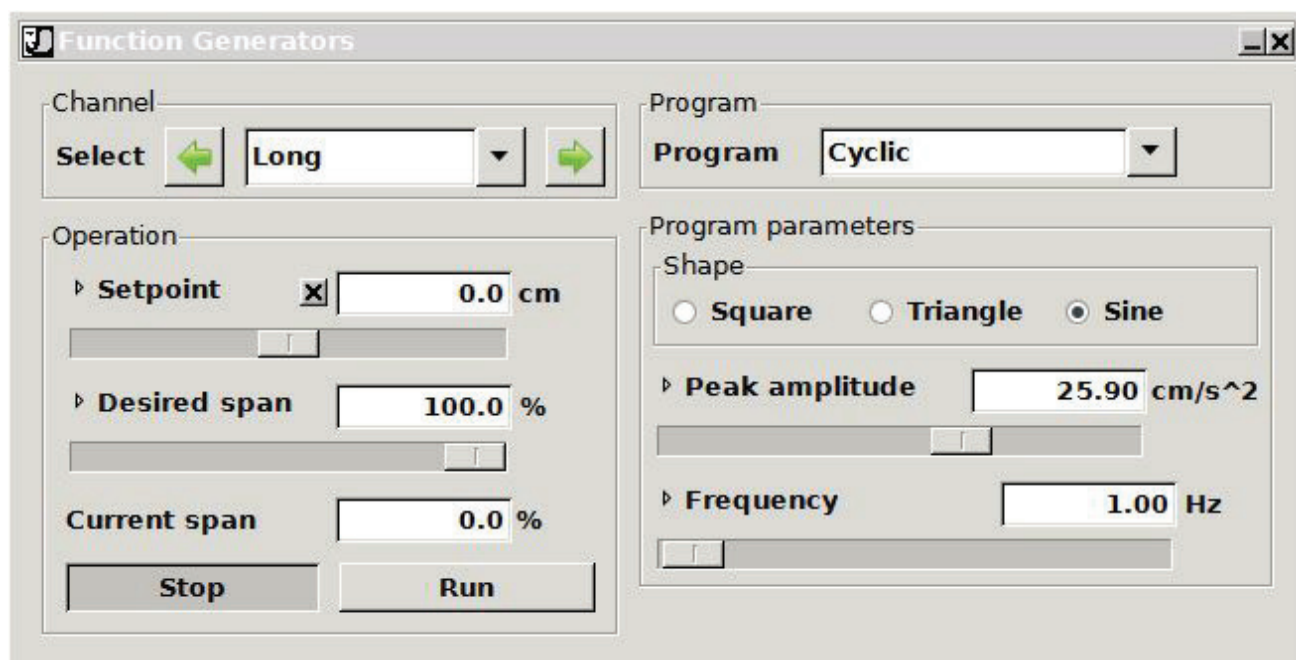
FRF Y-axis Controls

Control	Descriptions
Magnitude/Phase/Delay	Selects the type of Y-axis data to be displayed. The choices are: • Magnitude (in V/V) • Phase (in degrees) • Delay (in seconds)

Display Area Controls

Control	Descriptions
Display area text boxes	The text boxes surrounding the display area show the values of the upper and lower ranges currently displayed. • The top and bottom text boxes on the right and left sides show the minimum and maximum values of the A and B traces (respectively); the right and left text boxes on the bottom of the monitor show frequency. • If you click on a specific point in the display area, a dot appears, and the corresponding X and Y values will be shown in the text boxes in the right center, bottom center, and left center.
Save Plots button	Saves plotted values into a text file. Saved data will appear in 2 or 3 columns. Column 1 – Time axis data Column 2 – IRF A data Column 3 – IRF B data

Function Generators



Access

Main controller panel **Operation** menu > **Function Generators**

When to use the panel

Use the function generator for tuning, or use it for testing.

Panel description

The Function Generator panel allows you to select the program source and set the appropriate parameters.

Various function generator programs are available. Click the button next to Program to select the desired program. The settings that appear in the Function Generators panel vary for each program.

For More Information

Refer to: Function Generator Adjustments

Function Generators Reference



Warning:

Changes in Function Generator values made with hydraulic pressure on can result in unexpected actuator movement.

A moving actuator can injure anyone in its path.

Always clear the actuator area before changing values.

Channel Selection Controls

Control	Descriptions
text box	Displays the name of the selected channel.
Down Arrow	Use the down arrow to select a channel from the drop-down list
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

Controls for All Programs

Control	Descriptions
Setpoint slide bar and text box	Sets the setpoint position for the selected axis. When the table hydraulic pressure is turned on, the actuators will not move because the error is automatically set to zero when turning on the pressure. Adjusting the setpoint after the table pressure is on, will move the corresponding actuators to the new setpoint level. The Setpoint rate in the Ramp Rates panel sets the rate it takes to move from one setpoint level to another.
Desired span slide bar and text box	Scales the amplitude of the command applied to the axis (regardless of selected program). - If a program is currently running, it will be ramped to the new amplitude within 2 seconds. - If no program is currently running, the program will be ramped to the amplitude set by this control within 2 seconds after you click Run. This Desired span value for each axis is multiplied by the Desired span value on the main controller panel and the result is applied to the respective axis.
Current span display	Not editable. Displays the current span of the function generated for the selected axis.

Control	Descriptions
Stop/Run buttons	Pressing the Run button starts the program on the selected axis. The command ramps to the amplitude level set with the Desired span controls within 2 seconds. Pressing the Stop button stops the program for the selected channel. The command to the selected axis ramps to zero, as shown on the Current span display. The Desired span remains unchanged. Notice that this does not start or stop a test program; use the Run/Stop buttons on the main controller panel to apply the command to the selected axes. If Phase is selected for this axis and another axis is selected as the Master, the Run/Stop button on this channel cannot be used. The master channel controls running and stopping the command.
Program drop-down menu	Use the down-arrow to select the programming source from the drop-down list.

Cyclic Program Controls

Control	Descriptions
Shape radio buttons (Square , Triangle , Sine)	Selects the shape of the function to be generated for the selected axis by the cyclic function generator.
Peak amplitude slide bar and text box	Sets the peak amplitude of the function to be generated for the selected axis by the cyclic function generator. The command will ramp to new amplitude at the rate entered in the Ramp Rates panel.
Frequency slide bar and text box	Sets the frequency of the function to be generated for the selected axis by the cyclic function generator. The command ramps to new frequency at the rate entered in the Ramp Rates panel.

Sine Step Program Controls

Control	Descriptions
Peak amplitude text box	Sets the peak amplitude to be generated by the step function generator. The command ramps to new amplitude at the rate entered in the Ramp Rates panel.
Minimum freq text box	Sets the frequency of the first step.
Maximum freq text box	Sets the frequency of the last step. The command ramps to new frequency at the rate entered in the Ramp Rates panel.

Control	Descriptions
Step size text box	Sets the step size for incrementing from the minimum to the maximum frequency.
Pause interval text box	Sets the pause time between steps.
Cycles/Secs radio buttons	Selects Ramp/Dwell units to be Cycles or Seconds.
Ramp interval text box	Sets the ramp cycles/time to reach peak amplitude for each step.
Dwell interval text box	Sets the cycles/time to stay at peak amplitude for each step.
Current freq display	Displays the current frequency of the sweep function generator.
Reset button	Resets the step function to the minimum frequency.

Sweep Program Controls

Control	Descriptions
Sweep type drop-down menu	Selects the type of sweep (linear or logarithmic). The choices are: - Linear - Log
Sweep mode drop-down menu	Selects the sweep mode (one-time or continuous). The choices are: - Once - Cont If Once is selected, the function generator sweeps to the end of its sweep range, then dwells.
Direction radio buttons	Selects the sweep direction to be Down to lower frequency or Up to higher frequency.
Peak amplitude text box	Sets the peak amplitude of the function to be generated for the selected channel by the sweep function generator.
Initial freq text box	Sets the initial frequency of the sweep function for the selected channel.
Minimum freq radio button and text box	Sets the minimum frequency of the sweep function for the selected channel. Click on this radio button if you wish to make the sweep first start moving from the initial frequency towards the minimum frequency.
Maximum freq radio button and text box	Sets the maximum frequency of the sweep function for the selected channel. Click on this radio button if you wish to make the sweep first start moving from the initial frequency towards the maximum frequency.
Sweep rate text box	Selects the sweep rate of the function to be generated for the selected channel by the sweep function generator. Units are defined as dec/min for the log sweep and Hz/sec for the linear sweep.

Control	Descriptions
Jog increment text box	Sets the amount by which the dwell frequency can be raised or lowered by pressing the up or down jog arrows on the panel. For example if the jog increment is 0.1, pressing the down arrow lowers the dwell frequency by 0.1 Hz. You can enter a value in the text box.
Current freq text box	Displays the current frequency of the sweep function generator. Not editable while sweeping but you can enter the desired frequency when in Dwell mode.
Dwell button	Stops the sweep and maintains the current frequency.
Jog arrow buttons	Jog the dwell frequency up or down. The Jog increment text box specifies how much the dwell frequency is raised or lowered. Use the up arrow button to raise the frequency by the Jog increment amount. Use the down arrow button to lower the frequency by the Jog increment amount.

Phased Program Controls

Control	Descriptions
Control Descriptions for Phased Program	This selection can be considered a master/slave channel relationship. This source can only be selected if the master channel has a cyclic or sweep source. The master channel determines the frequency. The shape, amplitude and phase lag between the master/slave channels are selectable.
Master drop-down menu	Selects the master actuator.
Shape radio buttons (Square, Triangle, Sine)	Selects the shape of the function to be generated for the slave channel.
Peak amplitude slide bar and text box	Sets the peak amplitude of the function to be generated for the slave channel.

Random Program Controls

Control	Descriptions
Control Descriptions for Random Program	This selection consists of a uniform distribution random number generator followed by a band-pass filter. This filter has four adjustable parameters.
Shape drop-down menu	Selects the shape of the function to be generated for the selected channel by the random function generator. This is the shape of the band-pass filter's magnitude response as a function of frequency between minimum and maximum frequencies. Five shapes are available: $1/F^2$, $1/F$, Flat, F, and F^2, where "F" denotes frequency. $1/F^2$ — signal energy decreases with frequency as $1/f^2$ $1/F$ — signal energy decreases with frequency as $1/f$ Flat — signal energy constant for all frequencies F — signal energy increases with frequency as f F^2 — signal energy increases with frequency as f^2 The primary consideration in selecting the shape is to get the most energy into the system across the frequency band of interest without damaging the system by excessive velocity or acceleration. In acceleration control, "Flat" works well, but in displacement control, "Flat" will result in excessive velocity and acceleration at high frequencies; "$1/F$" or "$1/F^2$" is much gentler on the system in that case. Shapes "F" and "F^2" accentuate acceleration at high frequencies and so should not be used. Note that theoretically a shape of "$1/F$" or "$1/F^2$" results in a filter magnitude response that tends toward infinity as the frequency tends toward zero. This is neither desirable nor practical, so the filter response is rolled off to zero as the frequency approaches the minimum frequency. In addition, for technical reasons the minimum frequency is not allowed to be less than 1% of the maximum frequency when "$1/F$" and "$1/F^2$" shapes are selected.
RMS Amplitude slide bar and text box	Selects the root mean square amplitude for the function to be generated for the selected channel by the random function generator. Adjust the RMS amplitude to the minimum value possible to prevent damage to the test specimen. Keep in mind, however, that using too low of an amplitude will result in inaccurate estimates of the transfer function. If your system is significantly nonlinear, try to use an RMS amplitude similar in amplitude to the test waveform if possible, because in such systems the transfer function is a strong function of signal amplitude. Also, keep in mind that you are setting RMS amplitude, not peak amplitude; peak amplitude will be somewhat higher than RMS amplitude.

Control	Descriptions
Minimum freq slide bar and text box	Selects the minimum frequency content for the signal to be generated for the selected channel by the random function generator. This is the cut-in frequency of the band-pass filter. Set this according to the lowest frequency expected in your test waveform. A minimum frequency of zero is allowed. In velocity and acceleration control modes, this frequency should match the cut-in frequency of the Reference Generator.  Note: For $1/f^2$ or $1/f$, minimum frequency cannot be zero. If zero, it will automatically be set to same scale non-zero frequency value.
Maximum freq slide bar and text box	Selects the maximum frequency content for the signal to be generated for the selected channel by the random function generator. This is the cutoff frequency of the band-pass filter. Set this according to the highest frequency to which you expect to control.

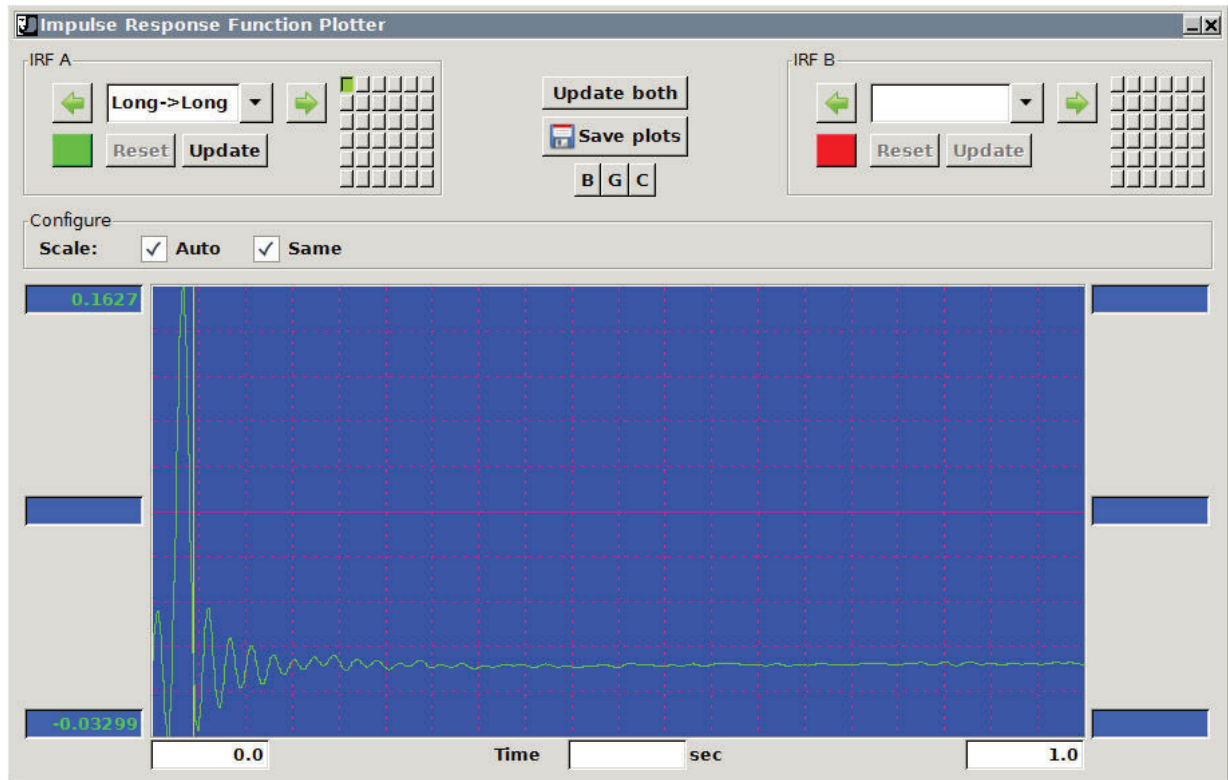
Other (External) Program Controls

Control	Descriptions
	 Note: The following controls are not selectable via the Function Generator panel. They are for display purposes only and are selected via the main controller panel. Some of these program sources are specific to certain systems and may not be implemented.
Data Player File	This option indicates that the program command to the table comes from playing a data file. Refer to Data Player panel information.
Online Iteration	This option indicates that the program command to the table comes from the Online Iteration panel. Refer to Online Iteration panel information.
Remote Application	This option indicates that the program command to the table is generated by a remote source to be determined by the user.
STEX Pro	This option indicates that the program command to the table is generated by the STEX Pro application.
External Analog	This option indicates that the program command to the table is generated by an analog device to be determined by the user.
Scramnet	This option indicates that the program command to the table is generated by a Scramnet connection from a source such as a modeling program.

For More Information

Refer to 469D Digital Seismic Table Controller

Impulse Response Function Plotter



Access

Main controller panel **Display** menu > **IRF Plotter**.

When to use the panel

The Impulse Response Function Plotter (IRF) Plotter panel is used for initial setup of adaptive inverse control and adaptive harmonic control. It allows you to select one or two channels, then view the impulse response characteristics of the adaptive filters for the selected channel(s).

Panel description

The IRF (impulse response function) is plotted as gain vs. time. The system impulse response interval is the time it takes the system response to settle after a step command.

You normally set the adaptive filter to a value slightly longer than this interval, to make sure the adaptive control is not applied before it can take effect. Too short an interval results in wandering coefficients. Too long an interval results in slower convergence. The Impulse Response Function Plotter can be re-sized by dragging the sides or corners to a new size.

Background Information

MTS provides a default impulse response suited to your system. If you are using both stroke and acceleration adaptive control, MTS provides a default for each type of control. If these settings seem wrong, or if you have any other questions about setting adaptive control parameters, consult MTS.

Impulse Response Function Plotter Reference

Channel Selection Controls

Control	Descriptions
text box	Displays the name of the selected channel.
Down Arrow	Use the down arrow to select a channel from the drop-down list
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.



Note:

You can also select a channel by clicking in a box in the cross-coupling configuration diagram.

Reset and Update Controls

Control	Descriptions
Reset button	The Reset button when activated is used with the spectrum analyzer. It resets the spectrum analyzer averaging to zero count and starts averaging again.
Update and Update both buttons	The Update button for each signal updates the display of adaptive control for that signal. The Update both button updates the display of adaptive control for both.

Cross Coupling Configuration Matrix Diagram

Control	Descriptions
	This diagram shows how each command signal is coupled to a feedback signal for adaptive control. The rows correspond to command signals, and the columns correspond to feedback signals.
	Callout in graphic: 1 — Feedback 2 — Command In the first example shown here, the first command (Long) is coupled to the first feedback (Long). The adaptive controller is said to be “on-diagonal,” coupling a command channel with its corresponding feedback channel. Each adaptive controller couples one command to one feedback, but these need not be associated with the same degree of freedom. In the second example shown here, the first command channel (Long) coupled to the third feedback channel (Pitch). In this configuration, the adaptive controller is said to be “off-diagonal,” coupling an actuator with a different transducer.

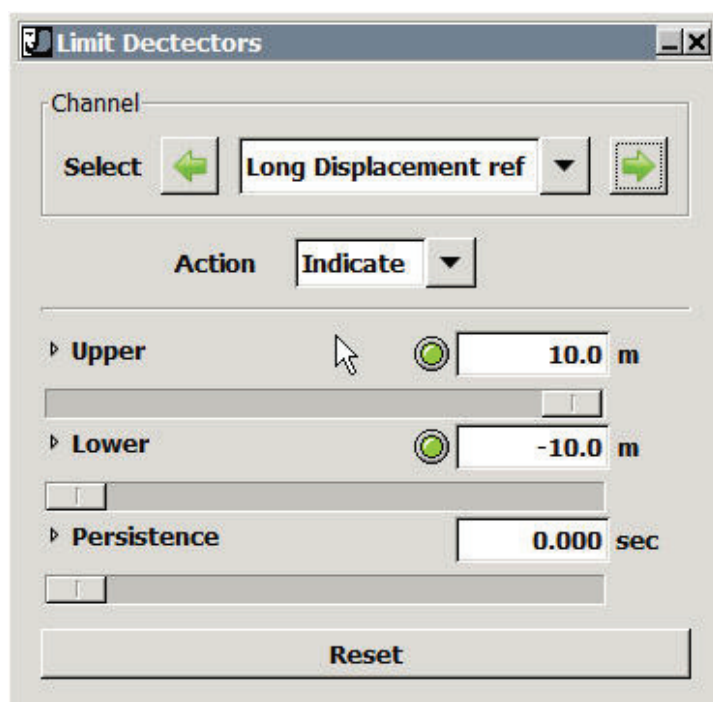
Display Area Controls

Control	Descriptions
Display area text boxes	The text boxes surrounding the display area show the values of the upper and lower ranges currently displayed. - The top and bottom text boxes on the right and left sides show the minimum and maximum values of the A and B traces (respectively); the right and left text boxes on the bottom of the monitor show frequency. - If you click on a specific point in the display area, a dot appears, and the corresponding X and Y values will be shown in the text boxes in the right center, bottom center, and left center.
Save icon	Saves plotted values into a text file. Saved data will appear in 2 or 3 columns. Column 1 – Time axis data Column 2 – IRF A data Column 3 – IRF B data

RF Plotter Scale Controls

Control	Descriptions
Auto check box	Selects independent auto-scaling. In this mode, the two signals are scaled to fill the entire display area, regardless of their relation to each other.
Same check box	If this box is checked, the same scaling is applied to both signals.

Limit Detectors



Access

Main controller panel **Operation** menu > **Function Generators**.

When to use the panel

Use the panel to set safety limits for the test system.

The limit detectors are enabled and disabled from the main controller panel. If not enabled, they will not set an indicator or interlock.

Panel description

The Limit Detector panel allows you to:

- Select a specific software signal for which a limit can be set
- Choose the action to be taken if a limit is exceeded
- Set an allowable operating range and persistence value for the signal
- Identify if an upper or lower out-of-limit has occurred
- Reset the software limit detector circuit.

Background Information

A limit event for a particular signal indicates that the signal has exceeded its upper or lower limit. The upper and lower limits establish a range of values that represent a desired system operating range. This band also represents the range where valid test data can be ensured. The persistence value is a time (in seconds) that an upper or lower out-of-limit condition can persist without causing an interlock.

When an out-of-limit condition occurs, the Message Log panel identifies the specific out-of-limit condition.

Function Generators Reference



Warning:

Limit and error detectors are generally used to minimize the chance of accidental damage to the test equipment or test specimen. Limit detectors can also act to maximize the validity of the test data.

Test equipment that is run within acceptable operating limits can still have the potential to cause death or severe injury to personnel.

Do not rely on limit and error detectors to protect personnel from injury.

Signal Selection Controls

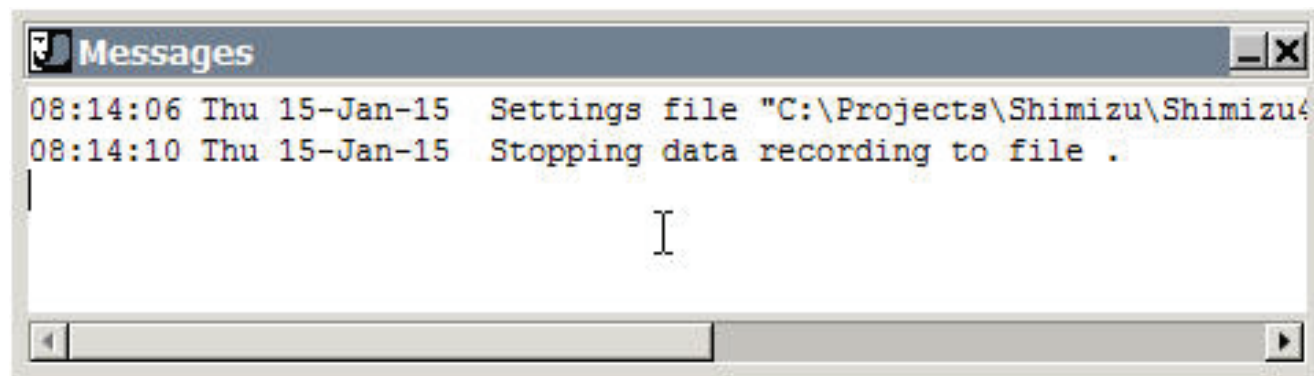
Control	Descriptions
text box	Displays the name of the selected channel.
Down Arrow	Use the down arrow to select a channel from the drop-down list
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

Limit Detector Controls

Control	Descriptions
Reset button	Click to clear the indicators and any software interlocks generated by an out-of-limit condition, if the channel is within limits.
Action drop-down menu	Select the result of an out-of-limit condition. Selections are: • Indicate – This selection causes the indicator to light only while the signal is outside of the limit. When the signal returns inside the limit, the indicator goes out. • Alert – This selection causes the indicator to light and latch. When the signal returns inside the limit, the indicator remains lit until the Reset button is used. The out-of-limit condition will be recorded in the message log. • Program Abort– This selection causes the system to trigger a program abort if the signal goes outside the limit where the master span will be ramped to zero at a rate entered in the Ramp Rates panel. The Reset button is required to reset the system. The out-of-limit condition will be recorded in the message log. • Interlock – This selection causes the system to trigger an Emergency Stop if the signal goes outside the limit. The Reset button is required to reset the system. The out-of-limit condition will be recorded in the message log.

Control	Descriptions
Upper slide bar and text box	Sets the upper limit of the selected signal. Note that when you set the upper limit value, the lower limit is automatically set to the negative of the upper limit value. If you desire a different lower limit value, you should change it using the lower slide bar after setting the upper limit.
Upper indicator	Lights when an out-of-limit condition occurs for the upper limit.
Lower slide bar and text box	Sets the lower limit of the selected signal. Setting this value does not affect the upper limit value.
Lower indicator	Lights when an out-of-limit condition occurs for the lower limit.
Persistence slide bar and text box	Sets the time, in seconds, that an upper or lower out-of-limit condition can persist without causing an interlock.

Message Log



Access

Main controller panel **Display** menu > **Message Log**.

When to use the panel

Use this panel to read the message log.

Panel description

The Message Log panel allows you to view messages generated by system events. Only messages from the current session are displayed. The messages.txt file stores all messages from all sessions. This file records many system actions automatically.

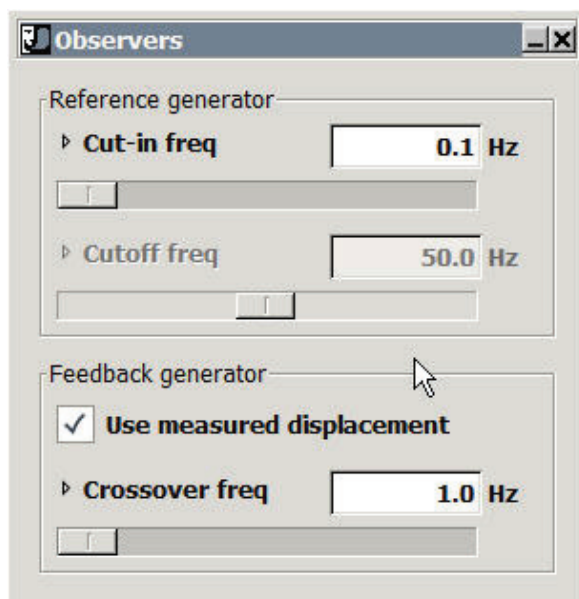


Note:

To prevent the message file from becoming too large or to create a historical record of each session,

MTS recommends that you create a new message log for each session. This can be done by renaming the original message file before launching the application. When you launch the application a new **messages.txt** file is created.

Observers



Access

Main controller panel **Configuration** menu > **Observers**.

When to use the panel

In the Reference Generator section:

- Input the cut-off frequency for the low-pass filter used when the command mode is displacement.
- Input the cut-in and cutoff frequency for the band-pass filter used when the command mode is velocity.
- Input the cut-in frequency for the high-pass filter used when the command mode is acceleration.

In the Feedback Generator section:

- Review the crossover frequency.

The velocity feedback signal is generated from both the position feedback and the acceleration feedback. At lower frequencies, the position feedback is dominant. At higher frequencies, the acceleration feedback is dominant. Crossover frequency is the frequency below which the displacement sensor has maximum influence on the computed feedbacks, and above which the acceleration sensor has maximum influence.



Important:

The Feedback generator Crossover freq value is set when the system is placed into commission. Normally you should not change the value.

Panel description

The Observers panel allows you to configure the Reference generator and Feedback generator for optimum use. The Observers Panel is where adjustments for the Reference Generator and Feedback Generator Observers are made (the term “observer” is control theory terminology for a special-purpose filter that computes a feedback signal).

For More Information

Refer to: Observer Panel Adjustments

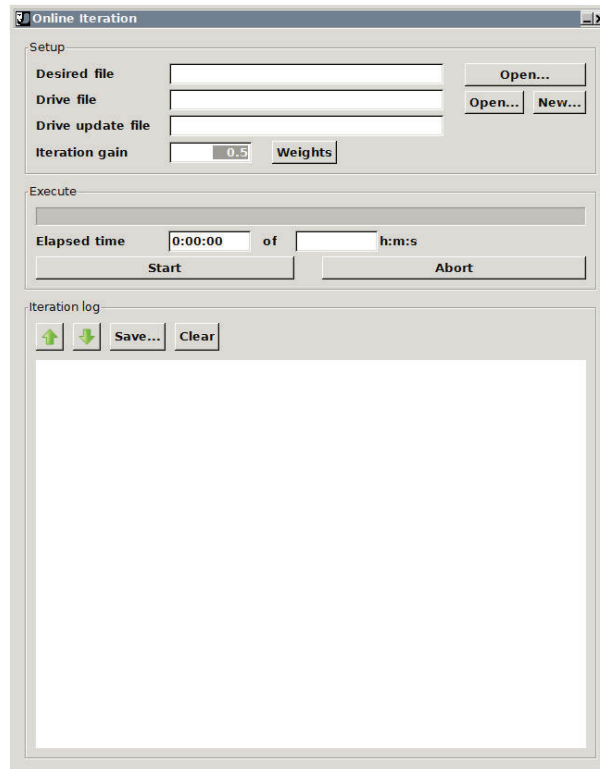
Observers Panel Reference

Reference Generator Controls

Control	Descriptions
Cut-in freq slide bar and text box	Input the cut-in frequency for the bandpass filter (velocity mode) or the high-pass filter (acceleration mode). Valid only in velocity and acceleration control modes, this is the frequency below which energy content in the reference signal is removed to prevent large commanded displacement. A lower value is better because less frequency content is removed from your reference signal, which results in improved reference-feedback matching. Physical displacement limits place a lower bound on this frequency. For sine waves, the amount of displacement amplitude X that can be expected given acceleration amplitude A can be computed from the formula: $X=A / (2\pi f)$ Discontinuities in the derivatives of the reference signal also place a lower bound on this frequency, because the high-pass filter acts as a double differentiator at low frequencies, greatly amplifying derivative discontinuities that emerge as large transients in the Displacement Reference. You can determine whether the cut-in frequency is high enough for your reference signal to prevent these problems by using the Preview feature available on the 469D Digital Seismic Table Controller panel, which allows you to play out a reference waveform and observe the Reference Generator outputs without actually moving the system. Use the Digital Meter's Max/Min displays to view the range of excursion of the displacement reference signal; if it exceeds the physical displacement limits, the cut-in frequency must be increased. Keep in mind that the filter is only second order and therefore makes a gradual transition between passband and stopband. Therefore a significant amount of signal energy below the cut-in frequency will leak through the filter.
Cutoff freq slide bar and text box	Input the cutoff frequency for the lowpass filter (displacement mode) or for the bandpass filter (velocity mode). Valid only in displacement and velocity control modes, this is the cutoff frequency of the lowpass filter and bandpass filter, respectively.
Use measured displacement	When checked, displacement feedback is direct.

Control	Descriptions
Crossover freq slide bar and text box	This is the frequency below which the displacement sensor has maximum influence on the computed feedbacks, and above which the acceleration sensor has maximum influence.  Warning: The Feedback Generator Crossover Freq value is set for optimal system response when the system is placed into commission. Changing the Feedback Generator Crossover Freq value without knowing the effects of the change can cause system instability, which can result in equipment or specimen damage. Do not change the Feedback Generator Crossover Freq value unless you are an experienced user or have first consulted MTS.

Online Iteration



Access

Main controller panel **Operation** menu > **Controllers** > **Online Iteration**.

When to use the panel

Use this panel when basic adaptive inverse control alone does not remove the tracking error because of nonlinearities. For example, nonlinearities arise in mixed mode applications, where the drive signal is of one type (for example, displacement) and the response of another (for example, acceleration).

Panel description

Online Iteration (OLI) is a control technique that repeatedly modifies the command input to a control system on an individual sample-by-sample basis until the control system response is almost a perfect replica of the original desired command.

The Online Iteration panel allows you to set up and run online iteration, including the following tasks:

- Select and open a desired file.
- Select and open or create a drive file.
- Set the iteration gain.
- Start manually, start automatically, or abort online iteration.
- Monitor the process in an iteration log, and save this log. This log is editable, so you can add comments.

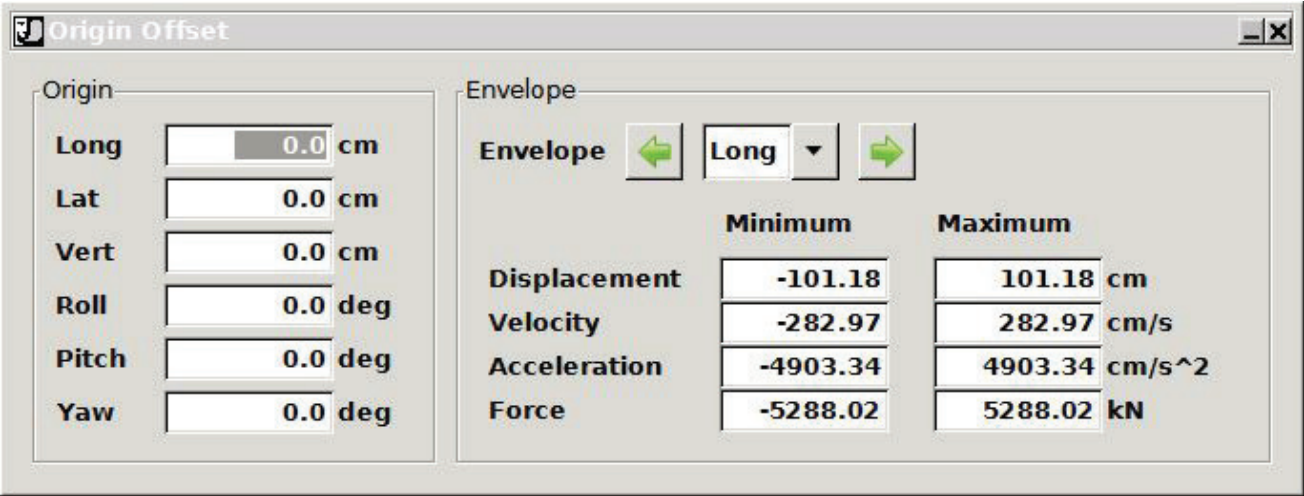
Enabling OLI will automatically put AIC into Frozen mode because online iteration requires adaptive iteration control be enabled before it can run.

Online Iteration Reference

OLI Configuration Controls

Control	Descriptions
Desired file text box and Open... button	Selects a desired time history file. You will be prompted with a file open dialog box.
Drive file text box and New button	Creates a new drive file sequence. You will be prompted to enter the root name of the drive file sequence with the dialog box.
Drive file text box, Open button	Opens an existing drive file. You will be prompted with a file open dialog box.
Drive update file text box	Displays the name of the current drive update file, a new command file generated by online iteration. A new drive update file is generated during every pass. When tracking, the update file from one pass automatically becomes the drive file for the next pass. When frozen, the drive update file is generated, but does not become the drive file for the next iteration. The filename for each update is formed by adding a numeral to the original drive filename extension. For example, a desired file named JTS.DES will generate files named JTS.D00, JTS.D01, and so on.
Iteration gain text box	Sets the rate at which the iterations converge to a final solution. Acceptable values range from zero to one.
Elapsed time display	Displays the elapsed time and the total length of an iteration textually. Elapsed time is also displayed graphically in the progress bar.
Progress bar	Shows the percent of the current file completed, as a progress bar that grows from left to right.
Start button	Starts the current iteration.
Abort button	Terminates the current iteration prematurely.
Auto check box	Specify automatic iteration mode. When checked, after completion of an iteration, the next iteration is begun immediately without having to press the Start button. If unchecked during an iteration, motion will stop at the end of the current iteration. Do not use this feature unless you have run a few iterations manually and are confident that the iteration process is progressing smoothly.
Iteration log display	Displays the results of each iteration so that iteration progress can be monitored.
Save button	Saves the text in the iteration log to a text file.
Clear button	Clears the text in the iteration log.

Origin Offset



Access
Main controller panel **Configuration** menu > **Origin Offset**.

When to use the panel
The system assumes that all loads and displacements are made to the system relative to the defined system origin. If you want to configure the test system to operate around a different origin, use the Origin Offset panel to create the offset for each axis.

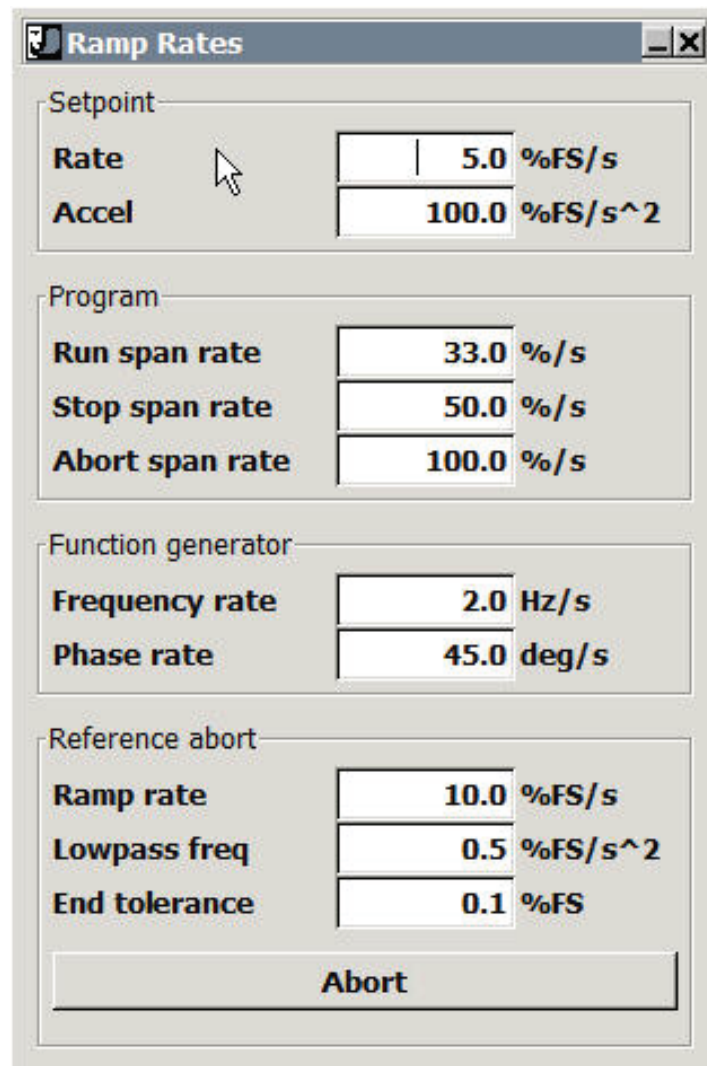
If you offset the origin, check the limit detector settings for each axis to make sure that the limits are not outside of the defined operational envelope.

Panel description
From the Origin Offset panel you can set an offset for each of the six degrees of freedom from the defined origin. If the origin is offset, the operational envelope for an axis may be affected. You can view the operational envelope for each of the six degrees of freedom, based upon the origin offset values, in the right portion of the panel.

Origin Offset Reference

Control	Descriptions
X, Y, and Z in mm (Translation)	Set the amount of offset for the longitudinal, lateral, and vertical axes in millimeters.
Roll, Pitch, and Yaw in degrees (Rotation)	Set the amount of offset for roll, pitch and yaw in degrees.
Envelope	Select an axis to view its operating envelope as calculated from the origin offset. A maximum and a minimum value are listed for Displacement, Velocity, Acceleration, and Force. The values cannot be edited from the Origin Offset panel.

Ramp Rates



Setpoint	
Rate	5.0 %FS/s
Accel	100.0 %FS/s ²

Program	
Run span rate	33.0 %/s
Stop span rate	50.0 %/s
Abort span rate	100.0 %/s

Function generator	
Frequency rate	2.0 Hz/s
Phase rate	45.0 deg/s

Reference abort	
Ramp rate	10.0 %FS/s
Lowpass freq	0.5 %FS/s ²
End tolerance	0.1 %FS

Abort

Access

Main controller panel **Configuration** menu > **Ramp Rates**.

When to use the panel

Use this panel to set limits on how fast the system can reach a setpoint and how fast it can ramp up or down.

Panel description

The Ramp Rates panel allows you to set maximum values for the setpoint generator velocity and acceleration, the span ramp rate and phase rate.

Ramp Rates Reference

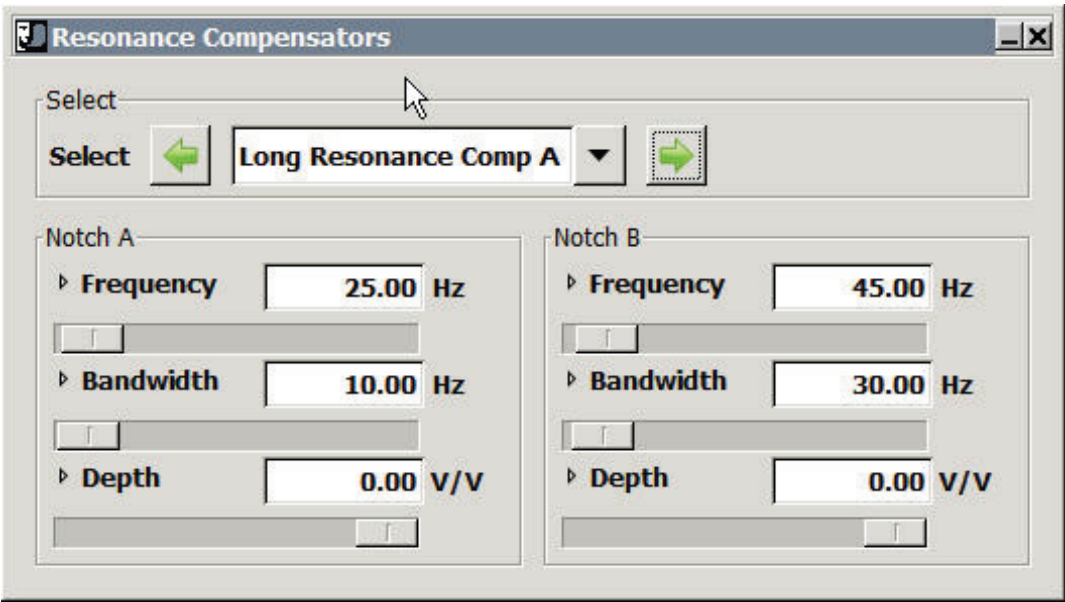
Ramp Rate Controls

Control	Descriptions
Setpoint rate text box	Input the maximum velocity that the system is allowed to achieve while trying to reach the displacement setpoint value set on the main controller panel.
Setpoint accel text box	Input the maximum acceleration that the system is allowed to achieve while trying to reach the acceleration setpoint value set on the main controller panel.
Run span rate text box	Input the maximum rate that the span function generator is allowed to ramp up when starting a program.
Stop span rate text box	Input the maximum rate that the span function generator is allowed to ramp down when stopping a program.
Abort span rate text box	Input the maximum rate that the span function generator is allowed to ramp down when aborting a program (abnormal stop). The limit detector will use this rate.
Frequency rate text box	Input the rate that the program will ramp to a new frequency when the program cyclic generator frequency is changed.
Phase rate text box	Input the rate that the phase lag between a master and slave channel can be changed.

Reference Abort Generator

Control	Descriptions
Ramp rate	Optimum value is 10%.
Lowpass freq	Optimum value is 1.0 Hz.
End Tolerance	Optimum value is 0.1%.

Resonance Compensators



Access

Main controller panel **Operation** menu > **Controllers** > **Resonance Comp.**

When to use the panel

You can use the Resonance Compensators panel to set up or adjust parameters for up to two TVC notches. Notches are used to remove specimen and/or multi-axis system resonances (actuator bowstring).

Panel description

The Resonance Compensators panel allows you to setup the extra TVC notch parameters. The Resonance Compensator consists of four identical notch filters, grouped into two pairs for user interface purposes because resonances usually come in resonance/anti resonance pairs. Like the TVC notch filter, the frequency response of the Resonance Compensator notch filters can be viewed in the FRF Plotter.

For More Information

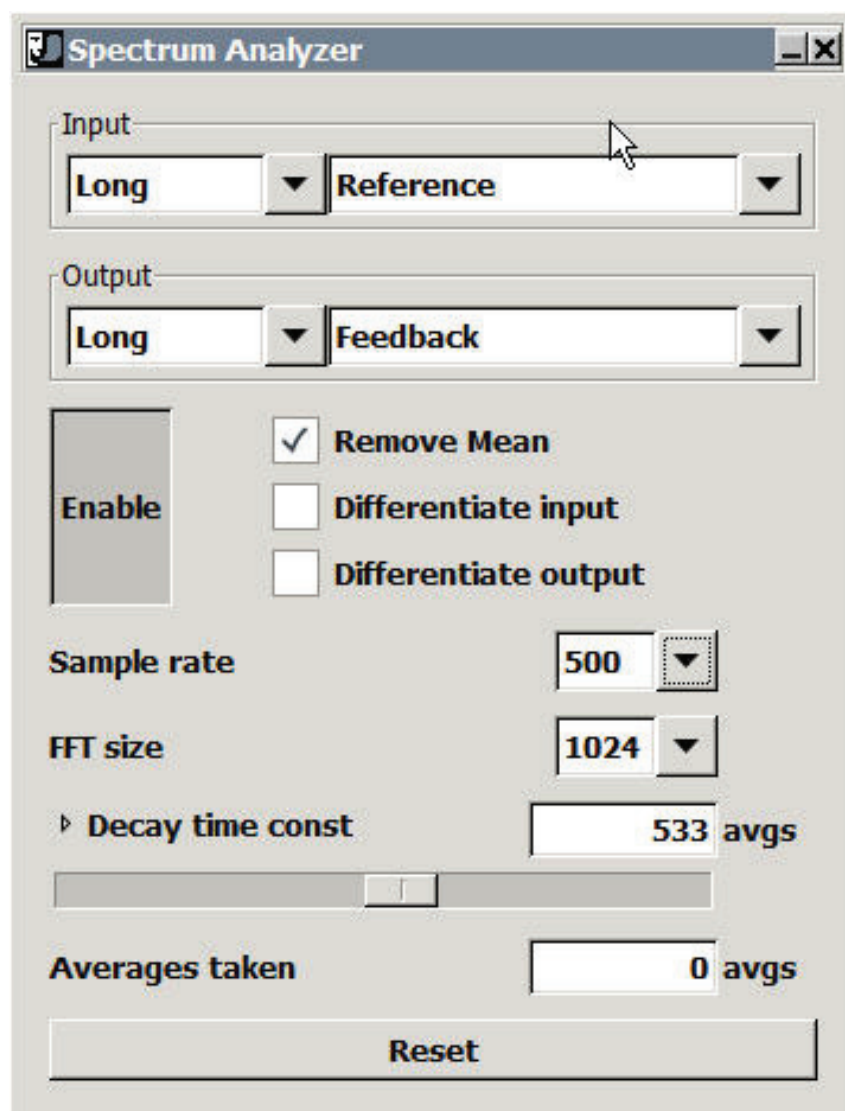
Refer to: Resonance Compensator Panel Adjustments

Resonance Compensators Reference

Channel Selection Controls

Control	Descriptions
text box	Displays the name of the selected channel.
Down Arrow	Use the down arrow to select a channel from the drop-down list
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

Spectrum Analyzer



Access

Main controller panel **Operation** menu > **Spectrum Analyzer**.

When to use the panel

Use the Spectrum Analyzer when tuning the system to monitor signals for frequency content and to check for system resonances.

The Spectrum Analyzer produces a true FFT transfer function with input and output PSDs and coherence functions. It uses hanning windows, 50% frame overlaps, and exponential averaging to minimize leverage effects and to smooth spectral estimates.

Panel description

The Spectrum Analyzer panel allows you to set up the spectrum analyzer to measure the forward transfer function between two channels. Use the FRF Plotter panel to display the transfer functions.

Spectrum Analyzer Reference

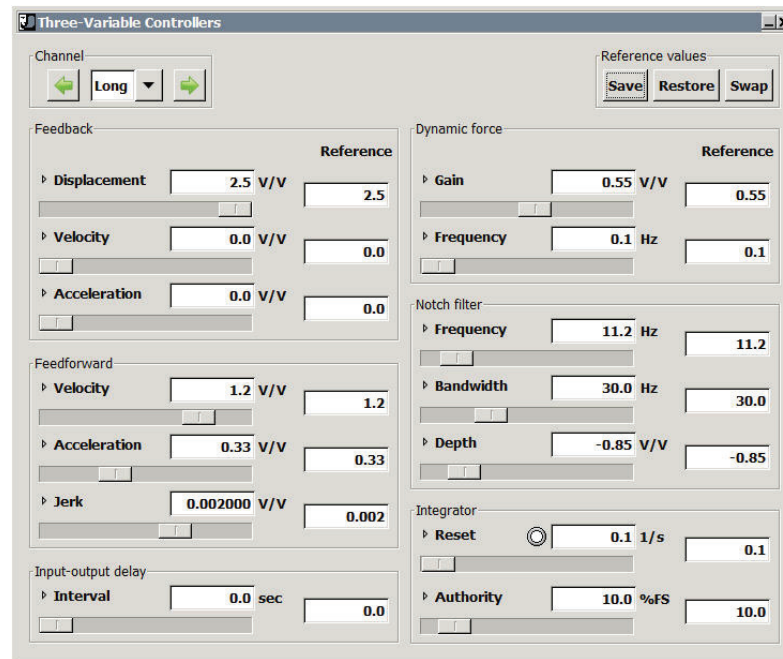
Channel Selection Controls

Control	Descriptions
Input and Output Channel selection text boxes	Displays the group and channel names of the selected signal. Select the signal group from the down list of the left text box. The group menu is displayed and the group can then be selected. After group selection, select the channel from the drop-down list in the right text box.

Spectrum Analyzer Controls

Control	Descriptions
Enable button	Use to enable/disable the spectrum analyzer.
Remove mean check box	When checked, removes the dc content of the signal by adding a hi-pass filter (with an extremely low cut-in frequency) to the input of the analyzer.
Differentiate input check box	When checked, the software will differentiate the input signal to remove any integrator between the input and output.
Differentiate output check box	When checked, the software will differentiate the output signal to remove any integrator between the input and output.
Sample rate drop-down menu	Use to select the desired sample rate of the spectrum analyzer. Click the down arrow button to display a list of sample rates. Select the desired sample rates and click the check mark button to accept the selection and close the list, or click the X button to decline the selection and close the list.
FFT size pop-up menu	Use to select the FFT size. The FFT size determines the frequency resolution of the analyzer ($\text{Resolution} = \text{Sample Rate} / \text{FFT size}$). Click the down arrow button to display a list of sizes. Select the desired size and click the check mark button to accept the selection and close the list, or click the X button to decline the selection and close the list.
Decay time constant slide bar and text box	Use to adjust the decay time constant which determines how long the analyzer keeps data before discounting it. A lower average will allow the analyzer to track better but spectral estimates will be noisier.
Averages taken display	Displays how many averages have been taken by the analyzer. Can be reset to zero using the Reset button.
Reset button	Use to reset the averaging process.

Three-Variable Controllers



Access

Main controller panel **Operation** menu > **Controllers** > **Three-Variable**.

When to use the panel

You can use the Three-Variable Controller panel to set up or adjust parameters for a TVC controller, including the following:

- Control variable
- Gains
- Lead values (feedforward)
- Input-output delay
- Dynamic Force
- Notch parameters
- Reset

A notch can be added to the controller to suppress excitation of the oil column. You can view the frequency response of the notch using the FRF panel.

Before making any adjustments, you may wish to use the Swap button to copy the current stable settings to the reference boxes. If the system becomes unstable, you can immediately click on this button again and restore these stable settings to the active boxes. You can then examine the gains that caused the instability.

Panel description

The Three-Variable Controller panel allows you to set up and tune the three-variable servo control loop. All current and reference gains are included in the parameters saved to a settings file.

Three-Variable Controllers Reference

Background Information

Each of the controls on the Three-Variable Controller panel affects the system in a distinct way. It is important to understand these effects before attempting to tune the system.

Channel Selection Controls

Control	Descriptions
text box	Displays the name of the selected channel.
Down Arrow	Use the down arrow to select a channel from the drop-down list
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

Reference or Active Values

Control	Descriptions
Save , Restore , and Swap buttons	Save copies the active gain values to the Reference text boxes. Restore copies the reference gain values back into the Active text boxes. Swap swaps Active and Reference values. Use the Save button to temporarily store a set of gains that you deem satisfactory but wish to improve. If subsequent tuning yields worse results, you can then use the Restore button to get back the original acceptable gains. If you have two sets of satisfactory gains but wish to see which one is better, you can quickly switch between the two using the Swap button. The Restore and Swap buttons are inactive when the program waveform is running because sudden gain changes while the system is in motion can result in large transients.

Feedback Controls

Control	Descriptions
Displacement	Adjusts the gain applied to the displacement error. This is the primary feedback gain used in TVC. Adjusts the gain applied to the displacement reference. It affects response at very low frequencies.
Velocity	Adjusts the gain applied to the velocity feedback.
Acceleration	Adjusts the gain applied to the acceleration feedback.

Feedforward Controls

Control	Descriptions
Velocity	Adjusts the gain applied to the velocity reference. It affects response at frequencies below the oil column natural frequency. This is the primary feedforward gain used in TVC.
Acceleration	Adjusts the gain applied to the acceleration reference. It affects response at frequencies near the oil column natural frequency.
Jerk	Adjusts the gain applied to the derivative of the acceleration reference. It affects response at frequencies above the oil column natural frequency.

Input-Output Delay Controls

Control	Descriptions
Input-output delay	Adjusts the amount of delay applied to the reference in order to align it with the feedback for display and error calculation purposes.

Dynamic Force Controls

Control	Descriptions
Gain	Adjusts the gain applied to the dynamic force feedback, which is a highpass version of the regular force feedback. It provides damping of the oil column resonance..
Frequency	Adjusts the cut-in frequency of the high pass filter applied to the force feedback. A value of 0.5 to 1.0 Hz is recommend for most systems.

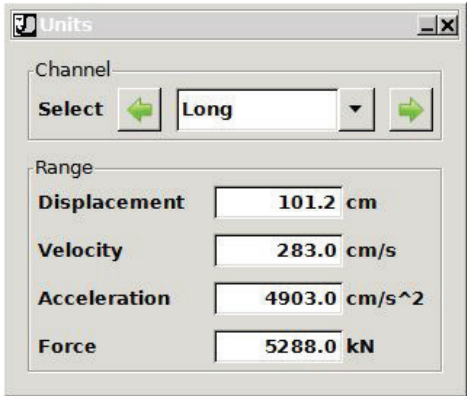
Notch Filter Settings

Control	Descriptions
Frequency	Adjusts the center frequency of the notch filter applied to the controller output. Use a value equal to the frequency of resonance that you are trying to compensate. To aid tuning, the frequency response of the TVC notch filter can be viewed in the FRF Plotter.
Bandwidth	Adjusts the 3dB bandwidth of the notch filter applied to the controller output. Use a value equal to the bandwidth of resonance that you are trying to compensate.
Depth	Adjusts the depth of the notch filter applied to the controller output. Use a negative value to suppress a resonance, a positive value to boost an antiresonance, and a zero value to do nothing.

Integrator Controls

Control	Descriptions
Reset	Displays the current state of the reset integration process using this color code: • White: The reset integrator is off. • Green: The reset integrator is integrating (“tracking”) and its contribution to the controller output is less than the Maximum Authority limit. • Red: The reset integrator is on but its output is pegged at the Maximum Authority limit (plus or minus). The conditions for tracking are: • Hydraulics are on and in high pressure. • The system is at rest. • The reset gain is greater than zero.
Authority	Adjusts the maximum amount of correction that reset integrator is allowed to apply to the controller output.

Units



Access

Main controller panel > **Configuration** menu > **Units**.

When to use the panel

Use this panel to determine scaling for BNC inputs and outputs, and when using the external analog program option.

Panel description

The Units panel displays the full-scale units for system feedback signals.

Units Reference

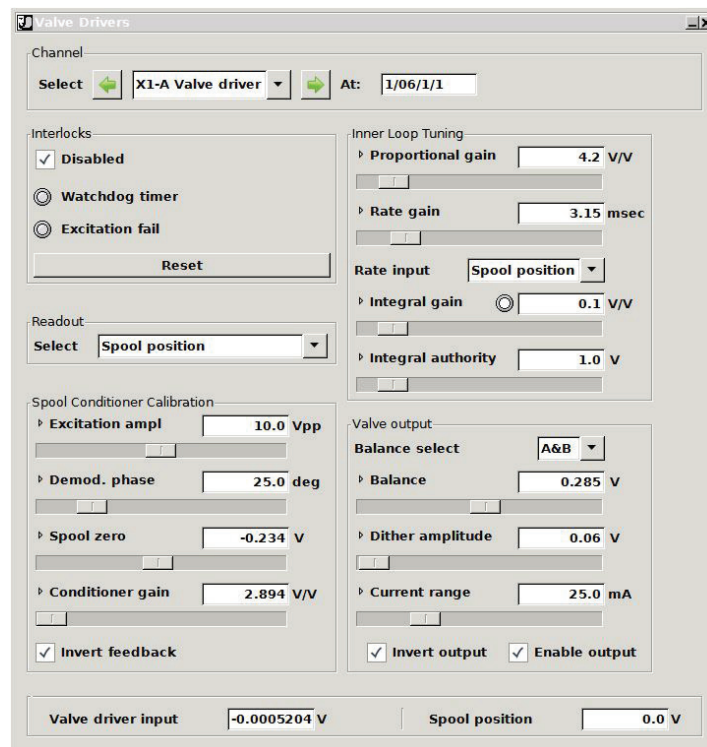
Channel Selection Controls

Control	Descriptions
text box	Displays the name of the selected channel.
Down Arrow	Use the down arrow to select a channel from the drop-down list
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

Units Display

Control	Descriptions
Displacement display box	Displays the full scale value for displacement.
Velocity display box	Displays the full scale value for velocity.
Acceleration display box	Displays the full scale value for acceleration.
Force display box	Displays the full scale value for force.

Valve Drivers



Access

Main controller panel **Calibration** menu > **Valve Drivers**.

When to use the panel

Use the panel during test setup.

Panel description

The Valve Drivers panel allows you to perform the following tasks:

- Select a specific valve driver channels.
- Adjust the dither amplitude and balance for the selected valve driver channel.
- View the value input to the valve driver by the servo controller.
- Insert the valve phase.
- Disable and/or reset interlocks.
- Monitor interlocks.
- Tune the inner loop.
- Make spool conditioner adjustments.

For more information, refer to the following topics:

Spool Conditioner Gain

Servo Gain Tuning

Spool Zero Adjustment

Valve Drivers Reference

Channel Selection Controls

Control	Descriptions
text box	Displays the name of the selected channel.
Down Arrow	Use the down arrow to select a channel from the drop-down list
Left Arrow	Use the left arrow to select the previous channel in the list.
Right Arrow	Use the right arrow to select the next channel in the list.

Interlock Controls

Control	Descriptions
Disabled check box	When checked, disables hardware interlocks for the selected channel.
Watchdog Timer indicator	Indicates the status of the watchdog timer.
Excitation fail indicator	Shows whether excitation has failed. This detector is always enabled, both in hardware and software. Excitation failure causes a system interlock because it may indicate a broken, defective or missing cable.
Reset button	When pressed, resets the hardware interlocks for the selected channel.

Readout Selection

Control	Descriptions
Select text box and drop-down menu	Selects a function for direct readout. Click the down arrow button to display a list of signals. Select the desired signal and click the check mark button to accept the selection and close the list, or click the X button to decline the selection and close the list.

Spool Conditioner Calibration Controls

Control	Descriptions
Excitation amplitude slide bar and text box	Sets the level of the excitation signal sent to the transducer. You can use the slide bar to set a value or enter it in the text box.
Demod. phase slide bar and text box	Sets the demodulator phase of the conditioner output. You can use the slide bar to set a value or enter it in the text box.
Spool zero slide bar and text box	Sets the spool position zero offset. You can use the slide bar to set a value or enter it in the text box.
Conditioner gain slide bar and text box	Adjusts the conditioner gain for the selected valve driver. You can use the slide bar to set a value or enter it in the text box.
Invert feedback check box	Selects inverted or non-inverted spool conditioner polarity.

Inner Loop Tuning Controls

Control	Descriptions
Proportional gain slide bar and text box	Adjusts the proportional gain for the selected valve driver. You can use the slide bar to set a value or enter it in the text box.
Rate gain slide bar and text box	Adjusts the derivative rate gain for the selected valve driver. You can use the slide bar to set a value or enter it in the text box.
Rate input radio buttons	Sets the signal source for rate input as spool position or spool.

Valve Output Controls

Control	Descriptions
Balance select drop-down menu	Select the servovalve from the drop-down menu.
Balance slide bar and text box	Adjusts the electrical balance of the servovalve.
Dither amplitude slide bar and text box	Adjusts the dither applied to the servovalve. You can use the slide bar to set a value or enter it in the text box.
Current range slide bar and text box	Not applicable for this system.) Current range is used to select the control current for 2-stage valves.
Invert output check box	Selects inverted or non-inverted valve phasing.
Enable output check box	When checked, sets input of valve driver to zero. (For tuning purposes only).

This page intentionally left blank.