

DVC-8

DIGITAL RANDOM VIBRATION CONTROLLER

DIGITAL RANDOM CONTROLLER
OPERATION MANUAL

Windows Xp/Vista Version 2.41

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Serial # 500 Up

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DVC-8 DIGITAL RANDOM VIBRATION 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 random type vibration tests with ease of use and automated record- keeping. The DVC-8 is used as the controller in a vibration test system for producing the desired shaped spectrum of vibrations for engineering test or production stress screening. Test profiles can be specified with up to 50 breakpoints and saved and recalled as needed.

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 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 can be 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: Start, Abort, Restart, and Pause; 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.

OUTPUT CHARACTERISTICS:

OUTPUT SIGNAL: Continuous Gaussian random drive.

DRIVE LEVEL: 16 Vp-p or 3 Vrms maximum.

PEAK LIMITING: User settable from 1 to 4 clipping ratio.

DYNAMIC RANGE: > 60 Db.

CONTROL CHARACTERISTICS:

CONTROL MODES: Single channel, Extremal, or Average.

CONTROL CHANNELS: One, two, three, or four.

FREQUENCY RANGE: 1.25-500 Hz, 2.5-1000 Hz, 5-2000 Hz, and 10-4000 Hz.

SPECTRAL RESOLUTION: 200, 400, 800, or 1600 lines.

CONTROL PROFILES: Up to 100 breakpoints; profiles may be saved and recalled from disk.

CONTROL ACCURACY: +/- 1 Db typical.

LOOP TIME: < 3 seconds for analysis and correction.

EQUALIZATION TIME: < 10 seconds for full correction of 10 Db change.

ANALYSIS WINDOWING: None, Hamming, Hanning, or Blackman selectable.

SINE-ON-RANDOM:

Up to ten sine tones can be entered into the setup table along with their control and abort parameters; these tones will be added to the random background when the S-O-R function is enabled. The initial and final frequencies, amplitudes, sweep types, rates and number of sweeps can all be set individually for each tone.

RANDOM-ON-RANDOM:

Up to ten narrow-band random tones can be entered into the setup table along with their control and abort parameters; these tones will be added to the random background when the R-O-R function is enabled. The initial and final frequencies, amplitudes, sweep types, rates and number of sweeps can all be set individually for each tone.

FIELD DATA REPLICATION:

Field acceleration data can either be recorded using the DVC-8 or previously saved files can be imported. The data is played through the DVC-8, applying necessary corrections using equalization curves to duplicate real-world situations. Common data formats can be converted

and short data can be looped indefinitely. Sampling rates: 1.28 Khz, 2.56 Khz, 5.12 Khz and 10.24 Khz for 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz frequency ranges.

TEST ARTICLE PROTECTION:

ABORT / ALARM LIMITS: User selectable from 3 Db to 99 Db.

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

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

PRETEST LIMITS: Settable by user.

EQUALIZATION: Low level equalization of system.

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

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

REFERENCE SPECTRUM: 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 spectrum of channel #2.

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

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

CH#5 CONTROL/ MONITOR CHANNEL: Response spectrum of channel #5.*

CH#6 CONTROL/ MONITOR CHANNEL: Response spectrum of channel #6.*

CH#7 CONTROL/ MONITOR CHANNEL: Response spectrum of channel #7.*

CH#8 CONTROL/ MONITOR CHANNEL: Response spectrum of channel #8.*

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

AVERAGE RESPONSE: Average response of the selected channels.

DRIVE OUTPUT: Spectrum of Controller drive output signal.

TRANSFER FUNCTION: Plots the transfer function of any channel or drive over any other channel or drive spectrum.

CH#1 WAVEFORM: Oscilloscope type plot of CH#1 input waveform.

CH#2 WAVEFORM: Oscilloscope type plot of CH#2 input waveform.

CH#3 WAVEFORM: Oscilloscope type plot of CH#3 input waveform.

CH#4 WAVEFORM: Oscilloscope type plot of CH#4 input waveform.

CH#5 WAVEFORM: Oscilloscope type plot of CH#5 input waveform.*

CH#6 WAVEFORM: Oscilloscope type plot of CH#6 input waveform.*

CH#7 WAVEFORM: Oscilloscope type plot of CH#7 input waveform.*

CH#8 WAVEFORM: Oscilloscope type plot of CH#8 input waveform.*

CH#9-16 WAVEFORM: Waveforms of channels #9-16 in DVC-8/16 models.

* Only active when 8 channel operation is activated.

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 CDø 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.

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 for the latest help on operation with Windows Vista.

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. 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.

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.

3.) SCREEN DESCRIPTIONS. The Random 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 start, "A" is abort, etc. The operator has full control of system operation with the mouse or a few easily remembered keys. Operation is "automatic" with the controlled response following the desired profile. If an abort condition is encountered the Stop 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.

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 Cancel button or pressing the 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 spectral response. The selected profile will be displayed in white and the responses for channels #1-4 plotted in red, purple, brown, and blue. Channel #5 through 8 responses are displayed (and Printed) with the same colors as #1-4, but with dashed lines. If the Trip limits have been turned on, they will also be displayed in yellow. The drive spectrum will be displayed in green if turned on also. The plot can be zoomed in/out using the VIEW menu commands or the X,x,Y,y,Z and z hotkeys. 16 Channel systems allow page-flipping between channels #1-8 and channels #9-16.

Clicking the mouse anywhere in the plot area will bring up a message box reading out the frequency line and the channel #1 ASD at that point, so click on the plot line for a readout of that point.

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 DVCFILER.*, 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. *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!*

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. Reports are normally named as DVCTESTR.*, 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 is to be saved. Saving a profile saves all of the setup parameters with it. Profiles are normally named as DVCFILER.*, 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 DVCTESTR.*, 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 www.vibrationworld.com for full details on the file format.

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

I) PRINT COLOR/MONOCHROME- Sets the colors outputted to the printer to either the

same colors as the screen, or all black for high contrast printouts. With some printer drivers this will automatically choose either color or black & white printing; others require setting the printer to color mode in the printer setup.

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

K) EXIT- Opens a Windows dialog box to confirm your intention of exiting 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 cards 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 the update rate, normally 10/Sec for Pentium grade computers.

E) UNITS- Set the units to be used, either English (Gø, IPS & mils), Metric (mm.,cm/sec.,m/sec².), 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 reset the channel # 1 through 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 #1 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- Opens Windows dialog boxes to record the accelerometer model # and serial #.

D) REMOTE CONTROL- Select whether the Remote control inputs are activated or not.

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 for full details and examples.

PROFILE SETUP MENU:

A) FREQUENCY RANGE- Choose either the 1.25-500, 2.5-1000, 5-2000, or 10-4000 Hz frequency ranges.

B) LINES OF RESOLUTION- May be set to 200, 400, or 800 lines of resolution or 1600 in

unlocked systems. The spectral resolution will be the frequency range divided by the lines of resolution, thus with 2000 Hertz and 400 lines, each spectral line will be spaced 5 Hertz apart.

C) MODIFY PROFILE- Displays a new form to display or set the profile levels and the frequency breakpoints. The Frequencies, Levels, and Abort Limits can be set for each of the 100 segments of the profile as well as comments added.

D) SINE-ON-RANDOM SETUP: Brings up a new screen for entering in the test parameters for Sine-On-Random operation; refer to section 4.2 for details.

E) RANDOM-ON-RANDOM SETUP: Brings up a new screen for entering in the test parameters for Random-On-Random operation; refer to section 4.3 for details.

F) FIELD DATA REPLICATION: Brings up a new screen for entering in the test parameters for field data replication; refer to section 4.4 for details.

G) CLIPPING RATIO- Dialog box to set the CLIPPING RATIO from 1 to 4.

H) FILTERS- Select either None (rectangular), Hamming, Hanning, or Blackman windowing filters.

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 each click on the arrow control increases or decreases the level by 10%.

SINE-ON-RANDOM- Enables Sine-On-Random operation; refer to section 4.2 for details.

RANDOM-ON-RANDOM- Enables Random-On-Random operation; refer to section 4.3 for details.

FIELD DATA REPLICATION- Enables field data replication; refer to section 4.4 for details.

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) TEST DURATION- Dialog box to set the test duration.

D) PRETEST LEVEL- Dialog box to set the pretest level in Db down from the full-test level.

E) FULLTEST TRANSITION- Sets the transition from PreTest to FullTest in Db down from the FullTest level; the default value is 2 (Db). If zero is entered, the test will remain at the pretest level until FullTest is clicked.

F) ABORT LIMITS- Dialog box to set the abort levels in Db above and below the reference spectrum. Uniformly sets an Abort Limit for all profile segments; this over-rides the individual values that may have been set in Modify Profile.

G) SPECTRAL CHECK- Turns on individual spectral line checking against the abort limits. After 60 seconds a warning will start flashing; after 60 more seconds the test will be aborted if the control has not been pulled within limits by then.

H) CORRECTION RATE- Alters the rate of spectral error correction; Normal is the default. May be set to Slow if instabilities are encountered, or to Fast to speed up correction.

I) DRIVE PRE-COMPENSATION- Allows the startup drive spectrum to be a normal flat curve or pre-compensated with a typical shaker curve; the shaker curve will usually result in faster equalization initially. Alternately customers typically run a short test (30 seconds) to check out the system before an actual test and the system will equalize during that period.

J) DRIVE LIMITS- The controller will normally try to achieve the desired test profile by increasing or decreasing drive at each spectral line as needed; this can sometimes result in exceeding the displacement limitations of the shaker with tests with large low-frequency components. The Drive Limits setting allows limiting the maximum drive at any line to prevent overtravel situations; it defaults to an ASD of 5.0 setting, but can be reduced to limit displacement or increased to improve low frequency control. Systems with poor low frequency gain may require adjusting this setting.

K) TITLE- Allows the user to type in a title up to 60 characters long for the report.

L) 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.

M) 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.

N) AUTO PRINT- Prints the test report at the conclusion of a test if turned on (checked in the menu).

O) AUTO SAVE- Saves the test report at the conclusion of a test if turned on (checked in the menu). The user will be prompted for the path and filename at the start of the test.

P) 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.

Q) DEMO- Runs the demonstration program if checked; if the Buss-Check detects that the card is not installed or not communicating the program will be placed in the Demo mode. The Demo

mode runs simulated tests, but all normal features are active.

TEST RUN MENU:

- A) START-** Turns the output On and starts the test.
- B) STOP-** Turns the output off and stops the test.
- C) PRE-TEST-** Reduces the test level to the pretest amount.
- D) FULL-TEST-** Raises the test level to the normal test level.
- E) EQUALIZE-** Places the program in the equalize mode, where the drive spectrum is adjusted to compensate for the system characteristics.
- F) HOLD-** Turns off the equalize function and holds the current values.
- G) PAUSE-** Temporarily halts the test; use RESTART to resume operation.
- H) RESTART-** Resumes operation after a PAUSE.
- I) CLEAR AVERAGES-** Erases all accumulated averages and starts over.
- J) CLEAR DRIVE SPECTRUM-** Returns the drive spectrum to it's initial reference spectrum starting point.
- K) ABORT-** Aborts the test.

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 side of the plot. Clicking the mouse anywhere in the plot area will

bring up a message box reading out the frequency line and the channel #1 ASD at that point, so click on the plot line for a readout of that point.

C) CH#2 RESPONSE- Displays the CH#2 response on the plot in purple if selected; the CH#1 legend appears in purple at the side of the plot.

D) CH#3 RESPONSE- Displays the CH#3 response on the plot in brown if selected ; the CH#1 legend appears in brown at the side of the plot

E) CH#4 RESPONSE- Displays the CH#4 response on the plot in blue if selected; the CH#1 legend appears in blue at the side 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 brown at the side 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 blue at the side 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 side 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 side 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; the selected channels will have check marks.

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

M) DRIVE SPECTRUM- Displays the drive spectrum on the plot in green if selected.

N) TRANSFER FUNCTION- Plots the transfer function of the selected channel, drive spectrum or test profile against a different channel, drive spectrum or test profile.

O) CH#1 WAVEFORM- An oscilloscope type snapshot of the channel #1 input waveform, plotted in red.

P) CH#2 WAVEFORM- An oscilloscope type snapshot of the channel #2 input waveform, plotted in purple.

Q) CH#3 WAVEFORM- An oscilloscope type snapshot of the channel #3 input waveform, plotted in brown.

R) CH#4 WAVEFORM- An oscilloscope type snapshot of the channel #4 input waveform, plotted in blue.

S) CH#5 WAVEFORM- An oscilloscope type snapshot of the channel #5 input waveform, plotted in red dotted lines. *

T) CH#6 WAVEFORM- An oscilloscope type snapshot of the channel #6 input waveform, plotted in purple dotted lines. *

U) CH#7 WAVEFORM- An oscilloscope type snapshot of the channel #7 input waveform, plotted in brown dotted lines. *

V) CH#8 WAVEFORM- An oscilloscope type snapshot of the channel #8 input waveform, plotted in blue dotted lines. *

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

X) REFRESH SCREEN- Redraws the screen to remove clutter.

Y) DISPLAY AVERAGING- Allows averaging the adjacent spectral lines to remove noise and present a clearer plot; it may be turned On or Off as desired.

Z) 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.

AA) 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.

AB) X-AXIS SCALE- ZOOM IN- Expands the scale of the plot X-axis one step; the ranges are 2.5-500 Hz, 5-1000 Hz, 10-2000 Hz, and 20-4000 Hz. The capitol X key (shift-x) does the same thing.

AC) X-AXIS SCALE- ZOOM OUT- Contracts the scale of the plot X-axis one step; the ranges are 1.25-500 Hz, 2.5-1000 Hz, 5-2000 Hz and 10-4000 Hz. The x key does the same thing.

AD) Y-AXIS SCALE- UPPER LIMIT- Sets the top scale of the plot Y-axis; the available scales are 100, 10, 1.0, 0.1, and .01. The capitol Y key (shift + y) shifts the scale up one range and the y key shifts the scale down one range.

AE) Y-AXIS SCALE- LOWER LIMIT- Sets the bottom scale of the plot Y-axis; the available scales are .01, .001, .0001, .00001 and .000001. The capitol Z key (shift + z) shifts the scale up one range and the z key shifts the scale down one range.

TOOLS MENU:

A) COPY TO CLIPBOARD- Copies the plot onto the system clipboard to incorporate 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 # 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-line 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) RANDOM CONTROLLER OPERATION. The TEST SETUP should be checked over and modified as necessary.

First review the SETUP parameters. The FREQUENCY RANGE should match that of the shaker system, typically 5-2000 Hz, and the DURATION set to the desired test length. CLIPPING RATIOS of 3.0, FILTERS = RECTANGULAR (none), and ABORT and PRETEST levels of 6 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 FREQUENCY and test LEVEL for accuracy and change if necessary. 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 DVCFILER.### where ### is a 0-999 number entered in. The program loads DVCFILER.000 initially so save your favorite settings there.

To run a test, turn the gain up and press "S" (or click on START); the system should slowly come up to the specified PRE-TEST level, increase to the FULL-TEST level, and the test run for the specified duration. Press "P" (or click PAUSE) and the test will pause until a RESTART is activated. Clicking on STOP or ABORT will end the test. 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.

4.2 SINE-ON-RANDOM MODE: Sine-On-Random, or S-O-R mode is the process of adding a group of sine waves to a random noise background; this is done to more faithfully replicate situations like helicopters, where there is a lot of noise, but also a dominant vibration from the rotor and its harmonics.

In practice the user should select Sine-On-Random Setup from the Test Profile menu, which brings up the S-O-R setup screen. There is a table allowing entering in test setup data for up to ten sine tones; the first three are seeded with typical data to get started. The user enters in the initial frequencies and desired test levels; normally the frequencies are harmonics of the first point, but they don't have to be. The pertinent sweep setup parameters are also entered here if the test includes sweeping the tones sweeps may be linear or logarithmic with rates expressed as Hz/Minute or Octaves/Minute. Click the Sweep Run button if the sweep function is desired.

At this point the software has been setup, but the controller is still operating in the normal control mode. To place the controller in the S-O-R mode, select Sine-On-Random from the Test Setup menu and a check mark will appear next to that selection, and the sine tones will be added to the

displayed test profile. Best results will usually be obtained by using a frequency range that best fits the test requirements, using a high resolution (800 or 1600 lines), and applying a windowing filter like Hanning.

Simply click Start to begin a test and the controller will equalize all the peaks to the desired levels; if the Sweep Run button was previously clicked the tones will start sweeping according to the settings, and the sweep can be paused or the settings checked by opening the SOR Setup screen again. To return to normal controller operation, simply deselect the S-O-R mode in the Test Setup menu.

4.3 RANDOM-ON-RANDOM MODE: Random-On-Random, or R-O-R mode is the process of adding a group of narrow-band random peaks to a random noise background; this is done to more faithfully replicate situations like helicopters, where there is a lot of noise, but also a dominant vibration from the rotor and its harmonics.

In practice the user should select Random-On-Random Setup from the Test Profile menu, which brings up the R-O-R setup screen. There is a table allowing entering in test setup data for up to ten random bands; the first three are seeded with typical data to get started. The user enters in the initial frequencies and desired test levels, and the bandwidth of the bands expressed in %; normally the frequencies are harmonics of the first point, but they don't have to be. The pertinent sweep setup parameters are also entered here if the test includes sweeping the tones; sweeps may be linear or logarithmic with rates expressed as Hz/Minute or Octaves/Minute. Click the Sweep Run button if the sweep function is desired.

At this point the software has been setup, but the controller is still operating in the normal control mode. To place the controller in the R-O-R mode, select Random-On-Random from the Test Setup menu and a check mark will appear next to that selection, and the R-O-R bands will be added to the displayed test profile. Best results will usually be obtained by using a frequency range that best fits the test requirements, using a high resolution (800 or 1600 lines), and applying a windowing filter like Hanning.

Simply click Start to begin a test and the controller will equalize all the peaks to the desired levels; if the Sweep Run button was previously clicked the tones will start sweeping according to the settings, incrementing every time the DOF setting is reached, and the sweep can be paused or the settings checked by opening the ROR Setup screen again. To return to normal controller operation, simply deselect the R-O-R mode in the Test Setup menu.

4.4) FIELD DATA REPLICATION: Field data replication is the process of recording real-time data from a test situation and playing back the recorded data through the shaker system with the controller making the necessary corrections so as to faithfully reproduce the desired test results. To accomplish this task the controller needs a source file to take data from and an equalization curve to apply to the data stream to for correction for the anomalies of the complete shaker system.

The first step is to record the field data; this can be done with a separate field recorder or with the DVC-8 itself and to save this data as a file. The data can be saved as raw data or as a wave file

and the DVC-8 software can convert the files. The second step is to run a flat-spectrum test and allow the system to equalize; this equalization curve can then be saved for faster initialization of the system.

In actual use, the user would first connect up the shaker system and run a flat-spectrum test; this is easily done by selecting New from the File menu to enter in the test profile and running the test, but for best results, please use the frequency range that will be used for the actual test. After a few minutes the test can be stopped and the equalization curve saved with the Save Equalization Curve in the File menu; any name can be used, but if the suggested file extension .equ is used, all previously saved curves will be listed in the file tree listing. Next select Field Data Replication Setup from the Test Profile menu, which brings up the FDR Setup screen. Click Browse next to the Equalization Curve box and select the previously saved curve.

If field test has been previously recorded and the file transferred to the computer containing the DVC-8 software, click Browse next to the Source File box and select the desired file. If the file was recorded with the DVC-8, or if it is a wave file, the DVC-8 can read the header and determine the sampling rate, # of channels, format, etc, and make the necessary conversions to the frequency range selected. If the field data was recorded in a different manner, you will have to enter in those parameters manually so that the software can correctly interpret the data. The file can be looped indefinitely if it is shorter than the desired test duration.

To record a new data file, first place the controller in the frequency range that best suits the application and enter in the accelerometer sensitivity and current settings. Click FDR Setup in the Profile Setup menu, which brings up the FDR Setup screen and enter in the test duration and number of channels to record. For best fidelity and to minimize file size, the sampling rate should be chosen to match that the DVC-4 will use in normal operation; sampling rates are 1.28 KHz, 2.56 KHz, 5.12 KHz and 10.24 KHz for 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz frequency ranges respectively. Click the Source File Browse button and choose a folder and filename and click Start Recording when ready; the recording will automatically terminate and save the file to the specified location and will appear in future Browse operations.

At this point the software has been setup, but the controller is still operating in the normal control mode. To place the controller in the FDR mode, select Field Data Replication from the Test Setup menu and a check mark will appear next to the selection. The equalization curve will be loaded in and the system placed in the Hold mode and the display showing a flat spectrum. When you click Start the system will start running, taking data from the source file instead of random noise and applying the equalization curve to it.

The system has no way to know what sensitivities were used in the recording, so it will control to the level specified in the Gref box, which is determined by the values in the Modify Profile menu. It can be increased or decreased with either the Up/Down arrows or by changing the values in the Modify Profile menu. The input data stream can be observed by selecting Input Data Stream from the View|Waveforms menu, but for serious manipulation of data we recommend the free program Audacity, which is included on the installation CD. Audacity also has excellent file conversion abilities if field data was recorded in an unsupported format.

To return to normal controller operation, simply deselect FDR mode or select Average from the Test Setup menu.

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 us 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's 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 C:\DVC8; locate and open the folder using Windows Explorer and identify the .EXE file (approximately 450K in size).

If you have an upgrade disk, insert the new disk and in Windows Explorer in 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 which is supported by the manufacturer.

5.3 DVC-8 RANDOM CONTROLLER CALIBRATION PROCEDURE:

1. TEST EQUIPMENT REQUIRED:

- 1.1: Personal Computer, Pentium or better running Windows
- 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: Sine Generator, 5-10,000 Hertz, THD < 0.5%.

NOTE: The Fluke 87 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 shaped-spectrum random noise generator and spectrum analyzer; there also are four, eight or sixteen switch-able accelerometer power supplies on the inputs. There are no adjustments on the system; all tests are of a verification nature. The card should be installed in a personal computer and the cable connected to the DVC-8 connector in the rear of the chassis. The computer should be turned on and the DVC-8 Random software should be loaded in, which should come up in the CONTROL PANEL screen 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. SPECTRUM ANALYZER VERIFICATION

4.0: Note: This test is of a verification nature and exact numbers are not required; typical peak readings of approximately ASD = 10 are expected results and any reading >5 is acceptable.

4.1: The input channels of the DRC are a spectrum analyzer for the vibration bands (5-2000 Hz); the gains are set by the sensitivity numbers in the **Inputs | Ch# - Sensitivity** menu. Connect the Sine Generator output into channels #1 through #8 inputs and set the generator output to 0.141 +/- 0.01 Vrms, 200 Hz. With the **Profile Setup | Frequency Range** menu select the **5-2000 Hz Frequency Range**, select **400 Lines** in the **Profile Setup** menu and select **HANNING** Filter in the **Profile Setup | Filtering** menu, select **Test Setup | Control Mode | Manual** and enter 100 MV/G Sensitivity for all channels in the **Inputs | Ch# - Sensitivity** menu. Be sure that **Display Averaging** is turned **Off** in the **View** menu.

4.2: Click on the **START** button to take a sample and observe the highest red line at 200 Hz. Click on the red **STOP** sign to abort and clear the readings, press **X** to clear the screen, and click the **View | Ch#2-8 Response** menus to plot all channels simultaneously and **START** again; verify an ASD reading >5 for all channels.

4.3: Select the **2.5-1000 Hz** Frequency Range in the **Profile Setup | Frequency Range** menu, set Sine Generator output to 0.100 +/- .01 Vrms, and repeat section 4.2 except at 100 Hz.

4.4: Select **1.25-500 Hz** Frequency Range in the **Profile Setup | Frequency Range** menu, set Sine Generator output to 0.071 +/- .01 Vrms, and repeat section 4.2 except at 50 Hz.

5. RANDOM NOISE GENERATOR VERIFICATION

5.1: Connect the SERVO OUTPUT to the CH#1 INPUT and the DVM set to AC Volts, select the NAVMAT P492 profile with the **File | Open Profile** menu if it is available, and select the 5-2000 Hz Frequency Range, Filters rectangular, abort limits=3 Db, CH#1-4 Sensitivities set to 10 MVIG, and all Currents OFF. If NAVMAT P9492 was not available select the **Profile Setup | Modify Profile** menu and set-up the following test:

FI=20 Hz § ASD=.01, F2=80 Hz, ASD=.04. F3=350 Hz, ASD=.04, F4=2000 @ ASD=.007; the calculated level will be 6.1 G-rms.

5.2: Click on the **START** button and the system should output a low level signal increasing to the Pretest level. It will automatically increase to the Full-test level; allow the system 2 minutes to equalize and then verify that the output level is 61.0+/- 10 MV-rms as best estimated on the varying readings on the DVM, and that the plotted response lies within the **ABORT** limit lines.

5.3: (Optional Spectrum Verification) Connect the input of a audio range spectrum analyzer such as a Stanford Research #SR760 to the **DRIVE OUTPUT** and monitor the test. Set up the analyzer for 100 averages minimum, repeat section 5.2 and verify that the analyzer output matches the screen plot within limits. *NOTE: analyzer setup can greatly affect the plot results! Use similar frequency range and filtering settings as the DRC software, and select appropriate input range and scale factor settings.*

This completes the calibration procedure.

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6.1) CONNECTOR PINOUT, SCSI-3 FEMALE:

P7

6.2) CONNECTOR PINOUT, REMOTE CONNECTOR:

P6

| | | |
|---------|---|---|
| START | 1 | O |
| ABORT | 2 | O |
| RESTART | 3 | O |
| PAUSE | 4 | O |
| N/C | 5 | O |
| GROUND | 6 | O |

Revised 6/01/2011 C:\DVC8DRManual.Doc