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# HD74LV138A

3-to-8 line Decoder / Demultiplexers

## HITACHI

ADE-205-261 (Z)  
1st Edition  
March 1999

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### Description

The HD74LV138A is designed to be used in high-performance memory-decoding or data-routing applications requiring very short propagation delay times. The conditions at the binary-select inputs and the three enable inputs select one of eight input lines.

Two active-low and one active-high enable inputs reduce the need for external gates or inverters when expanding. A 24-line decoder can be implemented without external inverters and a 32-line decoder requires only one inverter.

An enable input can be used as a data input for demultiplexing applications.

Low-voltage and high-speed operation is suitable for the battery-powered products (e.g., notebook computers), and the low-power consumption extends the battery life.

### Features

- $V_{CC} = 2.0\text{ V}$  to  $5.5\text{ V}$  operation
- All inputs  $V_{IH}$  (Max.) =  $5.5\text{ V}$  (@  $V_{CC} = 0\text{ V}$  to  $5.5\text{ V}$ )
- All outputs  $V_O$  (Max.) =  $5.5\text{ V}$  (@  $V_{CC} = 0\text{ V}$ )
- Typical  $V_{OL}$  ground bounce <  $0.8\text{ V}$  (@  $V_{CC} = 3.3\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )
- Typical  $V_{OH}$  undershoot >  $2.3\text{ V}$  (@  $V_{CC} = 3.3\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )
- Output current  $\pm 6\text{ mA}$  (@  $V_{CC} = 3.0\text{ V}$  to  $3.6\text{ V}$ ),  $\pm 12\text{ mA}$  (@  $V_{CC} = 4.5\text{ V}$  to  $5.5\text{ V}$ )

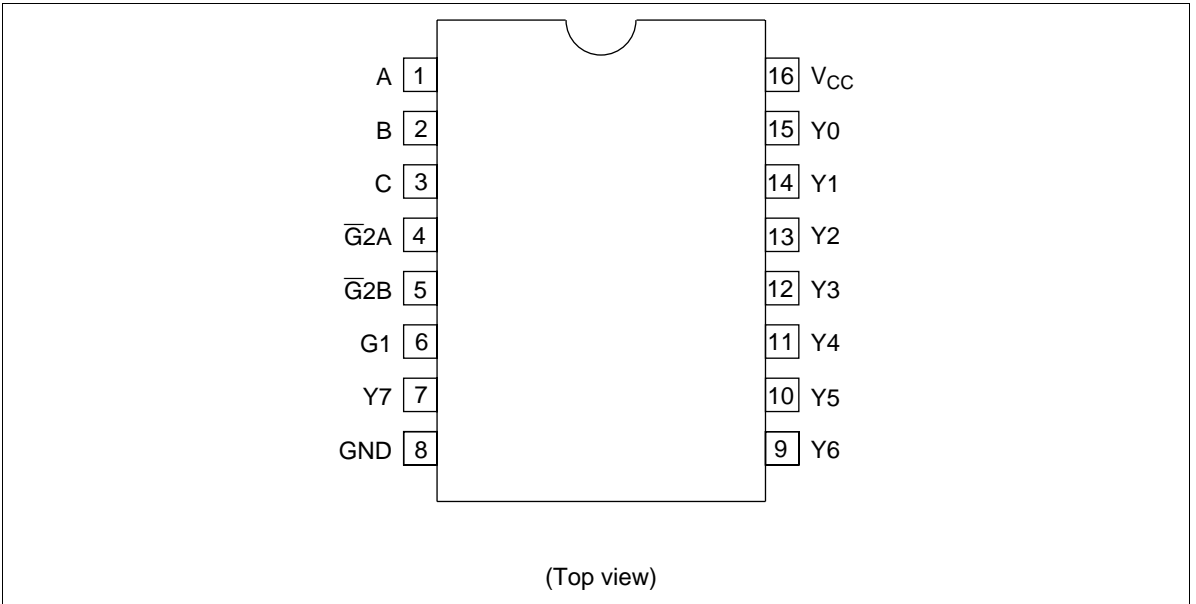
# HD74LV138A

## Function Table

Enable Inputs			Select Inputs			Outputs							
G1	$\overline{G2A}$	$\overline{G2B}$	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	H	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	L	H	H	H	H	H	L	H	H	H	H
H	L	L	H	L	L	H	H	H	H	L	H	H	H
H	L	L	H	L	H	H	H	H	H	H	L	H	H
H	L	L	H	H	L	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L

Note: H: High level  
L: Low level  
X: Immaterial

## Pin Arrangement



**Absolute Maximum Ratings**

Item	Symbol	Ratings	Unit	Conditions
Supply voltage range	$V_{CC}$	-0.5 to 7.0	V	
Input voltage range* <sup>1</sup>	$V_I$	-0.5 to 7.0	V	
Output voltage range* <sup>1,2</sup>	$V_O$	-0.5 to $V_{CC} + 0.5$ -0.5 to 7.0	V	Output: H or L $V_{CC}$ : OFF
Input clamp current	$I_{IK}$	-20	mA	$V_I < 0$
Output clamp current	$I_{OK}$	$\pm 50$	mA	$V_O < 0$ or $V_O > V_{CC}$
Continuous output current	$I_O$	$\pm 25$	mA	$V_O = 0$ to $V_{CC}$
Continuous current through $V_{CC}$ or GND	$I_{CC}$ or $I_{GND}$	$\pm 50$	mA	
Maximum power dissipation at $T_a = 25^\circ\text{C}$ (in still air)* <sup>3</sup>	$P_T$	785	mW	SOP
		500		TSSOP
Storage temperature	$T_{stg}$	-65 to 150	$^\circ\text{C}$	

Notes: The absolute maximum ratings are values which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

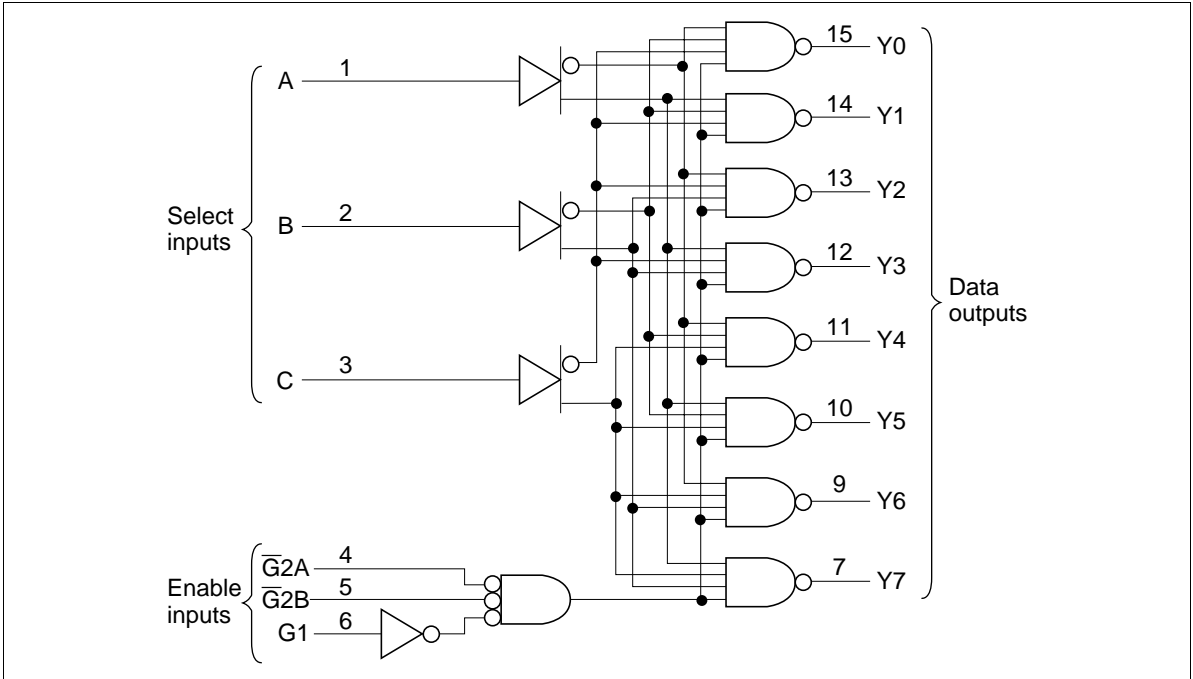
1. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. This value is limited to 5.5 V maximum.
3. The maximum package power dissipation was calculated using a junction temperature of  $150^\circ\text{C}$ .

**Recommended Operating Conditions**

Item	Symbol	Min	Max	Unit	Conditions
Supply voltage range	$V_{CC}$	2.0	5.5	V	
Input voltage range	$V_I$	0	5.5	V	
Output voltage range	$V_O$	0	$V_{CC}$	V	H or L
Output current	$I_{OH}$	—	−50	$\mu$ A	$V_{CC} = 2.0$ V
		—	−2	mA	$V_{CC} = 2.3$ to 2.7 V
		—	−6		$V_{CC} = 3.0$ to 3.6 V
		—	−12		$V_{CC} = 4.5$ to 5.5 V
	$I_{OL}$	—	50	$\mu$ A	$V_{CC} = 2.0$ V
		—	2	mA	$V_{CC} = 2.3$ to 2.7 V
		—	6		$V_{CC} = 3.0$ to 3.6 V
		—	12		$V_{CC} = 4.5$ to 5.5 V
Input transition rise or fall rate	$\Delta t/\Delta v$	0	200	ns/V	$V_{CC} = 2.3$ to 2.7 V
		0	100		$V_{CC} = 3.0$ to 3.6 V
		0	20		$V_{CC} = 4.5$ to 5.5 V
Operating free-air temperature	$T_a$	−40	85	°C	

Note: Unused or floating inputs must be held high or low.

Logic Diagram



## DC Electrical Characteristics

- $T_a = -40$  to  $85^\circ\text{C}$

Item	Symbol	$V_{CC}$ (V)*	Min	Typ	Max	Unit	Test Conditions
Input voltage	$V_{IH}$	2.0	1.5	—	—	V	
		2.3 to 2.7	$V_{CC} \times 0.7$	—	—		
		3.0 to 3.6	$V_{CC} \times 0.7$	—	—		
		4.5 to 5.5	$V_{CC} \times 0.7$	—	—		
	$V_{IL}$	2.0	—	—	0.5		
		2.3 to 2.7	—	—	$V_{CC} \times 0.3$		
		3.0 to 3.6	—	—	$V_{CC} \times 0.3$		
		4.5 to 5.5	—	—	$V_{CC} \times 0.3$		
Output voltage	$V_{OH}$	Min to Max	$V_{CC} - 0.1$	—	—	V	$I_{OH} = -50 \mu\text{A}$
		2.3	2.0	—	—		$I_{OH} = -2 \text{ mA}$
		3.0	2.48	—	—		$I_{OH} = -6 \text{ mA}$
		4.5	3.8	—	—		$I_{OH} = -12 \text{ mA}$
	$V_{OL}$	Min to Max	—	—	0.1		$I_{OL} = 50 \mu\text{A}$
		2.3	—	—	0.4		$I_{OL} = 2 \text{ mA}$
		3.0	—	—	0.44		$I_{OL} = 6 \text{ mA}$
		4.5	—	—	0.55		$I_{OL} = 12 \text{ mA}$
Input current	$I_{IN}$	0 to 5.5	—	—	$\pm 1$	$\mu\text{A}$	$V_I = 5.5 \text{ V}$ or GND
Quiescent supply current	$I_{CC}$	5.5	—	—	20	$\mu\text{A}$	$V_I = V_{CC}$ or GND, $I_O = 0$
Output leakage current	$I_{OFF}$	0	—	—	5	$\mu\text{A}$	$V_I$ or $V_O = 0 \text{ V}$ to $5.5 \text{ V}$
Input capacitance	$C_{IN}$	3.3	—	1.7	—	pF	$V_I = V_{CC}$ or GND

Note: For conditions shown as Min or Max, use the appropriate values under recommended operating conditions.

**Switching Characteristics**

- $V_{CC} = 2.5 \pm 0.2 \text{ V}$

$T_a = 25^\circ\text{C}$                        $T_a = -40 \text{ to } 85^\circ\text{C}$

Item	Symbol	Min	Typ	Max	Min	Max	Unit	Test Conditions	FROM (Input)	TO (Output)
Propagation delay time	$t_{PLH}$	—	11.7	17.6	1.0	21.0	ns	$C_L = 15 \text{ pF}$	A, B, C	Y
	$t_{PHL}$	—	14.9	21.4	1.0	25.0		$C_L = 50 \text{ pF}$		
		—	12.3	19.2	1.0	22.0		$C_L = 15 \text{ pF}$	G1	
		—	15.7	22.6	1.0	26.0		$C_L = 50 \text{ pF}$		
		—	11.4	18.2	1.0	21.0		$C_L = 15 \text{ pF}$	$\overline{G2A}$ , $\overline{G2B}$	
		—	14.8	22.0	1.0	25.0		$C_L = 50 \text{ pF}$		

- $V_{CC} = 3.3 \pm 0.3 \text{ V}$

$T_a = 25^\circ\text{C}$                        $T_a = -40 \text{ to } 85^\circ\text{C}$

Item	Symbol	Min	Typ	Max	Min	Max	Unit	Test Conditions	FROM (Input)	TO (Output)
Propagation delay time	$t_{PLH}$	—	8.1	11.4	1.0	13.5	ns	$C_L = 15 \text{ pF}$	A, B, C	Y
	$t_{PHL}$	—	10.3	15.8	1.0	18.0		$C_L = 50 \text{ pF}$		
		—	8.4	12.8	1.0	15.0		$C_L = 15 \text{ pF}$	G1	
		—	10.6	16.3	1.0	18.5		$C_L = 50 \text{ pF}$		
		—	7.8	11.4	1.0	13.5		$C_L = 15 \text{ pF}$	$\overline{G2A}$ , $\overline{G2B}$	
		—	10.0	14.9	1.0	17.0		$C_L = 50 \text{ pF}$		

## Switching Characteristics (cont)

- $V_{CC} = 5.0 \pm 0.5 \text{ V}$

Item	Symbol	Ta = 25°C			Ta = -40 to 85°C		Unit	Test Conditions	FROM (Input)	TO (Output)
		Min	Typ	Max	Min	Max				
Propagation delay time	$t_{PLH}$	—	5.6	8.1	1.0	9.5	ns	$C_L = 15 \text{ pF}$	A, B, C	Y
		—	7.0	10.1	1.0	11.5		$C_L = 50 \text{ pF}$		
	$t_{PHL}$	—	5.7	8.1	1.0	9.5		$C_L = 15 \text{ pF}$	G1	
		—	7.1	10.1	1.0	11.5		$C_L = 50 \text{ pF}$		
	—	5.4	8.1	1.0	9.5		$C_L = 15 \text{ pF}$	$\overline{G2A}, \overline{G2B}$		
	—	6.8	10.1	1.0	11.5		$C_L = 50 \text{ pF}$			

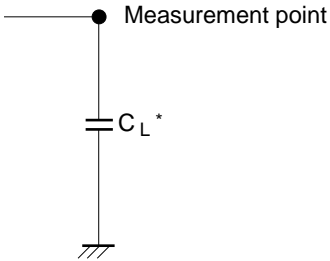
## Operating Characteristics

- $C_L = 50 \text{ pF}$

Item	Symbol	$V_{CC} \text{ (V)}$	Ta = 25°C			Unit	Test Conditions
			Min	Typ	Max		
Power dissipation capacitance	$C_{PD}$	3.3	—	16.8	—	pF	f = 10 MHz
		5.0	—	19.1	—		

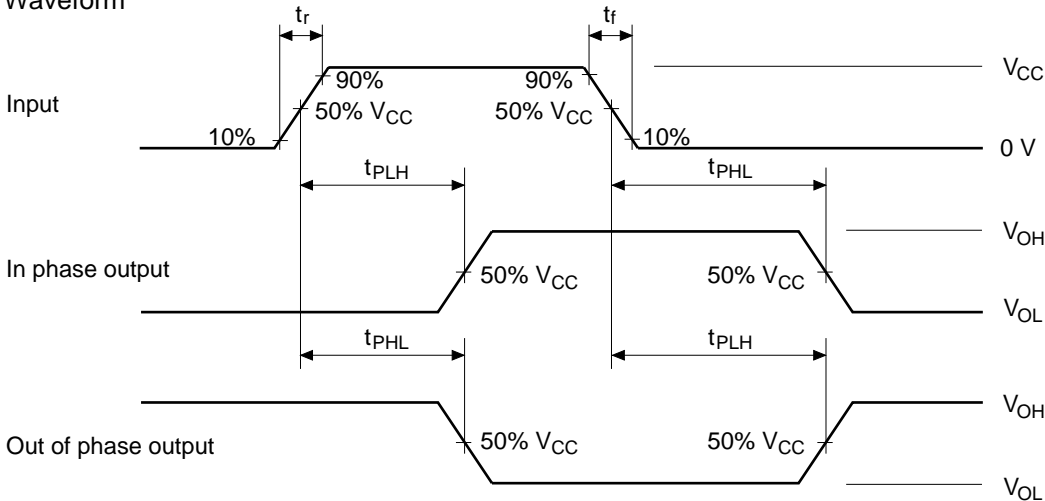


Test Circuit



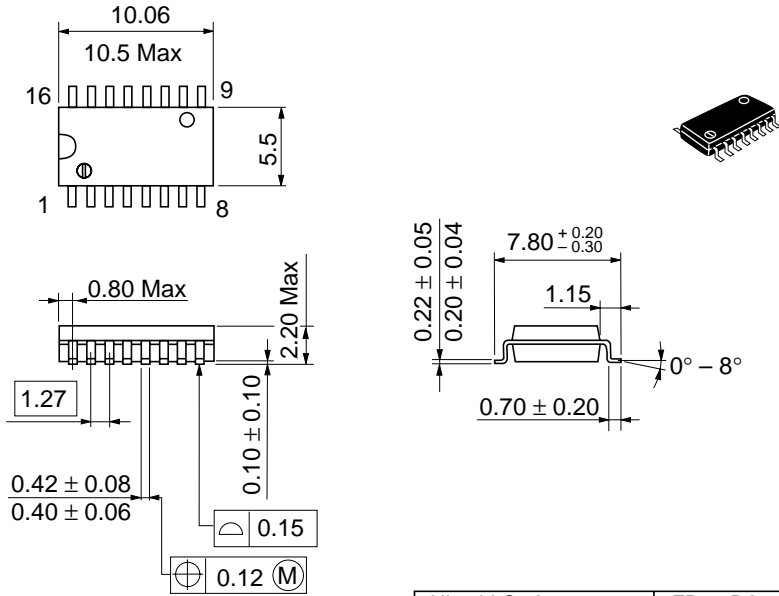
Note:  $C_L$  includes the probe and jig capacitance.

• Waveform



- Notes: 1. Input waveform:  $PRR \leq 1 \text{ MHz}$ ,  $Z_o = 50 \Omega$ ,  $t_r \leq 3 \text{ ns}$ ,  $t_f \leq 3 \text{ ns}$
- 2. The output is measured one at a time with one transition per measurement.

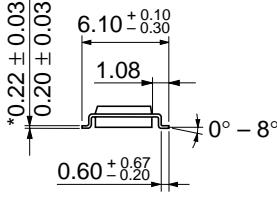
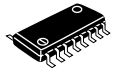
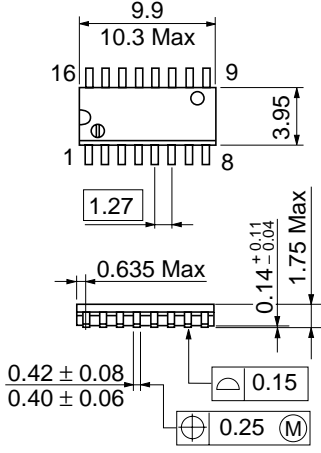
## Package Dimensions



Dimension including the plating thickness  
Base material dimension

Hitachi Code	FP-16DA
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.24 g

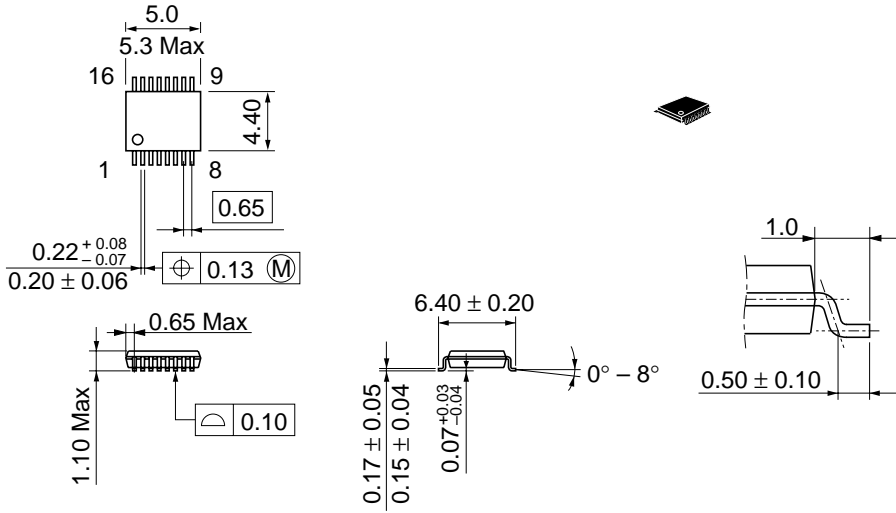
Unit: mm



Dimension including the plating thickness  
Base material dimension

Hitachi Code	FP-16DN
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	0.15 g

# HD74LV138A



Dimension including the plating thickness  
Base material dimension

Hitachi Code	TTP-16DA
JEDEC	—
EIAJ	—
Weight (reference value)	0.05 g

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## Hitachi, Ltd.

Semiconductor & Integrated Circuits.  
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan  
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

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## For further information write to:

Hitachi Semiconductor  
(America) Inc.  
179 East Tasman Drive,  
San Jose, CA 95134  
Tel: <1> (408) 433-1990  
Fax: <1> (408) 433-0223

Hitachi Europe GmbH  
Electronic components Group  
Dornacher Straße 3  
D-85622 Feldkirchen, Munich  
Germany  
Tel: <49> (89) 9 9180-0  
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.  
Electronic Components Group.  
Whitebrook Park  
Lower Cookham Road  
Maidenhead  
Berkshire SL6 8YA, United Kingdom  
Tel: <44> (1628) 585000  
Fax: <44> (1628) 778322

Hitachi Asia Pte. Ltd.  
16 Collyer Quay #20-00  
Hitachi Tower  
Singapore 049318  
Tel: 535-2100  
Fax: 535-1533

Hitachi Asia Ltd.  
Taipei Branch Office  
3F, Hung Kuo Building, No.167,  
Tun-Hwa North Road, Taipei (105)  
Tel: <886> (2) 2718-3666  
Fax: <886> (2) 2718-8180

Hitachi Asia (Hong Kong) Ltd.  
Group III (Electronic Components)  
7/F., North Tower, World Finance Centre,  
Harbour City, Canton Road, Tsim Sha Tsui,  
Kowloon, Hong Kong  
Tel: <852> (2) 735 9218  
Fax: <852> (2) 730 0281  
Telex: 40815 HITEC HX

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