



Integrated Device Technology, Inc.

FAST CMOS 16-BIT REGISTER (3-STATE)

IDT54/74FCT16374T/AT/CT/ET
IDT54/74FCT162374T/AT/CT/ET

FEATURES:

- **Common features:**
 - 0.5 MICRON CMOS Technology
 - **High-speed, low-power CMOS replacement for ABT functions**
 - **Typical $t_{sk(o)}$ (Output Skew) < 250ps**
 - **Low input and output leakage $\leq 1\mu A$ (max.)**
 - ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
 - Packages include 25 mil pitch SSOP, 19.6 mil pitch TSSOP, 15.7 mil pitch TVSOP and 25 mil pitch Cerpack
 - Extended commercial range of -40°C to +85°C
 - $V_{CC} = 5V \pm 10\%$
- **Features for FCT16374T/AT/CT/ET:**
 - High drive outputs (-32mA I_{OH} , 64mA I_{OL})
 - Power off disable outputs permit "live insertion"
 - Typical VOLP (Output Ground Bounce) < 1.0V at $V_{CC} = 5V, T_A = 25^\circ C$
- **Features for FCT162374T/AT/CT/ET:**
 - Balanced Output Drivers: $\pm 24mA$ (commercial), $\pm 16mA$ (military)
 - Reduced system switching noise
 - Typical VOLP (Output Ground Bounce) < 0.6V at $V_{CC} = 5V, T_A = 25^\circ C$

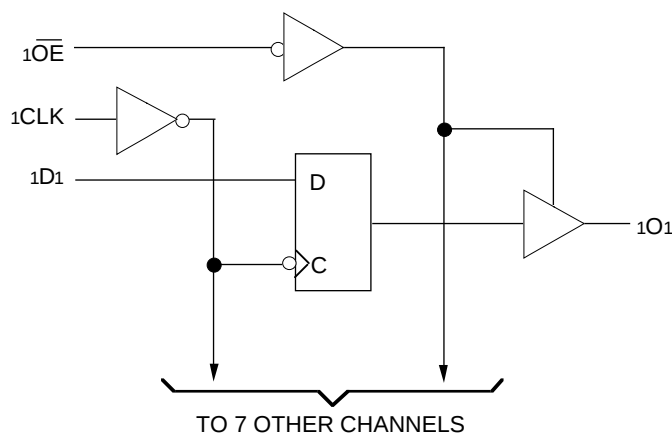
DESCRIPTION:

The FCT16374T/AT/CT/ET and FCT162374T/AT/CT/ET 16-bit edge-triggered D-type registers are built using advanced dual metal CMOS technology. These high-speed, low-power registers are ideal for use as buffer registers for data synchronization and storage. The Output Enable ($\overline{xOE}$) and clock ($xCLK$) controls are organized to operate each device as two 8-bit registers or one 16-bit register with common clock. Flow-through organization of signal pins simplifies layout. All inputs are designed with hysteresis for improved noise margin.

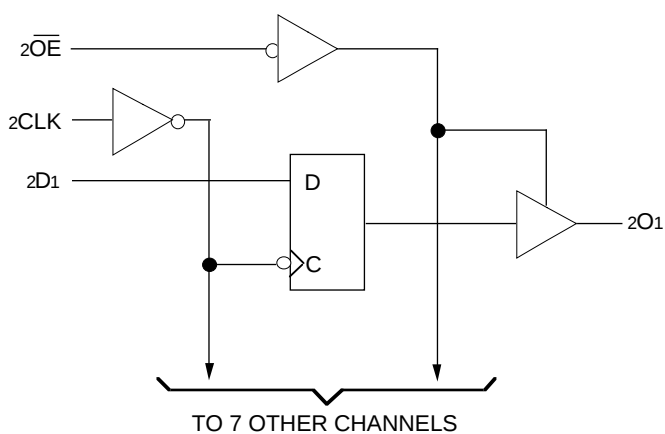
The FCT16374T/AT/CT/ET are ideally suited for driving high-capacitance loads and low-impedance backplanes. The output buffers are designed with power off disable capability to allow "live insertion" of boards when used as backplane drivers.

The FCT162374T/AT/CT/ET have balanced output drive with current limiting resistors. This offers low ground bounce, minimal undershoot, and controlled output fall times—reducing the need for external series terminating resistors. The FCT162374T/AT/CT/ET are plug-in replacements for the FCT16374T/AT/CT/ET and ABT16374 for on-board bus interface applications.

FUNCTIONAL BLOCK DIAGRAM



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MILITARY AND COMMERCIAL TEMPERATURE RANGES

AUGUST 1996

SSOP/ TSSOP/TVSOP TOP VIEW

Pin	Signal	Pin	Signal
1	1 $\overline{OE}$	25	2CLK
2	1O1	26	2D8
3	1O2	27	2D7
4	GND	28	GND
5	1O3	29	2D6
6	1O4	30	2D5
7	VCC	31	VCC
8	1O5	32	2D4
9	1O6	33	2D3
10	GND	34	GND
11	1O7	35	2D2
12	1O8	36	2D1
13	2O1	37	1D8
14	2O2	38	1D7
15	GND	39	GND
16	2O3	40	1D6
17	2O4	41	1D5
18	VCC	42	VCC
19	2O5	43	1D4
20	2O6	44	1D3
21	GND	45	GND
22	2O7	46	1D2
23	2O8	47	1D1
24	2 $\overline{OE}$	48	1CLK

E48-1

Pin	Signal
1	1CLK
2	1D1
3	1D2
4	GND
5	1D3
6	1D4
7	VCC
8	1D5
9	1D6
10	GND
11	1D7
12	1D8
13	2D1
14	2D2
15	GND
16	2D3
17	2D4
18	VCC
19	2D5
20	2D6
21	GND
22	2D7
23	2D8
24	2CLK

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CERPACK TOP VIEW

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PIN DESCRIPTION

Pin Names	Description
xDx	Data Inputs
xCLK	Clock Inputs
xOx	3-State Outputs.
$\overline{xOE}$	3-State Output Enable Input (Active LOW)

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FUNCTION TABLE⁽¹⁾

Function	Inputs			Outputs
	xDx	xCLK	$\overline{xOE}$	xOx
Hi-Z	X	L	H	Z
	X	H	H	Z
Load Register	L	↑	L	L
	H	↑	L	H
	L	↑	H	Z
	H	↑	H	Z

NOTE:

- H = HIGH Voltage Level
L = LOW Voltage Level
X = Don't Care
Z = High Impedance
↑ = LOW-to-HIGH Transition

2542 tbl 02

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Description	Max.	Unit
V _{TERM} (2)	Terminal Voltage with Respect to GND	−0.5 to +7.0	V
V _{TERM} (3)	Terminal Voltage with Respect to GND	−0.5 to V _{CC} +0.5	V
T _{STG}	Storage Temperature	−65 to +150	°C
I _{OUT}	DC Output Current	−60 to +120	mA

NOTES:

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- Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
- All device terminals except FCT162XXXT Output and I/O terminals.
- Output and I/O terminals for FCT162XXXT.

CAPACITANCE (T_A = +25°C, f = 1.0MHz)

Symbol	Parameter ⁽¹⁾	Conditions	Typ.	Max.	Unit
C _{IN}	Input Capacitance	V _{IN} = 0V	3.5	6.0	pF
C _{I/O}	I/O Capacitance	V _{OUT} = 0V	3.5	8.0	pF

NOTE:

- This parameter is measured at characterization but not tested.

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DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Commercial: $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = 5.0\text{V} \pm 10\%$; Military: $T_A = -55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{CC} = 5.0\text{V} \pm 10\%$

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
V_{IH}	Input HIGH Level	Guaranteed Logic HIGH Level		2.0	—	—	V
V_{IL}	Input LOW Level	Guaranteed Logic LOW Level		—	—	0.8	V
I_{IH}	Input HIGH Current (Input pins) ⁽⁵⁾	$V_{CC} = \text{Max.}$	$V_I = V_{CC}$	—	—	± 1	μA
	Input HIGH Current (I/O pins) ⁽⁵⁾			—	—	± 1	
I_{IL}	Input LOW Current (Input pins) ⁽⁵⁾		$V_I = \text{GND}$	—	—	± 1	
	Input LOW Current (I/O pins) ⁽⁵⁾			—	—	± 1	
I_{OZH}	High Impedance Output Current (3-State Output pins) ⁽⁵⁾	$V_{CC} = \text{Max.}$	$V_O = 2.7\text{V}$	—	—	± 1	μA
I_{OZL}			$V_O = 0.5\text{V}$	—	—	± 1	
V_{IK}	Clamp Diode Voltage	$V_{CC} = \text{Min.}, I_{IN} = -18\text{mA}$		—	-0.7	-1.2	V
I_{OS}	Short Circuit Current	$V_{CC} = \text{Max.}, V_O = \text{GND}^{(3)}$		-80	-140	-225	mA
V_H	Input Hysteresis	—		—	100	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	$V_{CC} = \text{Max.}, V_{IN} = \text{GND or } V_{CC}$		—	5	500	μA

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OUTPUT DRIVE CHARACTERISTICS FOR FCT16374T

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
I_O	Output Drive Current	$V_{CC} = \text{Max.}, V_O = 2.5\text{V}^{(3)}$		-50	—	-180	mA
V_{OH}	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -3\text{mA}$	2.5	3.5	—	V
			$I_{OH} = -12\text{mA MIL.}$ $I_{OH} = -15\text{mA COM'L.}$	2.4	3.5	—	V
			$I_{OH} = -24\text{mA MIL.}$ $I_{OH} = -32\text{mA COM'L.}^{(4)}$	2.0	3.0	—	V
V_{OL}	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 48\text{mA MIL.}$ $I_{OL} = 64\text{mA COM'L.}$	—	0.2	0.55	V
I_{OFF}	Input/Output Power Off Leakage ⁽⁵⁾	$V_{CC} = 0\text{V}, V_{IN} \text{ or } V_O \leq 4.5\text{V}$		—	—	± 1	μA

2542 Ink 06

OUTPUT DRIVE CHARACTERISTICS FOR FCT162374T

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
I_{ODL}	Output LOW Current	$V_{CC} = 5\text{V}, V_{IN} = V_{IH} \text{ or } V_{IL}, V_{OUT} = 1.5\text{V}^{(3)}$		60	115	200	mA
I_{ODH}	Output HIGH Current	$V_{CC} = 5\text{V}, V_{IN} = V_{IH} \text{ or } V_{IL}, V_{OUT} = 1.5\text{V}^{(3)}$		-60	-115	-200	mA
V_{OH}	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -16\text{mA MIL.}$ $I_{OH} = -24\text{mA COM'L.}$	2.4	3.3	—	V
V_{OL}	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 16\text{mA MIL.}$ $I_{OL} = 24\text{mA COM'L.}$	—	0.3	0.55	V

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NOTES:

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at $V_{CC} = 5.0\text{V}, +25^{\circ}\text{C}$ ambient.
- Not more than one output should be tested at one time. Duration of the test should not exceed one second.
- Duration of the condition can not exceed one second.
- The test limit for this parameter is $\pm 5\mu\text{A}$ at $T_A = -55^{\circ}\text{C}$.

POWER SUPPLY CHARACTERISTICS

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
ΔI_{CC}	Quiescent Power Supply Current TTL Inputs HIGH	$V_{CC} = \text{Max.}$ $V_{IN} = 3.4V^{(3)}$		—	0.5	1.5	mA
I_{CCD}	Dynamic Power Supply Current ⁽⁴⁾	$V_{CC} = \text{Max.}$ Outputs Open $\overline{xOE} = \text{GND}$ One Input Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	60	100	μA / MHz
I_C	Total Power Supply Current ⁽⁶⁾	$V_{CC} = \text{Max.}$ Outputs Open $f_{CP} = 10\text{MHz}$ 50% Duty Cycle $\overline{xOE} = \text{GND}$ $f_i = 5\text{MHz}$ 50% Duty Cycle One Bit Toggling	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	0.6	1.5	mA
			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	1.1	3.0	
		$V_{CC} = \text{Max.}$ Outputs Open $f_{CP} = 10\text{MHz}$ 50% Duty Cycle $\overline{xOE} = \text{GND}$ Sixteen Bits Toggling $f_i = 2.5\text{MHz}$ 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	3.0	5.5 ⁽⁵⁾	
			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	7.5	19.0 ⁽⁵⁾	

NOTES:

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- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at $V_{CC} = 5.0V$, $+25^\circ\text{C}$ ambient.
- Per TTL driven input ($V_{IN} = 3.4V$). All other inputs at V_{CC} or GND .
- This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
- Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.
- $I_C = I_{\text{QUIESCENT}} + I_{\text{INPUTS}} + I_{\text{DYNAMIC}}$
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP} N_{CP} / 2 + f_i N_i)$
 $I_{CC} = \text{Quiescent Current (} I_{CCL}, I_{CCH} \text{ and } I_{CCZ} \text{)}$
 $\Delta I_{CC} = \text{Power Supply Current for a TTL High Input (} V_{IN} = 3.4V \text{)}$
 $D_H = \text{Duty Cycle for TTL Inputs High}$
 $N_T = \text{Number of TTL Inputs at } D_H$
 $I_{CCD} = \text{Dynamic Current Caused by an Input Transition Pair (HLH or LHL)}$
 $f_{CP} = \text{Clock Frequency for Register Devices (Zero for Non-Register Devices)}$
 $N_{CP} = \text{Number of Clock Inputs at } f_{CP}$
 $f_i = \text{Input Frequency}$
 $N_i = \text{Number of Inputs at } f_i$

SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Symbol	Parameter	Condition ⁽¹⁾	FCT16374T/162374T				FCT16374AT/162374AT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	
tPLH tPHL	Propagation Delay xCLK to xOx	CL = 50pF RL = 500Ω	2.0	10.0	2.0	11.0	2.0	6.5	2.0	7.2	ns
tPZH tPZL	Output Enable Time		1.5	12.5	1.5	14.0	1.5	6.5	1.5	7.5	ns
tPHZ tPLZ	Output Disable Time		1.5	8.0	1.5	8.0	1.5	5.5	1.5	6.5	ns
tsu	Set-up Time HIGH or LOW, xDx to xCLK		2.0	—	2.0	—	2.0	—	2.0	—	ns
th	Hold Time HIGH or LOW, xDx to xCLK		1.5	—	1.5	—	1.5	—	1.5	—	ns
tw	xCLK Pulse Width HIGH or LOW		7.0	—	7.0	—	5.0	—	6.0	—	ns
tsk(o)	Output Skew ⁽³⁾		—	0.5	—	0.5	—	0.5	—	0.5	ns

Symbol	Parameter	Condition ⁽¹⁾	FCT16374CT/162374CT				FCT16374ET/162374ET				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	
tPLH tPHL	Propagation Delay xCLK to xOx	CL = 50pF RL = 500Ω	2.0	5.2	2.0	6.2	1.5	3.7	—	—	ns
tpZH tpZL	Output Enable Time		1.5	5.5	1.5	6.2	1.5	4.4	—	—	ns
tpHZ tPLZ	Output Disable Time		1.5	5.0	1.5	5.7	1.5	3.6	—	—	ns
tsu	Set-up Time HIGH or LOW, xDx to xCLK		2.0	—	2.0	—	1.5	—	—	—	ns
th	Hold Time HIGH or LOW, xDx to xCLK		1.5	—	1.5	—	0.0	—	—	—	ns
tw	xCLK Pulse Width HIGH or LOW		5.0	—	6.0	—	3.0 ⁽⁴⁾	—	—	—	ns
tsk(o)	Output Skew ⁽³⁾		—	0.5	—	0.5	—	0.5	—	—	ns

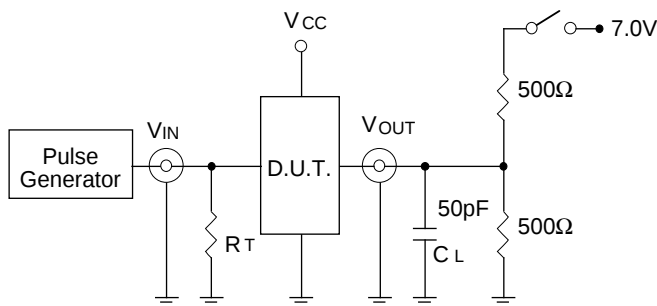
NOTES:

- See test circuit and waveforms.
- Minimum limits are guaranteed but not tested on Propagation Delays.
- Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.
- This limit is guaranteed but not tested.

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TEST CIRCUITS AND WAVEFORMS

TEST CIRCUITS FOR ALL OUTPUTS



2542 drw 05

SWITCH POSITION

Test	Switch
Open Drain Disable Low Enable Low	Closed
All Other Tests	Open

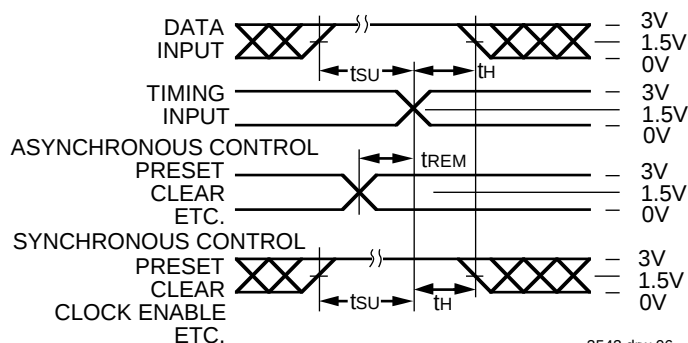
DEFINITIONS:

C_L = Load capacitance: includes jig and probe capacitance.

R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

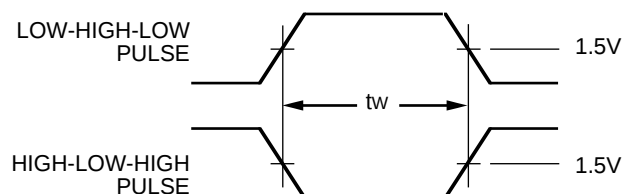
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SET-UP, HOLD AND RELEASE TIMES



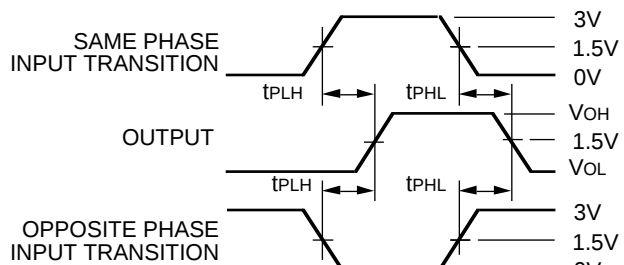
2542 drw 06

PULSE WIDTH



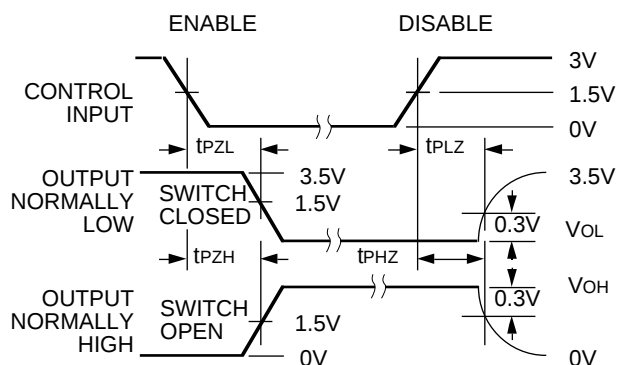
2542 drw 07

PROPAGATION DELAY



2542 drw 08

ENABLE AND DISABLE TIMES



NOTES:

- Diagram shown for input Control Enable-LOW and input Control Disable-HIGH
- Pulse Generator for All Pulses: Rate $\leq 1.0\text{MHz}$; $t_r \leq 2.5\text{ns}$; $t_f \leq 2.5\text{ns}$

2542 drw 09

ORDERING INFORMATION

IDT	XX	FCT	XXXX	X	X	
	Temp. Range		Device Type	Package	Process	
					Blank B	Commercial MIL-STD-883, Class B
					PV PA PF E	Shrink Small Outline Package (SO48-1) Thin Shrink Small Outline Package (SO48-2) Thin Very Small Outline Package (SO48-3) CERPACK (E48-1)
					16374T 16374AT 16374CT 16374ET 162374T 162374AT 162374CT 162374ET	Non-Inverting 16-Bit Register
					54 74	−55°C to +125°C −40°C to +85°C

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