July 2003

National Semiconductor

54AC74/54ACT74
Dual D-Type Positive Edge-Triggered Flip-Flop

General Description

The 'AC/'ACT74 is a dual D-type flip-flop with Asynchronous Clear and Set inputs and complementary (Q, $\overline{Q}$) outputs. Information at the input is transferred to the outputs on the positive edge of the clock pulse. Clock triggering occurs at a voltage level of the clock pulse and is not directly related to the transition time of the positive-going pulse. After the Clock Pulse input threshold voltage has been passed, the Data input is locked out and information present will not be transferred to the outputs until the next rising edge of the Clock Pulse input.

Asynchronous Inputs:

LOW input to $\overline{S}_D$ (Set) sets Q to HIGH level

LOW input to $\overline{C}_D$ (Clear) sets Q to LOW level

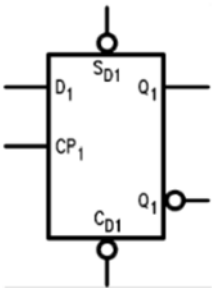
Clear and Set are independent of clock

Simultaneous LOW on $\overline{C}_D$ and $\overline{S}_D$ makes both Q and $\overline{Q}$ HIGH

Features

- I_{CC} reduced by 50%
- Output source/sink 24 mA
- 'ACT74 has TTL-compatible inputs
- Standard Microcircuit Drawing (SMD)
  - 'AC74: 5962-88520
  - 'ACT74: 5962-87525
- 54AC74 now qualified to 300Krad RHA designation, refer to the SMD for more information

Logic Symbols



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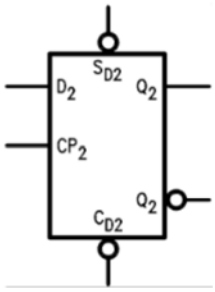

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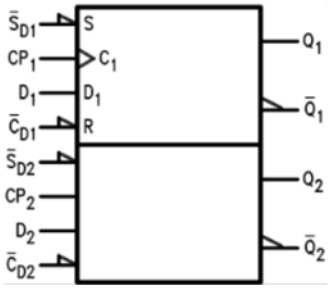
IEEE/IEC



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Pin Names	Description
D_1, D_2	Data Inputs
CP_1, CP_2	Clock Pulse Inputs
$\overline{C}_{D1}, \overline{C}_{D2}$	Direct Clear Inputs
$\overline{S}_{D1}, \overline{S}_{D2}$	Direct Set Inputs
$Q_1, \overline{Q}_1, Q_2, \overline{Q}_2$	Outputs

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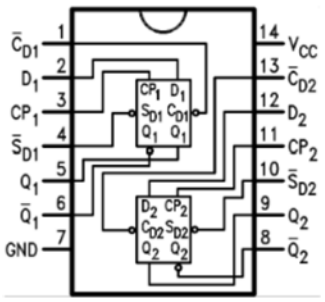
Connection Diagrams

Pin Assignment for DIP and Flatpak



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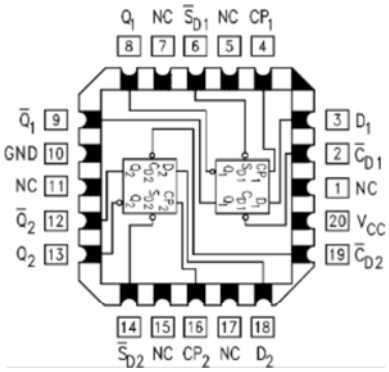
Pin Assignment for LCC



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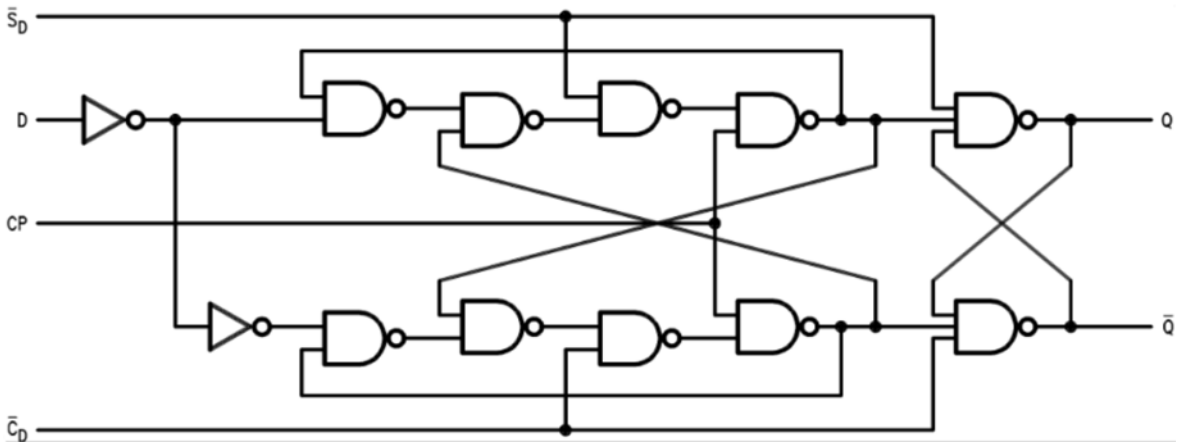
Truth Table

(Each Half)

Inputs				Outputs	
$\overline{S}_D$	$\overline{C}_D$	CP	D	Q	$\overline{Q}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H	H
H	H	N	H	H	L
H	H	N	L	L	H
H	H	L	X	Q_0	$\overline{Q}_0$

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
N = LOW-to-HIGH Clock Transition
Q_0 ($\overline{Q}_0$) = Previous Q ($\overline{Q}$) before LOW-to-HIGH Transition of Clock

Logic Diagram



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Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Diode Current (I_{IK})	
V_I = −0.5V	−20 mA
V_I = V_{CC} + 0.5V	+20 mA
DC Input Voltage (V_I)	−0.5V to V_{CC} + 0.5V
DC Output Diode Current (I_{OK})	
V_O = −0.5V	−20 mA
V_O = V_{CC} + 0.5V	+20 mA
DC Output Voltage (V_O)	−0.5V to V_{CC} + 0.5V
DC Output Source or Sink Current (I_O)	±50 mA
DC V_{CC} or Ground Current per Output Pin (I_{CC} or I_{GND})	±50 mA
Storage Temperature (T_{STG})	−65°C to +150°C
Junction Temperature (T_J)	
CDIP	175°C

Recommended Operating Conditions

Supply Voltage (V_{CC})	
'AC	2.0V to 6.0V
'ACT	4.5V to 5.5V
Input Voltage (V_I)	0V to V_{CC}
Output Voltage (V_O)	0V to V_{CC}
Operating Temperature (T_A)	
54AC/ACT	−55°C to +125°C
Minimum Input Edge Rate (ΔV/Δt)	
'AC Devices	
V_{IN} from 30% to 70% of V_{CC}	
V_{CC} @ 3.3V, 4.5V, 5.5V	125 mV/ns
Minimum Input Edge Rate (ΔV/Δt)	
'ACT Devices	
V_{IN} from 0.8V to 2.0V	
V_{CC} @ 4.5V, 5.5V	125 mV/ns

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation of FACT® circuits outside databook specifications.

DC Characteristics for 'AC Family Devices

Symbol	Parameter	V_{CC} (V)	54AC T_A = −55°C to +125°C Guaranteed Limits	Units	Conditions
V_{IH}	Minimum High Level Input Voltage	3.0	2.1	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
		4.5	3.15		
		5.5	3.85		
V_{IL}	Maximum Low Level Input Voltage	3.0	0.9	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
		4.5	1.35		
		5.5	1.65		
V_{OH}	Minimum High Level Output Voltage	3.0	2.9	V	I_{OUT} = −50 μA
		4.5	4.4		
		5.5	5.4		
					(Note 2) V_{IN} = V_{IL} or V_{IH}
		3.0	2.4	V	−12 mA
		4.5	3.7		I_{OH} −24 mA
		5.5	4.7		−24 mA
V_{OL}	Maximum Low Level Output Voltage	3.0	0.1	V	I_{OUT} = 50 μA
		4.5	0.1		
		5.5	0.1		
					(Note 2) V_{IN} = V_{IL} or V_{IH}

DC Characteristics for 'AC Family Devices (Continued)

Symbol	Parameter	V_{CC} (V)	54AC T_A = −55°C to +125°C Guaranteed Limits	Units	Conditions
		3.0	0.5		12 mA
		4.5	0.5	V	I_{OL} 24 mA
		5.5	0.5		24 mA
I_{IN}	Maximum Input Leakage Current	5.5	±1.0	µA	$V_I = V_{CC}$, GND
I_{OLD}	(Note 3) Minimum Dynamic Output Current	5.5	50	mA	V_{OLD} = 1.65V Max
I_{OHD}		5.5	−50	mA	V_{OHD} = 3.85V Min
I_{CC}	Maximum Quiescent Supply Current	5.5	40.0	µA	$V_{IN} = V_{CC}$ or GND

Note 2: All outputs loaded; thresholds on input associated with output under test.

Note 3: Maximum test duration 2.0 ms, one output loaded at a time.

Note 4: I_{IN} and I_{CC} @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V_{CC}. I_{CC} for 54AC @ 25°C is identical to 74AC @ 25°C.

DC Characteristics for 'ACT Family Devices

Symbol	Parameter	V_{CC} (V)	54ACT T_A = −55°C to +125°C Guaranteed Limits	Units	Conditions
V_{IH}	Minimum High Level Input Voltage	4.5	2.0	V	V_{OUT} = 0.1V
		5.5	2.0		or V_{CC} − 0.1V
V_{IL}	Maximum Low Level Input Voltage	4.5	0.8	V	V_{OUT} = 0.1V
		5.5	0.8		or V_{CC} − 0.1V
V_{OH}	Minimum High Level Output Voltage	4.5	4.4	V	I_{OUT} = −50 µA
		5.5	5.4		
					(Note 5) $V_{IN} = V_{IL}$ or V_{IH}
		4.5	3.70	V	I_{OH} −24 mA
		5.5	4.70		−24 mA
V_{OL}	Maximum Low Level Output Voltage	4.5	0.1	V	I_{OUT} = 50 µA
		5.5	0.1		
					(Note 5) $V_{IN} = V_{IL}$ or V_{IH}
		4.5	0.50	V	I_{OL} 24 mA
		5.5	0.50		24 mA
I_{IN}	Maximum Input Leakage Current	5.5	±1.0	µA	$V_I = V_{CC}$, GND
I_{CCT}	Maximum I_{CC}/Input	5.5	1.6	mA	$V_I = V_{CC}$ − 2.1V
I_{OLD}	(Note 6) Minimum Dynamic Output Current	5.5	50	mA	V_{OLD} = 1.65V Max
I_{OHD}		5.5	−50	mA	V_{OHD} = 3.85V Min

DC Characteristics for 'ACT Family Devices (Continued)

Symbol	Parameter	V_{CC} (V)	54ACT T_A = −55°C to +125°C Guaranteed Limits	Units	Conditions
I_{CC}	Maximum Quiescent Supply Current	5.5	40.0	µA	$V_{IN} = V_{CC}$ or GND

Note 5: All outputs loaded; thresholds on input associated with output under test.

Note 6: Maximum test duration 2.0 ms, one output loaded at a time.

Note 7: I_{CC} for 54ACT @ 25°C is identical to 74ACT @ 25°C.

AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V) (Note 8)	54AC T_A = −55°C to +125°C C_L = 50 pF Min	54AC Max	Units	Fig. No.
f_{max}	Maximum Clock Frequency	3.3	70		MHz	
		5.0	95			
t_{PLH}	Propagation Delay $\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to Q_n or $\overline{Q}_n$	3.3	1.0	13.0	ns	
		5.0	1.0	9.5		
t_{PHL}	Propagation Delay $\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to Q_n or $\overline{Q}_n$	3.3	1.0	14.0	ns	
		5.0	1.0	10.5		
t_{PLH}	Propagation Delay CP_n to Q_n or $\overline{Q}_n$	3.3	1.0	17.5	ns	
		5.0	1.0	12.0		
t_{PHL}	Propagation Delay CP_n to Q_n or $\overline{Q}_n$	3.3	1.0	13.5	ns	
		5.0	1.0	10.0		

Note 8: Voltage Range 3.3 is 3.3V ± 0.3V
Voltage Range 5.0 is 5.0V ± 0.5V

AC Operating Requirements

Symbol	Parameter	V_{CC} (V) (Note 9)	54AC T_A = −55°C to +125°C C_L = 50 pF Guaranteed Limits	Units	Fig. No.
t_s	Set-up Time, HIGH or LOW D_n to CP_n	3.3	5.0	ns	
		5.0	4.0		
t_h	Hold Time, HIGH or LOW D_n to CP_n	3.3	0.5	ns	
		5.0	0.5		
t_w	CP_n or $\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ Pulse Width	3.3	8.0	ns	
		5.0	5.5		
t_{rec}	Recovery Time $\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to CP	3.3	0.5	ns	
		5.0	0.5		

Note 9: Voltage Range 3.3 is 3.3V ±0.3V
Voltage Range 5.0 is 5.0V ±0.5V

AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V) (Note 10)	54ACT $T_A = -55°C$ to $+125°C$ $C_L = 50$ pF		Units	Fig. No.
			Min	Max		
f_{max}	Maximum Clock Frequency	5.0	85		MHz	
t_{PLH}	Propagation Delay $\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to Q_n or $\overline{Q}_n$	5.0	1.0	11.5	ns	
t_{PHL}	Propagation Delay $\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to Q_n or $\overline{Q}_n$	5.0	1.0	12.5	ns	
t_{PLH}	Propagation Delay CP_n to Q_n or $\overline{Q}_n$	5.0	1.0	14.0	ns	
t_{PHL}	Propagation Delay CP_n to Q_n or $\overline{Q}_n$	5.0	1.0	12.0	ns	

Note 10: Voltage Range 5.0 is 5.0V ±0.5V

AC Operating Requirements

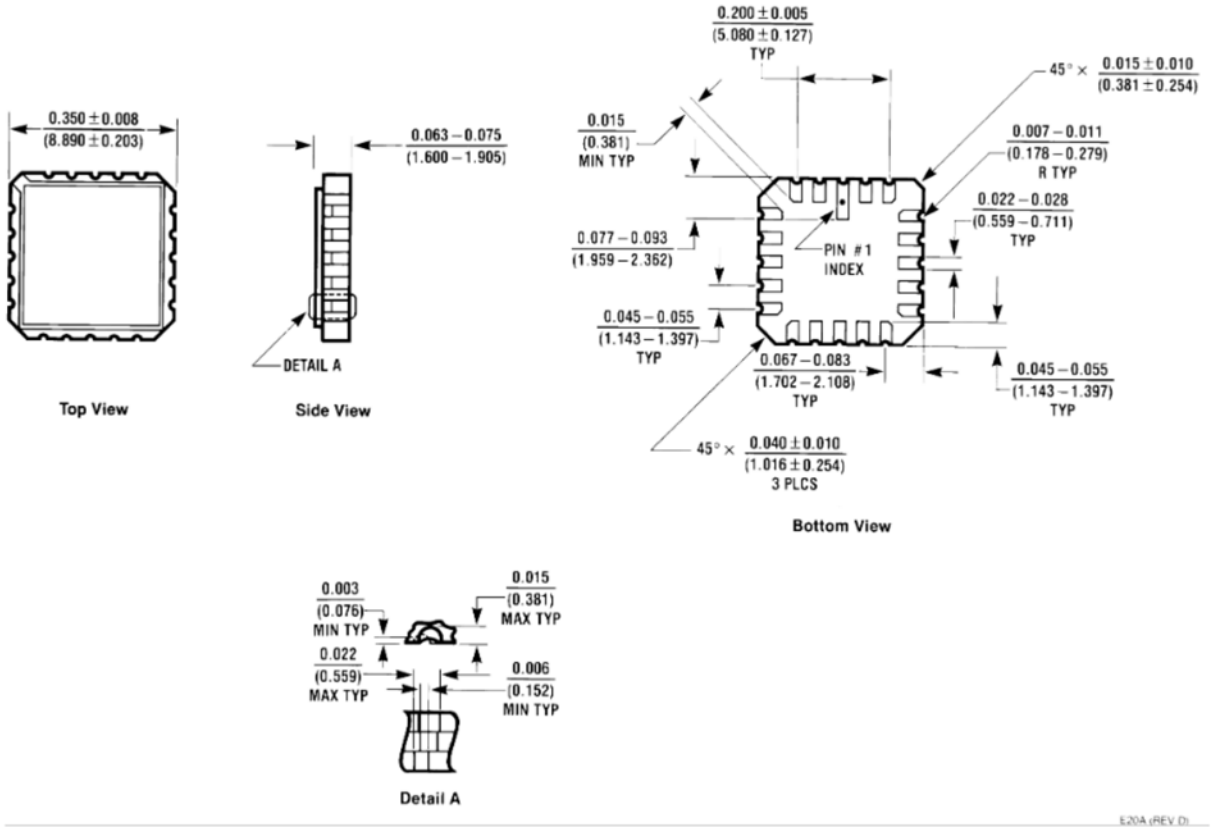
Symbol	Parameter	V_{CC} (V) (Note 11)	54ACT $T_A = -55°C$ $C_L = 50$ pF Guaranteed Limits	Units	Fig. No.
t_s	Set-up Time, HIGH or LOW D_n to CP_n	5.0	4.0	ns	
t_h	Hold Time, HIGH or LOW D_n to CP_n	5.0	1.0	ns	
t_w	CP_n or $\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ Pulse Width	5.0	7.0	ns	
t_{rec}	Recovery Time $\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to CP	5.0	0.5	ns	

Note 11: Voltage Range 5.0 is 5.0V ±0.5V

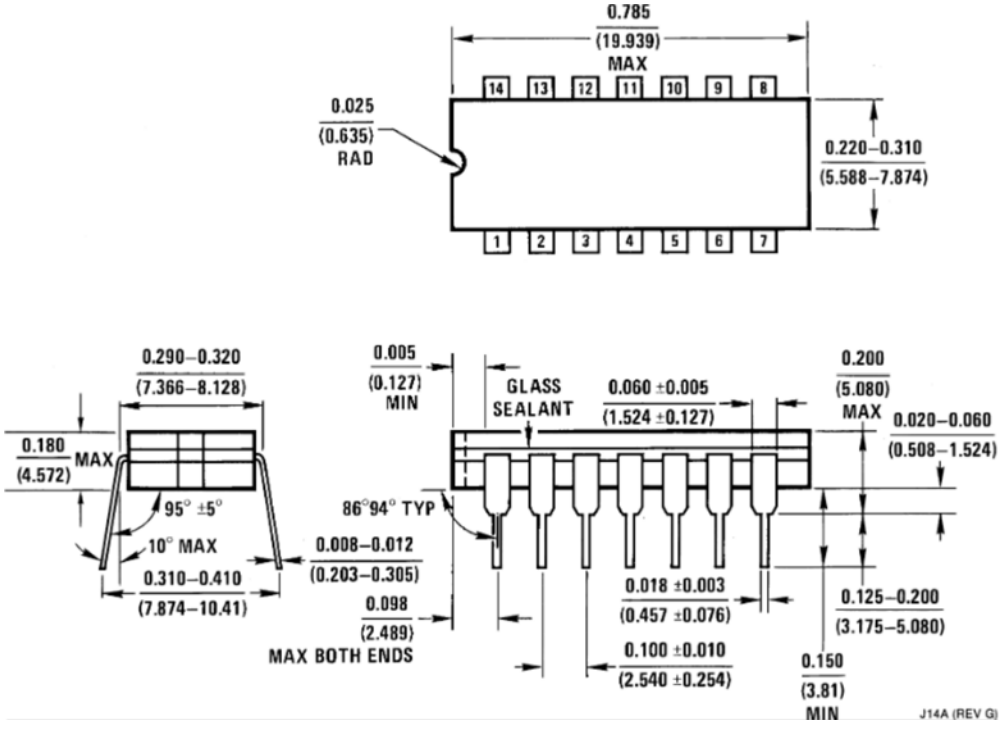
Capacitance

Symbol	Parameter	Typ	Units	Conditions
C_{IN}	Input Capacitance	4.5	pF	V_{CC} = OPEN
C_{PD}	Power Dissipation Capacitance	35.0	pF	V_{CC} = 5.0V

Physical Dimensions inches (millimeters) unless otherwise noted

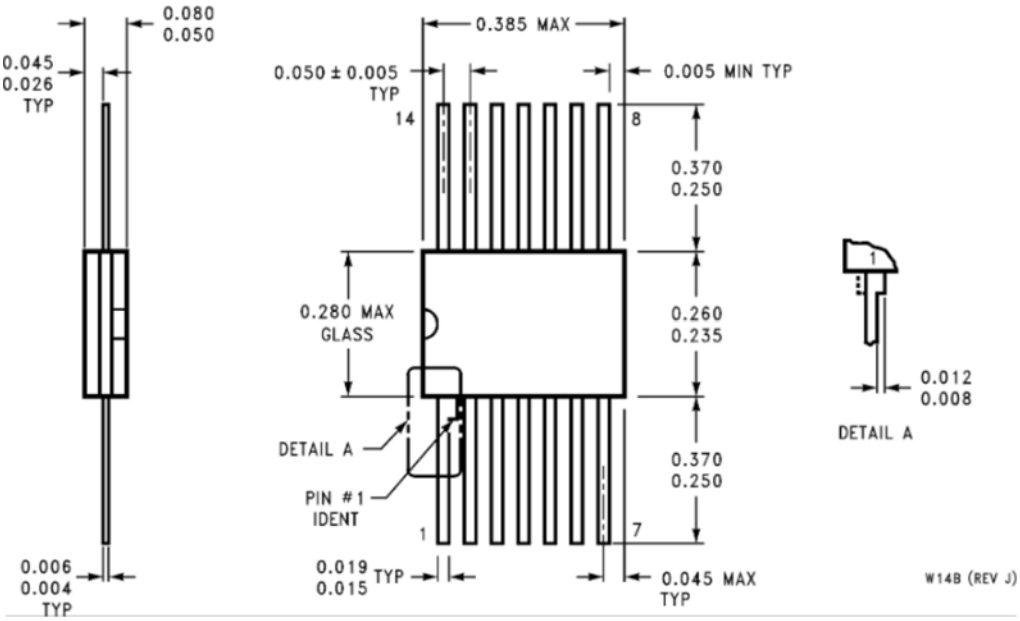


20-Terminal Ceramic Leadless Chip Carrier (L)
NS Package Number E20A



14-Lead Ceramic Dual-In-Line Package (D)
NS Package Number J14A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



14-Lead Ceramic Flatpak (F)
NS Package Number W14B

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