National Semiconductor

February 1988

CD40192BM/CD40192BC Synchronous 4-Bit Up/Down Decade Counter CD40193BM/CD40193BC Synchronous 4-Bit Up/Down Binary Counter

General Description

These up/down counters are monolithic complementary MOS (CMOS) integrated circuits. The CD40192BM and CD40192BC are BCD counters, while the CD40193BM and CD40193BC are binary counters.

Counting up and counting down is performed by two count inputs, one being held high while the other is clocked. The outputs change on the positive-going transition of this clock.

These counters feature preset inputs that are enabled when load is a logical "0" and a clear which forces all outputs to "0" when it is at logical "1". The counters also have carry and borrow outputs so that they can be cascaded using no external circuitry.

All inputs are protected against damage due to static discharge by clamps to V_{DD} and V_{SS}.

Features

- Wide supply voltage range   3V to 15V
- High noise immunity   0.45 V_{DD} (typ.)
- Low power TTL compatibility   Fan out of 2 driving 74L or 1 driving 74LS
- Carry and borrow outputs for easy expansion to N-bit by cascading
- Asynchronous clear
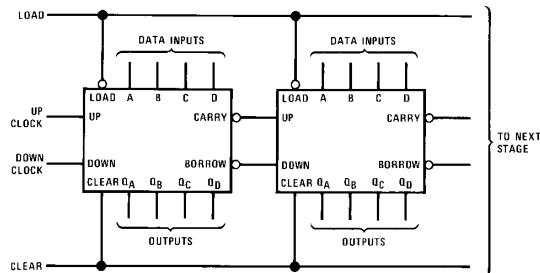- Equivalent to   MM54C192/MM74C192 and MM54C193/MM74C193

Connection Diagram

Dual-In-Line Package
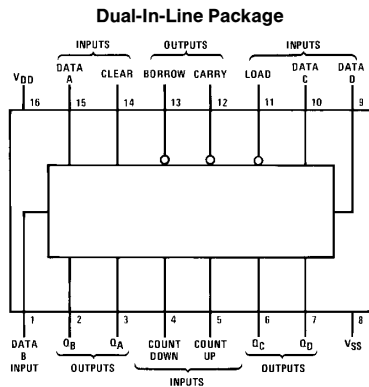
Order Number CD40192B or CD40193

TL/F/5988-1

Top View

Cascading Packages

TL/F/5988-2

Absolute Maximum Ratings (Notes 1 & 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

DC Supply Voltage (V_{DD})	-0.5 to $+18$ V_{DC}
Input Voltage (V_{IN})	-0.5 to V_{DD} $+0.5$ V_{DC}
Storage Temperature Range (T_S)	$-65°C$ to $+150°C$
Power Dissipation (P_D)	
Dual-In-Line	700 mW
Small Outline	500 mW
Lead Temperature (T_L)	
(Soldering, 10 seconds)	260°C

Recommended Operating Conditions (Note 2)

DC Supply Voltage (V_{DD})	3 to 15 V_{DC}
Input Voltage (V_{IN})	0 to V_{DD} V_{DC}
Operating Temperature Range (T_A)	
CD40192BM, CD40193BM	$-55°C$ to $+125°C$
CD40192BC, CD40193BC	$-40°C$ to $+85°C$

DC Electrical Characteristics CD40192BM/CD40193BM (Note 2)

Symbol	Parameter	Conditions	$-55°C$ Min	$-55°C$ Max	$+25°C$ Min	$+25°C$ Typ	$+25°C$ Max	$+125°C$ Min	$+125°C$ Max	Units
I_{DD}	Quiescent Device Current	V_{DD} = 5V, V_{IN} = V_{DD} or V_{SS}		5			5		150	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		10			10		300	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		20			20		600	μA
V_{OL}	Low Level Output Voltage	V_{DD} = 5V		0.05			0.05		0.05	V
		V_{DD} = 10V		0.05			0.05		0.05	V
		V_{DD} = 15V		0.05			0.05		0.05	V
V_{OH}	High Level Output Voltage	V_{DD} = 5V	4.95		4.95			4.95		V
		V_{DD} = 10V	9.95		9.95			9.95		V
		V_{DD} = 15V	14.95		14.95			14.95		V
V_{IL}	Low Level Input Voltage	V_{DD} = 5V, V_O = 0.5V or 4.5V		1.5			1.5		1.5	V
		V_{DD} = 10V, V_O = 1V or 9V		3.0			3.0		3.0	V
		V_{DD} = 15V, V_O = 1.5V or 13.5V		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	V_{DD} = 5V, V_O = 0.5V or 4.5V	3.5		3.5			3.5		V
		V_{DD} = 10V, V_O = 1V or 9V	7.0		7.0			7.0		V
		V_{DD} = 15V, V_O = 1.5V or 13.5V	11.0		11.0			11.0		V
I_{OL}	Low Level Output Current (Note 3)	V_{DD} = 5V, V_O = 0.4V	0.64		0.51	0.88		0.36		mA
		V_{DD} = 10V, V_O = 0.5V	1.6		1.3	2.25		0.9		mA
		V_{DD} = 15V, V_O = 1.5V	4.2		3.4	8.8		2.4		mA
I_{OH}	High Level Output Current (Note 3)	V_{DD} = 5V, V_O = 4.6V	-0.64		-0.51	-0.88		-0.36		mA
		V_{DD} = 10V, V_O = 9.5V	-1.6		-1.3	-2.25		-0.9		mA
		V_{DD} = 15V, V_O = 13.5V	-4.2		-3.4	-8.8		-2.4		mA
I_{IN}	Input Current	V_{DD} = 15V, V_{IN} = 0V		-0.1		-10^{-5}	-0.1		-1.0	μA
		V_{DD} = 15V, V_{IN} = 15V		0.1		10^{-5}	0.1		1.0	μA

DC Electrical Characteristics CD40192BC/CD40193BC (Note 2)

Symbol	Parameter	Conditions	$-40°C$ Min	$-40°C$ Max	$+25°C$ Min	$+25°C$ Typ	$+25°C$ Max	$+85°C$ Min	$+85°C$ Max	Units
I_{DD}	Quiescent Device Current	V_{DD} = 5V, V_{IN} = V_{DD} or V_{SS}		20			20		150	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		40			40		300	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		80			80		600	μA
V_{OL}	Low Level Output Voltage	V_{DD} = 5V		0.05			0.05		0.05	V
		V_{DD} = 10V		0.05			0.05		0.05	V
		V_{DD} = 15V		0.05			0.05		0.05	V
V_{OH}	High Level Output Voltage	V_{DD} = 5V	4.95		4.95			4.95		V
		V_{DD} = 10V	9.95		9.95			9.95		V
		V_{DD} = 15V	14.95		14.95			14.95		V
V_{IL}	Low Level Input Voltage	V_{DD} = 5V, V_O = 0.5V or 4.5V		1.5			1.5		1.5	V
		V_{DD} = 10V, V_O = 1V or 9V		3.0			3.0		3.0	V
		V_{DD} = 15V, V_O = 1.5V or 13.5V		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	V_{DD} = 5V, V_O = 0.5V or 4.5V	3.5		3.5			3.5		V
		V_{DD} = 10V, V_O = 1V or 9V	7.0		7.0			7.0		V
		V_{DD} = 15V, V_O = 1.5V or 13.5V	11.0		11.0			11.0		V
I_{OL}	Low Level Output Current (Note 3)	V_{DD} = 5V, V_O = 0.4V	0.52		0.44	0.88		0.36		mA
		V_{DD} = 10V, V_O = 0.5V	1.3		1.1	2.25		0.9		mA
		V_{DD} = 15V, V_O = 1.5V	3.6		3.0	8.8		2.4		mA

DC Electrical Characteristics CD40192BC/CD40193BC (Note 2) (Continued)

Symbol	Parameter	Conditions	−40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{OH}	High Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 4.6V$ $V_{DD} = 10V, V_O = 9.5V$ $V_{DD} = 15V, V_O = 13.5V$	−0.52 −1.3 −3.6		−0.44 −1.1 −3.0	−0.88 −2.25 −8.8		−0.36 −0.9 −2.4		mA mA mA
I_{IN}	Input Current	$V_{DD} = 15V, V_{IN} = 0V$ $V_{DD} = 15V, V_{IN} = 15V$		−0.3 0.3		-10^{-5} 10^{-5}	−0.3 0.3		−1.0 1.0	μA μA

AC Electrical Characteristics*

$T_A = 25°C$, $C_L = 50$ pF, $R_L = 200$ kΩ, input $t_r = t_f = 20$ ns, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PHL} or t_{PLH}	Propagation Delay Time from Count Up or Count Down to Q	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		250 100 80	400 160 130	ns ns ns
t_{PHL} or t_{PLH}	Propagation Delay Time from Count Up to Carry	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		120 50 40	200 80 65	ns ns ns
t_{PHL} or t_{PLH}	Propagation Delay Time from Count Down to Borrow	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		120 50 40	200 80 65	ns ns ns
t_{SU}	Time Prior to Load That Data Must Be Present	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		100 30 25	160 50 40	ns ns ns
t_{PHL}	Propagation Delay Time from Clear to Q	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		130 60 50	220 100 80	ns ns ns
t_{PLH} or t_{PHL}	Propagation Delay Time from Load to Q	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		300 120 95	480 190 150	ns ns ns
t_{TLH} or t_{THL}	Output Transition Time	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		100 50 40	200 100 80	ns ns ns
f_{CL}	Maximum Count Frequency	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$	2.5 6 7.5	4 10 12.5		MHz MHz MHz
t_{rCL} or t_{fCL}	Maximum Count Rise or Fall Time	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$	15 5 1			μs μs μs
t_{WH}, t_{WL}	Minimum Count Pulse Width	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		120 35 28	200 80 65	ns ns ns
t_{WH}	Minimum Clear Pulse Width	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		300 120 95	480 190 150	ns ns ns
t_{WL}	Minimum Load Pulse Width	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		100 40 32	160 65 55	ns ns ns
C_{IN}	Average Input Capacitance	Load and Data Inputs (A,B,C,D) Count Up, Count Down and Clear		5 10	7.5 15	pF pF
C_{PD}	Power Dissipation Capacity	(Note 4)		100		pF

*AC Parameters are guaranteed by DC correlated testing.

Note 1: ''Absolute Maximum Ratings'' are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of ''Recommended Operating Conditions'' and ''Electrical Characteristics'' provides conditions for actual device operation.
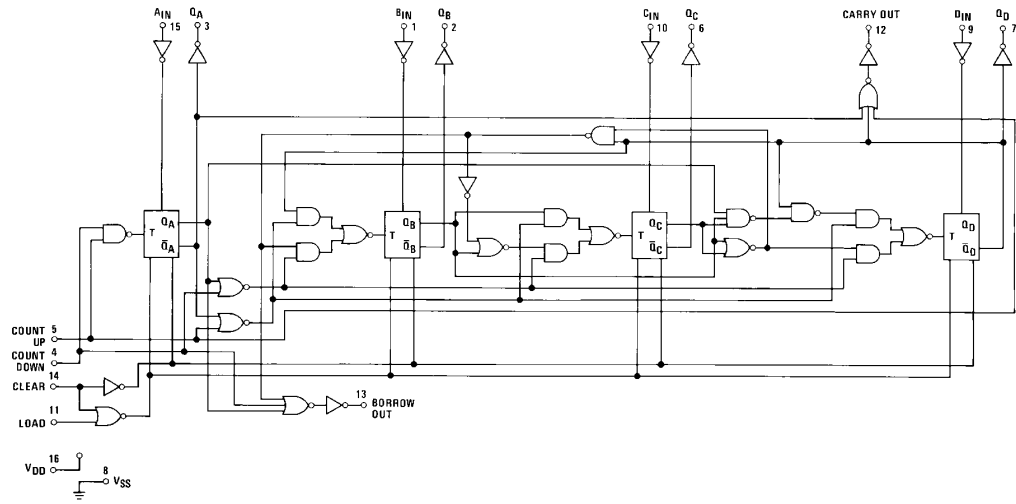
Note 2: $V_{SS} = 0V$ unless otherwise specified.

Note 3: I_{OH} and I_{OL} are tested one output at a time.

Note 4: C_{PD} determines the no load AC power consumption of any CMOS device. For complete explanation, see 54C/74C Family Characteristics application note, AN-90.
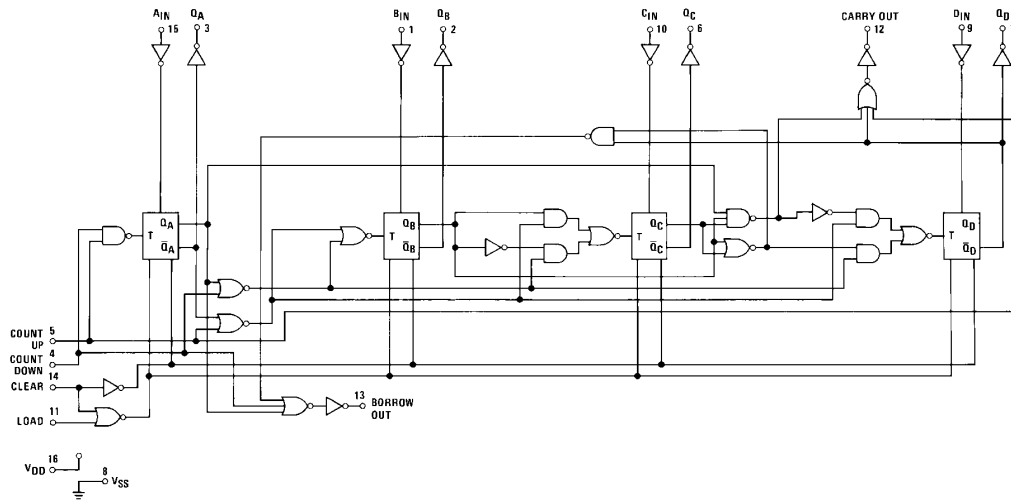
Schematic Diagrams

CD40192BM/CD40192BC Synchronous 4-Bit Up/Down Decade Counter
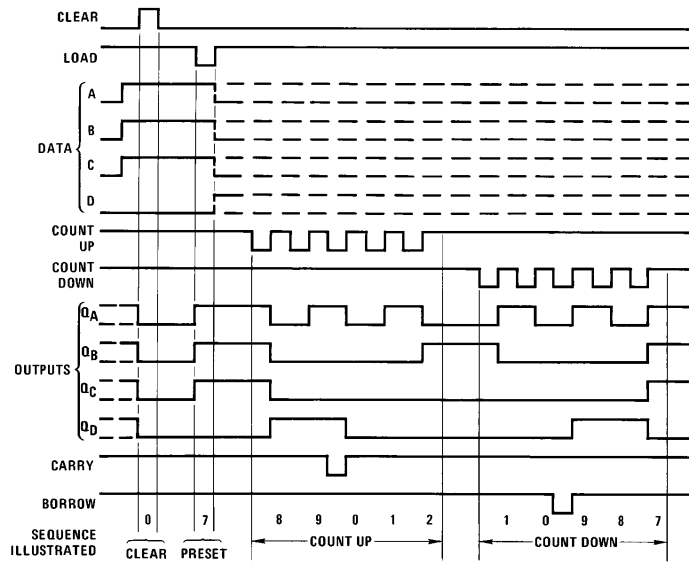

TL/F/5988–3

CD40193BM/CD40193BC Synchronous 4-Bit Up/Down Binary Counter

TL/F/5988–4
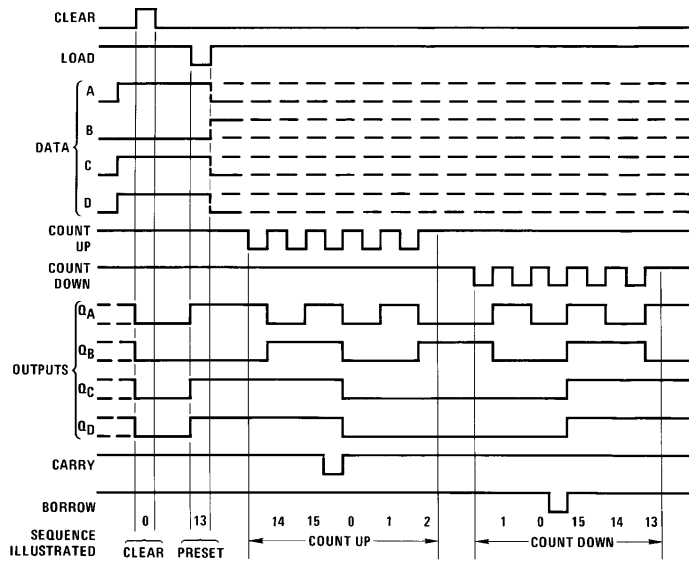
4

Timing Diagrams

CD40192BM/CD40192BC

TL/F/5988–5

Sequence:
1. Clear outputs to zero.
2. Load (preset) to BCD seven.
3. Count up to eight, nine, carry, zero, one and two.
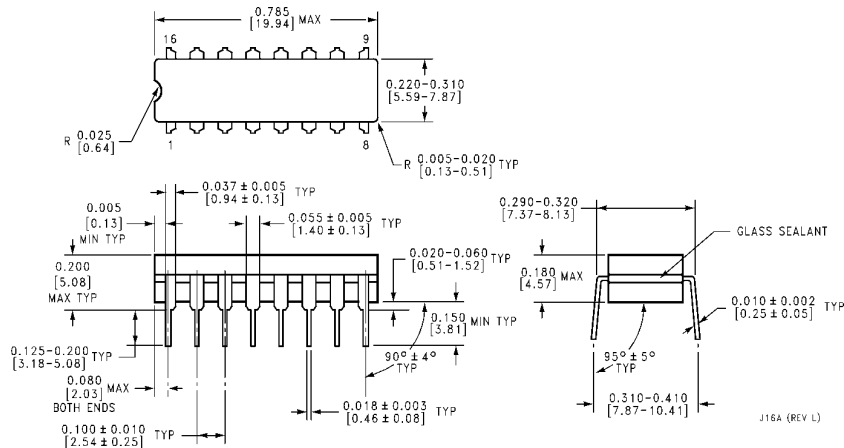4. Count down to one, zero, borrow, nine, eight and seven.
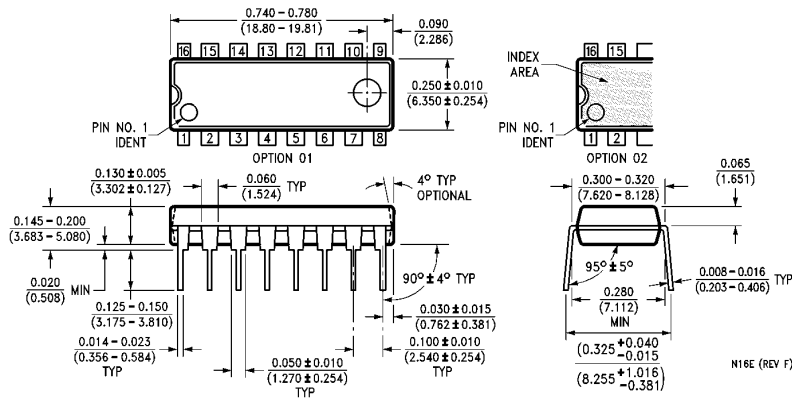
CD40193BM/CD40193BC

TL/F/5988–6

Sequence:
1. Clear outputs to zero.
2. Load (preset) to binary thirteen.
3. Count up to fourteen, fifteen, carry, zero, one and two.
4. Count down to one, zero, borrow, fifteen, fourteen and thirteen.

5

Physical Dimensions inches (millimeters)

0.785
[19.94] MAX

16   9

0.220-0.310
[5.59-7.87]

1   8

R 0.025
[0.64]

R 0.005-0.020
[0.13-0.51] TYP

0.037 ± 0.005
[0.94 ± 0.13] TYP

0.005
[0.13]
MIN TYP

0.055 ± 0.005
[1.40 ± 0.13] TYP

0.290-0.320
[7.37-8.13]

GLASS SEALANT

0.200
[5.08]
MAX TYP

0.020-0.060
[0.51-1.52] TYP

0.180
[4.57] MAX

0.010 ± 0.002
[0.25 ± 0.05] TYP

0.150
[3.81] MIN TYP

0.125-0.200
[3.18-5.08] TYP

0.080
[2.03] MAX
BOTH ENDS

90° ± 4°
TYP

95° ± 5°
TYP

0.310-0.410
[7.87-10.41]

J16A (REV L)

0.018 ± 0.003
[0.46 ± 0.08] TYP

0.100 ± 0.010
[2.54 ± 0.25] TYP

Ceramic Dual-In-Line Package (J)
Order Number CD40192BMJ, CD40192BCJ, CD40193BMJ or CD40193BCJ
NS Package Number J16A

0.740 - 0.780
(18.80 - 19.81)

0.090
(2.286)

16 15 14 13 12 11 10 9

0.250 ± 0.010
(6.350 ± 0.254)

INDEX
AREA

16 15

PIN NO. 1
IDENT

1 2 3 4 5 6 7 8

OPTION 01

PIN NO. 1
IDENT

1 2

OPTION 02

0.130 ± 0.005
(3.302 ± 0.127)

0.060
(1.524) TYP

4° TYP
OPTIONAL

0.300 - 0.320
(7.620 - 8.128)

0.065
(1.651)

0.145 - 0.200
(3.683 - 5.080)

0.020
(0.508) MIN

0.125 - 0.150
(3.175 - 3.810)

90° ± 4° TYP

95° ± 5°

0.280
(7.112)
MIN

0.008 - 0.016
(0.203 - 0.406) TYP

0.030 ± 0.015
(0.762 ± 0.381)

0.014 - 0.023
(0.356 - 0.584)
TYP

0.050 ± 0.010
(1.270 ± 0.254)
TYP

0.100 ± 0.010
(2.540 ± 0.254)
TYP

0.325 +0.040 -0.015
(8.255 +1.016 -0.381)

N16E (REV F)

Molded Dual-In-Line Package (N)
Order Number CD40192BMN, CD40192BCN, CD40193BMN or CD40193BCN
NS Package Number N16E

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.

2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

National Semiconductor was acquired by Texas Instruments.

This file is the datasheet for the following electronic components:

CD40193 - http://www.ti.com/product/cd40193?HQS=TI-null-null-dscatalog-df-pf-null-wwe

CD40192 - http://www.ti.com/product/cd40192?HQS=TI-null-null-dscatalog-df-pf-null-wwe