3.3V CMOS 16-BIT REGISTERED TRANSCEIVER WITH 3-STATE OUTPUTS, 5 VOLT TOLERANT I/O, BUS-HOLD

IDT74LVCHR16543A

FEATURES:

- Typical $t_{SK(0)}$ (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- 0.635mm pitch SSOP, 0.50mm pitch TSSOP and 0.40mm pitch TVSOP packages
- 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 LVCHR16543A:

- Balanced Output Drivers: ±12 mA
- Low switching noise

APPLICATIONS:

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

DESCRIPTION:

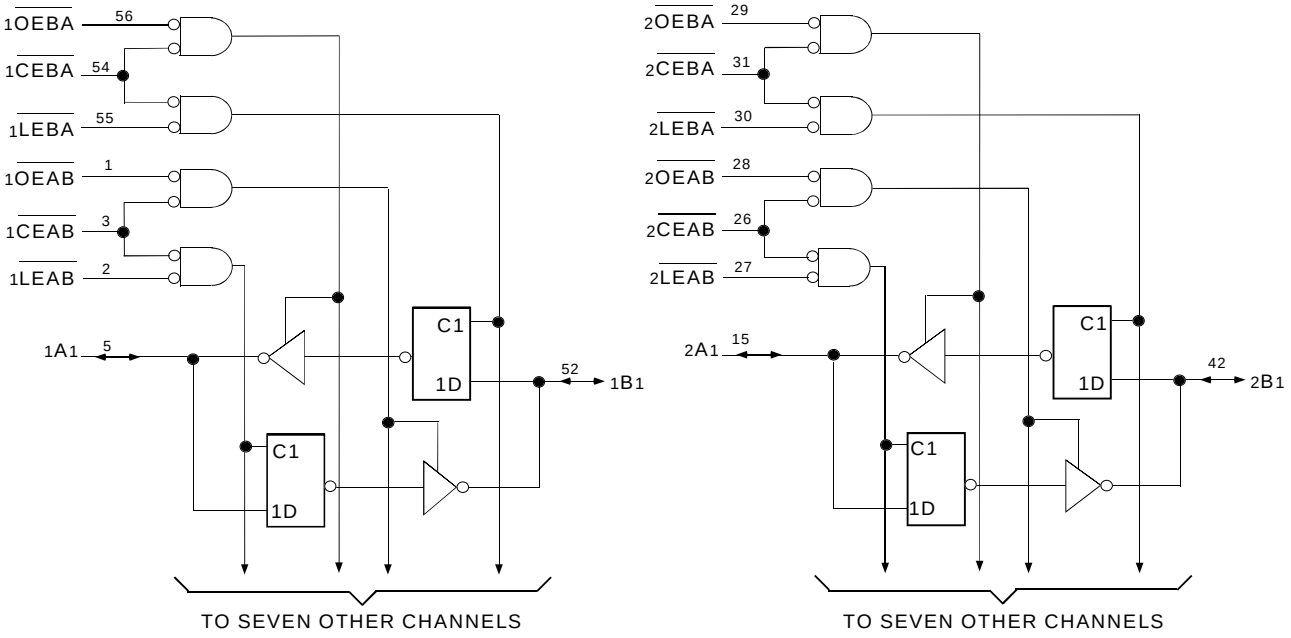
The LVCHR16543A 16-bit registered transceiver is built using advanced dual metal CMOS technology. The LVCHR16543A device can be used as two independent 8-bit transceivers or one 16-bit transceiver. Separate latch-enable ($\overline{LEAB}$ or $\overline{LEBA}$) and output-enable($\overline{OEAB}$ or $\overline{OEBA}$) inputs are provided for each register to permit independent control in either direction of data flow. The A-to-B enable ($\overline{CEAB}$) must be low in order to enter data from A or to output data from B. If $\overline{CEAB}$ is low and $\overline{LEAB}$ is low, the A-to-B latches are transparent; a subsequent low-to-high transition of $\overline{LEAB}$ puts the A latches in the storage mode. With $\overline{CEAB}$ and $\overline{OEAB}$ both low, the 3-state B outputs are active and reflect the data present at the output of the A latches. Data flow from B to A is similar, but requires using the $\overline{CEBA}$, $\overline{LEBA}$, and $\overline{OEBA}$ inputs. To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to Vcc through a pullup resistor; the minmum value of the resistor is determined by the current sinking capability of the driver.

The LVCHR16543A has series resistors in the device output structure which will significantly reduce line noise when used with light loads. The driver has been designed to drive ±12mA at the designated threshold levels.

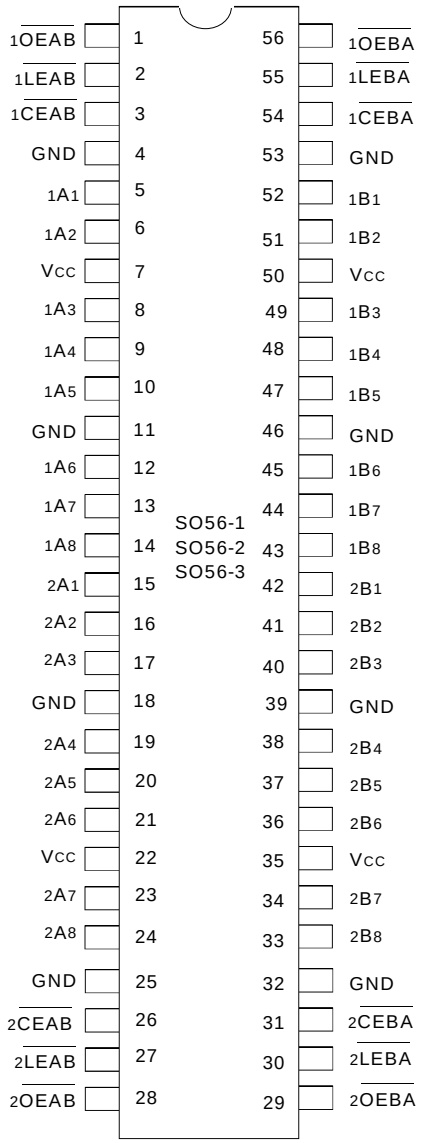
Inputs can be driven from either 3.3V or 5V devices. This feature allows the use of this device as a translator in a mixed 3.3V/5V supply system.

The LVCHR16543A has "bus-hold" which retains the input's 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



PIN CONFIGURATION



SSOP/ TSSOP/ TVSOP
TOP VIEW

PIN DESCRIPTION

Pin Names	Description
x$\overline{OEAB}$	A-to-B Output Enable Input (Active LOW)
x$\overline{OEBA}$	B-to-A Output Enable Input (Active LOW)
x$\overline{CEAB}$	A-to-B Enable Input (Active LOW)
x$\overline{CEBA}$	B-to-A Enable Input (Active LOW)
x$\overline{LEAB}$	A-to-B Latch Enable Input (Active LOW)
x$\overline{LEBA}$	B-to-A Latch Enable Input (Active LOW)
xAx	A-to-B Data Inputs or B-to-A 3-State Outputs(1)
xBx	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.

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.

FUNCTION TABLE (each 8-bit section) (1, 2)

Inputs				Outputs
x$\overline{CEAB}$	x$\overline{LEAB}$	x$\overline{OEAB}$	xAx	xBx
H	X	X	X	Z
X	X	H	X	Z
L	H	L	X	B_0(3)
L	L	L	L	L
L	L	L	H	H

NOTES:
1. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
   Z = High-Impedance
2. A-to-B data flow is shown; B-to-A flow control is the same except using $\overline{CEBA}$, $\overline{LEBA}$, and $\overline{OEBA}$.
3. Before $\overline{LEAB}$ LOW-to-HIGH Transition

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}	Quiescent Power Supply Current	V_{CC} = 3.6V	V_{IN} = GND or V_{CC}	—	—	10	µA
I_{CCZ}			$3.6 \leq V_{IN} \leq 5.5V$(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.

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.

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} = – 4mA	1.9	—	
			I_{OH} = – 6mA	1.7	—	
		V_{CC} = 2.7V	I_{OH} = – 4mA	2.2	—	
			I_{OH} = – 8mA	2	—	
		V_{CC} = 3.0V	I_{OH} = – 6mA	2.4	—	
			I_{OH} = – 12mA	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} = 4mA	—	0.4	
			I_{OL} = 6mA	—	0.55	
		V_{CC} = 2.7V	I_{OL} = 4mA	—	0.4	
			I_{OL} = 8mA	—	0.6	
		V_{CC} = 3.0V	I_{OL} = 6mA	—	0.55	
			I_{OL} = 12mA	—	0.8	

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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	Vcc = 2.7V		Vcc = 3.3V±0.3V		Unit
		Min.	Max.	Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay xAx to xBx or xBx to xAx	1.5	7	1.5	6	ns
t_{PLH} t_{PHL}	Propagation Delay x$\overline{LEBA}$ to xAx, x$\overline{LEAB}$ to xBx	1.5	8	1.5	7	ns
t_{PZH} t_{PZL}	Output Enable Time x$\overline{CEBA}$ or x$\overline{CEAB}$ to xAx or xBx	1.5	9	1.5	8	ns
t_{PZH} t_{PZL}	Output Enable Time x$\overline{OEBA}$ or x$\overline{OEAB}$ to xAx or xBx	1.5	9	1.5	8	ns
t_{PHZ} t_{PLZ}	Output Disable Time x$\overline{CEBA}$ or x$\overline{CEAB}$ to xAx or xBx	1.5	7.5	1.5	6.5	ns
t_{PHZ} t_{PLZ}	Output Disable Time x$\overline{OEBA}$ or x$\overline{OEAB}$ to xAx or xBx	1.5	7.5	1.5	6.5	ns
t_{SU}	Set-up Time, data before $\overline{CE}\uparrow$	2	—	2	—	ns
t_{SU}	Set-up Time, data before $\overline{LE}\uparrow$, $\overline{CE}$ LOW	2	—	2	—	ns
t_H	Hold Time, data after $\overline{CE}\uparrow$	2	—	2	—	ns
t_H	Hold Time, data after $\overline{LE}\uparrow$, $\overline{CE}$ LOW	2	—	2	—	ns
t_W	Pulse Duration x$\overline{LEAB}$ or x$\overline{LEBA}$, x$\overline{CEAB}$ or x$\overline{CEBA}$ LOW	5	—	5	—	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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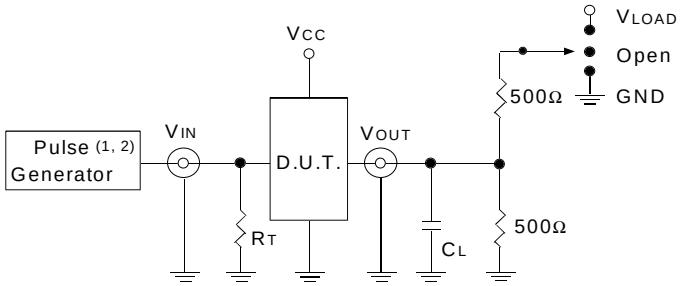
TEST CIRCUITS FOR ALL OUTPUTS



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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 ≤ 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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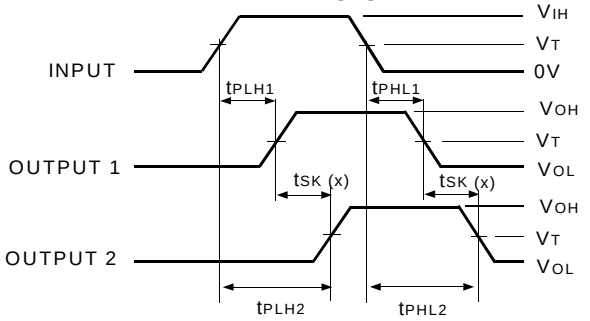
OUTPUT SKEW - tsk (x)



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

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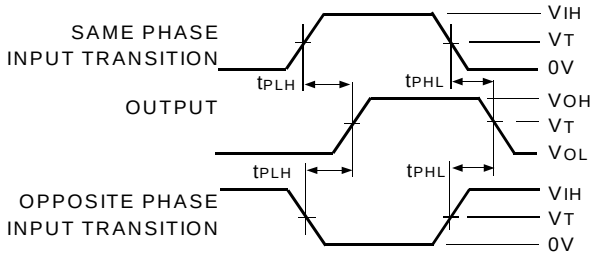
NOTES:

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



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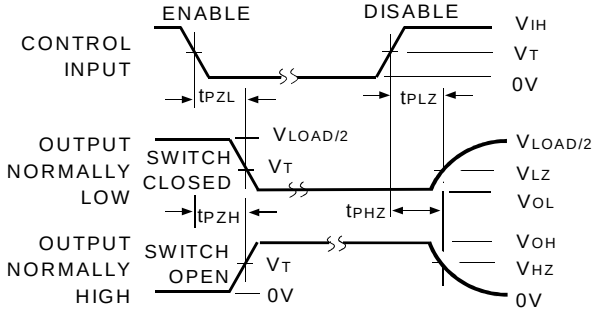
ENABLE AND DISABLE TIMES



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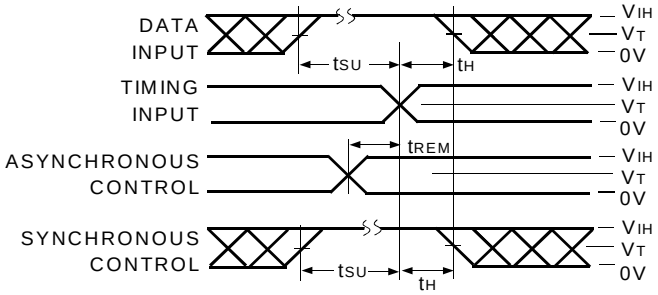
NOTE:

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

SET-UP, HOLD, AND RELEASE TIMES



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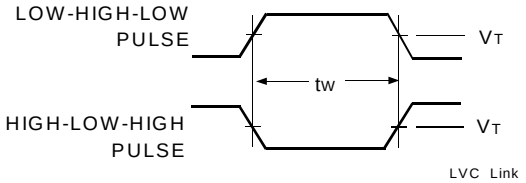
PULSE WIDTH



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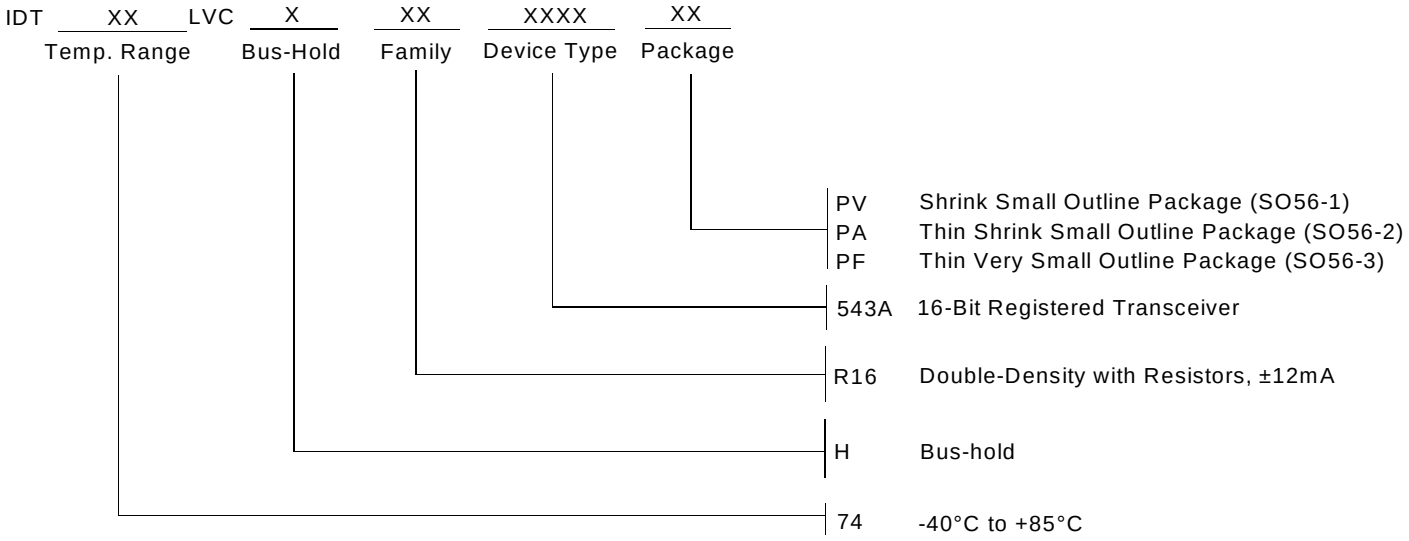
ORDERING INFORMATION



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