SuperH RISC engine C/C++ Compiler Package

APPLICATION NOTE : < Reference> Data of Library

This document publishes the number of execution cycles of mathematical function library and runtime routine(runtime library) , for the SuperH RISC engine C/C++ Compiler V.9.02

1. Mathematical Function Library

1.1 Condition of measurement

Compiler : SuperH RISC engine C/C++ Compiler V.9.02.00

Build Condition : A standard library is created with the condition of showing in Table 1.1.

Table 1.1 The Conditions for Creating a Standard Library

Condition	Options for Creating Library						
	cpu	pic	endian	denormal	round	fpu	double= float
1	sh1	–	big	–	–	–	None
2	sh2	0	big	–	–	–	None
3	sh3	0	big	–	–	–	None
4	sh2e	0	big	–	–	–	None
5	sh4	0	big	off	zero	None	–
6	sh4	0	big	off	zero	single	–
7	sh4	0	big	off	zero	double	–
8	sh4a	0	big	off	zero	None	–
9	sh4a	0	big	off	zero	single	–
10	sh4a	0	big	off	zero	double	–
11	sh2a	0	big	–	–	–	None
12	sh2afpu	0	big	off	zero	None	–
13	sh2afpu	0	big	off	zero	single	–
14	sh2afpu	0	big	off	zero	double	–

1.2 Number of Execution Cycles

Table 1.2 Execution Speed of Floating Point Library Functions (SH-1, SH-2, SH-3)

CPU		SH-1	SH-2	SH-3
Conditions for Creating Library		**1**	**2**	**3**
Single-precision	sinf	710	335	264
	cosf	711	336	266
	tanf	1,065	464	416
	asinf	3,407	3,258	3,486
	acosf	3,531	3,382	3,625
	atanf	741	337	309
	logf	793	315	326
	sqrtf	510	161	155
	expf	675	310	252
	powf	5,784	5,352	5,740
Double-precision	sin	3,600	3,003	3,277
	cos	3,593	2,996	3,277
	tan	5,031	4,327	4,650
	asin	9,311	8,570	9,115
	acos	9,457	8,716	9,323
	atan	6,204	5,570	6,023
	log	5,903	5,131	5,523
	sqrt	1,894	1,894	1,917
	exp	6,429	5,447	5,879
	pow	12,678	10,850	11,731

Note: Cycle units. The error margin is included in measurements.

Table 1.3 Execution Speed of Floating Point Library Functions (SH-2E)

CPU		SH-2E
Conditions for Creating Library		**4**
Single-precision	sinf	96
	cosf	92
	tanf	118
	asinf	185
	acosf	195
	atanf	99
	logf	115
	sqrtf	172
	expf	134
	powf	650
Double-precision	sin	4,665
	cos	4,589
	tan	6,449
	asin	7,877
	acos	7,264
	atan	6,698
	log	6,472
	sqrt	1,894
	exp	5,947
	pow	10,850

Note: Cycle units. The error margin is included in measurements.

Table 1.4 Execution Speed of Floating Point Library Functions (SH-4)

CPU		SH-4		
Conditions for Creating Library		**5**	**6**	**7**
Single-precision	sinf	76	70	248
	cosf	70	67	245
	tanf	84	82	337
	asinf	75	72	368
	acosf	74	73	360
	atanf	76	71	300
	logf	87	82	338
	sqrtf	-*	-*	-*
	expf	103	94	347
	powf	528	506	913
Double-precision	sin	329	70	248
	cos	311	67	245
	tan	418	82	337
	asin	538	72	368
	acos	501	73	360
	atan	425	71	300
	log	404	82	338
	sqrt	-*	-*	-*
	exp	398	94	347
	pow	1,589	506	913

Note: Cycle units. The error margin is included in measurements.
*The SH-4 supports the sqrt instruction, and so the sqrt function was omitted.

Table 1.5 Execution Speed of Floating Point Library Functions (SH-4A)

CPU		SH-4A		
Conditions for Creating Library		**8**	**9**	**10**
Single-precision	sinf	108	103	224
	cosf	105	102	224
	tanf	125	124	297
	asinf	106	100	309
	acosf	109	106	307
	atanf	113	106	233
	logf	117	115	259
	sqrtf	-*	-*	-*
	expf	143	136	299
	powf	593	578	839
Double-precision	sin	280	103	224
	cos	265	102	224
	tan	353	124	297
	asin	448	102	308
	acos	420	106	307
	atan	332	105	235
	log	310	115	259
	sqrt	-*	-*	-*
	exp	336	136	298
	pow	1,254	578	839

Note: Cycle units. The error margin is included in measurements.
*The SH-4A supports the sqrt instruction, and so the sqrt function was omitted.

Table 1.6 Execution Speed of Floating Point Library Functions (SH-2A,SH2A-FPU)

CPU		SH-2A	SH2A-FPU		
Conditions for Creating Library		**11**	**12**	**13**	**14**
Single-precision	sinf	175	80	76	246
	cosf	177	74	71	242
	tanf	275	88	88	336
	asinf	2,510	78	75	364
	acosf	2,607	73	74	353
	atanf	202	77	72	297
	logf	225	89	89	329
	sqrtf	100	-*	-*	-*
	expf	172	104	97	348
	powf	3,940	541	521	960
Double-precision	sin	2,232	298	76	246
	cos	2,227	287	71	242
	tan	3,353	389	88	336
	asin	6,914	472	75	364
	acos	7,027	444	74	353
	atan	4,409	373	72	297
	log	3,950	387	89	329
	sqrt	1,621	-*	-*	-*
	exp	4,123	386	97	348
	pow	8,254	1,313	521	960

Note: Cycle units. The error margin is included in measurements.
*The SH2A-FPU supports the sqrt instruction, and so the sqrt function was omitted.

2. Runtime Routine(Runtime Library)

2.1 Condition of measurement

Compiler : SuperH RISC engine C/C++ Compiler V.9.02.00

Build Condition : A runtime library is created with the condition of showing in Table 2.1.

Table 2.1 Library Creation Options

	cpu	pic	endian	denormaliaztion	round	fpu	double=float
SH-1	sh1	-	big	-	-	-	None
SH-2	sh2	1	big	-	-	-	None
SH-2A	sh2a	1	big	−	−	−	None
SH-3	sh3	1	big	−	−	−	None
SH-4	sh4	0	big	off	zero	None	−
SH-4A	sh4a	0	big	off	zero	None	−

2.2 Number of Execution Cycles

Table 2.2 List of Runtime Routine Speeds/FPL Speeds (1)

No.	Type		Function Name	Stack Size	Number of Execution Cycles					
					SH-1	SH-2	SH-2A	SH-3	SH-4	SH-4A
1.1	Integer operations	Multiply	_muli	12	38	-	-	-	-	-
2.1		Divide	_divbs	4	38	38	-	26	24	24
2.2			_divbu	0	28	28	-	19	18	18
2.3			_divws	4	49	50	-	34	31	31
2.4			_divwu	0	39	39	-	26	25	26
2.5			_divls	12	37 / 109	39 / 109	-	26 / 73	20 / 50	21 /61
2.6			_divlsp	12	-	84	-	-	-	-
2.7			_divlspnm	8	-	57	-	-	-	-
2.8			_divlu	8	31 / 82	33 / 84	-	22 /56	17 / 50	19 / 50
3.1		Remainder	_modbs	8	57	60	-	40	33	33
3.2			_modbu	4	39	40	-	27	23	25
3.3			_modws	8	66	69	-	46	39	39
3.4			_modwu	4	49	50	-	34	29	31
3.5			_modls	12	45 / 95	47 / 97	-	31 / 65	23 / 57	23 / 56
3.6			_modlsp	12	-	84	-	-	-	-
3.7			_modlspnm	8	-	57	-	-	-	-
3.8			_modlu	8	34 / 72	36 / 71	-	24 / 48	18 /43	20 /46

Note: Cycle units. The error margin is included in measurements.
The routine that processing is greatly different depending on the input value publishes each of the maximum pattern and the minimum pattern. [minimum/maximum]

Table 2.2 List of Runtime Routine Speeds/FPL Speeds (2)

No.	Type		Function Name	Stack Size	Number of Execution Cycles					
					SH-1	SH-2	SH-2A	SH-3	SH-4	SH-4A
4.1	Floating point operations	Add	_adds	24	129	139	60	80	-	-
4.2		Post Incre-ment Post Decre-ment	_addd_a	40	243	265	114	159	-	-
5.1		Substract	_subs	24	135	145	64	84	-	-
5.2			_subd_a	40	251	274	119	167	-	-
6.1		Multiply	_muls	24	144	125	62	86	-	-
6.2			_muld_a	60	379	318	151	210	-	-
7.1		Divide	_divs	20	175	192	93	120	-	-
7.2			_divd_a	56	536	512	265	325	-	-
8.1		Compare	_eqs	20	16	17	9	11	-	-
8.2			_eqd_a	32	90	108	50	69	-	-
8.3			_nes	20	16	17	9	11	-	-
8.4			_ned_a	32	90	108	50	69	-	-
8.5			_gts	20	33	36	16	24	-	-
8.6			_gtd_a	32	90	108	50	70	-	-
8.7			_lts	20	33	36	16	24	-	-
8.8			_ltd_a	32	90	108	50	70	-	-
8.9			_ges	20	33	36	16	24	-	-
8.10			_ged_a	32	90	108	50	70	-	-
8.11			_les	20	33	36	16	24	-	-
8.12			_led_a	32	90	108	50	70	-	-

Note: Cycle units. The error margin is included in measurements.

Table 2.2 List of Runtime Routine Speeds/FPL Speeds (3)

No.	Type	Function Name	Stack Size	Number of Execution Cycles					
				SH-1	SH-2	SH-2A	SH-3	SH-4	SH-4A
9.1	Convert sign	_negs	0	7	7	4	5	-	-
9.2		_negd_a	12	30	39	18	26	-	-
10.1	Convert	_stod_a	12	66	73	35	50	-	-
10.2		_dtos_a	20	122	128	61	82	-	-
10.3		_stoi	12	50	63	21	31	-	-
10.4		_dtoi_a	20	148	141	72	86	-	-
10.5		_stou	12	50	63	21	31	-	-
10.6		_dtou_a	20	148	141	72	86	-	-
10.7		_itos	12	88	91	45	59	-	-
10.8		_itod_a	12	189	179	96	110	-	-
10.9		_utos	8	81	82	46	52	-	-
10.10		_utod_a	8	99	96	51	61	-	-

Note: Cycle units. The error margin is included in measurements.

Table 2.2 List of Runtime Routine Speeds/FPL Speeds (4)

No.	Type	Function Name	Stack Size	Number of Execution Cycles					
				SH-1	SH-2	SH-2A	SH-3	SH-4	SH-4A
11.1	Move area	_quick_evn_mvn	4	12+3*(n/4)					
11.2		_quick_mvn	8	17+3*(n/4) (n<=64)					
				24+1.625*(n/4) (n>=68)					
11.3		_quick_odd_mvn	4	12+3*(n/4)					
11.4		_slow_mvn	12	21+5*n+3*((n-1)/4)					
12.1	Compare charactoer string	_quick_strcmp1	0	26+7*(n/4)+5*((n-1)%4)					
12.2		_slow_strcmp1	0	35+7*n					
13.1	Copy character string	_quick_strcpy	16	30+6*(n/4)+4*((n-1)%4)					
13.2		_slow_strcpy	24	24+6*n+2*((n-1)/4)					
14.1	Left-shift	_sftl	4	19 / 42	21 / 39	-	-	-	-
15.1	Right-shift	_sftrl	4	19 / 42	21 / 39	-	-	-	-
15.2		_sftra	4	20 /43	22 / 47	-	-	-	-
15.3		_sta_sftra6	0	13	14	-	-	-	-
15.4		_sta_sftra7	0	14	15	-	-	-	-
15.5		_sta_sftra10	0	16	18	-	-	-	-
15.6		_sta_sftra11	0	17	19	-	-	-	-
15.7		_sta_sftra12	0	17	19	-	-	-	-
15.8		_sta_sftra13	0	17	19	-	-	-	-
15.9		_sta_sftra21	0	13	14	-	-	-	-
15.10		_sta_sftra27	0	13	14	-	-	-	-
15.11		_sta_sftra28	0	13	14	-	-	-	-
15.12		_sta_sftra29	0	14	15	-	-	-	-
16.1	Packed structure	_pack1_st16	4	12	13	5	10	6	8
16.2		_pack1_st32	4	18	19	8	16	8	12
16.3		_pack1_st64	4	33	35	16	30	16	22
16.4		_pack1_ld16	4	17	18	10	13	11	14
16.5		_pack1_ld32	4	29	30	17	22	18	-
16.6		_pack1_ld64	8	67	73	38	52	39	53
16.7		_bfs64sp1	60	289 / 599	333 / 580	174 / 339	205 / 392	141 / 295	163 / 266
16.8		_bfs64up1	60	289 / 599	333 / 580	174 / 339	205 / 392	141 / 295	163 / 266
16.9		_bfx64sp1	36	239 / 591	276 / 563	144 / 334	194 / 385	130 / 289	147 / 256
16.10		_bfx64up1	40	227 / 588	264 / 550	144 / 332	186 / 377	124 / 282	149 / 266

Note: Cycle units. The error margin is included in measurements.
The routine that processing is greatly different depending on the input value publishes each of the maximum pattern and the minimum pattern. [minimum/maximum]

Table 2.2 List of Runtime Routine Speeds/FPL Speeds (5)

No.	Type	Function Name	Stack Size	Number of Execution Cycles					
				SH-1	SH-2	SH-2A	SH-3	SH-4	SH-4A
17.1	long long	_mul64	36	134	92	40	64	48	45
17.2		_div64s	64	148 / 601	165 / 351	87 / 183	108 / 245	72 / 195	64 / 161
17.3		_div64u	60	121 / 527	137 / 326	74 / 169	90 / 227	59 / 182	51 / 152
17.4		_mod64s	64	142 /550	158 / 342	80 / 179	105 / 241	65 / 190	61 / 155
17.5		_mod64u	60	117 / 569	132 / 312	70 / 165	87 / 223	55 / 178	48 / 147
17.6		_shlld64	20	86	96	35	45	27	35
17.7		_shlrd64	20	85	94	37	48	29	40
17.8		_shard64	24	93	105	38	49	29	39
17.9		_bfs64s	52	133 / 446	157 / 404	82 / 241	79 / 266	51 /205	59 / 160
17.10		_bfs64u	52	133 / 446	157 / 404	82 / 241	79 / 266	51 /205	59 / 160
17.11		_bfx64s	24	89 / 441	105 / 392	47 / 238	71 / 262	43 / 202	42 / 151
17.12		_bfx64u	24	77 / 428	93 / 379	49 / 238	63 / 254	37 / 195	38 / 148
17.13		_cmplt64	4	23	26	12	16	13	16
17.14		_cmplt64u	4	23	26	12	16	13	16
17.15		_cmpgt64	4	23	26	12	16	13	16
17.16		_cmpgt64u	4	23	26	12	16	13	16
17.17		_cmple64	4	23	26	12	16	13	16
17.18		_cmple64u	4	23	26	12	16	13	16
17.19		_cmpge64	4	23	26	12	16	13	16
17.20		_cmpge64u	4	23	26	12	16	13	16
17.21		_convs64	20	146	147	81	97	-	-
17.22		_convs64u	20	146	147	81	97	-	-
17.23		_convf64	20	-	-		-	74	67
17.24		_convf64u	20	-	-		-	74	67
17.25		_convw64	20	175	161	86	102	-	-
17.26		_convw64u	20	175	161	86	102	-	-
17.27		_convd64	20	-	-	-	-	75	77
17.28		_convd64u	20	-	-	-	-	75	77
17.29		_conv64s	24	258	260	141	166	-	-

Note: Cycle units. The error margin is included in measurements.
The routine that processing is greatly different depending on the input value publishes each of the maximum pattern and the minimum pattern. [minimum/maximum]

Table 2.2 List of Runtime Routine Speeds/FPL Speeds (6)

No.	Type	Function Name	Stack Size	Number of Execution Cycles					
				SH-1	SH-2	SH-2A	SH-3	SH-4	SH-4A
17.30	long long	_conv64us	24	242	246	136	156	-	-
17.31		_conv64f	28	-	-	-	-	78	75
17.32		_conv64uf	28	-	-	-	-	71	65
17.33		_conv64w	20	164	168	88	111	-	-
17.34		_conv64uw	20	133	140	72	93	-	-
17.35		_conv64d	20	-	-	-	-	80	84
17.36		_conv64ud	20	-	-	-	-	67	70

Note: Cycle units. The error margin is included in measurements.
The routine that processing is greatly different depending on the input value publishes each of the maximum pattern and the minimum pattern. [minimum/maximum]

Table 2.3 List of Runtime Routine Speeds/FPL Speeds

No.	Type	Function Name	Stack Size	Number of Execution Cycles		
				SH2-DSP	SH3-DSP	SH4AL-DSP
1.1	DSP	_padd24	8	50	33	32
1.2		_padd40	8	60	38	36
1.3		_pdiv16	24	830	514	442
1.4		_pdiv32	36	1164	742	625
1.5		_pdiv24	36	2279	1446	1246
1.6		_pdiv40	36	2750	1696	1439
1.7		_pmul32	16	51	35	32
1.8		_pmul24	24	143	94	87
1.9		_pmul40	44	188	135	105
1.10		_psub24	8	50	33	32
1.11		_psub40	8	60	38	36
1.12		_pconv16s	12	19 / 199	12 / 123	20 / 102
1.13		_pconv16w	16	57 / 212	37 / 126	39 / 115
1.14		_pconv32s	12	20 /340	12 / 196	19 / 140
1.15		_pconv32w	16	53 / 381	34 / 233	37 / 148
1.16		_pconv24s	12	18 / 280	11 / 171	19 / 116
1.17		_pconv24w	16	58 / 286	38 / 168	33 / 172
1.18		_pconv40s	16	29 / 568	18 / 339	24 / 220
1.19		_pconv40w	20	41 / 515	29 / 316	25 / 231
1.20		_pconvs16	16	71 / 1597	47 / 937	50 / 459
1.21		_pconvs32	16	70 / 1341	48 / 809	44 / 457
1.22		_pconvs24	16	104 / 1633	68 / 958	60 / 482
1.23		_pconvs40	16	106 / 1618	70 / 951	64 / 467
1.24		_pconvw16	16	86 / 12374	56 / 7223	49 / 3156
1.25		_pconvw32	20	106 / 3160	68 / 1848	59 / 853
1.26		_pconvw24	20	135 / 10354	86 / 6215	77 / 3172
1.27		_pconvw40	20	142 / 10338	91 / 6207	84 / 3160
1.28		_pcmplt40	4	30	19	17
1.29		_pcmple40	4	30	19	20
1.30		_pcmpgt40	4	30	19	20
1.31		_pcmpge40	4	30	19	20
1.32		_pcmpeq40	4	28	18	16
1.33		_pcmpne40	4	29	18	20
1.34		_pdiv16_sat	28	859	530	459
1.35		_pdiv32_sat	40	1262	790	625
1.36		_pmul32_sat	16	66	42	38

Note: Cycle units. The error margin is included in measurements.
The routine that processing is greatly different depending on the input value publishes each of the maximum pattern and the minimum pattern. [minimum/maximum]

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2.00	Apr.1.08	—	Re-measurement by V.9.02.00

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