NOR GATES: DUAL 3 INPUT PLUS INVERTER HBC/HBF 4000A
QUAD 2 INPUT HBC/HBF 4001A
DUAL 4 INPUT HBC/HBF 4002A
TRIPLE 3 INPUT HBC/HBF 4025A

- QUIESCENT CURRENT SPECIFIED TO 15V (see page 10)
- MAX. INPUT LEAKAGE CURRENT 1 μA @ 15V (FULL TEMP. RANGE)
- HIGH NOISE IMMUNITY: 45% of V_{DD} (TYP.)
- MEDIUM SPEED OPERATION: $t_{PHL} = t_{PLH}$ = 25 ns (TYP.) at C_L = 15 pF
- INPUTS FULLY PROTECTED
- LOW "1" and "0" OUTPUT LEVEL IMPEDANCE: 500Ω and 200Ω (TYP.), RESPECTIVELY at $V_{DD} - V_{SS}$ = 10V
- HIGH FANOUT: > 50

The **HBC 4000A, HBC 4001A, HBC 4002A, HBC 4025A** (extended temperature range) and **HBF 4000A, HBF 4001A, HBF 4002A, HBF 4025A** (standard temperature range) NOR gates are constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic chip. These complementary MOS logic gates find primary use where low power dissipation and/or high noise immunity is desired.
They are available in 14-lead dual in-line plastic or ceramic package and ceramic flat package.

ABSOLUTE MAXIMUM RATINGS

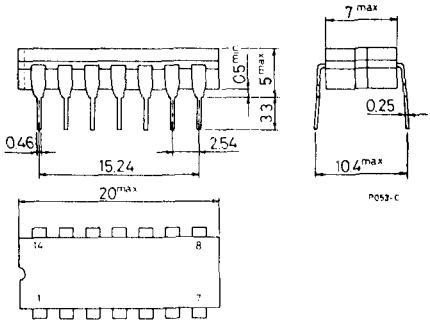
V_{DD}-V_{SS}	Supply voltage	-0.5 to 15 V
V_i	Input voltage (at any pin)	$V_{SS} \leqslant V_i \leqslant V_{DD}$
P_{tot}	Total power dissipation (per package)	200 mW
T_{stg}	Storage temperature	-65 to 150 °C
T_{op}	Operating temperature: for **HBC** types	-55 to 125 °C
	for **HBF** types	-40 to 85 °C

ORDERING NUMBERS:

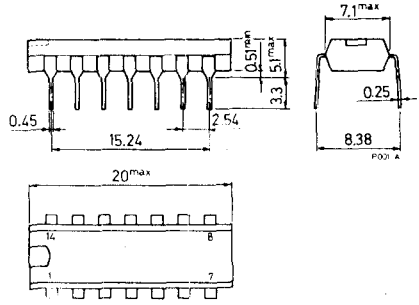
HBC 4 XXX AD for dual in-line ceramic package
HBC 4 XXX AF for dual in-line ceramic package frit seal (extended temperature range)
HBC 4 XXX AK for ceramic flat package
HBF 4 XXX AE for dual in-line plastic package
HBF 4 XXX AF for dual in-line ceramic package frit seal (standard temperature range)

MECHANICAL DATA (dimensions in mm)

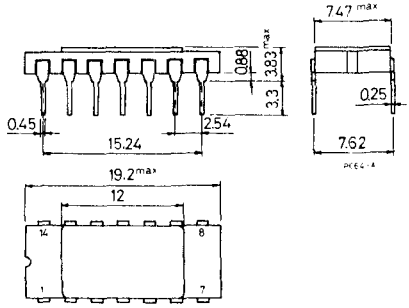
Dual in-line ceramic package
for HBC/HBF 4XXX AF



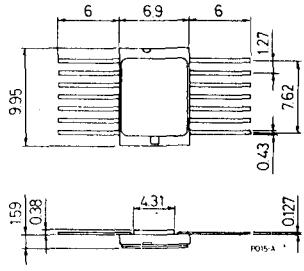
Dual in-line plastic package
for HBF 4XXX AE



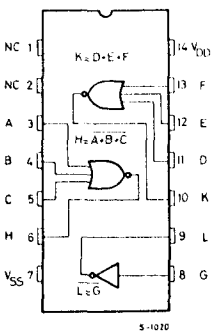
Dual in-line ceramic package
for HBC 4XXX AD



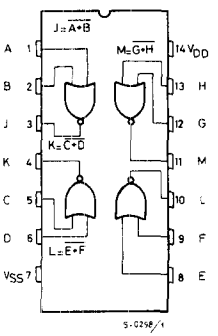
Ceramic flat package
for HBC 4XXX AK



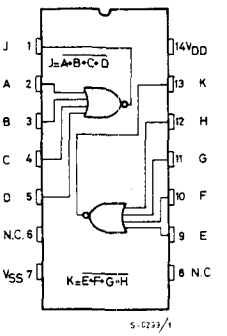
CONNECTION DIAGRAMS (top view)



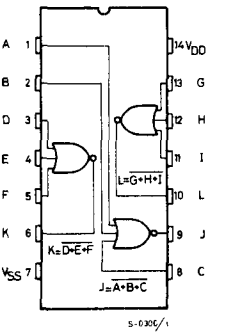
For **4000A**



For **4001A**



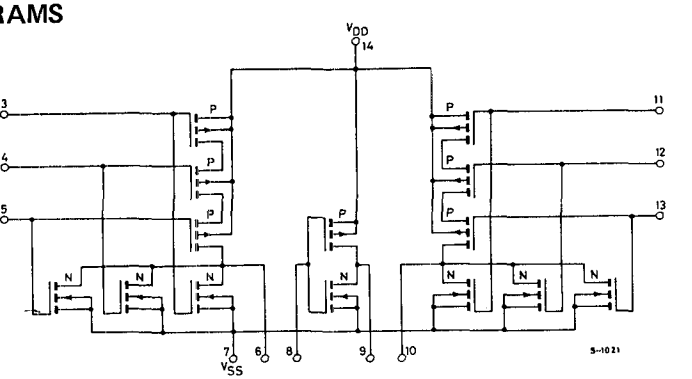
For **4002A**



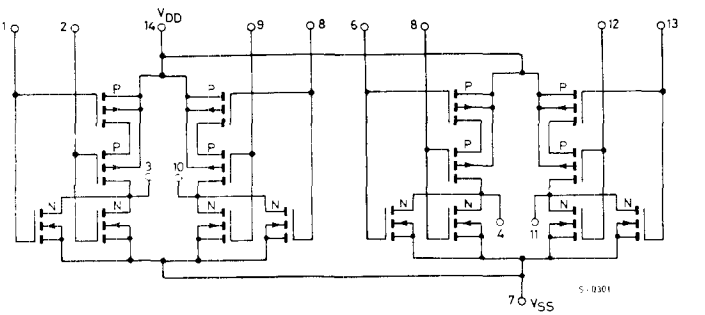
For **4025A**

SCHEMATIC DIAGRAMS

For **4000A**

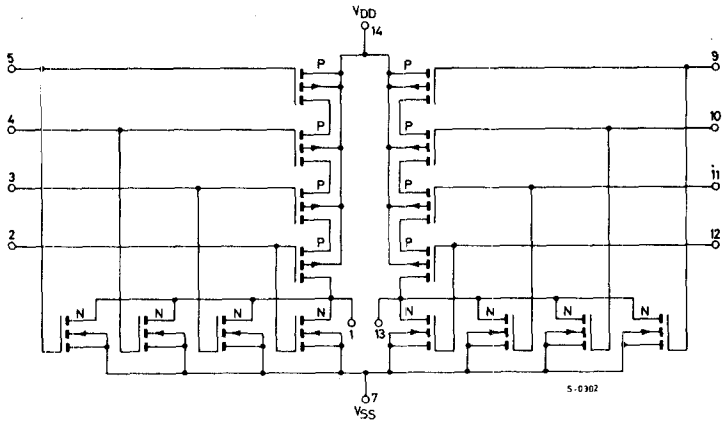


For **4001A**

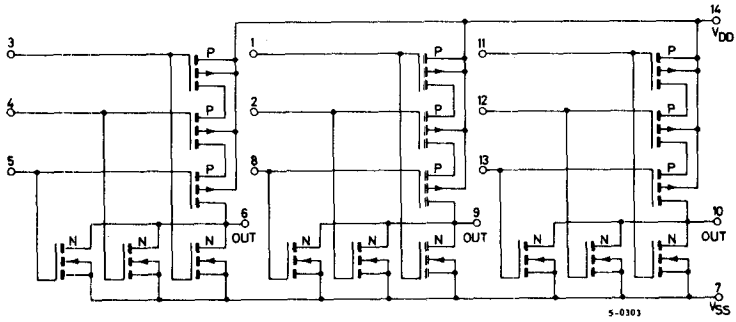


SCHEMATIC DIAGRAMS (continued)

For **4002A**



For **4025A**



RECOMMENDED OPERATING CONDITIONS

V_{DD} *	Supply voltage	3 to 15	V
V_i *	Input voltage	V_{DD} to V_{SS}	
T_{op}	Operating ternperature for **HBC** types	-55 to 125	°C
	for **HBF** types	-40 to 85	°C

* This is measured with respect to the V_{SS} pin voltage

STATIC ELECTRICAL CHARACTERISTICS

Parameter		Test conditions	Min.	Typ.	Max.	Unit
HBC types (extended temperature range)						
I_L	Quiescent current (for values at 15V see page 10)	V_{DD} = 5V				
		at T_{amb}=-55°C			0.05	μA
		at T_{amb}= 25°C		0.001	0.05	μA
		at T_{amb}=125°C			3	μA
		V_{DD} = 10V				
		at T_{amb}=-55°C			0.1	μA
		at T_{amb}= 25°C		0.001	0.1	μA
		at T_{amb}=125°C			6	μA
V_{OH}	Output high voltage	I_o = 0				
		V_{DD} = 5V				
		at T_{amb}=-55°C	4.99			V
		at T_{amb}= 25°C	4.99	5		V
		at T_{amb}=125°C	4.95			V
		V_{DD} = 10V				
		at T_{amb}=-55°C	9.99			V
		at T_{amb}= 25°C	9.99	10		V
		at T_{amb}=125°C	9.95			V
V_{OL}	Output low voltage	I_o = 0				
		V_{DD} = 5V or 10V				
		at T_{amb}=-55°C			0.01	V
		at T_{amb}= 25°C		0	0.01	V
		at T_{amb}=125°C			0.05	V
V_{NH}	Noise immunity	V_{DD} = 5V V_o = 0.95V				
		at T_{amb}=-55°C	1.4			V
		at T_{amb}= 25°C	1.5	2.25		V
		at T_{amb}=125°C	1.5			V
		V_{DD} = 10V V_o = 2.9V				
		at T_{amb}=-55°C	2.9			V
		at T_{amb}= 25°C	3	4.5		V
		at T_{amb}=125°C	3			V
V_{NL}	Noise immunity	V_{DD} = 5V V_o = 3.6V				
		at T_{amb}=-55°C	1.5			V
		at T_{amb}= 25°C	1.5	2.25		V
		at T_{amb}=125°C	1.4			V

STATIC ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
V_{NL}	Noise immunity	V_{DD} = 10V V_o = 7.2V				
		at T_{amb}=-55°C	3			V
		at T_{amb}= 25°C	3	4.5		V
		at T_{amb}=125°C	2.9			V
I_DN	Output drive current N-channel	V_{DD} = 5V V_o = 0.4V				
		at T_{amb}=-55°C	0.5			mA
		at T_{amb}= 25°C	0.4	1		mA
		at T_{amb}=125°C	0.28			mA
		V_{DD} = 10V V_o = 0.5V				
		at T_{amb}=-55°C	1.1			mA
		at T_{amb}= 25°C	0.9	2.5		mA
		at T_{amb}=125°C	0.65			mA
I_DP	Output drive current P-channel	V_{DD} = 5V V_o = 2.5V				
		at T_{amb}=-55°C	-0.62			mA
		at T_{amb}= 25°C	-0.5	-2		mA
		at T_{amb}=125°C	-0.35			mA
		V_{DD} = 10V V_o = 9.5V				
		at T_{amb}=-55°C	-0.62			mA
		at T_{amb}= 25°C	-0.5	-1		mA
		at T_{amb}=125°C	-0.35			mA
I_{IH}, I_{IL}	Input leakage current	V_{DD}= 15V (any input)		$\pm10^{-5}$	±1	µA

HBF types (standard temperature range)

I_L	Quiescent current (for values at 15V see page 10)	V_{DD} = 5V				
		at T_{amb}=-40°C			0.5	µA
		at T_{amb}= 25°C		0.005	0.5	µA
		at T_{amb}= 85°C			15	µA
		V_{DD} = 10V				
		at T_{amb}=-40°C			5	µA
		at T_{amb}= 25°C		0.005	5	µA
		at T_{amb}= 85°C			30	µA
V_{OH}	Output high voltage	I_o = O V_{DD} = 5V				
		at T_{amb}=-40°C	4.99			V
		at T_{amb}= 25°C	4.99	5		V
		at T_{amb}= 85°C	4.95			V

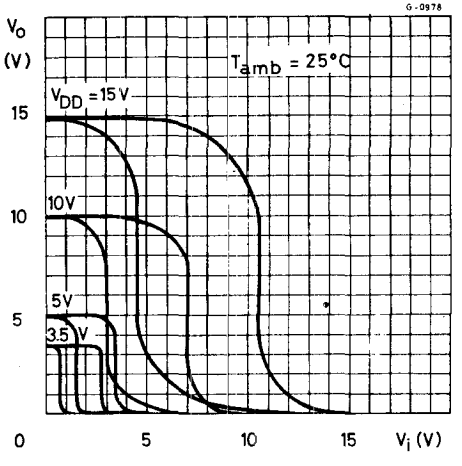
STATIC ELECTRICAL CHARACTERISTICS (continued)

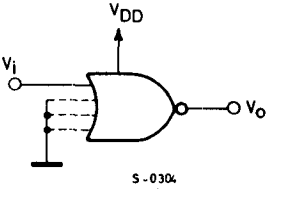
Parameter		Test conditions	Min.	Typ.	Max.	Unit
V_{OH}	Output high voltage	$I_o = 0$ $V_{DD} = 10V$				
		at T_{amb}=-40°C	9.99			V
		at T_{amb}= 25°C	9.99	10		V
		at T_{amb}= 85°C	9.95			V
V_{OL}	Output low voltage	$I_o = 0$ V_{DD} = 5V or 10V				
		at T_{amb}=-40°C			0.01	V
		at T_{amb}= 25°C		0	0.01	V
		at T_{amb}= 85°C			0.05	V
V_{NH}	Noise immunity	V_{DD} = 5V V_o = 0.95V				
		at T_{amb}=-40°C	1.4			V
		at T_{amb}= 25°C	1.5	2.25		V
		at T_{amb}= 85°C	1.5			V
		V_{DD} = 10V V_o = 2.9V				
		at T_{amb}=-40°C	2.9			V
		at T_{amb}= 25°C	3	4.5		V
		at T_{amb}= 85°C	3			V
V_{NL}	Noise immunity	V_{DD} = 5V V_o = 3.6V				
		at T_{amb}=-40°C	1.5			V
		at T_{amb}= 25°C	1.5	2.25		V
		at T_{amb}= 85°C	1.4			V
		V_{DD} = 10V V_o = 7.2V				
		at T_{amb}=-40°C	3			V
		at T_{amb}= 25°C	3	4.5		V
		at T_{amb}= 85°C	2.9			V
I_DN	Output drive current N-channel	V_{DD} = 5V V_o = 0.4V				
		at T_{amb}=-40°C	0.35			mA
		at T_{amb}= 25°C	0.3	1		mA
		at T_{amb}= 85°C	0.24			mA
		V_{DD} = 10V V_o = 0.5V				
		at T_{amb}=-40°C	0.72			mA
		at T_{amb}= 25°C	0.6	2.5		mA
		at T_{amb}= 85°C	0.48			mA

STATIC ELECTRICAL CHARACTERISTICS (continued)

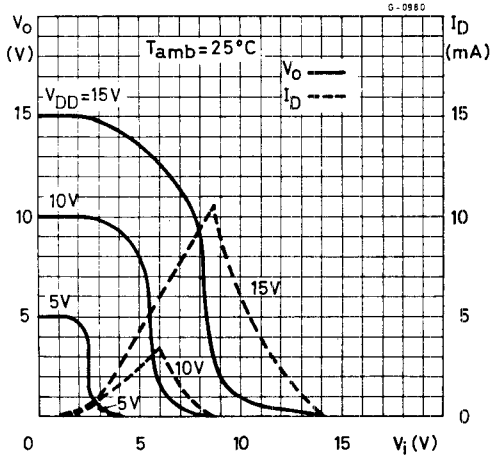
Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_DP Output drive current P-channel	V_{DD} = 5V V_o = 2.5V				
	at T_{amb}=-40°C		-0.35		mA
	at T_{amb}= 25°C		-0.3	-2	mA
	at T_{amb}= 85°C		-0.24		mA
	V_{DD} = 10V V_o = 9.5V				
	at T_{amb}=-40°C		-0.3		mA
	at T_{amb}= 25°C		-0.25	-1	mA
	at T_{amb}= 85°C		-0.2		mA
I_{IH}, I_{IL} Input leakage current	V_{DD}= 15V (any input)		$\pm 10^{-5}$	±1	μA

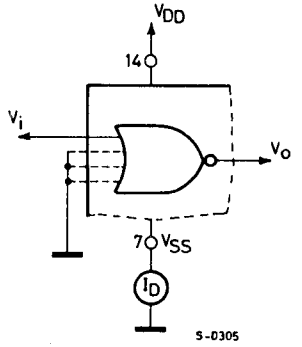
Minimum and maximum voltage transfer characteristic curves and test circuit



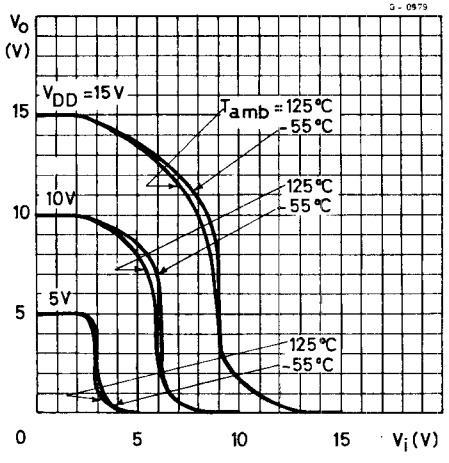


Typical current and voltage transfer characteristic curves and test circuit

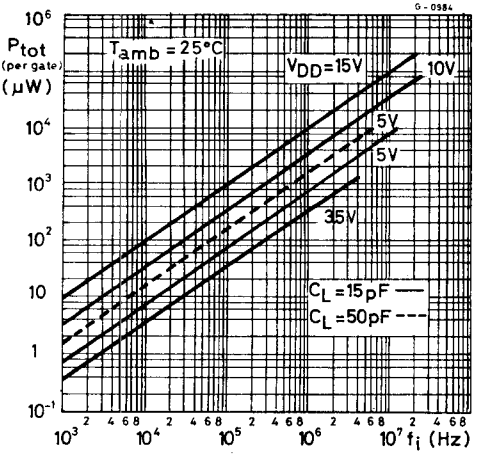




Typical voltage transfer characteristics vs. ambient temperature



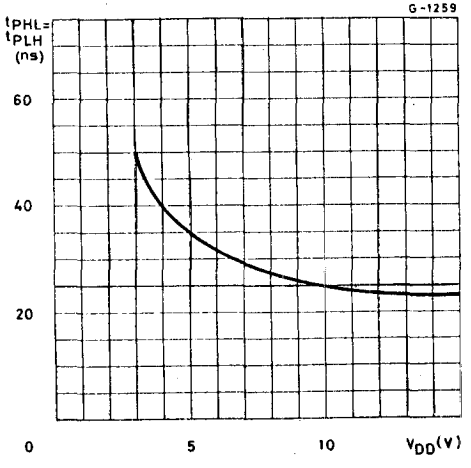
Typical power dissipation characteristics



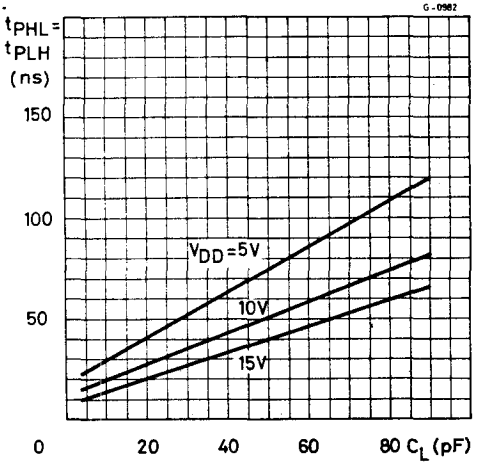
DYNAMIC ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, C_L = 15 pF, typical temperature coefficient for all V_{DD} = 0.3 %/°C values)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
t_{PLH}	Propagation delay time (low to high level)	V_{DD} = 5V				
		for **HBC** types		35	95	ns
		for **HBF** types		35	120	ns
		V_{DD} = 10V				
		for **HBC** types		25	45	ns
		for **HBF** types		25	65	ns
t_{PHL}	Propagation delay time (high to low level)	V_{DD} = 5V				
		for **HBC** types		35	50	ns
		for **HBF** types		35	80	ns
		V_{DD} = 10V				
		for **HBC** types		25	40	ns
		for **HBF** types		25	55	ns
t_{TLH}	Transition time (low to high level)	V_{DD} = 5V				
		for **HBC** types		65	175	ns
		for **HBF** types		65	300	ns
		V_{DD} = 10V				
		for **HBC** types		35	75	ns
		for **HBF** types		35	125	ns
t_{THL}	Transition time (high to low level)	V_{DD} = 5V				
		for **HBC** types		65	125	ns
		for **HBF** types		65	200	ns
		V_{DD} = 10V				
		for **HBC** types		35	70	ns
		for **HBF** types		35	115	ns
C_i	Input capacitance	Any input for **HBC** and **HBF** types		5		pF

Typical propagation delay time vs. V_{DD}



Typical propagation delay time vs. C_L



Typical transition time vs. C_L