3.3V CMOS 20-BIT FLIP-FLOP WITH 3-STATE OUTPUTS AND BUS-HOLD

IDT74ALVCH16721

FEATURES:

- 0.5 MICRON CMOS Technology
- Typical $t_{SK(o)}$ (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- V_{CC} = 3.3V ± 0.3V, Normal Range
- V_{CC} = 2.7V to 3.6V, Extended Range
- V_{CC} = 2.5V ± 0.2V
- CMOS power levels (0.4µ W typ. static)
- Rail-to-Rail output swing for increased noise margin
- Available in TSSOP package

DRIVE FEATURES:

- High Output Drivers: ±24mA
- Low switching noise

APPLICATIONS:

- 3.3V high speed systems
- 3.3V and lower voltage computing systems

DESCRIPTION:

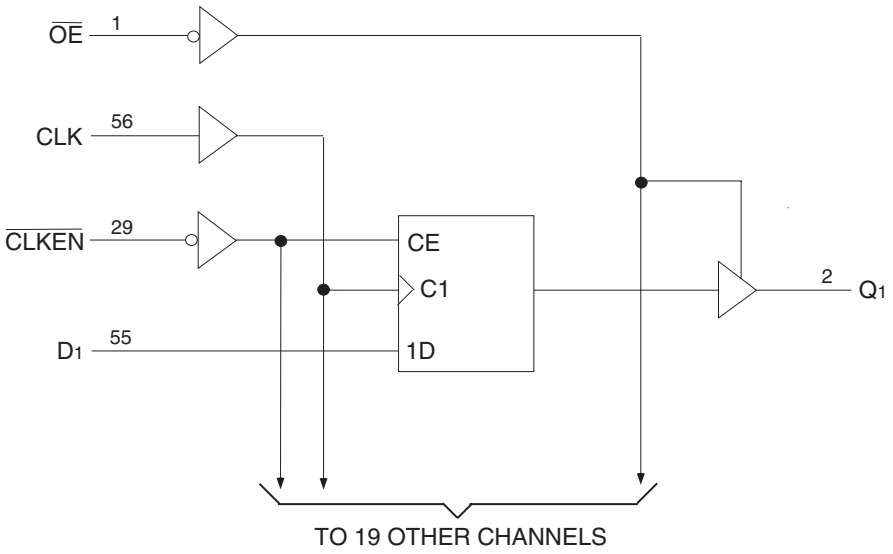
This 20-bit flip-flop is built using advanced dual metal CMOS technology. The 20 flip-flops of the ALVCH16721 are edge-triggered D-type flip-flops with qualified clock storage. On the positive transition of the clock (CLK) input, the device provides true data at the Q outputs if the clock-enable ($\overline{CLKEN}$) input is low. If $\overline{CLKEN}$ is high, no data is stored.

A buffered output-enable ($\overline{OE}$) input places the 20 outputs in either a normal logic state (high or low) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capability to drive bus lines without need for interface or pullup components. $\overline{OE}$ does not affect the internal operation of the flip-flops. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

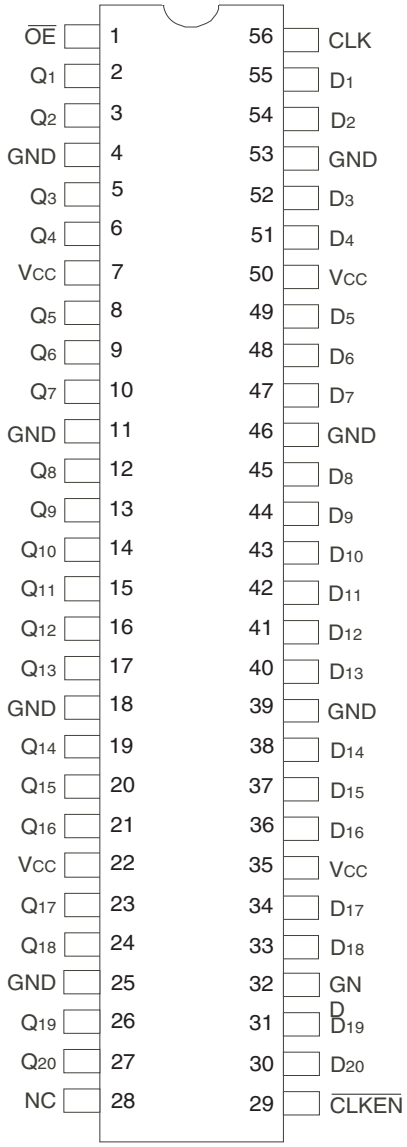
The ALVCH16721 has been designed with a ±24mA output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

The ALVCH16721 has "bus-hold" which retains the inputs' last state whenever the input goes to a high impedance. This prevents floating inputs and eliminates the need for pull-up/down resistor.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



TSSOP
TOP VIEW

ABSOLUTE MAXIMUM RATINGS(1)

Symbol	Description	Max	Unit
V_{TERM}(2)	Terminal Voltage with Respect to GND	–0.5 to +4.6	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	–50 to +50	mA
I_{IK}	Continuous Clamp Current, $V_I < 0$ or $V_I > V_{CC}$	±50	mA
I_{OK}	Continuous Clamp Current, $V_O < 0$	–50	mA
I_{CC} I_{SS}	Continuous Current through each V_{CC} or GND	±100	mA

NOTES:
1. 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.
2. V_{CC} terminals.
3. All terminals except V_{CC}.

CAPACITANCE (T_A = +25°C, F = 1.0MHz)

Symbol	Parameter(1)	Conditions	Typ.	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	5	7	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	7	9	pF
$C_{I/O}$	I/O Port Capacitance	V_{IN} = 0V	7	9	pF

NOTE:
1. As applicable to the device type.

PIN DESCRIPTION

Pin Names	Description
$\overline{OE}$	3–State Output Enable Input (Active LOW)
Dx	Data Inputs(1)
Qx	3-State Outputs
CLK	Clock Input
$\overline{CLKEN}$	Clock Enable Input (Active LOW)
NC	No Internal Connection

NOTE:
1. These pins have "Bus-Hold". All other pins are standard inputs, outputs, or I/Os.

FUNCTION TABLE (EACH FLIP-FLOP)(1)

Inputs				Output
$\overline{OE}$	$\overline{CLKEN}$	CLK	Dx	Qx
L	H	X	X	Q_0(2)
L	L	↑	H	H
L	L	↑	L	L
L	L	L or H	X	Q_0(2)
H	X	X	X	Z

NOTES:
1. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
   Z = High Impedance
   ↑ = LOW-to-HIGH transition
2. Output level before the indicated steady-state input conditions were established.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:
Operating Condition: T_A = –40°C to +85°C

Symbol	Parameter	Test Conditions		Min.	Typ.(1)	Max.	Unit
V_{IH}	Input HIGH Voltage Level	V_{CC} = 2.3V to 2.7V		1.7	—	—	V
		V_{CC} = 2.7V to 3.6V		2	—	—	
V_{IL}	Input LOW Voltage Level	V_{CC} = 2.3V to 2.7V		—	—	0.7	V
		V_{CC} = 2.7V to 3.6V		—	—	0.8	
I_{IH}	Input HIGH Current	V_{CC} = 3.6V	V_I = V_{CC}	—	—	±5	µA
I_{IL}	Input LOW Current	V_{CC} = 3.6V	V_I = GND	—	—	±5	µA
I_{OZH}	High Impedance Output Current	V_{CC} = 3.6V	V_O = V_{CC}	—	—	±10	µA
I_{OZL}	(3-State Output pins)		V_O = GND	—	—	±10	
V_{IK}	Clamp Diode Voltage	V_{CC} = 2.3V, I_{IN} = –18mA		—	–0.7	–1.2	V
V_H	Input Hysteresis	V_{CC} = 3.3V		—	100	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CC} = 3.6V V_{IN} = GND or V_{CC}		—	0.1	40	µA
ΔI_{CC}	Quiescent Power Supply Current Variation	One input at V_{CC} - 0.6V, other inputs at V_{CC} or GND		—	—	750	µA

NOTE:
1. Typical values are at V_{CC} = 3.3V, +25°C ambient.

BUS-HOLD CHARACTERISTICS

Symbol	Parameter(1)	Test Conditions		Min.	Typ.(2)	Max.	Unit
I_{BHH}	Bus-Hold Input Sustain Current	V_{CC} = 3V	V_I = 2V	–75	—	—	µA
I_{BHL}			V_I = 0.8V	75	—	—	
I_{BHH}	Bus-Hold Input Sustain Current	V_{CC} = 2.3V	V_I = 1.7V	–45	—	—	µA
I_{BHL}			V_I = 0.7V	45	—	—	
I_{BHHO}	Bus-Hold Input Overdrive Current	V_{CC} = 3.6V	V_I = 0 to 3.6V	—	—	±500	µA
I_{BHLO}							

NOTES:
1. Pins with Bus-Hold are identified in the pin description.
2. Typical values are at V_{CC} = 3.3V, +25°C ambient.

OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions[1]		Min.	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC} = 2.3V to 3.6V	I_{OH} = – 0.1mA	V_{CC} – 0.2	—	V
		V_{CC} = 2.3V	I_{OH} = – 6mA	2	—	
		V_{CC} = 2.3V	I_{OH} = – 12mA	1.7	—	
		V_{CC} = 2.7V		2.2	—	
		V_{CC} = 3V		2.4	—	
		V_{CC} = 3V	I_{OH} = – 24mA	2	—	
V_{OL}	Output LOW Voltage	V_{CC} = 2.3V to 3.6V	I_{OL} = 0.1mA	—	0.2	V
		V_{CC} = 2.3V	I_{OL} = 6mA	—	0.4	
			I_{OL} = 12mA	—	0.7	
		V_{CC} = 2.7V	I_{OL} = 12mA	—	0.4	
		V_{CC} = 3V	I_{OL} = 24mA	—	0.55	

NOTE:
1. V_{IH} and V_{IL} must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate V_{CC} range. T_A = – 40°C to + 85°C.

OPERATING CHARACTERISTICS, T_A = 25°C

Symbol	Parameter	Test Conditions	Vcc = 2.5V ± 0.2V	Vcc = 3.3V ± 0.3V	Unit
			Typical	Typical	
C_{PD}	Power Dissipation Capacitance Outputs enabled	C_L = 0pF, f = 10Mhz	55	59	pF
C_{PD}	Power Dissipation Capacitance Outputs disabled		46	49	

SWITCHING CHARACTERISTICS[1]

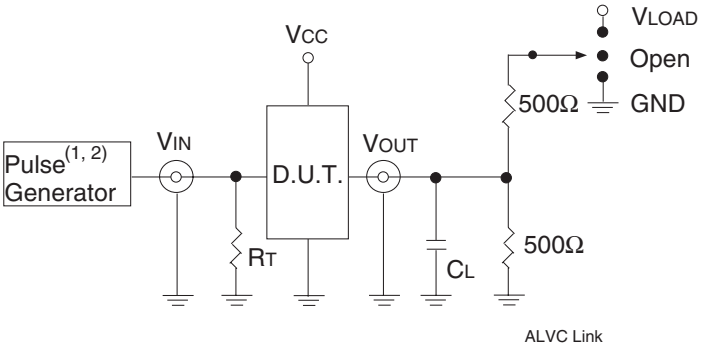
Symbol	Parameter	Vcc = 2.5V ± 0.2V		Vcc = 2.7V		Vcc = 3.3V ± 0.3V		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
f_{MAX}		150	—	150	—	150	—	MHz
t_{PLH} t_{PHL}	Propagation Delay CLK to Qx	1	5.6	1	5.1	1	4.3	ns
t_{PZH} t_{PZL}	Output Enable Time $\overline{OE}$ to Qx	1	6.1	1	5.8	1	4.8	ns
t_{PHZ} t_{PLZ}	Output Disable Time $\overline{OE}$ to Qx	1	5.5	1	4.7	1	4.4	ns
t_{SU}	Set-up Time, data before CLK↑	4	—	3.6	—	3.1	—	ns
t_{SU}	Set-up Time, $\overline{CLKEN}$ before CLK↑	3.4	—	3.1	—	2.7	—	ns
t_H	Hold Time, data after CLK↑	0	—	0	—	0	—	ns
t_H	Hold Time, $\overline{CLKEN}$ after CLK↑	0	—	0	—	0	—	ns
t_W	Pulse Width, CLK HIGH or LOW	3.3	—	3.3	—	3.3	—	ns
$t_{SK(O)}$	Output Skew[2]	—	—	—	—	—	500	ps

NOTES:
1. See TEST CIRCUITS AND WAVEFORMS. T_A = – 40°C to + 85°C.
2. Skew between any two outputs of the same package and switching in the same direction.

TEST CIRCUITS AND WAVEFORMS

TEST CONDITIONS

Symbol	$V_{CC}^{(1)}$=3.3V±0.3V	$V_{CC}^{(1)}$=2.7V	$V_{CC}^{(2)}$=2.5V±0.2V	Unit
V_{LOAD}	6	6	2 x Vcc	V
V_{IH}	2.7	2.7	Vcc	V
V_T	1.5	1.5	Vcc / 2	V
V_{LZ}	300	300	150	mV
V_{HZ}	300	300	150	mV
C_L	50	50	30	pF



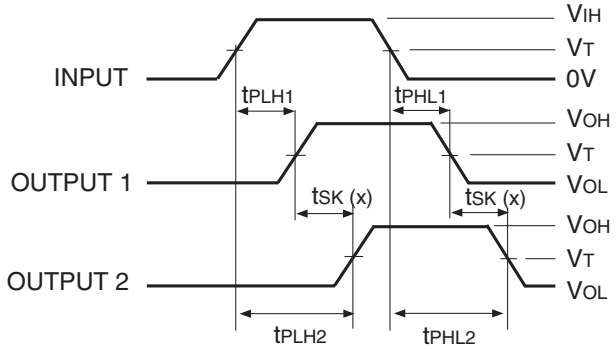
Test Circuit for All Outputs

DEFINITIONS:
C_L = Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

NOTES:
1. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t_F ≤ 2ns; t_R ≤ 2ns.

SWITCH POSITION

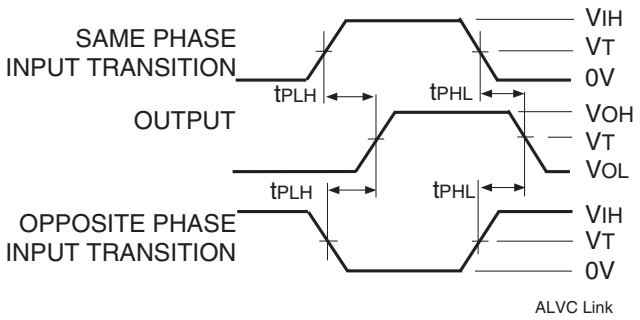
Test	Switch
Open Drain Disable Low Enable Low	V_{LOAD}
Disable High Enable High	GND
All Other Tests	Open



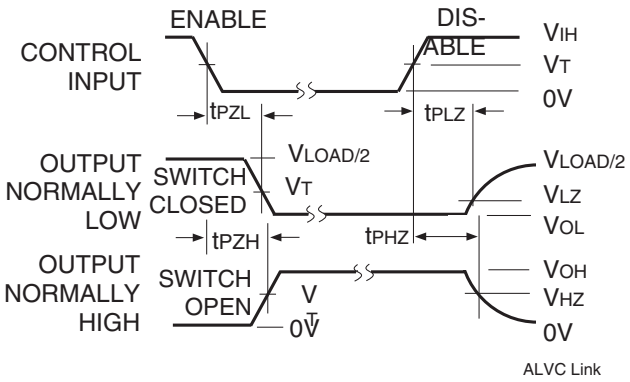
$t_{SK(x)} = |t_{PLH2} - t_{PLH}|$ or $|t_{PHL2} - t_{PHL}|$

Output Skew - $t_{SK(x)}$

NOTES:
1. For $t_{SK(o)}$ OUTPUT1 and OUTPUT2 are any two outputs.
2. For $t_{SK(b)}$ OUTPUT1 and OUTPUT2 are in the same bank.

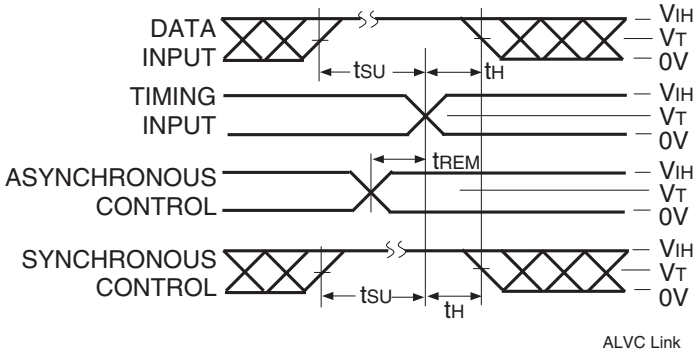


Propagation Delay

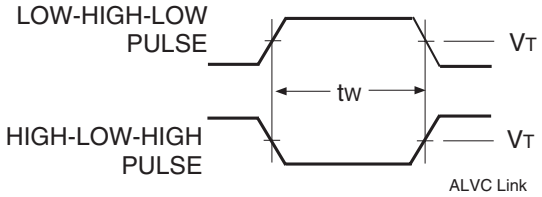


Enable and Disable Times

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

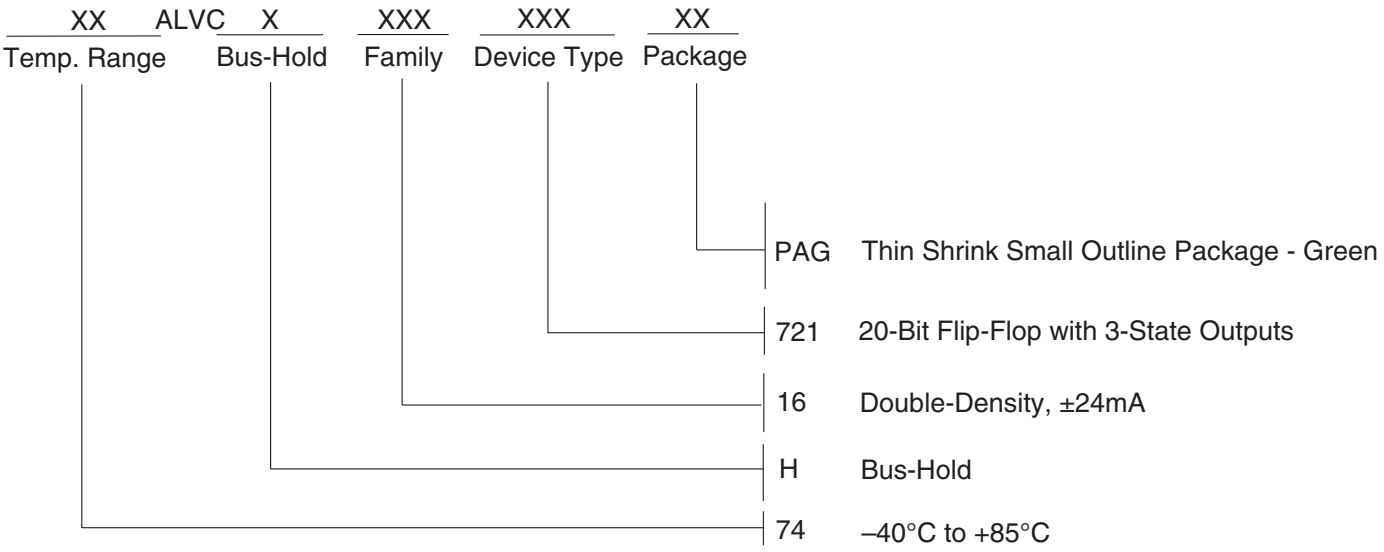


Set-up, Hold, and Release Times



Pulse Width

ORDERING INFORMATION



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