

## High Speed CMOS Logic Dual 4-Stage Static Shift Register

### Features

- **Maximum Frequency, Typically 60MHz**  
 $C_L = 15\text{pF}$ ,  $V_{CC} = 5\text{V}$ ,  $T_A = 25^\circ\text{C}$
- **Positive-Edge Clocking**
- **Overriding Reset**
- **Buffered Inputs and Outputs**
- **Fanout (Over Temperature Range)**
  - Standard Outputs . . . . . 10 LSTTL Loads
  - Bus Driver Outputs . . . . . 15 LSTTL Loads
- **Wide Operating Temperature Range . . .  $-55^\circ\text{C}$  to  $125^\circ\text{C}$**
- **Balanced Propagation Delay and Transition Times**
- **Significant Power Reduction Compared to LSTTL Logic ICs**
- **HC Types**
  - 2V to 6V Operation
  - High Noise Immunity:  $N_{IL} = 30\%$ ,  $N_{IH} = 30\%$  of  $V_{CC}$  at  $V_{CC} = 5\text{V}$

### Description

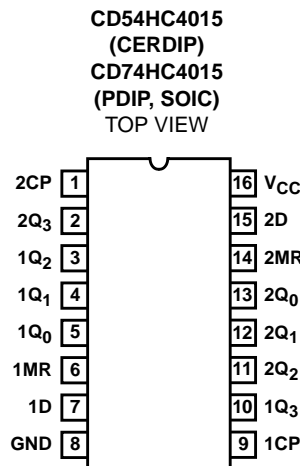
The 'HC4015 consists of two identical, independent, 4-stage serial-input/parallel-output registers. Each register has independent Clock (CP) and Reset (MR) inputs as well as a single serial Data input. "Q" outputs are available from each of the four stages on both registers. All register stages are D-type, master-slave flip-flops. The logic level present at the Data input is transferred into the first register stage and shifted over one stage at each positive-going clock transition. Resetting of all stages is accomplished by a high level on the reset line.

The device can drive up to 10 low power Schottky equivalent loads. The 'HC4015 is an enhanced version of equivalent CMOS types.

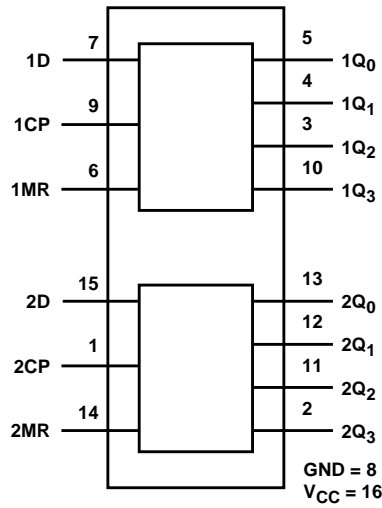
### Ordering Information

PART NUMBER	TEMP. RANGE ( $^\circ\text{C}$ )	PACKAGE
CD54HC4015F3A	-55 to 125	16 Ld CERDIP
CD74HC4015E	-55 to 125	16 Ld PDIP
CD74HC4015M	-55 to 125	16 Ld SOIC

### Pinout



**Functional Diagram**



**TRUTH TABLE**

INPUTS			OUTPUTS			
CP	D	R	Q <sub>0</sub>	Q <sub>1</sub>	Q <sub>2</sub>	Q <sub>3</sub>
↑	l	L	L	q' <sub>0</sub>	q' <sub>1</sub>	q' <sub>2</sub>
↑	h	L	H	q' <sub>0</sub>	q' <sub>1</sub>	q' <sub>2</sub>
↓	X	L	q' <sub>0</sub>	q' <sub>1</sub>	q' <sub>2</sub>	q' <sub>3</sub>
X	X	H	L	L	L	L

H = High Voltage Level

h = High Voltage Level One Set-up Time Prior to the Low to High Clock Transition

L = Low Voltage Level

l = Low Voltage Level One Set-up Time Prior to the Low to High Clock Transition

X = Don't Care.

↑ = Low to High Clock Transition

↓ = High to Low Clock Transition

q'<sub>n</sub> = Lower case letters indicate the state of the referenced output one set-up time prior to the Low to High clock transition.

## CD54HC4015, CD74HC4015

### Absolute Maximum Ratings

DC Supply Voltage, $V_{CC}$ .....	-0.5V to 7V
DC Input Diode Current, $I_{IK}$	
For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$ .....	$\pm 20mA$
DC Output Diode Current, $I_{OK}$	
For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$ .....	$\pm 20mA$
DC Output Source or Sink Current per Output Pin, $I_O$	
For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$ .....	$\pm 25mA$
DC $V_{CC}$ or Ground Current, $I_{CC}$ .....	$\pm 50mA$

### Thermal Information

Thermal Resistance (Typical, Note 1)	$\theta_{JA}$ ( $^{\circ}C/W$ )
E (PDIP) Package .....	67
M (SOIC) Package .....	73
Maximum Junction Temperature .....	150 $^{\circ}C$
Maximum Storage Temperature Range .....	-65 $^{\circ}C$ to 150 $^{\circ}C$
Maximum Lead Temperature (Soldering 10s) .....	300 $^{\circ}C$ (SOIC - Lead Tips Only)

### Operating Conditions

Temperature Range, $T_A$ .....	-55 $^{\circ}C$ to 125 $^{\circ}C$
Supply Voltage Range, $V_{CC}$	
HC Types .....	.2V to 6V
DC Input or Output Voltage, $V_I$ , $V_O$ .....	0V to $V_{CC}$
Input Rise and Fall Time	
2V .....	100ns (Max)
4.5V .....	500ns (Max)
6V .....	400ns (Max)

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

#### NOTE:

1. The package thermal impedance is calculated in accordance with JESD 51-7.

### DC Electrical Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		$V_{CC}$ (V)	25 $^{\circ}C$			-40 $^{\circ}C$ TO 85 $^{\circ}C$		-55 $^{\circ}C$ TO 125 $^{\circ}C$		UNITS	
		$V_I$ (V)	$I_O$ (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX		
High Level Input Voltage	$V_{IH}$	-	-	2	1.5	-	-	1.5	-	1.5	-	V	
				4.5	3.15	-	-	3.15	-	3.15	-	V	
				6	4.2	-	-	4.2	-	4.2	-	V	
Low Level Input Voltage	$V_{IL}$	-	-	2	-	-	0.5	-	0.5	-	0.5	V	
				4.5	-	-	1.35	-	1.35	-	1.35	V	
				6	-	-	1.8	-	1.8	-	1.8	V	
High Level Output Voltage CMOS Loads	$V_{OH}$	$V_{IH}$ or $V_{IL}$	-0.02	-0.02	2	1.9	-	-	1.9	-	1.9	-	V
			-0.02	-0.02	4.5	4.4	-	-	4.4	-	4.4	-	V
			-0.02	-0.02	6	5.9	-	-	5.9	-	5.9	-	V
High Level Output Voltage TTL Loads	$V_{OH}$	$V_{IH}$ or $V_{IL}$	-	-	-	-	-	-	-	-	-	V	
			-4	-4	4.5	3.98	-	-	3.84	-	3.7	-	V
			-5.2	-5.2	6	5.48	-	-	5.34	-	5.2	-	V
Low Level Output Voltage CMOS Loads	$V_{OL}$	$V_{IH}$ or $V_{IL}$	0.02	0.02	2	-	-	0.1	-	0.1	-	0.1	V
			0.02	0.02	4.5	-	-	0.1	-	0.1	-	0.1	V
			0.02	0.02	6	-	-	0.1	-	0.1	-	0.1	V
Low Level Output Voltage TTL Loads	$V_{OL}$	$V_{IH}$ or $V_{IL}$	-	-	-	-	-	-	-	-	-	V	
			4	4	4.5	-	-	0.26	-	0.33	-	0.4	V
			5.2	5.2	6	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	$I_I$	$V_{CC}$ or GND	-	6	-	-	$\pm 0.1$	-	$\pm 1$	-	$\pm 1$	$\mu A$	
Quiescent Device Current	$I_{CC}$	$V_{CC}$ or GND	0	6	-	-	8	-	80	-	160	$\mu A$	

## CD54HC4015, CD74HC4015

### Prerequisite for Switching Specifications

PARAMETER	SYMBOL	V <sub>CC</sub> (V)	25°C		-40°C TO 85°C		-55°C TO 125°C		UNITS
			MIN	MAX	MIN	MAX	MIN	MAX	
Maximum Clock Frequency	f <sub>MAX</sub>	2	6	-	5	-	4	-	MHz
		4.5	30	-	24	-	20	-	MHz
		6	35	-	28	-	24	-	MHz
Clock Pulse Width	t <sub>W</sub>	2	80	-	100	-	120	-	ns
		4.5	16	-	20	-	24	-	ns
		6	14	-	17	-	20	-	ns
MR Pulse Width	t <sub>W</sub>	2	150	-	190	-	225	-	ns
		4.5	30	-	38	-	45	-	ns
		6	26	-	33	-	38	-	ns
MR Recovery Time	t <sub>REC</sub>	2	50	-	65	-	75	-	ns
		4.5	10	-	13	-	15	-	ns
		6	9	-	11	-	13	-	ns
Set-up Time, Data-In to CP	t <sub>SUL</sub> , t <sub>SUH</sub>	2	60	-	75	-	90	-	ns
		4.5	12	-	15	-	18	-	ns
		6	10	-	13	-	15	-	ns
Hold Time, Data-In to CP	t <sub>H</sub>	2	0	-	0	-	0	-	ns
		4.5	0	-	0	-	0	-	ns
		6	0	-	0	-	0	-	ns

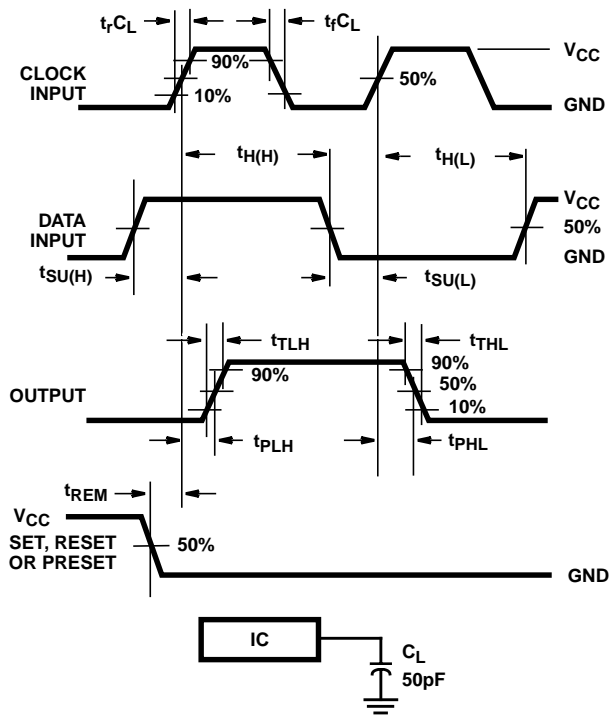
### Switching Specifications Input t<sub>r</sub>, t<sub>f</sub> = 6ns

PARAMETER	SYMBOL	TEST CONDITIONS	V <sub>CC</sub> (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Propagation Delay (Figure 1) Clock to Q <sub>n</sub>	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 50pF	2	-	-	175	-	220	-	270	ns
			4.5	-	-	35	-	44	-	54	ns
		C <sub>L</sub> = 15pF	5	-	14	-	-	-	-	-	ns
		C <sub>L</sub> = 50pF	6	-	-	30	-	37	-	46	ns
MR to Q <sub>n</sub> , (Clock High)	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 50pF	2	-	-	275	-	345	-	415	ns
			4.5	-	-	55	-	64	-	83	ns
		C <sub>L</sub> = 15pF	-	-	25	-	-	-	-	-	ns
		C <sub>L</sub> = 50pF	6	-	-	47	-	54	-	71	ns
MR to Q <sub>n</sub> , (Clock Low)	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 50pF	2	-	-	325	-	400	-	490	ns
			4.5	-	-	65	-	81	-	98	ns
		C <sub>L</sub> = 15pF	-	-	25	-	-	-	-	-	ns
		C <sub>L</sub> = 50pF	6	-	-	55	-	69	-	83	ns
Output Transition Time (Figure 1)	t <sub>TLH</sub> , t <sub>THL</sub>	C <sub>L</sub> = 50pF	2	-	-	75	-	95	-	110	ns
			4.5	-	-	15	-	19	-	22	ns
			6	-	-	13	-	16	-	19	ns
Input Capacitance	C <sub>IN</sub>	C <sub>L</sub> = 50pF	-	-	-	10	-	10	-	10	pF
Maximum Clock Frequency	f <sub>MAX</sub>	C <sub>L</sub> = 15pF	5	-	60	-	-	-	-	-	MHz
Power Dissipation Capacitance (Notes 2, 3)	C <sub>PD</sub>	C <sub>L</sub> = 15pF	5	-	43	-	-	-	-	-	pF

#### NOTES:

- C<sub>PD</sub> is used to determine the dynamic power consumption, per shift register.
- P<sub>D</sub> = V<sub>CC</sub><sup>2</sup> f<sub>i</sub> + Σ C<sub>L</sub> V<sub>CC</sub><sup>2</sup> where f<sub>i</sub> = Input Frequency, C<sub>L</sub> = Output Load Capacitance, V<sub>CC</sub> = Supply Voltage.

**Test Circuit and Waveform**



**FIGURE 1. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS**

## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-8995301EA	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962-8995301EA CD54HC4015F3A	<a href="#">Samples</a>
CD54HC4015F3A	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962-8995301EA CD54HC4015F3A	<a href="#">Samples</a>
CD74HC4015E	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-55 to 125	CD74HC4015E	<a href="#">Samples</a>
CD74HC4015M	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4015M	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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**OTHER QUALIFIED VERSIONS OF CD54HC4015, CD74HC4015 :**

- Catalog : [CD74HC4015](#)
- Military : [CD54HC4015](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.



N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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