

# CD40194B Types

## CMOS 4-Bit Bidirectional Universal Shift Register

High-Voltage Types (20 Volt Rating)

■ CD40194B is a universal shift register featuring parallel inputs, parallel outputs SHIFT RIGHT and SHIFT LEFT serial inputs, and a direct overriding clear input. In the parallel-load mode (S0 and S1 are high), data is loaded into the associated flip-flop and appears at the output after the positive transition of the CLOCK input. During loading, serial data flow is inhibited. Shift right and shift left are accomplished synchronously on the positive clock edge with data entered at the SHIFT RIGHT and SHIFT LEFT serial inputs, respectively. Clocking of the register is inhibited when both mode control inputs are low. When low, the RESET input resets all stages and forces all outputs low.

The CD40194B types are supplied in 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (NSR suffix), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).

### MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE RANGE, (V <sub>DD</sub> )	-0.5V to +20V
Voltages referenced to V <sub>SS</sub> Terminal)	
INPUT VOLTAGE RANGE, ALL INPUTS	-0.5V to V <sub>DD</sub> +0.5V
DC INPUT CURRENT, ANY ONE INPUT	±10mA
POWER DISSIPATION PER PACKAGE (P <sub>D</sub> ):	
For T <sub>A</sub> = -55°C to +100°C	500mW
For T <sub>A</sub> = +100°C to +125°C	Derate Linearity at 12mW/°C to 200mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR	
FOR T <sub>A</sub> = FULL PACKAGE-TEMPERATURE RANGE (All Package Types)	100mW
OPERATING-TEMPERATURE RANGE (T <sub>A</sub> )	-55°C to +125°C
STORAGE TEMPERATURE RANGE (T <sub>stg</sub> )	-65°C to +150°C
LEAD TEMPERATURE (DURING SOLDERING):	
At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10s max	+265°C

**NOT  
RECOMMENDED FOR  
NEW DESIGNS**

### Features:

- Medium-speed: f<sub>CL</sub> = 12 MHz (typ.) @ V<sub>DD</sub> = 10 V
- Fully static operation
- Synchronous parallel or serial operation
- Asynchronous master reset
- Standardized, symmetrical output characteristics
- 5-V, 10-V, and 15-V parametric ratings
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

### Applications:

- Arithmetic unit bus registers
- Serial/parallel conversions
- General-purpose register for bus-organized systems
- General-purpose registers

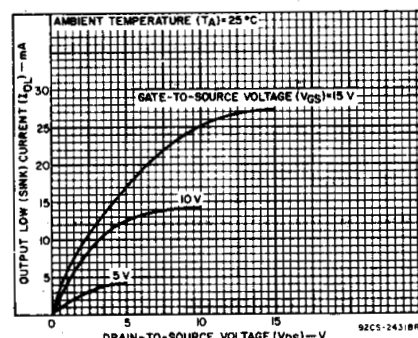
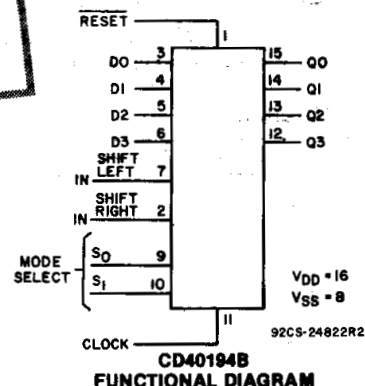


Fig. 1—Typical n-channel output low (sink) current characteristics.

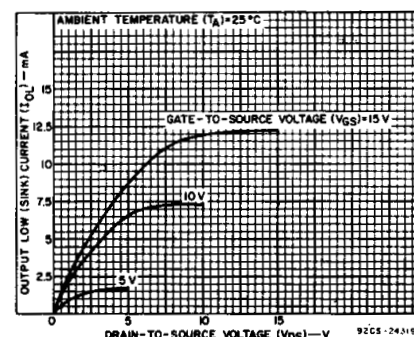


Fig. 2—Minimum n-channel output low (sink) current characteristics.

## CD40194B Types

**RECOMMENDED OPERATING CONDITIONS** at  $T_A = 25^\circ\text{C}$ , Except as Noted.  
For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

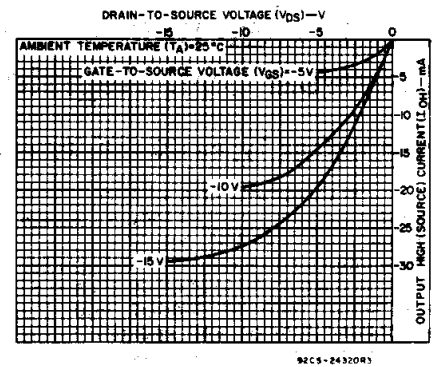
CHARACTERISTIC	VDD (V)	LIMITS		UNITS
		Min.	Max.	
Supply-Voltage Range (For Package-Temperature Range)		3	18	V
Setup Time, D0, D3, SR <sub>IN</sub> , SL <sub>IN</sub> to clock	5 10 15	100 70 50	—	ns
SELECT 0, SELECT 1 to clock	5 10 15	400 220 130	—	
Hold Time, D0, D3, SR <sub>IN</sub> , SL <sub>IN</sub> to clock	5 10 15	0 0 0	—	
SELECT 0, SELECT 1 to clock	5 10 15	0 0 0	—	
Clock Pulse Width,	5 10 15	180 80 50	—	
Clock Input Frequency	5 10 15	— — —	3 6 8	MHz
Clock Input Rise or Fall Time,	5 10 15	1000 100 100	—	μs
Reset Pulse Width,	5 10 15	300 200 140	—	ns

**CONTROL TRUTH TABLE FOR CD40194B SERIES**

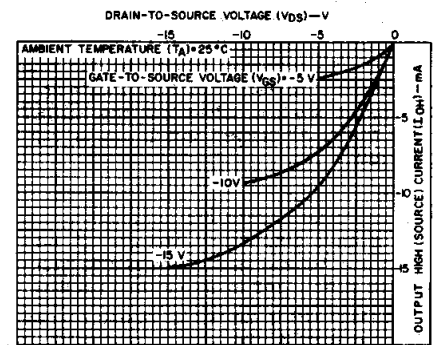
CLOCK	MODE SELECT		RESET	ACTION
	S <sub>0</sub>	S <sub>1</sub>		
X	0	0	1	No Change
	1	0	1	Shift Right (Q0 toward Q3)
	0	1	1	Shift Left (Q3 toward Q0)
	1	1	1	Parallel Load
X	X	X	0	Reset

1 = High level  
0 = Low level

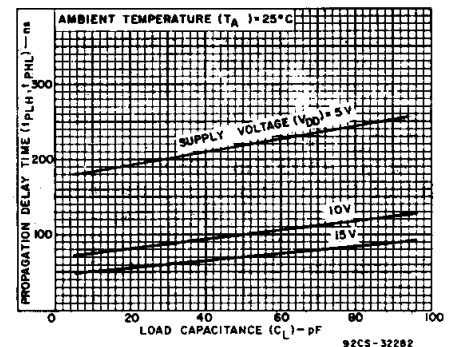
X = Don't care  
▲ = Level change



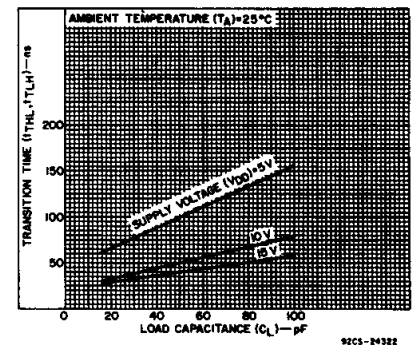
**Fig. 3—Typical p-channel output high (source) current characteristics.**



**Fig. 4—Minimum p-channel output high (source) current characteristics.**



**Fig. 5—Typical propagation delay time as a function of load capacitance, (CLOCK to Q).**



**Fig. 6—Typical transition time as a function of load capacitance.**

# CD40194B Types

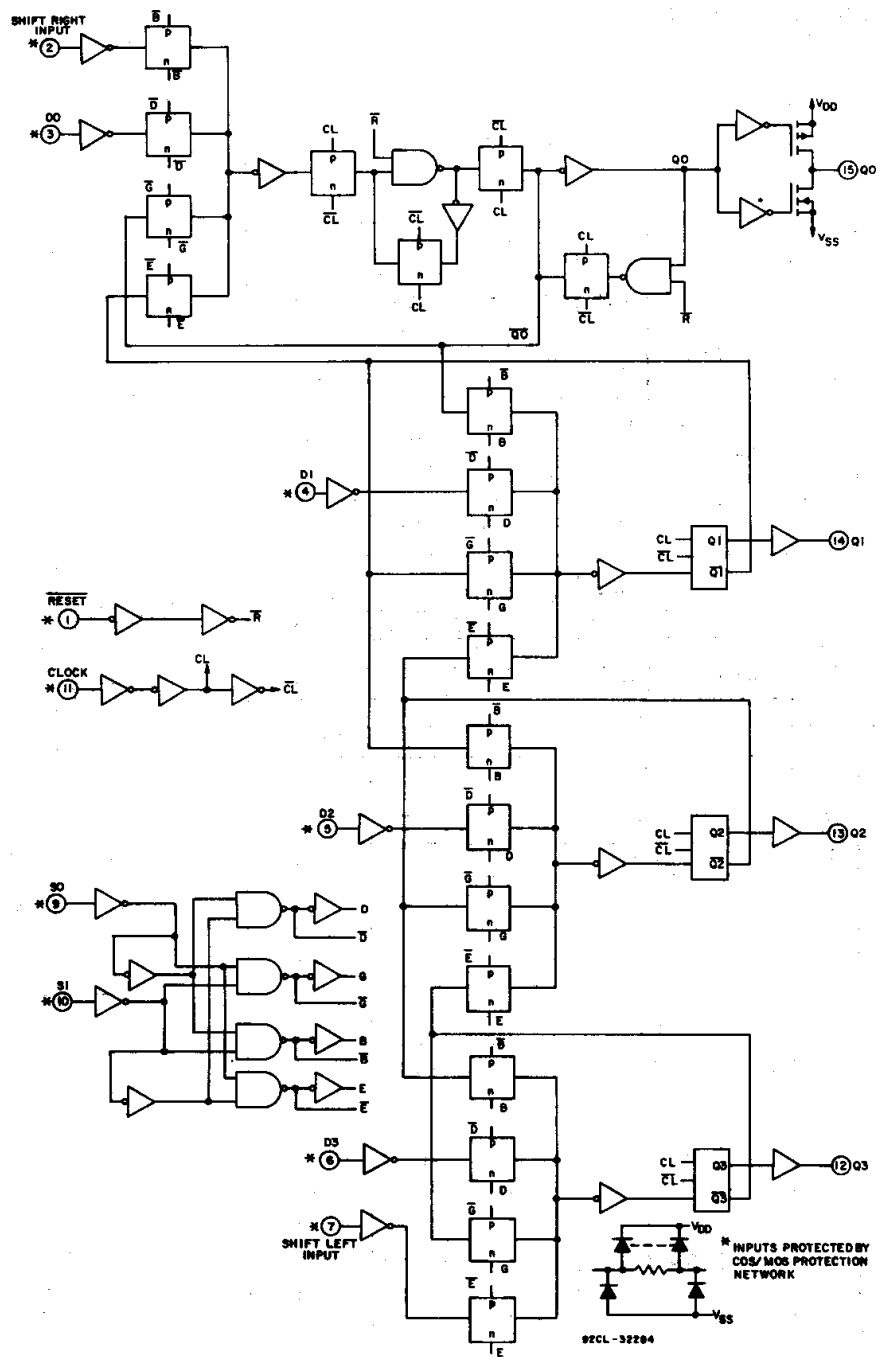


Fig. 8—CD40194B logic diagram.

# CD40194B Types

## STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V <sub>O</sub> (V)	V <sub>IN</sub> (V)	V <sub>DD</sub> (V)	-55	-40	+85	+125	+25			
								Min.	Typ.	Max.	
Quiescent Device Current, I <sub>DD</sub> Max.	—	0,5	5	5	5	150	150	—	0.04	5	μA
	—	0,10	10	10	10	300	300	—	0.04	10	
	—	0,15	15	20	20	600	600	—	0.04	20	
	—	0,20	20	100	100	3000	3000	—	0.08	100	
Output Low (Sink) Current, I <sub>OL</sub> Min.	0.4	0,5	5	0.64	0.61	0.42	0.36	0.51	1	—	mA
	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6	—	
	1.5	0,15	15	4.2	4	2.8	2.4	3.4	6.8	—	
Output High (Source) Current, I <sub>OH</sub> Min.	4.6	0,5	5	-0.64	-0.61	-0.42	-0.36	-0.51	-1	—	mA
	2.5	0,5	5	-2	-1.8	-1.3	-1.15	-1.6	-3.2	—	
	9.5	0,10	10	-1.6	-1.5	-1.1	-0.9	-1.3	-2.6	—	
	13.5	0,15	15	-4.2	-4	-2.8	-2.4	-3.4	-6.8	—	
Output Voltage: Low-Level, V <sub>OL</sub> Max.	—	0,5	5	0.05				—	0	0.05	V
	—	0,10	10	0.05				—	0	0.05	
	—	0,15	15	0.05				—	0	0.05	
Output Voltage: High-Level, V <sub>OH</sub> Min.	—	0,5	5	4.95				4.95	5	—	V
	—	0,10	10	9.95				9.95	10	—	
	—	0,15	15	14.95				14.95	15	—	
Input Low Voltage, V <sub>IL</sub> Max.	0.5,4.5	—	5	1.5				—	—	1.5	V
	1,9	—	10	3				—	—	3	
	1.5,13.5	—	15	4				—	—	4	
Input High Voltage, V <sub>IH</sub> Min.	0.5,4.5	—	5	3.5				3.5	—	—	V
	1,9	—	10	7				7	—	—	
	1.5,13.5	—	15	11				11	—	—	
Input Current I <sub>IN</sub> Max.	—	0,18	18	±0.1	±0.1	±1	±1	—	±10 <sup>-5</sup>	±0.1	μA
3-State Output Leakage Current, I <sub>OUT</sub> Max.	0,18	0,18	18	±0.4	±0.4	±12	±12	—	±10 <sup>-4</sup>	±0.4	μA

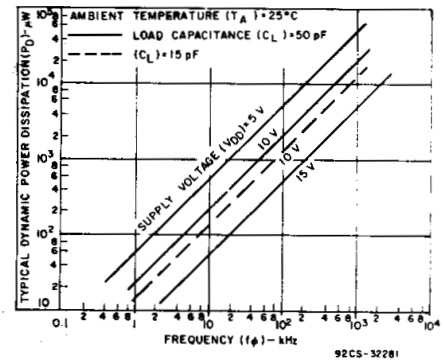


Fig. 9—Typical power dissipation as a function of frequency.

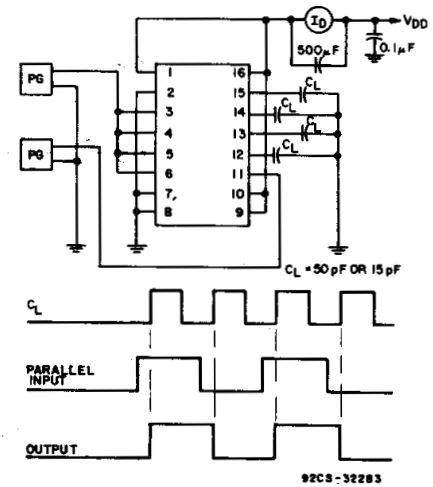


Fig. 10—Dynamic power dissipation test circuit.

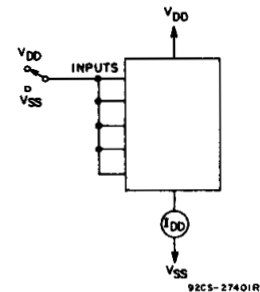


Fig. 11—Quiescent device current test circuit.

## CD40194B Types

**DYNAMIC ELECTRICAL CHARACTERISTICS at  $T_A = 25^\circ\text{C}$ ,  
Input  $t_r, t_f = 20\text{ ns}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$**

CHARACTERISTIC	TEST CONDITIONS	LIMITS			UNITS
		$V_{DD}$ V	Min.	Typ.	Max.
Propagation Delay Time: Clock to Q $t_{PHL}, t_{PLH}$		5	—	220	440
		10	—	100	200
		15	—	70	140
Output Transition Time $t_{THL}, t_{TLH}$		5	—	100	200
		10	—	50	100
		15	—	40	80
Minimum Setup Time: $t_s$ D0, D3, $SR_{IN}, SL_{IN}$ to Clock		5	—	80	160
		10	—	35	70
		15	—	20	50
SELECT 0, SELECT 1 to Clock		5	—	200	400
		10	—	110	220
		15	—	65	130
Minimum Hold Time: $t_H$ D0, D3, $SR_{IN}, SL_{IN}$ to Clock		5	—	-65	0
		10	—	-25	0
		15	—	-15	0
SELECT 0, SELECT 1 to Clock		5	—	-170	0
		10	—	-95	0
		15	—	-55	0
Minimum Clock Pulse Width $t_W$		5	—	90	180
		10	—	40	80
		15	—	25	50
Maximum Clock Input Frequency $f_{CL}$		5	3	6	—
		10	6	12	—
		15	8	15	—
Maximum Clock Rise or Fall Time $t_{rCL}, t_{fCL}$		5	—	—	1000
		10	—	—	100
		15	—	—	100
Minimum Reset Pulse Width* $t_{WR}$		5	—	150	300
		10	—	100	200
		15	—	70	140
Reset Propagation Delay $t_{PRHL}$		5	—	230	460
		10	—	90	180
		15	—	65	130
Input Capacitance $C_{IN}$	Any Input		—	5	7.5
					pF

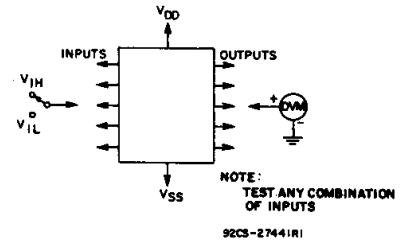


Fig. 12—Input-voltage test circuit.

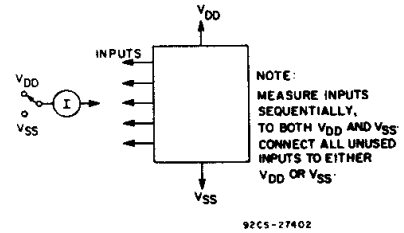
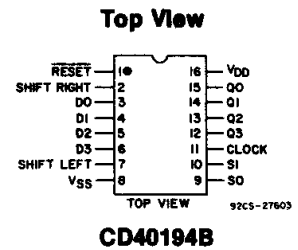


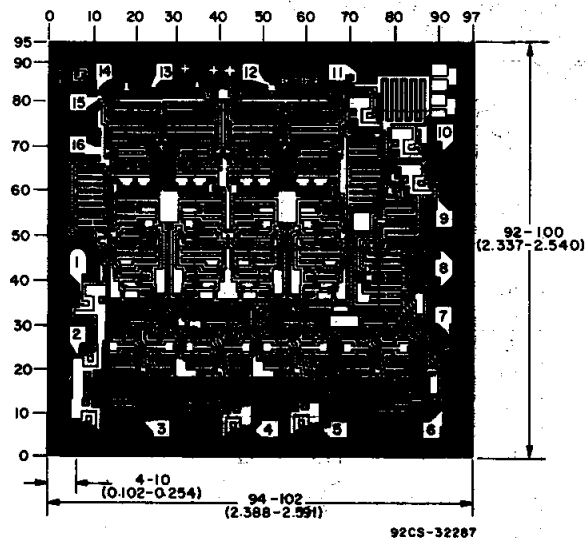
Fig. 13—Input current test circuit.

### TERMINAL DIAGRAM



**3**  
**COMMERCIAL CMOS**  
**HIGH VOLTAGE ICs**

## CD40194B Types



*Dimensions and pad layout for CD40194BH*

*Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils ( $10^{-3}$  inch).*

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
CD40194BE	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD40194BEE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type

<sup>(1)</sup> 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.

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

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



PINS **	14	16	18	20
DIM				
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	AA	BB	AC	AD



4040049/E 12/2002

- 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.



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DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>	Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Energy	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
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