



# 1.8V CMOS 16-BIT TRANSPARENT D-TYPE LATCH WITH 3-STATE OUTPUTS *IDT74AUC16373*

## FEATURES:

- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- 1.8V Optimized
- 0.8V to 2.7V Operating Range
- Inputs/outputs tolerant up to 3.6V
- Output drivers:  $\pm 9\text{mA}$  @ 2.3V
- Supports hot insertion
- Available in TSSOP, TVSOP, and VFBGA packages

## APPLICATIONS:

- high performance, low voltage communications systems
- high performance, low voltage computing systems

## DESCRIPTION:

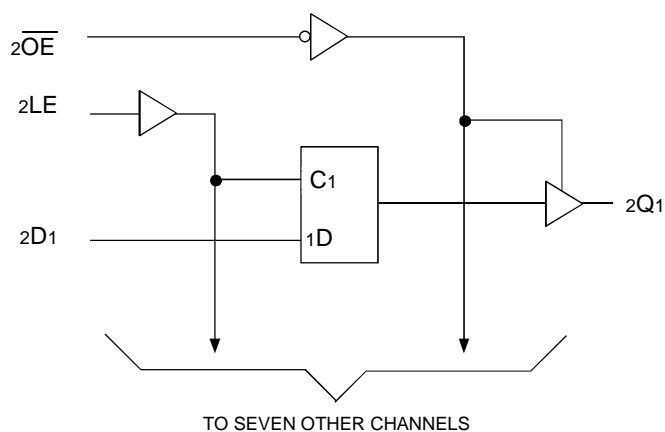
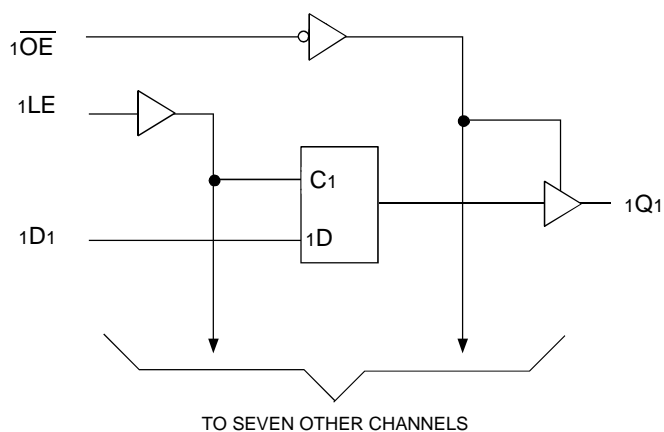
This 16-bit transparent D-type latch is built using advanced CMOS technology. The device can be used as a single 16-bit latch or as two 8-bit latches. When the latch enable (LE) input is high, the Q outputs follow the data (D) inputs. When LE is taken low, the Q outputs are latched at the levels set up at the D inputs.

A buffered output enable ( $\overline{\text{OE}}$ ) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The  $\overline{\text{OE}}$  input does not affect the internal operation of the latch.

This device is fully specified for partial power-down applications using I<sub>OFF</sub>. The I<sub>OFF</sub> circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

To ensure the high-impedance state during power up or power down,  $\overline{\text{OE}}$  should be tied to V<sub>DD</sub> through a pull-up resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

## FUNCTIONAL BLOCK DIAGRAM



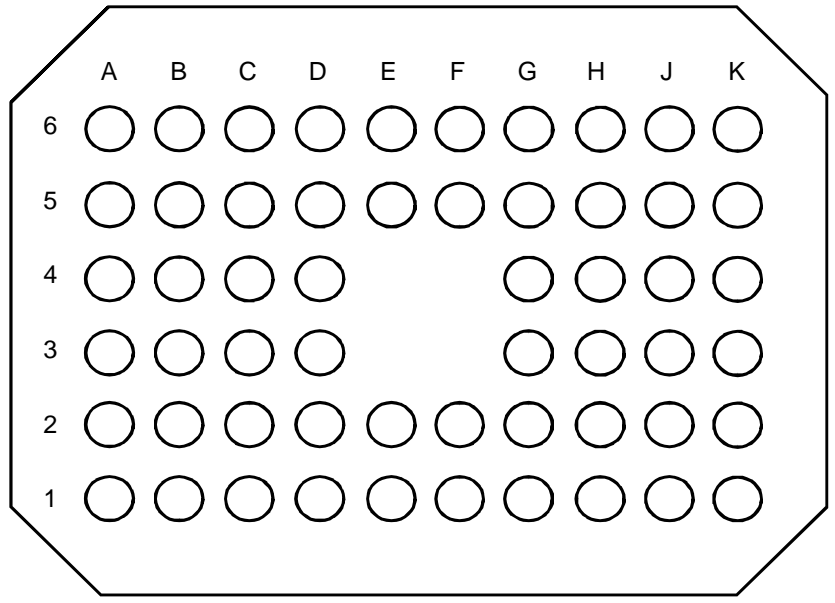
**PINOUT CONFIGURATION**

6	1LE	1D2	1D4	1D6	1D8	2D1	2D3	2D5	2D7	2LE
5	NC	1D1	1D3	1D5	1D7	2D2	2D4	2D6	2D8	NC
4	NC	GND	V <sub>DD</sub>	GND			GND	V <sub>DD</sub>	GND	NC
3	NC	GND	V <sub>DD</sub>	GND			GND	V <sub>DD</sub>	GND	NC
2	NC	1Q1	1Q3	1Q5	1Q7	2Q2	2Q4	2Q6	2Q8	NC
1	1 $\overline{OE}$	1Q2	1Q4	1Q6	1Q8	2Q1	2Q3	2Q5	2Q7	2 $\overline{OE}$
	A	B	C	D	E	F	G	H	J	K

**VFBGA**

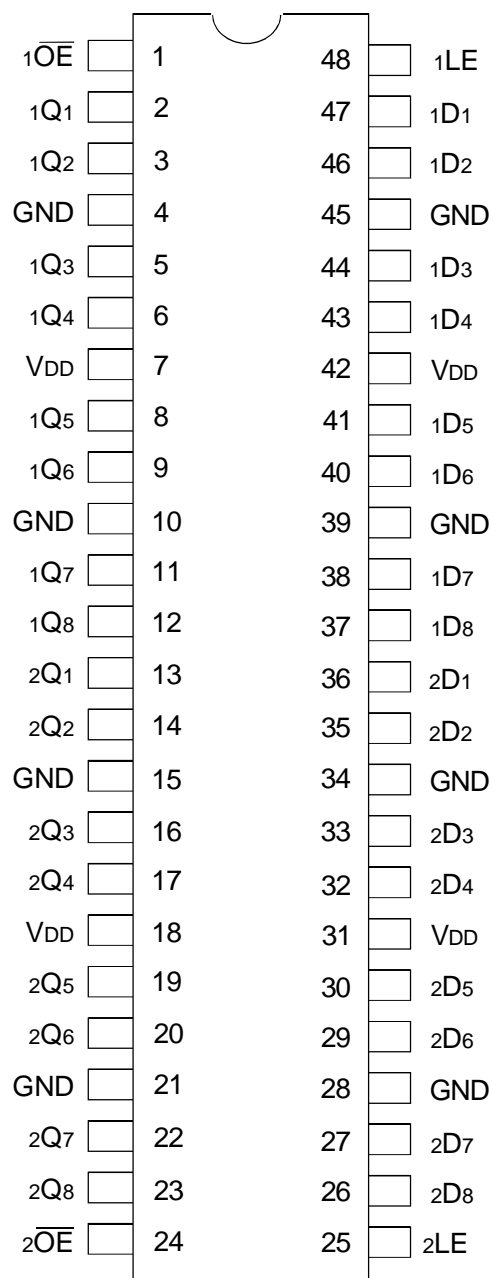
**NOTE:**  
 NC = No Internal Connection

**56 BALL VFBGA PACKAGE LAYOUT**



**TOP VIEW**

## PIN CONFIGURATION



TSSOP/ TVSOP  
TOP VIEW

## PIN DESCRIPTION

Pin Names	Description
xDx	Data Inputs
xLE	Latch Enable Inputs
xQx	3-State Outputs
xOE	3-State Output Enable Inputs (Active LOW)

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

Symbol	Description	Max	Unit
VTERM	Terminal Voltage with Respect to GND (all input and VDD terminals)	-0.5 to +3.6	V
VTERM	Terminal Voltage with Respect to GND (any I/O or Output terminals in high-impedance or power-off state)	-0.5 to +3.6	V
TSTG	Storage Temperature	-65 to +150	°C
IOUT	Continuous DC Output Current	±20	mA
I <sub>IK</sub>	Continuous Clamp Current, V <sub>i</sub> < 0, or V <sub>i</sub> > VDD	±50	mA
I <sub>OK</sub>	Continuous Clamp Current, V <sub>o</sub> < 0	-50	mA
I <sub>DD</sub> I <sub>SS</sub>	Continuous Current through each VDD or GND	±100	mA

### NOTE:

- 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.

## CAPACITANCE (T<sub>A</sub> = +25°C, f = 1.0MHz, VDD = 2.5V)

Symbol	Parameter	Conditions	Typ.	Max.	Unit
C <sub>IN</sub> <sup>(1)</sup>	Input Capacitance	V <sub>IN</sub> = 0V	3	4	pF
C <sub>OUT</sub> <sup>(2)</sup>	Output Capacitance	V <sub>OUT</sub> = 0V	5.5	6.5	pF
C <sub>I</sub> <sup>(3)</sup>	Input Port Capacitance	V <sub>IN</sub> = 0V	3	4	pF

### NOTES:

- Applies to Control Inputs.
- Applies to Data Outputs.
- Applies to Data Inputs.

## FUNCTION TABLE (EACH 8-BIT LATCH)<sup>(1)</sup>

Inputs			Output
xOE	xLE	xDx	xQx
L	H	H	H
L	H	L	L
L	L	X	Q <sup>(2)</sup>
H	X	X	Z

### NOTES:

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

- Level of Q before the indicated steady-state conditions were established.

RECOMMENDED OPERATING CHARACTERISTICS<sup>(1)</sup>

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
V <sub>DD</sub>	Supply Voltage		0.8	2.7	V
V <sub>IH</sub>	Input HIGH Voltage Level	V <sub>DD</sub> = 0.8V	V <sub>DD</sub>	—	V
		V <sub>DD</sub> = 1.1V to 1.3V	0.65 x V <sub>DD</sub>	—	
		V <sub>DD</sub> = 1.4V to 1.6V	0.65 x V <sub>DD</sub>	—	
		V <sub>DD</sub> = 1.65V to 1.95V	0.65 x V <sub>DD</sub>	—	
		V <sub>DD</sub> = 2.3V to 2.7V	1.7	—	
V <sub>IL</sub>	Input LOW Voltage Level	V <sub>DD</sub> = 0.8V	—	0	V
		V <sub>DD</sub> = 1.1V to 1.3V	—	0.35 x V <sub>DD</sub>	
		V <sub>DD</sub> = 1.4V to 1.6V	—	0.35 x V <sub>DD</sub>	
		V <sub>DD</sub> = 1.65V to 1.95V	—	0.35 x V <sub>DD</sub>	
		V <sub>DD</sub> = 2.3V to 2.7V	—	0.7	
V <sub>I</sub>	Input Voltage		0	2.7	V
V <sub>O</sub>	Output Voltage	Active State	0	V <sub>DD</sub>	V
		3-State	0	2.7	
I <sub>OH</sub>	HIGH Level Output Current	V <sub>DD</sub> = 0.8V	—	-0.7	mA
		V <sub>DD</sub> = 1.1V	—	-3	
		V <sub>DD</sub> = 1.4V	—	-5	
		V <sub>DD</sub> = 1.65V	—	-8	
		V <sub>DD</sub> = 2.3V	—	-9	
I <sub>OL</sub>	LOW Level Output Current	V <sub>DD</sub> = 0.8V	—	0.7	mA
		V <sub>DD</sub> = 1.1V	—	3	
		V <sub>DD</sub> = 1.4V	—	5	
		V <sub>DD</sub> = 1.65V	—	8	
		V <sub>DD</sub> = 2.3V	—	9	
Δt/Δv	Input Transition Rise or Fall Time		—	20	ns/V
T <sub>A</sub>	Operating Free-Air Temperature		-40	+85	°C

## NOTE:

- All unused inputs of the device must be held at V<sub>DD</sub> or GND to ensure proper operation.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE<sup>(1)</sup>

Following Conditions Apply Unless Otherwise Specified:

Operating Conditions: T<sub>A</sub> = -40°C to +85°C

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
I <sub>IH</sub> I <sub>IL</sub>	Input HIGH or LOW Current All Inputs	V <sub>DD</sub> = 2.7V, V <sub>I</sub> = V <sub>DD</sub> or GND	—	—	±5	μA	
I <sub>OFF</sub>	Input/Output Power Off Leakage	V <sub>DD</sub> = 0V, V <sub>IN</sub> or V <sub>O</sub> ≤ 2.7V	—	—	±10	μA	
I <sub>OZH</sub> I <sub>OZL</sub>	High Impedance Output Current (3-State Output Pins)	V <sub>DD</sub> = 2.7V					
			V <sub>O</sub> = V <sub>DD</sub>	—	—	±10	μA
			V <sub>O</sub> = GND	—	—	±10	μA
I <sub>DDL</sub> I <sub>BDDH</sub> I <sub>DDZ</sub>	Quiescent Power Supply Current	V <sub>DD</sub> = 0.8V to 2.7V V <sub>IN</sub> = GND or V <sub>DD</sub>	—	—	20	μA	

## NOTE:

- All unused inputs of the device must be held at V<sub>DD</sub> or GND to ensure proper operation.

## OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ.	Max.	Unit
V <sub>OH</sub>	Output HIGH Voltage	V <sub>DD</sub> = 0.8V - 2.7V	I <sub>OH</sub> = -100μA	V <sub>DD</sub> - 0.1	—	—	V
		V <sub>DD</sub> = 0.8V	I <sub>OH</sub> = -0.7mA	—	0.55	—	
		V <sub>DD</sub> = 1.1V <sup>(2)</sup>	I <sub>OH</sub> = -3mA	0.8	—	—	
		V <sub>DD</sub> = 1.4V <sup>(3)</sup>	I <sub>OH</sub> = -5mA	1	—	—	
		V <sub>DD</sub> = 1.65V <sup>(4)</sup>	I <sub>OH</sub> = -8mA	1.2	—	—	
		V <sub>DD</sub> = 2.3V <sup>(5)</sup>	I <sub>OH</sub> = -9mA	1.8	—	—	
V <sub>OL</sub>	Output LOW Voltage	V <sub>DD</sub> = 0.8V - 2.7V	I <sub>OH</sub> = 100μA	—	—	0.2	V
		V <sub>DD</sub> = 0.8V	I <sub>OL</sub> = 0.7mA	—	0.25	—	
		V <sub>DD</sub> = 1.1V <sup>(2)</sup>	I <sub>OL</sub> = 3mA	—	—	0.3	
		V <sub>DD</sub> = 1.4V <sup>(3)</sup>	I <sub>OL</sub> = 5mA	—	—	0.4	
		V <sub>DD</sub> = 1.65V <sup>(4)</sup>	I <sub>OL</sub> = 8mA	—	—	0.45	
		V <sub>DD</sub> = 2.3V <sup>(5)</sup>	I <sub>OL</sub> = 9mA	—	—	0.6	

**NOTES:**

- V<sub>IL</sub> and V<sub>IH</sub> must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS table for the appropriate V<sub>DD</sub> range. T<sub>A</sub> = -40°C to +85°C.
- Demonstrates operation for nominal V<sub>DD</sub> = 1.2V.
- Demonstrates operation for nominal V<sub>DD</sub> = 1.5V.
- Demonstrates operation for nominal V<sub>DD</sub> = 1.8V.
- Demonstrates operation for nominal V<sub>DD</sub> = 2.5V.

## OPERATING CHARACTERISTICS, T<sub>A</sub> = 25°C

Symbol	Parameter	Test Conditions	V <sub>DD</sub> = 0.8V	V <sub>DD</sub> = 1.2V	V <sub>DD</sub> = 1.5V	V <sub>DD</sub> = 1.8V	V <sub>DD</sub> = 2.5V	Unit
CPD	Power Dissipation Capacitance Outputs Enabled	C <sub>L</sub> = 0pF f = 10MHz	21	22	23	25	29	pF
CPD	Power Dissipation Capacitance Outputs Disabled		5	5	6	7	10	pF

## SWITCHING CHARACTERISTICS<sup>(1)</sup>

Symbol	Parameter	V <sub>DD</sub> = 0.8V	V <sub>DD</sub> = 1.2V±0.1V		V <sub>DD</sub> = 1.5V±0.1V		V <sub>DD</sub> = 1.8V±0.15V			V <sub>DD</sub> = 2.5V±0.2V		Unit	
		Typ.	Min.	Max.	Min.	Max.	Min.	Typ.	Max.	Min.	Max.		
t <sub>PLH</sub>	Propagation Delay	x <sub>D</sub> x to x <sub>Q</sub> x	8	1.1	3.8	0.6	2.4	0.7	1.5	2.4	0.6	1.9	ns
t <sub>PHL</sub>			x <sub>LE</sub> to x <sub>Q</sub> x	10.6	1.4	4.9	0.7	3.2	0.7	1.6	2.8	0.6	
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time x <sub>OE</sub> to x <sub>Q</sub> x	9	1.3	4.5	0.6	2.9	0.8	1.7	2.9	0.7	2.2	ns	
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time x <sub>OE</sub> to x <sub>Q</sub> x	13	2.4	7	2.4	4.8	1.1	2.7	4.6	0.4	2.5	ns	
t <sub>SJ</sub>	Set-up Time, Data before LE↓	1.7	0.7	—	0.5	—	0.4	—	—	0.4	—	ns	
t <sub>H</sub>	Hold Time, Data after LE↓	—	1.2	—	0.8	—	0.7	—	—	0.6	—	ns	
t <sub>w</sub>	Pulse Duration, LE HIGH	4.2	2.9	—	2.3	—	2.1	—	—	1.7	—	ns	

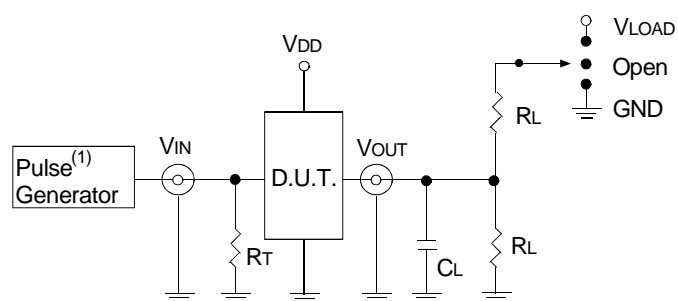
**NOTE:**

- See TEST CIRCUITS AND WAVEFORMS. T<sub>A</sub> = -40°C to +85°C.

## TEST CIRCUITS AND WAVEFORMS

TEST CONDITIONS<sup>(1)</sup>

Symbol	V <sub>DD</sub> = 0.8V	V <sub>DD</sub> = 1.2V±0.1V	V <sub>DD</sub> = 1.5V±0.1V	V <sub>DD</sub> = 1.8V±0.15V	V <sub>DD</sub> = 2.5V±0.2V	Unit
V <sub>LOAD</sub>	2xV <sub>DD</sub>	2xV <sub>DD</sub>	2xV <sub>DD</sub>	2xV <sub>DD</sub>	2xV <sub>DD</sub>	V
V <sub>T</sub>	V <sub>DD</sub> /2	V <sub>DD</sub> /2	V <sub>DD</sub> /2	V <sub>DD</sub> /2	V <sub>DD</sub> /2	V
V <sub>LZ</sub>	100	100	100	150	150	mV
V <sub>HZ</sub>	100	100	100	150	150	mV
R <sub>L</sub>	2	2	2	1	0.5	KΩ
C <sub>L</sub>	15	15	15	30	30	pF



Test Circuits for All Outputs

## DEFINITIONS:

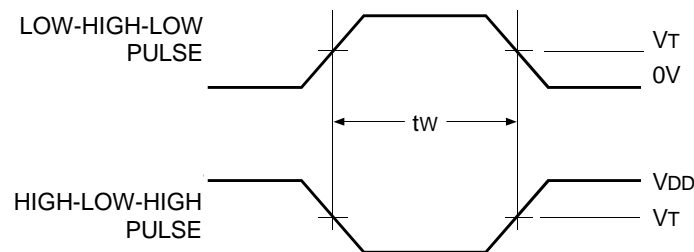
C<sub>L</sub> = Load capacitance: includes jig and probe capacitance.R<sub>T</sub> = Termination resistance: should be equal to Z<sub>OUT</sub> of the Pulse Generator.

## NOTE:

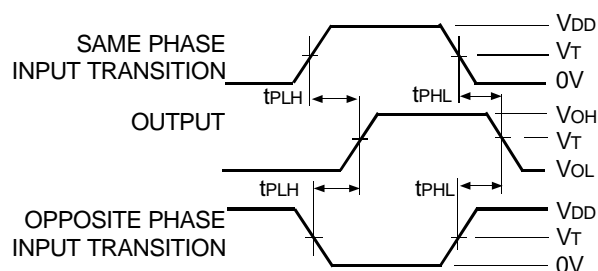
1. Pulse Generator for All Pulses: Rate ≤ 10MHz; Slew Rate ≥ 1V/ns.

## SWITCH POSITION

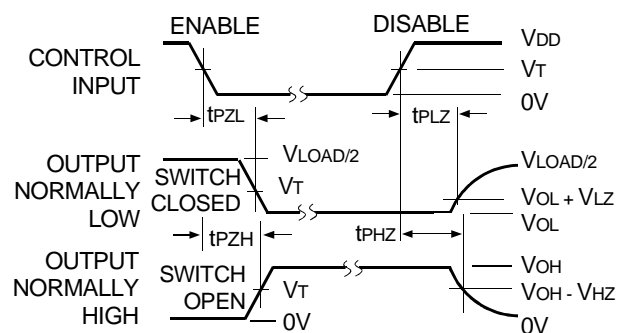
Test	Switch
Open Drain Disable Low Enable Low	V <sub>LOAD</sub>
Disable High Enable High	GND
All Other Tests	Open



Pulse Width



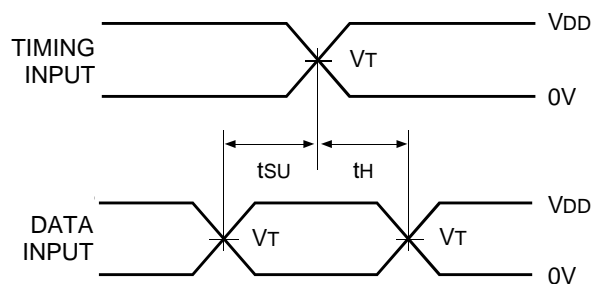
Propagation Delay



## NOTE:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.

Enable and Disable Times



Setup and Hold Times

## ORDERING INFORMATION

IDT	XX	AUC	X	XX	XXX	XX	X	
Temp. Range	Bus- Hold	Family	Device Type	Package	Temp.			
							I	Industrial Temperature Range
							BV	Very Fine Pitch Ball Grid Array
							PA	Thin Shrink Small Outline Package
							PF	Thin Very Small Outline Package
					373			16-Bit Transparent D-Type Latch with 3-State Outputs
				16				Double-Density
			Blank					No bus-hold
							74	-40°C to +85°C



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