

MM74C908/MM74C918 Dual CMOS 30V Relay Driver

General Description

The MM74C908 and MM74C918 are general purpose dual high voltage drivers, each capable of sourcing a minimum of 250 mA at $V_{OUT} = V_{CC} - 3V$, and $T_J = 65^\circ C$.

The MM74C908 and MM74C918 consist of two CMOS NAND gates driving an emitter follower Darlington output to achieve high current drive and high voltage capabilities. In the "OFF" state the outputs can withstand a maximum of $-30V$ across the device. These CMOS drivers are useful in interfacing normal CMOS voltage levels to driving relays, regulators, lamps, etc.

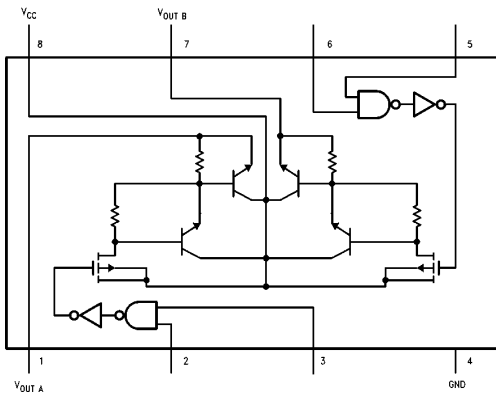
Features

- Wide supply voltage range 3V to 18V
- High noise immunity $0.45 V_{CC}$ (typ.)
- Low output "ON" resistance 8Ω (typ.)
- High voltage $-30V$
- High current 250 mA

Connection Diagrams

Dual-In-Line Package

MM74C908



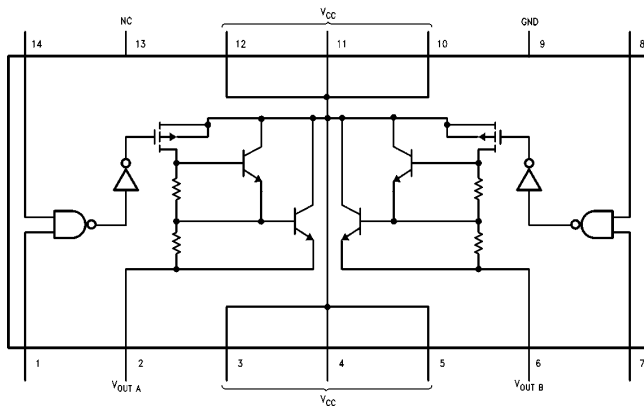
Top View

TL/F/5912-1

Order Number MM74C908

Dual-In-Line Package

MM74C918



Top View

TL/F/5912-2

Order Number MM74C918

TRI-STATE® is a registered trademark of National Semiconductor Corporation.

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 Input Pin	-0.3V to V_{CC} + 0.3V
Voltage at any Output Pin	32V
Operating Temperature Range MM74C908/MM74C918	-40°C to +85°C

Operating V_{CC} Range	4V to 18V
Absolute Maximum V_{CC}	19V
I_{SOURCE}	500 mA
Storage Temperature Range (T_S)	-65°C to +150°C
Lead Temperature (T_L) (Soldering, 10 seconds)	260°C
Power Dissipation (P_D)	Refer to Maximum Power Dissipation vs Ambient Temperature Graph

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	$V_{CC} = 5V$ $V_{CC} = 10V$	3.5 8.0			V V
$V_{IN(0)}$	Logical "0" Input Voltage	$V_{CC} = 5V$ $V_{CC} = 10V$			1.5 2.0	V V
$I_{IN(1)}$	Logical "1" Input Current	$V_{CC} = 15V, V_{IN} = 15V$		0.005	1.0	μA
$I_{IN(0)}$	Logical "0" Input Current	$V_{CC} = 15V, V_{IN} = 0V$	-1.0	-0.005		μA
I_{CC}	Supply Current	$V_{CC} = 15V$, Outputs Open Circuit		0.05	15	μA
	Output "OFF" Voltage	$V_{IN} = V_{CC}, I_{OUT} = -200 \mu A$		-30		V
CMOS/LPTTL INTERFACE						
$V_{IN(1)}$	Logical "1" Input Voltage MM74C908/MM74C918	$V_{CC} = 4.75V$	$V_{CC} - 1.5$			V
$V_{IN(0)}$	Logical "0" Input Voltage MM74C908/MM74C918	$V_{CC} = 4.75V$			0.8	V
OUTPUT DRIVE						
V_{OUT}	Output Voltage	$I_{OUT} = -300 mA, V_{CC} \geq 5V, T_J = 25^\circ C$ $I_{OUT} = -250 mA, V_{CC} \geq 5V, T_J = 65^\circ C$ $I_{OUT} = -175 mA, V_{CC} \geq 5V, T_J = 150^\circ C$	$V_{CC} - 2.7$ $V_{CC} - 3.0$ $V_{CC} - 3.15$	$V_{CC} - 1.8$ $V_{CC} - 1.9$ $V_{CC} - 2.0$		V V V
R_{ON}	Output Resistance	$I_{OUT} = -300 mA, V_{CC} \geq 5V, T_J = 25^\circ C$ $I_{OUT} = -250 mA, V_{CC} \geq 5V, T_J = 65^\circ C$ $I_{OUT} = -175 mA, V_{CC} \geq 5V, T_J = 150^\circ C$		6.0 7.5 10	9.0 12 18	Ω Ω Ω
	Output Resistance Coefficient			0.55	0.80	%/ $^\circ C$
θ_{JA}	Thermal Resistance MM74C908/MM74C918	(Note 3) (Note 3)		100 45	110 55	$^\circ C/W$ $^\circ C/W$

AC Electrical Characteristics*

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{pd1}	Propagation Delay to a Logical "1"	$V_{CC} = 5V, R_L = 50\Omega,$ $C_L = 50 pF, T_A = 25^\circ C$ $V_{CC} = 10V, R_L = 50\Omega,$ $C_L = 50 pF, T_A = 25^\circ C$		150 65	300 120	ns ns
t_{pd0}	Propagation Delay to a Logic "0"	$V_{CC} = 5V, R_L = 50\Omega,$ $C_L = 50 pF, T_A = 25^\circ C$ $V_{CC} = 10V, R_L = 50\Omega,$ $C_L = 50 pF, T_A = 25^\circ C$		2.0 4.0	10 20	μs μs
C_{IN}	Input Capacitance	(Note 2)		5.0		pF

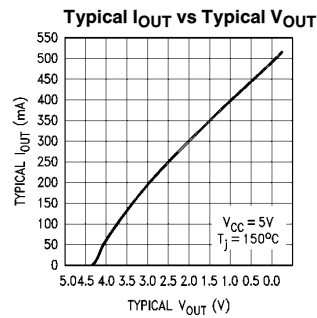
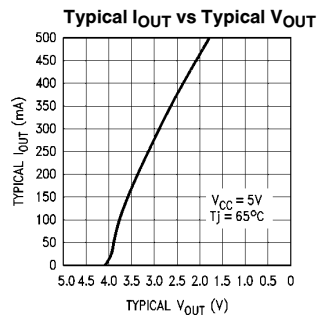
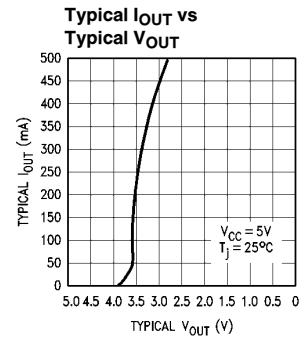
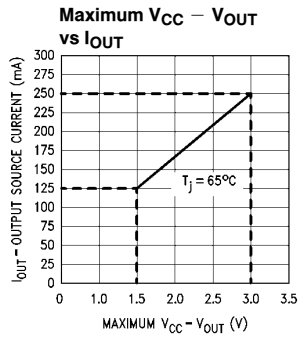
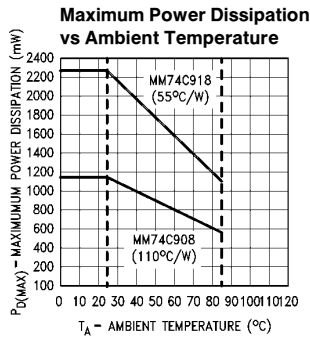
*AC Parameters are guaranteed by DC correlated testing.

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.

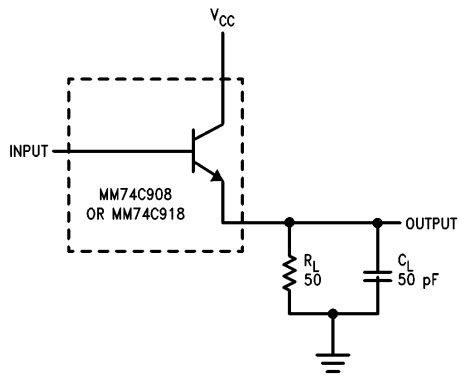
Note 3: θ_{JA} measured in free air with device soldered into printed circuit board.

Typical Performance Characteristics



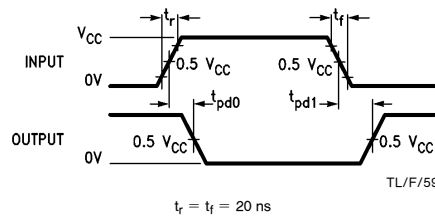
TL/F/5912-3

AC Test Circuit



TL/F/5912-4

Switching Time Waveforms



TL/F/5912-5

Power Considerations

Calculating Output "ON" Resistance ($R_L > 18\Omega$)

The output "ON" resistance, R_{ON} , is a function of the junction temperature, T_J , and is given by:

$$R_{ON} = 9(T_J - 25)(0.008) + 9 \quad (1)$$

and T_J is given by:

$$T_J = T_A + P_{DAV} \theta_{JA} \quad (2)$$

where T_A = ambient temperature, θ_{JA} = thermal resistance, and P_{DAV} is the average power dissipated within the device. P_{DAV} consists of normal CMOS power terms (due to leakage currents, internal capacitance, switching, etc.) which are insignificant when compared to the power dissipated in the outputs. Thus, the output power term defines the allowable limits of operation and includes both outputs, A and B. P_D is given by:

$$P_D = I_{OA}^2 R_{ON} + I_{OB}^2 R_{ON} \quad (3)$$

where I_O is the output current, given by:

$$I_O = \frac{V_{CC} - V_L}{R_{ON} + R_L} \quad (4)$$

V_L is the load voltage.

The average power dissipation, P_{DAV} , is a function of the duty cycle:

$$P_{DAV} = I_{OA}^2 R_{ON} (\text{Duty Cycle}_A) + I_{OB}^2 R_{ON} (\text{Duty Cycle}_B) \quad (5)$$

where the duty cycle is the % time in the current source state. Substituting equations (1) and (5) into (2) yields:

$$T_J = T_A + \theta_{JA} [9(T_J - 25)(0.008) + 9] [I_{OA}^2 (\text{Duty Cycle}_A) + I_{OB}^2 (\text{Duty Cycle}_B)] \quad (6a)$$

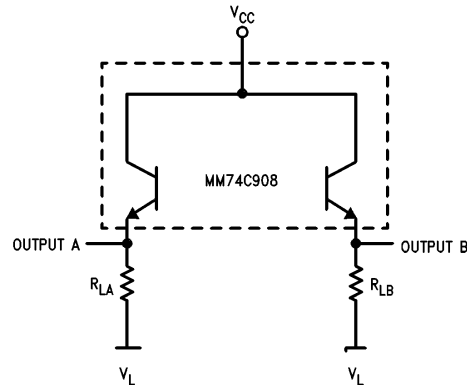
simplifying:

$$T_J = \frac{T_A + 7.2 \theta_{JA} [I_{OA}^2 (\text{Duty Cycle}_A) + I_{OB}^2 (\text{Duty Cycle}_B)]}{1 - 0.072 \theta_{JA} [I_{OA}^2 (\text{Duty Cycle}_A) + I_{OB}^2 (\text{Duty Cycle}_B)]}$$

Equations (1), (4), and (6b) can be used in an iterative method to determine the output current, output resistance and junction temperature.

Applications

(See AN-177 for applications)



TL/F/5912-6

For example, let $V_{CC} = 15V$, $R_{LA} = 100\Omega$, $R_{LB} = 100\Omega$, $V_L = 0V$, $T_A = 25^\circ C$, $\theta_{JA} = 110^\circ C/W$, $\text{Duty Cycle}_A = 50\%$, $\text{Duty Cycle}_B = 75\%$.

Assuming $R_{ON} = 11\Omega$, then:

$$I_{OA} = \frac{V_{CC} - V_L}{R_{ON} + R_{LA}} = \frac{15}{11 + 100} = 135.1 \text{ mA}$$

$$I_{OB} = \frac{V_{CC} - V_L}{R_{ON} + R_{LB}} = 135.1 \text{ mA}$$

and

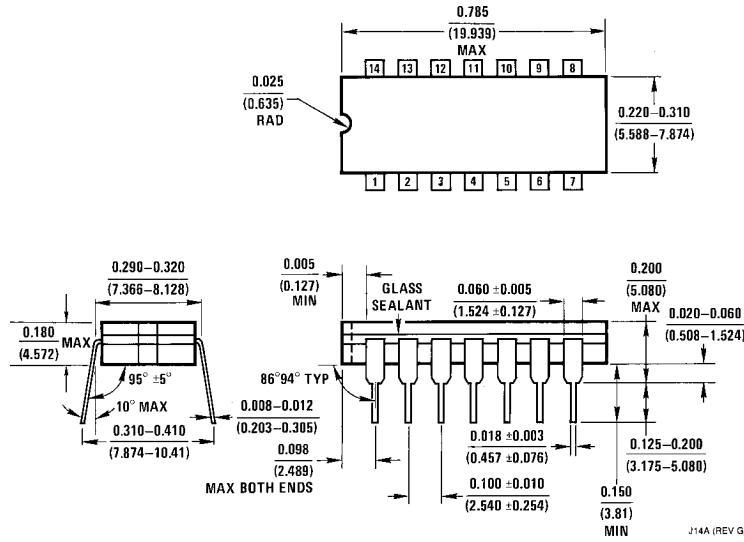
$$T_J = \frac{T_A + 7.2 \theta_{JA} [I_{OA}^2 (\text{Duty Cycle}_A) + I_{OB}^2 (\text{Duty Cycle}_B)]}{1 - 0.072 \theta_{JA} [I_{OA}^2 (\text{Duty Cycle}_A) + I_{OB}^2 (\text{Duty Cycle}_B)]}$$

$$T_J = \frac{25 + (7.2)(110) [(0.1351)^2 (0.5) + (0.1351)^2 (0.75)]}{1 - (0.072)(110) [(0.1351)^2 (0.5) + (0.1351)^2 (0.75)]}$$

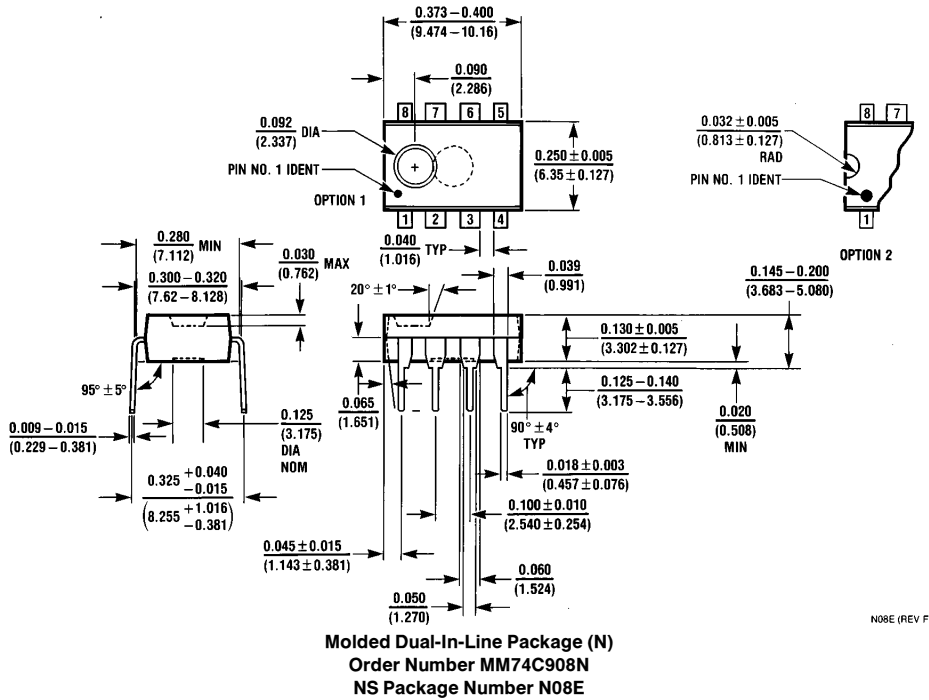
$$T_J = 52.6^\circ C$$

$$\text{and } R_{ON} = 9(T_J - 25)(0.008) + 9 \\ = 9(52.6 - 25)(0.008) + 9 = 11\Omega$$

Physical Dimensions inches (millimeters)

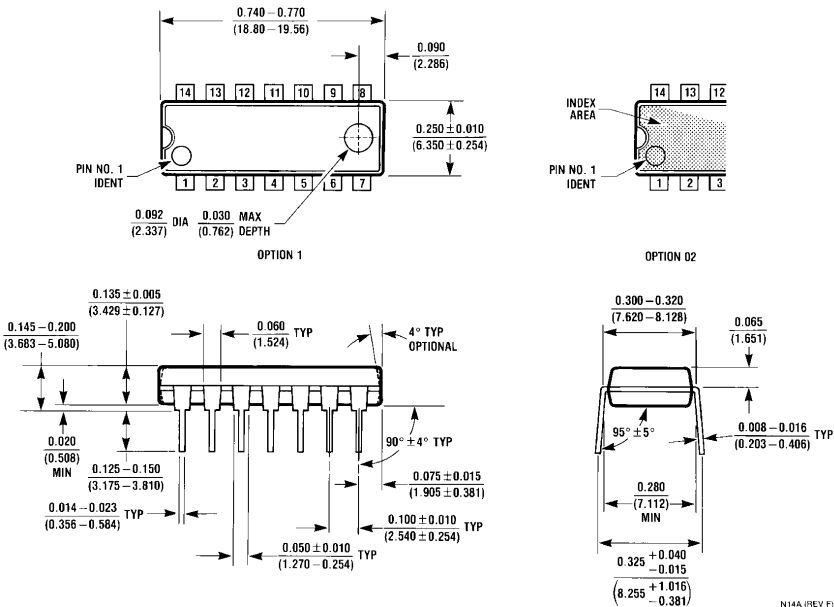


Ceramic Dual-In-Line Package (J)
Order Number MM74C918J
NS Package Number J14A



Molded Dual-In-Line Package (N)
Order Number MM74C908N
NS Package Number N08E

Physical Dimensions inches (millimeters) (Continued)




Molded Dual-In-Line Package (N)
Order Number MM74C918N
NS Package Number N14A

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.

 <p>National Semiconductor Corporation 1111 West Bardin Road Arlington, TX 76017 Tel: 1(800) 272-9959 Fax: 1(800) 737-7018</p>	<p>National Semiconductor Europe Fax: (+49) 0-180-530 85 86 Email: cnjwge@tevm2.nsc.com Deutsch Tel: (+49) 0-180-530 85 85 English Tel: (+49) 0-180-532 78 32 Français Tel: (+49) 0-180-532 93 58 Italiano Tel: (+49) 0-180-534 16 80</p>	<p>National Semiconductor Hong Kong Ltd. 19th Floor, Straight Block, Ocean Centre, 5 Canton Rd. Tsimshatsui, Kowloon Hong Kong Tel: (852) 2737-1600 Fax: (852) 2736-9960</p>	<p>National Semiconductor Japan Ltd. Tel: 81-043-299-2309 Fax: 81-043-299-2408</p>
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.