

Section 13 H8/3814 Series Electrical Characteristics

13.1 H8/3814 Series Absolute Maximum Ratings

Table 13-1 lists the absolute maximum ratings.

Table 13-1 Absolute Maximum Ratings

Item	Symbol	Value	Unit
Power supply voltage	V_{CC}	-0.3 to +7.0	V
Analog power supply voltage	AV_{CC}	-0.3 to +7.0	V
Input voltage	Ports other than ports B and C	V_{in}	-0.3 to $V_{CC} + 0.3$
	Ports B and C	AV_{in}	-0.3 to $AV_{CC} + 0.3$
Operating temperature	T_{opr}	-20 to +75	°C
Storage temperature	T_{stg}	-55 to +125	°C

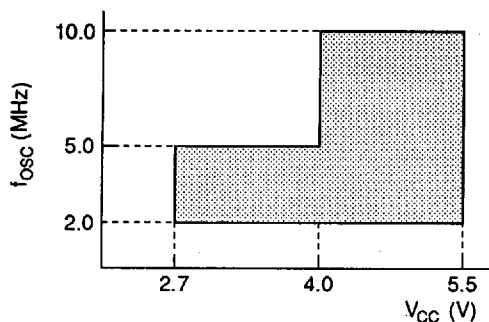
Note: Permanent damage may occur to the chip if maximum ratings are exceeded. Normal operation should be under the conditions specified in Electrical Characteristics. Exceeding these values can result in incorrect operation and reduced reliability.

13.2 H8/3814 Series Electrical Characteristics

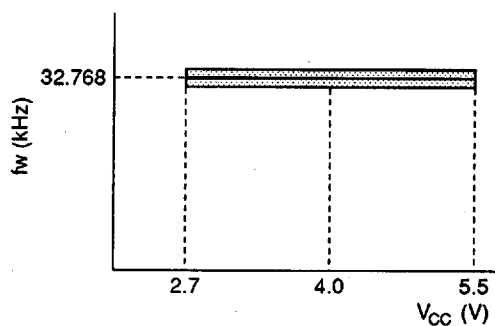
13.2.1 Power Supply Voltage and Operating Range

The power supply voltage and operating range of the H8/3814 Series are indicated by the shaded region in the figures below.

1. Power supply voltage vs. oscillator frequency range of H8/3814 Series

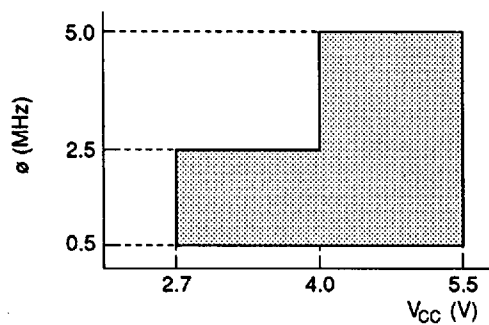


- Active mode (high speed)
- Sleep mode

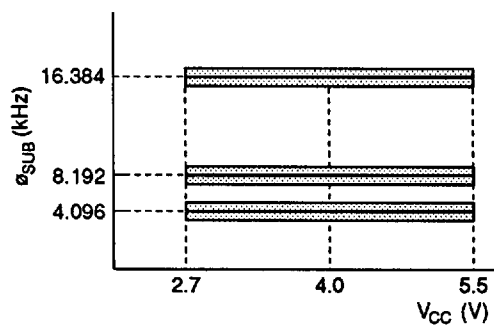


- All operating modes

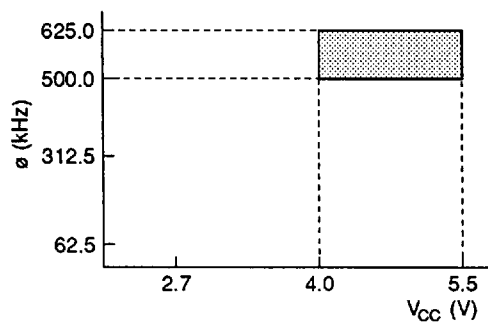
2. Power supply voltage vs. clock frequency range of H8/3814 Series



- Active mode (high speed)
- Sleep mode (except CPU)

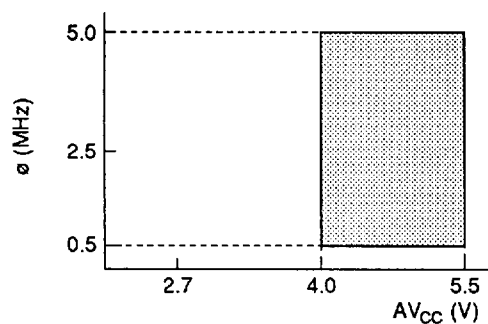


- Subactive mode
- Subsleep mode (except CPU)
- Watch mode (except CPU)

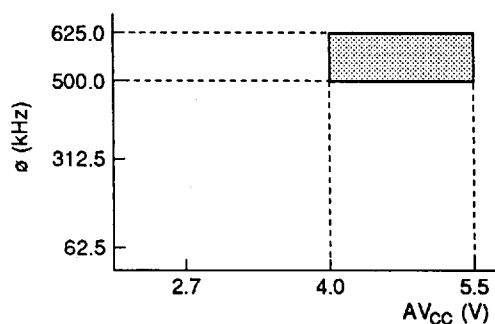


- Active mode (medium speed)

3. Analog power supply voltage vs. A/D converter operating range of H8/3814 Series



- Active (high speed) mode
- Sleep mode



- Active (medium speed) mode

13.2.2 DC Characteristics

Table 13-2 lists the DC characteristics of the H8/3814 Series.

Table 13-2 DC Characteristics of H8/3814 Series

$V_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -20^\circ\text{C to } +75^\circ\text{C}$, including subactive mode, unless otherwise indicated.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Note
Input high voltage	V_{IH}	$\overline{RES}$, MD0, $\overline{WKP}_0$ to $\overline{WKP}_7$, $\overline{IRQ}_0$ to $\overline{IRQ}_4$, TMIF	$0.8 V_{CC}$	—	$V_{CC} + 0.3$	V	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	
		TMIG, $\overline{SCK}_1$, $\overline{SCK}_3$, ADTRG	$0.9 V_{CC}$	—	$V_{CC} + 0.3$			
		SI ₁ , RXD	$0.7 V_{CC}$	—	$V_{CC} + 0.3$	V	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	
			$0.8 V_{CC}$	—	$V_{CC} + 0.3$			
		OSC ₁	$V_{CC} - 0.5$	—	$V_{CC} + 0.3$	V	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	
			$V_{CC} - 0.3$	—	$V_{CC} + 0.3$			
		P1 ₀ to P1 ₇ P2 ₀ to P2 ₇ P3 ₀ to P3 ₇ P4 ₀ to P4 ₃ P5 ₀ to P5 ₇ P6 ₀ to P6 ₇ P7 ₀ to P7 ₇ P8 ₀ to P8 ₇ P9 ₀ to P9 ₇ PA ₀ to PA ₃	$0.7 V_{CC}$	—	$V_{CC} + 0.3$	V	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	
			$0.8 V_{CC}$	—	$V_{CC} + 0.3$			
		PB ₀ to PB ₇ PC ₀ to PC ₃	$0.7 V_{CC}$	—	$AV_{CC} + 0.3$	V	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	
			$0.8 V_{CC}$	—	$AV_{CC} + 0.3$			
Input low voltage	V_{IL}	$\overline{RES}$, MD0, $\overline{WKP}_0$ to $\overline{WKP}_7$, $\overline{IRQ}_0$ to $\overline{IRQ}_4$, TMIF	-0.3	—	$0.2 V_{CC}$	V	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	
		TMIG, $\overline{SCK}_1$, $\overline{SCK}_3$, ADTRG	-0.3	—	$0.1 V_{CC}$			
		SI ₁ , RXD	-0.3	—	$0.3 V_{CC}$	V	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	
			-0.3	—	$0.2 V_{CC}$			
		OSC ₁	-0.3	—	0.5	V	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	
			-0.3	—	0.3			

Note: Connect pin TEST to V_{SS} .

Table 13-2 DC Characteristics of H8/3814 Series (cont)

$V_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -20^\circ\text{C to } +75^\circ\text{C}$, including subactive mode, unless otherwise indicated.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Note
Input low voltage	V_{IL}	P1 ₀ to P1 ₇ P2 ₀ to P2 ₇ P3 ₀ to P3 ₇ P4 ₀ to P4 ₃ P5 ₀ to P5 ₇ P6 ₀ to P6 ₇ P7 ₀ to P7 ₇ P8 ₀ to P8 ₇ P9 ₀ to P9 ₇ PA ₀ to PA ₃ PB ₀ to PB ₇ PC ₀ to PC ₃	-0.3	—	0.3 V_{CC}	V	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	
			-0.3	—	0.2 V_{CC}			
Output high voltage	V_{OH}	P1 ₀ to P1 ₇ P2 ₀ to P2 ₇ P3 ₀ to P3 ₇ P4 ₀ to P4 ₂ P5 ₀ to P5 ₇ P6 ₀ to P6 ₇ P7 ₀ to P7 ₇ P8 ₀ to P8 ₇ P9 ₀ to P9 ₇ PA ₀ to PA ₃	$V_{CC} - 1.0$	—	—	V	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$ $-I_{OH} = 1.0 \text{ mA}$	
			$V_{CC} - 0.5$	—	—		$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$ $-I_{OH} = 0.5 \text{ mA}$	
			$V_{CC} - 0.5$	—	—		$-I_{OH} = 0.1 \text{ mA}$	
Output low voltage	V_{OL}	P1 ₀ to P1 ₇ P4 ₀ to P4 ₂	—	—	0.6	V	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$ $I_{OL} = 1.6 \text{ mA}$	
			—	—	0.5		$I_{OL} = 0.4 \text{ mA}$	
		P5 ₀ to P5 ₇ P6 ₀ to P6 ₇ P7 ₀ to P7 ₇ P8 ₀ to P8 ₇ P9 ₀ to P9 ₇ PA ₀ to PA ₃	—	—	0.5		$I_{OL} = 0.4 \text{ mA}$	
		P2 ₀ to P2 ₇ P3 ₀ to P3 ₇	—	—	1.5		$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$ $I_{OL} = 10 \text{ mA}$	
			—	—	0.6		$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$ $I_{OL} = 1.6 \text{ mA}$	
			—	—	0.5		$I_{OL} = 0.4 \text{ mA}$	

Note: Connect pin TEST to V_{SS} .

Table 13-2 DC Characteristics of H8/3814 Series (cont)

$V_{CC} = 2.7\text{ V to } 5.5\text{ V}$, $AV_{CC} = 2.7\text{ V to } 5.5\text{ V}$, $V_{SS} = AV_{SS} = 0.0\text{ V}$, $T_a = -20^\circ\text{C to } +75^\circ\text{C}$, including subactive mode, unless otherwise indicated.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Note
Input leakage current	$ I_{IL} $	RES, P4 ₃	—	—	1	μA	$V_{IN} = 0.5\text{ V to } V_{CC} - 0.5\text{ V}$	
		OSC ₁ , MD0	—	—	1	μA	$V_{IN} = 0.5\text{ V to } V_{CC} - 0.5\text{ V}$	
		P1 ₀ to P1 ₇						
		P2 ₀ to P2 ₇						
		P3 ₀ to P3 ₇						
Pull-up MOS current	$-I_P$	P4 ₀ to P4 ₂						
		P5 ₀ to P5 ₇						
		P6 ₀ to P6 ₇						
		P7 ₀ to P7 ₇						
		P8 ₀ to P8 ₇						
Input capacitance	C_{IN}	P9 ₀ to P9 ₇						
		PA ₀ to PA ₃						
		PB ₀ to PB ₇	—	—	1		$V_{IN} = 0.5\text{ V to } AV_{CC} - 0.5\text{ V}$	
		PC ₀ to PC ₃						
Pull-up MOS current	$-I_P$	P1 ₀ to P1 ₇	50	—	300	μA	$V_{CC} = 5\text{ V}$, $V_{IN} = 0\text{ V}$	
		P3 ₀ to P3 ₇						
		P5 ₀ to P5 ₇	—	35	—	μA	$V_{CC} = 2.7\text{ V}$, $V_{IN} = 0\text{ V}$	Reference value
Input capacitance	C_{IN}	P6 ₀ to P6 ₇						
		All input pins except power supply pin	—	—	15	pF	$f = 1\text{ MHz}$, $V_{IN} = 0\text{ V}$ $T_a = 25^\circ\text{C}$	

Table 13-2 DC Characteristics of H8/3814 Series (cont)

$V_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -20^\circ\text{C to } +75^\circ\text{C}$, including subactive mode, unless otherwise indicated.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Note
Active mode current dissipation	I_{OPE1}	V_{CC}	—	12	24	mA	Active mode (high speed), $V_{CC} = 5 \text{ V}$, $f_{osc} = 10 \text{ MHz}$	1, 2
	I_{OPE2}	V_{CC}	—	2.5	5	mA	Active mode (medium speed), $V_{CC} = 5 \text{ V}$, $f_{osc} = 10 \text{ MHz}$	1, 2
Sleep mode current dissipation	I_{SLEEP}	V_{CC}	—	5	10	mA	$V_{CC} = 5 \text{ V}$, $f_{osc} = 10 \text{ MHz}$	1, 2
Subactive mode current dissipation	I_{SUB}	V_{CC}	—	50	130	μA	$V_{CC} = 2.7 \text{ V}$, LCD on, 32-kHz crystal oscillator ($\theta_{SUB} = \theta_{W/2}$)	1, 2
			—	40	—	μA	$V_{CC} = 2.7 \text{ V}$, LCD on, 32-kHz crystal oscillator ($\theta_{SUB} = \theta_{W/8}$)	Reference value 1, 2
Subsleep mode current dissipation	I_{SUBSP}	V_{CC}	—	40	90	μA	$V_{CC} = 2.7 \text{ V}$, LCD on, 32-kHz crystal oscillator ($\theta_{SUB} = \theta_{W/2}$)	1, 2
Watch mode current dissipation	I_{WATCH}	V_{CC}	—	—	6	μA	$V_{CC} = 2.7 \text{ V}$, LCD not used, 32-kHz crystal oscillator	1, 2
Standby mode current dissipation	I_{STBY}	V_{CC}	—	—	5	μA	32-kHz crystal oscillator not used	1, 2
RAM data retaining voltage	V_{RAM}	V_{CC}	2	—	—	V		1, 2

Notes: 1. Pin states during current measurement

Mode	RES Pin	Internal State	Other Pins	LCD Power Supply	Oscillator Pins
Active mode (high and medium speed)	V_{CC}	Operates	V_{CC}	Open	System clock oscillator: Crystal Subclock oscillator: Pin $X_1 = V_{CC}$
Sleep mode	V_{CC}	Only timer operates	V_{CC}	Open	
Subactive mode	V_{CC}	Operates	V_{CC}	Open	System clock oscillator: Crystal
Subsleep mode	V_{CC}	Only timer operates, CPU stops	V_{CC}	Open	Subclock oscillator: Crystal
Watch mode	V_{CC}	Only time-base clock operates, CPU stops	V_{CC}	Open	
Standby mode	V_{CC}	CPU and timers all stop	V_{CC}	Open	System clock oscillator: Crystal Subclock oscillator: Pin $X_1 = V_{CC}$

2. Excludes current in pull-up MOS transistors and output buffers.

Table 13-2 DC Characteristics H8/3814 Series (cont)

$V_{CC} = 2.7\text{ V to }5.5\text{ V}$, $AV_{CC} = 2.7\text{ V to }5.5\text{ V}$, $V_{SS} = AV_{SS} = 0.0\text{ V}$, $T_a = -20^\circ\text{C to }+75^\circ\text{C}$, including subactive mode, unless otherwise indicated.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition
Allowable output low current (per pin)	I_{OL}	Output pins except in ports 2 and 3	—	—	2	mA	$V_{CC} = 4.0\text{ V to }5.5\text{ V}$
		Ports 2 and 3	—	—	10		$V_{CC} = 4.0\text{ V to }5.5\text{ V}$
		All output pins	—	—	0.5		
Allowable output low current (total)	ΣI_{OL}	Output pins except in ports 2 and 3	—	—	40	mA	$V_{CC} = 4.0\text{ V to }5.5\text{ V}$
		Ports 2 and 3	—	—	80		$V_{CC} = 4.0\text{ V to }5.5\text{ V}$
		All output pins	—	—	20		
Allowable output high current (per pin)	$-I_{OH}$	All output pins	—	—	2	mA	$V_{CC} = 4.0\text{ V to }5.5\text{ V}$
			—	—	0.2		
Allowable output high current (total)	$\Sigma -I_{OH}$	All output pins	—	—	15	mA	$V_{CC} = 4.0\text{ V to }5.5\text{ V}$
			—	—	10		

13.2.3 AC Characteristics

Table 13-3 lists the control signal timing, and tables 13-4 and 13-5 list the serial interface timing of the H8/3814 Series.

Table 13-3 Control Signal Timing of H8/3814 Series

$V_{CC} = 2.7\text{ V to }5.5\text{ V}$, $AV_{CC} = 2.7\text{ V to }5.5\text{ V}$, $V_{SS} = AV_{SS} = 0.0\text{ V}$, $T_a = -20^{\circ}\text{C to }+75^{\circ}\text{C}$, including subactive mode, unless otherwise specified.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Reference Figure
System clock oscillation frequency	f_{OSC}	OSC ₁ , OSC ₂	2	—	10	MHz	$V_{CC} = 4.0\text{ V to }5.5\text{ V}$	
			2	—	5			
OSC clock (ϕ_{OSC}) cycle time	t_{OSC}	OSC ₁ , OSC ₂	100	—	1000	ns	$V_{CC} = 4.0\text{ V to }5.5\text{ V}$	1
			200	—	1000			Figure 13-1
System clock (ϕ) cycle time	t_{cyc}		2	—	16	t_{OSC}		1
			—	—	2000	ns		
Subclock oscillation frequency	f_W	X ₁ , X ₂	—	32.768	—	kHz		
Watch clock (ϕ_W) cycle time	t_W	X ₁ , X ₂	—	30.5	—	μs		
Subclock (ϕ_{SUB}) cycle time	t_{subcyc}		2	—	8	t_W		2
Instruction cycle time			2	—	—	t_{cyc} t_{subcyc}		
Oscillation stabilization time (crystal oscillator)	t_{rc}	OSC ₁ , OSC ₂	—	—	40	ms	$V_{CC} = 4.0\text{ V to }5.5\text{ V}$	
			—	—	60			
Oscillation stabilization time	t_{rc}	X ₁ , X ₂	—	—	2	s		
External clock high width	t_{CPH}	OSC ₁	40	—	—	ns	$V_{CC} = 4.0\text{ V to }5.5\text{ V}$	Figure 13-1
			80	—	—			
External clock low width	t_{CPL}	OSC ₁	40	—	—	ns	$V_{CC} = 4.0\text{ V to }5.5\text{ V}$	Figure 13-1
			80	—	—			
External clock rise time	t_{CPr}		—	—	15	ns	$V_{CC} = 4.0\text{ V to }5.5\text{ V}$	Figure 13-1
			—	—	20			
External clock fall time	t_{CPf}		—	—	15	ns	$V_{CC} = 4.0\text{ V to }5.5\text{ V}$	Figure 13-1
			—	—	20			
Pin RES low width	t_{REL}	RES	10	—	—	t_{cyc}		Figure 13-2

Notes: 1. A frequency between 1 MHz to 10 MHz is required when an external clock is input.
2. Selected with SA1 and SA0 of system clock control register 2 (SYSCR2).

Table 13-3 Control Signal Timing of H8/3814 Series (cont)

$V_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -20^\circ\text{C to } +75^\circ\text{C}$, including subactive mode, unless otherwise specified.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Reference Figure
Input pin high width	t_{IH}	$\overline{IRQ_0}$ to $\overline{IRQ_4}$ $\overline{WKP_0}$ to $\overline{WKP_7}$ ADTRG TMIF, TMIG	2	—	—	t_{cyc} t_{subcyc}		Figure 13-3
Input pin low width	t_{IL}	$\overline{IRQ_0}$ to $\overline{IRQ_4}$ $\overline{WKP_0}$ to $\overline{WKP_7}$ ADTRG TMIF, TMIG	2	—	—	t_{cyc} t_{subcyc}		Figure 13-3

Table 13-4 Serial Interface (SCI1) Timing of H8/3814 Series

$V_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -20^\circ\text{C to } +75^\circ\text{C}$, unless otherwise specified.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Reference Figure
Input serial clock cycle time	t_{scyc}	SCK ₁	2	—	—	t_{cyc}		Figure 13-4
Input serial clock high width	t_{SCKH}	SCK ₁	0.4	—	—	t_{scyc}		Figure 13-4
Input serial clock low width	t_{SCKL}	SCK ₁	0.4	—	—	t_{scyc}		Figure 13-4
Input serial clock rise time	t_{SCKr}	SCK ₁	—	—	60 80	ns	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	Figure 13-4
Input serial clock fall time	t_{SCKf}	SCK ₁	—	—	60 80	ns	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	Figure 13-4
Serial output data delay time	t_{SOD}	SO ₁	—	—	200 350	ns	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	Figure 13-4
Serial input data setup time	t_{SIS}	SI ₁	200 400	—	—	ns	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	Figure 13-4
Serial input data hold time	t_{SIH}	SI ₁	200 400	—	—	ns	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	Figure 13-4

Table 13-5 Serial Interface (SCI3) Timing of H8/3814 Series

$V_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -20^\circ\text{C to } +75^\circ\text{C}$, unless otherwise specified.

Item	Symbol	Min	Typ	Max	Unit	Test Condition	Reference Figure
Input clock cycle	Asynchronous	t_{scyc}	4	—	—	t_{cyc}	Figure 13-5
	Synchronous		6	—	—		
Input clock pulse width	t_{SCKW}	0.4	—	0.6	t_{scyc}		Figure 13-5
Transmit data delay time (synchronous mode)	t_{TXD}	—	—	1	t_{cyc}	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	Figure 13-6
		—	—	1			
Receive data setup time (synchronous mode)	t_{RXS}	200	—	—	ns	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	Figure 13-6
		400	—	—			
Receive data hold time (synchronous mode)	t_{RXH}	200	—	—	ns	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	Figure 13-6
		400	—	—			

13.2.4 A/D Converter Characteristics

Table 13-6 shows the A/D converter characteristics of the H8/3814 Series.

Table 13-6 A/D Converter Characteristics of H8/3814 Series

$V_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$, $AV_{SS} = V_{SS} = 0.0 \text{ V}$, $T_a = -20^\circ\text{C to } +75^\circ\text{C}$, unless otherwise specified.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Note
Analog power supply voltage	AV_{CC}	AV_{CC}	4.0	—	5.5	V		1
Analog input voltage	AV_{IN}	AN_0 to AN_{11}	$AV_{SS} - 0.3$	—	$AV_{CC} + 0.3$	V		
Analog power supply current	AI_{OPE}	AV_{CC}	—	—	1.5	mA	$AV_{CC} = 5.0 \text{ V}$	
	AI_{STOP1}	AV_{CC}	—	150	—	μA		2 Reference value
	AI_{STOP2}	AV_{CC}	—	—	5	μA		3
Analog input capacitance	C_{AIN}	AN_0 to AN_{11}	—	—	30	pF		
Allowable signal source impedance	R_{AIN}		—	—	10	k Ω		
Resolution (data length)			—	—	8	bit		
Non-linearity error			—	—	± 2.0	LSB		
Quantization error			—	—	± 0.5	LSB		
Absolute accuracy			—	—	± 2.5	LSB		
Conversion time			12.4	—	124	μs	$AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	
			24.8	—	124			

Notes: 1. Set $AV_{CC} = V_{CC}$ when the A/D converter is not used.

2. AI_{STOP1} is the current in active and sleep modes while the A/D converter is idle.

3. AI_{STOP2} is the current at reset and in standby, watch, subactive, and subsleep modes while the A/D converter is idle.

13.2.5 LCD Characteristics

Table 13-7 lists the LCD characteristics, and table 13-8 lists the AC characteristics for external segment expansion of the H8/3814 Series.

Table 13-7 LCD Characteristics of H8/3814 Series

$V_{CC} = 2.7\text{ V to }5.5\text{ V}$, $AV_{CC} = 2.7\text{ V to }5.5\text{ V}$, $V_{SS} = AV_{SS} = 0.0\text{ V}$, $T_a = -20^\circ\text{C to }+75^\circ\text{C}$, including subactive mode, unless otherwise specified.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Note
Segment driver voltage drop	V_{DS}	SEG ₁ to SEG ₄₀	—	—	0.6	V	$I_D = 2\text{ }\mu\text{A}$	1
Common driver voltage drop	V_{DC}	COM ₁ to COM ₄	—	—	0.3	V	$I_D = 2\text{ }\mu\text{A}$	1
LCD power supply voltage divider resistance	R_{LCD}		50	300	900	k Ω	Between V_1 and V_{SS}	
LCD power supply voltage	V_{LCD}	V_1	2.7	—	V_{CC}	V		2

Notes: 1. These are the voltage drops between the voltage supply pins V_1 , V_2 , V_3 , and V_{SS} , and the segment pins or common pins.

2. When V_{LCD} is supplied from an external source, the following relation must hold: $V_{CC} \geq V_1 \geq V_2 \geq V_3 \geq V_{SS}$

Table 13-8 AC Characteristics for External Segment Expansion of H8/3814 Series

$V_{CC} = 2.7\text{ V to }5.5\text{ V}$, $AV_{CC} = 2.7\text{ V to }5.5\text{ V}$, $V_{SS} = AV_{SS} = 0.0\text{ V}$, $T_a = -20^\circ\text{C to }+75^\circ\text{C}$, including subactive mode, unless otherwise specified.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Reference Figure
Clock high width	t_{CWH}	CL ₁ , CL ₂	800	—	—	ns	*	Figure 13-7
Clock low width	t_{CWL}	CL ₂	800	—	—	ns	*	Figure 13-7
Clock setup time	t_{CSU}	CL ₁ , CL ₂	500	—	—	ns	*	Figure 13-7
Data setup time	t_{SU}	DO	300	—	—	ns	*	Figure 13-7
Data hold time	t_{DH}	DO	300	—	—	ns	*	Figure 13-7
M delay time	t_{DM}	M	-1000	—	1000	ns		Figure 13-7
Clock rise and fall times	t_{CT}	CL ₁ , CL ₂	—	—	100	ns		Figure 13-7

Note: * Value when the frame frequency is set to between 30.5 Hz and 488 Hz.

13.3 H8/3814 Series Absolute Maximum Ratings (Wide Temperature Range (I-Spec) Version)

Table 13-9 lists the absolute maximum ratings.

Table 13-9 Absolute Maximum Ratings

Item	Symbol	Value	Unit
Power supply voltage	V_{CC}	-0.3 to +7.0	V
Analog power supply voltage	AV_{CC}	-0.3 to +7.0	V
Input voltage	Ports other than ports B and C	V_{in}	-0.3 to $V_{CC} + 0.3$
	Ports B and C	AV_{in}	-0.3 to $AV_{CC} + 0.3$
Operating temperature	T_{opr}	-40 to +85	°C
Storage temperature	T_{stg}	-55 to +125	°C

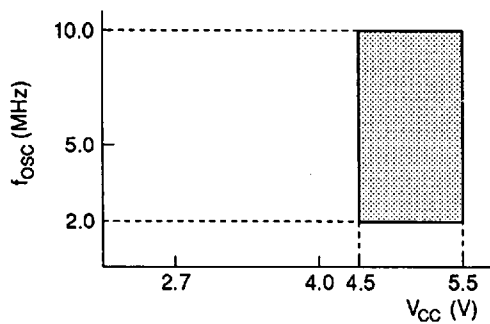
Note: Permanent damage may occur to the chip if maximum ratings are exceeded. Normal operation should be under the conditions specified in Electrical Characteristics. Exceeding these values can result in incorrect operation and reduced reliability.

13.4 H8/3814 Series Electrical Characteristics (Wide Temperature Range (I-Spec) Version)

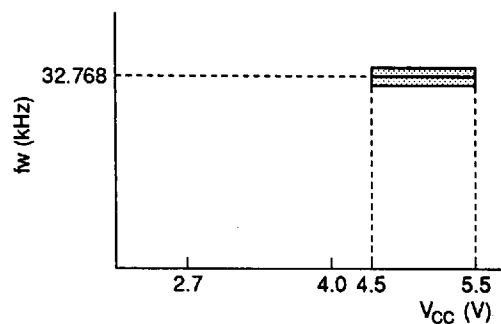
13.4.1 Power Supply Voltage and Operating Range

The power supply voltage and operating range of the H8/3814 Series (wide temperature range (I-spec) version) are indicated by the shaded region in the figures below.

- 1. Power supply voltage vs. oscillator frequency range of H8/3814 Series (wide temperature range (I-spec) version)

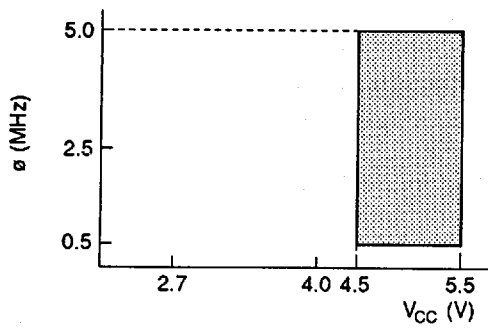


- Active mode (high speed)
- Sleep mode

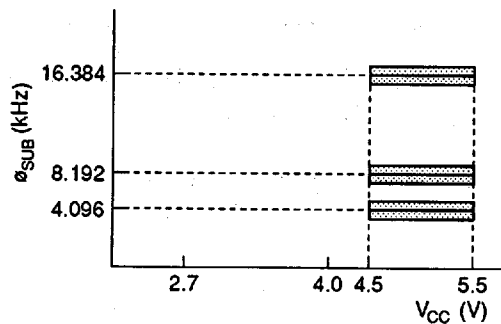


- All operating modes

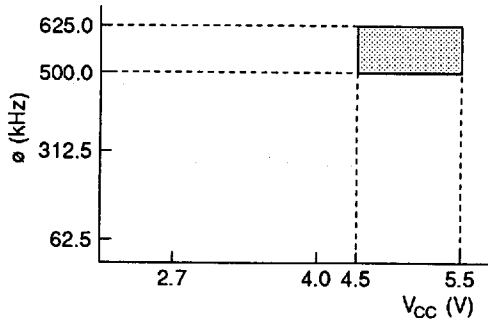
2. Power supply voltage vs. clock frequency range of H8/3814 Series (wide temperature range (I-spec) version)



- Active mode (high speed)
- Sleep mode (except CPU)

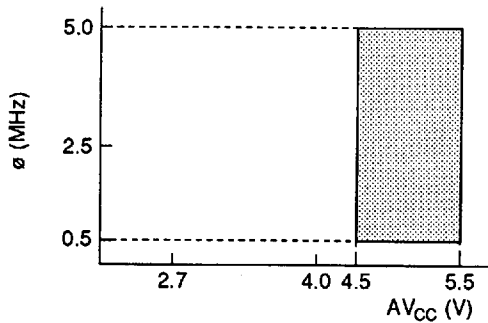


- Subactive mode
- Subsleep mode (except CPU)
- Watch mode (except CPU)

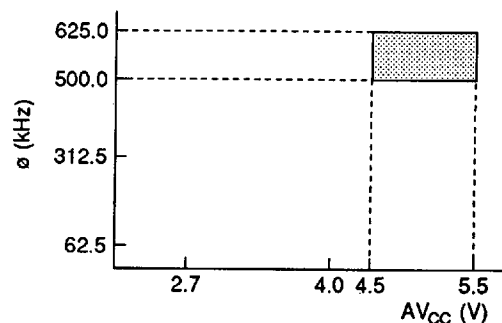


- Active mode (medium speed)

3. Analog power supply voltage vs. A/D converter operating range of H8/3814 Series (wide temperature range (I-spec) version)



- Active (high speed) mode
- Sleep mode



- Active (medium speed) mode

13.4.2 DC Characteristics

Table 13-10 lists the DC characteristics of the H8/3814 Series.

Table 13-10 DC Characteristics of H8/3814 Series (Wide Temperature Range (I-Spec) Version)

$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -40^\circ\text{C to } +85^\circ\text{C}$, including subactive mode, unless otherwise indicated.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Note
Input high voltage	V_{IH}	RES, MD0, WKP ₀ to WKP ₇ , IRQ ₀ to IRQ ₄ , TMIF TMIG, SCK ₁ , SCK ₃ , ADTRG	$0.8 V_{CC}$	—	$V_{CC} + 0.3$	V		
		SI ₁ , RXD	$0.7 V_{CC}$	—	$V_{CC} + 0.3$	V		
		OSC ₁	$V_{CC} - 0.5$	—	$V_{CC} + 0.3$	V		
		P1 ₀ to P1 ₇ P2 ₀ to P2 ₇ P3 ₀ to P3 ₇ P4 ₀ to P4 ₃ P5 ₀ to P5 ₇ P6 ₀ to P6 ₇ P7 ₀ to P7 ₇ P8 ₀ to P8 ₇ P9 ₀ to P9 ₇ PA ₀ to PA ₃	$0.7 V_{CC}$	—	$V_{CC} + 0.3$	V		
		PB ₀ to PB ₇ PC ₀ to PC ₃	$0.7 V_{CC}$	—	$AV_{CC} + 0.3$	V		
Input low voltage	V_{IL}	RES, MD0, WKP ₀ to WKP ₇ , IRQ ₀ to IRQ ₄ , TMIF TMIG, SCK ₁ , SCK ₃ , ADTRG	-0.3	—	$0.2 V_{CC}$	V	$V_{CC} = 4.0 \text{ V to } 5.5 \text{ V}$	
		SI ₁ , RXD	-0.3	—	$0.3 V_{CC}$	V		
		OSC ₁	-0.3	—	0.5	V		

Note: Connect pin TEST to V_{SS} .

Table 13-10 DC Characteristics of H8/3814 Series (Wide Temperature Range (I-Spec) Version) (cont)

$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -40^\circ\text{C to } +85^\circ\text{C}$, including subactive mode, unless otherwise indicated.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Note
Input low voltage	V_{IL}	P1 ₀ to P1 ₇ P2 ₀ to P2 ₇ P3 ₀ to P3 ₇ P4 ₀ to P4 ₃ P5 ₀ to P5 ₇ P6 ₀ to P6 ₇ P7 ₀ to P7 ₇ P8 ₀ to P8 ₇ P9 ₀ to P9 ₇ PA ₀ to PA ₃ PB ₀ to PB ₇ PC ₀ to PC ₃	-0.3	—	0.3 V_{CC}	V		
Output high voltage	V_{OH}	P1 ₀ to P1 ₇ P2 ₀ to P2 ₇ P3 ₀ to P3 ₇ P4 ₀ to P4 ₂ P5 ₀ to P5 ₇ P6 ₀ to P6 ₇ P7 ₀ to P7 ₇ P8 ₀ to P8 ₇ P9 ₀ to P9 ₇ PA ₀ to PA ₃	$V_{CC} - 1.0$	—	—	V	$-I_{OH} = 1.0 \text{ mA}$	
			$V_{CC} - 0.5$	—	—		$-I_{OH} = 0.5 \text{ mA}$	
Output low voltage	V_{OL}	P1 ₀ to P1 ₇ P4 ₀ to P4 ₂	—	—	0.6	V	$I_{OL} = 1.6 \text{ mA}$	
		P5 ₀ to P5 ₇ P6 ₀ to P6 ₇ P7 ₀ to P7 ₇ P8 ₀ to P8 ₇ P9 ₀ to P9 ₇ PA ₀ to PA ₃	—	—	0.5		$I_{OL} = 0.4 \text{ mA}$	
			—	—	1.5		$I_{OL} = 10 \text{ mA}$	
			—	—	0.6		$I_{OL} = 1.6 \text{ mA}$	

Note: Connect pin TEST to V_{SS} .

Table 13-10 DC Characteristics of H8/3814 Series (Wide Temperature Range (I-Spec) Version) (cont)

$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -40^\circ\text{C to } +85^\circ\text{C}$, including subactive mode, unless otherwise indicated.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Note
Input leakage current	$ I_{IL} $	$\overline{RES}$, P4 ₃	—	—	2	μA	$V_{IN} = 0.5 \text{ V to } V_{CC} - 0.5 \text{ V}$	
		OSC ₁ , MD0	—	—	2	μA	$V_{IN} = 0.5 \text{ V to } V_{CC} - 0.5 \text{ V}$	
		P1 ₀ to P1 ₇ P2 ₀ to P2 ₇ P3 ₀ to P3 ₇ P4 ₀ to P4 ₂ P5 ₀ to P5 ₇ P6 ₀ to P6 ₇ P7 ₀ to P7 ₇ P8 ₀ to P8 ₇ P9 ₀ to P9 ₇ PA ₀ to PA ₃						
		PB ₀ to PB ₇ PC ₀ to PC ₃	—	—	2		$V_{IN} = 0.5 \text{ V to } AV_{CC} - 0.5 \text{ V}$	
Pull-up MOS current	$-I_P$	P1 ₀ to P1 ₇ P3 ₀ to P3 ₇ P5 ₀ to P5 ₇ P6 ₀ to P6 ₇	20	—	330	μA	$V_{CC} = 5 \text{ V}$, $V_{IN} = 0 \text{ V}$	
Input capacitance	C_{IN}	All input pins except power supply pin	—	—	15	pF	$f = 1 \text{ MHz}$, $V_{IN} = 0 \text{ V}$ $T_a = 25^\circ\text{C}$	

Table 13-10 DC Characteristics of H8/3814 Series (Wide Temperature Range (I-Spec) Version) (cont)

$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -40^\circ\text{C to } +85^\circ\text{C}$, including subactive mode, unless otherwise indicated.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Note
Active mode current dissipation	I_{OPE1}	V_{CC}	—	12	30	mA	Active mode (high speed), $V_{CC} = 5 \text{ V}$, $f_{osc} = 10 \text{ MHz}$	1, 2
	I_{OPE2}	V_{CC}	—	2.5	6	mA	Active mode (medium speed), $V_{CC} = 5 \text{ V}$, $f_{osc} = 10 \text{ MHz}$	1, 2
Sleep mode current dissipation	I_{SLEEP}	V_{CC}	—	5	12	mA	$V_{CC} = 5 \text{ V}$, $f_{osc} = 10 \text{ MHz}$	1, 2
Subactive mode current dissipation	I_{SUB}	V_{CC}	—	100	—	μA	$V_{CC} = 5 \text{ V}$, LCD on, 32-kHz crystal oscillator ($\phi_{SUB} = \phi_{w/2}$)	Reference value 1, 2
			—	70	—	μA	$V_{CC} = 5 \text{ V}$, LCD on, 32-kHz crystal oscillator ($\phi_{SUB} = \phi_{w/8}$)	Reference value 1, 2
Subsleep mode current dissipation	I_{SUBSP}	V_{CC}	—	60	90	μA	$V_{CC} = 5 \text{ V}$, LCD on, 32-kHz crystal oscillator ($\phi_{SUB} = \phi_{w/2}$)	Reference value 1, 2
Watch mode current dissipation	I_{WATCH}	V_{CC}	—	6	—	μA	$V_{CC} = 5 \text{ V}$, LCD not used, 32-kHz crystal oscillator	Reference value 1, 2
Standby mode current dissipation	I_{STBY}	V_{CC}	—	—	10	μA	32-kHz crystal oscillator not used	1, 2
RAM data retaining voltage	V_{RAM}	V_{CC}	2	—	—	V		1, 2

Notes: 1. Pin states during current measurement

Mode	$\overline{\text{RES}}$ Pin	Internal State	Other Pins	LCD Power Supply	Oscillator Pins
Active mode (high and medium speed)	V_{CC}	Operates	V_{CC}	Open	System clock oscillator: Crystal Subclock oscillator: Pin $X_1 = V_{CC}$
Sleep mode	V_{CC}	Only timer operates	V_{CC}	Open	
Subactive mode	V_{CC}	Operates	V_{CC}	Open	System clock oscillator: Crystal Subclock oscillator: Crystal
Subsleep mode	V_{CC}	Only timer operates, CPU stops	V_{CC}	Open	
Watch mode	V_{CC}	Only time-base clock operates, CPU stops	V_{CC}	Open	
Standby mode	V_{CC}	CPU and timers all stop	V_{CC}	Open	System clock oscillator: Crystal Subclock oscillator: Pin $X_1 = V_{CC}$

2. Excludes current in pull-up MOS transistors and output buffers.

Table 13-10 DC Characteristics H8/3814 Series (Wide Temperature RAnge (I-Spec) Version)
(cont)

$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -40^\circ\text{C to } +85^\circ\text{C}$, including subactive mode, unless otherwise indicated.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition
Allowable output low current (per pin)	I_{OL}	Output pins except in ports 2 and 3	—	—	2	mA	
		Ports 2 and 3	—	—	10		
Allowable output low current (total)	ΣI_{OL}	Output pins except in ports 2 and 3	—	—	40	mA	
		Ports 2 and 3	—	—	80		
Allowable output high current (per pin)	$-I_{OH}$	All output pins	—	—	2	mA	
Allowable output high current (total)	$\Sigma -I_{OH}$	All output pins	—	—	15	mA	

13.4.3 AC Characteristics

Table 13-11 lists the control signal timing, and tables 13-12 and 13-13 list the serial interface timing of the H8/3814 Series (wide temperature range (I-spec) version).

Table 13-11 Control Signal Timing of H8/3814 Series (Wide Temperature Range (I-Spec) Version)

$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -40^\circ\text{C to } +85^\circ\text{C}$, including subactive mode, unless otherwise specified.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Reference Figure
System clock oscillation frequency	f_{OSC}	OSC ₁ , OSC ₂	2	—	10	MHz		
OSC clock (θ_{OSC}) cycle time	t_{OSC}	OSC ₁ , OSC ₂	100	—	1000	ns		1 Figure 13-1
System clock (θ) cycle time	t_{cyc}		2	—	16	t_{osc}		1
			—	—	2000	ns		
Subclock oscillation frequency	f_W	X ₁ , X ₂	—	32.768	—	kHz		
Watch clock (θ_W) cycle time	t_W	X ₁ , X ₂	—	30.5	—	μs		
Subclock (θ_{SUB}) cycle time	t_{subcyc}		2	—	8	t_W		2
Instruction cycle time			2	—	—	t_{cyc} t_{subcyc}		
Oscillation stabilization time (crystal oscillator)	t_{rc}	OSC ₁ , OSC ₂	—	—	40	ms		
Oscillation stabilization time	t_{rc}	X ₁ , X ₂	—	—	2	s		
External clock high width	t_{CPH}	OSC ₁	40	—	—	ns		Figure 13-1
External clock low width	t_{CPL}	OSC ₁	40	—	—	ns		Figure 13-1
External clock rise time	t_{CPr}		—	—	15	ns		Figure 13-1
External clock fall time	t_{CPf}		—	—	15	ns		Figure 13-1
Pin $\overline{\text{RES}}$ low width	t_{REL}	$\overline{\text{RES}}$	10	—	—	t_{cyc}		Figure 13-2

Notes: 1. A frequency between 1 MHz to 10 MHz is required when an external clock is input.
2. Selected with SA1 and SA0 of system clock control register 2 (SYSCR2).

Table 13-11 Control Signal Timing of H8/3814 Series (Wide Temperature Range (I-Spec) Version) (cont)

$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -40^\circ\text{C to } +85^\circ\text{C}$, including subactive mode, unless otherwise specified.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Reference Figure
Input pin high width	t_{IH}	$\overline{IRQ_0}$ to $\overline{IRQ_4}$ $\overline{WKP_0}$ to $\overline{WKP_7}$ $\overline{ADTRG}$ TMIF, TMIG	2	—	—	t_{cyc} t_{subcyc}		Figure 13-3
Input pin low width	t_{IL}	$\overline{IRQ_0}$ to $\overline{IRQ_4}$ $\overline{WKP_0}$ to $\overline{WKP_7}$ $\overline{ADTRG}$ TMIF, TMIG	2	—	—	t_{cyc} t_{subcyc}		Figure 13-3

Table 13-12 Serial Interface (SCI1) Timing of H8/3814 Series (Wide Temperature Range (I-Spec) Version)

$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -40^\circ\text{C to } +85^\circ\text{C}$, unless otherwise specified.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Reference Figure
Input serial clock cycle time	t_{scyc}	SCK_1	2	—	—	t_{cyc}		Figure 13-4
Input serial clock high width	t_{SCKH}	SCK_1	0.4	—	—	t_{scyc}		Figure 13-4
Input serial clock low width	t_{SCKL}	SCK_1	0.4	—	—	t_{scyc}		Figure 13-4
Input serial clock rise time	t_{SCKr}	SCK_1	—	—	60	ns		Figure 13-4
Input serial clock fall time	t_{SCKf}	SCK_1	—	—	60	ns		Figure 13-4
Serial output data delay time	t_{SOD}	SO_1	—	—	200	ns		Figure 13-4
Serial input data setup time	t_{SIS}	SI_1	200	—	—	ns		Figure 13-4
Serial input data hold time	t_{SIH}	SI_1	200	—	—	ns		Figure 13-4

Table 13-13 Serial Interface (SCI3) Timing of H8/3814 Series (Wide Temperature Range (I-Spec) Version)

$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -40^\circ\text{C to } +85^\circ\text{C}$, unless otherwise specified.

Item		Symbol	Min	Typ	Max	Unit	Test Condition	Reference Figure
Input clock cycle	Asynchronous	t_{scyc}	4	—	—	t_{cyc}		Figure 13-5
	Synchronous		6	—	—			
Input clock pulse width		t_{SCKW}	0.4	—	0.6	t_{scyc}		Figure 13-5
Transmit data delay time (synchronous mode)		t_{TXD}	—	—	1	t_{cyc}		Figure 13-6
Receive data setup time (synchronous mode)		t_{RXS}	200	—	—	ns		Figure 13-6
Receive data hold time (synchronous mode)		t_{RXH}	200	—	—	ns		Figure 13-6

13.4.4 A/D Converter Characteristics

Table 13-14 shows the A/D converter characteristics of the H8/3814 Series (wide temperature range (I-spec) version).

Table 13-14 A/D Converter Characteristics of H8/3814 Series (Wide Temperature Range (I-Spec) Version)

$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{SS} = V_{SS} = 0.0 \text{ V}$, $T_a = -40^\circ\text{C to } +85^\circ\text{C}$, unless otherwise specified.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Note
Analog power supply voltage	AV_{CC}	AV_{CC}	4.5	—	5.5	V		1
Analog input voltage	AV_{IN}	AN_0 to AN_{11}	-0.3	—	$AV_{CC} + 0.3$	V		
Analog power supply current	AI_{OPE}	AV_{CC}	—	—	1.7	mA	$AV_{CC} = 5.0 \text{ V}$	
	AI_{STOP1}	AV_{CC}	—	150	—	μA		2 Reference value
	AI_{STOP2}	AV_{CC}	—	—	7	μA		3
Analog input capacitance	C_{AIN}	AN_0 to AN_{11}	—	—	30	pF		
Allowable signal source impedance	R_{AIN}		—	—	10	k Ω		
Resolution (data length)			—	—	8	bit		
Non-linearity error			—	—	± 2.0	LSB		
Quantization error			—	—	± 0.5	LSB		
Absolute accuracy			—	—	± 2.5	LSB		
Conversion time			12.4	—	124	μs		

Notes: 1. Set $AV_{CC} = V_{CC}$ when the A/D converter is not used.

2. AI_{STOP1} is the current in active and sleep modes while the A/D converter is idle.

3. AI_{STOP2} is the current at reset and in standby, watch, subactive, and subsleep modes while the A/D converter is idle.

13.4.5 LCD Characteristics

Table 13-15 lists the LCD characteristics, and table 13-16 lists the AC characteristics for external segment expansion of the H8/3814 Series (wide temperature range (I-spec) version).

Table 13-15 LCD Characteristics of H8/3814 Series (Wide Temperature Range (I-Spec) Version)

$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -40^\circ\text{C to } +85^\circ\text{C}$, including subactive mode, unless otherwise specified.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Note
Segment driver voltage drop	V_{DS}	SEG ₁ to SEG ₄₀	—	—	0.6	V	$I_D = 2 \mu\text{A}$	1
Common driver voltage drop	V_{DC}	COM ₁ to COM ₄	—	—	0.3	V	$I_D = 2 \mu\text{A}$	1
LCD power supply voltage divider resistance	R_{LCD}		40	300	1000	k Ω	Between V_1 and V_{SS}	
LCD power supply voltage	V_{LCD}	V_1	4.5	—	V_{CC}	V		2

Notes: 1. These are the voltage drops between the voltage supply pins V_1 , V_2 , V_3 , and V_{SS} , and the segment pins or common pins.
 2. When V_{LCD} is supplied from an external source, the following relation must hold: $V_{CC} \geq V_1 \geq V_2 \geq V_3 \geq V_{SS}$

Table 13-16 AC Characteristics for External Segment Expansion of H8/3814 Series (Wide Temperature Range (I-Spec) Version)

$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $V_{SS} = AV_{SS} = 0.0 \text{ V}$, $T_a = -40^\circ\text{C to } +85^\circ\text{C}$, including subactive mode, unless otherwise specified.

Item	Symbol	Applicable Pins	Min	Typ	Max	Unit	Test Condition	Reference Figure
Clock high width	t_{CWH}	CL ₁ , CL ₂	800	—	—	ns	*	Figure 13-7
Clock low width	t_{CWL}	CL ₂	800	—	—	ns	*	Figure 13-7
Clock setup time	t_{CSU}	CL ₁ , CL ₂	500	—	—	ns	*	Figure 13-7
Data setup time	t_{SU}	DO	300	—	—	ns	*	Figure 13-7
Data hold time	t_{DH}	DO	300	—	—	ns	*	Figure 13-7
M delay time	t_{DM}	M	-1000	—	1000	ns		Figure 13-7
Clock rise and fall times	t_{CT}	CL ₁ , CL ₂	—	—	100	ns		Figure 13-7

Note: * Value when the frame frequency is set to between 30.5 Hz and 488 Hz.

13.5 Operation Timing

Figures 13-1 to 13-7 show timing diagrams.

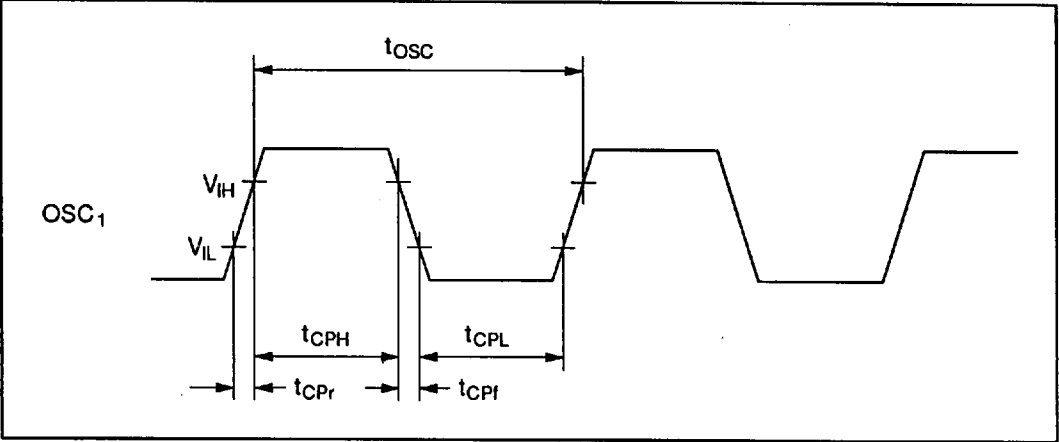


Figure 13-1 System Clock Input Timing

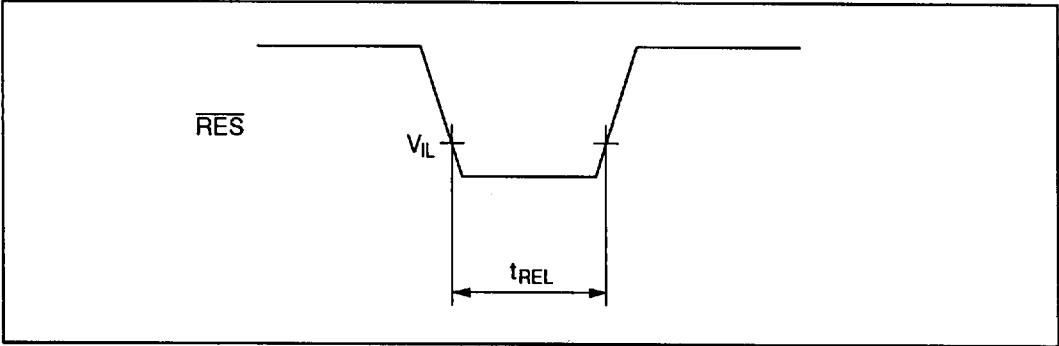


Figure 13-2 $\overline{RES}$ Low Width

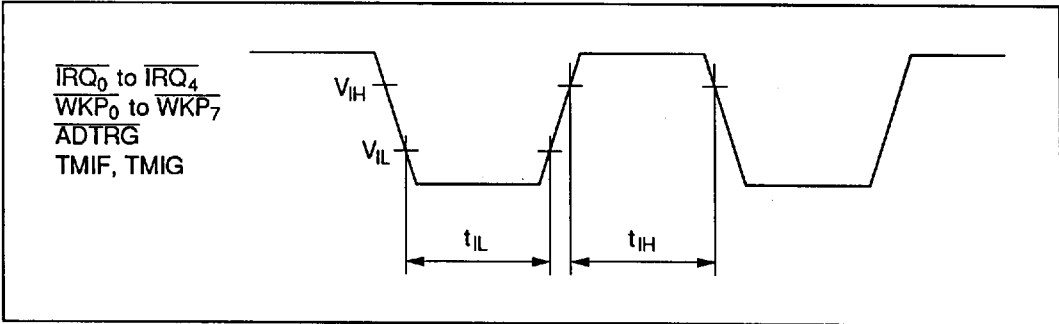
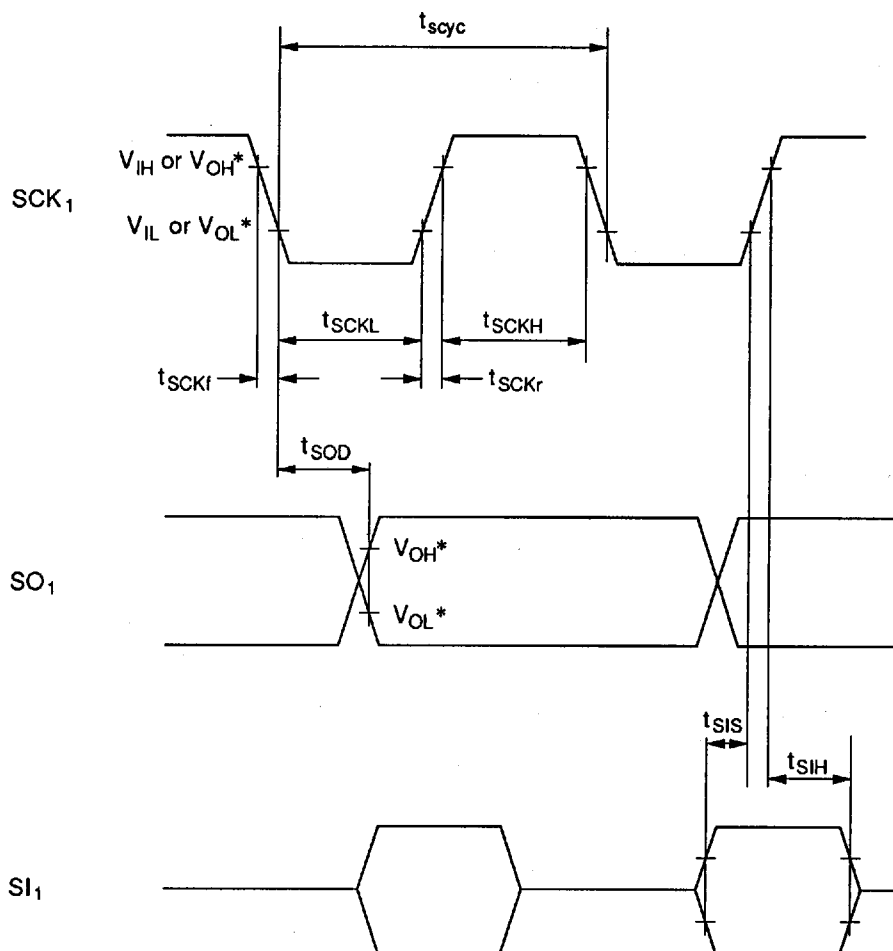


Figure 13-3 Input Timing



Notes: * Output timing reference levels
 Output high: $V_{OH} = 2.0\text{ V}$
 Output low: $V_{OL} = 0.8\text{ V}$
 Load conditions are shown in figure 13-8.

Figure 13-4 Serial Interface 1 Input/Output Timing

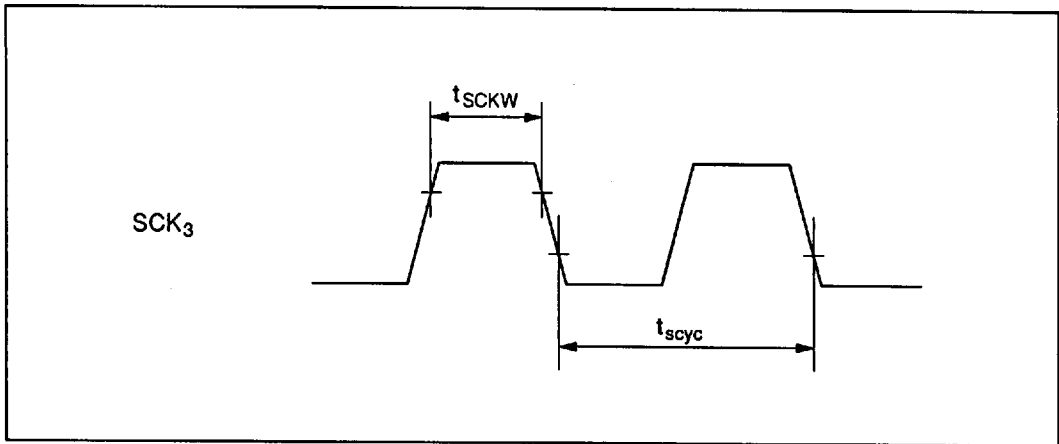


Figure 13-5 SCK₃ Input Clock Timing

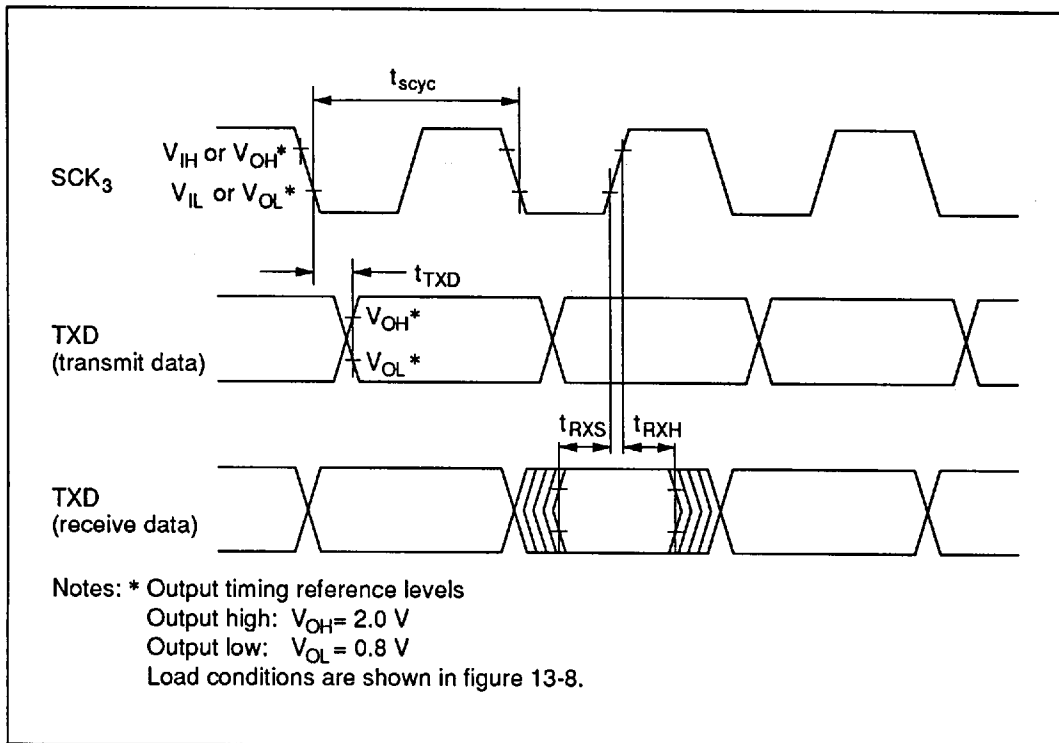


Figure 13-6 Input/Output Timing of Serial Interface 3 in Synchronous Mode

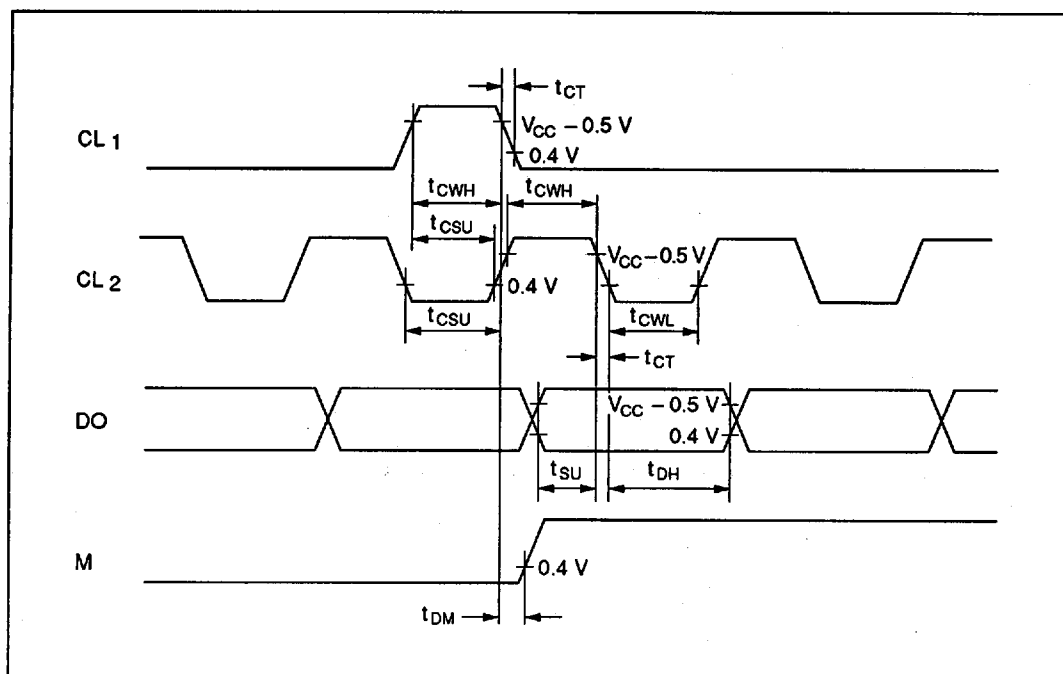


Figure 13-7 Segment Expansion Signal Timing

13.6 Output Load Circuit

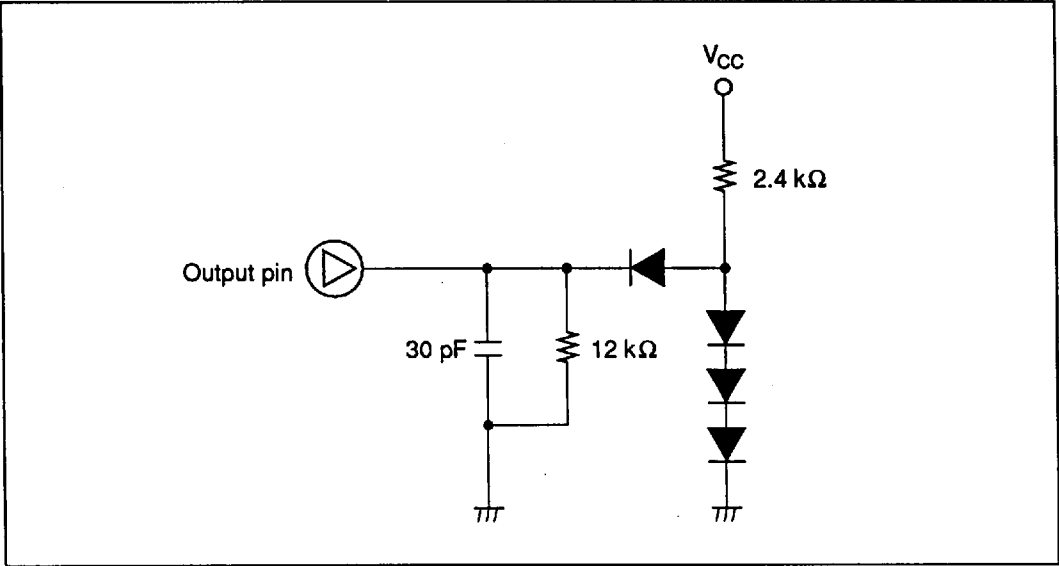


Figure 13-8 Output Load Condition