

Dual octal D-type flip-flop with enable

MB2377

FEATURES

- Ideal for addressable register applications
- Two 8-bit positive edge-triggered registers
- Two Enable inputs for address and data synchronization applications
- Power-up reset
- Output capability: +64mA/-32mA
- Latch-up protection exceeds 500mA per Jedec JC40.2 Std 17

- ESD protection exceeds 2000 V per MIL STD 883 Method 3015 and 200 V per Machine Model

DESCRIPTION

The MB2377 high-performance BiCMOS device combines low static and dynamic power dissipation with high speed and high output drive.

The MB2377 has two 8-bit, edge triggered registers, with individual D inputs and Q outputs. The common buffered clock (1CP or

2CP) input will load a set of eight flip-flops simultaneously when the corresponding Enable (1E or 2E) input is Low.

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

The nE inputs must be stable one setup time prior to the Low-to-High clock transition for predictable operation.

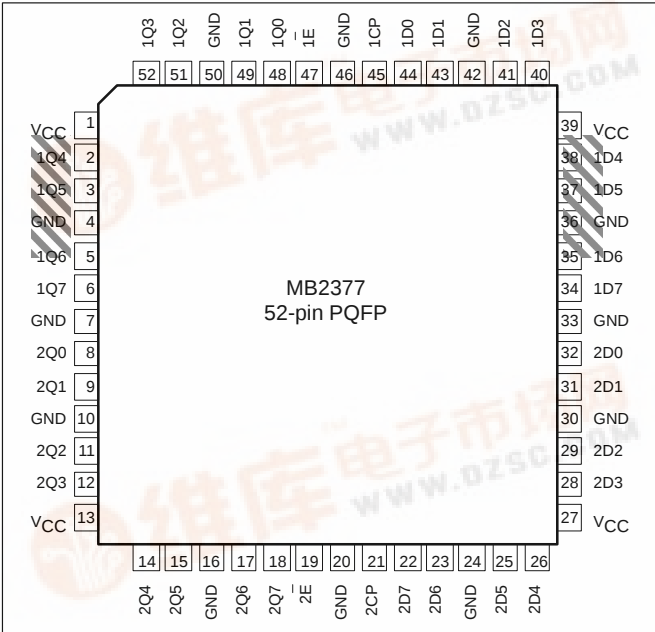
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS $T_{amb} = 25^{\circ}C$; GND = 0V	TYPICAL	UNIT
t_{PLH} t_{PHL}	Propagation delay nCP to nQx	$C_L = 50pF$; $V_{CC} = 5V$	4.8	ns
C_{IN}	Input capacitance	$V_I = 0V$ or V_{CC}	4	pF

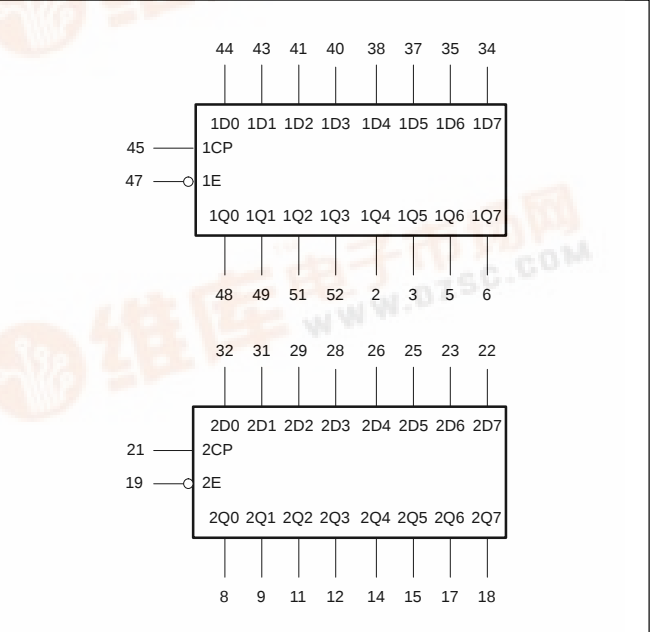
ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	ORDER CODE	DRAWING NUMBER
52-pin plastic Quad Flat Pack (QFP)	-40°C to +85°C	MB2377BB	1418B

PIN CONFIGURATION



LOGIC SYMBOL



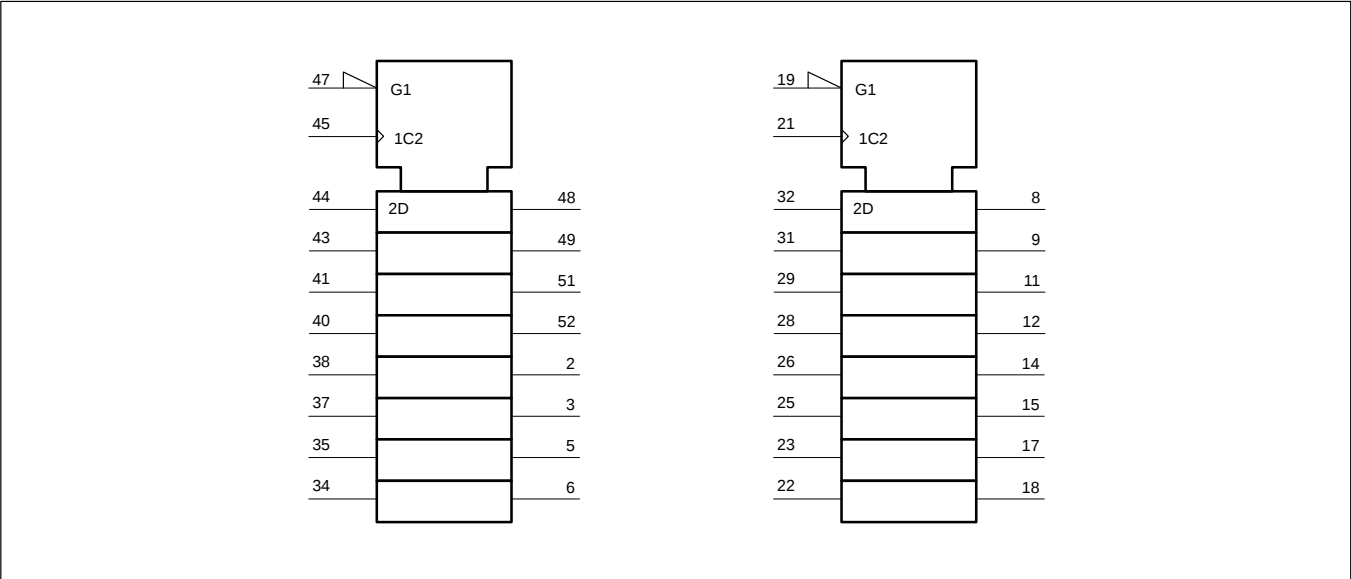
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MB2377

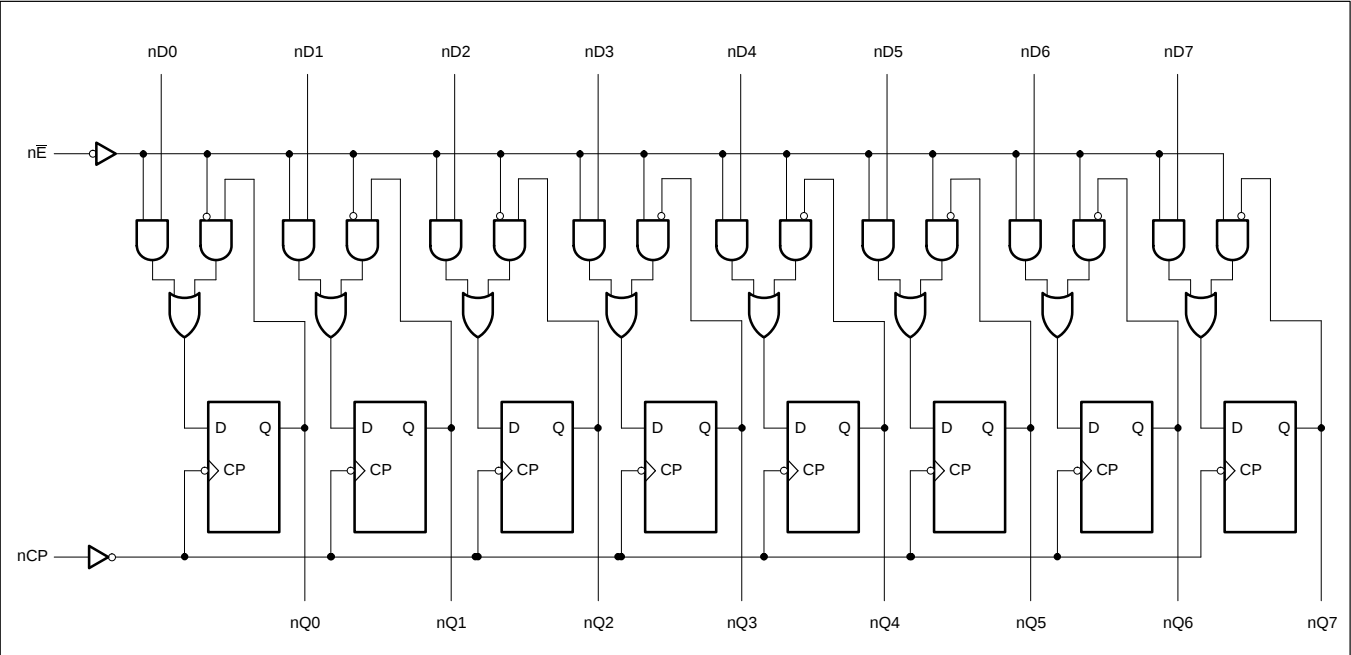
PIN DESCRIPTION

PIN NUMBER	SYMBOL	FUNCTION
44, 43, 41, 40, 38, 37, 35, 34, 32, 31, 29, 28, 26, 25, 23, 22	1D0 – 1D7 2D0 – 2D7	Data inputs
48, 49, 51, 52, 2, 3, 5, 6, 8, 9, 11, 12, 14, 15, 17, 18	1Q0 – 1Q7 2Q0 – 2Q7	Data outputs
47, 19	1E, 2E	Enable inputs (active-Low)
45, 21	1CP, 2CP	Clock pulse inputs (active rising edge)
4, 7, 10, 16, 20, 24, 30, 33, 36, 42, 46, 50	GND	Ground (0V)
1, 13, 27, 39	VCC	Positive supply voltage

LOGIC SYMBOL (IEEE/IEC)



LOGIC DIAGRAM



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MB2377

FUNCTION TABLE

INPUTS			OUTPUTS	OPERATING MODE
n $\bar{E}$	nCP	nDx	nQx	
l	↑	h	H	Load "1"
l	↑	l	L	Load "0"
h H	↑ X	X X	no change no change	Hold (do nothing)

H = High voltage level

h = High voltage level one set-up time prior to the Low-to-High clock transition

L = Low voltage level

l = Low voltage level one set-up time prior to the Low-to-High clock transition

X = Don't care

↑ = Low-to-High clock transition

ABSOLUTE MAXIMUM RATINGS^{1, 2}

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
V _{CC}	DC supply voltage		−0.5 to +7.0	V
I _{IK}	DC input diode current	V _I < 0	−18	mA
V _I	DC input voltage ³		−1.2 to +7.0	V
I _{OK}	DC output diode current	V _O < 0	−50	mA
V _{OUT}	DC output voltage ³	output in Off or High state	−0.5 to +5.5	V
I _{OUT}	DC output current	output in Low state	128	mA
T _{stg}	Storage temperature range		−65 to 150	°C

NOTES:

- Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150°C.
- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS		UNIT
		Min	Max	
V _{CC}	DC supply voltage	4.5	5.5	V
V _I	Input voltage	0	V _{CC}	V
V _{IH}	High-level input voltage	2.0		V
V _{IL}	Low-level Input voltage		0.8	V
I _{OH}	High-level output current		−32	mA
I _{OL}	Low-level output current		64	mA
Δt/Δv	Input transition rise or fall rate	0	10	ns/V
T _{amb}	operating free-air temperature range	−40	+85	°C

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MB2377

DC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS					UNIT
			T _{amb} = +25°C			T _{amb} = −40°C to +85°C		
			MIN	TYP	MAX	MIN	MAX	
V _{IK}	Input clamp voltage	V _{CC} = 4.5V; I _{IK} = −18mA		−0.9	−1.2		−1.2	V
V _{OH}	High-level output voltage	V _{CC} = 4.5V; I _{OH} = −3mA; V _I = V _{IL} or V _{IH}	2.5	2.9		2.5		V
		V _{CC} = 5.0V; I _{OH} = −3mA; V _I = V _{IL} or V _{IH}	3.0	3.4		3.0		V
		V _{CC} = 4.5V; I _{OH} = −32mA; V _I = V _{IL} or V _{IH}	2.0	2.4		2.0		V
V _{OL}	Low-level output voltage	V _{CC} = 4.5V; I _{OL} = 64mA; V _I = V _{IL} or V _{IH}		0.42	0.55		0.55	V
V _{RST}	Power-up output voltage ³	V _{CC} = 5.5V; I _O = 1mA; V _I = GND or V _{CC}		0.13	0.55		0.55	V
I _I	Input leakage current	V _{CC} = 5.5V; V _I = GND or 5.5V		±0.01	±1.0		±1.0	μA
I _{OFF}	Power-off leakage current	V _{CC} = 0.0V; V _O or V _I ≤ 4.5V		±5.0	±100		±100	μA
I _{CEX}	Output High leakage current	V _{CC} = 5.5V; V _O = 5.5V; V _I = GND or V _{CC}		5.0	50		50	μA
I _O	Output current ¹	V _{CC} = 5.5V; V _O = 2.5V	−50	−70	−180	−50	−180	mA
I _{CCH}	Quiescent supply current	V _{CC} = 5.5V; Outputs High, V _I = GND or V _{CC}		120	250		250	μA
I _{CCL}		V _{CC} = 5.5V; Outputs Low, V _I = GND or V _{CC}		48	60		60	mA
ΔI _{CC}	Additional supply current per input pin ²	V _{CC} = 5.5V; one input at 3.4V, other inputs at V _{CC} or GND		0.5	1.5		1.5	mA

NOTES:

1. Not more than one output should be tested at a time, and the duration of the test should not exceed one second.
2. This is the increase in supply current for each input at 3.4V.
3. For valid test results, data must not be loaded into the flip-flops (or latches) after applying the power.

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MB2377

AC CHARACTERISTICS

GND = 0V, $t_R = t_F = 2.5\text{ns}$, $C_L = 50\text{pF}$, $R_L = 500\Omega$

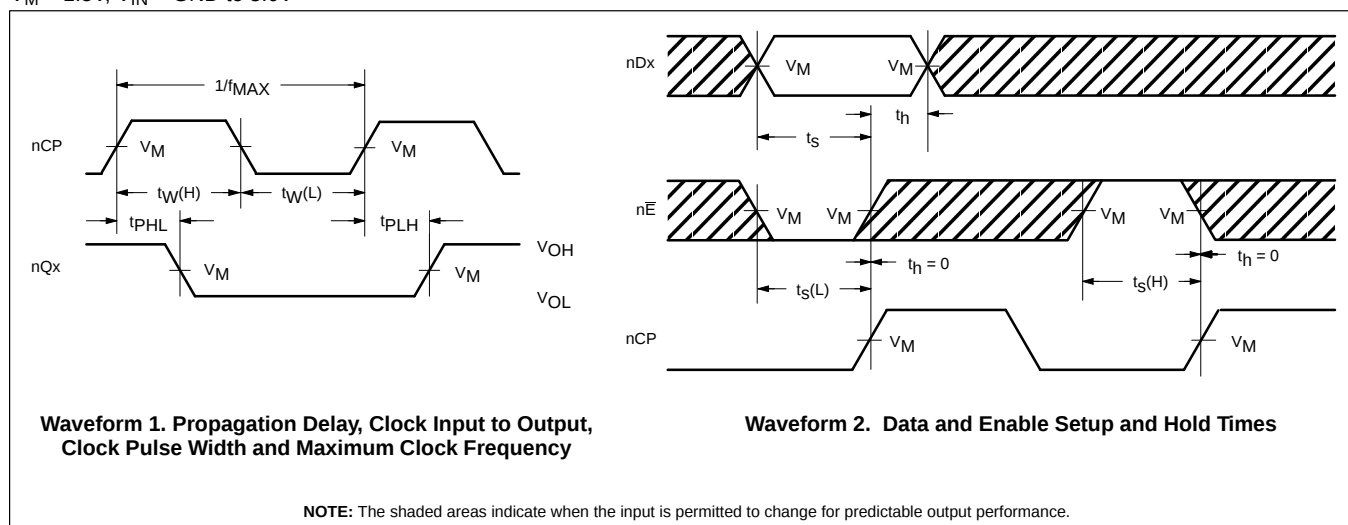
SYMBOL	PARAMETER	WAVEFORM	LIMITS					UNIT
			T _{amb} = +25°C V _{CC} = +5.0V			T _{amb} = -40 to +85°C V _{CC} = +5.0V ±0.5V		
			Min	Typ	Max	Min	Max	
f _{MAX}	Maximum clock frequency	1	180	230		180		MHz
t _{PLH} t _{PHL}	Propagation delay nCP to nQx	1	1.8 1.8	3.8 3.8	5.3 5.3	1.8 1.8	5.8 5.8	ns

AC SETUP REQUIREMENTS

GND = 0V, $t_R = t_F = 2.5\text{ns}$, $C_L = 50\text{pF}$, $R_L = 500\Omega$

SYMBOL	PARAMETER	WAVEFORM	LIMITS			UNIT
			$T_{\text{amb}} = +25^{\circ}\text{C}$ $V_{\text{CC}} = +5.0\text{V}$		$T_{\text{amb}} = -40 \text{ to } +85^{\circ}\text{C}$ $V_{\text{CC}} = +5.0\text{V} \pm 0.5\text{V}$	
			Min	Typ	Min	
$t_{\text{S}}(\text{H})$ $t_{\text{S}}(\text{L})$	Setup time, High or Low nDx to nCP	2	1.0 1.0	0.4 0.3	1.0 1.0	ns
$t_{\text{H}}(\text{H})$ $t_{\text{H}}(\text{L})$	Hold time, High or Low nDx to nCP	2	0.5 0.5	−0.3 −0.4	0.5 0.5	ns
$t_{\text{S}}(\text{H})$ $t_{\text{S}}(\text{L})$	Setup time, High or Low nE to nCP	2	2.5 3.0	1.0 1.5	2.5 3.0	ns
$t_{\text{H}}(\text{H})$ $t_{\text{H}}(\text{L})$	Hold time, High or Low nE to nCP	2	0.0 0.0	−1.5 −0.8	0.0 0.0	ns
$t_{\text{W}}(\text{H})$ $t_{\text{W}}(\text{L})$	Clock Pulse width High or Low	1	2.8 2.8	1.2 1.5	2.8 2.8	ns

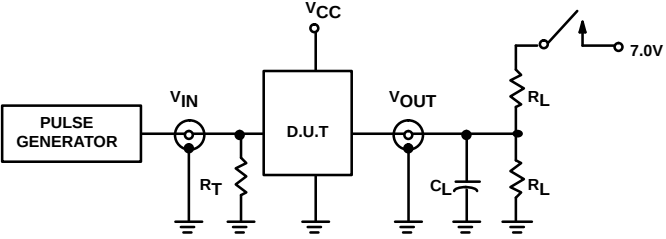
AC WAVEFORMS

 $V_M = 1.5\text{V}$, $V_{\text{IN}} = \text{GND to } 3.0\text{V}$ 

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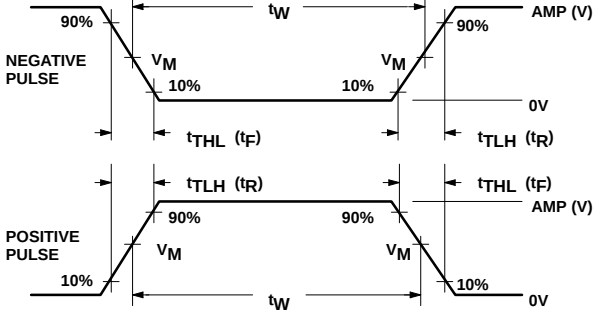
MB2377

TEST CIRCUIT AND WAVEFORM



The test circuit diagram shows a Pulse Generator connected to the input of a D.U.T. (Device Under Test). The input signal line includes a termination resistor R_T to ground. The output of the D.U.T. is connected to a load resistor R_L and a load capacitor C_L to ground. The output is also connected to a switch that can be moved to a 7.0V supply. The circuit is powered by V_{CC} .

Test Circuit for 3-State Outputs



The input pulse definition shows two waveforms: a Negative Pulse and a Positive Pulse. The Negative Pulse starts at 90% of V_M , drops to 10% of V_M , and then returns to 90% of V_M . The Positive Pulse starts at 10% of V_M , rises to 90% of V_M , and then returns to 10% of V_M . The pulse width is t_W . The rise and fall times are t_{TLH} (t_R) and t_{THL} (t_F) respectively. The voltage levels are marked at V_M and 0V.

Input Pulse Definition

$V_M = 1.5V$

TEST	SWITCH
All	open

DEFINITIONS

R_L = Load resistor; see AC CHARACTERISTICS for value.

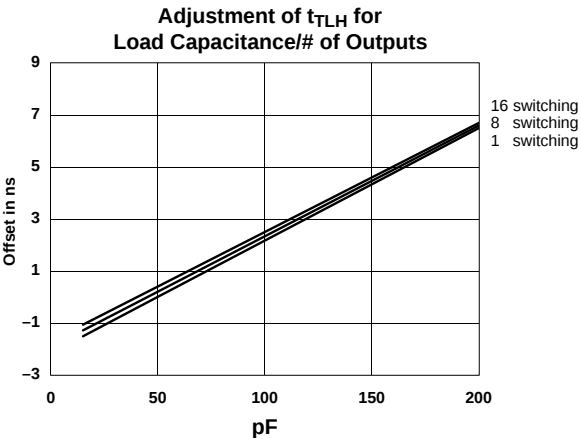
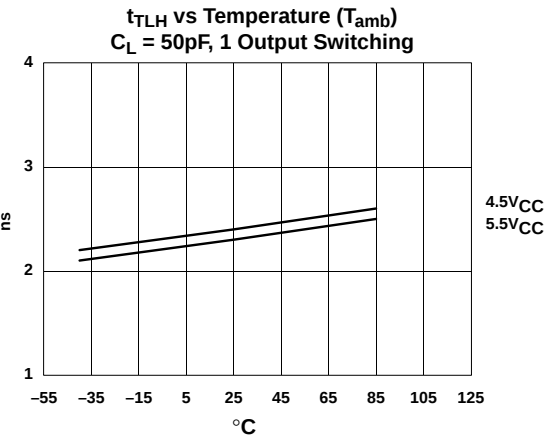
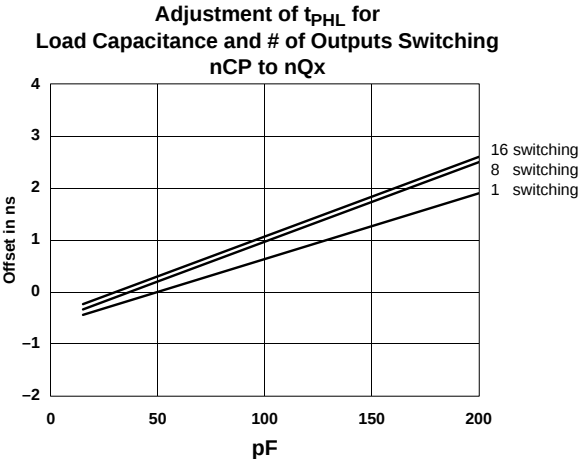
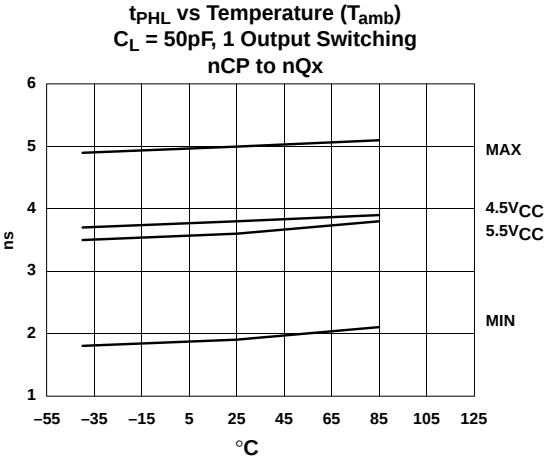
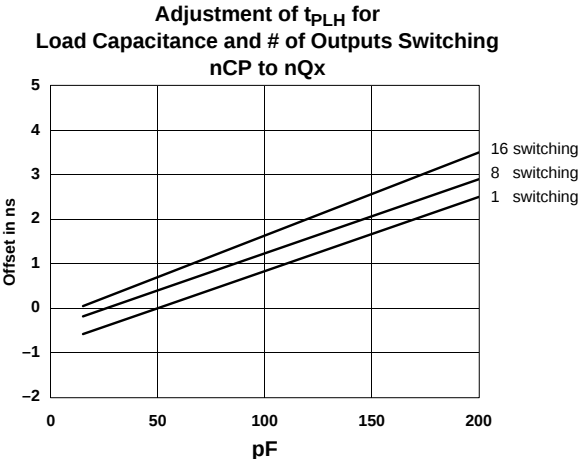
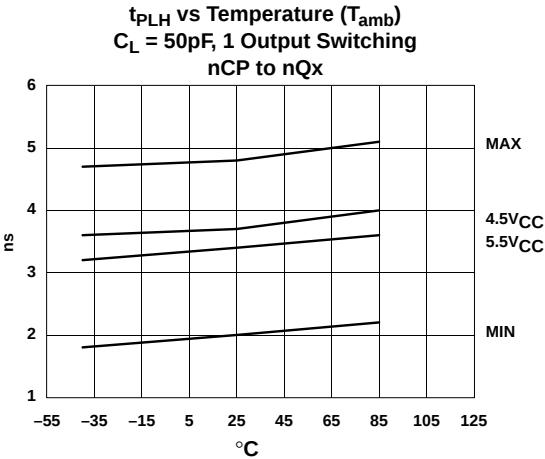
C_L = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.

R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

FAMILY	INPUT PULSE REQUIREMENTS				
	Amplitude	Rep. Rate	t_W	t_R	t_F
MB	3.0V	1MHz	500ns	2.5ns	2.5ns

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