74AHC04; 74AHCT04

hex inverter

Rev. 6 — 7 November 2011

Product data sheet

1. General description

The 74AHC04; 74AHCT04 is a high-speed Si-gate CMOS device and is pin compatible with Low-power Schottky TTL (LSTTL). It is specified in compliance with JEDEC standard No. 7-A.

The 74AHC04; 74AHCT04 provides six inverting buffers.

2. Features and benefits

- Balanced propagation delays
- Inputs accept voltages higher than V_{CC}
- Input levels:
 - ◆ For 74AHC04: CMOS level
 - ◆ For 74AHCT04: TTL level
- ESD protection:
 - ◆ HBM EIA/JESD22-A114F exceeds 2000 V
 - MM EIA/JESD22-A115-A exceeds 200 V
 - CDM EIA/JESD22-C101C exceeds 1000 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

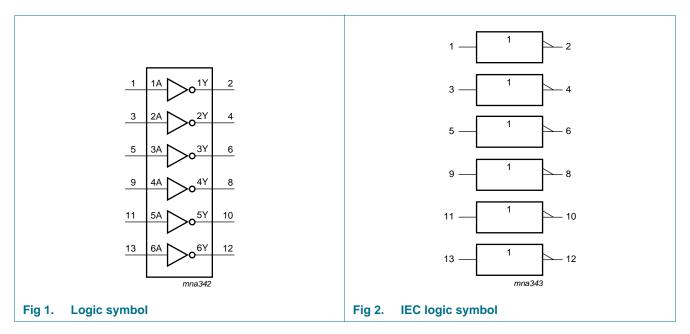
Type number	Package								
	Temperature range	Name	Description	Version					
74AHC04									
74AHC04D	–40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1					
74AHC04PW	–40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1					
74AHC04BQ	–40 °C to +125 °C	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body $2.5 \times 3 \times 0.85$ mm	SOT762-1					

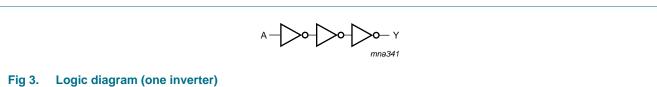


 Table 1.
 Ordering information ...continued

Type number	number Package								
	Temperature range	Name	Description	Version					
74AHCT04									
74AHCT04D	–40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1					
74AHCT04PW	–40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1					
74AHCT04BQ	–40 °C to +125 °C	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body $2.5 \times 3 \times 0.85$ mm	SOT762-1					

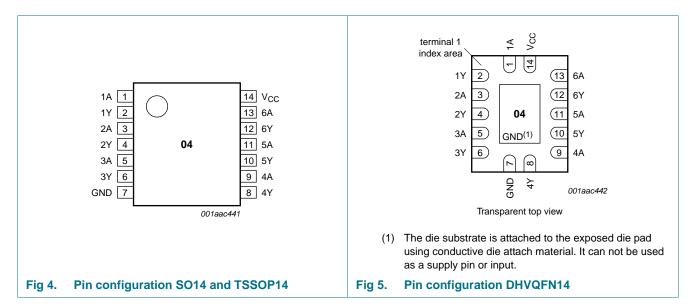
4. Functional diagram





5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1A, 2A, 3A, 4A, 5A, 6A	1, 3, 5, 9, 11, 13	data input
1Y, 2Y, 3Y, 4Y, 5Y, 6Y	2, 4, 6, 8, 10, 12	data output
GND	7	ground (0 V)
V _{CC}	14	supply voltage

6. Functional description

Table 3. Function table[1]

Input nA	Output nY
L	Н
Н	L

[1] H = HIGH voltage level;

L = LOW voltage level.

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-0.5	+7.0	V
V_{I}	input voltage		-0.5	+7.0	V
I _{IK}	input clamping current	$V_{I} < -0.5 \text{ V}$	<u>[1]</u> –20	-	mA
I _{OK}	output clamping current	V_O < -0.5 V or V_O > V_{CC} + 0.5 V	<u>[1]</u> –20	+20	mA
Io	output current	$V_{O} = -0.5 \text{ V to } (V_{CC} + 0.5 \text{ V})$	-25	+25	mA
I _{CC}	supply current		-	+75	mA
I_{GND}	ground current		-75	-	mA
T _{stg}	storage temperature		-65	+150	°C
P _{tot}	total power dissipation	$T_{amb} = -40 ^{\circ}\text{C}$ to +125 $^{\circ}\text{C}$	[2] _	500	mW

^[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

8. Recommended operating conditions

Table 5. Operating conditions

Cumahal	Davamatav	Canditions	N#:	T	Mass	l linit
Symbol	Parameter	Conditions	Min	Тур	Max	Unit
74AHC0	4					
V_{CC}	supply voltage		2.0	5.0	5.5	V
V_{I}	input voltage		0	-	5.5	V
Vo	output voltage		0	-	V_{CC}	V
T _{amb}	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	-	-	100	ns/V
		$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	-	-	20	ns/V
74AHCT	04					
V _{CC}	supply voltage		4.5	5.0	5.5	V
VI	input voltage		0	-	5.5	V
Vo	output voltage		0	-	V_{CC}	V
T _{amb}	ambient temperature		-40	+25	+125	°C
Δt/ΔV	input transition rise and fall rate	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	-	-	20	ns/V

^[2] For SO14 packages: above 70 °C the value of P_{tot} derates linearly at 8 mW/K.
For TSSOP14 packages: above 60 °C the value of P_{tot} derates linearly at 5.5 mW/K.
For DHVQFN14 packages: above 60 °C the value of P_{tot} derates linearly at 4.5 mW/K.

9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		25 °C		-40 °C 1	to +85 °C	-40 °C to	o +125 °C	Uni
			Min	Тур	Max	Min	Max	Min	Max	
74AHC0	4									
V _{IH}	HIGH-level	V _{CC} = 2.0 V	1.5	-	-	1.5	-	1.5	-	V
	input voltage	V _{CC} = 3.0 V	2.1	-	-	2.1	-	2.1	-	V
		V _{CC} = 5.5 V	3.85	-	-	3.85	-	3.85	-	V
V_{IL}	LOW-level	V _{CC} = 2.0 V	-	-	0.5	-	0.5	-	0.5	V
	input voltage	V _{CC} = 3.0 V	-	-	0.9	-	0.9	-	0.9	V
		V _{CC} = 5.5 V	-	-	1.65	-	1.65	-	1.65	V
V _{OH}	HIGH-level	$V_I = V_{IH}$ or V_{IL}								
	output voltage	$I_O = -50 \mu A$; $V_{CC} = 2.0 V$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_O = -50 \mu A$; $V_{CC} = 3.0 V$	2.9	3.0	-	2.9	-	2.9	-	V
		$I_O = -50 \mu A$; $V_{CC} = 4.5 V$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_O = -4.0 \text{ mA}; V_{CC} = 3.0 \text{ V}$	2.58	-	-	2.48	-	2.40	-	V
		$I_{O} = -8.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.94	-	-	3.80	-	3.70	-	V
V _{OL}	LOW-level	$V_I = V_{IH}$ or V_{IL}								
output voltage	$I_O = 50 \mu A; V_{CC} = 2.0 V$	-	0	0.1	-	0.1	-	0.1	V	
		$I_O = 50 \mu A; V_{CC} = 3.0 V$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 50 \mu A; V_{CC} = 4.5 V$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 4.0 \text{ mA}; V_{CC} = 3.0 \text{ V}$	-	-	0.36	-	0.44	-	0.55	V
		$I_O = 8.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	-	-	0.36	-	0.44	-	0.55	V
ı	input leakage current	$V_I = 5.5 \text{ V or GND};$ $V_{CC} = 0 \text{ V to 5.5 V}$	-	-	0.1	-	1.0	-	2.0	μΑ
CC	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5 \text{ V}$	-	-	2.0	-	20	-	40	μΑ
Cı	input capacitance	$V_I = V_{CC}$ or GND	-	3	10	-	10	-	10	рF
74AHCT	04									
V _{IH}	HIGH-level input voltage	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	2.0	-	-	2.0	-	2.0	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	-	-	8.0	-	0.8	-	8.0	V
√он	HIGH-level	$V_I = V_{IH}$ or V_{IL} ; $V_{CC} = 4.5 \text{ V}$								
	output voltage	$I_{O} = -50 \mu A$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_0 = -8.0 \text{ mA}$	3.94	-	-	3.80	-	3.70	-	V
/ _{OL}	LOW-level	$V_I = V_{IH}$ or V_{IL} ; $V_{CC} = 4.5 \text{ V}$								
	output voltage	Ι _Ο = 50 μΑ	-	0	0.1	-	0.1	-	0.1	٧
		I _O = 8.0 mA	-	-	0.36	-	0.44	-	0.55	٧
lı	input leakage current	V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	μΑ

74AHC_AHCT04

 Table 6.
 Static characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		25 °C		-40 °C to +85 °C		–40 °C to +125 °C		Unit
			Min	Тур	Max	Min	Max	Min	Max	
I _{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5 \text{ V}$	-	-	2.0	-	20	-	40	μΑ
Δl _{CC}	additional supply current	per input pin; $V_I = V_{CC} - 2.1 \text{ V}$; other pins at V_{CC} or GND; $I_O = 0 \text{ A}$; $V_{CC} = 4.5 \text{ V}$ to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
Cı	input capacitance	$V_I = V_{CC}$ or GND	-	3	10	-	10	-	10	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 7.

Symbol	Parameter	Conditions			25 °C		-40 °C te	o +85 °C	-40 °C to +125 °C		Unit
				Min	Typ[1]	Max	Min	Max	Min	Max	
74AHC0	4		ľ				'		'	•	•
t _{pd}	propagation delay	nA to nY; see Figure 6	2]								
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$									
		C _L = 15 pF		-	4.0	8.5	1.0	10.5	1.0	11.0	ns
		C _L = 50 pF		-	6.0	11.4	1.0	13	1.0	14.5	ns
		$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$									
		C _L = 15 pF		-	3.0	5.5	1.0	6.5	1.0	7.0	ns
		C _L = 50 pF		-	4.5	7.5	1.0	8.5	1.0	9.5	ns
C_{PD}	power dissipation capacitance	$f_i = 1 \text{ MHz}; V_I = \text{GND to } V_{CC}$	3]	-	13.5	-	-	-	-	-	pF

 Table 7.
 Dynamic characteristics ...continued

Voltages are referenced to GND (ground = 0 V); for test circuit see <u>Figure 7</u>.

Symbol Parameter		Conditions		25 °C -			-40 °C to +85 °C		–40 °C to +125 °C		Unit
				Min	Typ[1]	Max	Min	Max	Min	Max	
74AHCT	04; V _{CC} = 4.5	V to 5.5 V	·						•	•	
F		nA to nY; see Figure 6	[2]								
	delay	C _L = 15 pF		-	3.0	6.7	1.0	7.5	1.0	8.5	ns
		C _L = 50 pF		-	4.5	7.7	1.0	8.5	1.0	10.0	ns
C _{PD}	power dissipation capacitance	$f_i = 1 \text{ MHz}; V_I = \text{GND to } V_{CC}$	[3]	-	13.9	-	-	-	-	-	pF

- [1] Typical values are measured at nominal supply voltage ($V_{CC} = 3.3 \text{ V}$ and $V_{CC} = 5.0 \text{ V}$).
- [2] t_{pd} is the same as t_{PLH} and t_{PHL} .
- [3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma (C_L \times V_{CC}^2 \times f_o) \text{ where:}$

 f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

 $\Sigma(C_L \times V_{CC}^2 \times f_0)$ = sum of the outputs.

11. Waveforms

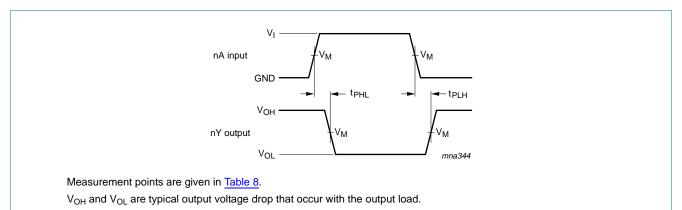
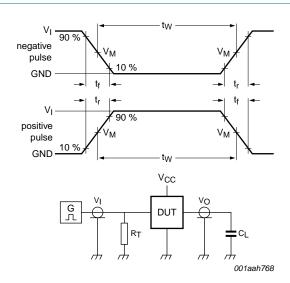


Fig 6. Input to output propagation delay

Table 8. Measurement points

Туре	Input	Output
	V _M	V_{M}
74AHC04	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
74AHCT04	1.5 V	$0.5 \times V_{CC}$

74AHC_AHCT04



Test data is given in Table 9.

Definitions test circuit:

 R_T = termination resistance should be equal to output impedance Z_0 of the pulse generator.

 C_L = load capacitance including jig and probe capacitance.

Fig 7. Load circuitry for measuring switching times

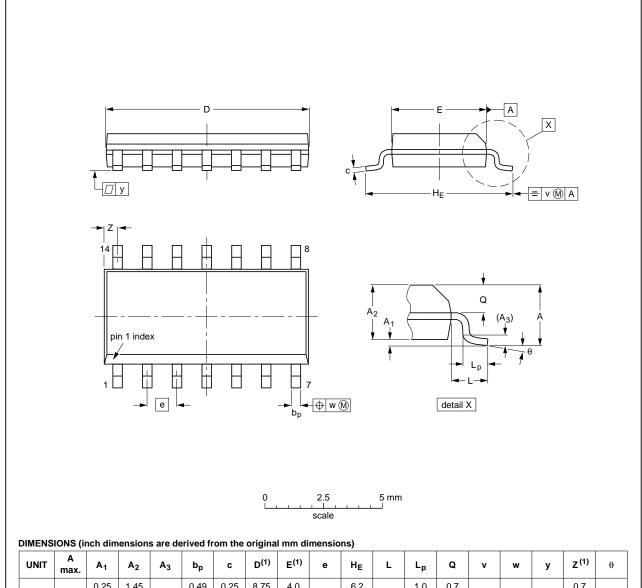
Table 9. Test data

Туре	Input		Load	Test
	VI	t _r , t _f	CL	
74AHC04	V _{CC}	≤ 3.0 ns	15 pF, 50 pF	t _{PLH} , t _{PHL}
74AHCT04	3.0 V	≤ 3.0 ns	15 pF, 50 pF	t _{PLH} , t _{PHL}

12. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



UNIT	A max.	A ₁	A ₂	A ₃	bp	С	D ⁽¹⁾	E ⁽¹⁾	е	HE	L	Lp	Q	v	w	у	z ⁽¹⁾	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8°
inches	0.069	0.010 0.004	0.057 0.049	0.01	l	0.0100 0.0075		0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016		0.01	0.01	0.004	0.028 0.012	0°

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

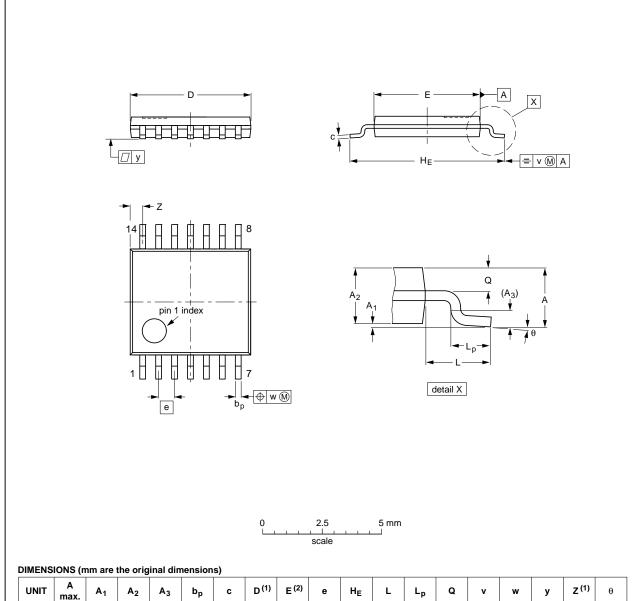
OUTLINE		REFER	EUROPEAN	ISSUE DATE			
VERSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE	
SOT108-1	076E06	MS-012				99-12-27 03-02-19	

Fig 8. Package outline SOT108-1 (SO14)

74AHC_AHCT04

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



UNIT	A max.	A ₁	A ₂	A ₃	bp	С	D ⁽¹⁾	E (2)	е	HE	L	Lp	Q	٧	w	у	Z ⁽¹⁾	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.72 0.38	8° 0°

Notes

- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE		REFER	EUROPEAN	ISSUE DATE		
VERSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE
SOT402-1		MO-153				-99-12-27 03-02-18
)	03-02-10

Fig 9. Package outline SOT402-1 (TSSOP14)

74AHC_AHCT04

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DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; SOT762-1 14 terminals; body 2.5 x 3 x 0.85 mm

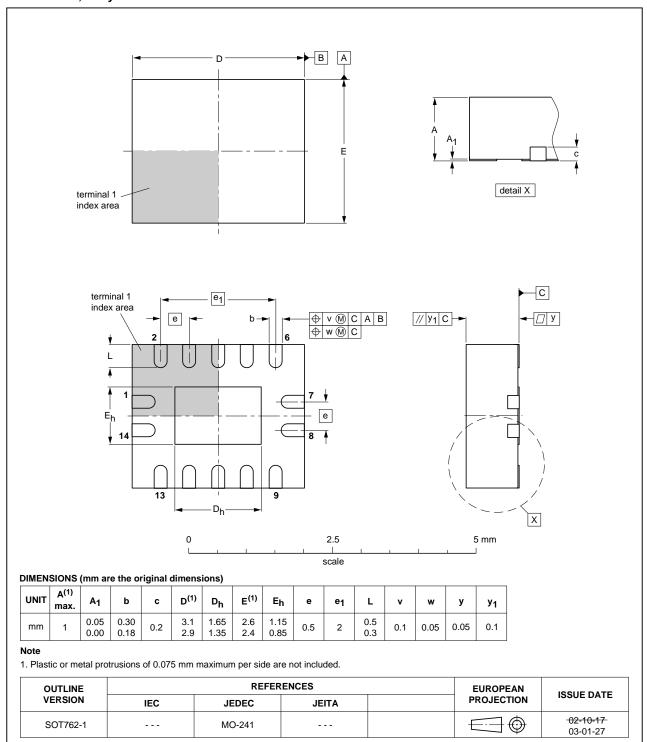


Fig 10. Package outline SOT762-1 (DHVQFN14)

74AHC_AHCT04

13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
НВМ	Human Body Model
LSTTL	Low-power Schottky Transistor-Transistor Logic
MM	Machine Model

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT04 v.6	20111107	Product data sheet	-	74AHC_AHCT04 v.5
Modifications:	 Legal pages 	s updated.		
74AHC_AHCT04 v.5	20110411	Product data sheet	-	74AHC_AHCT04 v.4
74AHC_AHCT04 v.4	20080514	Product data sheet	-	74AHC_AHCT04 v.3
74AHC_AHCT04 v.3	20050207	Product data sheet	-	74AHC_AHCT04 v.2
74AHC_AHCT04 v.2	19990927	Product specification	-	74AHC_AHCT04 v.1
74AHC_AHCT04 v.1	19990225	Product specification	-	-

15. Legal information

15.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

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74AHC_AHCT04

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