CHAPTER 6

Timing Benchmarks For The Wideband TMS320C3x/4x Optimized Math Library

The following series of benchmarks were derived by examining Wideband Optimized-Math Library source code for the Texas Instruments TMS320C3x and TMS320C4x DSP microprocessors. The values reported are based on measurments using the small memory model. In cases where stack argument passing versus register argument passing result in differences in execution speed (in scalar routines only), the tables and the routine descriptions note the differences. Typically, the register passing convention is slightly faster, but this only affects the "Overhead In Cycles" description category. The use of the large memory model does not significantly effect the timing benchmarks reported here.

The "Overhead In Cycles" category of the benchmarks represents the minimum number of instructions necessary to enter and exit a given routine. Note that this is a one-time cost incurred each time the routine is called and becomes less significant the more data points that are processed by the routine.

The "Inner-Loop Cycles/Element" category represents the number of processor cycles necessary to compute the final answer for each element that is to be processed.

These benchmarks were derived using test cases where all stride arguments were equal (the optimal case). If you plan to call the routines with arguments where strides are not equal, you should assume slightly longer overhead time (5 to 10 cycles in some cases) and slightly longer "Inner-Loop Cycle/Element" times depending on the symmetry of the stride arguments.

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TABLE 6-1 Scalar Power Functions

Function Name	Function Description	Cycles/Routine
exp (c3x)	Exponential Register Passing Model	If x >87 or <=-87 then 11 Cycles To Error If -87<x<87 then 53 Cycles
exp (c3x)	Exponential Stack Passing Model	If x >87 or <=-87 then 14 Cycles To Error If -87<x<87 then 56 Cycles
exp (c4x)	Exponential Register Passing Model	If x >87 or <=-87 then Cycles To Error If -87<x<87 then Cycles
exp (c4x)	Exponential Stack Passing Model	If x >87 or <=-87 then Cycles To Error If -87<x<87 then Cycles
exp10 (c3x)	Base 10 Exponential Register Passing Model	If x >38 or <=-38 then 11 Cycles To Error If -38<x<38 then 55 Cycles
exp10 (c3x)	Base 10 Exponential Stack Passing Model	If x >38 or <=-38 then 14 Cycles To Error If -38<x<38 then 57 Cycles
exp10 (c4x)	Base 10 Exponential Register Passing Model	If x >38 or <=-38 then Cycles To Error If -38<x<38 then Cycles
exp10 (c4x)	Base 10 Exponential Stack Passing Model	If x >38 or <=-38 then Cycles To Error If -38<x<38 then Cycles
log (c3x)	Natural Logarithm Register Passing Model	If x <= 0 then 6 Cycles to Error If x > 0 then 52 Cycles
log (c3x)	Natural Logarithm Stack Passing Model	If x <= 0 then 8 Cycles to Error If x > 0 then 54 Cycles
log (c4x)	Natural Logarithm Register Passing Model	If x <= 0 then 6 Cycles to Error If x > 0 then 40 Cycles
log (c4x)	Natural Logarithm Stack Passing Model	If x <= 0 then 8 Cycles to Error If x > 0 then 40 Cycles

TABLE 6-1 Scalar Power Functions

log10 (c3x)	Base 10 Logarithm Register Passing Model	If x <= 0 then 7 Cycles to Error If x > 0 then 52 Cycles
log10 (c3x)	Base 10 Logarithm Stack Passing Model	If x <= 0 then 9 Cycles to Error If x > 0 then 54 Cycles
log10 (c4x)	Base 10 Logarithm Register Passing Model	If x <= 0 then 7 Cycles to Error If x > 0 then 40 Cycles
log10 (c4x)	Base 10 Logarithm Stack Passing Model	If x <= 0 then 9 Cycles to Error If x > 0 then 42 Cycles
pow(c3x)	Power Register Passing Model	24 Cycles to Error 138 Cycles
pow(c3x)	Power Stack Passing Model	27 Cycles to Error 141 Cycles
pow(c4x)	Power Register Passing Model	24 Cycles to Error 79 Cycles
pow(c4x)	Power Stack Passing Model	27 Cycles to Error 82 Cycles

TABLE 11 Simple Scalar Trigonometric Functions

Function Name	Function Description	Cycles/Routine
cos (c3x)	Cosine Register Passing Model	33 Cycles
cos (c3x)	Cosine Stack Passing Model	35 Cycles
cos (c4x)	Cosine Register Passing Model	33 Cycles
cos (c4x)	Cosine Stack Passing Model	35 Cycles
sin (c3x)	Sine Register Passing Model	31 Cycles
sin (c3x)	Sine Stack Passing Model	33 Cycles
sin (c4x)	Sine Register Passing Model	31 Cycles
sin (c4x)	Sine Stack Passing Model	33 Cycles
tan (c3x)	Tangent Register Passing Model	54 Cycles
tan (c3x)	Tangent Stack Passing Model	55 Cycles
tan (c4x)	Tangent Register Passing Model	42 Cycles
tan (c4x)	Tangent Stack Passing Model	43 Cycles

TABLE 12 Simple Scalar Functions

Function Name	Function Description	Cycles/Routine
fabs (c3x, c4x)	Absolute Value Register & Stack Passing Model	5 Cycles
fmod (c3x)	Floating-Point Remainder Register Passing Model	If y = 0 then 7 Cycles If x = y then 14 Cycles 36 Cycles Normal
fmod (c3x)	Floating-Point Remainder Stack Passing Model	If y = 0 then 11 Cycles If x = y then 17 Cycles 39 Cycles Normal
fmod (c4x)	Floating-Point Remainder Register Passing Model	If y = 0 then 7 Cycles If x = y then 14 Cycles 24 Cycles Normal
fmod (c4x)	Floating-Point Remainder Stack Passing Model	If y = 0 then 11 Cycles If x = y then 17 Cycles 27 Cycles Normal
frexp (c3x, c4x)	Get Mantissa & Exponent Register Passing Model	If x = 0.0 then 13 Cycles to Error 20 Cycles Normal
frexp (c3x, c4x)	Get Mantissa & Exponent Stack Passing Model	If x = 0.0 then 13 Cycles to Error 22 Cycles Normal
ldexp (c3x)	Multiply By A Power of 2 Register Passing Model	If 0 <= x >127 then 17 Cycles If x >0 then 24 Cycles If x <= 127 then 36 Cycles
ldexp (c3x)	Multiply By A Power of 2 Stack Passing Model	If 0 <= x >127 then 18 Cycles If x >0 then 24 Cycles If x <= 127 then 39 Cycles
ldexp (c4x)	Multiply By A Power of 2 Register Passing Model	If 0 <= x >127 then 17 Cycles If x >0 then 24 Cycles If x <= 127 then 19 Cycles
ldexp (c4x)	Multiply By A Power of 2 Stack Passing Model	If 0 <= x >127 then 18 Cycles If x >0 then 24 Cycles If x <= 127 then 19 Cycles

TABLE 12 Simple Scalar Functions

modf (c3x, c4x)	Get Fraction & Integer Register Passing Model	If Integer Overflow then 12 Cycles If x > 0 then 14 Cycles
modf (c3x, c4x)	Get Fraction & Integer Stack Passing Model	If Integer Overflow then 15 Cycles If x > 0 then 17 Cycles
rsqrt (c3x)	Reciprocal Square Root Register Passing Model	If x = 0 then 5 Cycles If x < 0 then 10 Cycles If x > 0 then 38 Cycles
rsqrt (c3x)	Reciprocal Square Root Stack Passing Model	If x = 0 then 6 Cycles If x < 0 then 10 Cycles If x > 0 then 39 Cycles
rsqrt (c4x)	Reciprocal Square Root Register Passing Model	If x = 0 then 5 Cycles If x < 0 then 9 Cycles If x > 0 then 19 Cycles
rsqrt (c4x)	Reciprocal Square Root Stack Passing Model	If x = 0 then 6 Cycles If x < 0 then 10 Cycles If x > 0 then 20 Cycles
sqrt (c3x)	Square Root Register Passing Model	If x = 0 then 5 Cycles If x < 0 then 9 Cycles If x > 0 then 39 Cycles
sqrt (c3x)	Square Root Stack Passing Model	If x = 0 then 6 Cycles If x < 0 then 10 Cycles If x > 0 then 40 Cycles
sqrt (c4x)	Square Root Register Passing Model	If x = 0 then 5 Cycles If x < 0 then 9 Cycles If x > 0 then 20 Cycles
sqrt (c4x)	Square Root Stack Passing Model	If x = 0 then 6 Cycles If x < 0 then 10 Cycles If x > 0 then 21Cycles

TABLE 13 Scalar Arc Trigonometric Functions

Function Name	Function Description	Cycles/Routine
atan (c3x)	Arc Tangent Register Passing Model	45 Cycles
atan (c3x)	Arc Tangent Stack Passing Model	47 Cycles
atan (c4x)	Arc Tangent Register Passing Model	33 Cycles
atan (c4x)	Arc Tangent Stack Passing Model	35 Cycles
acos (c3x)	Arc Cosine Register Passing Model	If x <= 0.5 then 54 Cycles If x > 0.5 then 90 Cycles
acos (c3x)	Arc Cosine Stack Passing Model	If x <= 0.5 then 56 Cycles If x > 0.5 then 92 Cycles
acos (c4x)	Arc Cosine Register Passing Model	If x <= 0.5 then 42 Cycles If x > 0.5 then 58 Cycles
acos (c4x)	Arc Cosine Stack Passing Model	If x <= 0.5 then 44 Cycles If x > 0.5 then 60 Cycles
asin (c3x)	Arc Sine Register Passing Model	If x < 0.5 then 49 Cycles If x >= 0.5 then 89 Cycles
asin (c3x)	Arc Sine Stack Passing Model	If x < 0.5 then 51 Cycles If x >= 0.5 then 91 Cycles
asin (c4x)	Arc Sine Register Passing Model	If x < 0.5 then 37 Cycles If x >= 0.5 then 57 Cycles
asin (c4x)	Arc Sine Stack Passing Model	If x < 0.5 then 39 Cycles If x >= 0.5 then 59 Cycles
atan2 (c3x)	Arc Tangent 2 Register Passing Model	74 Cycles
atan2 (c3x)	Arc Tangent 2 Stack Passing Model	77 Cycles
atan2 (c4x)	Arc Tangent 2 Register Passing Model	50 Cycles
atan2 (c4x)	Arc Tangent 2 Stack Passing Model	53 Cycles

TABLE 14 Scalar Hyperbolic Functions

Function Name	Function Description	Cycles/Routine
cosh (c3x)	Hyperbolic Cosine Register Passing Model	72 Cycles
cosh (c3x)	Hyperbolic Cosine Stack Passing Model	74 Cycles
cosh (c4x)	Hyperbolic Cosine Register Passing Model	48 Cycles
cosh (c4x)	Hyperbolic Cosine Stack Passing Model	50 Cycles
sinh (c3x)	Hyperbolic Sine Register Passing Model	If x <= 0.5 then 22 Cycles If x >= 0.5 then 75 Cycles
sinh (c3x)	Hyperbolic Sine Stack Passing Model	If x <= 0.5 then 24 Cycles If x >= 0.5 then 77 Cycles
sinh (c4x)	Hyperbolic Sine Register Passing Model	If x <= 0.5 then 22 Cycles If x >= 0.5 then 51 Cycles
sinh (c4x)	Hyperbolic Sine Stack Passing Model	If x <= 0.5 then 24 Cycles If x >= 0.5 then 53 Cycles
tanh (c3x)	Hyperbolic Tangent Register Passing Model	If x >=10 then 24 Cycles If x < 0.00001 then 33 Cycles If 0.00001 <=x <= 0.5 then 62 Cycles If 0.5 < x < 10 then 95 Cycles
tanh (c3x)	Hyperbolic Tangent Stack Passing Model	If x >=10 then 24 Cycles If x < 0.00001 then 33 Cycles If 0.00001 <=x <= 0.5 then 64 Cycles If 0.5 < x < 10 then 97 Cycles
tanh (c4x)	Hyperbolic Tangent Register Passing Model	If x >=10 then 24 Cycles If x < 0.00001 then 33 Cycles If 0.00001 <=x <= 0.5 then 50 Cycles If 0.5 < x < 10 then 71 Cycles
tanh (c4x)	Hyperbolic Tangent Stack Passing Model	If x >=10 then 24 Cycles If x < 0.00001 then 33 Cycles If 0.00001 <=x <= 0.5 then 52 Cycles If 0.5 < x < 10 then 73 Cycles

TABLE 15 Scalar Inverse Hyperbolic Functions

Function Name	Function Description	Cycles/Routine
acosh (c3x)	Inverse Hyperbolic Cosine Register Passing Model	If x >= 1 then 82 Cycles If x < 1 then 13 Cycles
acosh (c3x)	Inverse Hyperbolic Cosine Stack Passing Model	If x >= 1 then 85 Cycles If x < 1 then 15 Cycles
acosh (c4x)	Inverse Hyperbolic Cosine Register Passing Model	If x >= 1 then 54 Cycles If x < 1 then 13 Cycles
acosh (c4x)	Inverse Hyperbolic Cosine Stack Passing Model	If x >= 1 then 57 Cycles If x < 1 then 15 Cycles
asinh (c3x)	Inverse Hyperbolic Sine Register Passing Model	84 Cycles
asinh (c3x)	Inverse Hyperbolic Sine Stack Passing Model	86 Cycles
asinh (c4x)	Inverse Hyperbolic Sine Register Passing Model	55 Cycles
asinh (c4x)	Inverse Hyperbolic Sine Stack Passing Model	53 Cycles
atanh (c3x)	Inverse Hyperbolic Tangent Register Passing Model	If x = 1 then 11 Cycles to Error If x = -1 then 19 Cycles to Error 108 Cycles Normal
atanh (c3x)	Inverse Hyperbolic Tangent Stack Passing Model	If x = 1 then 13 Cycles to Error If x = -1 then 21 Cycles to Error 110 Cycles Normal
atanh (c4x)	Inverse Hyperbolic Tangent Register Passing Model	If x = 1 then 11 Cycles to Error If x = -1 then 19 Cycles to Error 49 Cycles Normal
atanh (c4x)	Inverse Hyperbolic Tangent Stack Passing Model	If x = 1 then 13 Cycles to Error If x = -1 then 21 Cycles to Error 51 Cycles Normal

TABLE 16 Scalar Vector Truncation Functions

Function Name	Function Description	Cycles/Routine
ceil (c3x, c4x)	Truncate To Next Higher Whole Number Register Passing Model	7 Cycles
ceil (c3x, c4x)	Truncate To Next Higher Whole Number Stack Passing Model	9 Cycles
floor (c3x, c4x)	Round Down To Next Lower Whole Number Register Passing Model	5 Cycles
floor (c3x, c4x)	Round Down To Next Lower Whole Number Stack Passing Model	7 Cycles

TABLE 6-2 Simple Vector Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vabs	Vector Absolute Value	19	1	1
vnabs	Vector Negate Absolute Value	21	2	2
vfill	Vector Fill	26	0.5	0.5
vmov	Vector Move	19	1	1
vclr	Vector Clear	26	0.5	0.5
vneg	Vector Negate	19	1	1
vrecip	Vector Reciprocal	19	20	8
vrvrs	Vector Reverse Order	21	0.5	0.5
vswap	Vector Swap	17	0.5	0.5

TABLE 17 Vector Power Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycle /Element	C4x Inner-Loop Cycle /Element
vcube	Vector Cube	20	2	2
vdist	Vector Distance			
vexp	Vector Exponential	26	47	35
vexp10	Vector Base 10 Exponential	29	47	35
vexp2	Vector Base 2 Exponential	29	48	35
vlog	Vector Logarithm	29	41	29
vlog10	Vector Base 10 Logarithm	29	41	29
vlog2	Vector Base 2 Logarithm	29	42	30
vpow	Vector Power	29	42	30
vpythag	Vector Pythagoras	38	38	18
vrsqrt	Vector Reciprocal Square Root	17	31	12
vrsqrtz	Vector Reciprocal Square Root With Domain Check	17	33	
vsq	Vector Square	20	2	2
vsqrt	Vector Square Root	23	32	12
vssq	Vector Signed Square	20	3	3

TABLE 18 Simple Vector Trigonometric Functions

Function Name	Function Description	Over-head In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vcos	Vector Cosine	28	26	26
vcot	Vector Cotangent	25	46	28
vcsc	Vector Cosecant	27	43	31
vsec	Vector Secant	27	45	29
vsin	Vector Sine	26	24	24
vtan	Vector Tangent	25	46	34

TABLE 19 Vector Arc Trigonometric Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vatan	Vector Arc Tangent	33	38	26
vacos	Vector Arc Cosine	30	If x > 0.5 then 82 If x <= 0.5 then 44	If x > 0.5 then 50 If x <= 0.5 then 32
vasin	Vector Arc Sine	29	If x > 0.5 then 80 If x <= 0.5 then 41	If x > 0.5 then 48 If x <= 0.5 then 29
vatan2	Vector Arc Tangent 2	39	66	42

TABLE 20 Vector Hyperbolic Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vcosh	Hyperbolic Cosine	24	47	35
vsinh	Hyperbolic Sine	24	If x < 0.5 then 17 If x >= 0.5 then 53	If x < 0.5 then 17 If x >= 0.5 then 41
vtanh	Hyperbolic Tangent	25	If x >= 10 then 10 If x < 0.5 then 62 If x < 0.0001 then 50	If x >= 10 then 10 If x < 0.5 then 50 If x < 0.0001 then 38

TABLE 21 Vector Inverse Hyperbolic Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vacosh	Inverse Hyperbolic Cosine	29	83	52
vasinh	Inverse Hyperbolic Sine	34	75	46
vatanh	Inverse Hyperbolic Tangent	31	If x = 1 then 7*N If x = -1 then 11*N else 61	If x = 1 then 7*N If x = -1 then 11*N else 49

TABLE 22 Vector Averaging & Summing Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
mve	Mean Value of Vector Elements	c3x = 38 c4x = 26	1	1
mvemg	Mean Value of Vector Element Magnitudes	c3x = 39 c4x = 27	2	2
mvesq	Mean Value of Vector Element Squares	c3x = 42 c4x = 30	1	1
mvessq	Mean Value of Vector Element Signed Squares	c3x = 42 c4x = 30	3	3
rmvesq	Root Mean Square of Vector Elements	c3x = 75 c4x = 43	1	1
sve	Vector Summation	18	1	1
svemg	Sum of Vector Element Magnitudes	18	2	2
svesq	Sum of Vector Element Squares	21	1	1
svessq	Sum of Vector Element Signed Squares	18	3	3

TABLE 23 Vector Comparison Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
venvlp	Vector Envelope	37	7	7
veq	Logical Vector Equal	36	3	3
vge	Logical Vector Greater Than or Equal	36	3	3
vgt	Logical Vector Greater Than	36	3	3
vle	Logical Vector Less Than or Equal	36	3	3
vlt	Logical Vector Less Than	36	3	3
vne	Vector Not Equal	36	3	3
vcmprs	Vector Compress	20	5	3
vcmerg	Vector Compressed Merge	37	4	4
vlmerg	Vector Logical Merge	38	3	3
vnmerg	Vector Negative Merge	38	3	3
vpmerg	Vector Positive Merge	38	3	3
vtmerg	Vector Tapered Merge	45	9	9

TABLE 24 Vector Fix, Float & Truncation Functions

Function Name	Function Description	Over-head In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vceil	Vector Truncate To Next Higher Whole Number	17	7	7
vfix	Vector Floating-Point To Integer Conversion	17	1	1
vfloat	Vector Integer To Floating-Point Conversion	19	1	1
vfloor	Vector Truncate To Next Lower Whole Number	17	4	4
vfrac	Vector Truncate To Fraction	18	8	8
vieee	Vector Convert TI Format To IEEE Format	c3x = 26 c4x = 19	13	1
vround	Vector Floating-Point To Nearest Integer Conversion	18	4	4
vtiflt	Vector Convert IEEE Format To TI Format	18	13	1

TABLE 25 Vector Limiting Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vclip	Vector Clip	23	5	5
viclip	Vector Inverse Clip	26	6, 11, 15	6, 11, 15
vlim	Vector Limit	20	4	4
vthr	Vector Threshold Normalized	20	3	3
vthres	Vector Threshold, Zero Fill	20	3	3
vthrsc	Vector Threshold, Signed Constant	22	4	4

TABLE 26 Vector Logical Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop In Cycles	C4x Inner-Loop In Cycles
vand	Vector Logical And	29	2	2
vashift	Vector Arithmetic Shift	20	1	1
vlshift	Vector Logical Shift	20	1	1
vnand	Vector Logical And Followed By And	29	3	3
vnor	Vector Logical Or Followed By Complement	29	3	3
vnot	Vector Logical Complement	19	1	1
vnxor	Vector Not Exclusive Bitwise Or	29	3	3
vor	Vector Logical Or	29	2	2
vrol	Vector Rotate Left	20	2	2
vror	Vector Rotate Right	20	2	2
vrot	Vector Rotate	21	5	5
vxor	Vector Logical Exclusive Or	29	2	2

TABLE 27 2-Vector & 1-Scalar Math Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vscadd	Vector Scalar Add	20	1	1
vscdiv	Vector Scalar Divide	c3x = 41 c4x = 29	1	1
vscmul	Vector Scalar Multiply	16	1	1
vscsub	Vector Scalar Subtract	20	1	1

TABLE 28 2-Vector & 2-Scalar Math Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vsmsad	Vector Scalar Multiply & Scalar Add	22	2	2
vsmssb	Vector Scalar Multiply & Scalar Subtract	22	2	2
vssbsa	Vector Scalar Subtract & Scalar Add	22	2	2
vssbsm	Vector Scalar Subtract & Scalar Multiply	22	2	2
vsassb	Vector Scalar Add & Scalar Subtract	22	2	2
vsasm	Vector Scalar Add & Scalar Multiply	27	2	2

TABLE 29 3-Vector Math Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vadd	Vector Add	29	2	2
vdiv	Vector Divide	34	21	9
vdivz	Vector Divide with Domain Check	41	26	14
vmul	Vector Multiply	31	2	2
vsub	Vector Subtract	26	2	2

TABLE 30 3-Vector and 1-Scalar Math Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vascm	Vector Add & Scalar Multiply	32	2	2
vascs	Vector Add & Scalar Subtract	30	3	3
vmsca	Vector Multiply & Scalar Add	31	2	2
vmscs	Vector Multiply & Scalar Subtract	31	2	2
vssca	Vector Subtract & Scalar Add	32	2	2
vscma	Vector Scalar Multiply & Vector Add	31	1	1
vscmsb	Vector Scalar Multiply & Vector Subtract	31	2	2
vsscm	Vector Subtract & Scalar Multiply	32	2	2

TABLE 31 4-Vector Math Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vam	Vector Add & Multiply	38	3	3
vma	Vector Multiply & Add	40	3	3
vms	Vector Multiply & Subtract	40	3	3
vsm	Vector Subtract & Multiply	38	2	2

TABLE 32 5-Vector Math Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vaam	Vector Add, Add & Multiply	64	3	3
vasm	Vector Add, Subtract & Multiply	62	3	3
vmma	Vector Multiply, Multiply & Add	62	3	3
vmms	Vector Multiply, Multiply & Subtract	63	3	3
vssm	Vector Subtract, Subtract & Multiply	64	3	3

TABLE 33 Vector Maximum/Minimum Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
maxv	Maximum Element of a Vector	18	2	2
minv	Minimum Element of a Vector	18	2	2
maxvi	Maximum Element of a Vector With Index	22	4	4
minvi	Minimum Element of a Vector With Index	22	4	4
vmax	Vector Maximum	30	3	3
vmin	Vector Minimum	30	3	3
maxmgv	Maximum Magnitude	18	3	3
minmgv	Minimum Magnitude	18	3	3
vmaxmg	Vector Maximum Magnitudes	30	4	4
vminmg	Vector Minimum Magnitudes	30	4	4

TABLE 34 Vector Gather/Scatter Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vgathr	Vector Gather	23	2	2
vscatr	Vector Scatter	20	3	3
vindex	Vector Index	24	3	3

TABLE 35 Vector Comparison Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vcmerg	Vector Compressed Merge	37	4	
vcmprs	Vector Compress	20	5	

TABLE 36 Vector Conversion Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
polar	Rectangular to Polar Conversion	36	103	60
rect	Polar to Rectangular Conversion	38	52	52
vdblina	Vector Convert Decibels to Linear Amplitude	24	49	37
vdblinp	Vector Convert Decibels to Linear Power	24	49	37
vlindba	Vector Convert Linear Volt Units to Decibels Amplitude	20	42	30
vlindbp	Vector Convert Linear Power to Decibels	20	42	30

TABLE 37 Other Vector Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vxcs	Vector Multiply By Sin &Cosine	57	55	55

TABLE 38 Complex Vector Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
cdotpr	Complex Vector Dot Product			
cvexp	Complex Vector Exponential	31	50	50
cvma	Complex Vector Multiply & Add	61	8	8
cvexpm	Complex Vector Exponential & Multiply	44	51	
cvphase	Complex Vector Phase	33	68	44
cvsqrt	Complex Vector Square Root			
coher	Coherence Function	19	21	16
cspec	Accululating Cross Spectrum	34	3	3

TABLE 39 Complex Vector Magnitude Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
cvmags	Complex Vector Magnitude Squared	23	3	3
cvmgsa	Complex Vector Magnitude Squared & Add	46	3	3

TABLE 40 Complex Vector Conversion Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
cvcmpx	Complex Vector Create From Real	34	2	2
vimag	Create Vector From Imaginary Components	21	1	1
vreal	Create Vector From Real Components	20	1	1

TABLE 41 Complex Vector Simple Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
cvabs	Complex Absolute Value	59	35	15
cvrecp	Complex Vector Reciprocal	c3x = 63 c4x = 34	25	13
cvfill	Complex Vector Fill	21	0.5	0.5
cvmov	Complex Vector Move	23	1	1
cvneg	Complex Vector Negate	26	1	1

TABLE 42 Complex Vector Fundamental Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
cvadd	Complex Vector Add	39	7	7
cvmul	Complex Vector Multiply	39	6	6
cvsub	Complex Vector Subtract	48	3	3
cvdiv	Complex Divide	46	29	17

TABLE 43 Complex Vector Real Vector Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
cvradd	Complex Vector Add With Real Vector	44	3	3
cvrdiv	Complex Vector Divided By Real Vector	c3x = 62 c4x = 50	22	10
cvrmul	Complex Vector Multiplied By Real Vector	44	3	3
cvrsub	Complex Vector Subtracted From Real Vector	44	3	3

TABLE 44 Complex Vector Conjugation Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
cvcma	Complex Vector Conjugate, Multiply & Add	62	7	7
cvcmul	Complex Vector Conjugate & Multiply	40	6	6
cvconj	Complex Vector Conjugate	23	2	2

TABLE 45 Complex Vector Complex Scalar Function

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop In Cycles	C4x Inner-Loop In Cycles
cvsadd	Complex Vector Scalar Add	32	2	2
cvsdiv	Complex Vector Scalar Divide	c3x = 60 c4x = 48	8	8
cvsma	Complex Vector Scalar Multiply & Add Complex Vector	48	8	8
cvsmul	Complex Vector Scalar Multiply	26	6	6
cvssub	Complex Vector Scalar Subtract	32	2	2

TABLE 6-3 Convolution Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycle /Element	C4x Inner-Loop Cycle /Element
conv	Convolution	30	15*(N+H)	15*(N+H)
conv3x3	2-Dimensional Convolution, 3x3 Kernal	34	34*(9*N)	34*(9*N)
conv5x5	2-Dimensional Convolution, 5x5 Kernal	31	9*(28*N)	9*(28*N)

TABLE 46 Correlation Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
acort	Auto-Correlation Time Domain	32	16*(1*N)	16*(1*N)
ccort	Cross-Correlation Time Domain	32	16*(1*N)	16*(1*N)
corr	Correlation	30	15*(N+H)	15*(N+H)

Filtering Functions

TABLE 47

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
fir	Direct Form FIR Filter	21	8*(N+H)	8*(N+H)
firdec	Direct Form Decimating FIR Filter			
cfir	Direct Form Complex FIR Filter	20	8*N+5*H	8*N+5*H
iir	Bi-Quad IIR Filter			

Windowing Functions

TABLE 48

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
blkman	Blackman Window Multiply	27	9*N	9*N
hamm	Hamming WindowMultiply	27	4*N	4*N
hann	Hanning WindowMultiply	27	5*N	5*N

FFT Functions

TABLE 49

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
cfft	Complex FFT			
cffti	Inverse Complex FFT			
fftwts	FFT Weights Array			
rfft	Real FFT			

Integration Functions

TABLE 50

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vhist	Vector Histogram	60	18*N	18*N
vintb	Vector Linear Interpolate	c3x = 22 c4x = 26	5	6
vpoly	Vector Polynomial Evaluation	21	14*(2*N)	15*(2*N)
vramp	Vector Build Ramp			
vrsum	Vector Running Sum			
vsimp	Simpson's Integration	33	4	4
vtrapz	Trapezoidal Integration	24	6	6

TABLE 51 Distribution Generation Functions

Function Name	Function Description	Overhead In Cycles	C3x Inner-Loop Cycles/Element	C4x Inner-Loop Cycles/Element
vrandg	Vector Build Gaussian Distribution	27	120*N	120*N
vrandu	Vector Build Uniform Distribution	23	7	7