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VDSP31

EIGHT CHANNEL
DIGITAL SERVO CONTROLLER
USER'S MANUAL

360-19-000-4000
Revision 1.9
May, 1998

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SCOPE

This document will specify the hardware and software components that comprise the VDSP31 Digital Servo Controller. The application of the VDSP31 to structural testing is beyond the scope of this document. In addition, this document will specify the HPIB command syntax and communications protocols.

INTRODUCTION

The VDSP31 is a VXI based, digital servo control module. The VDSP31 offers a complete solution for high performance closed loop applications. The VDSP31 has been designed to solve specific problems related to the control of hydraulic actuators. Signal conditioning modules can be combined on a per channel basis to configure the VDSP31 for load or displacement feedback. The VDSP31 contains application firmware that will control up to eight hydraulic actuators. The board can be programmed using VXI Message Based commands or by directly accessing the VDSP31 registers through the dual-access RAM. Shown below in **Figure 1** is a functional block diagram of the system. Host commands are processed by the VXIbus command processor and routed to the various subsystems. The Sine and Endpoint blocks are used to generate setpoints for the servo. The composite setpoint is fed to a control law that calculates a control output based on the actuator feedback. The dither generator applies a small amplitude waveform to the valve to eliminate valve “stiction”.

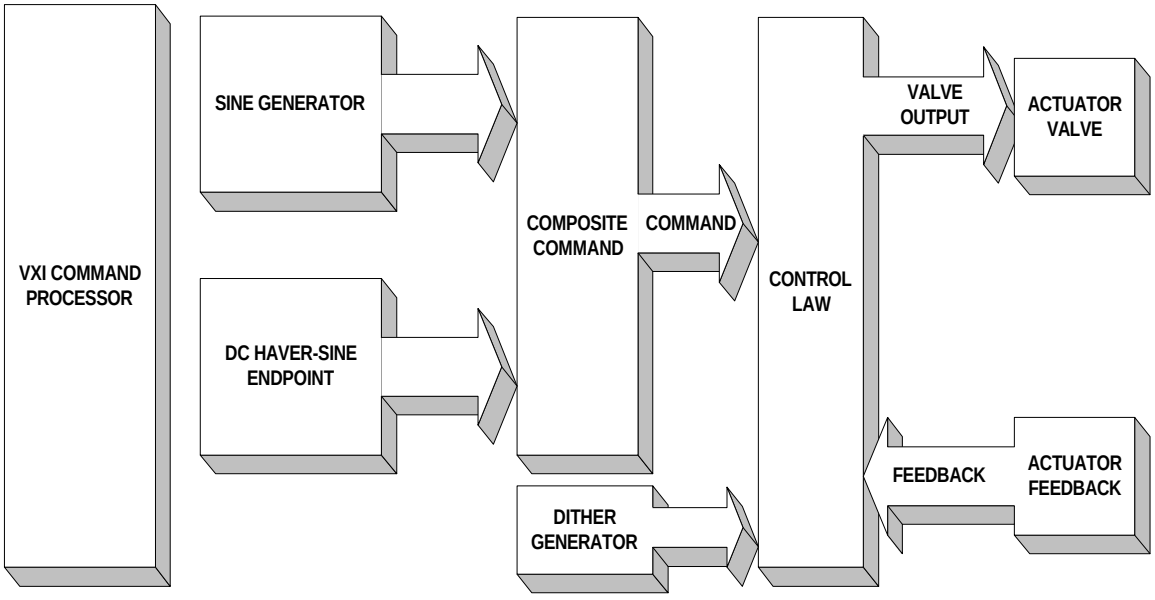


Figure 1

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FIRMWARE SPECIFICATIONS

VXI TO VDSP COMMUNICATION

The VXI host communicates with the VDSP31 firmware through a shared RAM interface. The VXI host can download setup and configuration data for each servo channel. Once configured, the VDSP31 firmware will wait for commands to be sent by the VXI host. The VDSP31 can be programmed to interrupt to the VXI host upon command completion or if an error occurs. The VDSP31 is designed to operate on its own without VXI host intervention. The VXI host need only communicate with the VDSP31 to send new commands or to check status. The VDSP31 maintains time history information and status for each channel such that the VXI host can monitor servo performance.

VXI A16 REGISTER MAP

The VDSP incorporates all the configuration registers and message-based device registers required by the VXIbus specification. All registers accessible by the VXIbus conform to the definitions and rules given in the VXIbus specification. The register map for the VXIbus is shown below :

OFFSET	FUNCTION
00	ID/LOGICAL ADDRESS
02	DEVICE TYPE
04	STATUS/CONTROL
06	OFFSET
08	PROTOCOL/SIGNAL
0A	RESPONSE
0C	UNUSED
0E	DATA LOW
10	A24 POINTER HIGH
12	A24 POINTER LOW
14	A32 POINTER HIGH
16	A24 POINTER LOW
18 - 1E	VXI RESERVED

Table 1

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A16 ADDRESS

The VDSP31 is setup at the factory for dynamic configuration. The power-up logical address is 255. The VXI resource manager will assign the VDSP31 a logical address during system configuration. To VDSP31 can be located at a fixed address by installing jumpers as described in the VDSP31 User's Manual.

A24 ADDRESS SPACE CONFIGURATION

The VDSP shared RAM is located in either A24 space. The VDSP will request 2 MB of memory from the VXI Resource Manager. The Resource Manager shall assign the address of this shared memory.

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SETPOINT GENERATOR

Please refer to **Figure 2** during this discussion. The shaded boxes represent user programmable parameters. The Setpoint Generator is a digital function generator that drives the PID controller command on each channel. The generator contains an AC section and a DC section. The AC section contains a 256 point +/- 1 volt sine wave lookup table. The VDSP maintains a read pointer that increments at a rate determined by the **AC Period** parameter. The AC period value applies to all channels. Phase for each channel is calculated by adding a fixed offset to the table read pointer. The **AC Phase** parameter is used to change the phase for each channel. The AC amplitude for each channel is calculated by multiplying a span constant with the current table value. The **AC Span** parameter is used to vary the amplitude. The DC section contains a 256 point +/- 1 volt haver-sine lookup table, which spans -90.0 to +90.0 degrees of a sinusoid. The VDSP maintains a read pointer unique to each channel for use as an index into this table. The DC index increments at a rate determined by the **DC Period** parameter. The DC index will begin to change when a channel has received a new **DC Offset** command. The outputs of the AC and DC sections are combined to form a composite command that is sent to the PID summing junction.

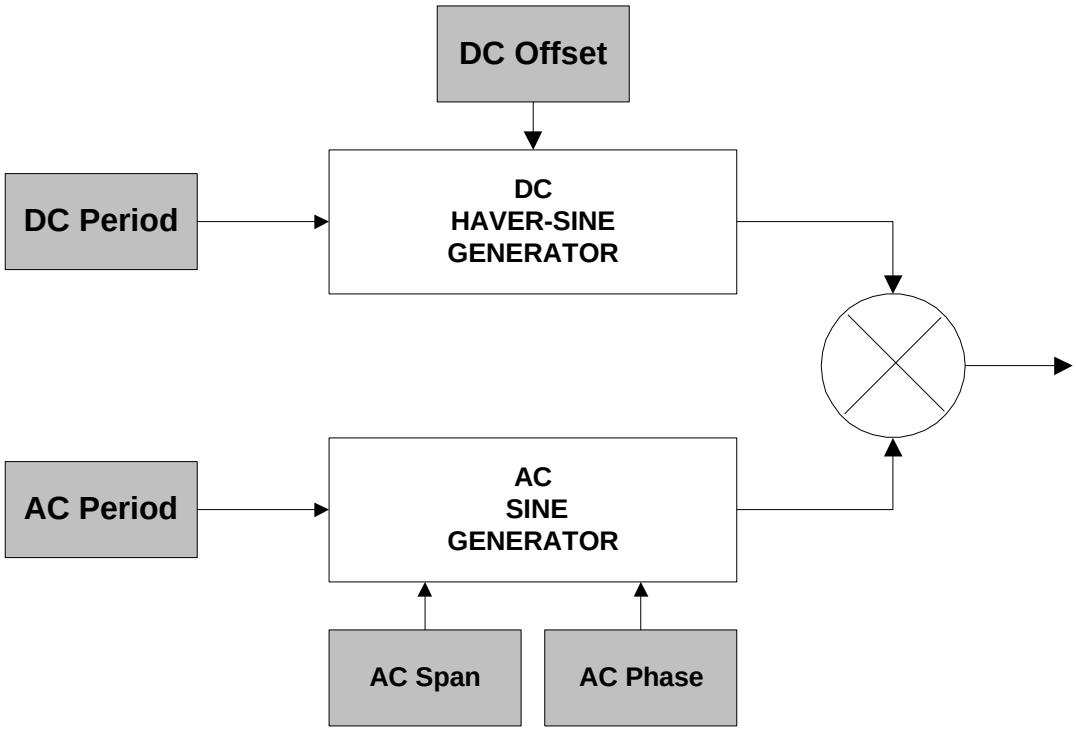
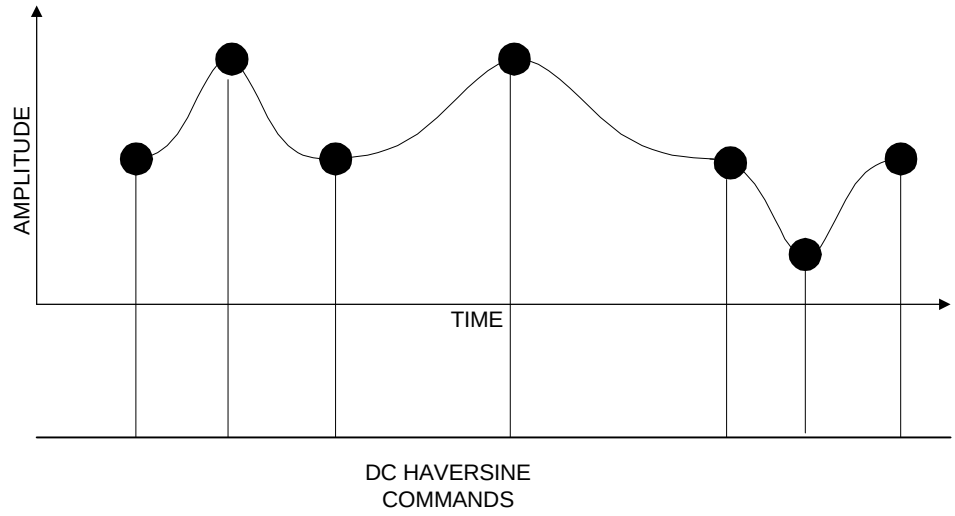


Figure 2

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As shown below in **Figure 3**, the setpoint generator can be used generate complex DC transitions and AC waveforms.



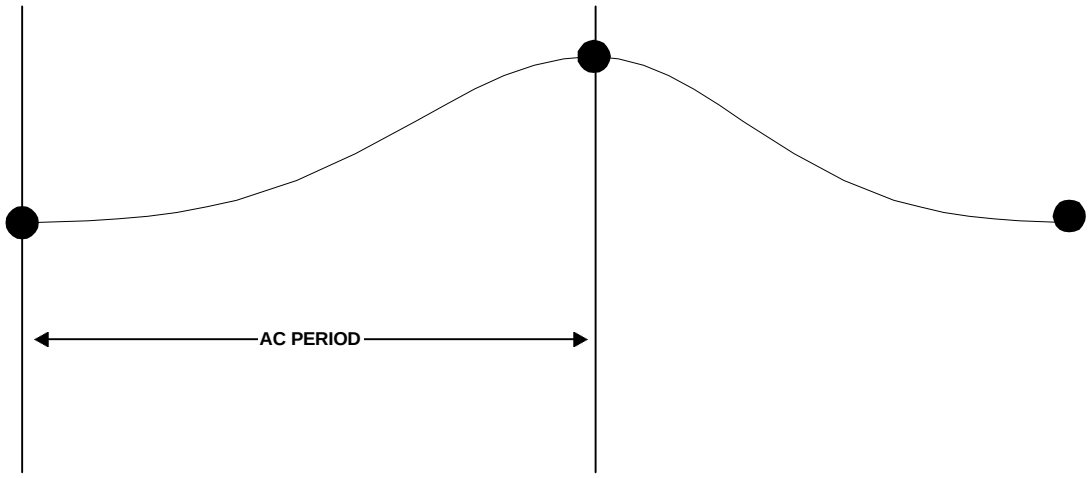


Figure 3

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FEEDBACK SUBSYSTEM

Please refer to **Figure 4** for this discussion. The shaded boxes represent user programmable parameters. External low-level bridge input signals from the front panel connectors are fed to a programmable instrumentation amplifier. The amplifier gain is programmable in fixed ranges of 1,2,4,8,100,200,400 and 800. The **PGA Range** parameter is used to select the gain range. The output of this amplifier is summed with a D/A converter that offsets or nulls the amplifier output from -10.0 to + 10.0 volts DC. This helps preserve the dynamic range of the input signal. The **PGA Offset** parameter is used to provide the DC offset. The VDSP is able to perform software polarity switching for the high level feedback signal. The **Polarity** parameter is used to select normal or reverse polarity. A second D/A provides bridge excitation from 0.0 to 10.0 volts DC. The **DC Excitation** parameter is used to change the excitation output. A calibration relay can apply a shunt calibration resistor to one leg of a bridge transducer. The VDSP is supplied with 100 KΩ precision resistors.

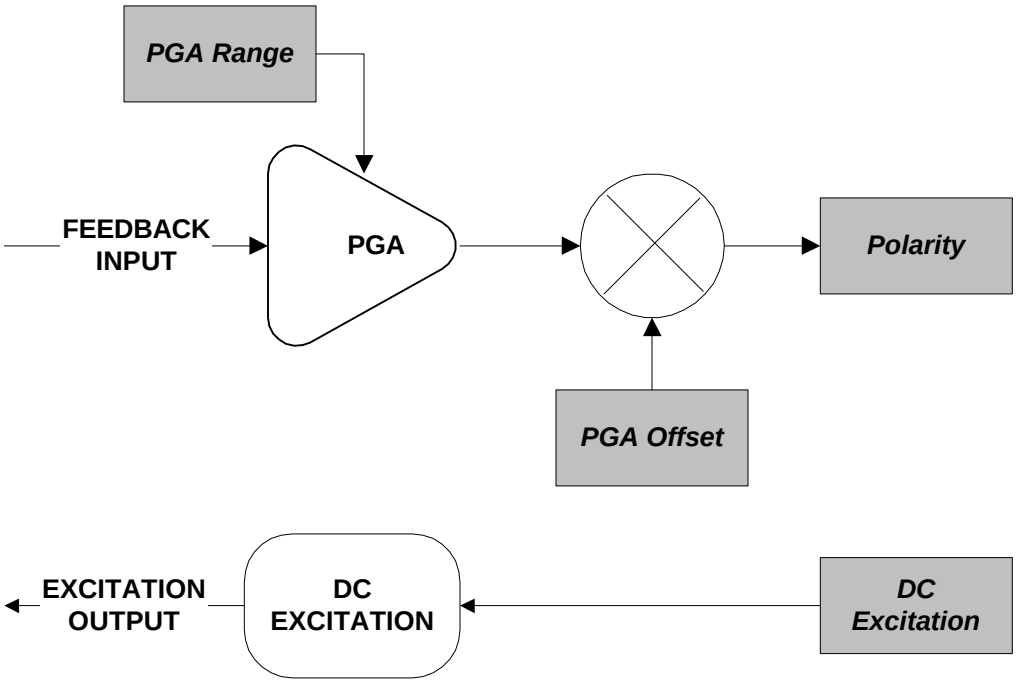


Figure 4

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CONTROL AND VALVE SUBSYSTEMS

Please refer to **Figure 5** for this discussion. The shaded boxes represent user programmable parameters. Each VDSP channel contains a valve output D/A with 16 bit resolution. The output of the valve D/A is converted into a current and made available to the front panel connectors. The VDSP performs PID calculations on each channel 1000 times per second. The result of this calculation is a voltage that is supplied to the valve D/A. The VDSP sums a 500 Hz square wave dither signal with the final valve output. The **DITHER AMPLITUDE** parameter is used to set the dither level. The VDSP is able to reverse the valve voltage polarity. The **POLARITY** parameter is used to select the valve polarity. The **VALVE OFFSET** parameter can be used to provide an electronic offset for mechanical valves that are not balanced. The **ILIMIT** parameter is used to bind the absolute value for the integrator at a fixed voltage. The **DSPER** parameter is used to change the sampling interval for the derivative function. The **P GAIN** parameter is used to set the Proportional gain. The **I GAIN** parameter is used to set the Integral gain. The **D GAIN** parameter is used to set the Derivative gain.

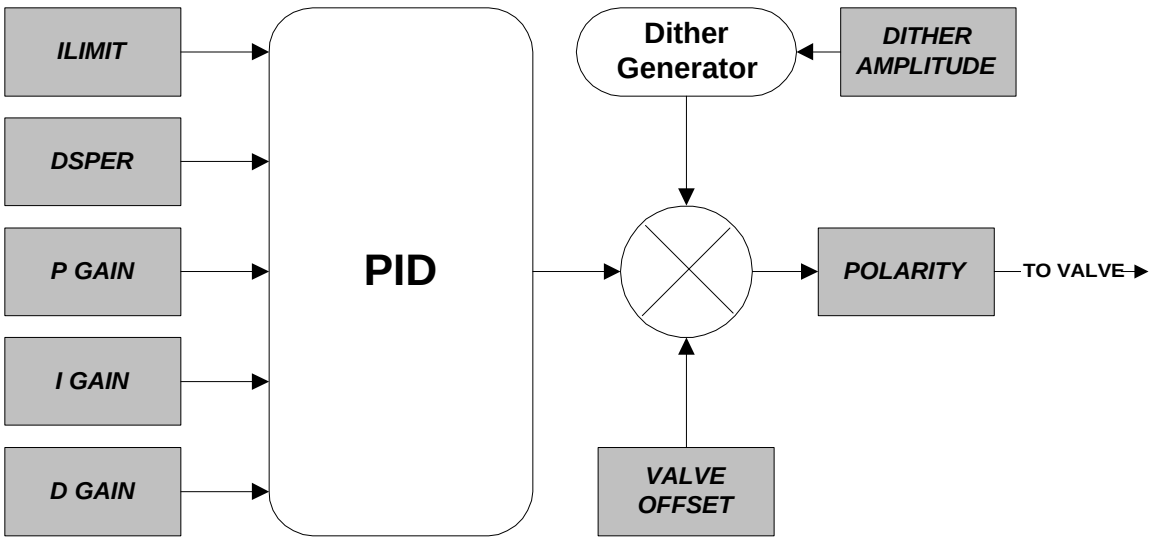


Figure 5

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MONITORING INTERNAL VARIABLES

The VDSP firmware converts selected internal variables into voltage signals. These voltage signals are made available at the VDSP front panel through four miniature BNC connectors. The VDSP composite setpoint command, feedback, error and valve outputs for a single channel can be viewed by connecting a scope or other monitoring device to these connectors. **Figure 6** below depicts the association of VDSP variables to front panel connectors. The firmware command **FP_CHANNEL** can be used to change which VDSP channel is sent to the front panel monitor.

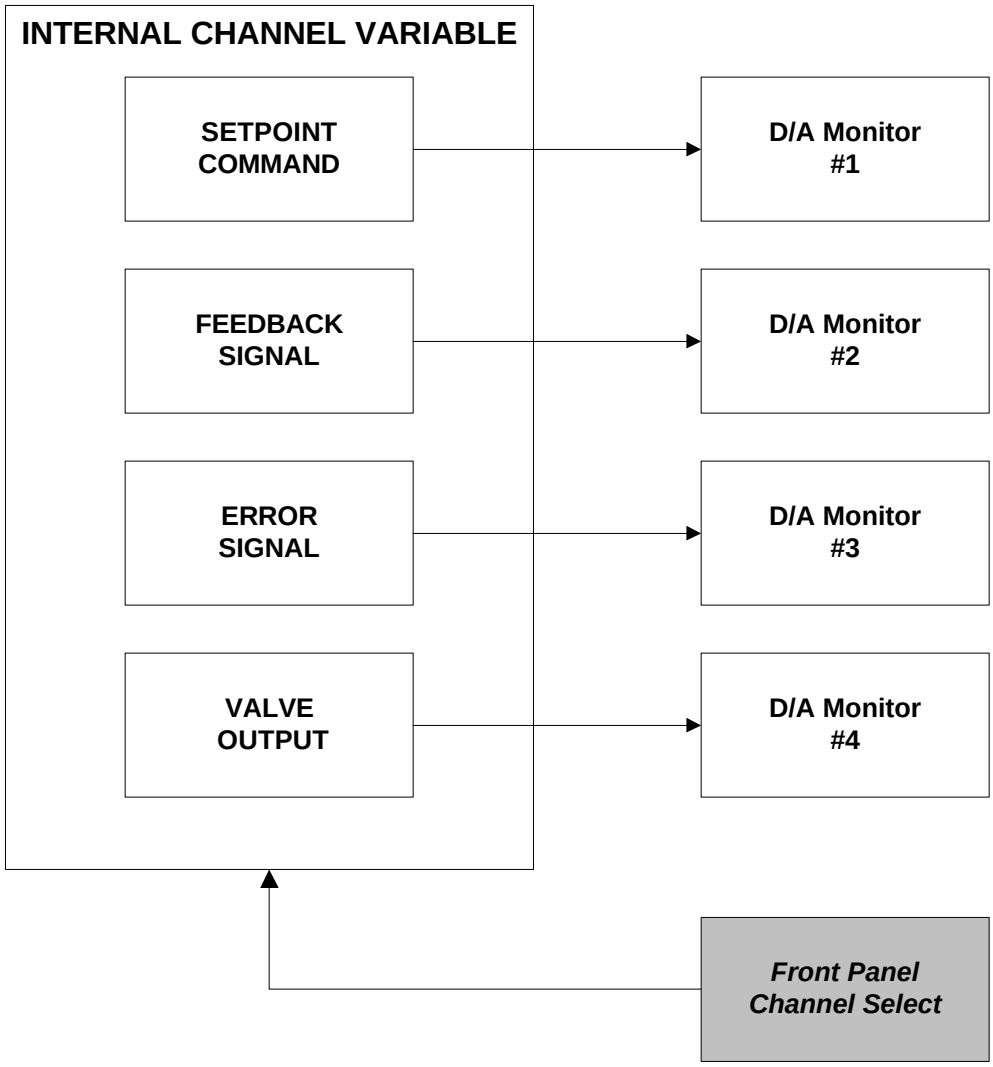


Figure 6

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ADAPTIVE CORRECTION

Please refer to **figure 7** during this discussion. The shaded boxes in **figure 7** show user programmable parameters. The adaptive control section provides corrections to the command generator in order to compensate for phase lag, amplitude roll-off and static offset errors. The VDSP31 analyzes the time history feedback on each channel and calculates single amplitude cyclic, mean, and phase. These values are compared to ideal references or patterns stored in the VDSP31 memory, and corrections are calculated every two cycles. During each correction cycle, the VDSP31 limits the amount of the correction change and maximum correction output, which can be applied to the command generator. Each adaptive reference parameter has a user defined tolerance window that the adaptive controller uses to drive TTL status outputs. The first TTL output indicates whether ac amplitude and dc offset are within tolerance. The second output indicates whether phase is within tolerance. Each channel can be enabled or disabled for adaptive control. In addition, a master adapt enable for all channels is provided.

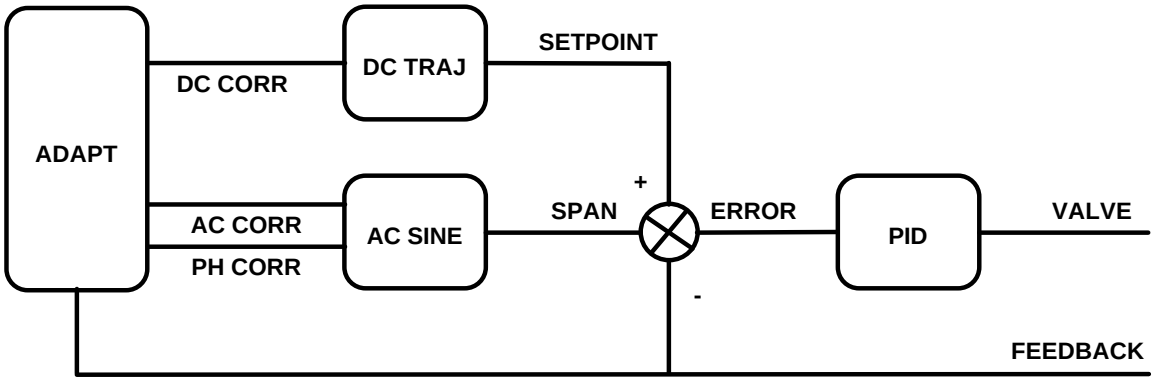


Figure 7

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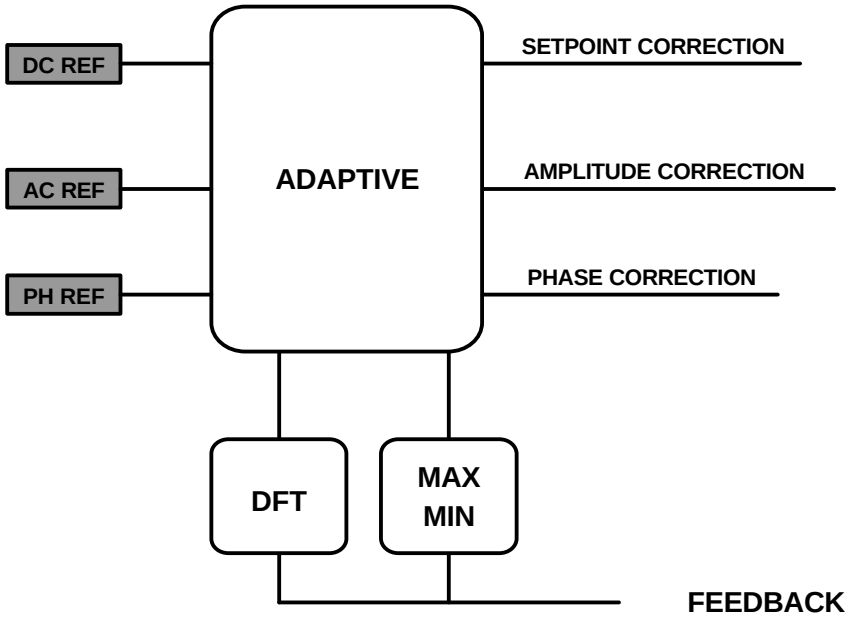


Figure 8

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VDSP31 IEEE-488 (HPIB) COMMANDS

MESSAGE BASED COMMAND REFERENCE

BOOTROM COMMANDS

The following commands may be sent to the VDSP after a hardware reset. These commands are used to update the firmware inside the VDSP and to start the application firmware loaded into the flash memory. Following a hardware reset, the VDSP must be instructed by the VXI host to begin booting an application. Refer to the following HP Basic example:

```
ASSIGN @vdsp to 70901
CLEAR @vdsp
OUTPUT @vdsp;"BOOT:FLASH"
WAIT 1
CLEAR @vdsp
```

The VDSP should now be ready to accept additional commands.

LOAD PROGRAM INTO VXI SHARED MEMORY

This command instructs the VDSP31 that a Tektronix Hex file should be loaded into shared memory. This command is used in conjunction with the BOOT:RAM and PROG:FLASH commands.

LOAD:RAM

BOOT PROGRAM FROM SHARED MEMORY

This command instructs the VDSP31 to boot from shared memory. The LOAD:RAM command normally precedes this command. This command can be used to verify new firmware operation prior to Flash programming.

BOOT:RAM

BOOT PROGRAM FROM FLASH MEMORY

This command instructs the VDSP31 to boot from flash memory.

BOOT:FLASH

PROGRAM FLASH MEMORY

This command instructs the VDSP31 to program the Flash Memory with the data contained in the shared memory.

PROG:FLASH

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COMMON COMMAND SET

VALVE DITHER

This command changes the dither amplitude applied to the servo valve for the specified channel(s). The VDSP generates a 500 Hz square wave dither signal for each valve.

VLV:DITH channel volts
VLV:DITH? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
volts	amplitude of dither	0.0 - 10.0

Examples

```
OUTPUT @vdsp;"VLV:DITH ALL 0.1"
OUTPUT @vdsp;"VLV:DITH 4 1.0"
OUTPUT @vdsp;"VLV:DITH? ALL"
ENTER @vdsp;Array(*)
```

VALVE OFFSET

This command changes the valve offset for the specified channel. Valve offset provides compensation for servo valves, which have a mechanical bias.

VLV:TRIM channel volts
VLV:TRIM? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
volts	level of offset	-10.0 to +10.0

Examples

```
OUTPUT @vdsp;"VLV:TRIM ALL 0.0"
OUTPUT @vdsp;"VLV:TRIM 1 .225"
OUTPUT @vdsp;"VLV:TRIM? ALL"
ENTER @vdsp;Array(*)
OUTPUT @vdsp;"VLV:TRIM? 1"
ENTER @vdsp;Trim
```


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VALVE POLARITY

This command changes the signal polarity applied to the servo valve.

VLV:INVERT channel [ON or OFF]
VLV:INVERT? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
on/off	On = Reverse Off = Normal	ON or OFF 1 or 0

Examples

```
OUTPUT @vdsp;"VLV:INVERT ALL OFF"
OUTPUT @vdsp;"VLV:INVERT 1 ON"
OUTPUT @vdsp;"VLV:INVERT 2 0"
OUTPUT @vdsp;"VLV:INVERT? ALL"
ENTER @vdsp;Array(*)
```

VALVE GAIN

This command scales the voltage applied to the servo valve drive amplifiers. The gain is given as a ratio from 0.0 to 1.0

VLV:GAIN channel ratio
VLV:GAIN? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
Ratio	1.0 = 100% of current driver setting,	0.0 – 1.0

Examples

```
OUTPUT @vdsp;"VLV:GAIN ALL 1.0"
OUTPUT @vdsp;"VLV:GAIN 5 .25"
OUTPUT @vdsp;"VLV:GAIN? ALL"
ENTER @vdsp;Array(*)
```


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FEEDBACK POLARITY

This command changes the signal polarity applied to the feedback signal.

FBK:INVERT channel [ON or OFF]
FBK:INVERT? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
on/off	On = Reverse Off = Normal	ON or OFF 1 or 0

Examples

```
OUTPUT @vdsp;"FBK:INVERT ALL ON"
OUTPUT @vdsp;"FBK:INVERT? ALL"
ENTER @vdsp;Array(*)
```

FEEDBACK OFFSET

This command changes the DC feedback offset for the specified channel.

FBK:OFFSET channel volts
FBK:OFFSET? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
volts	voltage level of offset to apply	-10.0 to +10.0

Examples

```
OUTPUT @vdsp;"FBK:OFFSET 1 .024"
OUTPUT @vdsp;"FBK:OFFSET? ALL"
ENTER @vdsp;Array(*)
```


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FEEDBACK GAIN

This command changes the instrumentation amplifier range for the specified channel. Each VDSP channel is equipped with a programmable gain amplifier (PGA).

FBK:GAIN channel range
FBK:GAIN? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
range	selects the gain range	0=1, 1=2, 2=4 3=8, 4=100 5=200,6=400 7=800

Examples

```
OUTPUT @vdsp;"FBK:GAIN ALL 6"
OUTPUT @vdsp;"FBK:GAIN 4 5"
OUTPUT @vdsp;"FBK:GAIN? ALL"
ENTER @vdsp;Array(*)
```


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FEEDBACK EXCITATION

This command changes the DC excitation applied to strain gauge or bridge transducers for the specified channel. Each VDSP channel is equipped with a programmable DC excitation source.

FBK:EXC channel volts
FBK:EXC? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
volts	sets the level of the excitation voltage	0.0 to +10.0

Examples

```
OUTPUT @vdsp;"FBK:EXC 4 5.0"
OUTPUT @vdsp;"FBK:EXC? 4"
ENTER @vdsp;A
```

CALIBRATION RELAY

This command changes the state of calibration relay for the specified channel. Each VDSP channel is equipped with a calibration relay. This relay can be used to apply a 100K R-CAL equivalent across a strain gage or bridge transducer. ON=Apply Shunt-Cal, OFF=Remove Shunt-Cal.

FBK:RELAY channel state
FBK:RELAY? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
state	ON or 1 = Close relay OFF or 0 = Open relay	ON or OFF 1 or 0

Examples

```
OUTPUT @vdsp;"FBK:RELAY ALL ON"
OUTPUT @vdsp;"FBK:RELAY ALL OFF"
OUTPUT @vdsp;"FBK:RELAY? ALL"
ENTER @vdsp;Relay(*)
```


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FEEDBACK READ PARAMETER

This command reads one of several derived feedback variables for the specified channel(s). **MAX** returns the last maximum Value. **MIN** returns the last minimum Value. **AVG** returns the last mean Value. **PHS** returns the phase angle based on a discrete Fourier transform. **MAG** returns the single amplitude Value based on a discrete Fourier transform. The parameter type is optional, and if omitted, FBK:READ? Simply returns the current feedback voltage level.

FBK:READ? channel [parameter]

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
parameter	select which type of measurement is to be made	MAX,MIN,AVG,CYC PHS, or MAG

Examples

```
OUTPUT @vdsp;"FBK:READ? ALL"
ENTER @vdsp;Volts(*)
```

NOTE:
The VDSP can not calculate derived feedback parameters unless it has been programmed with an AC period value. All derived parameters are based on numerical methods, which evaluate the feedback over a time period specified by the SETP:AC:APER command.

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MAP FEEDBACK CHANNELS

This command specifies which feedback channels are to mapped to the specified servo channel.

FBK:MAP channel fbkA fbkB
FBK:MAP? channel

Parameters	Description	Range
channel	servo channel number	1-8
fbkA	selects the feedback “A” channel	1-8
fbkB	selects the feedback “B” channel	1-8

Examples

```
OUTPUT @vdsp;"FBK:MAP 1 1 2"
OUTPUT @vdsp;"FBK:MAP? 1"
ENTER @vdsp;Ch1,Ch2
```

FEEDBACK SELECT

This command selects the feedback source for the control loop channel.

FBK:SEL channel select
FBK:SEL? channel

Parameters	Description	Range
channel	servo channel number	1-8
select	specifies which feedback source to use	A or B 0 or 1

Examples

```
OUTPUT @vdsp;"FBK:SEL 1 B"
OUTPUT @vdsp;"FBK:SEL? 1"
ENTER @vdsp;A
```


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PID LOOP GAINS

This function changes the PID loop gains for the specified Channel.

PID:GAIN channel Kp Ki Kd Il Ds
PID:GAIN? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
Kp	Proportional Gain	0.0 - 100.0
Ki	Integral Gain	0.0 - 100.0
Kd	Derivative Gain	0.0 - 100.0
Il	Integration Limit	0.0 - 10.0
Ds	Derivative Sample Period	0 - 32

Examples

```
OUTPUT @vdsp;"PID:GAIN 1";Kp,Ki,Kd,Il,Ds
OUTPUT @vdsp;"PID:GAIN? 1"
ENTER @vdsp;Kp,Ki,Kd,Il,Ds
```

PID READ PARAMETER

This command reads the specified parameter from the specified Channel. Parameter CMD returns the current composite command Value. ERR returns the current error Value at the PID summing junction. VLV returns the current valve output including dither, if any. FBK returns the current Value of the Feedback Transducer.

PID:READ? channel parameter

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
parameter	selects the parameter type to read	CMD,ERR,VLV,FBK

Examples

```
OUTPUT @vdsp;"PID:READ? ALL CMD"
ENTER @vdsp;Cmd(*)
```


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ENABLE SERVO LOOP

This command enables or disables the PID control loop on the specified channel(s).

PID:ENABLE channel state
PID:ENABLE? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
state	specifies the state of the PID enable	ON or OFF 1 or 0

Examples

```
OUTPUT @vdsp;"PID:ENABLE ALL ON"
OUTPUT @vdsp;"PID:ENABLE? 1"
ENTER @vdsp;A
```

READ DIGITAL INPUTS

This command returns the state of the VDSP31 digital inputs.

DIG:IN?

Examples

```
OUTPUT @vdsp;"DIG:IN?"
ENTER @vdsp;DigIn
DISP DVAL$(DigIn,2)
```

WRITE DIGITAL OUTPUTS

This command writes a value to the VDSP31 digital outputs.

DIG:OUT value

Parameters	Description	Range
value	32-bit signed integer	-2147483647 to +2147483647

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FRONT PANEL MONITOR

This command specifies which PID channel parameters to route to the front panel for monitoring.

FPMON channel
FPMON?

Parameters	Description	Range
channel	servo channel number	1-8

Examples

```
OUTPUT @vdsp;"FPMON 1"
OUTPUT @vdsp;"FPMON?"
ENTER @vdsp;Mon
```

CHANGE SETPOINT

This command changes the DC setpoint on the specified channel. Parameter volts range is +/-10.0. Upon receipt of this command, the VDSP will begin to transition to the new setpoint. The transition rate is controlled by the command SETP:DC:RPER. The transition shape (linear or haver-sine) is controlled by the command SETP:DC:HSINE.

SETP:DC:LEVEL channel volts
SETP:DC:LEVEL? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
volts	voltage level for new setpoint	-10.0 to + 10.0

Examples

```
OUTPUT @vdsp;"SETP:DC:RPER 1.0"
OUTPUT @vdsp;"SETP:DC:HSINE ON"
OUTPUT @vdsp;"SETP:DC:LEVEL ALL 0.0"
```


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SETPOINT RAMP PERIOD

SETP:DC:RPER <seconds>

This command changes the DC ramp period for all Channels. The parameter <seconds> determines how long the ramp will take to transition from the current setpoint to any new setpoint.

SETP:DC:RPER period
SETP:DC:RPER?

Parameters	Description	Range
period	period in seconds for DC setpoint command to complete	.020 to 20.0

Examples

```
OUTPUT @vdsp;"SETP:DC:RPER .1"
OUTPUT @vdsp;"SETP:DC:RPER?"
ENTER @vdsp;Period
```

RAMP SHAPE

This command changes the DC ramp shape for all channels.

SETP:DC:HSINE select
SETP:DC:HSINE?

Parameters	Description	Range
select	selects either Linear Ramp or Haver-Sine shape. ON = Use Haver-Sine OFF = Use Linear Ramp	ON or OFF 1 or 0

Examples

```
OUTPUT @vdsp;"SETP:DC:HSINE OFF"
```


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DC TRANSITION TABLE SHAPE

This command changes the DC transition table shape for all channels.
If param = DEFAULT, the firmware selects the built-in haver-sine table.
If param = CUSTOM, the firmware waits for a user defined 256 point table
To be downloaded.

SETP:DC:TTABLE param

Parameters	Description	Range
Param	Selects either default haver-sine transition table or allows custom table to be downloaded.	DEFAULT Or CUSTOM

Examples

OUTPUT @vdsp;"SETP:DC:HSINE OFF"

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AC PHASE

This function changes the AC phase for the composite command. Upon receipt of this command, the VDSP will change the phase for the specified channel. The new phase will be updated by the VDSP as each channel crosses zero. The phase reference is where the peak is relative to 0 degrees. Range 0.0 to 360.0 degrees.

SETP:AC:PHASE **channel phase**
SETP:AC:PHASE? **channel**

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
phase	phase for AC command	0.0 to 360.0 Resolution is approx 1.40625 degrees

Examples

```
OUTPUT @vdsp;"SETP:AC:PHASE 1 0.0"
OUTPUT @vdsp;"SETP:AC:PHASE 2 45.0"
OUTPUT @vdsp;"SETP:AC:PHASE 3 90.0"
```

AC SPAN

This function changes the AC or cyclic portion of the composite command. Upon receipt of this command, the VDSP will change the single amplitude cyclic. The new amplitude will be updated by the VDSP as each channel crosses zero. This allows bumpless AC amplitude Changes.

SETP:AC:SPAN **channel volts**
SETP:AC:SPAN? **channel**

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
volts	single-amplitude cyclic value	0.0 to 10.0

Examples

```
OUTPUT @vdsp;"SETP:AC:SPAN 1 .567"
```


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MASTER SPAN CONTROL

This function changes the master span for all Channels. Master span allows the user to increase or decrease AC amplitude as a function of an individual channels full scale AC span.

SETP:AC:MSPAN ratio
SETP:AC:MSPAN?

Parameters	Description	Range
ratio	percentage ratio 1.0 = 100% of an individual channels span	0.0 to 1.0

Examples

```
OUTPUT @vdsp;"SETP:AC:MSPAN .50"
OUTPUT @vdsp;"SETP:AC:MSPAN?"
ENTER @vdsp;Mspan
```

AC PERIOD

This command changes the AC waveform period for all channels. The parameter "period" determines the period for 1 cycle to complete.

SETP:AC:APER period
SETP:AC:APER?

Parameters	Description	Range
period	period in seconds to complete one sinusoidal cycle	.020 to 20.0

Examples

```
OUTPUT @vdsp;"SETP:AC:APER .1"
```


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TRIGGER MODE

This command changes the trigger mode for the setpoint generators. **EXT** specifies external trigger mode. **INT** specifies internal trigger mode.

SETP:TRIG:MODE mode
SETP:TRIG:MODE?

Parameters	Description	Range
mode	selects the trigger mode.	EXT or INT 1 or 0

Examples

OUTPUT @vdsp;"SETP:TRIG:MODE EXT"

TUNE ENABLE

This command enable an internal square wave function generator. This command can be used in conjunction with setup or tuning software to adjust the PID loop gains. The amplitude of the square wave is set by the TUNE:TAMP command. The period of the square wave is set by the TUNE:TPER command.

TUNE:ENABLE channel
TUNE:ENABLE? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL

Examples

OUTPUT @vdsp;"TUNE:ENABLE 1 ON"

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TUNE AMPLITUDE

This command changes the amplitude of the square wave command generator for the specified servo channel.

TUNE:TAMP channel volts
TUNE:TAMP? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
volts	voltage amplitude of square wave	0.0 - 10.0

Examples

OUTPUT @vdsp;"TUNE:TAMP 1 .25"

TUNE PERIOD

This command changes the amplitude of the square wave command generator for the specified servo channel.

TUNE:TPER channel period
TUNE:TPER? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
period	period of square wave	.1 to 10.0

Examples

OUTPUT @vdsp;"TUNE:TPER 1 1.0"

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SYSTEM ERROR QUERY

This command returns the most recent error message.

SYSTEM:ERROR?
SYST:ERR?

Examples

```
ALLOCATE Err$(1)[256]
CLEAR @vdsp
OUTPUT @vdsp;"SYSTEM:ERROR?"
ENTER @vdsp;Err$
DISP Err$(*)
```

SYSTEM VERSION QUERY

This command shall return the firmware revision and the date/time of the last modification.

SYSTEM:VERSION?
SYST:VER?

Examples

```
ALLOCATE Version$(1)[256]
CLEAR @vdsp
OUTPUT @vdsp;"SYSTEM:VERSION?"
ENTER @vdsp;Version$
DISP Version$(*)
```

SYSTEM IDENTIFY QUERY

This command returns a string that identifies the VDSP31 model,serial number and revision code.

***IDN?**

Examples

```
OUTPUT @vdsp;"*IDN?"
ENTER @vdsp;Id$
```


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VDSP RESET

This command performs a soft reset that returns the VDSP into the BOOTROM code.

***RST**

Examples

```
OUTPUT @vdsp;"*RST"
WAIT 2
OUTPUT @vdsp;”BOOT:FLASH”
```

PID ERROR LIMIT

This command changes the PID loop error limit setting for the specified channels(s). If the absolute value of the error signal exceeds this limit, the fault output is asserted and the valve is driven is zero.

ERROR:LIMIT channel limit
ERROR:LIMIT? channel

Parameters	Description	Range
channel	Servo channel number	1-8 or ALL
limit	limit value for comparison limit value of 0.0 disables comparison	0.0 - 10.0

Examples

```
OUTPUT @vdsp;"ERROR:LIMIT 1 0.0"
OUTPUT @vdsp;"ERROR:LIMIT 2 0.1"
OUTPUT @vdsp;"ERROR:LIMIT? 4"
ENTER @vdsp;Limit4
```


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PID CHANNEL STATUS

This command returns the PID status word for the specified channels(s)

CHAN:STAT? channel

Parameters	Description	Range
channel	Servo channel number	1-8 or ALL

Examples

```
ALLOCATE ChanStatus(8)
OUTPUT @vdsp;"CHAN:STAT? ALL"
ENTER @vdsp;ChanStatus(*)
```

BIT	FUNCTION
0	PidEnable 1=PID Enabled
1	AdaptEnable 1=ADAPT Enabled
2	CmdChg 1=DC Command Changing
3	Btoggle 1=Toggle Cyclic measurement buffer
4	Bank 1=Cyclic buffer B, 0=buffer A
5	TuneEnable 1=Tune Active, 0=Tune Inactive
6	NullPace 1=Null Pace On, 0=Off
7	ABCompare 1=A/B Compare On, 0=Off
8	FbkSelB 1=Feeback B active, 0=A
9	NullPaceHold 1=Holding, 0=Not Holding
10	ABCompareFail 1=Fail, 0=OK
11	ErrLimit 1=Limit Detected, 0=OK
12	ErrEnable 1=Limit Detection On,0=Off
13	AdaptUseDFT 1=Use DFT, 0=Max-Min
14-15	Spares

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EXTERNAL DUMP ENABLE

This command enables or disables external dump capability.

DUMP:ENABLE state
DUMP:ENABLE?

Parameters	Description	Range
state	specifies the state of the DUMP enable. On reset, external DUMP is disabled.	ON or OFF 1 or 0

Examples

```
OUTPUT @vdsp;"DUMP:ENABLE ON"
OUTPUT @vdsp;"DUMP:ENABLE?"
ENTER @vdsp;A
```


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ENGINEERING UNIT RATE/SLOPE

This command is used to define engineering unit constants.

EU:RATE channel rate
EU:RATE? channel rate

Parameters	Description	Range
Channel	Servo channel number	1-8 or ALL
Rate	Rate Constant	

Examples

OUTPUT @vdsp;"EU:RATE 1 .5678”
OUTPUT @vdsp;"EU:RATE 2 .118”
OUTPUT @vdsp;"EU:RATE 3 .2278”
OUTPUT @vdsp;"EU:RATE 4 .234234”

ENGINEERING UNIT ZEROS

This command is used to define engineering unit constants.

EU:ZERO channel zero
EU:ZERO? Channel zero

Parameters	Description	Range
Channel	Servo channel number	1-8 or ALL
Zero	Zero Constant	

Examples

OUTPUT @vdsp;"EU:ZERO 1 .001”
OUTPUT @vdsp;"EU:RATE 2 -.005”

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ADAPTIVE CYCLIC COMMAND SET

ADAPT ENABLE

This command enables or disables adaptive corrections on the specified channel(s).

ADAPT:ENABLE channel state
ADAPT:ENABLE? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
state	state of adapt enable	ON or OFF 1 or 0

Examples

```
OUTPUT @vdsp;"ADAPT:ENABLE ALL ON"
OUTPUT @vdsp;"ADAPT:ENABLE ALL OFF"
```


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ADAPT AC REFERENCE

This function changes the AC reference value used by the adaptive sub-system. If adaptive control is enabled, the current AC command will begin to move toward the AC reference.

ADAPT:REF:AC channel volts
ADAPT:REF:AC? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
volts	specifies the reference value in volts	0.0 to 10.0

Examples

```
OUTPUT @vdsp;"ADAPT:REF:AC 1 2.5"
OUTPUT @vdsp;”ADAPT:REF:AC? ALL”
ENTER @vdsp;AcRef(*)
```

ADAPT DC REFERENCE

This function changes the DC reference value used by the adaptive sub-system. If adaptive control is enabled, the current DC command will begin to move toward the DC reference.

ADAPT:REF:DC channel volts
ADAPT:REF:DC? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
volts	specifies the reference value in volts	-10.0 to 10.0

Examples

```
OUTPUT @vdsp;"ADAPT:REF:DC 7 -4.56"
OUTPUT @vdsp;”ADAPT:REF:DC? ALL”
ENTER @vdsp;DcRef(*)
```


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ADAPT PHASE REFERENCE

This function changes the PHASE reference value used by the adaptive sub-system. If adaptive control is enabled, the current PHASE command will begin to move toward the PHASE reference.

ADAPT:REF:PH channel phase
ADAPT:REF:PH? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
phase	specifies the reference value in degrees	0.0 to 360.0

Examples

```
OUTPUT @vdsp;"ADAPT:REF:PH 1 0.0"
OUTPUT @vdsp;"ADAPT:REF:PH 2 45.0"
OUTPUT @vdsp;"ADAPT:REF:PH 3 270.0”
OUTPUT @vdsp;”ADAPT:REF:PH? ALL”
ENTER @vdsp;PhRef(*)
```


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ADAPT DC TOLERANCE WINDOWS

This command changes the DC tolerance windows for the adaptive control sub-system. Tolerance windows are used by the VDSP to determine if the difference between the DC reference and the feedback is within acceptable limits. Upon receipt of this command, the VDSP will alter the windows for specified channel(s). The tolerance windows are symmetrical.

ADAPT:DCTWIN channel window1 window2
ADAPT:DCTWIN? channel

Parameters	Description	Range
channel	Servo channel number	1-8 or ALL
Window1	Specifies the window1 level	
Window2	Specifies the window2 level	

Examples

OUTPUT @vdsp;"ADAPT:DCTWIN ALL .5 .1"

ADAPT AC TOLERANCE WINDOW

This command changes the AC tolerance windows for the adaptive control sub-system. These tolerance windows are used by the VDSP to determine if the difference between the AC reference and the feedback is within acceptable limits. Upon receipt of this command, the VDSP will alter the windows for the specified Channel. The tolerance windows are symmetrical.

ADAPT:ACTWIN channel window1 window2
ADAPT:ACTWIN? channel

Parameters	Description	Range
Channel	Servo channel number	1-8 or ALL
Window1	Specifies the window1 level	
Window2	Specifies the window2 level	

Examples
OUTPUT @vdsp;"ADAPT:ACTWIN ALL .34 .1"

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ADAPT PHASE TOLERANCE WINDOW

This command changes the PHASE tolerance windows for the adaptive control sub-system. These tolerance windows are used by the VDSP to determine if the difference between the PHASE reference and the feedback is within acceptable limits. Upon receipt of this command, the VDSP will alter the windows for the specified Channel. The tolerance windows are symmetrical.

ADAPT:PHTWIN channel window1 window2
ADAPT:PHTWIN? channel

Parameters	Description	Range
Channel	Servo channel number	1-8 or ALL
Window1	Specifies the window1 level	
Window2	Specifies the window2 level	

Examples

OUTPUT @vdsp;"ADAPT:PHTWIN ALL 5.0 10.0"

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ADAPT MAX DC CORRECTION

This command changes the maximum DC setpoint correction that the VDSP adaptive control sub-system can apply per iteration. Upon receipt of this command, the VDSP will update the Max DC correction for the specified channel(s).

ADAPT:MDCORR channel correction1 correction2
ADAPT:MDCORR? channel

Parameters	Description	Range
Channel	Servo channel number	1-8 or ALL
Correction1	Correction1 Level	
Correction2	Correction2 Level	

Examples

```
OUTPUT @vdsp;"ADAPT:MDCORR  1 .010 .050"
OUTPUT @vdsp;"ADAPT:MDCORR? ALL"
ENTER @vdsp;Mdcorr(*)
```

ADAPT MAX AC CORRECTION

This function changes the maximum AC span correction that the VDSP adaptive control sub-system can apply per iteration. Upon receipt of this command, the VDSP will update the Max AC correction for the specified channel.

ADAPT:MACORR channel correction1 correction2
ADAPT:MACORR? channel

Parameters	Description	Range
Channel	Servo channel number	1-8 or ALL
Correction1	Correction1 Level	
Correction2	Correction2 Level	

Examples

```
OUTPUT @vdsp;"ADAPT:MACORR 1 .1 .25"
OUTPUT @vdsp;"ADAPT:MACORR? ALL"
ENTER @vdsp;Macorr(*)
```


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ADAPT MAX PHASE CORRECTION

This function changes the maximum PHASE correction that the VDSP adaptive control sub-system can apply per iteration. Upon receipt of this command, the VDSP will update the Max PHASE correction for the specified channel(s).

ADAPT:MPCORR channel phase
ADAPT:MPCORR? channel

Parameters	Description	Range
Channel	Servo channel number	1-8 or ALL
Correction1	Correction1 Level	
Correction2	Correction2 Level	

Examples

```
OUTPUT @vdsp;"ADAPT:MPCORR 1 2.0 5.0"
OUTPUT @vdsp;”ADAPT:MPCORR? ALL”
ENTER @vdsp;Mpcorr(*)
```

ADAPT AC LIMIT

This function changes the maximum AC (span) value allowed for use by the adaptive sub-system. Adaptive AC corrections can not exceed this Value. Upon receipt of this command, the VDSP will update the AC limit for the specified channel(s).

ADAPT:ACLMT channel limit
ADAPT:ACLMT? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
limit	specifies the maximum span correction	0.0 to 10.0

Examples

```
OUTPUT @vdsp;"ADAPT:ACLMT 1 9.999"
OUTPUT @vdsp;”ADAPT:ACLMT? ALL”
ENTER @vdsp;Aclmt(*)
```


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ADAPT DC UPPER LIMIT

This function changes the upper limit for DC(setpoint) value allowed for use by the adaptive sub-system. Adaptive DC corrections can not exceed this value. Upon receipt of this command, the VDSP will update the DC upper limit for the specified channel(s).

ADAPT:DCULMT channel limit
ADAPT:DCULMT? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
limit	specifies the upper DC limit	-10.0 to +10.0

Examples

```
OUTPUT @vdsp;"ADAPT:DCULMT 1 5.5"
OUTPUT @vdsp;"ADAPT:DCULMT? ALL"
ENTER @vdsp;Dculmt(*)
```

ADAPT DC LOWER LIMIT

This function changes the upper limit for DC(setpoint) value allowed for use by the adaptive sub-system. Adaptive DC corrections can not exceed this value. Upon receipt of this command, the VDSP will update the DC lower limit for the specified channel(s).

ADAPT:DCLLMT channel limit
ADAPT:DCLLMT? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
limit	specifies the lower DC limit	-10.0 to +10.0

Examples

```
OUTPUT @vdsp;"ADAPT:DCLLMT 1 -.5"
OUTPUT @vdsp;"ADAPT:DCLLMT? ALL"
ENTER @vdsp;Dcllmt(*)
```


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ADAPT LOCK STATUS

This function returns the adaptive control lock status words. Each Status word contains 8 bits, one for each channel. Bit 0 = Channel 1, and Bit 7 = Channel 8. When a lock bit is SET, the adaptive control system thinks that the channel is within the tolerance window for that parameter.

ADAPT:STAT?

Examples

OUTPUT @vdsp;"ADAPT:STAT?"
ENTER @vdsp;DCLock,ACLock,PHLock

DC LOCK STATUS WORD
1=DC WITHIN LIMITS, 0=OUT OF LIMITS

07	06	05	04	03	02	01	00
CH08	CH07	CH06	CH05	CH04	CH03	CH02	CH01

AC LOCK STATUS WORD
1=AC WITHIN LIMITS, 0=OUT OF LIMITS

07	06	05	04	03	02	01	00
CH08	CH07	CH06	CH05	CH04	CH03	CH02	CH01

PHASE LOCK STATUS WORD
1=PHASE WITHIN LIMITS, 0=OUT OF LIMITS

07	06	05	04	03	02	01	00
CH08	CH07	CH06	CH05	CH04	CH03	CH02	CH01

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ADAPT USE DFT

This function determines how the adaptive control subsystem will calculate the feedback single amplitude. The VDSP will use the DFT calculation by default, state = ON. The VDSP will derive the single amplitude cyclic based on max-min if state = OFF.

ADAPT:DFT channel state
ADAPT:DFT? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
state	state of DFT enable	ON or OFF 1 or 0

Examples

```
OUTPUT @vdsp;"ADAPT: DFT 1 OFF"
OUTPUT @vdsp;”ADAPT:DFT ALL ON”
OUTPUT @vdsp;”ADAPT:DFT? ALL”
ENTER @vdsp;DFTEnable(*)
```


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BLOCK SPECTRUM COMMANDS

MANEUVER BLOCK FORMAT

The following table details the Maneuver format used by several of the Block Spectrum commands:

Array Position(s)	Name	Function
1	LastManeuver	1=Last Maneuver in a block, 0=Continue
2	NumCycles	Number of Cycles to run for this Maneuver
3	CycleCount	Number of Cycles actual updated by firmware
4	ACPeriod	Period in Seconds for Cyclic
5	DCPeriod	Period in Seconds for DC transitions`
6	Reserved 1	Reserved
7	Reserved 2	Reserved
8 – 15	CtrlWord	Maneuver Control Word Array Channels 1 – 8
16 – 23	DCLevelTarget	DC Setpoint Target Array Channels 1 – 8
24 – 31	ACSpanTarget	AC Span Target Array Channels 1 – 8
32 – 39	ACPhaseTarget	AC Phase Target Array Channels 1 – 8
40 – 47	DCLevelActual	DC Setpoint Actual Array Channels 1 – 8
48 – 55	ACSpanActual	AC Span Actual Array Channels 1 – 8
56 – 63	ACPhaseActual	AC Phase Actual Array Channels 1 – 8
64 – 71	MaxAClimit	Max AC Span Limit Array Channels 1 – 8
72 – 79	MaxUDClimit	Max Upper DC Limit Array Channels 1 – 8
80 – 87	MaxLDClimit	Max Lower DC Limit Array Channels 1 – 8
88 – 95	MaxDCCorr1	Max DC Correction 1 Array Channels 1 – 8
96 – 103	MaxACCorr1	Max AC Correction 1 Array Channels 1 – 8
104 – 111	MaxPHCorr1	Max Phase Correction 1 Array Channels 1 – 8
112 – 119	MaxDCCorr2	Max DC Correction 2 Array Channels 1 – 8
120 – 127	MaxACCorr2	Max AC Correction 2 Array Channels 1 – 8
128 – 135	MaxPHCorr2	Max Phase Correction 2 Array Channels 1 – 8
136 – 143	Dctwin1	DC Tolerance Window 1 Array Channels 1 – 8
144 – 151	Actwin1	AC Tolerance Window 1 Array Channels 1 – 8
152 – 159	Phtwin1	Phase Tolerance Window 1 Array Channels 1 – 8
160 – 167	Dctwin2	DC Tolerance Window 2 Array Channels 1 – 8
168 – 175	Actwin2	AC Tolerance Window 2 Array Channels 1 – 8
176 – 183	Phtwin2	Phase Tolerance Window 2 Array Channels 1 – 8

Table 2

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BLOCK SPECTRUM ENABLE

This command enables or disables Block Spectrum mode. The firmware Will execute any maneuver blocks until Block Spectrum mode is enabled.

BLKS:ENABLE state
BLKS:ENABLE?

Parameters	Description	Range
State	specifies the state of the Block Spectrum enable. On reset, Block Spectrum is disabled.	ON or OFF 1 or 0

Examples

```
OUTPUT @vdsp;"BLKS:ENABLE ON"
OUTPUT @vdsp;"BLKS:ENABLE?"
ENTER @vdsp;A
```

DEFINE MANEUVER

This command is used to define a maneuver block. Up to 512 maneuver blocks can be defined. Maneuver blocks are run by the Block Spectrum firmware after Transition from a Startup state. Refer to the BLKS:DEF:STARTUP and BLKS:STARTUP commands.

BLKS:DEF:MANEUVER maneuver
BLKS:DEF:MANEUVER? maneuver

Parameters	Description	Range
Maneuver	Specifies the maneuver number to define or read	1 – 512

Examples

```
OUTPUT @vdsp;"BLKS:DEF:MANEUVER 1"
OUTPUT @vdsp;Array(*)
```


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DEFINE STARTUP SEQUENCE

This command is used to define a sequence of startup blocks. Up to 64 blocks can be defined. Startup blocks are run by the Block Spectrum firmware upon reception of a BLKS:STARTUP command. The BLKS:STARTUP command must be sent and the Startup sequence must complete before any maneuver blocks will execute. The startup sequence is not repeatable.

BLKS:DEF:STARTUP **maneuver**
BLKS:DEF:STARTUP? **maneuver**

Parameters	Description	Range
Maneuver	Specifies the maneuver number to define or read	1 – 64

Examples

```
OUTPUT @vdsp;"BLKS:DEF:STARTUP 1"
OUTPUT @vdsp;Array(*)
```

DEFINE SHUTDOWN SEQUENCE

This command is used to define a sequence of shutdown blocks. Up to 64 blocks can be defined. Shutdown blocks are run by the Block Spectrum firmware upon reception of a BLKS:SHUTDOWN command.

BLKS:DEF:SHUTDOWN **maneuver**
BLKS:DEF:SHUTDOWN? **maneuver**

Parameters	Description	Range
Maneuver	Specifies the maneuver number to define or read	1 – 64

Examples

```
OUTPUT @vdsp;"BLKS:DEF:SHUTDOWN 1"
OUTPUT @vdsp;Array(*)
```


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BEGIN STARTUP SEQUENCE

This command is used to initiate a Startup sequence. Startup sequences are defined with the BLKS:DEF:STARTUP command.

BLKS:STARTUP

Examples

OUTPUT @vdsp;"BLKS:STARTUP"

BEGIN SHUTDOWN SEQUENCE

This command is used to initiate a Shutdown sequence. Shutdown sequences are defined with the BLKS:DEF:SHUTDOWN command.

BLKS:SHUTDOWN

Examples

OUTPUT @vdsp;"BLKS:SHUTDOWN"

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DEFINE BLOCK, MANEUVER, AND CYCLE COUNT

This command is used to define the Block, Maneuver and Cycle Counts for the Block Spectrum mode. The firmware can repeat a sequence of Maneuvers “N” times. The command BLKS:REPEAT can be used to define the number of Block repetitions.

BLKS:INDEX block maneuver cycles
BLKS:INDEX?

Parameters	Description	Range
Block	Specifies the current Block Repeat Count	0 - 2^{32}
Maneuver	Specifies Maneuver number	1 – 512
Cycles	Specifies Cycle Count in Maneuver	0 - 2^{32}

Examples

```
!  We are on Block 4, Maneuver 10, with 10500 cycles elasped

OUTPUT @vdsp;"BLKS:INDEX  4 10 10500"
OUTPUT @vdsp;"BLKS:INDEX?”
ENTER @vdsp;BlockNum
ENTER @vdsp;ManeuverNum
ENTER @vdsp;CycleCount
```


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DEFINE MANEUVER RANGE

This command is used to define a Maneuver range. The Maneuver range defines a block which can be repeated N times. The BLKS:REPEAT command Is used to specifiy how many times a block should be repeated.

BLKS:RANGE maneuver1 maneuve2
BLKS:RANGE?

Parameters	Description	Range
Maneuver1	Specifies the starting maneuver number in a block	1 - 512
Maneuver2	Specifies the ending maneuver number in a block	1 - 512

Examples

```
!  Define a block consisting of Maneuvers 10 - 35

OUTPUT @vdsp;"BLKS:RANGE  10 35"
```


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SPECTRUM BLOCK REPEAT

This command is used to define the number of times a block of maneuvers will repeat. The Maneuver range is set using the BLKS:RANGE command.

BLKS:REPEAT count
BLKS:REPEAT?

Parameters	Description	Range
Count	Specifies the number of times a Block Spectrum will repeat. 0 = No Repeat, 1 – 2^32 defines number of repetitions	0 – 2^32

Examples

```
!  Disable Block Repeat

OUTPUT @vdsp;"BLKS:REPEAT 0"

!  Repeat Maneuvers 1 – 12  10 times

OUTPUT @vdsp;”BLKS:RANGE  1 12”
OUTPUT @vdsp;"BLKS:REPEAT 10"
```


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SPECTRUM BLOCK HOLD

This command is used to hold the current Maneuver.

BLKS:HOLD state
BLKS:HOLD?

Parameters	Description	Range
state	specifies the state of HOLD mode ON = HOLD, OFF = NO HOLD	ON or OFF 1 or 0

Examples

```
OUTPUT @vdsp;"BLKS:HOLD OFF"
OUTPUT @vdsp;"BLKS:HOLD?"
ENTER @vdsp;Hold
```

BLOCK SPECTRUM STATUS WORD

This command is used to read the block spectrum status word.

BLKS:STAT?

Examples

```
OUTPUT @vdsp;"BLKS:STAT?"
ENTER @vdsp;Stat
```

STATUS WORD FORMAT

BIT	DESCRIPTION
0	Enable 1=Enabled, 0=Disabled
1	Hold 1=Hold ON, 0=Hold OFF
2	Repeat 1=Repeat ON, 0=Repeat OFF

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END-POINT COMMAND SET

END-POINT HARDWARE MAPPING

ALL DIGITAL INPUTS ON THE VDSP ARE PULLED UP TO 5 VOLTS VIA A PULL-UP RESISTOR. IF AN INPUT IS LEFT UNCONNECTED, THE VDSP WILL READ THAT INPUT AS A DIGITAL 1 OR HIGH.

DIGITAL INPUTS	FUNCTION
DIN00	NEXT END-POINT (EXTERNAL TRIGGER FOR END-POINTS) 1=NEXT POINT, 0=WAIT REQUIRES THAT "ENDP:TRIG:MODE EXT" BE USED
DIN01	DUMP REQUEST FROM DATA SYSTEM OR HOST 1=DUMP, 0=OK REQUIRES THAT "DUMP:ENABLE ON" BE SENT
DIN02	HYDRAULICS SENSE 1=HYDRAULICS ARE ON, 0=OFF DISABLES THE INTEGRATOR WHEN "OFF" IS SENSED

DIGITAL OUTPUTS	FUNCTION
DOUT00	AT END-POINT
DOUT01	DATA TRIGGER REQUIRES THAT THE "ENDP:DTRG:VECT" COMMAND AND AT LEAST ONE ARRAY POSITION TO BE NON-ZERO

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END-POINT RECORD

This command is used to retrieve a block of related endpoint information. This command returns the following information in an array for the specified channel:

ARRAY POSITION	CONTENTS
1	End-Point Status Word
2	End-Point Cycle Count
3	End-Point Index
4-19	16 Command End-Points
20-35	16 Feedback End-Points

ENDP:REC? channel

Parameters	Description	Range
channel	servo channel number	1-8

Examples

```
ALLOCATE REAL Endpinfo(35)
OUTPUT @vdsp;"ENDP:REC? 1"
ENTER @vdsp;Endpinfo(*)
```

END-POINT MODE ENABLE

This command determines if the VDSP31 will operate in end-point mode. You must call this function prior to calling any other end-point related functions. The VDSP31 will ignore end-point commands until you do so.

ENDP:ENABLE state
ENDP:ENABLE?

Parameters	Description	Range
state	specifies if End-Point mode is enabled	ON or OFF 1 or 0

Examples

```
OUTPUT @vdsp;"ENDP:ENABLE ON"
OUTPUT @vdsp;"ENDP:ENABLE OFF"
OUTPUT @vdsp;"ENDP:ENABLE?"
ENTER @vdsp;A
```


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END-POINT TRIGGER MODE

This command determines if the VDSP31 will use the external connector or a VXI software command as the end-point trigger source. Set to “EXT” to use the external trigger and “INT” to enable the software command trigger. The VDSP31 will place the end-point generator in HOLD after execution of this command.

ENDP:TRIG:MODE mode
ENDP:TRIG:MODE?

Parameters	Description	Range
mode	specifies the End-Point trigger mode	EXT or INT 1 or 0

Examples

OUTPUT @vdsp;"ENDP:TRIG:MODE EXT"

END-POINT ACCUMULATED COUNT

This command reads or writes the number of end-point accumulated counts.

ENDP:COUNT count
ENDP:COUNT?

Parameters	Description	Range
count	accumulated end-point count	0 - 2^32

Examples

OUTPUT @vdsp;"ENDP:COUNT?"
ENTER @vdsp;Epcount

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END-POINT TIME VECTOR

This command is used to upload or download a TIME PERIOD column vector common to all end-point channels.

ENDP:TIME:VECT NumPoints
ENDP:TIME:VECT? NumPoints

Parameters	Description	Range
NumPoints	Number of array elements to follow	1 - 16384

Examples

```
ALLOCATE REAL TimeVect(8192)
MAT TimeVect = (1.0)
OUTPUT @vdsp;"ENDP:TIME:VECT 8192"
OUTPUT @vdsp;TimeVect(*)
OUTPUT @vdsp;"ENDP:TIME:VECT? 8192"
ENTER @vdsp;TimeVect(*)
```


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END-POINT AMPLITUDE VECTOR

This command is used to upload or download an AMPLITUDE column vector for a single channel specified by “channel”.

ENDP:AMPL:VECT channel NumPoints
ENDP:AMPL:VECT? channel NumPoints

Parameters	Description	Range
channel	servo channel number	1-8
NumPoints	number of array elements to follow	1 - 16384

Examples

```
ALLOCATE REAL AmplVect(8192)
MAT AmplVect = (1.0)
OUTPUT @vdsp;"ENDP:AMPL:VECT 1 8192"
OUTPUT @vdsp;AmplVect(*)
OUTPUT @vdsp;"ENDP:AMPL:VECT? 1 8192"
ENTER @vdsp;AmplVect(*)
```


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END-POINT DATA TRIGGER VECTOR

This command instructs the VDSP to accept an array of data trigger enables. Each array position is associated with each end-point amplitude vector. When an end-point is reached, the data trigger array is checked to see if it is non-zero. If the data trigger array postion is non-zero, the VDSP drives the data trigger digital output indicating to an external data system that a data point has been reached.

ENDP:DTRG:VECT NumPoints
ENDP:DTRG:VECT? NumPoints

Parameters	Description	Range
NumPoints	number of array elements to follow	1 - 16384

Control Word BIT assignments

BIT	FUNCTION
0	1=ISSUE DATA TRIGGER TO DIGITAL OUTPUT 0=NO TRIGGER OUTPUT
1	1=GO TO END-POINT HOLD STATE 0=NO HOLD, CONTINUE
2-15	RESERVED FOR FUTURE USE

Examples

```
ALLOCATE REAL DtrgVect(8192)
! Trigger on every end-point
MAT DtrgVect = (1.0)
! Go on “Hold” at point 100
DtrgVect(100) = 3
OUTPUT @vdsp;”ENDP:DTRG:VECT 8192”
OUTPUT @vdsp;DtrgVect(*)
```


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READ CURRENT END-POINT COMMAND

This command returns the current value of the VDSP31 internal end-point command channel(s). These values are the composite command sent to the control law.

ENDP:CMD? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL

Examples

```
ALLOCATE REAL Volts(8)
OUTPUT @vdsp;"ENDP:CMD? ALL"
ENTER @vdsp;Volts(*)
```


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READ CURRENT END-POINT FEEDBACK

This command returns the current value of the VDSP31 feedback channel(s). The feedback values are updated at all times even if no end-point transition is in progress.

ENDP:FBK? channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL

Examples

```
ALLOCATE REAL Volts(8)
OUTPUT @vdsp;"ENDP:FBK? ALL"
ENTER @vdsp;Volts(*)
```

END-POINT MASTER SPAN

This command determines the master span value applied to amplitude. The master amplitude span setting affects all 8 end-point channels.

ENDP:MSPAN ratio
ENDP:MSPAN?

Parameters	Description	Range
ratio	span multiplier common to all end-point channels. 1.0 = 100%	0.0 to 10.0

Examples

```
OUTPUT @vdsp;"ENDP:MSPAN 1.0"
OUTPUT @vdsp;"ENDP:MSPAN 0.0"
OUTPUT @vdsp;"ENDP:MSPAN?"
ENTER @vdsp;Mspan
```


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END-POINT TIME SPAN

This command determines the master span value applied to time. The master time span setting affects all 8 end-point channels.

ENDP:TSPAN ratio
ENDP:TSPAN?

Parameters	Description	Range
ratio	time multiplier common to all end-point channels. 1.0 = 100%	.1 to 10.0

Examples

```
OUTPUT @vdsp;"ENDP:TSPAN 1.0"
OUTPUT @vdsp;"ENDP:TSPAN 0.1"
OUTPUT @vdsp;"ENDP:TSPAN?"
ENTER @vdsp;Tspan
```

END-POINT START RAMP

This command begins a ramp to a predefined amplitude. This command does not affect the end-point index or accumulated count variables.

ENDP:RAMP:START

Examples

```
OUTPUT @vdsp;”ENDP:RAMP:START”
```


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END-POINT RAMP TIME

This command sets the time period for all channels to ramp to predefined amplitude values. The amplitude values are set with the “ENDP:RAMP:AMPL” command. The “ENDP:RAMP:START” command should be used to the ramp.

ENDP:RAMP:TIME period
ENDP:RAMP:TIME?

Parameters	Description	Range
period	time in seconds for the ramp period	.050 to 20.0

Examples

OUTPUT @vdsp;”ENDP:RAMP:TIME 1.0”

END-POINT RAMP AMPLITUDE

This command sets amplitude value for each channel to ramp to following a “ENDP:RAMP:START message. The time for the ramp is set with the “ENDP:RAMP:TIME” command. The “ENDP:RAMP:START” command should be used to the ramp.

ENDP:RAMP:AMPL Channel Volts
ENDP:RAMP:AMPL? Channel

Parameters	Description	Range
channel	servo channel number	1-8 or ALL
Value	Voltage value for the specified channel(s)	+/- 10v

Examples

OUTPUT @vdsp;”ENDP:RAMP:AMPL ALL 0.0”
OUTPUT @vdsp;”ENDP:RAMP:AMPL 1 0.5”

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END-POINT CURRENT INDEX

This command reads or writes the current end-point index. This function can be used to locate the end-point index at any position in the end-point buffer. Note that the end-point generator will placed in a HOLD state following this command.

ENDP:INDEX index
ENDP:INDEX?

Parameters	Description	Range
index	index into end-point table	1 - 8192

Examples

```
OUTPUT @vdsp;"ENDP:INDEX 5432"
OUTPUT @vdsp;"ENDP:INDEX?"
ENTER @vdsp;Index
```

END-POINT START/STOP RANGE

This command is used to set the Start and Stop end-point indexes. By default, the end-point generator will halt when “index2” is reached. At this point, the VDSP31 will be placed into a HOLD state. *If the end-point buffer is in REPEAT AT END mode (See ENDP:REPEAT), the end-point generator will reset to “index1” and continue.*

ENDP:INDEX index1 index2
ENDP:INDEX?

Parameters	Description	Range
index1	start index into end-point table	1 - 8192
index2	stop index into end-point table	1 - 8192

Examples

```
OUTPUT @vdsp;"ENDP:RANGE 1 8192"
OUTPUT @vdsp;"ENDP:RANGE?"
ENTER @vdsp;R1,R2
```


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END-POINT REPEAT

This command is used to enable or disable REPEAT mode. If enabled, the end-point generator will cycle between indexes as specified by the ENDP:RANGE command.

ENDP:REPEAT state
ENDP:REPEAT?

Parameters	Description	Range
state	specifies the state of REPEAT mode	ON or OFF 1 or 0

Examples

OUTPUT @vdsp;"ENDP:REPEAT OFF"

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END-POINT HOLD

This command is used to enable or disable HOLD mode. If HOLD is ON, the end-point generator will remain at the current end-point and ignore end-point triggers.

ENDP:HOLD state
ENDP:HOLD?

Parameters	Description	Range
state	specifies the state of HOLD mode ON = HOLD, OFF = NO HOLD	ON or OFF 1 or 0

Examples

```
OUTPUT @vdsp;"ENDP:HOLD OFF"
OUTPUT @vdsp;"ENDP:HOLD?"
ENTER @vdsp;Hold
```

END-POINT BANK SELECTION

This command is used to select which end-point buffer bank (A or B) is active.

ENDP:BANK select
ENDP:BANK?

Parameters	Description	Range
select	selects which buffer bank is active	A or B 0 or 1

Examples

```
OUTPUT @vdsp;"ENDP:BANK A"
OUTPUT @vdsp;"ENDP:BANK?"
ENTER @vdsp;Bank
```


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END-POINT SOFTWARE TRIGGER

This command is used to send a software end-point trigger.

ENDP:SOFT:TRIG
ENDP:SOFT:TRIG?

Examples

```
OUTPUT @vdsp;"ENDP:SOFT:TRIG"
```

END-POINT STATUS WORD

This command is used to read the end-point generator status word.

ENDP:STAT?

Examples

```
OUTPUT @vdsp;"ENDP:STAT?"
ENTER @vdsp;Stat
```

BIT	DESCRIPTION
0	Endpoint Enable 1=Enabled, 0=Disabled
1	Hold 1=Hold ON, 0=Hold OFF
2	Bank 1=BANK B, 0=BANK A
3	Repeat 1=Repeat ON, 0=Repeat OFF
4	Btoggle 1=Buffer Toggle, 0=No Toggle
5	Endpoint trigger mode 0=INT, 1=EXT
6	Moving 1=Moving to Endpoint, 0=Done
7	Endpoint Trigger 1=Triggered,0=Waiting

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END-POINT USE SINGLE BUFFER

This command enables or disables a single 16384 point end-point buffer. The default state is OFF. The default state supports two 8192 point A/B banks.

ENDP:BUFF:SINGLE state
ENDP:BUFF:SINGLE?

Parameters	Description	Range
state	state of SINGLE BUFFER enable	1 or ON 0 or OFF

Examples

! Enable 16384 point buffering
OUTPUT @vdsp;"ENDP:BUFF:SINGLE ON"

! Disable 16384 point buffering, the DEFAULT
OUTPUT @vdsp;"ENDP:BUFF:SINGLE OFF"

END-POINT NULL PACE LIMITS

This command specifies two limits for Null Pacing applications. The limit(s) are applied to the specified channel. Limit1 specifies the error limit windows to be applied during a waypoint transition. Limit2 is optional, and if specified, determines the error limit to be applied after reaching a new end-point.

ENDP:NULLP:LIMIT chan limit1 [limit2]
ENDP:NULLP:LIMIT?

Parameters	Description	Range
chan	channel number to apply limit(s) to	1-8 or ALL
limit1	Limit applied during a transition	0.0 - 10.0
limit2	Limit applied at end of transition	0.0 - 10.0

Examples

! Set channel 1 waypoint limit to .25 and end-point limit to .01
OUTPUT @vdsp;"ENDP:NULLP:LIMIT 1 .25 .01"

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ENABLE CIRCULAR TRACE BUFFER

This command enables or disables the circular trace buffer data storage. If enabled (ON), the firmware will begin to store both CMD and FBK into a circular buffer. The trace buffer size if 16384 samples. Samples are written to the trace buffer at 1 millisecond intervals. When disabled (OFF), data samples are NOT written to the trace buffer.

TRACE:ENABLE enable
TRACE:ENABLE?

Parameters	Description	Range
enable	sets the state of the trace buffer logging.	ON or OFF 1 or 0

Examples

OUTPUT @vdsp;"TRACE:ENABLE ON"

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CONFIGURE TRACE BUFFER

This command changes the PRE and POST trigger sample counters. The PRE trigger value determines how many samples are to be retained prior to trigger reception. The POST value determines how many additional samples will be stored following a trigger.

TRACE:CONFIG PreCount PostCount
TRACE:CONFIG?

Parameters	Description	Range
PreCount	Number of samples to keep before trigger	0 - 16384
PostCount	Number of samples to store after trigger	0 - 16384

Examples

```
OUTPUT @vdsp;"TRACE:CONFIG 1000 2000"
OUTPUT @vdsp;"TRACE:CONFIG?"
ENTER @vdsp;PreCount, PostCount
```


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READ TRACE BUFFER

This command is used to retrieve the contents of the trace buffer for the specified channel. The number of samples available for transfer is based on the sum of the PRE and POST trigger count configuration variables. These variables are set with the TRACE:CONFIG command.

TRACE:READ:CMD? channel
TRACE:READ:FBK? channel

Parameters	Description	Range
channel	Servo channel number	1-8

Examples

```
ALLOCATE Volts(1200)

OUTPUT @vdsp;"TRACE:CONFIG 200 1000"
OUTPUT @vdsp;"TRACE:ENABLE ON"
OUTPUT @vdsp;"TRACE:SOFT:TRIG"

LOOP
   OUTPUT @vdsp;"TRACE:STAT?"
   ENTER @vdsp;A
   IF A THEN
      EXIT LOOP
   END IF
END LOOP

OUTPUT @vdsp;"TRACE:READ:CMD? 1"
ENTER @vdsp;Volts(*)
```


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TRACE BUFFER STATUS

Returns a 1 if the trace buffer has been triggered and ready.
0 if not ready.

TRACE:STAT?

Examples

```
OUTPUT @vdsp;"TRACE:STAT?"
ENTER @Vdsp;Stat
```

SOFTWARE TRIGGER OF TRACE BUFFER

This command triggers the trace data collection by software.
The trace buffer will begin storing POST trigger scans.

TRACE:SOFT:TRIG

Examples

```
OUTPUT @vdsp;"TRACE:SOFT:TRIG"
```


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DUAL FEEDBACK A/B COMPARE

This command changes the limit value for feedback A/B compare. Limit values of 0.0 disable the compare. Both A and B feedback channels are compared against the “limit” value. Out of limit conditions will initiate a DUMP sequence.

ABCMP:LIMIT channel limit
ABCMP:LIMIT? channel

Parameters	Description	Range
channel	Servo channel number	1-8 or ALL
limit	limit value for comparison limit value of 0.0 disables comparison	0.0 - 10.0

Examples

```
OUTPUT @vdsp;"ABCMP:LIMIT 1 0.0"
OUTPUT @vdsp;"ABCMP:LIMIT? ALL"
ENTER @vdsp;Limits(*)
```


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NULL PACE ERROR LIMIT

This command changes the error limit value for Null Pace. Limit values of 0.0 disable the compare. The absolute value of the servo error signal is compared to the error limit. If the error is outside the limit the current setpoint command is held at the last point.

NULLP:LIMIT channel limit
NULLP:LIMIT? channel

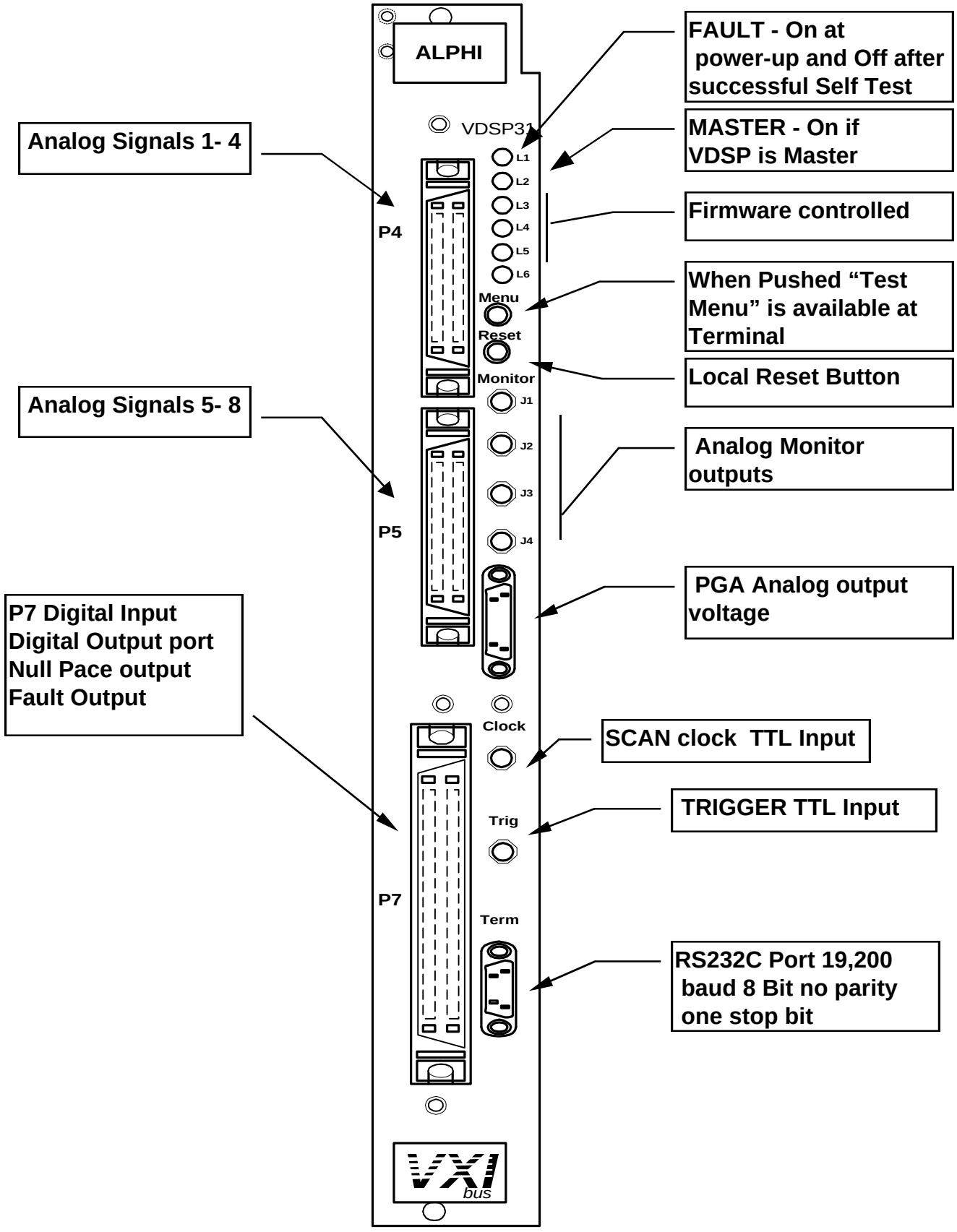
Parameters	Description	Range
channel	Servo channel number	1-8 or ALL
limit	limit value for comparison limit value of 0.0 disables comparison	0.0 - 10.0

Examples

```
OUTPUT @vdsp;"NULLP:LIMIT 1 0.0"
OUTPUT @vdsp;"NULLP:LIMIT 2 0.1"
OUTPUT @vdsp;"NULLP:LIMIT? 4"
ENTER @vdsp;Limit4
```


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BRIDGE TRANSDUCER SIGNAL CONDITIONING

PROGRAMMABLE GAIN AMPLIFIER (PGA)

Low level bridge transducer input signals are amplified by a high precision low noise dual stage instrumentation amplifier. Common mode voltage, taken at the output of the first stage of the PGA, is made available at the input connector forming a driven guard shield. This active guard can be enabled by installing jumper J1 at the PGA module. The first amplifier stage can provide a gain of 1 or 100. This gain selection can be fixed by jumper J2 or software selectable via a relay. To allow software to program the gain, J2 must be omitted. The second stage is used amplify the output signal from the first stage by a ratio of 1, 2, 4 or 8. The second stage gain is programmable by software. The total gain combinations are 1,2,4,8,100,200,400 and 800. A functional block diagram of the PGA module is depicted below in **Figure 9**:

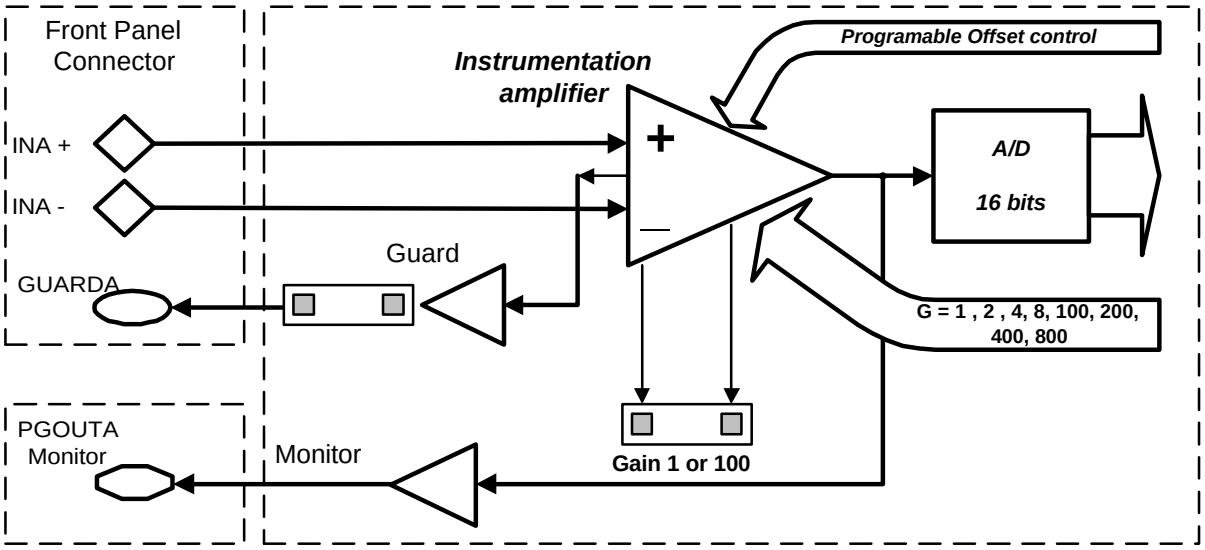


Figure 9

PGA OUTPUT OFFSET

The output of the PGA can be offset by up to +/- 10 volts under software control. The final amplified signal is then routed to a high precision Analog to Digital (A/D) converter.

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PGA FRONT PANEL MONITOR

The analog output of the PGA can be monitored at the Front Panel. This signal is the same signal that will be digitized by the A/D converter. A unity gain amplifier buffers the signal.
The PGA Front Panel Monitor connector pinout is described in the Appendices.

Figure 10 shown below, illustrates the PGA module jumper locations:

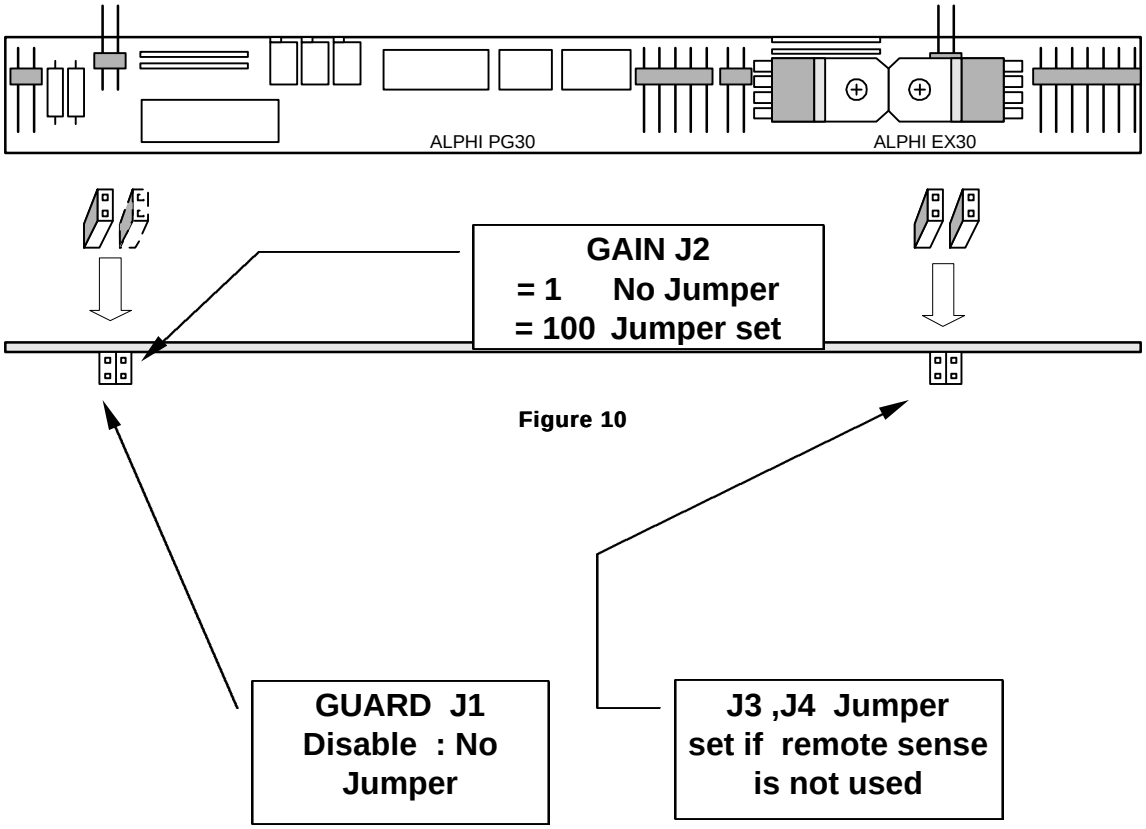


Figure 10

PGA FACTORY CONFIGURATION :
Active guard disable, J1 = no jumper
Gain 1/100 programmable by software, J2 = no jumper

EXCITATION FACTORY CONFIGURATION :
Remote sense not used, connected at module level. J3, J4 jumpers installed

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BRIDGE DC EXCITATION

Figure 11 below depicts a function block diagram of the Bridge Excitation Module. The Excitation Module is a voltage power amplifier output that is controlled by a 16 bit D/A. The output voltage is proportional to the D/A output voltage. The maximum output is +/- 10 volts with a load of 200Ω. The load is floating between +10 and -10v. This allows the differential input signal of the load cell to be close to the zero volts. Remote sense lines can be enabled to compensate for voltage drop do to long cable connections. The return path can be connected at the level of the Excitation Module (**J3, J4**) or externally at the bridge transducer. Refer to **Figure 10** on the preceding page for the location of J3 and J4.

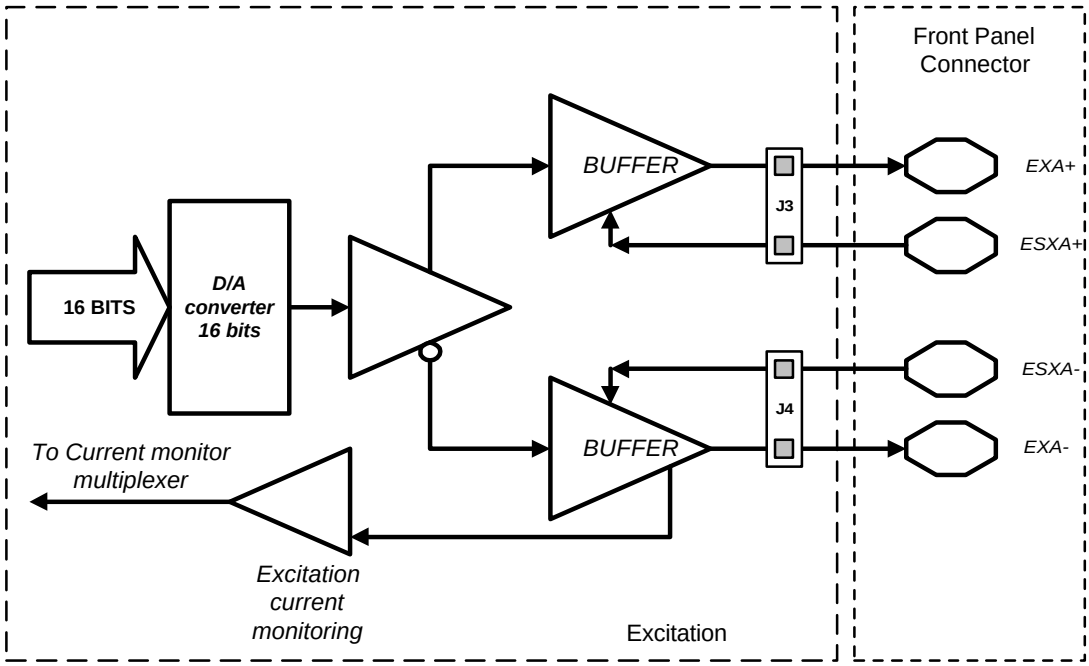
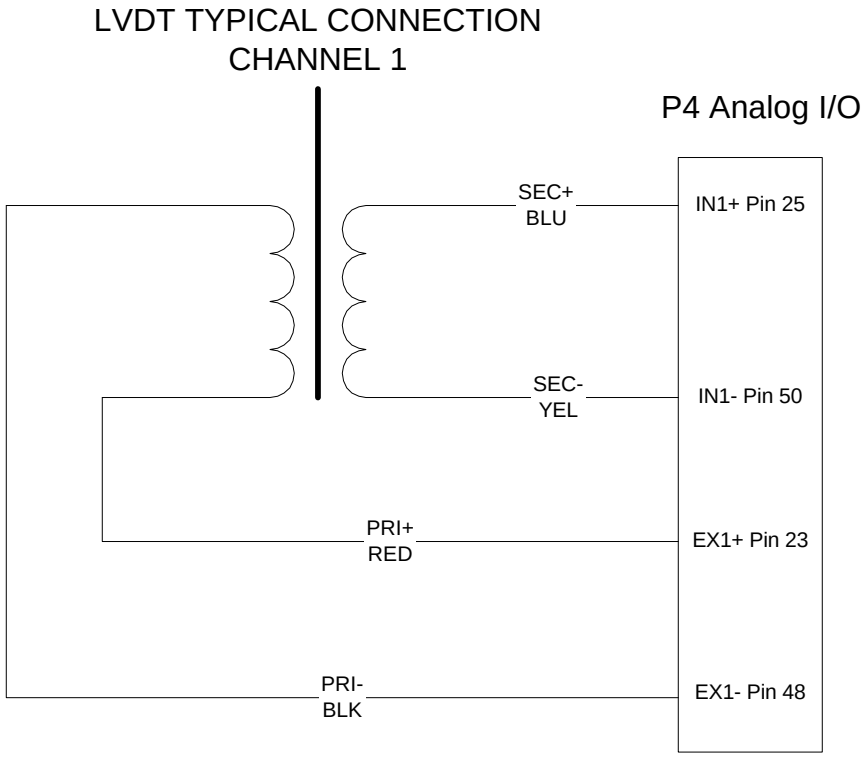


Figure 11

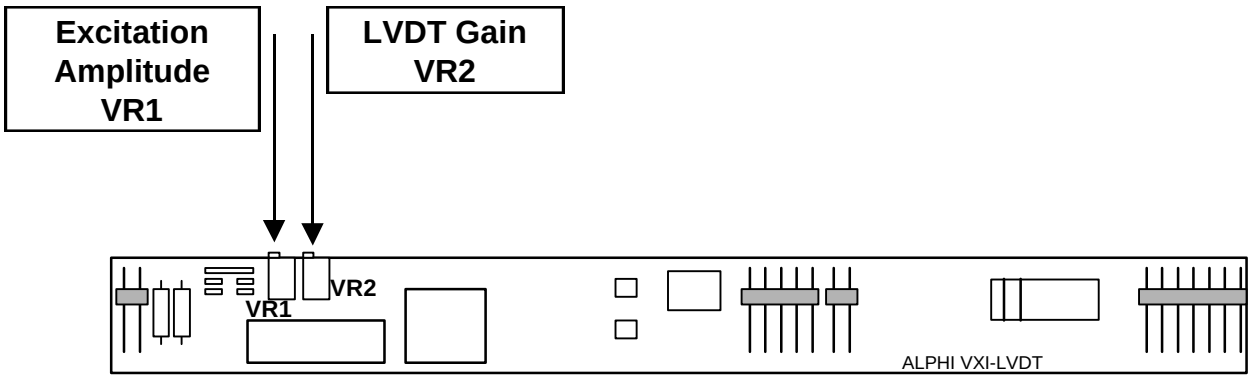
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LVDT SIGNAL CONDITIONING



Excitation level adjustment VR1 is set at the factory to supply 7.0 vpp to the LVDT primary windings. ***The demodulator is ratiometric and is insensitive to changes in excitation level***. Gain adjustment VR2 is set at the factory for a sensitivity of approximately 3v/inch when using an MTS 390751-03J or Collins LMT-711P34. These adjustments are designed to provide a +/- 9 volt output for a +/- 3 inch stroke.



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VALVE DRIVER MODULE

DESCRIPTION

The valve driver module is able to provide up to 100 mA to with a 200 Ω load. The output of a 16 bit D/A converter drives two power amplifiers. The power amplifiers convert the input voltage signal to a current signal. The current output is directly proportional to the voltage input. The valve current output can be read back by the processor via a differential amplifier that converts the output current back into a voltage signal that is directly proportional to the current. A block diagram of the valve driver module is presented below in **Figure 12:**

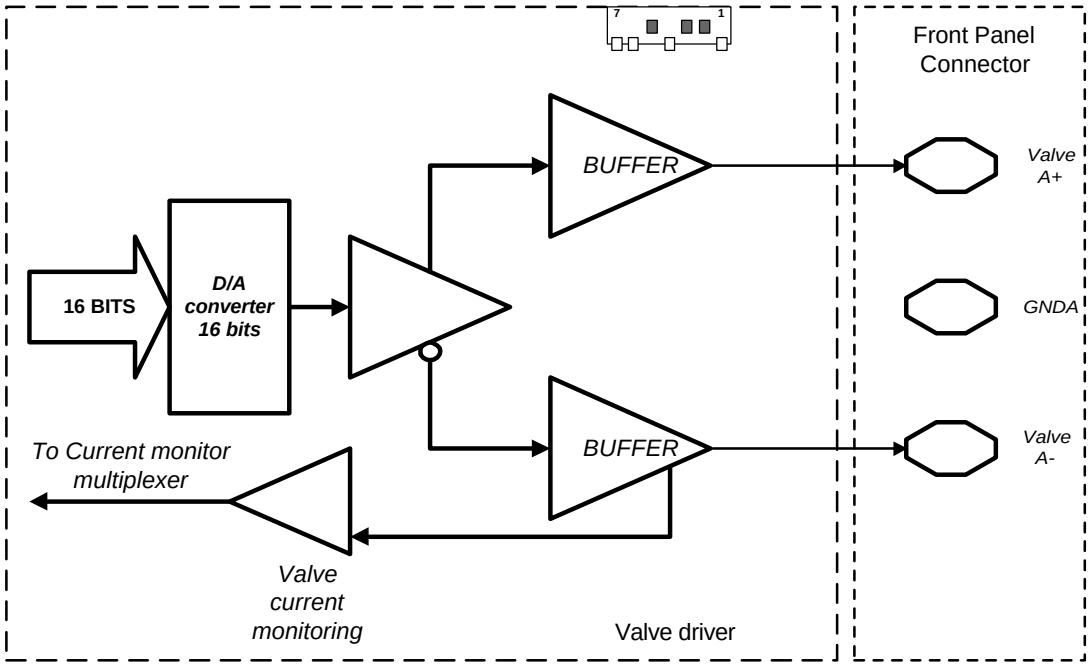


Figure 12

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VALVE DRIVER JUMPER CONFIGURATION AND LOCATION

A dip switch selects different output configurations as shown in **Figure 13** below. The valve driver module can be configured to output +/- 10 V, +/- 25 mA,+/ - 50 mA or +/- 100 mA. ***The full scale range is based on a 5 volt output from the valve driver D/A.***

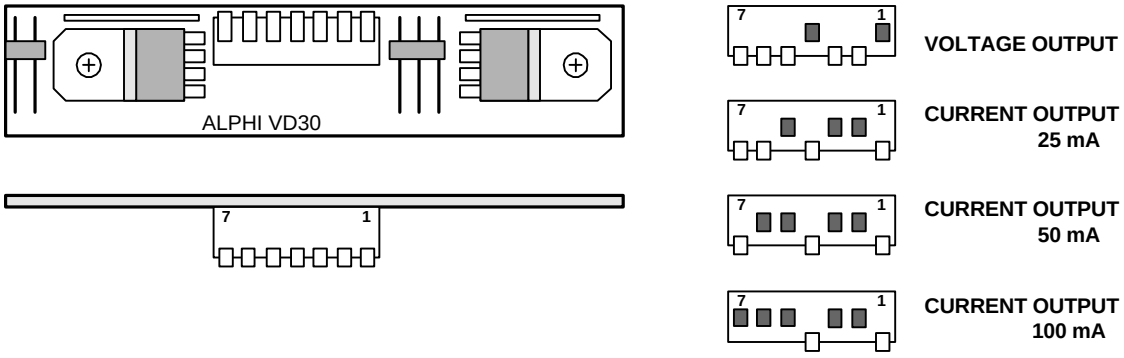


Figure 13

FACTORY CONFIGURATION : *Current output 50 mA*

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TYPICAL EXTERNAL CONNECTIONS

External connections for servo channel 1 are depicted below in **Figure 14**:

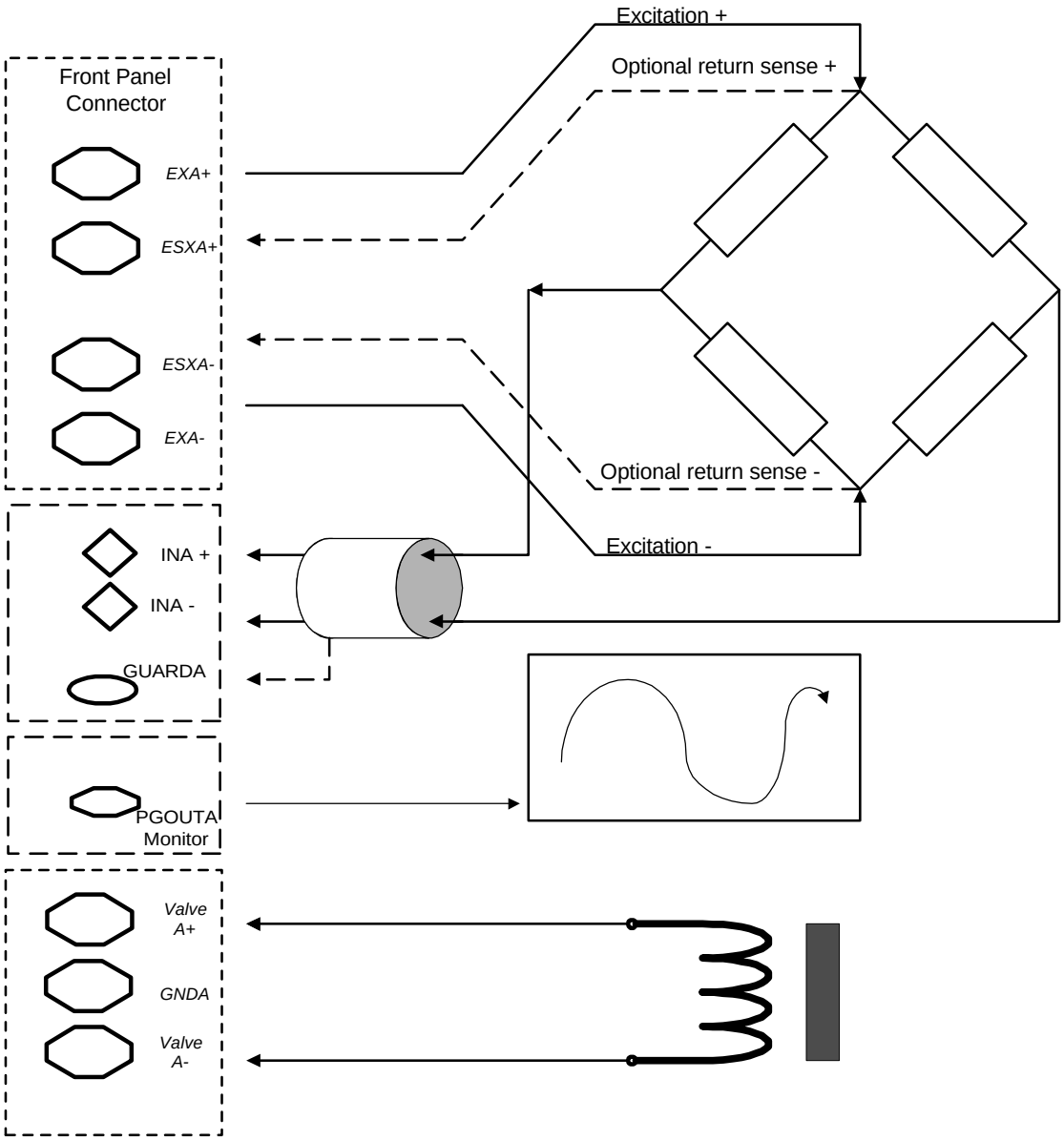


Figure 14

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INTERNAL SIGNAL MONITORING

The VDSP31 provides the capability to monitor the activity of signals internal to the control calculations. The VDSP31 firmware converts internal floating point variables into voltages using four 16 bit digital to analog converters. One channel at a time is sent to the front panel monitor through SMB connectors. The variables monitored at the front panel are:

SMB connector #1	***Command***
SMB connector #2	***Feedback***
SMB connector #3	***Error***
SMB connector #4	***Valve***

By default, the four signals for servo channel 1 are selected for monitoring. The servo channel to be monitored can changed under software control.

DIGITAL I/O

INPUTS

The VDSP31 has 32 TTL inputs. Each input is pulled-up to +5v with a 20 K resistor.

OUTPUTS

The VDSP31 has 32 TTL outputs. Each output is able to drive up to 5 mA.

FRONT PANEL LED'S

Six front panel LED's provide visual feedback as to the health of the module

LED	FUNCTION
L6	Flashes to indicate that the control law is running
L5	This LED indicates the level of VXI WordSerial traffic
L4	This LED indicates that a VXI or SCPI command is being processed
L3	This LED toggles whenever the trace buffer has reached the end of buffer
L2	Master when "on" the module is the source of the SCAN clock and TRIGGER signal
L1	Watchdog active upon reset, cleared by the module after correct initialization. Active if the module fails

Table 3

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SERIAL PORT

The VDSP31 supports a System Console port at the front panel. The System Console is an RS-232 compatible port. A PC or Terminal can be connected to this port to alter the VDSP31 configuration and to execute diagnostic programs. The VDSP31 communication settings for this port are 19200 Baud, 8 bit, no parity. The VDSP31 firmware outputs ANSI escape sequences to clear the screen, position the cursor, etc. Make sure that your terminal or communications software is using VT100 /ANSI terminal emulation.

VDSP31 RESET

The VDSP31 can be RESET from the three locations. The sources for the VDSP31 reset signal are:

- Power-on , the SYSRESET* line set the output RSTCR* of a watchdog timer DS1232 low for 200 ms
- Reset bit RST from the VXI Control register set to a “1”.
- Front Panel REST button

VDSP31 FAULT OUTPUT

The VDSP31 contains a watch dog safety circuit. The watch dog circuitry must be accessed by the DSP at regular intervals. If the DSP fails to perform the required access for any reason, the watch dog will pull the Fault Output low to inform the outside world that the VDSP31 hardware or software have failed. The watch dog fail output is also used to hold valve driver module D/A hardware in reset (0v). This signal can be connected to external relays, indicators other hardware Watch dog outputs from multiple VDSP31 boards can be connected in parallel if required.

NULL PACE OUTPUT

The NULL PACE output signal is a firmware controlled output. The Null Pace signal is not currently supported by the firmware. This output can be Ored with the Null Pace outputs from other VDSP31 modules. The Open Drain output can drive up to 10 mA.

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VXI A16 BASE ADDRESS

There are two ways to configure the VDSP31 A16 address. The first method is static configuration. The second method is dynamic configuration. Static configuration allows the user to preset the Logical Address to a fixed value. Dynamic configuration relegates this task to the VXIbus Resource Manager. Both methods will be described here.

STATIC CONFIGURATION

The device's Logical Address is set by jumper manually. When a jumper is installed, the address bit is equal to 0. For example, with a jumper installed on 1-2 and all other jumpers open, the Logical Address is set to 254. Jumper J4 select the base address as follows in **Table 3** below :

J4	Jumper between	Address Bit
	1-2	0
	3-4	1
	5-6	2
	7-8	3
	9-10	4
	11-12	5
	13-14	6
	15-16	7

Table 4

DYNAMIC CONFIGURATION

If there are no jumpers installed, the Logical Address value will be 255. Therefore the VDSP31 will become a Dynamic Configured (DC) device. In DC operation, the VDSP31 monitors the MODID signal as a device qualifier, allowing a Resource Manager to program Its internal Logical Address register. Once the Logical Address has been programmed, the MODID signal is ignored.

FACTORY CONFIGURATION : ***Dynamic configuration , no jumper installed on J4***

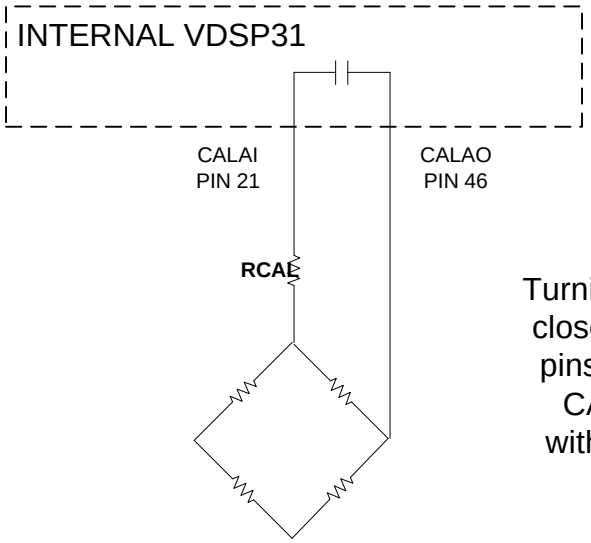
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CALIBRATION RESISTANCE

The VDSP31 is installed with precision resistors (100 K .1%) on each bridge transducer channel. These resistors can be used to shunt calibrate a bridge transducer with a 100 K RCAL equivalent. Each side of the resistors are available at the front panel connector. The VDSP31 firmware controls the state of a relay that can be used to compete a parallel circuit with one arm of a bridge transducer. This resistance can be connected externally to any arm of the bridge transducer. At reset, all of the relays are disabled.

VDSP31 Channel A
CAL Relay
Example



Turning the CAL Relay "ON" closes the contact between pins 21 and 46 putting the CAL resistor in parallel with one leg of the bridge

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CONNECTORS

ANALOG I/O CONNECTORS P4 AND P5 ORIENTATION

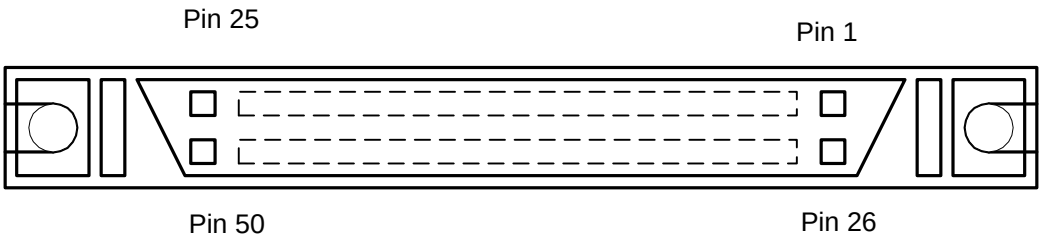


Figure 15

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ANALOG I/O CONNECTOR P4 AND P5 PINOUT

P4 Pin	P4 Signal	P4 Pin	P4 Signal		P5 Pin	P5 Signal	P5 Pin	P5 Signal
Pin 1	VALVE1+	Pin 26	VALVE3+		Pin 1	VALVE5+	Pin 26	VALVE7+
Pin 2	VALVE1 -	Pin 27	VALVE3-		Pin 2	VALVE5 -	Pin 27	VALVE7-
Pin 3	GNDA	Pin 28	GNDA		Pin 3	GNDA	Pin 28	GNDA
Pin 4	VALVE2+	Pin 29	VALVE4+		Pin 4	VALVE6+	Pin 29	VALVE8+
Pin 5	VALVE2 -	Pin 30	VALVE4-		Pin 5	VALVE6 -	Pin 30	VALVE8-
Pin 6	CAL4I	Pin 31	CAL4O		Pin 6	CAL8I	Pin 31	CAL8O
Pin 7	EXS4+	Pin 32	EXS4-		Pin 7	EXS8+	Pin 32	EXS8-
Pin 8	EX4+ PRI RED	Pin 33	EX4- PRI BLK		Pin 8	EX8+ PRI RED	Pin 33	EX8- PRI BLK
Pin 9	GUARD4	Pin 34	GNDA		Pin 9	GUARD8	Pin 34	GNDA
Pin 10	IN4+ SEC BLU	Pin 35	IN4- SEC YEL		Pin 10	IN8+ SEC BLU	Pin 35	IN8- SEC YEL
Pin 11	CAL3I	Pin 36	CAL3O		Pin 11	CAL7I	Pin 36	CAL7O
Pin 12	EXS3+	Pin 37	EXS3-		Pin 12	EXS7+	Pin 37	EXS7-
Pin 13	EX3+ PRI RED	Pin 38	EX3- PRI BLK		Pin 13	EX7+ PRI RED	Pin 38	EX7- PRI BLK
Pin 14	GUARD3	Pin 39	GNDA		Pin 14	GUARD7	Pin 39	GNDA
Pin 15	IN3+ SEC BLU	Pin 40	IN3- SEC YEL		Pin 15	IN7+ SEC BLU	Pin 40	IN7- SEC YEL
Pin 16	CAL2I	Pin 41	CAL2O		Pin 16	CAL6I	Pin 41	CAL6O
Pin 17	EXS2+	Pin 42	EXS2-		Pin 17	EXS6+	Pin 42	EXS6-
Pin 18	EX2+ PRI RED	Pin 43	EX2- PRI BLK		Pin 18	EX6+ PRI RED	Pin 43	EX6- PRI BLK
Pin 19	GUARD2	Pin 44	GNDA		Pin 19	GUARD6	Pin 44	GNDA
Pin 20	IN2+ SEC BLU	Pin 45	IN2- SEC YEL		Pin 20	IN6+ SEC BLU	Pin 45	IN6- SEC YEL
Pin 21	CAL1I	Pin 46	CAL1O		Pin 21	CAL5I	Pin 46	CAL5O
Pin 22	EXS1+	Pin 47	EXS1-		Pin 22	EXS5+	Pin 47	EXS5-
Pin 23	EX1+ PRI RED	Pin 48	EX1- PRI BLK		Pin 23	EX5+ PRI RED	Pin 48	EX5- PRI BLK
Pin 24	GUARD1	Pin 49	GNDA		Pin 24	GUARD5	Pin 49	GNDA
Pin 25	IN1+ SEC BLU	Pin 50	IN1- SEC YEL		Pin 25	IN5+ SEC BLU	Pin 50	IN5- SEC YEL

Table 5

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PROGRAMMABLE GAIN AMPLIFIER OUTPUT MONITOR

These signals are available at the Front Panel using a 15 Pin female connector:

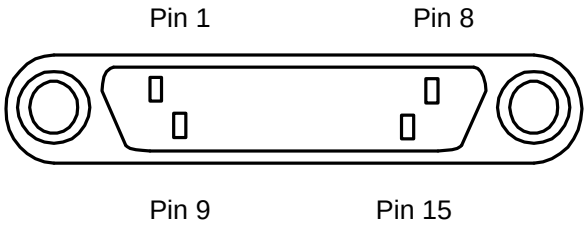


Figure 16

Pin	Signal	Pin	Signal
Pin 1	PGOUT01	Pin 9	GNDA
Pin 2	PGOUT02	Pin 10	GNDA
Pin 3	PGOUT03	Pin 11	GNDA
Pin 4	PGOUT04	Pin 12	GNDA
Pin 5	PGOUT05	Pin 13	GNDA
Pin 6	PGOUT06	Pin 14	GNDA
Pin 7	PGOUT07	Pin 15	GNDA
Pin 8	PGOUT08		

Table 6

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SYSTEM CONSOLE RS-232 PORT

The System Console uses a 9 Pin Subminiature female connector for the RS-232C interface.

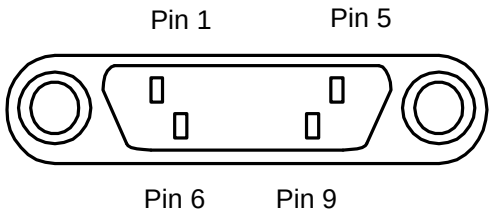


Figure 17

Pin	Signal	Direction
Pin 1		
Pin 2	RS232_TX	Output
Pin 3	RS232_RX	Input
Pin 4	RS232_CTS	Input
Pin 5	GND	
Pin 6	RS232_RTS	Output
Pin 7	GND	
Pin 8		
Pin 9		

Table 7

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DIGITAL I/O CONNECTOR P7 ORIENTATION

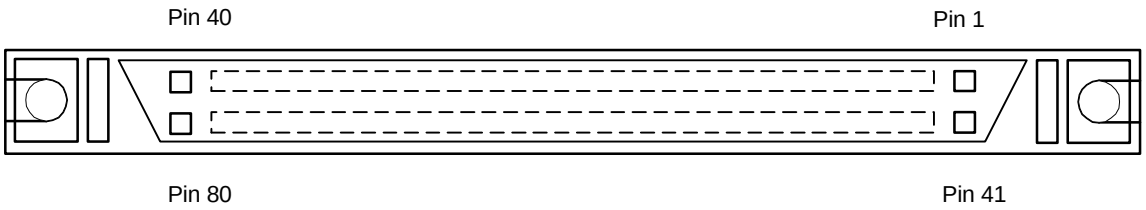


Figure 18

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DIGITAL I/O CONNECTOR P7 PINOUT

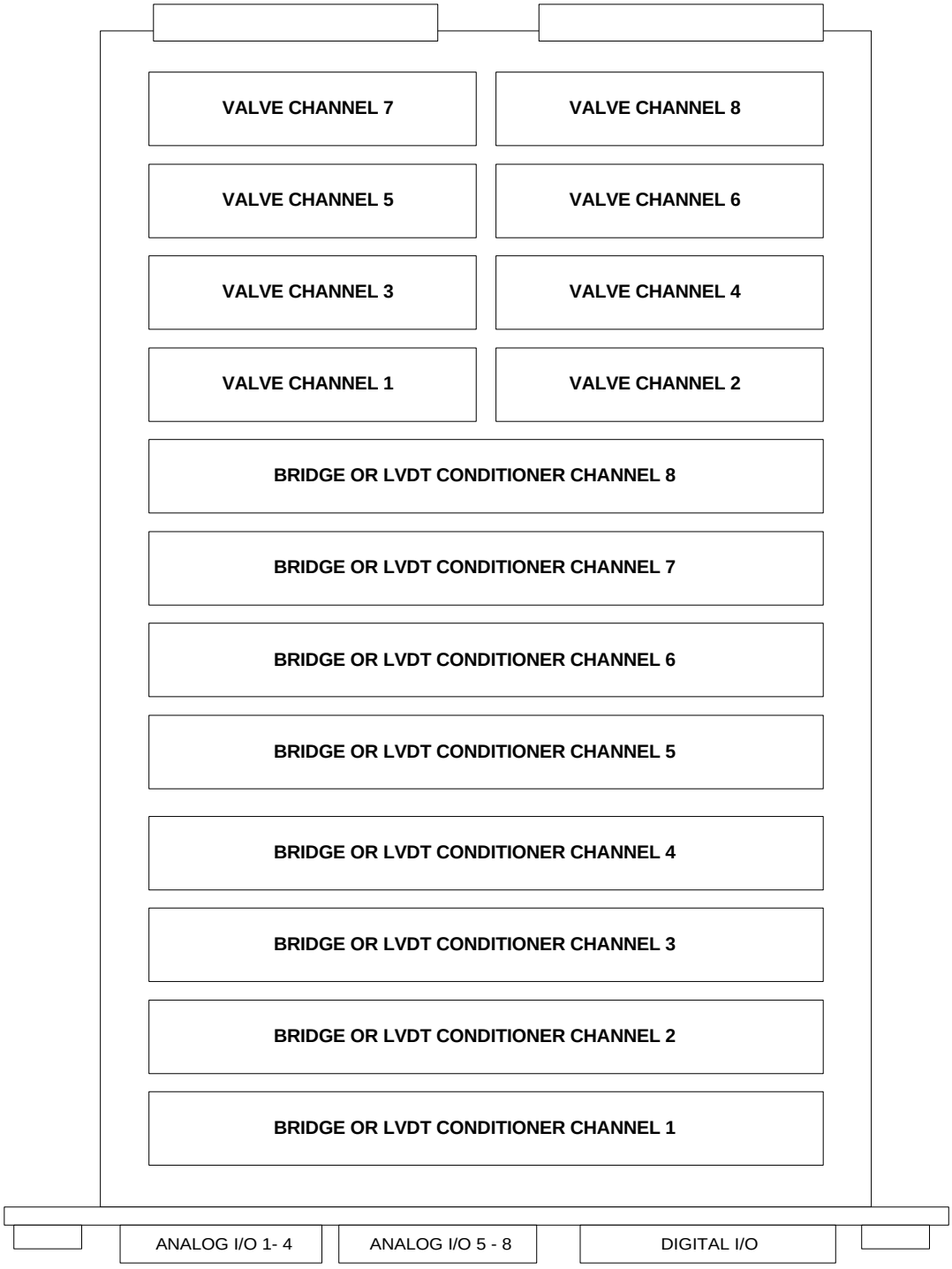
Pin	Signal	P7	Pin	Signal
Pin 1	DIN15		Pin 41	DIN31
Pin 2	DIN14		Pin 42	DIN30
Pin 3	DIN13		Pin 43	DIN29
Pin 4	DIN12		Pin 44	DIN28
Pin 5	DIN11		Pin 45	DIN27
Pin 6	DIN10		Pin 46	DIN26
Pin 7	DIN09		Pin 47	DIN25
Pin 8	DIN08		Pin 48	DIN24
Pin 9	GND		Pin 49	GND
Pin 10	GND		Pin 50	GND
Pin 11	DIN07		Pin 51	DIN23
Pin 12	DIN06		Pin 52	DIN22
Pin 13	DIN05		Pin 53	DIN21
Pin 14	DIN04		Pin 54	DIN20
Pin 15	DIN03		Pin 55	DIN19
Pin 16	DIN02		Pin 56	DIN18
Pin 17	DIN01		Pin 57	DIN17
Pin 18	DIN00		Pin 58	DIN16
Pin 19	GND		Pin 59	GND
Pin 20	GND		Pin 60	GND
Pin 21	DOUT15		Pin 61	DOUT31
Pin 22	DOUT14		Pin 62	DOUT30
Pin 23	DOUT13		Pin 63	DOUT29
Pin 24	DOUT12		Pin 64	DOUT28
Pin 25	DOUT11		Pin 65	DOUT27
Pin 26	DOUT10		Pin 66	DOUT26
Pin 27	DOUT09		Pin 67	DOUT25
Pin 28	DOUT08		Pin 68	DOUT24
Pin 29	GND		Pin 69	GND
Pin 30	GND		Pin 70	GND
Pin 31	DOUT07		Pin 71	DOUT23
Pin 32	DOUT06		Pin 72	DOUT22
Pin 33	DOUT05		Pin 73	DOUT21
Pin 34	DOUT04		Pin 74	DOUT20
Pin 35	DOUT03		Pin 75	DOUT19
Pin 36	DOUT02		Pin 76	DOUT18
Pin 37	DOUT01		Pin 77	DOUT17
Pin 38	DOUT00		Pin 78	DOUT16
Pin 39	GND		Pin 79	GND
Pin 40	RESTOC*		Pin 80	NULL PACE*

Table 8

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VDSP SIGNAL CONDITIONING MODULE LOCATIONS



FRONT PANEL

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