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
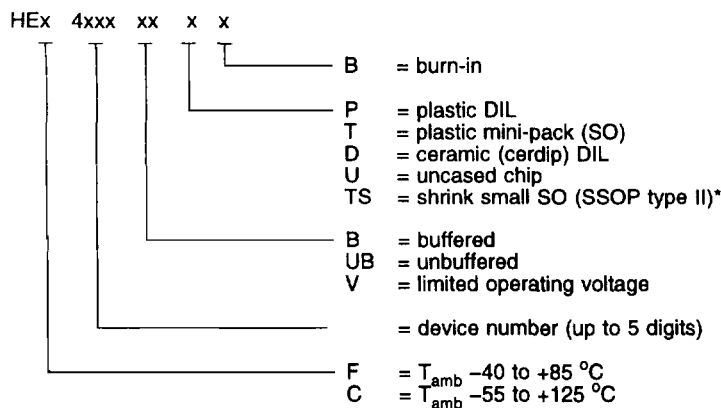
Recommended supply voltage range 3 to 15 V.

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.

HEx4xxxxxxx   complete type number which can be split as follows:

HEx   4xxx   xx   x   x

$$B \quad = \text{burn-in}$$

P	= plastic DIL
T	= plastic mini-pack (SO)
D	= ceramic (cerdip) DIL
U	= uncased chip
TS	= shrink small SO (SSOP type II)*

B	= buffered
UB	= unbuffered
V	= limited operating voltage

= device number (up to 5 digits)

F	$= T_{amb}$ −40 to +85 °C
C	$= T_{amb}$ −55 to +125 °C

* For selected types only

LOGIC
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INTEGRATED CIRCUITS
GENERAL PURPOSE

HE4000B FAMILY SPECIFICATIONS (cont.)

The HE family is designed with standardized output drive characteristics which, combined with relative intensitivity 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 ±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

Storage temperature range T_{stg} −65 to +150 °C

Operating ambient temperature range
HEF T_{amb} −40 to +85 °C
HEC T_{amb} −55 to +125 °C

INTEGRATED CIRCUITS
GENERAL PURPOSE

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

parameter	symbol	T_{amb} = −40 °C min.	max.	T_{amb} = +25 °C min.	max.	T_{amb} = +85 °C min.	max.	V_{DD} V	conditions
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 $|I_O| < 1$ µA	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 $|I_O| < 1$ µA	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 $|I_O| < 1$ µA (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 $|I_O| < 1$ µA (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 $|I_O| < 1$ µA (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 $|I_O| < 1$ µA (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)	0.52	–	0.44	–	0.36	–	5	V_O=0.4; V_I=0/5V
		1.3	–	1.1	–	0.9	–	10	V_O=0.5; V_I=0/10V
		3.6	–	3.0	–	2.4	–	15	V_O=1.5; V_I=0/15V
Output (source) current HIGH	$-I_{OH}$ (mA)	0.52	–	0.44	–	0.36	–	5	V_O=4.6; V_I=0/5V
		1.3	–	1.1	–	0.9	–	10	V_O=9.5; V_I=0/10V
		3.6	–	3.0	–	2.4	–	15	V_O=13.5; V_I=0/15V
Output (source) current (HIGH)	$-I_{OH}$ (mA)	1.7	–	1.4	–	1.1	–	5	V_O=2.5; V_I=0/5V
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

INTEGRATED CIRCUITS
GENERAL PURPOSE

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

parameter	symbol	T_{amb} = –55 °C		T_{amb} = +25 °C		T_{amb} = +125 °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 $|I_O| < 1$ µA	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 $|I_O| < 1$ µA	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 $|I_O| < 1$ µA (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 $|I_O| < 1$ µA (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 $|I_O| < 1$ µA (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 $|I_O| < 1$ µA (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	$V_O=0.4$; $V_I=0/5V$
		1.6	–	1.3	–	0.9	--	10	$V_O=0.5$; $V_I=0/10V$
		4.2	–	3.4	–	2.4	–	15	$V_O=1.5$; $V_I=0/15V$
Output (source) current HIGH	$-I_{OH}$ (mA)	0.64	–	0.5	–	0.36	–	5	$V_O=4.6$; $V_I=0/5V$
		1.6	–	1.3	–	0.9	–	10	$V_O=9.5$; $V_I=0/10V$
		4.2	–	3.4	–	2.4	–	15	$V_O=13.5$; $V_I=0/15V$
Output (source) current (HIGH)	$-I_{OH}$ (mA)	1.7	–	1.4	–	1.1	–	5	$V_O=2.5$; $V_I=0/5V$
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

INTEGRATED CIRCUITS
GENERAL PURPOSE

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HE4000B SERIES		HEF HEC

ARITHMETIC FUNCTIONS

4008B	4-bit binary full adder	—o—
4531B	13-input parity checker/generator	—o—

BUFFERS

4007UB	dual complementary pair and inverter	—o— —o—
4041B	quadruple true/complement buffer	—o—
4049B	hex inverting buffers	—o— —o—
4050B	hex non-inverting buffers	—o— —o—
4502B	strobed hex inverter/buffer	—o—
40097B	3-state hex non-inverting buffer	—o— —o—
40098B	3-state hex inverting buffer	—o— —o—
40240B	octuple buffers with 3-state outputs	—o—
40244B	octal buffers with 3-state outputs	—o—

COMPARATORS

4585B	4-bit magnitude comparator	—o— —o—

COUNTERS

4017B	5-stage Johnson counter	—o— —o—
4018B	presettable divide-by-n counter	—o—
4020B	14-stage binary counter	—o— —o—
4022B	4-stage divide-by-8 Johnson counter	—o—
4024B	7-stage binary counter	—o— —o—
4029B	synchronous up/down counter, binary/decade counter	—o—
4040B	12-stage binary counter	—o— —o—
4059B	programmable divide-by-n counter	—o—
4060B	14-stage ripple-carry binary counter/divider and oscillator	—o—
4510B	BCD up/down counter	—o— —o—
4516B	binary up/down counter	—o—
4518B	dual BCD counter	—o—
4520B	dual binary counter	—o— —o—
4521B	24-stage frequency divider	—o—
4522B	programmable 4-bit BCD down counter	—o—
4526B	programmable 4-bit binary down counter	—o—
4534B	real time 5-decade counter	—o—
4737B	quadruple static decade counter	—o—
4737V	quadruple static decade counter	—o—
4751V	universal divider	—o— —o—
40160B	4-bit synchronous decade counter; asynchronous reset	—o—
40161B	4-bit synchronous binary counter; asynchronous reset	—o—
40162B	4-bit synchronous decade counter; synchronous reset	—o—
40163B	4-bit synchronous binary counter; synchronous reset	—o—
40192B	4-bit up/down decade counter	—o—
40193B	4-bit up/down binary counter	—o—

DECODERS/DEMULTIPLEXERS

4028B	1-of-10 decoder	—o—
4511B	BCD to 7-segment latch/decoder/driver	—o— —o—
4514B	1-of-16 decoder/demultiplexer with input latches	—o—
4515B	1-of-16 decoder/demultiplexer with input latches	—o—
4543B	BCD to 7-segment latch/decoder/driver	—o—
4555B	dual 1-of-4 decoder/demultiplexer	—o—
4556B	dual 1-of-4 decoder/demultiplexer	—o— —o—

LOGIC
HE4000B series

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INTEGRATED CIRCUITS
GENERAL PURPOSE

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HE4000B SERIES		HEF HEC

DRIVERS

| 4511B | BCD to 7-segment latch/decoder/driver | —o——o— |
| 4543B | BCD to 7-segment latch/decoder/driver | —o——— |

ENCODERS

| 4532B | 8-input priority encoder | —o——— |

D-type FLIP-FLOPS

4013B	dual D-type flip-flop	—o——o—
40174B	hex D-type flip-flop	—o——o—
40175B	quadruple D-type flip-flop	—o——o—
40374B	octal D-type flip-flop with 3-state outputs	—o———

JK FLIP-FLOPS

| 4027B | dual JK flip-flop | —o——o— |

AND GATES

4073B	triple 3-input AND gate	—o——o—
4081B	quadruple 2-input AND gate	—o——o—
4082B	dual 4-input AND gate	—o———

Complex GATES

| 4085B | dual 2-wide 2-input AND-OR-invert gate | —o——— |
| 4086B | 4-wide 2-input AND-OR-invert gate | —o——— |

EXCLUSIVE-OR GATES

| 4030B | quadruple EXCLUSIVE-OR gate | —o——o— |
| 4070B | quadruple EXCLUSIVE-OR gate | —o——o— |

EXCLUSIVE-NOR GATES

| 4077B | quadruple EXCLUSIVE-NOR gate | —o——— |

NAND GATES

4011B	quadruple 2-input NAND gate	—o——o—
4011UB	quadruple 2-input NAND gate; unbuffered	—o———
4012B	dual 4-input NAND gate	—o——o—
4023B	triple 3-input NAND gate	—o——o—
4068B	8-input NAND gate	—o——o—

NOR GATES

4000B	dual 3-input NOR gate and inverter	—o———
4001B	quadruple 2-input NOR gate	—o——o—
4001UB	quadruple 2-input NOR gate; unbuffered	—o———
4002B	dual 4-input NOR gate	—o——o—
4025B	triple 3-input NOR gate	—o——o—
4078B	8-input NOR gate	—o———

OR GATES

4071B	quadruple 2-input OR gate	—o——o—
4072B	dual 4-input OR gate	—o———
4075B	triple 3-input OR gate	—o———

INVERTERS

4007UB	dual complementary pair and inverter	—o——o—
4069UB	hex inverter	—o——o—
7069UB	hex inverter; open drain	—o———

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HE4000B SERIES		HEF HEC

LATCHES

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

MEMORIES

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

MULTIPLEXERS/DEMULTIPLEXERS

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

MULTIVIBRATORS

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

REGISTERS

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

SCHMITT TRIGGERS

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

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INTEGRATED CIRCUITS
GENERAL PURPOSE

HE4000B SERIES		HEF	HEC

SPECIAL FUNCTIONS

4046B	phase-locked loop	—o—	
4104B	quadruple low-to-high voltage translator with 3-state outputs	—o—	
4527B	BCD rate multiplier	—o—	
4738V	IEC/IEEE bus interface	—o—	
4750V	frequency synthesizer	—o—	—o—
4752V	AC motor control circuit	—o—	
4754V	18-element bar graph LCD driver	—o—	
4755V	transceiver for serial data communication	—o—	

SWITCHES

4016B	quadruple bilateral switches	—o—	—o—
4066B	quadruple bilateral switches	—o—	—o—

TIMING CIRCUITS

4541B	programmable timer	—o—	—o—
4753B	universal timer module	—o—	
4753V	universal timer module	—o—	

TRANSCEIVERS

40245B	octuple bus transceiver with 3-state outputs	—o—	