National *Semiconductor*

MM78C29/MM88C29 Quad Single-Ended Line Driver
MM78C30/MM88C30 Dual Differential Line Driver

General Description

The MM78C30/MM88C30 is a dual differential line driver that also performs the dual four-input NAND or dual four-input AND function. The absence of a clamp diode to V_{CC} in the input protection circuitry of the MM78C30/MM88C30 allows a CMOS user to interface systems operating at different voltage levels. Thus, a CMOS digital signal source can operate at a V_{CC} voltage greater than the V_{CC} voltage of the MM78C30 line driver. The differential output of the MM78C30/MM88C30 eliminates ground-loop errors.

The MM78C29/MM88C29 is a non-inverting single-wire transmission line driver. Since the output ON resistance is a low 20Ω typ., the device can be used to drive lamps, relays, solenoids, and clock lines, besides driving data lines.

Features

■ Wide supply voltage range   3V to 15V
■ High noise immunity   0.45 V_{CC} (typ.)
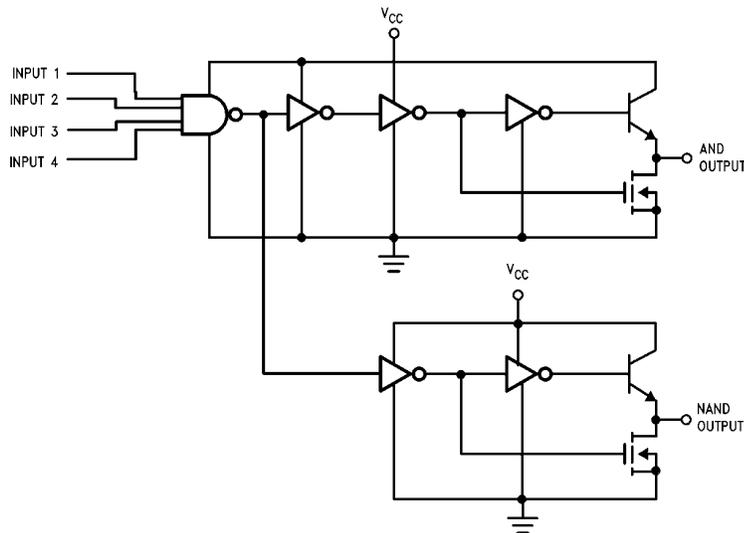■ Low output ON resistance   20Ω (typ.)

Logic Diagrams

1/4 MM78C29/MM88C29
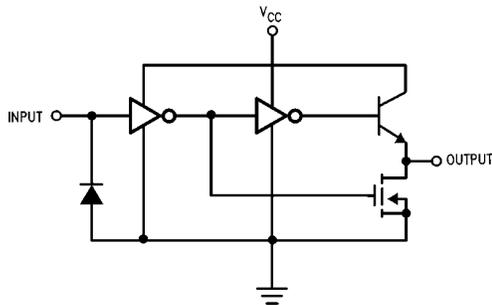
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1/2 MM78C30/MM88C30

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Absolute Maximum Ratings (Note 1)

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

Voltage at Any Pin (Note 1)	$-0.3V$ to $V_{CC} +16V$

Operating Temperature Range
MM78C29/MM78C30 $-55°C$ to $+125°C$
MM88C29/MM88C30 $-40°C$ to $+85°C$
Storage Temperature $-65°C$ to $+150°C$
Power Dissipation (P_D)
  Dual-In-Line   700 mW
  Small Outline   500 mW

Operating V_{CC} Range   3V to 15V
Absolute Maximum V_{CC} 18V
Average Current at Output
  MM78C30/MM88C30   50 mA
  MM78C29/MM88C29   25 mA
Maximum Junction Temperature, T_j 150°C
Lead Temperature
  (Soldering, 10 seconds)   260°C

DC Electrical Characteristics Min/Max limits apply across temperature range unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
CMOS TO CMOS						
$V_{IN(1)}$	Logical "1" Input Voltage	$V_{CC} = 5V$	3.5			V
		$V_{CC} = 10V$	8			V
$V_{IN(0)}$	Logical "0" Input Voltage	$V_{CC} = 5V$			1.5	V
		$V_{CC} = 10V$			2	V
$I_{IN(1)}$	Logical "1" Input Current	$V_{CC} = 15V$, $V_{IN} = 15V$		0.005	1	μA
$I_{IN(0)}$	Logical "0" Input Current	$V_{CC} = 15V$, $V_{IN} = 0V$	-1	-0.005		μA
I_{CC}	Supply Current	$V_{CC} = 5V$		0.05	100	mA
OUTPUT DRIVE						
I_{SOURCE}	Output Source Current MM78C29/MM78C30	$V_{OUT} = V_{CC} -1.6V$, $V_{CC} \geq 4.5V$, $T_j = 25°C$	-57	-80		mA
		$T_j = 125°C$	-32	-50		mA
	MM88C29/MM88C30	$V_{OUT} = V_{CC} - 1.6V$, $V_{CC} \geq 4.75V$, $T_j = 25°C$	-47	-80		mA
		$T_j = 85°C$	-32	-60		mA
	MM78C29/MM88C29 MM78C30/MM88C30	$V_{OUT} = V_{CC} - 0.8V$ $V_{CC} \geq 4.5V$	-2	-20		mA
I_{SINK}	Output Sink Current MM78C29/MM78C30	$V_{OUT} = 0.4V$, $V_{CC} = 4.5V$, $T_j = 25°C$	11	20		mA
		$T_j = 125°C$	8	14		mA
		$V_{OUT} = 0.4V$, $V_{CC} = 10V$, $T_j = 25°C$	22	40		mA
		$T_j = 125°C$	16	28		mA
	MM88C29/MM88C30	$V_{OUT} = 0.4V$, $V_{CC} = 4.75V$, $T_j = 25°C$	9.5	22		mA
		$T_j = 85°C$	8	18		mA
		$V_{OUT} = 0.4V$, $V_{CC} = 10V$, $T_j = 25°C$	19	40		mA
		$T_j = 125°C$	15.5	33		mA
I_{SOURCE}	Output Source Resistance MM78C29/MM78C30	$V_{OUT} = V_{CC} - 1.6V$, $V_{CC} \geq 4.5V$, $T_j = 25°C$		20	28	Ω
		$T_j = 125°C$		32	50	Ω
	MM88C29/MM88C30	$V_{OUT} = V_{CC} - 1.6V$, $V_{CC} \geq 4.75V$, $T_j = 25°C$		20	34	Ω
		$T_j = 85°C$		27	50	Ω

DC Electrical Characteristics
Min/Max limits apply across temperature range, unless otherwise noted (Continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
OUTPUT DRIVE (Continued)						
I_{SINK}	Output Sink Resistance MM78C29/MM78C30	$V_{OUT} = 0.4V$, $V_{CC} = 4.50V$, $T_j = 25°C$ $T_j = 125°C$		20 28	36 50	Ω Ω
		$V_{OUT} = 0.4V$, $V_{CC} = 10V$, $T_j = 25°C$ $T_j = 125°C$		10 14	18 25	Ω Ω
	MM88C29/MM88C30	$V_{OUT} = 0.4V$, $V_{CC} = 4.75V$, $T_j = 25°C$ $T_j = 85°C$		18 22	41 50	Ω Ω
		$V_{OUT} = 0.4V$, $V_{CC} = 10V$, $T_j = 25°C$ $T_j = 85°C$		10 12	21 26	Ω Ω
	Output Resistance Temperature Coefficient Source Sink			0.55 0.40		%/°C %/°C
θ_{JA}	Thermal Resistance MM78C29/MM78C30 (D-Package)			100		°C/W
	MM88C29/MM88C30 (N-Package)			150		°C/W

AC Electrical Characteristics* $T_A = 25°C$, $C_L = 50$ pF

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{pd}	Propagation Delay Time to Logical ''1'' or ''0'' MM78C29/MM88C29	(See *Figure 2*) $V_{CC} = 5V$ $V_{CC} = 10V$		80 35	200 100	ns ns
	MM78C30/MM88C30	$V_{CC} = 5V$ $V_{CC} = 10V$		110 50	350 150	ns ns
t_{pd}	Differential Propagation Delay Time to Logical ''1'' or ''0'' MM78C30/MM88C30	$R_L = 100\Omega$, $C_L = 5000$ pF (See *Figure 1*) $V_{CC} = 5V$ $V_{CC} = 10V$			400 150	ns ns
C_{IN}	Input Capacitance MM78C29/MM88C29 MM78C30/MM88C30	(Note 3) (Note 3)		5.0 5.0		pF pF
C_{PD}	Power Dissipation Capacitance MM78C29/MM88C29 MM78C30/MM88C30	(Note 3) (Note 3)		150 200		pF 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. Except for ''Operating Temperature Range'' they are not meant to imply that the devices should be operated at these limits. The table of ''Electrical Characteristics'' provides conditions for actual device operation.

Note 2: Capacitance is guaranteed by periodic testing.

Note 3: 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 (CMOS Logic Databook).
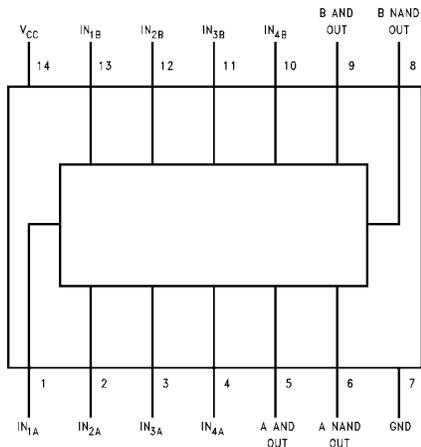
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Connection Diagrams

Dual-In-Line Package
MM78C29/MM88C29

VCC	NC	IN₄	NC	IN₃	OUT₃	OUT₄
14	13	12	11	10	9	8

1	2	3	4	5	6	7
NC	IN₁	NC	IN₂	OUT₂	OUT₁	GND
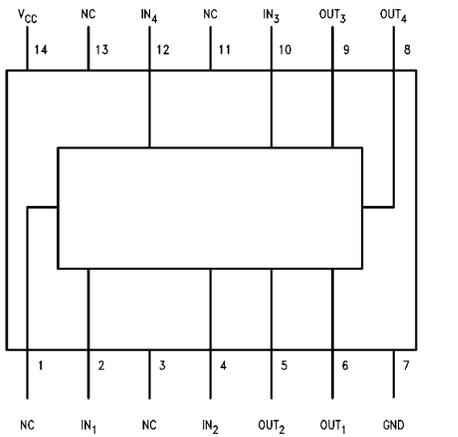
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Top View

Dual-In-Line Package
MM78C30/MM88C30

VCC	IN₁ᵦ	IN₂ᵦ	IN₃ᵦ	IN₄ᵦ	B AND OUT	B NAND OUT
14	13	12	11	10	9	8

1	2	3	4	5	6	7
IN₁ₐ	IN₂ₐ	IN₃ₐ	IN₄ₐ	A AND OUT	A NAND OUT	GND

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Top View

Order Number MM88C29M or MM88C29N Order Number MM88C30M or MM88C30N

For Complete Military 883 Specifications, see RETS Data Sheet.
Order Number MM78C29J/883, MM78C29W/883, MM78C30J/883 or MM78C30W/883

Typical Performance Characteristics

MM78C29/MM88C29
Typical Propagation Delay vs Load Capacitance
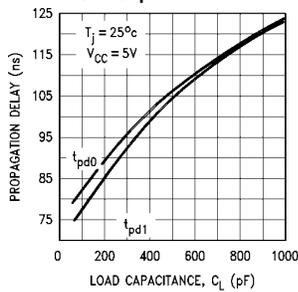
MM78C29/MM88C29
Typical Propagation Delay vs Load Capacitance
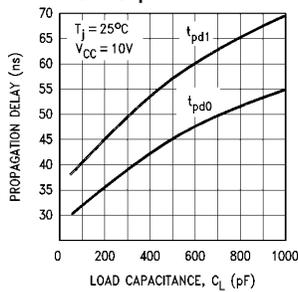
MM78C30/MM88C30
Typical Propagation Delay vs Load Capacitance
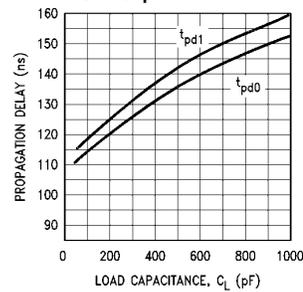
MM78C30/MM88C30
Typical Propagation Delay vs Load Capacitance
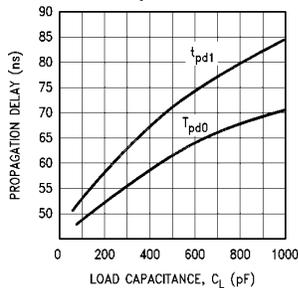
Typical Sink Current vs Output Voltage
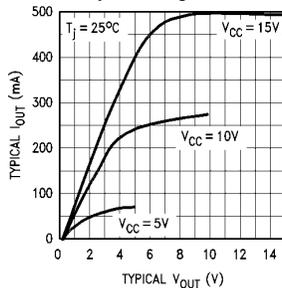
Typical Source Current vs Output Voltage
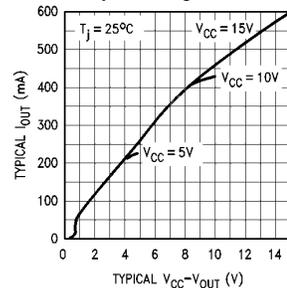
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AC Test Circuits
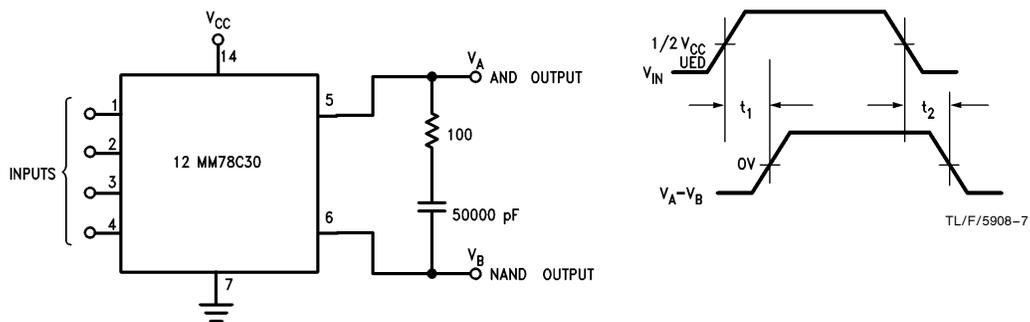
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FIGURE 1
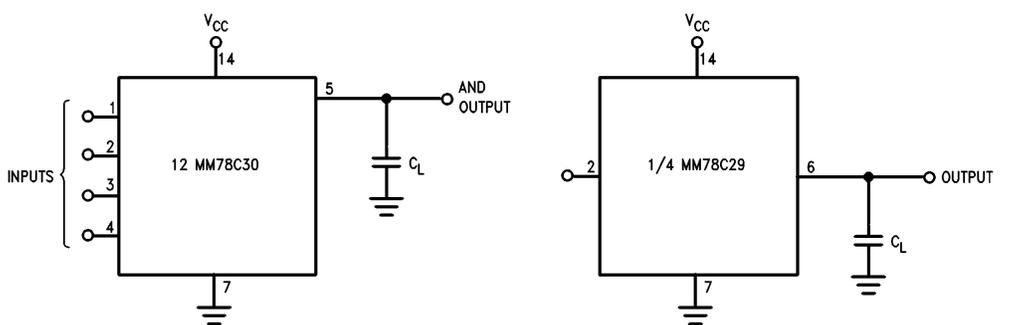
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FIGURE 2

Typical Applications
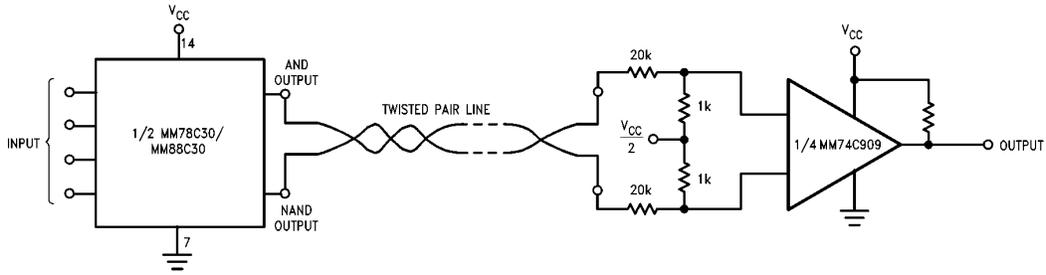
Digital Data Transmission
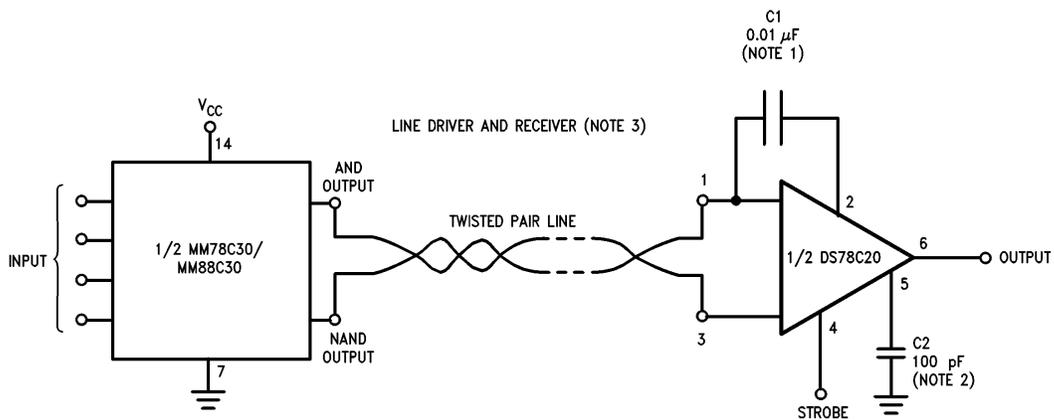
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Note 1: Exact value depends on line length.
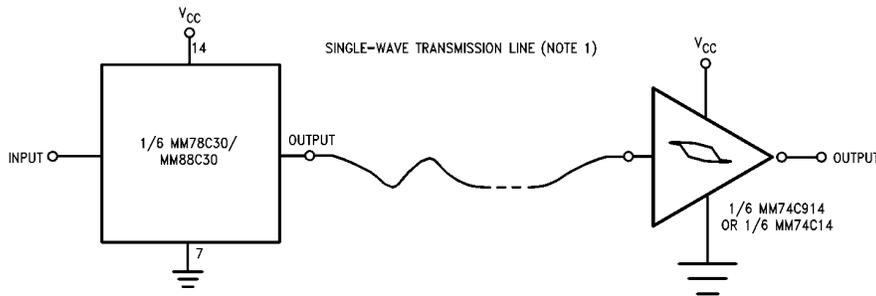
Note 2: Optional to control response time.

Note 3: V_{CC} = 4.5V to 5.5V for the DS7820, V_{CC} = 4.5V to 15V for the DS78C20.

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Typical Applications (Continued)

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SINGLE-WAVE TRANSMISSION LINE (NOTE 1)

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Note 1: V_{CC} is 3V to 15V

Typical Data Rate vs Transmission Line Length
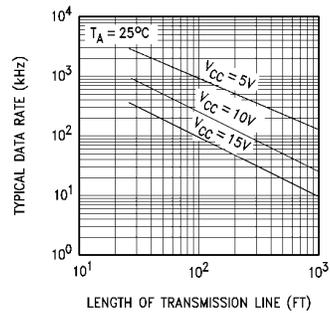
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Note 1: The transmission line used was #22 gauge unshielded twisted pair (40k termination).

Note 2: The curves generated assume that both drivers are driving equal lines, and that the maximum power is 500 mW/package.

Physical Dimensions inches (millimeters)

0.785
(19.939)
MAX

0.025
(0.635)
RAD

14 13 12 11 10 9 8

1 2 3 4 5 6 7

0.220−0.310
(5.588−7.874)

0.290−0.320
(7.366−8.128)

0.180
(4.572) MAX

95° ±5°

10° MAX

0.310−0.410
(7.874−10.41)

0.005
(0.127)
MIN

GLASS
SEALANT

86°94° TYP

0.008−0.012
(0.203−0.305)

0.098
(2.489)
MAX BOTH ENDS

0.060 ±0.005
(1.524 ±0.127)

0.018 ±0.003
(0.457 ±0.076)

0.100 ±0.010
(2.540 ±0.254)

0.200
(5.080)
MAX

0.020−0.060
(0.508−1.524)

0.125−0.200
(3.175−5.080)

0.150
(3.81)
MIN
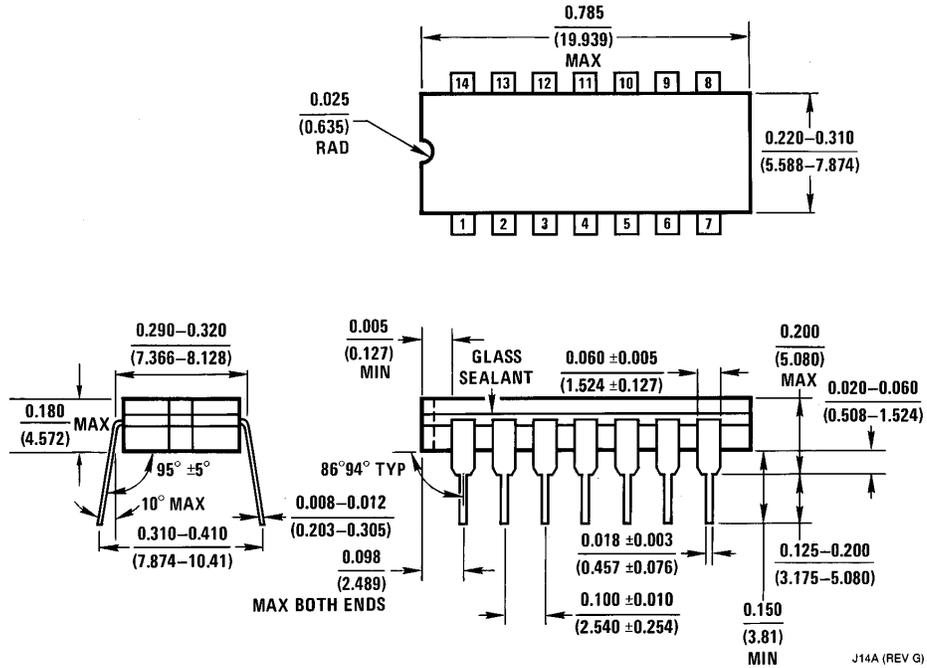
J14A (REV G)

Ceramic Dual-In-Line Package (J)
Order Number MM78C29J, MM78C30J, MM88C29J or MM88C30J
NS Package Number J14A

Physical Dimensions inches (millimeters) (Continued)
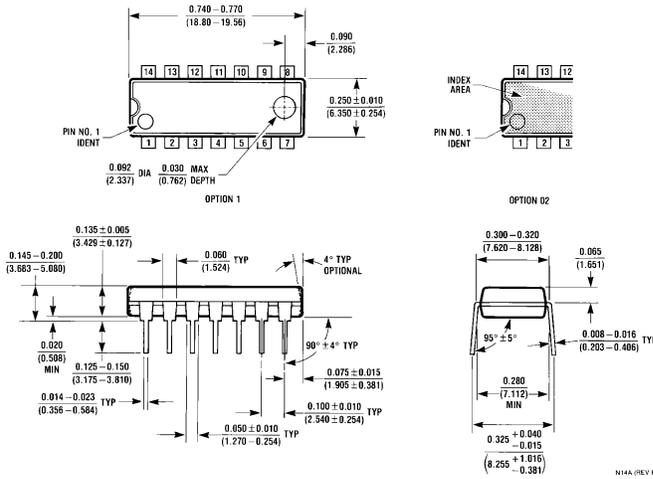
Molded Dual-In-Line Package (N)
Order Number MM78C29N, MM78C30N, MM88C29N or MM88C30N
NS Package Number N14A

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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.