National Semiconductor Corporation

DM9024/DM8024 Dual J-K Flip-Flops with Preset and Clear

General Description

The DM9024 series device is designed to be used in existing systems as replacements for Fairchild 9000-type circuits. These DM9024 circuits offer several significant advantages over 9024 type circuits, some of which are:

■ Input clamp diodes
■ Output short-circuit current specified to guarantee the high-level impedance.

The DM9024 circuit is characterized for operation over the industrial temperature range of 0°C to 75°C.

For the new designs, the 54/74 families of TTL circuits offer the industry's broadest choice of high-performance digital circuits. Series 54/74 pin-for-pin equivalents are available for the following SSI types:
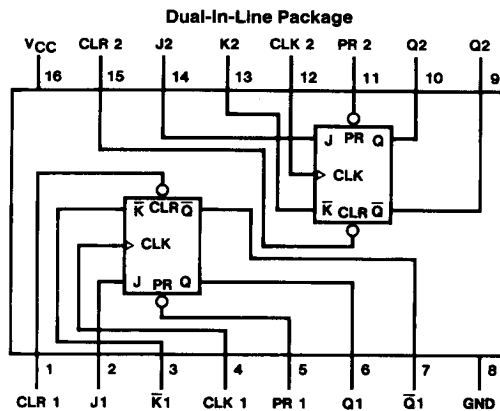
DM9000 Series	Equivalent Series 74
DM9024	DM74109

Connection Diagram

Dual-In-Line Package

Order Number DM9024J or DM8024N
See NS Package Number J16A or N16A

TL/F/6599–1

Function Table

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Inputs					Outputs	
Preset	Clear	Clock	J	$\overline{K}$	Q	$\overline{Q}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H*	H*
H	H	↑	L	L	L	H
H	H	↑	H	L	TOGGLE	
H	H	↑	L	H	Q_0	$\overline{Q}_0$
H	H	↑	H	H	H	L
H	H	L	X	X	Q_0	$\overline{Q}_0$

H = High Level (Steady State), L = Low Level (Steady State).

X = Don't Care

↑ = Transition from low to high level

Q_0 = The level of Q before the indicated input conditions were established.

TOGGLE: Each output changes to the complement of its previous level on each active transition of the clock.

*This configuration is nonstable. That is, it will not persist when preset and clear inputs return to their inactive (high) level.

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Absolute Maximum Ratings (Note)

Specifications for Military/Aerospace products are not contained in this datasheet. Refer to the associated reliability electrical test specifications document.

Supply Voltage	7V
Input Voltage	5.5V
Operating Free Air Temperature Range	
DM90	$-55°C$ to $+125°C$
DM80	$0°C$ to $+70°C$
Storage Temperature Range	$-65°C$ to $+150°C$

Note: *The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.*

Recommended Operating Conditions

Symbol	Parameter		DM9024			DM8024			Units
			Min	Nom	Max	Min	Nom	Max	
V_{CC}	Supply Voltage		4.5	5.0	5.5	4.75	5.0	5.25	V
V_{IH}	High Level Input Voltage	T_A = Min	2.0			1.9			V
		T_A = 25°C	1.7			1.8			
		T_A = Max	1.4			1.6			
V_{IL}	Low Level Input Voltage				0.9			0.85	V
I_{OH}	High Level Output Current				-1.2			-1.2	mA
I_{OL}	Low Level Output Current				12.4			14.1	mA
f_{CLK}	Clock Frequency (Note 2)		0	40	30	0	40	30	MHz
t_W	Pulse Width (Note 2)	Clock High	20			20			ns
		Clock Low	20			20			
		PR, CLR Low	20			20			
t_{SU}	Setup Time (Notes 1 & 2)		15 ↑			15 ↑			ns
T_H	Hold Time (Notes 1 & 2)		10 ↑			10 ↑			ns
T_A	Free Air Operating Temperature		-55		125	0		75	°C

Note 1: The symbol (↑) indicates rising edge of clock pulse is used for reference.
Note 2: T_A = 25°C and V_{CC} = 5V.

Electrical Characteristics over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions		Min	Typ (Note 1)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = -12 mA				-1.5	V
V_{OH}	High Level Output Voltage	V_{CC} = Min, I_{OH} = Max V_{IL} = Max, V_{IH} = Min		2.4			V
V_{OL}	Low Level Output Voltage	V_{CC} = Min I_{OL} = Max V_{IL} = Max V_{IH} = Min	DM90			0.4	V
			DM80			0.45	
		I_{OL} = 16 mA V_{CC} = Max	DM90			0.4	
			DM80			0.45	
I_{IH}	High Level Input Current	V_{CC} = Max V_I = 4.5V Other Inputs at Ground	J, K			60	µA
			Clock			120	
			Preset			120	
			Clear			240	

Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted) (Continued)

Symbol	Parameter	Conditions		Min	Typ (Note 1)	Max	Units
I_{IL}	Low Level Input Current	V_{CC} = Max V_I = 0.40V (DM90) V_I = 0.45V (DM80) Other Inputs at 4.5V	J, K			−1.6	
			Clock			−3.2	
			Preset			−3.2	
			Clear			−4.8	
		V_{CC} = Min V_I = 0.40V (DM90) Other Inputs at 4.5V	J, K			−1.24	mA
			Clock			−2.48	
			Preset			−2.48	
			Clear			−3.72	
		V_{CC} = Min V_I = 0.40V (DM80) Other Inputs at 4.5V	J, K			−1.41	
			Clock			−2.82	
			Preset			−2.82	
			Clear			−4.23	
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 2)	DM90	−30		−85	mA
			DM80	−30		−85	
I_{CC}	Supply Current	V_{CC} = Max (Note 3)				28	mA

Note 1: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 2: Not more than one output should be shorted at a time, and the duration should not exceed one second.

Note 3: I_{CC} is measured with all inputs open, first with PRESET at 4.5V and all other inputs grounded, then with CLEAR at 4.5V and all other inputs grounded.

Switching Characteristics at V_{CC} = 5V and T_A = 25°C (See Section 1 for Test Waveforms and Output Load)

Symbol	Parameter	From (Input) To (Output)	R_L = 400Ω, C_L = 15 pF		Units
			Min	Max	
f_{MAX}	Maximum Clock Frequency		30		MHz
t_{PLH}	Propagation Delay Time Low to High Level Output	Preset to Q		14	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Preset to $\overline{Q}$		29	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	Clear to $\overline{Q}$		14	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Clear to Q		25	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	Clock to Q, $\overline{Q}$		18	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Clock to Q, $\overline{Q}$		28	ns

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