

# DVC-8

# DIGITAL

# SWEPT-SINE

# CONTROLLER

OPERATION MANUAL

Windows Xp/Vista Version 2.41

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Serial # 500 Up

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# DVC-8 DIGITAL SINE CONTROLLER OPERATING INSTRUCTIONS

## 1.) PRODUCT DESCRIPTION.

The DVC-8 series are vibration control systems for use with IBM compatible personal computers; it is essentially a programmable digital waveform generator and data acquisition system with sophisticated control and analysis software. It is shipped along with a computer interface card, Windows Xp/Vista/7 software on a CD and a 3' cable, although a complete system would also have a shaker, amplifier, and an accelerometer at a minimum. It is available as both the 8-channel DVC-8 and 4-channel DVC-8/4 and 16 channel DVC-8/16 models.

It is designed for controlling a wide variety of swept-sine type vibration tests with ease of use and automated record- keeping. The DVC-8 is as a swept sine controller for producing continuously swept plots of the response of a system; either linear or logarithmic sweeps can be used over a wide range of sweep rates. Profiles can be specified with a combination of constant displacement, velocity, or acceleration sections.

The computer interface card installs in the computer in a PCI slot; it is a 16 bit 16 channel data acquisition card with two 16 bit analog outputs and has a 24 line 8255 type digital interface. Several vendor cards may be used, but all follow the I/O Tech DaqBoard1000 SCSI-3 connector interface. The PCI card is installed by the Windows plug-and-play software, and the board configuration must be checked after installation.

The DVC-8 Controller module connects to the computer interface card via a short SCSI-3 HD68 male- male cable, and all drive and feedback connections are made with the BNC connectors. A 6 pin Molex type connector is available for remote control of the System. The DVC-8 Controller can be configured for either 4 or 8 channel operation in Sine, Random, or Classical Shock modes; the software automatically detects the Controller configuration and enables the appropriate features.

Persons new to vibration testing should read the tutorial in section 1.1 to gain a better knowledge of the processes and terms used. Additional information is available on the web site [www.vibrationworld.com](http://www.vibrationworld.com) which is supported by the manufacturer.

**1.1) VIBRATION TESTING DESCRIPTION:** Vibration testing is the process of applying a controlled amount of vibration to a test specimen, usually for the purposes of establishing reliability or testing to destruction. In practice the test article is securely mounted on a shaker table or actuator, which may be operated by electro-dynamic or hydraulic force; typically hydraulic force is used at very low frequencies because of the large displacements involved, and electro-dynamic force is used where higher frequencies are involved.

An electro-dynamic shaker is a linear motor: a moving coil in a fixed magnetic field that is the same principle used in the construction of a loud-speaker. The magnetic field is generated by either permanent magnets or by DC current in a field coil, and audio power is provided by an amplifier of suitable rating, typically about 10 watts of audio/ pound force generated.

Some type of signal source is necessary to drive the amplifier, and an accelerometer is needed to measure the vibration response of the test article. Accelerometers are referred to as "Integrated", meaning they have a built-in amplifier and need a current source for power, or "Charge" type, requiring an external charge-converter to make a usable signal from their output. If the test article is large, then the response may vary across its surface and multiple accelerometers may be used and the outputs averaged.

The overall response curve is usually VERY non-uniform due to the response curves of the amplifier and shaker, and mechanical resonances of the shaker, test article, and mounting fixtures. To cure this, a controller is used to servo the actual measured response to the desired response curve. Controllers may be rack-mounted analog instruments or digital computer-based products.

The signal source usually attempts to simulate the real-world environment that the test article will operate in. Two methodologies are commonly used: Swept-sine and Random testing. In the Swept-sine approach the frequency is swept back and forth with amplitudes corresponding to the desired test levels. In Random testing the frequency spectrum of a noise source is shaped to represent the environment that the article will operate in. An additional test approach is Classical shock testing where the article is subjected to one or more high level shock pulses; this is similar to a one time drop-test that might occur in shipping. In all three approaches the test level can be increased until destruction occurs, thus establishing the safety margins.

## 1.2 ) SPECIFICATIONS.

### INPUT CHARACTERISTICS:

**INPUT CHANNELS:** 4, 8, or 16; the first 4 are either control or monitor.

**INPUT SENSITIVITY:** Settable from 5 to 1000 MV/G, 20 Vp-p max input.

**CURRENT SOURCES:** Four, eight, or sixteen, 4 MA each input, 18 VDC compliance, software selectable.

**REMOTE CONTROL:** Servo On, Abort, Run, and Hold; 5 volt logic activated by switch closure to ground.

**SOFTWARE REMOTE CONTROL:** Control of major functions by remote software; refer to the application note for details.

### FREQUENCY:

**FREQUENCY RANGE:** 1 to 10,000 Hz, digitally synthesized.

**STABILITY:** +/- 100 ppm/C crystal controlled.

**DISTORTION:** <0.5% THD, 0.25% typical.

**LIMITS:** Sweeps between programmed lower and upper limits.

### SWEEP:

**SWEEP MODES:** Continuous up to 9999 cycles, half-cycle, Mil-167, or manual control.

**SWEEP RATES:** 0.1 to 9.99 octaves/min logarithmic or 0.1 to 99.9 Hz/sec for linear sweeps.

**TEST PROFILES:** Up to 100 frequency breakpoints or levels of D, V, A, or S for slope in Db may be specified for each test, or stored on disk for reuse. This allows virtually any imaginable test profile to be configured.

**DWELL POINTS:** Ten dwell frequencies and dwell times may be specified.

### SERVO COMPRESSOR:

**SIGNAL OUTPUT:** SERVO OUT- 0-5 Vrms output for amplifier drive, short-circuit protected.

**DYNAMIC RANGE:** >70 Db.

**CONTROL ACCURACY:** < +/- 0.5 Db nominally.

**COMPRESSION RATE:** Slow/Medium/Fast = 0.1/0.3/1.0 Db/Sec/Hz.

**CONTROL LIMITS:** From 0.2 to 200 g with 10 Mv/g input.

### DISPLAY MONITOR:

**SWEEP:** Frequency, direction, rate (logarithmic or linear), lower & upper Limit, sweep count.

**COMPRESSOR:** Rate, speed, Db and % of compression.

**ACCELERATION:** From 0 to 200 g-peak or M/sec<sup>2</sup>.

**VELOCITY:** From 0 to 200 in/sec (IPS) or CM/sec.

**DISPLACEMENT:** From 0 to 9999 Mils or MM p-p.

**TIME:** Time, date, test run time,

**PLOTS:** CH#1 through CH#4/8/16 response plots, reference profile, transfer functions and abort limits.

**TEST DOCUMENTATION:** Any of the following plots can be stored on disk or printed out on a printer in either color or monochrome:

**CONTROL PROFILE:** The control profile that was entered in.

**ABORT LIMITS:** Upper and lower abort limit lines.

**CH#1 CONTROL CHANNEL:** Response spectrum of channel #1.

**CH#2 CONTROL/ MONITOR CHANNEL:** Response of channel #2.

**CH#3 CONTROL/ MONITOR CHANNEL:** Response of channel #3.

**CH#4 CONTROL/ MONITOR CHANNEL:** Response of channel #4.

**CH#5 MONITOR CHANNEL:** Response of channel #5.\*

**CH#6 MONITOR CHANNEL:** Response of channel #6.\*

**CH#7 MONITOR CHANNEL:** Response of channel #7.\*

**CH#8 MONITOR CHANNEL:** Response of channel #8.\*

**CH#9-16 MONITOR CHANNEL:** Response of channels #9-16 in DVC-8/16 models.

\* Only active when 8 channel operation is activated.

**TEST ARTICLE PROTECTION:**

**ABORT LIMITS:** User settable abort limits from 1 Db to 99 Db with soft shut-down.

**SYSTEM LIMITS:** Settable system limits for D, V, A; low-level gain and open-loop checks.

**OVERALL LIMITS:** Overall D, V, A limits settable by user.

**CONTROL SIGNAL LOSS:** Low gain and open loop detector check.

**MANUAL ABORT:** From keyboard, mouse, or optional remote panel.

**SYSTEM REQUIREMENTS:**

**COMPUTER:** Pentium 1Ghz or better with SVGA display, 512 Mb RAM and 20 Mb of hard disk space required

**POWER REQUIREMENTS:** Powered by wall power supply, 1 W required.

**SIZE:** 2.5öH x 7.25öW x 9öD Controller box with standard 1/3 AT size PC interface card ( 4.5" x 4.5" ).

**CONNECTIONS:** Via SCSI-3 connectors and cable from computer to Controller box and BNC connectors to signals; optional remote control connections via 6 pin Molex connector.

## 2.) INSTALLATION

**2.1 ) SOFTWARE INSTALLATION.** The software should be installed on the computer before the hardware is installed. There are two programs to install on the computer: one for the PCI interface card installed inside the computer, and the DVC8DSC software for vibration control; each comes standard on CD's provided. The software installs for all versions of Windows; the Windows NT/2000/Xp/Vista driver is automatically installed.

The DVC8DSC.EXE software comes on a CD and requires about 20 mb of hard disk space. The disks also contains some sample profiles; using the program in the Demo mode is highly recommended as a training tool to get used to the software without risking possible damage to the equipment. Load by inserting the CD into the disk drive and follow the directions and it should automatically install on the hard drive; run SETUP.EXE on the CD if it doesn't automatically start. The default directory is C:\Program Files\DVC8, but it can be changed during the setup if desired, although not recommended. Currently only 32 bit versions of Windows are supported.

To install the software for the IOtech Daq1000 board, insert the CD and run the Setup program, agree to the EULA, select DAQ1000 from the drop down list, next and check only DaqView and DacX Support and install.

The DVC8DSC program is 32 bit software intended for use on all Windows platforms; please read the CD QuickStart instructions or go to [www.vibrationworld.com](http://www.vibrationworld.com) for the latest help on operation with Windows Vista/7.

**2.2 ) HARDWARE INSTALLATION.** Turn of the computer and install the DVC-8 computer interface card in a PCI expansion card slot of an IBM compatible personal computer of Pentium grade or better with Windows software; next connect the SCSI-3 cable between the computer and DVC-8 box and connect the wall power supply to the DVC-8 and plug it in; the green Power LED on 8-channel models should now be lit. A 1 Gb Pentium or better is recommended for superior performance. The PCI card is installed by the Windows plug-and-play software, and the board configuration must be checked after installation. 16 Channel versions will have a second PCI card, DVC-8 box and cable and should all be installed at the same time, but the software only needs to be installed once.

The DVC-8 Controller module connects to the computer interface card via a short SCSI-3 HD68 male- male cable, and all drive and feedback connections are made with the BNC connectors. A 6 pin Molex type connector is available for remote control of the System. The DVC-8 Controller can be configured for either 4, 8, or 16 channel operation in Sine, Random, or Classical Shock modes; the software automatically detects the Controller configuration and enables the appropriate features. Remote control is accomplished by switch closures to ground by any of the 4 Remote Control pins on the Remote connector; refer to the connector pin-out diagram.

After the hardware installation above, turn on the computer and the system should detect a new PCI card. The Daq1000 must be initially configured according to the instructions in the I/O Tech

instructions before it is ready for use. This involves finding the DaqSetup application in the Windows Control Panel; switch to classic view if you can't locate it.

### 3) SCREEN DESCRIPTIONS.

The Sine Windows software features a Control Panel screen and many windows offering expanded information; a description of each of these screens follows.

**3.1 ) CONTROL PANEL.** This is a "virtual instrument" screen that mimics a real instrument with large digital displays, a plot of the response, LED type indicators and a monitor section that displays all system parameters. The operation is controlled either by the mouse or from the keyboard with single key keystrokes; the active keys are listed in the HELP Keyboard menu; for example "S" is servo on, "A" is abort, etc. The operator has full control of system operation with the mouse or a few easily remembered keys. Operation can be "automatic" with the servo following the desired profile, or by "manual" control of operation. If an abort condition is encountered the OFF button will change from green to red and one of the following messages appear: OPEN LOOP, LOW GAIN, OVER-TEST, >D-LIMIT, >V-LIMIT, or >A-LIMIT. Press F3 to enter the Control Panel from another screen.

**3.2 ) MENU BAR.** If the setup conditions of the test need to be checked or changed, or files saved, loaded or printed, use the Menu Bar to list all of the setup conditions and the profile to be run. Use the mouse or up/down arrow keys to move the cursor to the item to be changed and click or press enter and the default value will be displayed. If that is OK, press enter and nothing is changed. If you wish to make a change, type in the new value and enter; if it is out of bounds it is thrown out and try again, and the Cancel button or ESCAPE key restores the original value. If the value is a choice, (e.g. SLOW, ON etc.) click on the desired choice.

The Menu Bar is divided up into categories; selecting one will drop down a menu listing the items that the user can set. The categories are listed below:

**3.3 ) RESPONSE PLOT.** This graphic screen is a LOG-LOG graph of the frequency range and acceleration range. The selected profile will be displayed in white and the responses for channels #1-4 plotted in red, purple, brown and blue. If the Trip limits have been turned on, they will be displayed in yellow. Channel #5 through 8 responses are displayed ( and Printed ) with the same colors as #1-4, but with dashed lines. The plot can be zoomed in/out using the VIEW menu commands or the X,x,Y,y hotkeys. 16 Channel systems allow page-flipping between channels #1-8 and channels #9-16.

## FILE MENU:

**A) NEW PROFILE-** Clears out existing test profile parameters.

**B) OPEN PROFILE-** Opens a Windows dialog box to select the path and name of the previously saved test profile to be loaded. Opening a profile loads all of the setup parameters with it. Profiles are normally named as DVCFILES.\*, where \* is a number from 000 to 999, or \*.prf files, but any name with any extension can be used instead. *Caution: when opening or saving files, the last used folder will be displayed; be sure that you are saving them where you want, and not creating orphan files!*

**C) OPEN DVC-4 PROFILE-** For opening legacy DVC-4 profiles, which will then be converted to DVC-8 format when saved. Opens a Windows dialog box to select the path and name of the previously saved test profile to be loaded. Opening a profile loads all of the setup parameters with it. Profiles are normally named as DVCFILES.\*, where \* is a number from 000 to 999, or \*.prf files, but any 8 character name with 3 digit extension can be used instead.

**D) OPEN REPORT-** Opens a Windows dialog box to select the path and name of the previously saved test report to be loaded. Opening a report loads all of the setup parameters with it. Profiles are normally named as DVCTESTS.\*, where \* is a number from 000 to 999, or \*.rpt files, but any 8 character name with 3 digit extension can be used instead.

**E) SAVE PROFILE-** Opens a Windows dialog box to select the path and name where the test profile to be saved. Saving a profile saves all of the setup parameters with it. Profiles are normally named as DVCFILES.\*, where \* is a number from 000 to 999, or \*.prf files, but any 8 character name with 3 digit extension can be used instead. *Caution: when opening or saving files, the last used folder will be displayed; be sure that you are saving them where you want, and not creating orphan files!*

**F) SAVE REPORT-** Opens a Windows dialog box to select the path and name where the test report to be saved. Saving a report saves all of the setup parameters with it. Reports are normally named as DVCTESTS.\*, where \* is a number from 000 to 999, or \*.rpt files, but any 8 character name with 3 digit extension can be used instead. *Note: the response plot is saved with the current background color; if the report will be printed out later, it may be desirable to use the white background to save ink.*

**G) EXPORT TEST DATA-** Exports the test setup parameters and test data into an Excel-format file; the suggested naming convention is DvcDataS.\*, where \* is a user assigned number. Refer to the application note on the installation CD or on [www.vibrationworld.com](http://www.vibrationworld.com) for full details on the file format.

**H) PRINTER SETUP-** Opens a Windows dialog box to select the printer to be used and it's setup options.

**I) PRINT COLORS/MONOCROME.** Sets the printer colors to either those of the screen or all black for high contrast printouts. Some printer drivers will automatically print either color or black & white from this selection; others also need setting in the PRINTER SETUP.

**J) PRINT REPORT-** Prints the report on the default printer, or the one selected in Printer Setup.

**K) EXIT-** Opens a dialog box confirming the user's intention to exit from the program.

## **SYSTEM MENU:**

**A) COMPUTER INTERFACE-** Selects the interface between the computer and DVC-8 box; currently the DAQ1000 PCI card is the only supported interface.

**B) ACTIVE INPUT CHANNELS-** May be set to 4, 8 or 16, but never more than the system configuration allows. An 8 channel system can be set to 4 if the other channels are not needed for somewhat faster loop times or for use with older slower computers. Two 8 channel systems can be installed in one computer and operated in a Master/Slave manner for 16 channels. The inactive menu functions will be grayed out depending on the selection.

**C) PCI CARD ADDRESS-** Dialog box to set the computer interface card address, for the Daq1000 PCI card the Windows plug-and-play software sets the address, which is typically board #0. *This number must match the system setting for the controller to work!* If two systems are installed in a computer for 16 channel operation, the Master will be board #0 and the Slave will be board #1.

**D) UPDATE RATE-** Dialog box to set the software update rate, normally 50/Sec for Pentium grade computers.

**E) UNITS-** Set the units to be used, either English ( Gø, IPS & mils ), Metric (mm.,cm/sec.,m/sec<sup>2</sup>.), or Hybrid ( Gø, cm/sec & mm ).

**F) NUMERIC SEPARATORS-** Selects either English ( 1,000.00 ) or Metric ( 1.000,00 ).

**G) MANUAL MODE STEPS-** Opens a dialog box to set the step size for Manual Level control; the default value is 0.1 ( +/- 10% increments ).

**H) MAX. DISPLACEMENT-** Dialog box to set the maximum displacement allowable to protect the shaker. This value should be supplied by the shaker manufacturer.

**I) MAX. VELOCITY-** Dialog box to set the maximum velocity allowable to protect the shaker. This value should be supplied by the shaker manufacturer.

**J) MAX. ACCELERATION-** Dialog box to set the maximum acceleration allowable to protect the shaker. This value should be supplied by the shaker manufacturer.

**K) LOW GAIN TRIP POINT-** Dialog box to set the Low Gain error message trip point. Enter the Low Gain Trip point in Db. greater than 1.0. Low-Gain is defined as the compression point, or Db below maximum drive output where at least 0.25 G feedback is expected.

**L) OPEN LOOP TRIP POINT-** Dialog box to set the Open Loop error message trip point. Enter the Open-Loop trip point in Db. greater than 0.1. Open-Loop is defined as the minimum compression point ( maximum drive output voltage allowed ).This should be set above normal operating levels.

**M) CALIBRATION FACTORS, CH#-- GAIN:** Dialog box to change the channel #1 through Ch#8 or #16 scale calibration factors. The nominal value is 1.00. *NOTE: Altering this value will affect the system accuracy; this should be done as part of the calibration procedure.*

**N) UPDATE CALIBRATION FACTORS:** Saves the current calibration factors in the file "DVC8CAL.DAT" located in the C:\Program Files\DVC8 folder.

## **INPUTS MENU:**

**A) INPUT SENSITIVITIES-** Lists the four, eight or sixteen input channels; selecting any one brings up a dialog box to set that CHANNEL # sensitivity from 5-1000 MV/G. *Note that the maximum input voltage is 2.00 volts; therefore a 10 MV/G signal will limit at 200 G and a 100 MV/G signal will limit at 20 G, etc.*

**B) CURRENT SOURCES-** Lists the four, eight or sixteen input channels; selecting any one will place or remove a check mark next to the appropriate channel and turn that CHANNEL #, 4 MA current source, either ON or OFF.

**C) ACCELEROMETER-** Allows the user to record the accelerometer model # and serial #.

**D) REMOTE CONTROL-** Select whether the Remote control inputs are activated or not; a check mark indicates activation.

**E) SOFTWARE REMOTE CONTROL-** Enables control of the DVC8DSC.EXE software by another program through a shared file; a check mark indicates activation. The standard Remote Control functions are accessible and all keystroke commands; refer to the application note at the end of this manual and sample programs on [www.vibrationworld.com](http://www.vibrationworld.com) for full details and examples.

## **SWEEP SETUP MENU:**

**A) LOWER LIMIT-** Dialog box to set the LOWER frequency limit from 1 to 6250 Hz.

**B) UPPER LIMIT-** Dialog box to set the UPPER frequency limit from 5 to 10,000 Hz.

**C) SWEEP TYPE-** Select the SWEEP MODE, either linear, logarithmic, or MIL-167 sweep, which is 1 Hz steps/5 minutes.

**D) SWEEP RATE-** Sub-menus to enter in either the sweep time or rate. Rate opens a dialog box to set the SWEEP RATE from 0.1 to 99.9 Hz/sec in linear, 0.1 to 9.99 oct/min in log, or 0.1 to 99.9 steps/x minutes in MIL-167 mode, where x is set in the SWEEP TIME menu. Time opens a dialog box to enter the sweep time and the rate is calculated.

**E) # SWEEPS-** Dialog box to set the # of SWEEPS from 0.5 to 9999 for test duration. One sweep is a full up/down cycle; 0.5 would be up only.

**F) DWELL POINTS-** Allows setting the frequency and time duration for up to ten separate dwell points. Setting the frequency to 0 will disable a point.

**G) SERVO RATE-** Select the SERVO RATE, either slow, medium or fast; this is the servo response time, or bandwidth. Use medium for most tests and slow or fast as needed for increased stability or accuracy.

## TEST SETUP MENU:

**A) CONTROL MODE-** Selects the control mode, either AVERAGE, EXTREMAL, or MANUAL control of the level. As the names imply, Average uses the average of the selected channels, Extremal uses the highest value of the selected channels, and Manual control turns off automatic and uses the mouse for manual control. In manual the level is changed + or - 10% for each click on the arrow control.

**B) CONTROL CHANNELS-** Sets the channels to be active in the control loop; #1, #2, #3, and/or #4 can be made active. Channel #1 should always be one of the active channels.

**C) MODIFY PROFILE-** Displays a new form to display or set the profile levels; the frequency breakpoints can be calculated automatically. The Frequencies, Control Modes, Levels, and Abort Limits can be set for each of the 32 segments of the profile as well as comments added.

The Modify Profile screen allows entering in the individual breakpoints that configure the test profile. Each line consists of a frequency, mode and level; the mode can be D for displacement, V for velocity, A for acceleration or S for slope as specified in Db/octave. Please be careful to specify the correct units, e.g. mils instead of inches in English units. S ( for Slope ) specifies the starting frequency for that leg and the slope of the line above that frequency until the next one in units of Db/octave. An octave is a doubling of frequency and there are 3.322 octaves in a decade.

After entering in all the values, double-check them for errors and click Breakpoints to calculate the exact crossover frequencies. It is possible to enter in tests with discontinuities, but it is highly recommended that you do not do so as that will create shocks during the transitions.

**D) ABORT LIMITS-** Dialog box to set the abort level in Db. Uniformly sets an Abort Limit for all profile segments; this over-rides the individual values that may have been set in Modify Profile.

**E) TEST TITLE-** Dialog box that allows the user to type in a title for the report up to 60 characters long..

**F) TEST SUBTITLE1-** Dialog box that allows the user to type in a sub-title for the report up to 60 characters long that will be printed at the top of the plot.

**G) TEST SUBTITLE2-** Dialog box that allows the user to type in a sub-title for the report up to 60 characters long that will be printed at the top of the plot below SubTitle1.

**H) AUTO PRINT-** Prints the test report at the conclusion of a test if turned on.

**I) AUTO SAVE-** Saves the test report at the conclusion of a test if turned on; at the start of the test the user will be prompted for the filename and path.

**J) AUTO EXPORT DATA-** Saves the test report at the conclusion of a test if turned on; at the start of the test the user will be prompted for the filename and path. It saves the test data to the

designated file for later inserting into Word or Excel reports. See the Export Data folder on the installation CD for details and sample templates.

## **TEST RUN MENU:**

- A) SERVO ON-** Turns the servo On.
- B) SERVO OFF-** Turns the servo OFF
- C) SWEEP RUN-** Starts the sweep running.
- D) SWEEP HOLD-** Stops the sweep.
- E) LOWER LIMIT-** Resets the frequency to the Lower Limit.
- F) UPPER LIMIT-** Sets the frequency to the Upper Limit.
- G) DIRECTION-** Set the Direction either Up or Down.
- H) ABORT-** Abort the Test.
- I) TOGGLE CH#1- CH#4/8/16-** Toggles the displayed channel LED readout.
- J) DEMO ROUTINE-** Puts the system into the Demo mode where simulated tests are run; all normal features are active in the Demo mode.

## **VIEW MENU:**

\* Only active when 8 channel operation is activated.

**A) VIEW CHANNELS| ALL-** Allows selecting any combination of available channels to be displayed at once

**VIEW CHANNELS| CH#1-8-** Allows viewing any combination of Ch#1-8 channels to be displayed at once

**VIEW CHANNELS| CH#9-16-** Allows selecting any combination of Ch#9-16 channels to be displayed at once on 16 channel systems. This feature allows page-flipping between the lower and upper 8 channels to limit screen confusion.

**B) CH#1 RESPONSE-** Displays the CH#1 response on the plot in red if selected; the CH#1 legend appears in red at the top left of the plot.

**C) CH#2 RESPONSE-** Displays the CH#2 response on the plot in purple if selected; the CH#2 legend appears in purple at the top left of the plot.

**D) CH#3 RESPONSE-** Displays the CH#3 response on the plot in brown if selected; the CH#3 legend appears in brown at the top left of the plot.

**E) CH#4 RESPONSE-** Displays the CH#4 response on the plot in blue if selected; the CH#4 legend appears in blue at the top left of the plot.

**F) CH#5 RESPONSE-** Displays the CH#5 response on the plot in red dotted lines if selected; the CH#5 legend appears in red at the top left of the plot.\*

**G) CH#6 RESPONSE-** Displays the CH#6 response on the plot in purple dotted lines if selected; the CH#6 legend appears in purple at the top left of the plot.\*

**H) CH#7 RESPONSE-** Displays the CH#7 response on the plot in brown dotted lines if selected; the CH#7 legend appears in brown at the top left of the plot.\*

**I) CH#8 RESPONSE-** Displays the CH#8 response on the plot in blue dotted lines if selected; the CH#8 legend appears in blue at the top left of the plot.\*

**J) CH#9 RESPONSE through CH#16 RESPONSE** will be active in 16 channel systems; the colors will be the same as Ch#1-8.

**K) AVERAGE RESPONSE-** Displays the average of the selected channels ( Ch#1-Ch#8 ) instead of the individual responses; check marks indicate which channels are selected.

**L) ABORT LIMITS-** Displays the abort limits on the plot in white if selected

**M) DRIVE AMPLITUDE-** Displays the plot of the drive amplitude ( opposite of compression ) as the sweep progresses.

**N) TRANSFER FUNCTION-** Displays the plot of the transfer function of the selected channel ( #1 ó 8 ), drive amplitude or test level against the selected over the selected channel ( #1 ó 8 ), drive amplitude or test level as the sweep progresses.

**O) DISPLAY MODE-** Displays either acceleration only in the LED readout or the Control mode value ( D, V, or A). Acceleration mode should be used for profiles containing slopes.

**P) REFRESH SCREEN-** Redraws the screen to remove clutter.

**Q) PLOT BACKGROUND- BLACK-** Selects black as the plot background color; black views the best on-screen, but uses excessive ink during printing when using COPY TO CLIPBOARD to export into other applications.

**R) PLOT BACKGROUND- WHITE-** Selects white as the plot background color; white doesn't view as well as black on-screen, but uses less ink during printing when using COPY TO CLIPBOARD to export into other applications.

- S) **X-AXIS SCALE- ZOOM IN-** Expands the scale of the plot X-axis one step.
- T) **X-AXIS SCALE- ZOOM OUT-** Contracts the scale of the plot X-axis one step.
- U) **Y-AXIS SCALE- ZOOM IN-** Expands the scale of the plot Y-axis one step.
- V) **Y-AXIS SCALE- ZOOM OUT-** Contracts the scale of the plot Y-axis one step.

## **TOOLS MENU:**

**A) COPY TO CLIPBOARD-** Copies the plot onto the system clipboard to be pasted or incorporated into other applications. Press the Print-Screen key to copy the entire screen to the clipboard. The plot background color will be that set in the VIEW| PLOT BACKGROUND menu.

**B) COPY DATA TO CLIPBOARD-** Copies the test data to the Windows clipboard for pasting into Word or Excel reports. See the Export Data folder on the installation CD for details and sample templates.

## **HELP MENU:**

**A) ABOUT SOFTWARE-** Displays the version number of the software and pertinent phone numbers.

**B) ABOUT HARDWARE-** Reads the Controller configuration registers and displays the serial number and lists the hardware capabilities.

**C) KEYBOARD-** Displays the keyboard hot keys that control operation without a mouse.

**D) WHAT'S NEW-** Lists the new features in this version.

**E) HELP FILE-** Opens a Windows help file containing the on-screen manual.

**F) AUTHORIZATION CODE-** Opens a window to enter an authorization code if additional software packages have been purchased; unlocked systems do not require an authorization code and the setting should be left at zero.

## 4.) OPERATING INSTRUCTIONS

**4.1 ) SWEPT SINE CONTROLLER OPERATION.** The TEST SETUP should be checked over and modified as necessary. Swept Sine operation is selected by choosing either LINEAR or LOGARITHMIC in the SWEEP MODE; MIL-167 is a special form of linear sweep where the frequency steps 1 Hz at a time at a very slow rate. The rate is specified in either Hertz/second in linear or octaves/minute for log sweeps. Selecting either sweep mode will redraw the profile columns as segments with from- frequencies, control modes, and control levels.

First review the SETUP parameters. The UPPER & LOWER LIMITS should match those of the shaker system, typically 10-5000 Hz, and the SWEEP MODE should read "LOG " or "LINEAR"; a SWEEP RATE of 2.0 OCT/MIN allows ample time to settle as it sweeps and is usually adequate. SERVO values of RATE=MED and ABORT=3 DB should suffice for most applications. The INPUT SENS numbers should match the nominal sensitivities of the accelerometers being used and the CURRENT sources should be turned on if external power supplies are not used.

The test profile will be displayed on the plot screen in white with the Abort Limits in yellow; it can be changed by opening up the Modify Profile window in Test Setup. Check the profile columns of FREQ, MODE, and test LEVEL for accuracy and change if necessary. D stands for constant displacement, V for constant velocity, A for constant acceleration and S for a slope specified in Db/octave from the specified starting frequency and level. The TITLE may also be changed to a more meaningful label. Next select SYSTEM CONFIGURATION to review the system setups and modify if necessary. All of the above setups comprise a profile that can be saved by selecting SAVE PROFILE in the FILE Menu; it is recommended that they be saved under the filename DVCFILES.### where ### is a 0-999 number entered in, although any name can be used. The program loads DVCFILES.000 initially so save your favorite settings there.

To run a sweep turn the gain up and click START or press "S" and the system should come up to the specified level; click RUN or press "R" and the frequency should sweep to the UPPER LIMIT at the specified rate and sweep back down a total number of times as set in # OF SWEEPS. Change direction by clicking on the arrows or pressing "D", abort by clicking on the stop-sign or pressing "A". Click HELP|KEYBOARD for a list of the keyboard commands. If a hard copy is desired, Select PRINT in the FILE Menu.

If there is any question of system accuracy, then the controller self-check described in section 5.1.1 should be run prior to calibration tests and any system problems ironed out.

## 5.) SERVICE

**5. 1) TROUBLESHOOTING.** The controller is usually blamed for problems in vibration test systems when in fact controllers rarely ever fail and setup and cabling is usually the actual problem. The controller self-check is the best way to verify proper operation of the controller. If you are unable to locate the problem please have your serial # from the HELP|ABOUT HARDWARE menu, software versions from the HELP|ABOUT SOFTWARE menu, and equipment description ready before calling for technical support. The serial # is also located on the label on the bottom of the DVC-8.

**5.1.1 BUSS-CHECK FAILS.** Most likely the system address for the PCI computer interface does not match the setting in the SYSTEM|ADDRESS menu item; refer to section 2.2 Software Installation for instructions on checking the settings. Start by running the Daq Configuration utility to verify the PCI card performance and check cabling and the DVC-8 power module.

**5.1.2 CONTROLLER SELF-CHECK.** Referred to as a "closed-loop" test, this is the most basic test of performance that should always be performed before connecting up the shaker. Connect the SERVO OUT to the CH#1 input with a BNC cable and run a swept-sine test. The servo should control at the specified levels throughout the run; repeat for all channels by using "tee" and BNC cables to connect all inputs and Servo Out together and the Channel #1 through #8 plots should be superimposed. If not, see 5.1.3 below.

**5.1.3 POOR ACCURACY.** Run the self-check in 5.1.2; if the plot inaccuracies exceed +/- 1 Db (10%), then something is wrong and must be found before real tests can be run. If erratic errors are observed, check for ground loops, excessive cable lengths, loose connections, or other noise-inducing problems. *Plug all instrumentation into the same 115V circuit as the computer to minimize ground differences and choose a ground point common to the amplifier and shaker ground.*

**5.1.4) ) WON'T PRINT OR PRINTER ERROR MESSAGE.** The wrong printer might have been selected in Print Setup, or no printer has been installed at all in Windows. Installing a generic printer in Windows Printer Setup will suffice if no printer is to be used.

**5.1.5) SCREEN LOCKED UP.** Communication problem; check that both the address of both the card and software are the same, that the card is firmly seated in the connector, and that no other card is installed with the same address. If the computer goes to sleep or hibernates while running a test, the computer may freeze up waiting for data; it is best to set the Windows Power Settings for NEVER for the sleep and hibernate timeout settings.

**5.1.6) NO VIBRATION OUTPUT OR LOW GAIN MESSAGE.** Check that the cables are securely connected and that the amplifier gain was turned up. If the red compression bar graph drops yet there is no shaker table motion, then the signal is not getting to the amplifier, the amplifier is not functioning, etc; use standard troubleshooting techniques to diagnose the problem. Using an external signal generator set to 200 Hertz into the amplifier may be of assistance.

**5.1.7 ) OPEN LOOP MESSAGE APPEARS.** Check that the current sources or power supplies were turned on, that all cables are connected, the amplifier is turned on with gain up and all interlocks satisfied, and that there is motion on the shaker table. Open Loop implies that the controller put out its maximum drive voltage and less than 0.25 G response was returned; this is usually an accelerometer problem.

**5.1.8 ) WON'T READ PROFILE.** Check that the profile is stored on the default drive in the current directory, which is typically C:\Program Files\DVC8. If the folder wasn't checked when previously saving files, they may have been orphaned into lost locations; perform a search for that filename to find the missing file.

**5.1.9 ) >D-LIMIT, >V-LIMIT, or >A-LIMIT MESSAGE APPEARS.** The system limits that were set up in the SYSTEM CONFIGURATION sub-menu have been exceeded; check that the limits were properly set and that the level and/or frequency are not exceeding the limits. This is very important as exceeding limits can cause very expensive damage to the shaker, and it is important to determine the cause before proceeding. The first place to start is the test profile that has been entered: does it provide reasonable margin below the shaker limits? Be sure that correct units were entered, as in entering numbers as inches instead of mils, or confusing mils with mm.

**5.1.10 ) WINDOWS PROBLEMS.** The DVC-8 software is supplied in 32 bit Windows Xp/Vista format; be sure that you are using the right driver to match the computer operating system. Serial #s above 500 use V2.4x. See HELP|ABOUT SOFTWARE for version #s. Currently only 32 bit versions of Windows are supported.

## **5.2) UPGRADING SOFTWARE WITH THE LATEST RELEASE:**

The Setup disks contain approximately 40 files in compressed ( zipped) format; most of them are Microsoft Windows shared files that are necessary for the program to run, but do not change with program upgrades. In fact the only files that change are the .EXE files ( named DVC8DSC.EXE for Sine, DVC8DRC.EXE for Random, and DVC8CSC.EXE for Shock ); to upgrade is a simple matter of copying a new version over the old one. Setup de-compresses ( un-zips ) the files when installing them so the un-zipped version must be used in upgrades.

The files are normally placed in a directory or folder named DVC8 that is usually in the C:\Program Files folder; locate and open the folder using Windows Explorer and identify the .EXE file ( approximately 500K in size ).

If you have an upgrade disk, insert the new disk and in Windows Explorer click the appropriate Drive, select the new file, then click EDIT and then COPY; scroll down to the previously located folder and click to open it; now Click EDIT and then PASTE and you will be asked if you want to copy the new one over the old one, and click YES. The new file will replace the old one and you are finished.

The latest versions of the software are always available for downloading from the Internet; the WEB site URL is listed in the HELP|ABOUT SOFTWARE menu message.

Additional information is available on the web site [www.vibrationworld.com](http://www.vibrationworld.com) which is supported by the manufacturer.

### 5.3 DVC-8 SINE CONTROLLER CALIBRATION PROCEDURE:

#### **1. TEST EQUIPMENT REQUIRED:**

**1.1:** Personal Computer, Pentium or better running Windows Xp or Vista

**1.2:** Digital Voltmeter, true RMS reading.

**1.3:** Frequency counter, 5-5,000 Hz.

**1.4:** Low-current shunt (e.g., 100 ohm or 1K-ohm 1% resistor), or DC current reading DVM.

**1.5:** BNC cables and "tee"s.

**1.6:** Distortion Analyzer, Hewlett-Packard #331-A or better.

NOTE: The Fluke 8060A true RMS Multi-meter meets all requirements of sections 1.2-1.4.

**2.1:** The DVC-8 is a digital vibration controller that uses a PCI expansion card for the computer interface; it performs the functions of signal generation and control of a low-distortion sine-wave generator; there also are switch-able accelerometer power supplies on the inputs. There are only four, eight or sixteen gain adjustments on the system as appropriate and these are done in software; all other tests are of a verification nature. The PCI card should be installed in a personal computer along with the Daq Configuration and DVC-8 software and the cable connected to the DVC-8 connector in the rear of the chassis. The computer should be turned on, power applied to the DVC-8 and the DVC-8 Sine software should be loaded in, which should come up in the CONTROL PANEL screen in the AUTOMATIC mode.

#### **3. CURRENT SOURCE TESTS:**

**3.1:** Connect a DC current reading DVM, or precision resistor and DVM from Channel #1 Input to ground: a BNC cable with BNC-Banana jack adapter is a convenient way to accomplish this.

**3.2:** Activate the channel #1 current source with the **Inputs | Ch#1 Current** menu selection; click on the menu item to turn on the current source. Verify a DC current flow of 4.0 +/- 0.5 MA on the Input.

**3.3:** Move the meter to Channel #2 input connector, and repeat the steps in section 3.2 except use the **Inputs | Ch #2 Current** menu selection. Verify a 4.0 +/- 0.5 MA current on Channel #2 input also.

**3.4:** Repeat for channels #3 through #4, #8 or #16 as appropriate..

#### **4. CALIBRATION AND ADJUSTMENT:**

**4.1:** Using BNC cables and tees, connect the DRIVE OUTPUT on the DVC-8 box to a calibrated VRMS multi-meter and Ch#1 through Ch#8 inputs.

**4.2:** With the DVC-8 in the automatic mode setup a four-level profile in the **Test Setup | Modify Profile** menu that has the following shape: a D level of 500 Mils @ 5 Hertz, a G level of 10 Gø @ 20 Hertz, a D level of 100 Mils @ 44.3 Hertz, and a G level of 100.0 G's at 144 Hertz with the final point a G level of 100 Gø @ 5000 Hertz. Click Update Profile and then Close. Make sure current sources for all channels are turned off, the sensitivities are set to 10 mv/g, and only Ch#1 Control is enabled.

**4.3:** Click ON and let the servo come up to level and settle; click RUN and let the frequency

sweep to 200 Hz and click HOLD. Adjust the calibration factor in the SYSTEM|CAL FACTORS|CH#1 GAIN menu until the output reads 0.707 VRMS on the multi-meter. Toggle to read Ch#2 with the "T" key and adjust the Ch#2 gain calibration factor to read 100.0 G's on the display. Repeat for channels #3 through #4, #8 or #16 as appropriate; all channels are now calibrated. Click UPDATE CALIBRATION FACTORS to save the results.

**4.4:** Tee the DRIVE OUTPUT to the distortion analyzer input and verify that the distortion is within the limit with 0.5%.

**4.4:** Verify that the frequency matches the display within +/- 0.25 Hz.

**4.6:** Click the **TEST RUN | Lower Limit** menu to reset the frequency, click ON then RUN and let the system complete a full sweep up and back down and verify that the response plot falls within the Abort Limits.

This completes the calibration procedure.

## **6.1) CONNECTOR PINOUT, SCSI-3 HD68 FEMALE:**

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**P7**

## 6.2) CONNECTOR PINOUT, REMOTE CONNECTOR:

### P6

|        |   |   |
|--------|---|---|
| START  | 1 | O |
| ABORT  | 2 | O |
| RUN    | 3 | O |
| HOLD   | 4 | O |
| N/C    | 5 | O |
| GROUND | 6 | O |

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