Quad D flip-flop

54F175

FEATURES

- Four edge-triggered D flip-flops
- Buffered common Clock
- Buffered, asynchronous Master Reset
- True and complementary output

DESCRIPTION

The 54F175 is a quad, edge-triggered D-type flip-flop with individual D inputs and both Q and $\overline{Q}$ outputs. The common buffered Clock (CP) and Master Reset ($\overline{MR}$) inputs load and reset (clear) all flip-flops simultaneously.

The register is fully edge-triggered. The state of each D input, one setup time before the Low-to-High clock transition, is transferred to the corresponding flip-flop's Q output.

All Q outputs will be forced Low independently of Clock or Data inputs by a Low voltage level on the $\overline{MR}$ input. The device is useful for applications where both true and complement outputs are required, and the Clock and Master Reset are common to all storage elements.

ORDERING INFORMATION

DESCRIPTION	ORDER CODE	PACKAGE DESIGNATOR*
16-Pin Ceramic DIP	54F175/BEA	GDIP1-T16
16-Pin Ceramic Flat Pack	54F175/BFA	GDFP2-F16
20-Pin Ceramic LLCC	54F175/B2A	CQCC2-N20

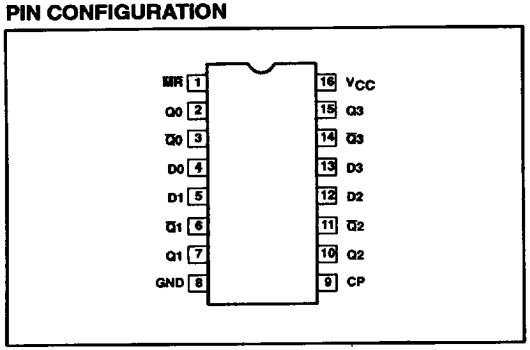
* MIL-STD 1835 or Appendix A of 1995 Military Data Handbook

INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

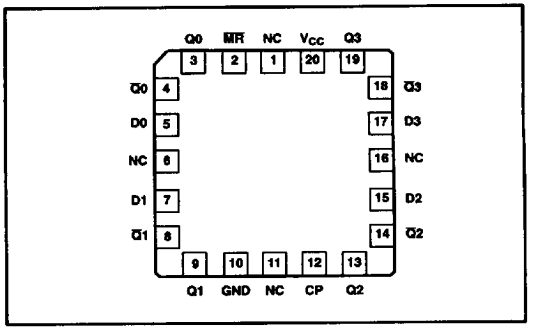
PINS	DESCRIPTION	54F (U.L.) HIGH/LOW	LOAD VALUE HIGH/LOW
D0 - D3	Data inputs	1.0/1.0	20µA/0.6mA
CP	Clock pulse input (active rising edge)	1.0/1.0	20µA/0.6mA
$\overline{MR}$	Master Reset input (active Low)	1.0/1.0	20µA/0.6mA
Q0 - Q3	True outputs	50/33	1.0mA/20mA
$\overline{Q}0$ - $\overline{Q}3$	Complementary outputs	50/33	1.0mA/20mA

NOTE: One (1.0) FAST Unit Load (U.L.) is defined as: 20µA in the High state and 0.6mA in the Low state.

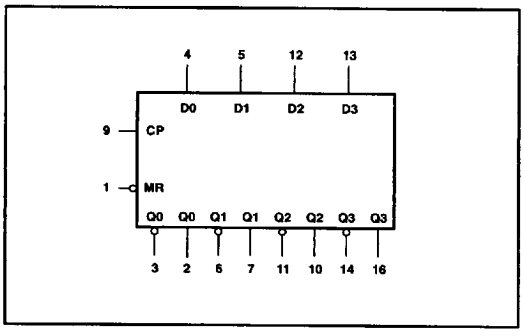
PIN CONFIGURATION



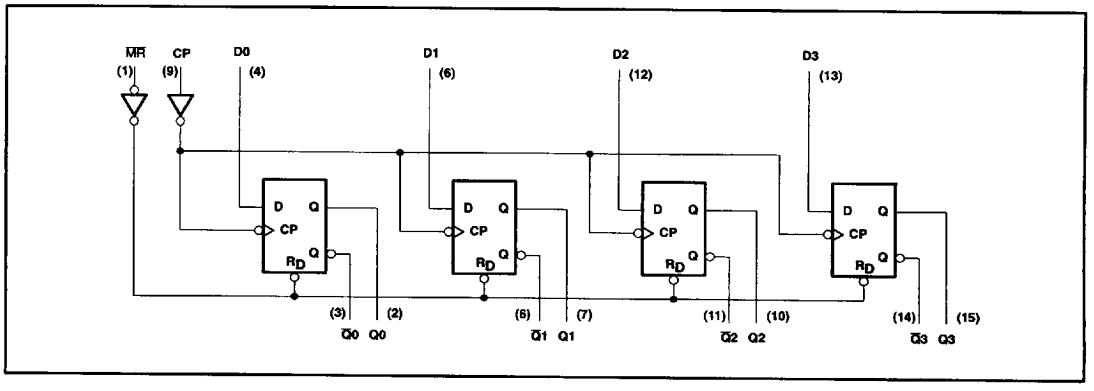
LLCC LEAD CONFIGURATION



LOGIC SYMBOL



LOGIC DIAGRAM



FUNCTION TABLE

OPERATING MODE	INPUTS			OUTPUTS	
	$\overline{MR}$	CP	Dn	Qn	$\overline{Qn}$
Reset (clear)	L	X	X	L	H
Load "1"	H	↑	h	H	L
Load "0"	H	↑	l	L	H

H = High voltage level steady state.
h = High voltage level one setup time prior to the Low-to-High Clock transition.
L = Low voltage level steady state.
l = Low voltage level one setup time prior to the Low-to-High Clock transition.
X = Don't Care.
↑ = Low-to-High Clock transition.

ABSOLUTE MAXIMUM RATINGS

(Operation beyond the limits set forth in this table may impair the useful life of the device. Unless otherwise noted these limits are over the operating free-air temperature range.)

SYMBOL	PARAMETER	RATING	UNIT
V_{CC}	Supply voltage range	-0.5 to +7.0	V
V_I	Input voltage range	-0.5 to +7.0	V
I_I	Input current range	-30 to +5.0	mA
V_O	Voltage applied to output in High output state range	-0.5 to +V_{CC}	V
I_O	Current applied to output in Low output state	40	mA
T_{STG}	Storage temperature range	-65 to +150	°C

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS			UNIT
		MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5.0	5.5	V
V_{IH}	High-level input voltage	2.0			V
V_{IL}	Low-level input voltage			0.8	V
I_{IK}	Input clamp current			-18	mA
I_{OH}	High-level output current			-1	mA
I_{OL}	Low-level output current			20	mA
T_{amb}	Operating free-air temperature range	-55		+125	°C

DC ELECTRICAL CHARACTERISTICS

(Over recommended operating free-air temperature range unless otherwise noted.)

SYMBOL	PARAMETER	TEST CONDITIONS[1,4]	LIMITS			UNIT
			MIN	TYP[2]	MAX	
V_{OH}	High-level output voltage	V_{CC} = MIN, V_{IL} = MAX, I_{OH} = MAX, V_{IH} = MIN	2.5			V
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IL} = MAX, I_{OL} = MAX, V_{IH} = MIN		0.35	0.50	V
V_{IK}	Input clamp voltage	V_{CC} = MIN, I_I = I_{IK}		-0.73	-1.2	V
I_{IH2}	Input current at maximum input voltage	V_{CC} = MAX, V_I = 7.0V			100	µA
I_{IH1}	High-level input current	V_{CC} = MAX, V_I = 2.7V		1	20	µA
I_{IL}	Low-level input current	V_{CC} = MAX, V_I = 0.5V		-0.4	-0.6	mA
I_{OS}	Short-circuit output current[3]	V_{CC} = MAX	-60		-150	mA
I_{CC}	Supply current (total)	V_{CC} = MAX, Dn = $\overline{MR}$ ≥ 4.0V, CP = ↑		25	34	mA

AC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS					UNIT
			T_{amb} = +25°C V_{CC} = +5.0V C_L = 50pF, R_L = 500Ω			T_{amb} = -55°C to +125°C V_{CC} = +5.0V ± 10% C_L = 50pF, R_L = 500Ω		
			MIN	TYP	MAX	MIN	MAX	
f_{MAX}	Maximum Clock frequency	Waveform 1	100	140		80[5]		MHz
t_{PLH} t_{PHL}	Propagation delay CP to Qn or $\overline{Qn}$	Waveform 1	4.0 4.0	5.0 6.5	6.5 8.5	3.5 4.0	8.5 10.5	ns ns
t_{PHL}	Propagation delay $\overline{MR}$ to Qn	Waveform 3	4.5	9.0	11.5	4.5	15	ns
t_{PLH}	Propagation delay $\overline{MR}$ to $\overline{Qn}$	Waveform 3	4.0	6.5	8.0	4.0	10	ns

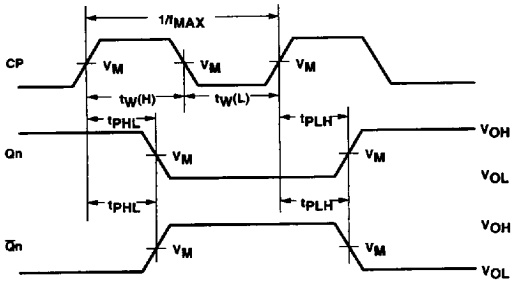
AC SETUP REQUIREMENTS

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS					UNIT
			T_{amb} = +25°C V_{CC} = +5.0V C_L = 50pF, R_L = 500Ω			T_{amb} = -55°C to +125°C V_{CC} = +5.0V ± 10% C_L = 50pF, R_L = 500Ω		
			MIN	TYP	MAX	MIN	MAX	
$t_s(H)$ $t_s(L)$	Setup time, High or Low Dn to CP	Waveform 2	3.0 3.0			3.0 3.0		ns ns
$t_h(H)$ $t_h(L)$	Hold time, High or Low Dn to CP	Waveform 2	1.0 1.0			1.0 1.0		ns ns
$t_w(H)$[6] $t_w(L)$[6]	CP pulse width, High or Low	Waveform 1	4.0 5.0			4.0 5.0		ns ns
$t_w(L)$[6]	$\overline{MR}$ pulse width Low	Waveform 3	5.0			5.0		ns
t_{rec}	Recovery time $\overline{MR}$ to CP	Waveform 3	5.0			5.0		ns

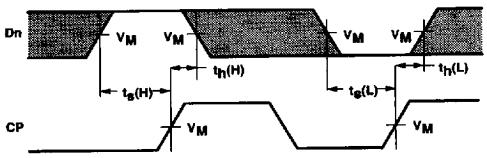
NOTES:

1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type and function table operating mode.
2. All typical values are at V_{CC} = 5V, T_A = 25°C.
3. Not more than one output should be shorted at a time. For testing I_{OS}, the use of high-speed test apparatus and/or sample-and-hold techniques are preferable in order to minimize internal heating and more accurately reflect operational values. Otherwise, prolonged shorting of a High output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter tests, I_{OS} tests should be performed last.
4. When testing devices to the functional table specified refer to the "Recommended Operating Conditions Section" of Application Note 202, "Testing and Specifying FAST Logic".
5. These parameters are guaranteed, but not tested.
6. T_w tested to 7.0ns but guaranteed as specified. This is due to tester limitations.

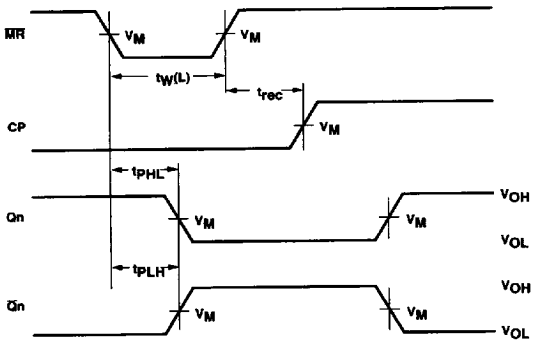
AC WAVEFORMS



Waveform 1. Clock to Output Delays and Clock Pulse Width



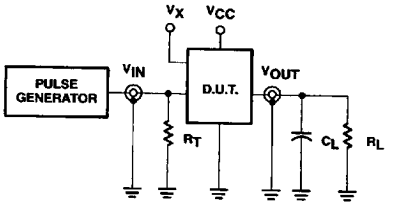
Waveform 2. Data Setup and Hold Times



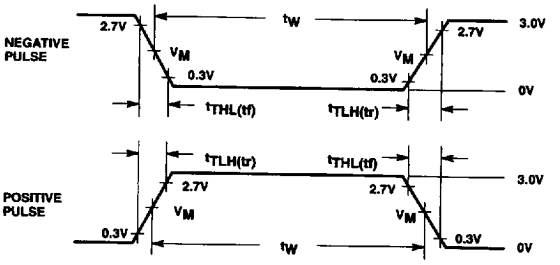
Waveform 3. Master Reset to Output Delay, Master Reset Pulse Width, and Master Reset Recovery Time

NOTE: For all waveforms V_M = 1.5V
The shaded areas indicate when the input is permitted to change for predictable output performance

TEST CIRCUIT AND WAVEFORM



Test Circuit for Totem-Pole Outputs



$V_M = 1.5V$

Input Pulse Definition

DEFINITIONS:

R_L = Load Resistor; see AC Characteristics for value.
C_L = Load capacitance includes jig and probe capacitance; see AC Characteristics for value.
R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.
V_X = Unclocked pins must be held at: ≤0.8V; ≥2.7V or open per FunctionTable.

INPUT PULSE CHARACTERISTICS				
Family	**Rep. Rate**	**Pulse Width**	**t_{TLH}**	**t_{THL}**
54F	1MHz	500ns	≤2.5ns	≤2.5ns