HEWLETT PACKARD

HP DSP Engine Software with Throughput to Disk

Product Overview

HP E3200A - for Microsoft® Windows Environment

HP E3201A - for HP-UX Environments

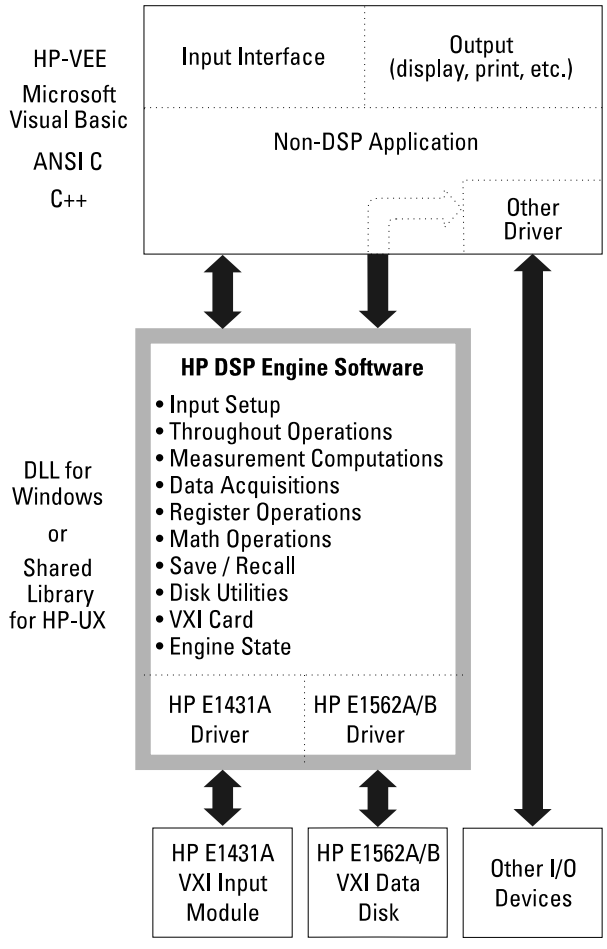
Rapid program development for DSP[1] systems implemented in VXI

Approach your dynamic data acquisition and storage applications efficiently—at a high level—without becoming bogged down in vendor-specific hardware details. With HP DSP Engine, you will *rapidly* develop sophisticated dynamic data acquisition and digital signal processing systems with the performance and data integrity of vendor-defined proprietary systems. HP DSP Engine simplifies your programming task by wrapping low-level DSP and device driver functionality into relatively few high-level functions—major catagories include measurement computations, block math, through-put-to-disk as well as device drivers for HP's E1431A VXI input module and E1562A/B VXI Data Disk. You don't have to be a DSP expert to get expert results with HP DSP Engine.

HP DSP Engine is optimized to extract all the available performance from the HP E1431A 8-channel input module and the HP E1562A/B 2/4-Gbyte data disk VXI modules.

The results are superior performance and data integrity. For example, HP DSP Engine can achieve throughput to internal disks at up to 5.2 Mbytes/ sec for over 13 minutes between the HP E1431A and HP E1562B with no data loss.

You choose the development environment. HP DSP Engine is available as a DLL for use with Microsoft Visual Basic, Microsoft C++ and HP VEE in Microsoft Windows or as a shared library for use with HP ANSI C, C++ and HP VEE in HP-UX.



HP DSP Engine is a building block for sophisticated data acquisition and analysis programs

[1] Digital Signal Processing

High-level functions replace months of programming

- > 100 high-level functions
- Reduce time for quality audit
- Built-in DSP expertise
- Optimum hardware integration
- Highly transportable code

Over 100 functions—many representing weeks of programming and years of DSP expertise—enable you to rapidly develop programs without having to know the details of DSP operations. The subtleties of DSP programming are built-in, and because each function does so much you have a fraction of the code to audit for quality. You save time in both initial program development and quality verification, and your final product is a more reliable program.

Being freed from knowing the device-specific details of the data acquisition and disk hardware allows you to focus on your area of expertise and your application. With HP DSP Engine, both data acquisition and DSP operations are programmed with a relatively few functions.

For example, only fourteen functions are used to program throughput from the HP E1431A 8-channel Input Module to the HP E1562A VXI data disk. A myriad of details are managed and optimized with those few functions. Imagine—only fourteen functions to program up to eighty channels of throughput-to-disk data organized in LIF[2] format.

To illustrate how HP DSP Engine simplifies your programming job, let's consider the power spectrum—a relatively simple DSP engine function. This single command combines at least six steps and significant DSP expertise. The first operation combines two steps; windowing and amplitude correction for the selected window (each window requires different corrections, of course). Next the windowed data is transformed into the frequency domain. In the fourth step, the signal amplitude is corrected for loss of negative frequency components. In the final two steps, the conjugate is taken and multiplied times the original complex spectrum. The result is a single power spectrum function, but with a nice additional benefit—programming the power spectrum for each of 80 channels of data is as easy as programming the power spectrum for one channel.

Chances are good you will be able to program in the language and environment of your choice. HP DSP Engine supports three popular languages in Microsoft Windows and HP-UX. Moving between languages is easy. Function definitions are as consistent as possible between programming languages.

Microsoft Windows	HP-UX
Microsoft Visual Basic	HP ANSI C/C++
Microsoft Visual C++	HP VEE
HP VEE	

[2] HP proprietary format

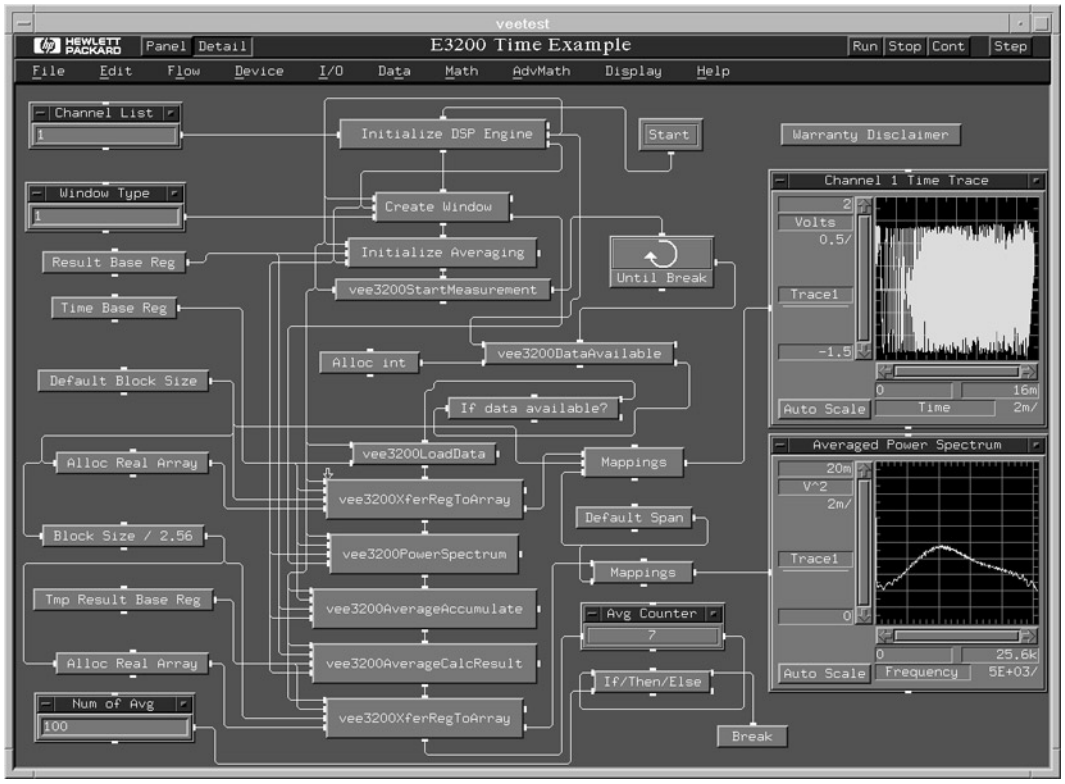
Using HP DSP Engine, this short fragment of C code is all that is necessary to read 40 channels of time domain data, window the data and calculate the power spectrum for each channel.

```
long id, register, array size = 1024;
double data [1024];

error = e3200Open ("VXI;255", &id);

error = e3200CreateWindow (id, 100, 1, E3200_WINDOW_HANN_NARROW);

 /* load the data for each active channel into a sequential block of registers starting with register 1 */

error = e3200LoadData (id, 1);

 /* Convert the time data for all active channels to power spectrum data using the window in register 100 */

error = e3200PowerSpectrum (id, 1, 40, 100);

/* transfer the contents of each register with power spectrum data from the
HP DSP Engine to this program's data array then plot the data. */

        for (register = 1; register <= 40; ++ register)
        {
           error = e3200XferRegToArray (id, register, array_size, & data [0]);
        }
```

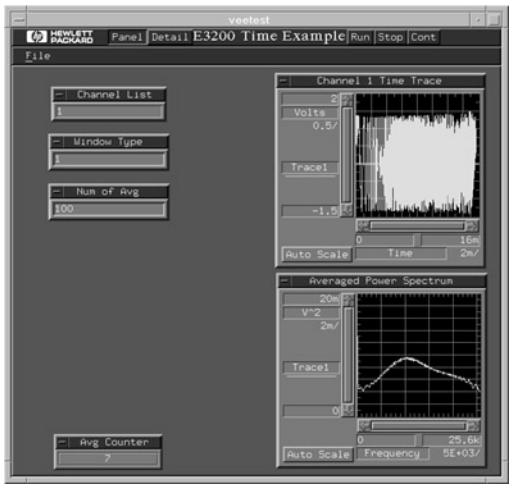
Graphical programming for DSP applications: HP VEE and HP DSP Engine

HP DSP Engine supercharges HP VEE by providing a rich set of graphical functions optimized for frequency domain analysis. For example, the display update rate for power spectrums is *>10 times* faster using HP DSP Engine, and multiple channels are programmed with only one set of graphical function blocks. HP DSP Engine gives you even *faster* program development and even *simpler* programming of frequency domain tests—all the reasons you bought HP VEE in the first place.

The integration of the VEE -compatible version of HP DSP Engine and HP VEE is virtually seamless. You'll enjoy all the benefits of graphical programming with HP DSP engine.



This simple HP VEE program measures eight channels of dynamic data with a 25.6k Hz span and displays both the time domain waveform and averaged frequency domain power spectrum of the first channel. HP DSP Engine component labels begin with vee 3200.



The panel view of the same program provides a simple easy-to-use operator interface.

HP VEE Cuts Program Development Time

In a hurry? Users report HP VEE reduces their programming time from 50% to 80%. HP VEE is a *graphical* programming language that speeds up and simplifies your test programming. With HP VEE you literally "flowchart" your way through a test program—thinking on a global, stuctural level—while HP VEE does the detail work.

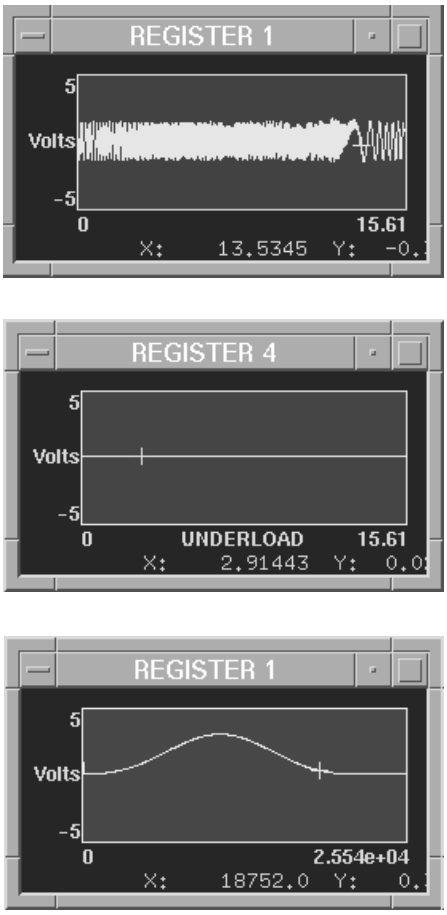
High-speed throughput to disk with monitoring

- Up to 5.2 Mbyte/sec throughput to disk
- 4 Gbytes of disk space (HP E1562B)
- Monitor throughput data
- DAT backup (HP E1562A)

You no longer have to accept gaps in your data when capturing high-speed transient events. Using HP's VXI Local Bus, data can be transferred from the HP E1431A input module to the dual-disk HP E1562B, at a real-time, sustained rate of 5.2 Mbytes/second without missing a single byte of data. With over 4 Gbytes of disk space, you can continuously store 38 channels of 25.6 kHz span (65536 samples/sec) dynamic data for more than 13 minutes. For a 400 Hz span, typically used when testing mechanical structures, 38 channels of data can be stored continuously for more than 14 hours.

Monitoring throughput data gives you confidence the data you're saving is the data you need. Throughput data in either the time or frequency domain can be transferred to the internal shared RAM for on-line monitoring at a 2 Mbyte/sec rate[3]. For most applications, this rate is sufficient to verify the test is pro-ceeding as expected. The impact of monitoring on the throughput rate is negligible since throughput activity is managed mainly by the HP E1562A, and monitoring is managed in the host.

With the HP E1562A, the DAT drive can back-up the 2 Gbyte disk without host intervention. Other back-up schemes using the host are also possible. (See the Product Overview for the HP E1562A VXI data disk, DAT & SCSI-2 interface module for more information.)



Throughput data can be monitored in both the time or frequency domain.

[3] The host reads the shared RAM. Actual monitoring rates depend on host computer performance.

Standard Data Format

- Support by major third parties
- Unlimited user comment fields
- Data exchange analyzers

Data saved on the throughput disk is directly compatible with most major third party products such as CADA-X from LMS and TDAS from SDRC. Throughput data is stored in HP's Standard Data Format (SDF). SDF provides unlimited space for the information you need to make your data meaningful. Ancillary data, such as test identification, test conditions, location, etc., can be stored in a user-defined file header for each data set. Data stored in SDF can be input into most HP DSA analyzers and the HP 35639A Data Viewer.

HP DSP Engine supports the HP E1431A and HP E1562A/B

- Simplified system integration
- Throughput disk frees-up the host computer

HP DSP Engine provides highly optimized drivers for the HP E1431A input module and the HP E1562A/B VXI data disk and a window to other I/O devices via functions that read and write to registers within the engine. Complete support for the HP E1431A and HP E1562A allowed HP designers to provide the HP DSP Engine's powerful—yet simple—high speed throughput capability. Each VXI module also makes a unique individual contribution to your system. The HP E1431A is a complete front-end that simplifies system integration while the HP E1562A/B is an intelligent throughput disk that frees up the host for other tasks.

The HP E1431A input module simplifies system integration by providing everything you need—including signal conditioning—in a single-wide C-size VXI module. Since the entire signal path is contained in a single module, errors are minimized, and the performance of the entire signal path can be guaranteed.

- 8 differential/grounded inputs
- Simultaneous sample and hold
- Separate 16-bit A/Ds for each channel
- AC/DC coupling
- ICP® power for accelerometers
- Individually programmable gains
- Programmable digital filters

The HP E1562A and HP E1562B are throughput data disks with the intelligence to manage the throughput process. This makes high throughput rates of up to 5.2 Mbytes/sec possible and frees the host for other activities—like monitoring the throughput data.

The HP E1562 is available in both A and B models; both are two slot wide C-sized modules. The HP E1562A contains a 2.1 Gbyte internal disk, an internal DAT tape drive for data backup and dual SCSI-2 interfaces for throughput to external disks. The HP E1562B allows you to trade DAT backup for more disk space. It contains two 2.1 Gbyte internal disks and dual SCSI-2 interfaces. Appropriate cables and terminators are available for both models.

Support

Most programmers will have no trouble programming in HP DSP Engine using the on-line help and the documentation provided. A host of well-documented programs for each language is included for use as building blocks in your program or as examples of best practices. In the event you do get stuck, programming support is available. Ask your local HP Sales Representative about the HP E3220A Knowledge Transfer consulting service.

A ninety-day warranty covers questions on installation as well as any defects in material.

Standard VXI measurement hardware

- Modular
- High-performance
- Industry standard

Modularity lets you purchase only the functionality you need. Expand your system when you're ready, and integrate new tech-nologies as they become available —all without obsoleting your existing equipment. VXI let's you optimize the system to meet your unique needs—today and in the future.

VXI is a standard instrumentation platform developed by a consortium of instrument companies to provide users with a flexible and compact modular measurement system *without* compromising performance. The secret to VXI's high performance is an internal data bus that exchanges data between the individual modules as though they were part of the same instrument. Today over 300 companies are licensed to produce VXI instruments.

Benchmarks for HP E3200A and HP E3201A

All benchmark data are typical values. Actual performance may vary as a function of a number of factors including system configuration and other system software.

DSP processing speeds for 1 channel

The total execution time for an FFT, a power spectrum and a linear spectrum are presented in the tables below.

VXI HP RADI-EPC-7 - 50 MHz

Block Size	FFT	Power Spectrum	Linear Spectrum
16384	670 ms	800 ms	770 ms
4096	119 ms	157 ms	140 ms
1024	26 ms	38 ms	32 ms
256	5.4 ms	9 ms	7 ms

HP 9000 715 - 50 MHz

Block Size	FFT	Power Spectrum	Linear Spectrum
16384	96 ms	124 ms	125 ms
4096	7 ms	16 ms	13 ms
1024	1.2 ms	2.7 ms	2.3 ms
256	280 us	75 us	61 us

HP V/743 - 100 MHz

Block Size	FFT	Power Spectrum	Linear Spectrum
16384	64 ms	71 ms	74 ms
4096	5 ms	10 ms	9.2 ms
1024	900 us	1.8 ms	1.6 ms
256	210 us	440 us	380 us

Averaging

The number of averages per second for a power spectrum with windowing is presented in the tables below.

VXI HP RADI-EPC-7 - 50 MHz

Block Size	25,600 Hz span		3,200 Hz span		100 Hz span	
	1-Channel	8-Channel	1-Channel	8-Channel	1-Channel	8-Channel
16384	1.2	0.15	0.5	0.15		
4096	5.6	0.7	1.9	0.7	0.1	0.0625
1024	22	2.9	7.4	2.9	0.2	0.25

HP 9000 715 - 50 MHz with MXI Interconnection

Block Size	25,600 Hz span			3,200 Hz span			100 Hz span		
	1-Channel	8-Channel	16-Channel	1-Channel	8-Channel	16-Channel	1-Channel	8-Channel	16-Channel
16384	3.4	0.76	0.39	0.5	0.43	0.39		0.012	
4096	13	3.86	2.38	2	1.69	1.46	0.1	0.62	0.062
1024	49	18.3	8.4	7.6	6.59	5.68	0.2	0.25	0.24

Throughput to disk

The following table shows the number of active channels (typical) as a function of block size and frequency span that can throughput data from the HP E1431A to the HP E1562A/B in real time[4]. The first columm (Single) under each span is the number of channels for recording to a single disk, and the second column (Combined) the number of channels for recording to a "combined" disk (i.e., both disks in the HP E1562B acting as a single disk). Since throughput is controlled almost exclusively by the HP E1562A/B, performance is likewise almost independent of the computer used.

Monitoring

The following table gives typical values for the number of channels that can be monitored during a throughput session. Like throughput, monitoring performance is determined by the performance of the HP E1562A and therefore almost independent of the computer used.

Block Size	25,600 Hz Span	12,800 Hz Span	≤ 6,400 Hz Span
8192	15	15	15
4096	15	31	31
2048	15	31	63
1024	15	31	80
64	15	31	80

HP 9000 715 - 50 MHz
VXI HP RADI-EPC-7 - 50 Mhz
HP V/743 - 100 MHz

Where two numbers are given xx/yy, the first number xx refers to the performance of the HP 9000 Series 715/50 and the HP V/743/100. The second number yy refers to the VXI HP RADI-EPC-7 throughput performance.

Block Size	25,600 Hz Span		12,800 Hz Span		≤ 6,400 Hz Span
	Single	Combined	Single	Combined	Single & Combined
8192	17	17	40	56	80/72
4096	23	38	46	80/72[5]	80/72
2048	24	37	47	80/72	80/72
1024	25	36	49	80/72	80/72
512	24	35	49	79/72	80/72
256	24	31	49	72	80/72
128	23	28	48	70	80/72
64	16	19	46	56	80/72

[4] without missing any data

[5] The second number refers to the HP VXI RADI-EPC-7 throughput performance

Ordering Information
HP E3200A
HP DSP Engine for Microsoft Windows and VXI

Includes license to use, manuals, example programs and software on 3.5” high density disks.

The HP E3200A contains a complete set of DSP engine library functions for HP VEE, Microsoft Visual Basic and C++. Supported versions are given below.

HP E2120A HP VEE for Microsoft Windows	Revision 2.3.1 or higher
Microsoft Visual Basic	Revision 3.0
ANSI C/Microsoft Visual C++	Revision 1.5 16-bit version

* Note HP DSP Engine consumes about 5 MBytes of hard disk space.

HP E3200A System Requirements

HP RADI-EPC7 VXI Embedded Controller

VXI embedded PC (80486) with a 3.5 inch floppy disk drive. MS-DOS® and Microsoft Windows are included.

HP Radi-EPC7 Options

Option 821 EPConnect	Development Bundle for Microsoft Windows and MS DOS Release 4.0
Option 108	Upgrade to 8 MBytes (recommended)

HP Instrumentation Requirements:

At least one HP E1431A 8-channel input module (up to nine are allowed)

HP E1562A/B VXI data disk, DAT & SCSI-2 interface module (optional)

HP E1401A 13-slot or E1421A 6-slot VXI C-size mainframe

Ordering Information
HP E3201A
HP DSP Engine for HP-UX and VXI

Includes license to use, manuals, example programs and software on DAT tape in DDS format.

The HP E3201A contains a complete set of DSP engine library functions for HP VEE and HP ANSI C/HP C++. Supported versions are given below.

HP E2110B HP VEE for HP-UX	Revision 8.03.01
HP ANSI C/HP C++	Revisions compatible with HP-UX 9.05

* Note HP DSP Engine consumes about 5 MBytes of hard disk space.

HP E3201A System Requirements

System requirements vary slightly depending on the style of S700 Series controller selected.

HP 9000 Series-700 Workstation Family Controllers including the HP V743/50/100 VXI Embedded Contoller.

Series 700 Required Options:

32 MBytes of RAM on the workstations (recommended)

HP E4208A VXI SCSI disk module if a VXI embedded disk is desired.

DAT tape drive for installation (HP Series 6400 Model 200 for example).

HP-UX 9.05

HP E2091C instrument control I/O library for the S700 Series controller family. (Revision 3.02f or higher)

HP Instrumentation Requirements:

At least one HP E1431A 8-channel input module (up to ten are allowed)

HP E1562A/B VXI data disk, DAT & SCSI-2 interface module (optional)

HP E1401A 13-slot or HP E1421A 6-slot VXI C-size mainframe

Table of HP E3200A/E3201A DSP engine library functions

VXI card configuration
AddressToArray()
ArrayToAddress()
CardInfoLongGet()
DetectCards()

Engine state
Close()
CloseAll()
DebugMaskSet/Get()
ErrorText()
Open()
OpenGet()
Reset()
Version()
VersionNumber()

Input setup
ActiveChannelsSet/Get()
AntiAliasSet/Get()
ArmModeSet/Get()
AutoRange()
BlockSizeSet/Get()
CouplingSet/Get()
InputHighSet/Get()
InputLowSet/Get()
InputModeSet/Get()
RangeSet/Get()
ResetInputs()
SpanSet/Get()
TriggerChannelSet/Get()
TriggerDelaySet/Get()
TriggerLevelSet/Get()
TriggerModeSet/Get()
TriggerSlopeSet/Get()
VXITriggerLinesSet/Get()

Data acquisition
ArmMeasurement()
AverageAccumulate()
AverageCalcResult()
AverageInit()
AverageInitHistogram()
DataAvailable()
GetMeasurementState()
LoadData()
LoadDataTimeoutSet/Get()
StartMeasurement()
StopMeasurement()
TriggerMeasurement()

Measurement computations
DBVLinear()
DBVPower()
FFT()
LinearSpectrum()
Mag()
MagSq()
Phase()
PowerSpectrum()
Unwrap()
Window()

Register operations
Copy()
CopyList()
CreateWindow()
DeleteReg()
DeltaXSet/Get()
LoadComplexConst()
LoadConst()
LoadMagPhaseConst()
Random()
RegInfoDoubleSet/Get()
RegInfoLongSet/Get()
ShiftCirc()
ShiftZero()
StartXSet/Get()
SwapHalves()
XferArrayToReg()
XferRegToArray()

Disk utilities
DirEntryGet()
DirOpen()
DiskDefaultSet/Get()
DiskInit()
DiskPack()
FileCopy()
FileDelete()
FileRename()

Throughput operations
ThruProcBlockSizeSet/Get()
ThruProcNumChanGet()
ThruProcOpen()
ThruProcOpenGet()
ThruProcOverlapSet/Get()
ThruProcTimeEnvComp()
ThruProcTimeEnvLoad()
ThruProcTimeEnvSave()
ThruProcTimeSet/Get()
Thruproc Delta X Get()
Thruproc Timelength Get()
ThruRecNumMonGet()
ThruRecOpen()
ThruRecStatus()

Save/recall
SDFCommentSet/Get()
SDFCommentSizeSet/Get()
SDFFieldNumSet/Get()
SDFFieldStrSet/Get()
XferRegToSDF()
XferSDFToReg()

Math operations
Abs()
Add()
ArcCos()
ArcSin()
ArcTan()
Conj()
Cos()
Differentiate()
Div()
Exp()
Exp10()
Imag()
Integrate()
Inv()
Log()
Log10()
Mult()
Negate()
Offset()
Real()
Scale()
Sin()
Sqrt()
Square()
Sub()
Tan()

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