

SECTION 8. H4CPlus DC ELECTRICAL CHARACTERISTICS

Table 8-1 Preliminary Electrical Considerations for H4CPlus Series Arrays

ABSOLUTE MAXIMUM RATINGS				
Symbol	Parameter	$V_{DD}=3V/3.3V\pm 0.3V$	$V_{DD}=5V\pm 10\%$	Unit
V_{DD}	DC Supply Voltage	-0.5 to 4.6	-0.5 to 6.0	V
V_{in}	DC Input Voltage	-0.5 to $V_{DD} + 0.5$	-0.5 to $V_{DD} + 0.5$	V
V_{out}	DC Output Voltage	-0.5 to $V_{DD} + 0.5$	-0.5 to $V_{DD} + 0.5$	V
I	DC Current Drain per Pin, Any Single Input or Output	± 50	± 50	mA
I	DC Current Drain per Pin, Any Paralleled Outputs	± 100	± 100	mA
I	DC Current Drain VDD and VSS Pins	± 100	± 100	mA
T_{stg}	Storage Temperature	-65 to +150	-65 to +150	°C
T_L	Lead Temperature (10 second soldering)	300	300	°C

Note: Maximum ratings are those values beyond which damage to the device may occur.

RECOMMENDED OPERATING CONDITIONS (to guarantee functionality)				
Symbol	Parameter	Min	Max	Unit
V_{DD}^*	DC Supply Voltage, $V_{DD} = 5.0V$ (Nominal)	4.5	5.5	V
V_{DD}^*	DC Supply Voltage, $V_{DD} = 3.0/3.3V$ (Nominal)	2.7	3.6	V

* For testing, only. V_{DD} range is wider for simulation purposes.

Notes:

1. All parameters are characterized for DC conditions after thermal equilibrium has been established.
2. Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{ss} or V_{DD}).
3. This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit. For proper operation it is recommended that V_{in} and V_{out} be constrained to the range $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$.

Table 8-2 DC Electrical Characteristics for H4CPlus Series Arrays ($T_a = -40^\circ\text{C}$ to 85°C)

Sym.	Parameter	Condition	†† $V_{DD}=3\text{V}/3.3\text{V}\pm 0.3\text{V}$ Guaranteed		†† $V_{DD}=5\text{V}\pm 10\%$ Guaranteed		Unit
			Min.	Max.	Min.	Max.	
V_{IH}	Input High Voltage, ** CMOS Inputs (3.3V and 5V core)		2.0	$V_{DD}+0.3$	$0.7 V_{DD}$	$V_{DD}+0.3$	V
	TTL Inputs (3.3V and 5V core)		2.0	$V_{DD}+0.3$	2.2*	$V_{DD}+0.3$	
V_{IL}	Input Low Voltage, ** CMOS Inputs (3.3V and 5V core)		-0.3	0.8	-0.3	$0.3 V_{DD}$	V
	TTL Inputs (3.3V and 5V core)		-0.3	0.8	-0.3	0.8	
V_{T+}	Positive Threshold Voltage, CMOS Schmitt Trigger		-	$0.75V_{DD}$	-	$0.7V_{DD}$	V
	TTL Schmitt Trigger		N/A	N/A	-	2.4	
V_{T-}	Negative Threshold Voltage, CMOS Schmitt Trigger		$0.25V_{DD}$	-	$0.25V_{DD}$	-	V
	TTL Schmitt Trigger		N/A	N/A	0.8	-	
V_{Hy}	Hysteresis - CMOS Schmitt Trigger	V_{T+} to V_{T-}	$0.1V_{DD}$		$0.12V_{DD}$	-	V
	Hysteresis - TTL Schmitt Trigger		N/A	N/A	$0.05V_{DD}$	-	
I_{OH}^\dagger	Output High Current, ON32 Output Type	$V_{DD} = \text{Min},$ $V_{OH} \text{ Min} = 0.8V_{DD}$	-24.0	-	-48.0	-	mA
	ON16 Output Type		-12.0	-	-24.0	-	
	ON8 Output Type		-6.0	-	-12.0	-	
	ON4 Output Type		-3.0	-	-6.0	-	
	ON2 Output Type		-2.0	-	-3.0	-	
I_{OL}	Output Low Current, ON32 Output Type	$V_{DD} = \text{Min},$ $V_{OL} \text{ Max} = 0.4 \text{ Volts}$	24	-	48.0	-	mA
	ON16 Output Type		12	-	24.0	-	
	ON8 Output Type		6	-	12.0	-	
	ON4 Output Type		3	-	6.0	-	
	ON2 Output Type		2	-	3.0	-	
V_{OH}	Output High Voltage, LVCMOS	$V_{DD} = \text{Min}, I_{OH} = -100\mu\text{A}$	$0V_{DD3}-0.2$	-	$0V_{DD3}-0.2$	-	V
V_{OL}	Output Low Voltage, LVCMOS	$V_{DD} = \text{Min}, I_{OL} = +100\mu\text{A}$	-	0.2	-	0.2	V
I_{in}	Input Leakage Current, No Pull Resistor	$V_{in} = V_{DD}$ or V_{SS}	-5	5	-5	5	μA
	with Pullup Resistor	PUL; $V_{in} = V_{SS}$	-5	-100	-10	-200	
	with Pulldown Resistor	PDL; $V_{in} = V_{DD}$	5	100	10	200	
I_{oz}	Output Leakage Current, 3-State Output	Output = Off-State $V_{out} = V_{DD}$ or V_{SS}	-10	10	-10	10	μA
	Output Leakage Current, Open Drain Output (Device Off)	Output = Off-State $V_{out} = V_{DD}$	-10	10	-10	10	
I_{DD}	Max Quiescent Supply Current	$I_{out} = 0\text{mA}$ $V_{in} = V_{DD}$ or V_{SS}	Design Dependent				mA

* $V_{IH} = 2.0\text{V}$ at $V_{DD} = 5\text{V}\pm 5\%$

** Use 3.3V system interface voltage for macros: ICXN, ICXNH, BICXN, ISXN, ISXNH, and BISXN.

† For 3.3V ± 0.3 and 5V $\pm 10\%$, only. For 2.7 V consult factory.

†† V_{DD} refers to the System interface Voltage

N/A = Not Applicable

Table 8-3 DC Electrical Characteristics for H4CPlus Series GTL Driver ($T_a = -40^{\circ}\text{C}$ to 85°C)

Sym.	Parameter	Conditions	$V_{DD}=3.3V\pm0.3V$ Guaranteed		$V_{DD}=5V\pm10\%$ Guaranteed		Unit
			Min.	Max.	Min.	Max.	
DC Characteristics for GTL Receivers							
V_{IH}	Input High Voltage, GTL Inputs	-	$V_{VR08}+0.10$	$V_{DD}+0.30$	$V_{VR08}+0.10$	$V_{DD}+0.30$	V
V_{IL}	Input Low Voltage, GTL Inputs	-	-0.30	$V_{VR08}-0.10$	-0.30	$V_{VR08}-0.10$	V
V_{IDH}	Minimum Input High Voltage, GTL Differential Input	-	-	100	-	100	mV
V_{IDL}	Input Low Voltage, GTL Differential Input	-	-	100	-	100	mV
V_{ICM}	Input Common Mode Voltage Range, V_{CM} min	-	0.40	-	0.6	-	V
	V_{CM} max	-	-	1.1	-	2.0	V
I_{IH}	Input High Current, GTL Input	$V_{in}=V_{TT}, V_{DD}=\text{Max}$	-	5	-	5	μA
I_{IL}	Input Low Current, GTL Inputs	$V_{in}=0.4V, V_{DD}=\text{Max}$	-	-5	-	-5	μA
V_{VR08}	GTL Ref. Voltage	-	0.68	0.90	0.68	0.90	V
I_{DD}	Typical Quiescent Supply Current	-	-	1.3	-	3.8	mA
DC Characteristics for GTL Drivers							
V_{OH}	Output High Voltage, 20mA Output Macros	$I_{OH}=-10\mu\text{A}, V_{DD}=\text{Min}$	$V_{TT}-0.05$	$V_{TT}+0.05$	$V_{TT}-0.05$	$V_{TT}+0.05$	V
	40mA Output Macros	$I_{OH}=-10\mu\text{A}, V_{DD}=\text{Min}$	$V_{TT}-0.05$	$V_{TT}+0.05$	$V_{TT}-0.05$	$V_{TT}+0.05$	
V_{OL}	Output Low Voltage, 20mA Output Macros	$I_{OL}=20\text{mA}, V_{DD}=3\text{V}$	-	0.4	-	-	V
	40mA Output Macros	$I_{OL}=40\text{mA}, V_{DD}=3\text{V}$	-	0.4	-	-	
V_{OL}	Output Low Voltage, 20mA Output Macros	$I_{OL}=24\text{mA}, V_{DD}=4.5\text{V}$	-	-	-	0.4	V
	40mA Output Macros	$I_{OL}=48\text{mA}, V_{DD}=4.5\text{V}$	-	-	-	0.4	
V_{OD}	Differential Output Voltage, 20mA Output Macros	$I_{OL}=20\text{mA}$	$V_{TT}-0.45$	-	-	-	V
		$I_{OL}=24\text{mA}$	-	-	$V_{TT}-0.45$	-	
I_{OZH}	GTL Output Off Current High	$V_{out}=1.2V, V_{DD}=\text{Max}$	-	10	-	10	μA
I_{OZL}	GTL Output Off Current Low	$V_{out}=0.4V, V_{DD}=\text{Max}$	-	-10	-	-10	μA

* Not tested.

Notes:

1. Recommended: $V_{TT} = 1.2V \pm 5\%$, $V_{VR08} = (2/3) V_{TT}$, $R_T = 25\Omega/50\Omega$, $V_{TT\text{ MAX}} = V_{DD}+0.3V$

Table 8-4 DC Electrical Characteristics for H4CPlus CMTL Buffers ($T_a = -40^{\circ}\text{C}$ to 85°C)

Sym.	Parameter	Conditions	$V_{DD}=3.3V\pm 0.3V$ Guaranteed		$V_{DD}=5V\pm 10\%$ Guaranteed		Unit
			Min.	Max.	Min.	Max.	
DC Characteristics for CMTL Receivers							
V_{IDH}	Minimum Input High Voltage, CMTL Inputs (Differential)	-	-	100	-	100	mV
V_{IDL}	Maximum Input Low Voltage, CMTL Inputs (Differential)	-	-	100	-	100	mV
V_{ICM}	Input Common Mode Voltage Range, V_{ICM} Min	V_{DDmax}	0.6	-	1.0	-	V
	V_{ICM} Max	V_{DDmin}	-	2.2	-	3.5	V
I_{IH}	Input High Current, CMTL Inputs (No Termination)	$V_{in}=V_{OHmax}, V_{DD}=Max$	-	5	-	5	μA
I_{IL}	Input Low Current, CMTL Inputs (No Termination)	$V_{in}=V_{OLmin}, V_{DD}=Max$	-	5	-	5	μA
I_{DD}^*	Max Quiescent Supply Current	-	-	1.8	-	4.7	mA
DC Characteristics for CMTL Drivers							
V_{OH}	Minimum Output High Voltage, CMTL Outputs (no Load)**	$V_{DD}= Min$	-	-	2.5	3.7	V
	CMTL Outputs (50 Ω)†		1.3	2.0	2.4	3.1	
	CMTL Outputs (100 Ω)†		1.4	2.1	2.5	3.2	
	CMTL Outputs $I_{OH}=0.5\text{mA}$		N/A	N/A	-	3.5	
V_{OL}	Maximum Output Low Voltage, CMTL Outputs (no Load)**	$V_{DD}= Min$	-	-	1.0	2.0	V
	CMTL Outputs (50 Ω)†		1.1	2.0	1.6	2.4	
	CMTL Outputs (100 Ω)†		1.0	1.9	1.5	2.3	
	CMTL Outputs $I_{OL}=20\text{mA}$		N/A	N/A	1.7	2.7	
$ V_{OD} $	Differential Output Voltage, CMTL Outputs (no Load)**	$V_{DD}= Min$	-	-	1.0	2.5	V
	CMTL Outputs (50 Ω)†		0.19 Typ.		0.4	1.1	
	CMTL Outputs (100 Ω)†		0.29 Typ.		0.5	1.4	
V_{OS}	Output Offset Voltage, CMTL Outputs (no Load)**	$V_{DD}= Min$	-	-	2.1	2.6	V
	CMTL Outputs (50 Ω)†		1.35	1.85	2.1	2.65	
	CMTL Outputs (100 Ω)†		1.35	1.85	2.1	2.65	
I_{OZH}	CMTL Output Off Current High	$V_{out}=V_{DD}, V_{DD}=Max$	-10	10	-10	10	μA
I_{OZL}	CMTL Output Off Current Low	$V_{out}=V_{SS}, V_{DD}=Max$	-10	10	-10	10	μA
R_o	Output Impedance (Typical)	$100\Omega \leq Load \leq 200\Omega \uparrow$	50		30		Ω

* Not tested.

** OD32TCMT and BOD32TCMT macros, only.

† Loads across differential CMTL outputs.

N/A = Not Applicable

Table 8-5 Electrical Characteristics for H4CPlus PECL Receivers ($T_a = -40^{\circ}\text{C}$ to 85°C)

Sym.	Parameter	Conditions	$V_{DD} = 3.3V \pm 0.3V$ Guaranteed		$V_{DD} = 5V \pm 10\%$ Guaranteed		Unit
			Min.	Max.	Min.	Max.	
DC Characteristics for PECL Receivers							
V_{IH}	Input High Voltage, PECL Single-Ended	-	$V_{VR38} + 0.10$	$V_{DD} + 0.30$	$V_{VR38} + 0.10$	$V_{DD} + 0.30$	V
V_{IL}	Input Low Voltage, PECL Single-Ended	-	-0.30	$V_{VR38} - 0.10$	-0.30	$V_{VR38} - 0.10$	V
V_{IDH}	Minimum Input High Voltage, PECL Differential Input	-	-	100	-	100	mV
V_{IDL}	Input Low Voltage, PECL Differential Input	-	-	100	-	100	mV
V_{ICM}	Input Common Mode Voltage Range, V_{CM} min	-	1.2	-	1.4	-	V
	V_{CM} max	-	-	$V_{DD} - 0.8$	-	$V_{DD} - 0.8$	V
I_{IH}	Input High Current, PECL Input	$V_{in} = V_{DD}$, $V_{DD} = \text{Max}$	-	5	-	5	μA
I_{IL}	Input Low Current, PECL Input	$V_{in} = V_{SS}$, $V_{DD} = \text{Max}$	-	5	-	5	μA
I_{DD}^*	Max Quiescent Supply Current	-	-	1.5 (ILP-) 5.3 (IPX-)	-	4.3 (IPD) 5.1 (IPN)	mA
V_{VR38}	PECL Reference Voltage	PECL Single-Ended	$V_{DD} - 1.3$ Typ.		$V_{DD} - 1.3$ Typ.		V

* Not tested.

Table 8-6 DC Electrical Characteristics for H4CPlus Series PCI Buffers ($T_a = -40^{\circ}\text{C}$ to 85°C)

Sym.	Parameter	Condition	$V_{DD} = 3.3V \pm 0.3V$ Guaranteed		$V_{DD} = 5V \pm 10\%$ Guaranteed		Unit
			Min.	Max.	Min.	Max.	
DC Characteristics for PCI Receivers							
V_{IH}	Input High Voltage		$0.5V_{DD}$	$V_{DD} + 0.5$	2.0	$V_{DD} + 0.5$	V
V_{IL}	Input Low Voltage		-0.5	$0.3V_{DD}$	-0.5	0.8	V
I_{IH}	Input High Leakage Current	3.3 V: $0 < V_{in} < V_{DD}$ 5.0 V: $V_{in} = 2.7$ V	-	10	-	70	μA
I_{IL}	Input Low Leakage Current	3.3 V: $0 < V_{in} < V_{DD}$ 5.0 V: $V_{in} = 0.5$ V	-	-10	-	-70	μA
DC Characteristics for PCI Drivers							
V_{OH}	Output High Voltage	3.3 V: $I_{out} = -500 \mu\text{A}$ 5.0 V: $I_{out} = -2$ mA	$0.9V_{DD}$	-	2.4	-	V
V_{OL}	Output Low Voltage	3.3 V: $I_{out} = 1500 \mu\text{A}$ 5.0 V: $I_{out} = 6$ mA	-	$0.1V_{DD}$	-	0.55	V
AC Characteristics for PCI Drivers (Not Tested)							
V_{OHmin}	Output High Voltage Minimum	3.3 V: $I_{out} = -12(V_{DD})\text{mA}$ 5.0 V: $I_{out} = -44$ mA	$0.3V_{DD}$	-	1.4	-	V
V_{OHmax}	Output High Voltage Maximum	3.3 V: $I_{out} = -32(V_{DD})\text{mA}$ 5.0 V: $I_{out} = -142$ mA	-	$0.7V_{DD}$	-	3.1	V

Table 8-6 DC Electrical Characteristics for H4CPlus Series PCI Buffers ($T_a = -40^{\circ}\text{C}$ to 85°C)

Sym.	Parameter	Condition	$V_{DD}=3.3V\pm0.3V$ Guaranteed		$V_{DD}=5V\pm10\%$ Guaranteed		Unit
			Min.	Max.	Min.	Max.	
V_{OLmin}	Output Low Voltage Minimum	3.3 V: $I_{out} = 38(V_{DD})$ mA 5.0 V: $I_{out} = 206$ mA	$0.18 V_{DD}$	-	0.71	-	V_{OLmin}
V_{OLmax}	Output Low Voltage Maximum	3.3 V: $I_{out} = 16(V_{DD})$ mA 5.0 V: $I_{out} = 95$ mA	-	$0.6V_{DD}$	-	2.2	V_{OLmax}

Table 8-7 DC Electrical Characteristics for H4CPlus Series Fail-Safe and Extended Voltage Range Bidirectional I/O ($T_a = -40^{\circ}\text{C}$ to 85°C)

Sym.	Parameter	Condition	$V_{DD}=3.3V\pm0.3V$ Guaranteed		$V_{DD}=5V\pm10\%$ Guaranteed		Unit
			Min.	Max.	Min.	Max.	
Leakage Current for Fail-Safe and Extended Voltage Range Bidirectional I/O							
I_{off}	Leakage Current for bidirectional Fail-Safe I/O, i.e: ON8TF and BON8TF No pull resistor	$V_{DD} = 0V_{DD5} = 0$ to MAX $V_{in} = V_{DD}$ or V_{SS} Output = Off-State	-	-	-20	+20	μA
	Leakage Current for bidirectional Fail-Safe I/O, with pulldown resistor	$V_{DD} = 0V_{DD5} = 0$ to MAX $V_{in} = V_{DD}$ or V_{SS} Output = Off-State	-	-	-20	+200	
I_{off}	Leakage Current for Fail-Safe Outputs with Regulator, i.e: ON8TFA and BON8TFA No pull resistor	$V_{DD} = 0V_{DD5} = \leq 2.5V$ $V_{in} = 0$ to 5.5 V Output = Enabled	-	-	-20	+20	μA
	Leakage Current for Fail-Safe Outputs with Regulator, i.e: ON8TFA and BON8TFA with pulldown resistor	$V_{DD} = 0V_{DD5} = \leq 2.5V$ $V_{in} = 0$ to 5.5 V Output = Enabled	-	-	-20	+200	
I_{off}^*	Leakage Current for bidirectional extended voltage range I/O, No pull resistor	$V_{in} = 0$ to 5.5 V Output = Off-State	-20	+20	-	-	μA
	Leakage Current for bidirectional extended voltage range I/O, with pulldown resistor	$V_{in} = 0$ to 5.5 V Output = Off-State	-20	+200	-	-	

*For the bidirectional extended voltage range I/O, the bidirectional input macro must be a 3.3V System and 3.3V Core macro.

N/A = Not Applicable