

October 1987 Revised January 1999

MM74C908 Dual CMOS 30-Volt Relay Driver

General Description

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

The MM74C908 consists 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

Ordering Code:

Order Number	Package Number	Package Description			
MM74C908N	N08E	8-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide			

Connection Diagram

Pin Assignments for DIP Vout 8 7 8 7 6 5 Vout A Top View

Absolute Maximum Ratings(Note 1)

Voltage at any Input Pin -0.3V to V_{CC} +0.3V Voltage at any Output Pin 32V -40°C to +85°C Operating Temperature Range Operating V_{CC} Range 4V to 18V Absolute Maximum V_{CC} 19V 500 mA I_{SOURCE} Storage Temperature +150°C Range (T_S) -65°C to +150°C **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 Electrical Characteristics table provides conditions for actual device operation.

DC Electrical Characteristics

Min/Max limits apply across temperature range, unless otherwise noted

Symbol	Parameter	Conditions	Min	Тур	Max	Units
CMOS TO	CMOS		<u> </u>			1
V _{IN(1)}	Logical "1" Input Voltage	V _{CC} = 5V	3.5			V
		V _{CC} = 10V	8.0			V
V _{IN(0)}	Logical "0" Input Voltage	V _{CC} = 5V			1.5	V
		V _{CC} = 10V			2.0	V
I _{IN(1)}	Logical "1" Input Current	V _{CC} = 15V, V _{IN} = 15V		0.005	1.0	μΑ
I _{IN(0)}	Logical "0" Input Current	V _{CC} = 15V, V _{IN} = 0V	-1.0	-0.005		μΑ
I _{CC}	Supply Current	V _{CC} = 15V, Outputs Open Circuit		0.05	15	μΑ
	Output "OFF" Voltage	$V_{IN} = V_{CC}$, $I_{OUT} = -200 \mu A$		-30		V
CMOS/LPT	TL INTERFACE	•			U	
V _{IN(1)}	Logical "1" Input Voltage	V _{CC} = 4.75V	V _{CC} – 1.5			V
V _{IN(0)}	Logical "0" Input Voltage	V _{CC} = 4.75V			0.8	V
OUTPUT D	PRIVE	•			U	
V _{OUT}	Output Voltage	$I_{OUT} = -300 \text{ mA}, V_{CC} \ge 5V, T_J = 25^{\circ}\text{C}$	V _{CC} -2.7	V _{CC} -1.8		V
		$I_{OUT} = -250 \text{ mA}, V_{CC} \ge 5\text{V}, T_{J} = 65^{\circ}\text{C}$	V _{CC} -3.0	V _{CC} -1.9		V
		$I_{OUT} = -175 \text{ mA}, V_{CC} \ge 5V, T_J = 150^{\circ}\text{C}$	V _{CC} -3.15	V _{CC} -2.0		V
R _{ON}	Output Resistance	$I_{OUT} = -300 \text{ mA}, V_{CC} \ge 5\text{V}, T_J = 25^{\circ}\text{C}$		6.0	9.0	Ω
		$I_{OUT} = -250 \text{ mA}, V_{CC} \ge 5\text{V}, T_{J} = 65^{\circ}\text{C}$		7.5	12	Ω
		$I_{OUT} = -175 \text{ mA}, V_{CC} \ge 5V, T_J = 150^{\circ}\text{C}$		10	18	Ω
	Output Resistance			0.55	0.80	%/°C
	Coefficient					
θ_{JA}	Thermal Resistance	(Note 2)		100	110	°C/W
	MM74C908	(Note 2)		45	55	°C/W

Note 2: θ_{JA} measured in free air with device soldered into printed circuit board.

AC Electrical Characteristics (Note 3)

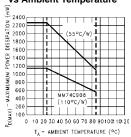
Symbol	Parameter	Conditions	Min	Тур	Max	Units
t _{pd1}	Propagation Delay	$V_{CC} = 5V$, $R_L = 50\Omega$,		150	300	ns
	to a Logical "1"	C _L = 50 pF, T _A = 25°C				
		$V_{CC} = 10V$, $R_L = 50\Omega$,		65	120	ns
		C _L = 50 pF, T _A = 25°C				
t _{pd0}	Propagation Delay	$V_{CC} = 5V$, $R_L = 50\Omega$,		2.0	10	μs
	to a Logic "0"	C _L = 50 pF, T _A = 25°C				
		$V_{CC} = 10V$, $R_L = 50\Omega$,		4.0	20	μs
		$C_L = 50 \text{ pF, } T_A = 25^{\circ}C$				
C _{IN}	Input Capacitance	(Note 4)		5.0		pF

Note 3: AC Parameters are guaranteed by DC correlated testing.

Note 4: Capacitance is guaranteed by periodic testing.

Typical Performance Characteristics

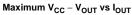
Maximum Power Dissipation vs Ambient Temperature

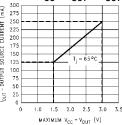


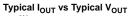
Typical V_{OUT}

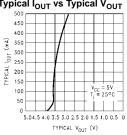
Typical I_{OUT} vs

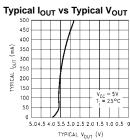
TYPICAL V_{OUT} (V)





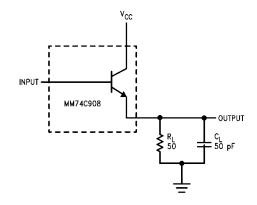


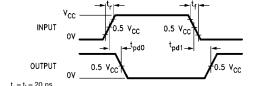




AC Test Circuit

Switching Time Waveforms





Power Considerations

Calculating Output "ON" Resistance ($R_1 > 18\Omega$)

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

$$R_{ON} = 9 (T_J - 25) (0.008) + 9:$$
 (1) and T_J is given by:

$$T_{J} = T_{A} + P_{DAV} \theta_{JA},: \quad (2)$$

where $T_{A}=\mbox{ambient temperature},\;\theta_{JA}=\mbox{thermal resistance},$ and PDAV is the average power dissipated within the device. $\mathbf{P}_{\mathrm{DAV}}$ 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:

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

where I_O is the output current, given by:

$$I_O = \frac{V_{CC} - V_L}{R_{ON} + R_L}$$

(4)

V_L is the load voltage.

The average power dissipation, PDAV, is a function of the duty cycle:

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

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

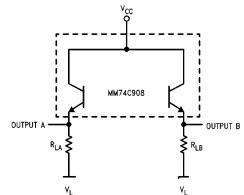
$$T_J = T_A + \theta_{JA} [9 (T_J - 25) (0.008) + 9]$$
: (6a)

$$[I_{OA}^2 \text{ (Duty Cycle}_A) + I_{OB}^2 \text{ (Duty Cycle}_B)]$$

simplifying:

$$\label{eq:TJ} \begin{split} T_{\text{J}} &= \frac{T_{\text{A}} + 7.2\,\theta_{\text{JA}}\,[l_{\text{OA}}^2\,(\text{Duty Cycle}_{\text{A}}) \,+\, l_{\text{OB}}^2\,(\text{Duty Cycle}_{\text{B}})]}{1 - 0.072\,\theta_{\text{JA}}\,[l_{\text{OA}}^2\,(\text{Duty Cycle}_{\text{A}}) \,+\, l_{\text{OB}}^2\,(\text{Duty Cycle}_{\text{B}})]} \end{split}$$

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



 V_L V_L For example, let $V_{CC} = 15V$, $R_{LA} = 100Ω$, $R_{LB} =$ $V_L = 0V$, $T_A = 25$ °C, $\theta_{JA} = 110$ °C/W, Duty Cycle_A = 50%, 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

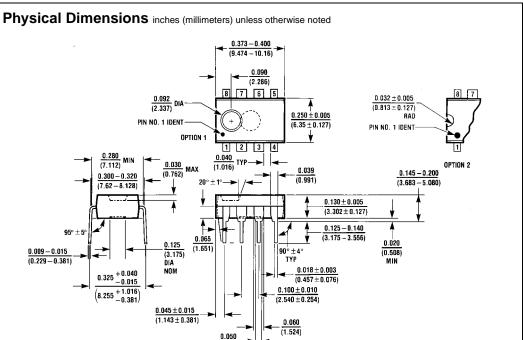
$$\mathsf{T_J} = \frac{\mathsf{T_A} \, + \, 7.2 \, \theta_{\mathsf{JA}} \, [\mathsf{I}_{\mathsf{OA}^2} \, (\mathsf{Duty} \, \mathsf{Cycle}_{\mathsf{A}}) \, + \, \mathsf{I}_{\mathsf{OB}^2} \, (\mathsf{Duty} \, \mathsf{Cycle}_{\mathsf{B}})]}{1 - 0.072 \, \theta_{\mathsf{JA}} \, [\mathsf{I}_{\mathsf{OA}^2} \, (\mathsf{Duty} \, \mathsf{Cycle}_{\mathsf{A}}) \, + \, \mathsf{I}_{\mathsf{OB}^2} \, (\mathsf{Duty} \, \mathsf{Cycle}_{\mathsf{B}})]}$$

$$\begin{split} T_J &= \frac{25 + (7.2) \, (110) \, [(0.1351)^2 \, (0.5) \, + \, (0.1351)^2 \, (0.75)]}{1 - \, (0.072) \, (110) \, [(0.1351)^2 \, (0.5) \, + \, (0.1351)^2 \, (0.75)]} \\ T_J &= 52.6^{\circ}C \\ \text{and } R_{ON} &= 9 \, (T_J - 25) \, (0.008) + 9 \\ &= 9 (52.6 - 25) \, (0.008) + 9 = 11 \Omega \end{split}$$

Applications

(See AN-177 for applications)

NOBE (REV F)



8-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide Package Number N08E

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