3.3V CMOS 36-BIT REGISTERED TRANSCEIVER WITH 5 VOLT TOLERANT I/O AND BUS-HOLD

IDT74LVCH32501A

FEATURES:

- Typical $t_{SK(o)}$ (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- 0.8mm pitch LFBGA package, 114 balls
- Extended commercial range of -40°C to +85°C
- V_{CC} = 3.3V ±0.3V, Normal Range
- V_{CC} = 2.7V to 3.6V, Extended Range
- CMOS power levels (0.4µW typ. static)
- All inputs, outputs and I/O are 5 Volt tolerant
- Supports hot insertion

Drive Features for LVCH32501A:

- High Output Drivers: ±24mA
- Reduced system switching noise

APPLICATIONS:

- 5V and 3.3V mixed voltage systems
- Data communication and telecommunication systems

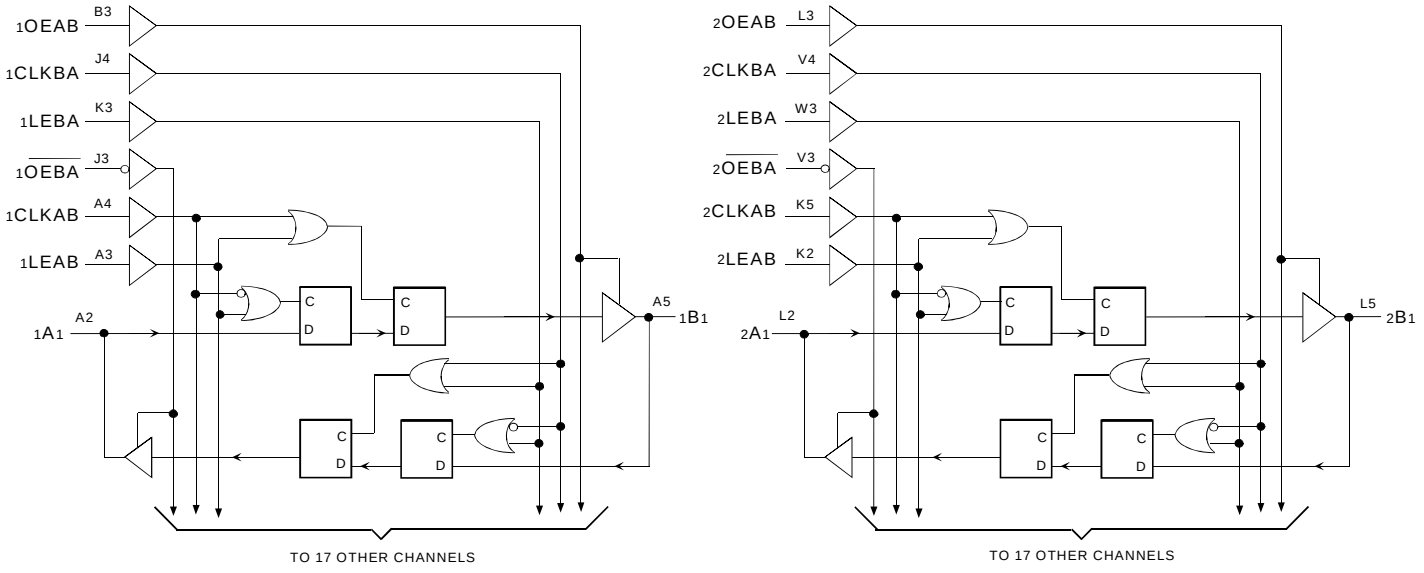
DESCRIPTION:

This 36-bit registered transceiver is built using advanced dual metal CMOS technology. This device combines D-type latches and D-type flip-flops to allow data flow in transparent, latched, and clocked modes. Data flow in each direction is controlled by output-enable (OEAB and $\overline{OEBA}$), latch enable (LEAB and LEBA), and clock (CLKAB and CLKBA) inputs. For A-to-B data flow, the device operates in transparent mode when LEAB is HIGH. When LEAB is LOW, the A data is latched if CLKAB is held at a HIGH or LOW logic level. If LEAB is LOW, the A bus data is stored in the latch/flip-flop on the LOW-to-HIGH transition of CLKAB. OEAB performs the output enable function on the B port. Data flow from B port to A port is similar but requires using $\overline{OEBA}$, LEBA and CLKBA. Flow-through organization of signal pins simplifies layout. All inputs are designed with hysteresis for improved noise margin.

The LVCH32501A has been designed with a ±24mA output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

The LVCH32501A 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 resistors.

FUNCTIONAL BLOCK DIAGRAM



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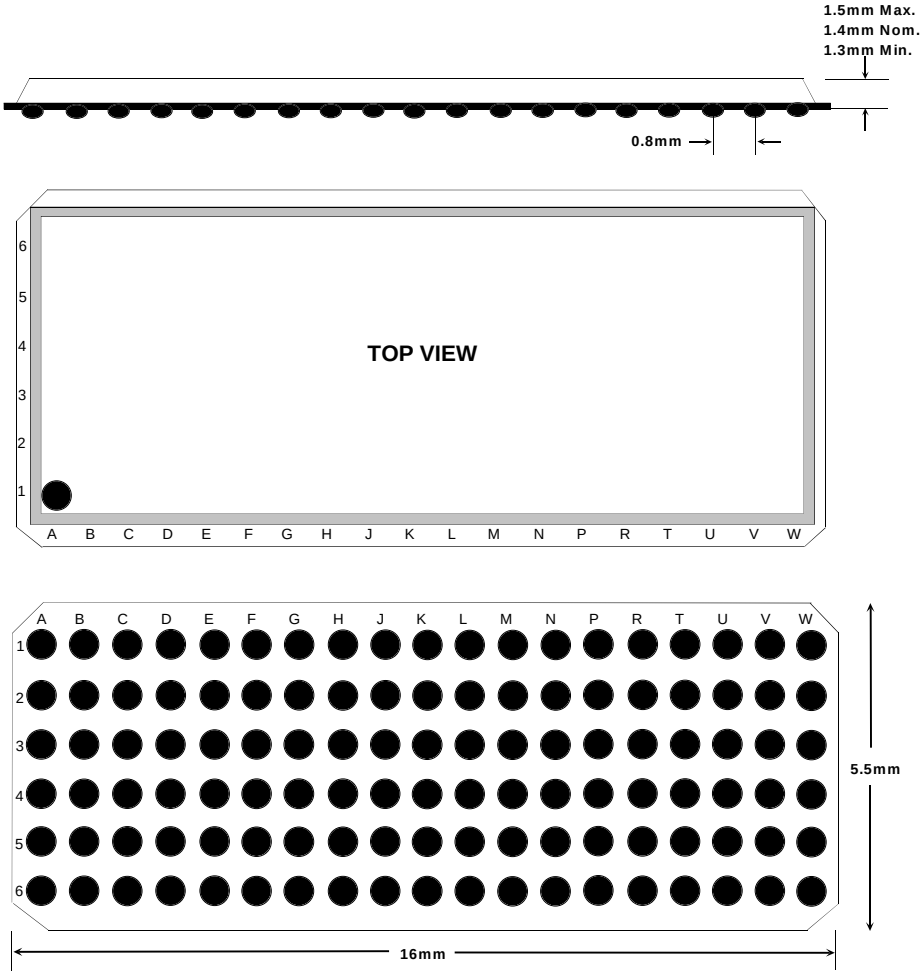
PIN CONFIGURATION

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	T	U	V	W
6	$1B_2$	$1B_4$	$1B_6$	$1B_8$	$1B_{10}$	$1B_{12}$	$1B_{14}$	$1B_{15}$	$1B_{17}$	NC	$2B_2$	$2B_4$	$2B_6$	$2B_8$	$2B_{10}$	$2B_{12}$	$2B_{14}$	$2B_{15}$	$2B_{17}$
5	$1B_1$	$1B_3$	$1B_5$	$1B_7$	$1B_9$	$1B_{11}$	$1B_{13}$	$1B_{16}$	$1B_{18}$	$2CLKAB$	$2B_1$	$2B_3$	$2B_5$	$2B_7$	$2B_9$	$2B_{11}$	$2B_{13}$	$2B_{16}$	$2B_{18}$
4	$1CLKAB$	GND	GND	V_{CC}	GND	GND	V_{CC}	GND	$1CLKBA$	GND	GND	GND	V_{CC}	GND	GND	V_{CC}	GND	$2CLKBA$	GND
3	$1LEAB$	$1OEAB$	GND	V_{CC}	GND	GND	V_{CC}	GND	$1\overline{OEBA}$	$1LEBA$	$2OEAB$	GND	VCC	GND	GND	VCC	GND	$2\overline{OEBA}$	$2LEBA$
2	$1A_1$	$1A_3$	$1A_5$	$1A_7$	$1A_9$	$1A_{11}$	$1A_{13}$	$1A_{16}$	$1A_{18}$	$2LEAB$	$2A_1$	$2A_3$	$2A_5$	$2A_7$	$2A_9$	$2A_{11}$	$2A_{13}$	$2A_{16}$	$2A_{18}$
1	$1A_2$	$1A_4$	$1A_6$	$1A_8$	$1A_{10}$	$1A_{12}$	$1A_{14}$	$1A_{15}$	$1A_{17}$	NC	$2A_2$	$2A_4$	$2A_6$	$2A_8$	$2A_{10}$	$2A_{12}$	$2A_{14}$	$2A_{15}$	$2A_{17}$

32501

LFBGA
TOP VIEW

114 BALL LFBGA PACKAGE ATTRIBUTES



ABSOLUTE MAXIMUM RATINGS (1)

Symbol	Description	Max.	Unit
V_{TERM}	Terminal Voltage with Respect to GND	– 0.5 to +6.5	V
T_{STG}	Storage Temperature	– 65 to +150	°C
I_{OUT}	DC Output Current	– 50 to +50	mA
I_{IK} I_{OK}	Continuous Clamp Current, $V_I < 0$ or $V_O < 0$	– 50	mA
I_{CC} I_{SS}	Continuous Current through each V_{CC} or GND	±100	mA

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NOTE:
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.

CAPACITANCE (T_A = +25°C, f = 1.0MHz)

Symbol	Parameter(1)	Conditions	Typ.	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	4.5	6	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	6.5	8	pF
$C_{I/O}$	I/O Port Capacitance	V_{IN} = 0V	6.5	8	pF

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NOTE:
1. As applicable to the device type.

PIN DESCRIPTION

Pin Names	Description
OEAB	A-to-B Output Enable Input
$\overline{OEBA}$	B-to-A Output Enable Input (Active LOW)
LEAB	A-to-B Latch Enable Input
LEBA	B-to-A Latch Enable Input
CLKAB	A-to-B Clock Input
CLKBA	B-to-A Clock Input
Ax	A-to-B Data Inputs or B-to-A 3-State Outputs(1)
Bx	B-to-A Data Inputs or A-to-B 3-State Outputs(1)

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

FUNCTION TABLE (1, 2)

Inputs				Outputs
OEAB	LEAB	CLKAB	Ax	Bx
L	X	X	X	Z
H	H	X	L	L
H	H	X	H	H
H	L	↑	L	L
H	L	↑	H	H
H	L	L	X	B(3)
H	L	H	X	B(4)

NOTES:
1. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
   Z = High Impedance
   ↑ = LOW-to-HIGH Transition
2. A-to-B data flow is shown. B-to-A data flow is similar but uses $\overline{OEBA}$, LEBA, and CLKBA.
3. Output level before the indicated steady-state input conditions were established.
4. Output level before the indicated steady-state input conditions were established, provided that CLKAB was HIGH before LEAB went LOW.

BUS-HOLD CHARACTERISTICS

Symbol	Parameter(1)	Test Conditions		Min.	Typ.(2)	Max.	Unit
I_{BHH}	Bus-Hold Input Sustain Current	V_{CC} = 3.0V	V_I = 2.0V	– 75	—	—	µA
I_{BHL}			V_I = 0.8V	75	—	—	
I_{BHH}	Bus-Hold Input Sustain Current	V_{CC} = 2.3V	V_I = 1.7V	—	—	—	µA
I_{BHL}			V_I = 0.7V	—	—	—	
I_{BHHO}	Bus-Hold Input Overdrive Current	V_{CC} = 3.6V	V_I = 0 to 3.6V	—	—	± 500	µA
I_{BHLO}							

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

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} I_{IL}	Input Leakage Current	V_{CC} = 3.6V	V_I = 0 to 5.5V	—	—	±5	µA
I_{OZH} I_{OZL}	High Impedance Output Current (3-State Output pins)	V_{CC} = 3.6V	V_O = 0 to 5.5V	—	—	±10	µA
I_{OFF}	Input/Output Power Off Leakage	V_{CC} = 0V, V_{IN} or $V_O \leq$ 5.5V		—	—	±50	µA
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}	—	—	10	µA
			$3.6 \leq V_{IN} \leq 5.5V$(2)	—	—	10	
ΔI_{CC}	Quiescent Power Supply Current Variation	One input at V_{CC} - 0.6V other inputs at V_{CC} or GND		—	—	500	µA

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NOTES:
1. Typical values are at V_{CC} = 3.3V, +25°C ambient.
2. This applies in the disabled state only.

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} = 3.0V		2.4	—	
		V_{CC} = 3.0V	I_{OH} = – 24mA	2.2	—	
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} = 3.0V	I_{OL} = 24mA	—	0.55	

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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, V_{CC} = 3.3V ± 0.3V, T_A = 25°C

Symbol	Parameter	Test Conditions	Typical	Unit
C_{PD}	Power Dissipation Capacitance per transceiver Outputs enabled	C_L = 0pF, f = 10Mhz		pF
C_{PD}	Power Dissipation Capacitance per transceiver Outputs disabled			pF

SWITCHING CHARACTERISTICS (1)

Symbol	Parameter		V_{CC} = 2.7V		V_{CC} = 3.3V±0.3V		Unit
			Min.	Max.	Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay Ax to Bx or Bx to Ax		1.5	5.2	1.5	4.6	ns
t_{PLH} t_{PHL}	Propagation Delay LEBA to Ax, LEAB to Bx		1.5	6	1.5	5.3	ns
t_{PLH} t_{PHL}	Propagation Delay CLKBA to Ax, CLKAB to Bx		1.5	6	1.5	5.3	ns
t_{PZH} t_{PZL}	Output Enable Time $\overline{OEBA}$ to Ax, OEAB to Bx		1.5	6	1.5	5.6	ns
t_{PHZ} t_{PLZ}	Output Disable Time $\overline{OEBA}$ to Ax, OEAB to Bx		1.5	6.5	1.5	5.8	ns
t_{SU}	Set-up Time, HIGH or LOW Ax to CLKAB, Bx to CLKBA		3	—	3	—	ns
t_H	Hold Time, HIGH or LOW Ax to CLKAB, Bx to CLKBA		0	—	0	—	ns
t_{SU}	Set-up Time HIGH or LOW	Clock LOW	3	—	3	—	ns
	Ax to LEAB, Bx to LEBA	Clock HIGH	2	—	2	—	ns
t_H	Hold Time HIGH or LOW Ax to LEAB, Bx to LEBA		1.5	—	1.5	—	ns
t_W	LEAB or LEBA Pulse Width HIGH		3	—	3	—	ns
t_W	CLKAB or CLKBA Pulse Width HIGH or LOW		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

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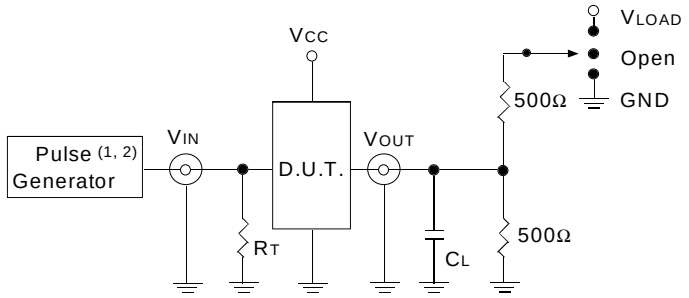
TEST CIRCUITS FOR ALL OUTPUTS



DEFINITIONS: LVC Link

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

NOTE:

1. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 10MHz; 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

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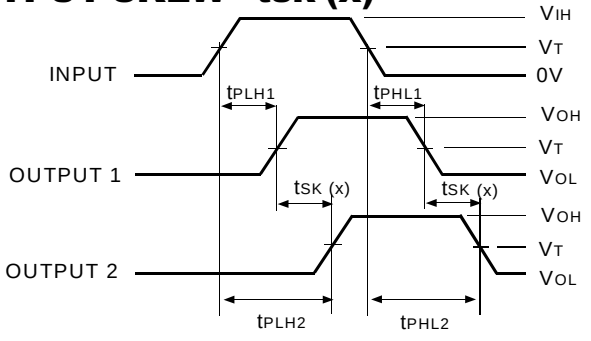
OUTPUT SKEW - tsk (x)

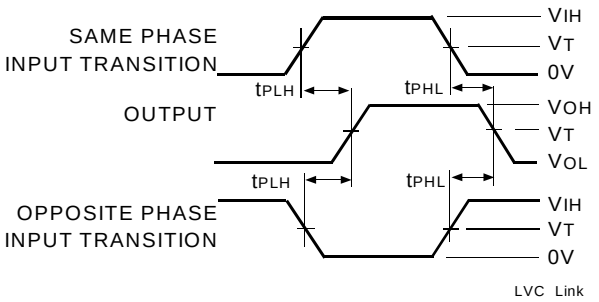


$t_{SK(x)} = |t_{PLH2} - t_{PLH1}|$ or $|t_{PHL2} - t_{PHL1}|$

NOTES: LVC Link

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



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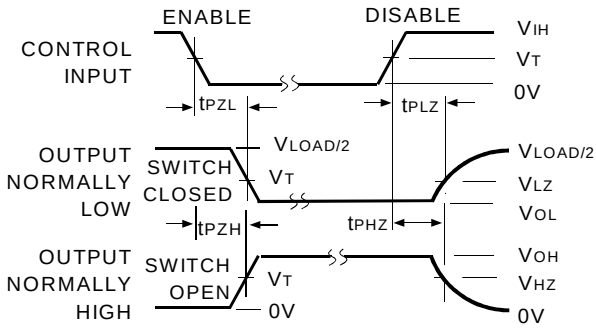
ENABLE AND DISABLE TIMES



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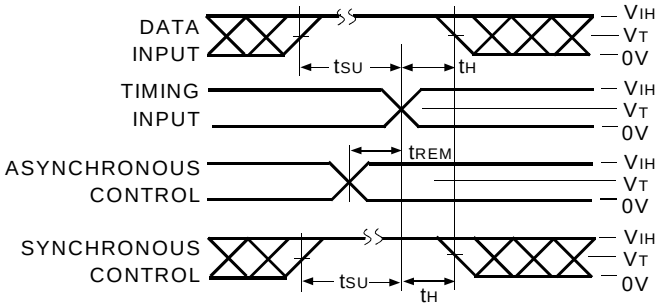
NOTE:

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

SET-UP, HOLD, AND RELEASE TIMES



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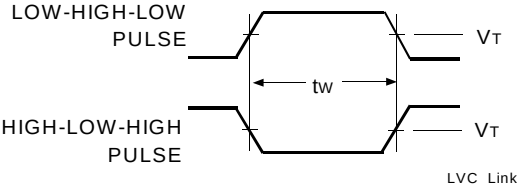
PULSE WIDTH



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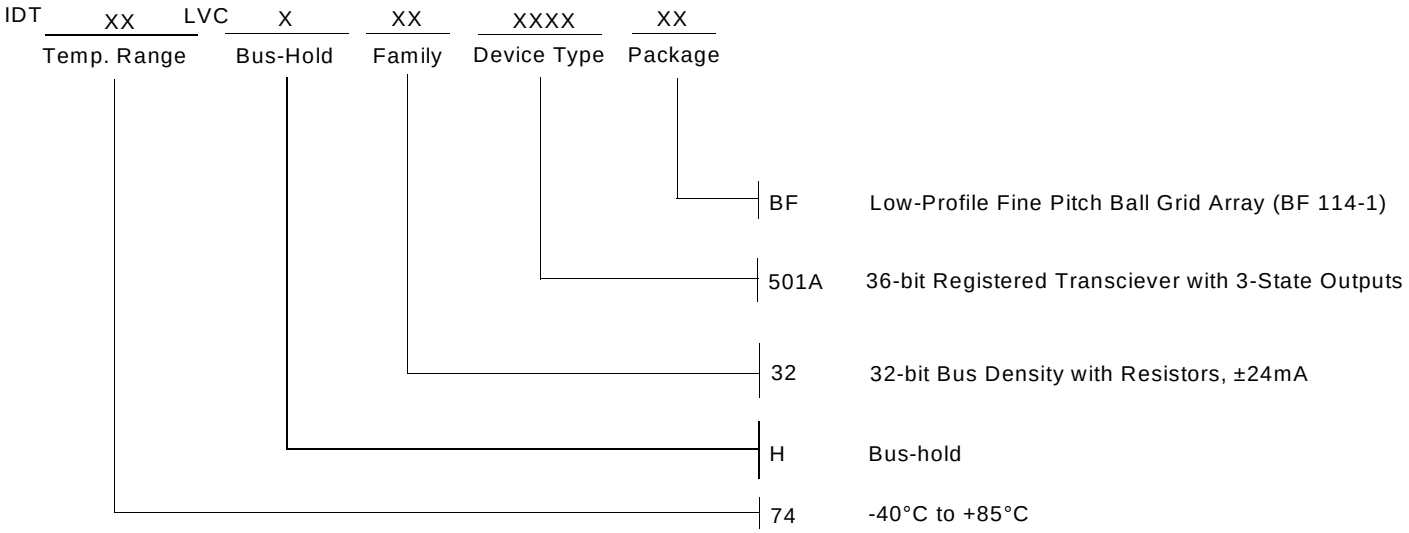
ORDERING INFORMATION



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