

INTEGRATED CIRCUITS

GENERAL PURPOSE

LOGIC

HE4000B series

HE4000B FAMILY SPECIFICATIONS

The LOCMOS HE4000B range is a fully buffered digital integrated circuit family which meets the Jedec-B specifications. The members of this family are plug-in replacements for the well-known CMOS 4000 and 14500 ranges.

The HE family has the same advantages as conventional CMOS circuits, plus the additional LOCMOS advantages.

Advantages of CMOS

- low power dissipation - typically 10 nW per gate (static)
- wide operating supply voltage range
- wide operating temperature ranges:
 - 40 to +85 °C for standard temperature range (HEF)
 - 55 to +125 °C for extended temperature range (HEC)
- high DC fan-out
- inputs and outputs are protected against electrostatic voltages

In addition to these, the **LOCMOS HE4000B** range has:

- buffered outputs on **all** circuits
- higher speed
- higher packing density — essential for MSI/LSI
- excellent noise immunity

Recommended supply voltage range 3 to 15 V.

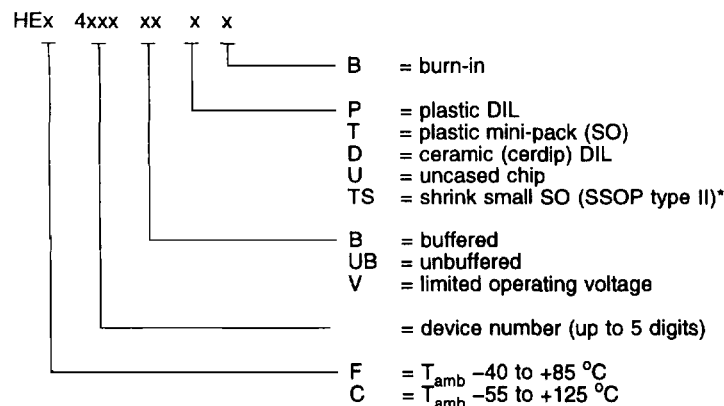
LOCMOS means Local Oxidation Complementary MOS

Inputs and outputs are protected against electrostatic effects in a wide variety of device-handling situations. However, to be totally safe, handling precautions should be taken into account.

Type number designation

Type numbers have a suffix which signifies the type of package and burn-in option.

HEx4xxxxxx complete type number which can be split as follows:



* For selected types only

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HE4000B FAMILY SPECIFICATIONS (cont.)

The HE family is designed with standardized output drive characteristics which, combined with relative intensity to output capacitance loading, simplify system design.

Family ratings

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage range	V_{DD} -0,5 to +18 V
Voltage on any input	V_I -0,5 to ($V_{DD} + 0,5$) V

DC current into any input or output $\pm I$ max. 10 mA

Power dissipation per package:

HEF (plastic and ceramic DIL)	
$T_{amb} = -40$ to $+70$ °C	P_{tot} max. 500 mW
$T_{amb} = +70$ to $+85$ °C	derate linearly by 8 mW/K

HEF (plastic SO mini-pack)	
$T_{amb} = -40$ to $+70$ °C	P_{tot} max. 400 mW
$T_{amb} = +70$ to $+85$ °C	derate linearly by 6 mW/K

HEC (ceramic DIL)	
$T_{amb} = -55$ to $+70$ °C	P_{tot} max. 500 mW
$T_{amb} = +70$ to $+125$ °C	derate linearly by 8 mW/K

Power dissipation per output	P max. 100 mW
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Storage temperature range	T_{stg} -65 to $+150$ °C
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Operating ambient temperature range

HEF	T_{amb} -40 to $+85$ °C
HEC	T_{amb} -55 to $+125$ °C

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DC family characteristics for HEF at $V_{SS} = 0$ V

parameter	symbol	$T_{amb} = -40^{\circ}\text{C}$		$T_{amb} = +25^{\circ}\text{C}$		$T_{amb} = +85^{\circ}\text{C}$		V_{DD} V	conditions
		min.	max.	min.	max.	min.	max.		
Quiescent device current for gates	I_{DD} (μA)	–	1.0	–	1.0	–	7.5	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD} ; $I_O = 0$
		–	2.0	–	2.0	–	15.0	10	
		–	4.0	–	4.0	–	30.0	15	
Quiescent device current for buffers and flip-flops	I_{DD} (μA)	–	4.0	–	4.0	–	30	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD} ; $I_O = 0$
		–	8.0	–	8.0	–	60	10	
		–	16.0	–	16.0	–	120	15	
Quiescent device current for MSI	I_{DD} (μA)	–	20	–	20	–	150	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD} ; $I_O = 0$
		–	40	–	40	–	300	10	
		–	80	–	80	–	600	15	
Quiescent device current for LSI	I_{DD} (μA)	–	50	–	50	–	375	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD} ; $I_O = 0$
		–	100	–	100	–	750	10	
		–	200	–	200	–	1500	15	
Output voltage LOW $ I_{OI} < 1 \mu\text{A}$	V_{OL} (V)	–	0.05	–	0.05	–	0.05	5	$V_I = V_{SS}$ or V_{DD} $V_I = V_{SS}$ or V_{DD} $V_I = V_{SS}$ or V_{DD}
		–	0.05	–	0.05	–	0.05	10	
		–	0.05	–	0.05	–	0.05	15	
Output voltage HIGH $ I_{OI} < 1 \mu\text{A}$	V_{OH} (V)	4.95	–	4.95	–	4.95	–	5	$V_I = V_{SS}$ or V_{DD} $V_I = V_{SS}$ or V_{DD} $V_I = V_{SS}$ or V_{DD}
		9.95	–	9.95	–	9.95	–	10	
		14.95	–	14.95	–	14.95	–	15	
Input voltage LOW $ I_{OI} < 1 \mu\text{A}$ (buffered stages only)	V_{IL} (V)	–	1.5	–	1.5	–	1.5	5	$V_O = 0.5$ or 4.5V $V_O = 1.0$ or 9.0V $V_O = 1.5$ or 13.5V
		–	3.0	–	3.0	–	3.0	10	
		–	4.0	–	4.0	–	4.0	15	
Input voltage HIGH $ I_{OI} < 1 \mu\text{A}$ (buffered stages only)	V_{IH} (V)	3.5	–	3.5	–	3.5	–	5	$V_O = 0.5$ or 4.5V $V_O = 1.0$ or 9.0V $V_O = 1.5$ or 13.5V
		7.0	–	7.0	–	7.0	–	10	
		11.0	–	11.0	–	11.0	–	15	
Input voltage LOW $ I_{OI} < 1 \mu\text{A}$ (unbuffered stages only)	V_{IL} (V)	–	1.0	–	1.0	–	1.0	5	$V_O = 0.5$ or 4.5V $V_O = 1.0$ or 9V $V_O = 1.5$ or 13.5V
		–	2.0	–	2.0	–	2.0	10	
		–	2.5	–	2.5	–	2.5	15	
Input voltage HIGH $ I_{OI} < 1 \mu\text{A}$ (unbuffered stages only)	V_{IH} (V)	4.0	–	4.0	–	4.0	–	5	$V_O = 0.5$ or 4.5V $V_O = 1.0$ or 9.0V $V_O = 1.5$ or 13.5V
		8.0	–	8.0	–	8.0	–	10	
		12.5	–	12.5	–	12.5	–	15	
Output (sink) current LOW	I_{OL} (mA)	0.52	–	0.44	–	0.36	–	5	$V_O=0.4$; $V_I=0/5\text{V}$ $V_O=0.5$; $V_I=0/10\text{V}$ $V_O=1.5$; $V_I=0/15\text{V}$
		1.3	–	1.1	–	0.9	–	10	
		3.6	–	3.0	–	2.4	–	15	
Output (source) current HIGH	$-I_{OH}$ (mA)	0.52	–	0.44	–	0.36	–	5	$V_O=4.6$; $V_I=0/5\text{V}$ $V_O=9.5$; $V_I=0/10\text{V}$ $V_O=13.5$; $V_I=0/15\text{V}$
		1.3	–	1.1	–	0.9	–	10	
		3.6	–	3.0	–	2.4	–	15	
Output (source) current (HIGH)	$-I_{OH}$ (mA)	1.7	–	1.4	–	1.1	–	5	$V_O=2.5$; $V_I=0/5\text{V}$
Input leakage current	$\pm I_{IN}$ (μA)	–	0.3	–	0.3	–	1.0	15	$V_I = 0$ or 15 V
3-state output leakage current HIGH	I_{OZH} (μA)	–	1.6	–	1.6	–	12.0	15	output returned to V_{DD}
3-state output leakage current LOW	$-I_{OZL}$ (μA)	–	1.6	–	1.6	–	12.0	15	output returned to V_{SS}
Input capacitance per unit load	C_I (pF)	–	–	–	7.5	–	–	–	digital inputs

LOGIC
HE4000B series
INTEGRATED CIRCUITS
GENERAL PURPOSE
DC family characteristics for HEC at $V_{SS} = 0$ V

parameter	symbol	$T_{amb} = -55^{\circ}\text{C}$		$T_{amb} = +25^{\circ}\text{C}$		$T_{amb} = +125^{\circ}\text{C}$		V_{DD}	conditions
		min.	max.	min.	max.	min.	max.	V	
Quiescent device current for gates	I_{DD} (μA)	–	0.25	–	0.25	–	7.5	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD} ; $I_O = 0$
		–	0.5	–	0.5	–	15.0	10	
		–	1.0	–	1.0	–	30.0	15	
Quiescent device current for buffers and flip-flops	I_{DD} (μA)	–	1.0	–	1.0	–	30	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD} ; $I_O = 0$
		–	2.0	–	2.0	–	60	10	
		–	4.0	–	4.0	–	120	15	
Quiescent device current for MSI	I_{DD} (μA)	–	5.0	–	5.0	–	150	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD} ; $I_O = 0$
		–	10.0	–	10.0	–	300	10	
		–	20.0	–	20.0	–	600	15	
Quiescent device current for LSI	I_{DD} (μA)	–	15.0	–	15.0	–	375	5	all valid input combinations; $V_I = V_{SS}$ or V_{DD} ; $I_O = 0$
		–	25.0	–	25.0	–	750	10	
		–	50.0	–	50.0	–	1500	15	
Output voltage LOW $ I_O < 1 \mu\text{A}$	V_{OL} (V)	–	0.05	–	0.05	–	0.05	5	$V_I = V_{SS}$ or V_{DD}
		–	0.05	–	0.05	–	0.05	10	$V_I = V_{SS}$ or V_{DD}
		–	0.05	–	0.05	–	0.05	15	$V_I = V_{SS}$ or V_{DD}
Output voltage HIGH $ I_O < 1 \mu\text{A}$	V_{OH} (V)	4.95	–	4.95	–	4.95	–	5	$V_I = V_{SS}$ or V_{DD}
		9.95	–	9.95	–	9.95	–	10	$V_I = V_{SS}$ or V_{DD}
		14.95	–	14.95	–	14.95	–	15	$V_I = V_{SS}$ or V_{DD}
Input voltage LOW $ I_O < 1 \mu\text{A}$ (buffered stages only)	V_{IL} (V)	–	1.5	–	1.5	–	1.5	5	$V_O = 0.5$ or 4.5V
		–	3.0	–	3.0	–	3.0	10	$V_O = 1.0$ or 9.0V
		–	4.0	–	4.0	–	4.0	15	$V_O = 1.5$ or 13.5V
Input voltage HIGH $ I_O < 1 \mu\text{A}$ (buffered stages only)	V_{IH} (V)	3.5	–	3.5	–	3.5	–	5	$V_O = 0.5$ or 4.5V
		7.0	–	7.0	–	7.0	–	10	$V_O = 1.0$ or 9.0V
		11.0	–	11.0	–	11.0	–	15	$V_O = 1.5$ or 13.5V
Input voltage LOW $ I_O < 1 \mu\text{A}$ (unbuffered stages only)	V_{IL} (V)	–	1.0	–	1.0	–	1.0	5	$V_O = 0.5$ or 4.5V
		–	2.0	–	2.0	–	2.0	10	$V_O = 1.0$ or 9V
		–	2.5	–	2.5	–	2.5	15	$V_O = 1.5$ or 13.5V
Input voltage HIGH $ I_O < 1 \mu\text{A}$ (unbuffered stages only)	V_{IH} (V)	4.0	–	4.0	–	4.0	–	5	$V_O = 0.5$ or 4.5V
		8.0	–	8.0	–	8.0	–	10	$V_O = 1.0$ or 9.0V
		12.5	–	12.5	–	12.5	–	15	$V_O = 1.5$ or 13.5V
Output (sink) current LOW	I_{OL} (mA)	0.64	–	0.5	–	0.36	–	5	$V_O=0.4$; $V_I=0/5\text{V}$
		1.6	–	1.3	–	0.9	–	10	$V_O=0.5$; $V_I=0/10\text{V}$
		4.2	–	3.4	–	2.4	–	15	$V_O=1.5$; $V_I=0/15\text{V}$
Output (source) current HIGH	$-I_{OH}$ (mA)	0.64	–	0.5	–	0.36	–	5	$V_O=4.6$; $V_I=0/5\text{V}$
		1.6	–	1.3	–	0.9	–	10	$V_O=9.5$; $V_I=0/10\text{V}$
		4.2	–	3.4	–	2.4	–	15	$V_O=13.5$; $V_I=0/15\text{V}$
Output (source) current (HIGH)	$-I_{OH}$ (mA)	1.7	–	1.4	–	1.1	–	5	$V_O=2.5$; $V_I=0/5\text{V}$
Input leakage current	$\pm I_{IN}$ (μA)	–	0.3	–	0.3	–	1.0	15	$V_I = 0$ or 15 V
3-state output leakage current HIGH	I_{OZH} (μA)	–	1.6	–	1.6	–	12.0	15	output returned to V_{DD}
3-state output leakage current LOW	$-I_{OZL}$ (μA)	–	1.6	–	1.6	–	12.0	15	output returned to V_{SS}
Input capacitance per unit load	C_I (pF)	–	–	–	7.5	–	–	–	digital inputs

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LOGIC
HE4000B series

HE4000B SERIES		HEF	HEC
ARITHMETIC FUNCTIONS			
4008B	4-bit binary full adder		
4531B	13-input parity checker/generator		
BUFFERS			
4007UB	dual complementary pair and inverter		
4041B	quadruple true/complement buffer		
4049B	hex inverting buffers		
4050B	hex non-inverting buffers		
4502B	strobed hex inverter/buffer		
40097B	3-state hex non-inverting buffer		
40098B	3-state hex inverting buffer		
40240B	octuple buffers with 3-state outputs		
40244B	octal buffers with 3-state outputs		
COMPARATORS			
4585B	4-bit magnitude comparator		
COUNTERS			
4017B	5-stage Johnson counter		
4018B	presettable divide-by-n counter		
4020B	14-stage binary counter		
4022B	4-stage divide-by-8 Johnson counter		
4024B	7-stage binary counter		
4029B	synchronous up/down counter, binary/decade counter		
4040B	12-stage binary counter		
4059B	programmable divide-by-n counter		
4060B	14-stage ripple-carry binary counter/divider and oscillator		
4510B	BCD up/down counter		
4516B	binary up/down counter		
4518B	dual BCD counter		
4520B	dual binary counter		
4521B	24-stage frequency divider		
4522B	programmable 4-bit BCD down counter		
4526B	programmable 4-bit binary down counter		
4534B	real time 5-decade counter		
4737B	quadruple static decade counter		
4737V	quadruple static decade counter		
4751V	universal divider		
40160B	4-bit synchronous decade counter; asynchronous reset		
40161B	4-bit synchronous binary counter; asynchronous reset		
40162B	4-bit synchronous decade counter; synchronous reset		
40163B	4-bit synchronous binary counter; synchronous reset		
40192B	4-bit up/down decade counter		
40193B	4-bit up/down binary counter		
DECODERS/DEMULPLEXERS			
4028B	1-of-10 decoder		
4511B	BCD to 7-segment latch/decoder/driver		
4514B	1-of-16 decoder/demultiplexer with input latches		
4515B	1-of-16 decoder/demultiplexer with input latches		
4543B	BCD to 7-segment latch/decoder/driver		
4555B	dual 1-of-4 decoder/demultiplexer		
4556B	dual 1-of-4 decoder/demultiplexer		

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HE4000B series

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HE4000B SERIES		HEF	HEC
DRIVERS			
4511B	BCD to 7-segment latch/decoder/driver		
4543B	BCD to 7-segment latch/decoder/driver		
ENCODERS			
4532B	8-input priority encoder		
D-type FLIP-FLOPS			
4013B	dual D-type flip-flop		
40174B	hex D-type flip-flop		
40175B	quadruple D-type flip-flop		
40374B	octal D-type flip-flop with 3-state outputs		
JK FLIP-FLOPS			
4027B	dual JK flip-flop		
AND GATES			
4073B	triple 3-input AND gate		
4081B	quadruple 2-input AND gate		
4082B	dual 4-input AND gate		
Complex GATES			
4085B	dual 2-wide 2-input AND-OR-invert gate		
4086B	4-wide 2-input AND-OR-invert gate		
EXCLUSIVE-OR GATES			
4030B	quadruple EXCLUSIVE-OR gate		
4070B	quadruple EXCLUSIVE-OR gate		
EXCLUSIVE-NOR GATES			
4077B	quadruple EXCLUSIVE-NOR gate		
NAND GATES			
4011B	quadruple 2-input NAND gate		
4011UB	quadruple 2-input NAND gate; unbuffered		
4012B	dual 4-input NAND gate		
4023B	triple 3-input NAND gate		
4068B	8-input NAND gate		
NOR GATES			
4000B	dual 3-input NOR gate and inverter		
4001B	quadruple 2-input NOR gate		
4001UB	quadruple 2-input NOR gate; unbuffered		
4002B	dual 4-input NOR gate		
4025B	triple 3-input NOR gate		
4078B	8-input NOR gate		
OR GATES			
4071B	quadruple 2-input OR gate		
4072B	dual 4-input OR gate		
4075B	triple 3-input OR gate		
INVERTERS			
4007UB	dual complementary pair and inverter		
4069UB	hex inverter		
7069UB	hex inverter; open drain		

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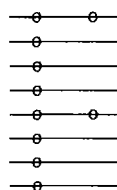
HE4000B series

HE4000B SERIES

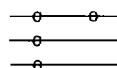
HEF HEC

LATCHES

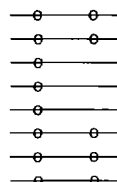
4042B	quadruple D-latch
4043B	quadruple R/S latch with 3-state outputs
4044B	quadruple R/S latch with 3-state outputs
4508B	dual 4-bit latch
4511B	BCD to 7-segment latch/decoder/driver
4543B	BCD to 7-segment latch/decoder/driver
4724B	8-bit addressable latch
40373B	octal transparent latch with 3-state output

**MEMORIES**

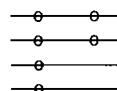
4505B	64-bit, 1-bit per word static read/write RAM
4720B	256-bit, 1-bit per word RAM
4720V	256-bit, 1-bit per word RAM

**MULTIPLEXERS/DEMULTIPLEXERS**

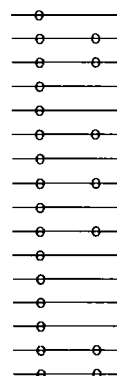
4019B	quadruple 2-input multiplexer
4051B	8-channel analog multiplexer/demultiplexer
4052B	dual 4-channel analog multiplexer/demultiplexer
4053B	triple 2-channel analog multiplexer/demultiplexer
4067B	16-channel analog multiplexer/demultiplexer
4512B	8-input multiplexer with 3-state output
4519B	quadruple 2-input multiplexer
4539B	dual 4-input multiplexer

**MULTIVIBRATORS**

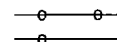
4047B	monostable/astable multivibrator
4528B	dual monostable multivibrator
4538B	dual precision monostable multivibrator
4938B	dual precision monostable multivibrator

**REGISTERS**

4006B	18-stage static shift register
4014B	8-bit static shift register
4015B	dual 4-bit static shift register
4021B	8-bit static shift register
4031B	64-stage static shift register
4035B	4-bit universal shift register
4076B	quadruple D-type register with 3-state outputs
4094B	8-stage shift-and-store bus register
4517B	dual 64-bit static shift register
4557B	1-to-64 bit variable length shift register
4731B	quadruple 64-bit static shift register
4731V	quadruple 64-bit static shift register
4794B	8-stage shift-and-store register LED driver
4894B	8-stage shift-and-store register LED driver
40194B	4-bit bidirectional universal shift register
40195B	4-bit universal shift register

**SCHMITT TRIGGERS**

4093B	quadruple 2-input NAND Schmitt trigger
40106B	hex inverting Schmitt trigger



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HE4000B SERIES		HEF	HEC
SPECIAL FUNCTIONS			
4046B	phase-locked loop		
4104B	quadruple low-to-high voltage translator with 3-state outputs		
4527B	BCD rate multiplier		
4738V	IEC/IEEE bus interface		
4750V	frequency synthesizer		
4752V	AC motor control circuit		
4754V	18-element bar graph LCD driver		
4755V	transceiver for serial data communication		
SWITCHES			
4016B	quadruple bilateral switches		
4066B	quadruple bilateral switches		
TIMING CIRCUITS			
4541B	programmable timer		
4753B	universal timer module		
4753V	universal timer module		
TRANSCIVERS			
40245B	octuple bus transceiver with 3-state outputs		