



FAST CMOS 8-INPUT UNIVERSAL SHIFT REGISTER

IDT54/74FCT299T/AT/CT

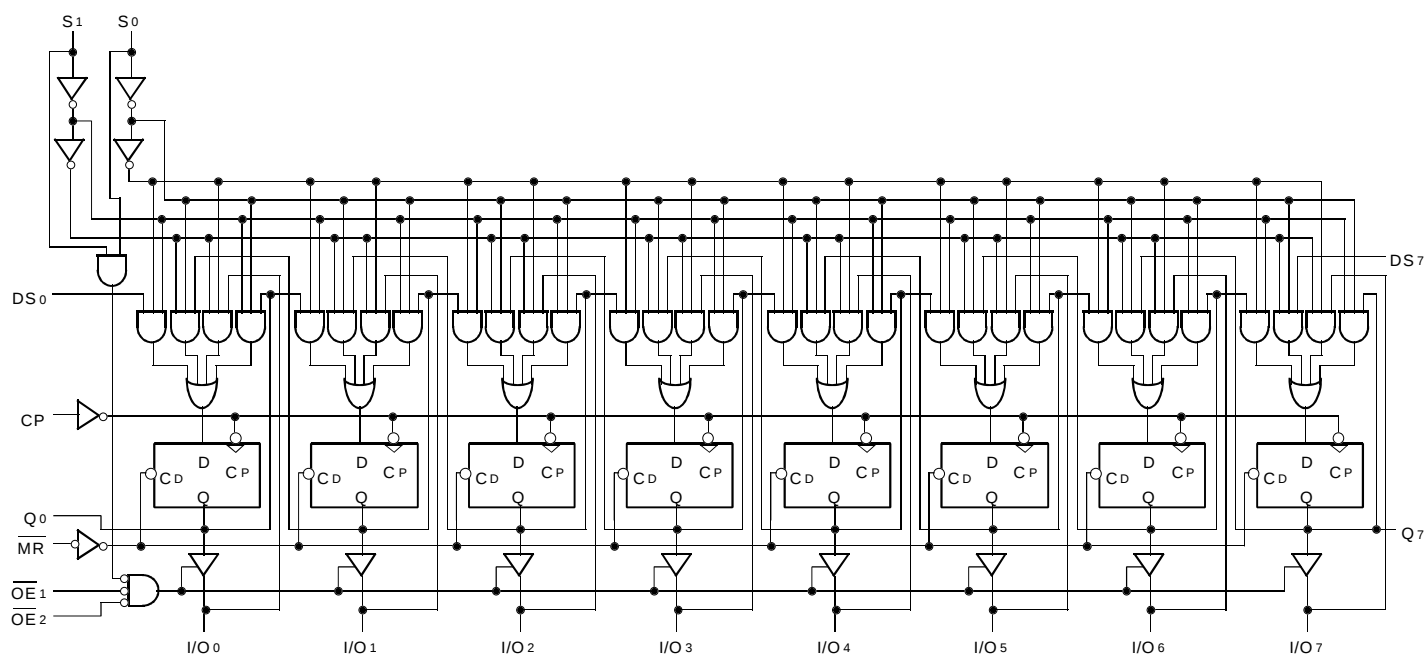
FEATURES:

- Std., A and C speed grades
- Low input and output leakage $\leq 1\mu\text{A}$ (max.)
- CMOS power levels
- True TTL input and output compatibility
 - $V_{OH} = 3.3\text{V}$ (typ.)
 - $V_{OL} = 0.3\text{V}$ (typ.)
- High drive outputs (-15mA IOH, 48mA IOL)
- Power off disable outputs permit "live insertion"
- Meets or exceeds JEDEC standard 18 specifications
- Military product compliant to MIL-STD-883, Class B and DESC listed (dual marked)
- Available in the following packages:
 - Industrial: SOIC, QSOP
 - Military: CERDIP, LCC, CERPACK

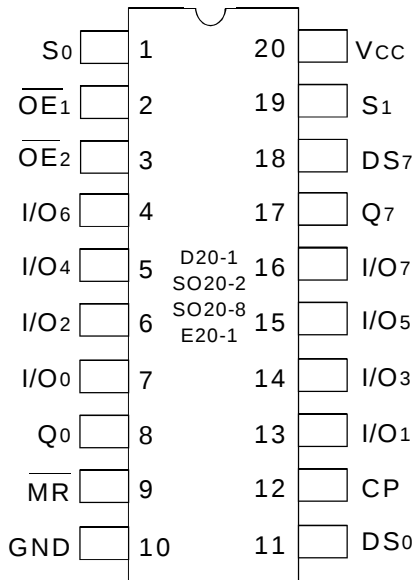
DESCRIPTION:

The FCT299T/AT/CT are built using an advanced dual metal CMOS technology. The FCT299T/AT/CT are 8-input universal shift/storage registers with 3-state outputs. Four modes of operation are possible: hold (store), shift left, shift right and load data. The parallel load inputs and flip-flop outputs are multiplexed to reduce the total number of package pins. Additional outputs are provided for flip-flops Q₀ and Q₇ to allow easy serial cascading. A separate active low Master Reset is used to reset the register.

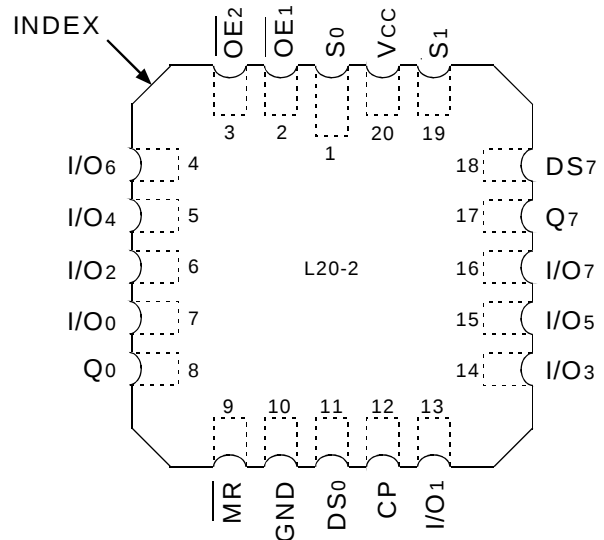
FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



CERDIP/ SOIC/ QSOP/ CERPACK
TOP VIEW



LCC
TOP VIEW

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Rating	Max.	Unit
V _{TERM} ⁽²⁾	Terminal Voltage with Respect to GND	−0.5 to +7	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

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NOTES:

- 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. No terminal voltage may exceed V_{CC} by +0.5V unless otherwise noted.
- Inputs and V_{CC} terminals only.
- Outputs and I/O terminals only.

CAPACITANCE (T_A = +25°C, f = 1.0MHz)

Symbol	Parameter ⁽¹⁾	Conditions	Typ.	Max.	Unit
C _{IN}	Input Capacitance	V _{IN} = 0V	6	10	pF
C _{OUT}	Output Capacitance	V _{OUT} = 0V	8	12	pF

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NOTE:

- This parameter is measured at characterization but not tested.

PIN DESCRIPTION

Pin Names	Description
CP	Clock Pulse Input (Active Edge Rising)
DS0	Serial Data Input for Right Shift
DS7	Serial Data Input for Left Shift
S0, S1	Mode Select Inputs
MR	Asynchronous Master Reset Input (Active LOW)
OE1, OE2	3-State Output Enable Inputs (Active LOW)
I/O0–I/O7	Parallel Data Inputs or 3-State Parallel Outputs
Q0, Q7	Serial Outputs

FUNCTION TABLE⁽¹⁾

Inputs				Response
MR	S1	S0	CP	
L	X	X	X	Asynchronous Reset Q0–Q7 = LOW
H	H	H	↑	Parallel Load; I/O _n → Q _n
H	L	H	↑	Shift Right; DS0 → Q0, Q0 → Q1, etc.
H	H	L	↑	Shift Left; DS7 → Q7, Q7 → Q6, etc.
H	L	L	X	Hold

NOTE:

- H = HIGH Voltage Level
L = LOW Voltage Level
X = Don't Care
↑ = LOW-to-HIGH clock transition

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Industrial: $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = 5.0\text{V} \pm 5\%$; 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	—	—	V
V_{IL}	Input LOW Level	Guaranteed Logic LOW Level		—	—	0.8	V
I_{IH}	Input HIGH Current ⁽⁴⁾	$V_{CC} = \text{Max.}$	$V_I = 2.7\text{V}$	—	—	± 1	μA
I_{IL}	Input LOW Current ⁽⁴⁾	$V_{CC} = \text{Max.}$	$V_I = 0.5\text{V}$	—	—	± 1	μA
I_I	Input HIGH Current ⁽⁴⁾	$V_{CC} = \text{Max.}, V_I = V_{CC} (\text{Max.})$		—	—	± 1	μA
V_{IK}	Clamp Diode Voltage	$V_{CC} = \text{Min.}, I_N = -18\text{mA}$		—	-0.7	-1.2	V
I_{OS}	Short Circuit Current	$V_{CC} = \text{Max.}^{(3)}, V_O = \text{GND}$		-60	-120	-225	mA
V_{OH}	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -6\text{mA MIL}$ $I_{OH} = -8\text{mA IND}$	2.4	3.3	—	V
			$I_{OH} = -12\text{mA MIL}$ $I_{OH} = -15\text{mA IND}$	2	3	—	
V_{OL}	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 32\text{mA MIL}$ $I_{OL} = 48\text{mA IND}$	—	0.3	0.5	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
V_H	Input Hysteresis	—		—	200	—	mV
I_{CC}	Quiescent Power Supply Current	$V_{CC} = \text{Max.}$ $V_{IN} = \text{GND or } V_{CC}$		—	0.01	1	mA

OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
V_{OH}	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -6\text{mA MIL}$ $I_{OH} = -8\text{mA IND}$	2.4	3.3	—	V
			$I_{OH} = -12\text{mA MIL}$ $I_{OH} = -15\text{mA IND}$	2	3	—	V
V_{OL}	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 48\text{mA MIL}$ $I_{OL} = 64\text{mA IND}$	—	0.3	0.55	V
I_{OS}	Short Circuit Current	$V_{CC} = \text{Max.}, V_O = \text{GND}^{(3)}$		-60	-120	-225	mA

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 shorted at one time. Duration of the short circuit test should not exceed one second.
- The test limit for this parameter is $\pm 5\mu\text{A}$ at $T_A = -55^{\circ}\text{C}$.
- This parameter is guaranteed but not tested.

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	2	mA
I_{CCD}	Dynamic Power Supply Current ⁽⁴⁾	$V_{CC} = \text{Max.}$ Outputs Open $\overline{OE}_1 = \overline{OE}_2 = \text{GND}$ $\overline{MR} = V_{CC}$ $S_0 = S_1 = V_{CC}$ $DS_0 = DS_1 = \text{GND}$ One Input Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	0.15	0.25	mA/MHz
I_C	Total Power Supply Current ⁽⁶⁾	$V_{CC} = \text{Max.}$ Outputs Open $f_{CP} = 10\text{MHz}$ 50% Duty Cycle $\overline{OE}_1 = \overline{OE}_2 = \text{GND}$ $\overline{MR} = V_{CC}$ $S_0 = S_1 = V_{CC}$ $DS_0 = DS_7 = \text{GND}$ One Bit Toggling at $f_i = 5\text{MHz}$ 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	1.5	3.5	mA
			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	2	5.5	
		$V_{CC} = \text{Max.}$ Outputs Open $f_{CP} = 10\text{MHz}$ 50% Duty Cycle $\overline{OE}_1 = \overline{OE}_2 = \text{GND}$ $\overline{MR} = V_{CC}$ $S_0 = S_1 = V_{CC}$ $DS_0 = DS_7 = \text{GND}$ Eight Bits Toggling at $f_i = 2.5\text{MHz}$ 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	3.8	7.3 ⁽⁵⁾	
			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	6	16.3 ⁽⁵⁾	

NOTES:

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at $V_{CC} = 5.0V$, $+25^\circ\text{C}$ 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.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_i N_i)$
 $I_{CC} = \text{Quiescent Current}$
 $\Delta I_{CC} = \text{Power Supply Current for a TTL High Input } (V_{IN} = 3.4V)$
 $D_H = \text{Duty Cycle for TTL Inputs High}$
 $N_T = \text{Number of TTL Inputs at } D_H$
 $I_{CCD} = \text{Dynamic Current Caused by an Output Transition Pair (HLH or LHL)}$
 $f_{CP} = \text{Clock Frequency for Register Devices (Zero for Non-Register Devices)}$
 $f_i = \text{Input Frequency}$
 $N_i = \text{Number of Inputs at } f_i$
All currents are in milliamps and all frequencies are in megahertz.

SWITCHING CHARACTERISTICS OVER OPERATING RANGE

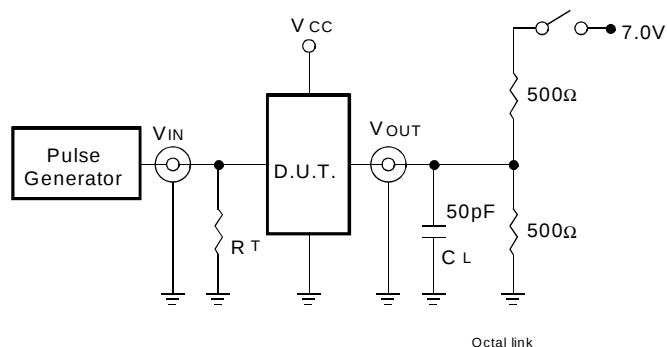
Symbol	Parameter	Condition ⁽¹⁾	IDT54/74FCT299T				IDT54/74FCT299AT				IDT54/74FCT299CT				Unit
			Ind.		Mil.		Ind.		Mil.		Ind.		Mil.		
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	
tPLH tPHL	Propagation Delay CP to Q ₀ or Q ₇	CL = 50pF RL = 500Ω	2	10	2	14	2	7.2	2	9.5	2	6.5	2	7.5	ns
tPLH tPHL	Propagation Delay CP to I/On		2	12	2	12	2	7.2	2	9.5	2	6.5	2	7.5	ns
tPHL	Propagation Delay MR to Q ₀ or Q ₇		2	10	2	10.5	2	7.2	2	9.5	2	6.5	2	7.5	ns
tPHL	Propagation Delay MR to I/On		2	15	2	15	2	8.7	2	11.5	2	6.5	2	7.5	ns
tPZH tPZL	Output Enable Time OE _n to I/On		1.5	11	1.5	15	1.5	6.5	1.5	7.5	1.5	6.5	1.5	7.5	ns
tPHZ tPLZ	Output Disable Time OE _n to I/On		1.5	7	1.5	9	1.5	6	1.5	6.5	1.5	6	1.5	6.5	ns
tsu	Set-up Time HIGH or LOW S ₀ or S ₁ to CP		7.5	—	7.5	—	3.5	—	4	—	3.5	—	4	—	ns
tsu	Set-up Time HIGH or LOW I/On, DS ₀ or DS ₇ to CP		5.5	—	5.5	—	4	—	4.5	—	4	—	4.5	—	ns
th	Hold Time HIGH or LOW S ₀ or S ₁ to CP		1	—	1	—	1	—	1	—	1	—	1	—	ns
th	Hold Time HIGH or LOW I/On, DS ₀ or DS ₇ to CP		1.5	—	1.5	—	1.5	—	1.5	—	1.5	—	1.5	—	ns
tw	CP Pulse Width HIGH or LOW		7	—	7	—	5	—	6	—	5	—	6	—	ns
tw	MR Pulse Width LOW		7	—	7	—	5	—	6	—	5	—	6	—	ns
tREM	Recovery Time	7	—	7	—	5	—	6	—	5	—	6	—	ns	

NOTES:

1. See test circuit and waveforms.
2. Minimum units are guaranteed but not tested on Propagation Delays.

TEST CIRCUITS AND WAVEFORMS

TEST CIRCUITS FOR ALL OUTPUTS



SWITCH POSITION

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

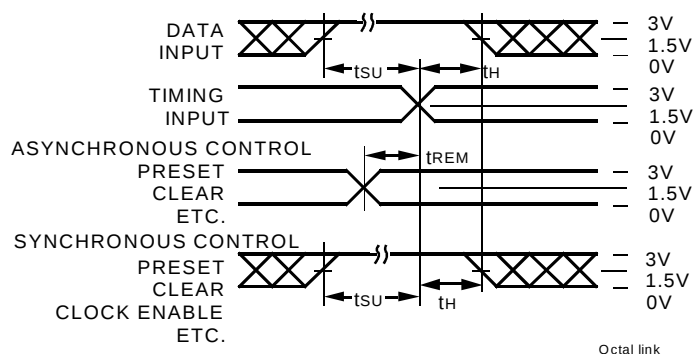
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DEFINITIONS:

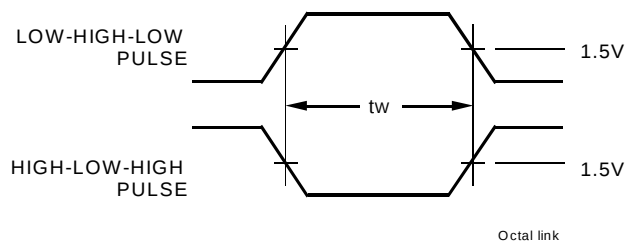
CL = Load capacitance: includes jig and probe capacitance.

RT = Termination resistance: should be equal to ZOUT of the Pulse Generator.

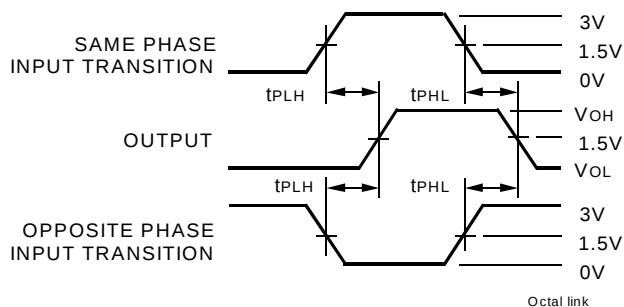
SET-UP, HOLD, AND RELEASE TIMES



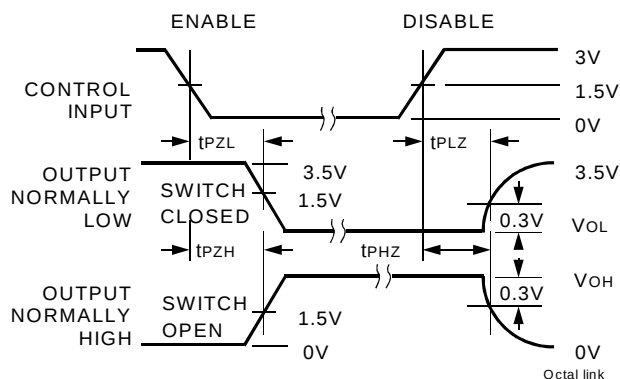
PULSE WIDTH



PROPAGATION DELAY



ENABLE AND DISABLE TIMES



NOTES:

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

ORDERING INFORMATION

IDT	XX	FCT	XXXX	XX	X	
	Temp. Range		Device Type	Package	Process	
					Blank	Industrial
					B	MIL-STD-883, Class B
					SO	<u>Industrial Options</u>
					Q	Small Outline IC (SO20-2)
						Quarter-size Small Outline Package (SO20-8)
					D	<u>Military Options</u>
					E	CERDIP (D20-1)
					L	CERPACK (E20-1)
						Leadless Chip Carrier (L20-1)
					299T	8-Input Universal Shift Register
					299AT	
					299CT	
					54	– 55°C to +125°C
					74	– 40°C to +85°C



CORPORATE HEADQUARTERS

2975 Stender Way
 Santa Clara, CA 95054

for SALES:

800-345-7015 or 408-727-6116
 fax: 408-492-8674
www.idt.com*

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