Data sheet acquired from Harris Semiconductor
SCHS198C

November 1997 - Revised May 2003

High Speed CMOS Logic Dual 4-Stage Static Shift Register

Features

- **Maximum Frequency, Typically 60MHz C_L = 15pF, V_{CC} = 5V, T_A = 25°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°C to 125°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} = 5V**

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.

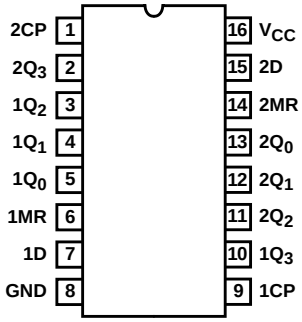
The device can drive up to 10 low power Schottky equivalent loads. The ’HC4015 is an enhanced version of equivalent CMOS types.

Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE
CD54HC4015F3A	-55 to 125	16 Ld CERDIP
CD74HC4015E	-55 to 125	16 Ld PDIP
CD74HC4015M	-55 to 125	16 Ld SOIC

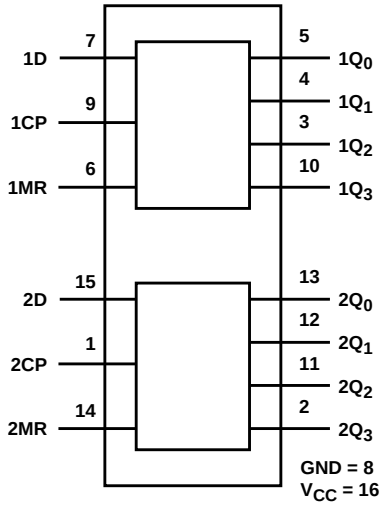
Pinout

CD54HC4015
(CERDIP)
CD74HC4015
(PDIP, SOIC)
TOP VIEW



CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper IC Handling Procedures.

Functional Diagram



TRUTH TABLE

INPUTS			OUTPUTS			
CP	**D**	**R**	**Q_0**	**Q_1**	**Q_2**	**Q_3**
↑	l	L	L	q'_0	q'_1	q'_2
↑	h	L	H	q'_0	q'_1	q'_2
↓	X	L	q'_0	q'_1	q'_2	q'_3
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'_n = Lower case letters indicate the state of the referenced output one set-up time prior to the Low to High clock transition.

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 . . . . . ±20mA
DC Output Diode Current, I_{OK}
For V_O < -0.5V or V_O > V_{CC} + 0.5V . . . . . ±20mA
DC Output Source or Sink Current per Output Pin, I_O
For V_O > -0.5V or V_O < V_{CC} + 0.5V . . . . . ±25mA
DC V_{CC} or Ground Current, I_{CC} . . . . . ±50mA

Operating Conditions

Temperature Range, T_A . . . . . -55^oC to 125^oC
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 . . . . . 1000ns (Max)
4.5V. . . . . 500ns (Max)
6V . . . . . 400ns (Max)

Thermal Information

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

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°C			-40°C TO 85°C		-55°C TO 125°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	2	1.9	-	-	1.9	-	1.9	-	V
			-0.02	4.5	4.4	-	-	4.4	-	4.4	-	V
			-0.02	6	5.9	-	-	5.9	-	5.9	-	V
High Level Output Voltage TTL Loads			-	-	-	-	-	-	-	-	-	V
			-4	4.5	3.98	-	-	3.84	-	3.7	-	V
			-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	2	-	-	0.1	-	0.1	-	0.1	V
			0.02	4.5	-	-	0.1	-	0.1	-	0.1	V
			0.02	6	-	-	0.1	-	0.1	-	0.1	V
Low Level Output Voltage TTL Loads			-	-	-	-	-	-	-	-	-	V
			4	4.5	-	-	0.26	-	0.33	-	0.4	V
			5.2	6	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	I_I	V_{CC} or GND	-	6	-	-	±0.1	-	±1	-	±1	µA
Quiescent Device Current	I_{CC}	V_{CC} or GND	0	6	-	-	8	-	80	-	160	µA

Prerequisite for Switching Specifications

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

Switching Specifications Input t_r, t_f = 6ns

PARAMETER	SYMBOL	TEST CONDITIONS	V_{CC} (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_n	t_{PLH}, t_{PHL}	C_L = 50pF	2	-	-	175	-	220	-	270	ns
			4.5	-	-	35	-	44	-	54	ns
		C_L =15pF	5	-	14	-	-	-	-	-	ns
		C_L = 50pF	6	-	-	30	-	37	-	46	ns
MR to Q_n, (Clock High)	t_{PLH}, t_{PHL}	C_L = 50pF	2	-	-	275	-	345	-	415	ns
			4.5	-	-	55	-	64	-	83	ns
		C_L =15pF			25	-	-	-	-	-	ns
		C_L = 50pF	6	-	-	47	-	54	-	71	ns
MR to Q_n, (Clock Low)	t_{PLH}, t_{PHL}	C_L = 50pF	2	-	-	325	-	400	-	490	ns
			4.5	-	-	65	-	81	-	98	ns
		C_L =15pF			25	-	-	-	-	-	ns
		C_L = 50pF	6	-	-	55	-	69	-	83	ns
Output Transition Time (Figure 1)	t_{TLH}, t_{THL}	C_L = 50pF	2	-	-	75	-	95	-	110	ns
			4.5	-	-	15	-	19	-	22	ns
			6	-	-	13	-	16	-	19	ns
Input Capacitance	C_{IN}	C_L = 50pF	-	-	-	10	-	10	-	10	pF
Maximum Clock Frequency	f_{MAX}	C_L =15pF	5	-	60	-	-	-	-	-	MHz
Power Dissipation Capacitance (Notes 2, 3)	C_{PD}	C_L =15pF	5	-	43	-	-	-	-	-	pF

NOTES:

2. C_{PD} is used to determine the dynamic power consumption, per shift register.
3. $P_D = V_{CC}^2 f_i + \Sigma C_L V_{CC}^2$ where f_i = Input Frequency, C_L = Output Load Capacitance, V_{CC} = Supply Voltage.

Test Circuit and Waveform

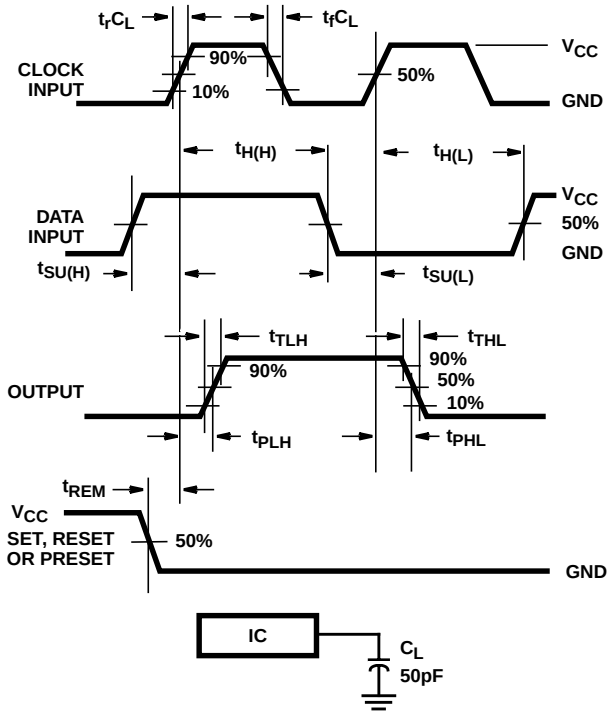


FIGURE 1. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
5962-8995301EA	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8995301EA CD54HC4015F3A
CD54HC4015F3A	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8995301EA CD54HC4015F3A
CD54HC4015F3A.A	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8995301EA CD54HC4015F3A
CD74HC4015E	Active	Production	PDIP (N) | 16	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HC4015E
CD74HC4015E.A	Active	Production	PDIP (N) | 16	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HC4015E
CD74HC4015M	Active	Production	SOIC (D) | 16	40 | TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4015M
CD74HC4015M.A	Active	Production	SOIC (D) | 16	40 | TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4015M

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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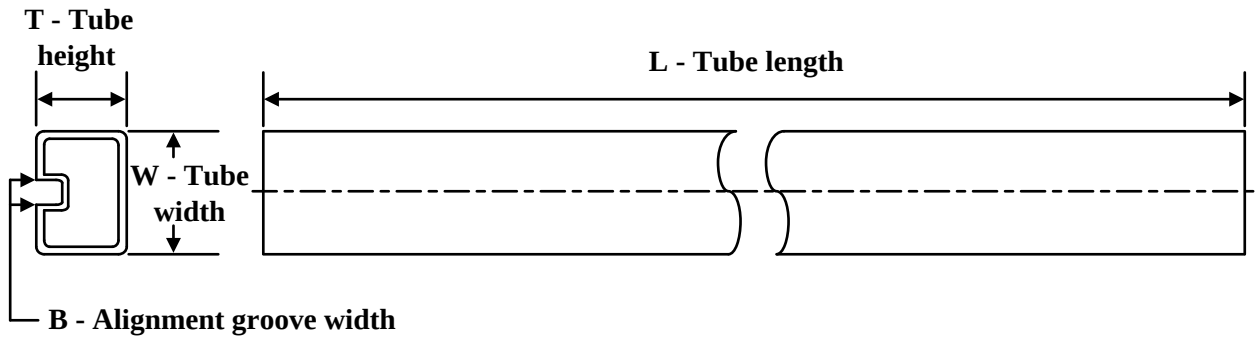
OTHER QUALIFIED VERSIONS OF CD54HC4015, CD74HC4015 :

- Catalog : CD74HC4015
- Military : CD54HC4015

NOTE: Qualified Version Definitions:

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

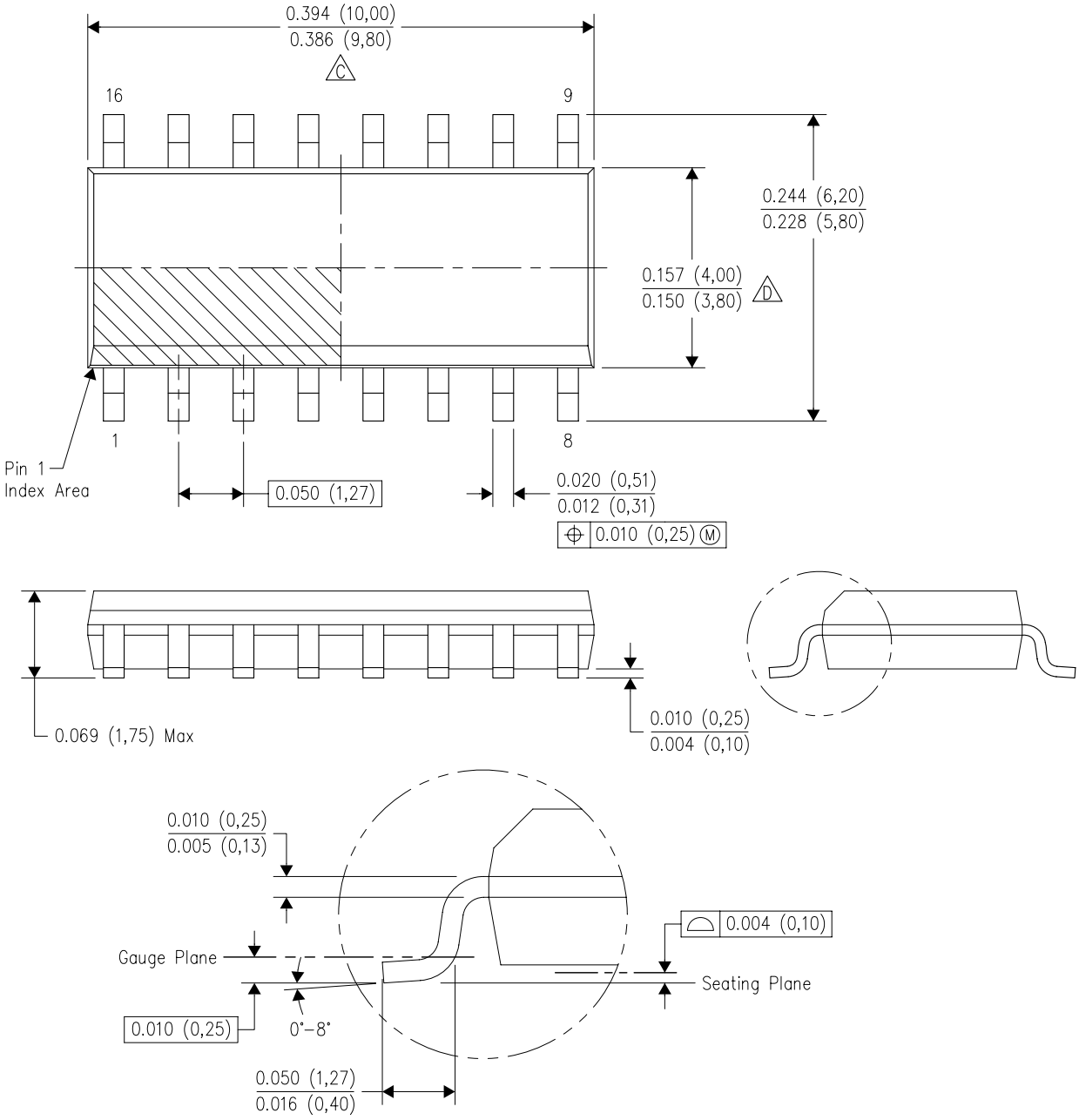
TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
CD74HC4015E	N	PDIP	16	25	506	13.97	11230	4.32
CD74HC4015E	N	PDIP	16	25	506	13.97	11230	4.32
CD74HC4015E.A	N	PDIP	16	25	506	13.97	11230	4.32
CD74HC4015E.A	N	PDIP	16	25	506	13.97	11230	4.32
CD74HC4015M	D	SOIC	16	40	507	8	3940	4.32
CD74HC4015M.A	D	SOIC	16	40	507	8	3940	4.32

D (R–PDSO–G16) PLASTIC SMALL OUTLINE

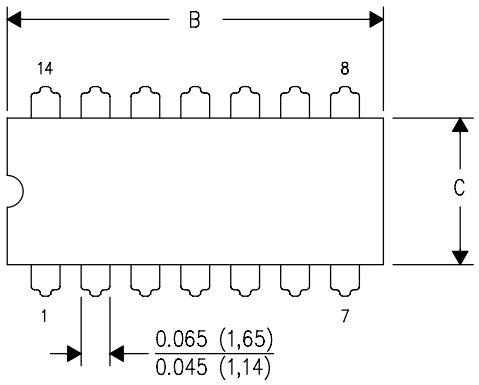


NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead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

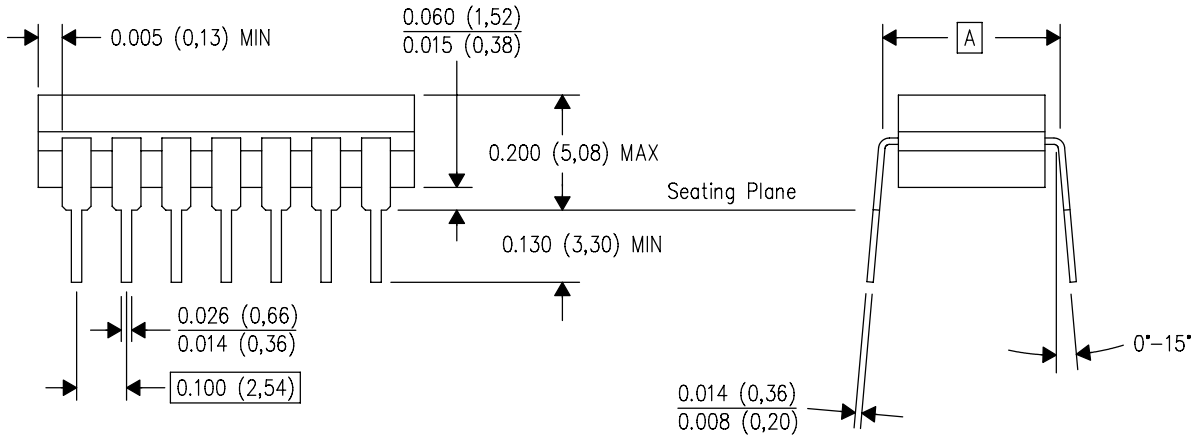
J (R–GDIP–T**)

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)



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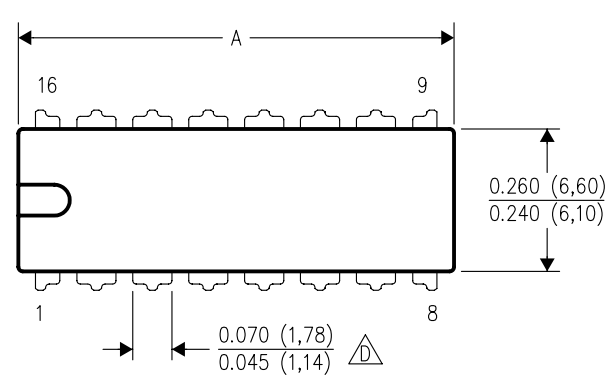
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package is hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls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

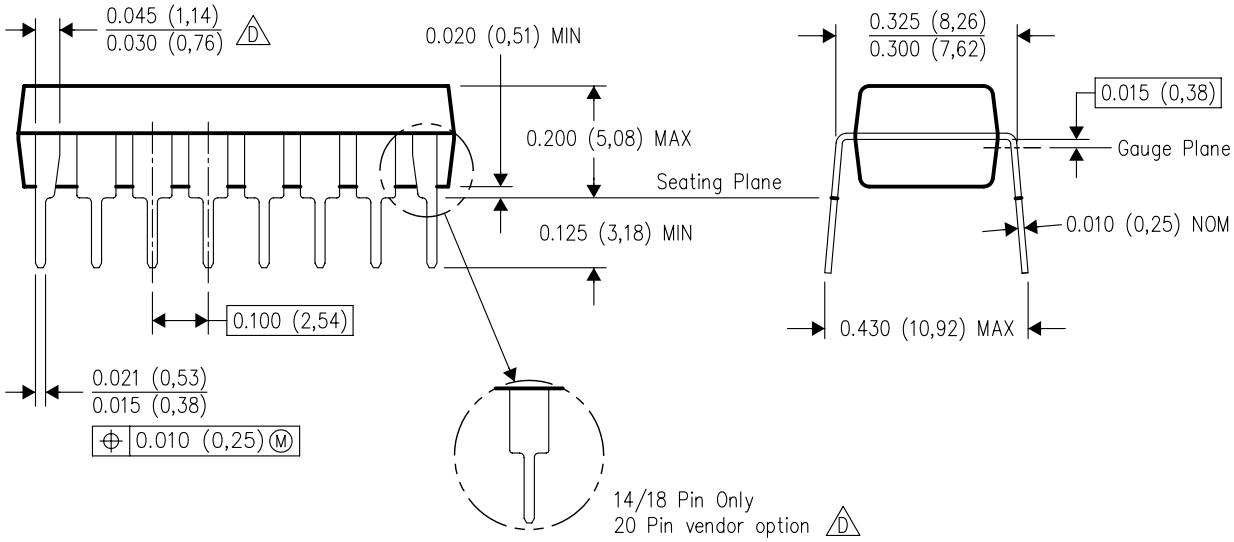
N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS–001 VARIATION (C)	AA	BB	AC	AD



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

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