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JEDEC STANDARD

Standard for Description of Fast CMOS TTL Compatible Logic

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ELECTRONIC INDUSTRIES ASSOCIATION
ENGINEERING DEPARTMENT



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STANDARD FOR DESCRIPTION OF FAST CMOS TTL COMPATIBLE LOGIC

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**STANDARD FOR DESCRIPTION OF
FAST CMOS TTL COMPATIBLE LOGIC**

(From JEDEC Council Ballot JCB-92-41 formulated under the cognizance of JEDEC Committee JC40.2 on CMOS Digital Logic.)

1. INTERFACE STANDARD

1.1 Purpose

To develop a standard of specifications to provide for uniformity, multiplicity of sources, elimination of confusion, and ease of device specification and design by users.

1.2 Scope

This standard covers specifications for description of Fast CMOS TTL compatible devices.

1.3 Definitions

FCT Series

Includes devices whose input logic levels are TTL input compatible and outputs are specified at TTL levels.

FCTXXX

Includes devices with a complementary output stage. These are generally referred to as devices with CMOS output swing.

FCTXXXT

Includes devices with reduced output swing. These devices are generally referred to as devices with TTL output swing.

Suffixes

Suffixes 'A', 'B', 'C', etc. immediately following the device number indicate the speed grade for the device. For example, FCT244A refers to the 'A' speed version of the '244' function with CMOS output swing. FCT244AT refers to the 'A' speed version of the '244' function with TTL output swing.

Prefixes

Prefixes '54' or '74' immediately preceding 'FCT' indicate the operating temperature range. For example, 54FCTXXX refers to the Military (MIL) version of devices which are specified over the temperature range of -55°C to 125°C. 74FCTXXX refers to the Commercial (COM'L) version of devices which are specified over 0°C to 70°C.

1.4 Standard Specifications

All voltages listed are referenced to ground except where noted.

1.4.1 Absolute Maximum Ratings

Supply Voltage: -0.5 V to 6.0 V

DC Input Current: $|I_{IK}|$ 20 mA

DC Input Voltage: V_I -0.5 V to $V_{CC} + 0.5$ V

DC Output Current: $|I_{OK}|$ 50 mA

DC Output Voltage: V_O -0.5 V to $V_{CC} + 0.5$ V

DC Output Sink Current per Pin: $2 \times I_{OL}$ but ≤ 70 mA

DC Output Source Current per Pin: $2 \times I_{OH}$ but ≤ 30 mA

Static Ground Current: (Note 2) N times I_{OL} plus M times ΔI_{CC}
where N is number of active outputs and M is number of active inputs.

Static Power Supply Current: N times I_{OH} plus M times ΔI_{CC}
where N is number of active outputs and M is number of active inputs.

Storage Temperature: T_{stg} -65°C to $+150^\circ\text{C}$

NOTE 1: Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not guaranteed.

NOTE 2: ΔI_{CC} is defined in Table 1 - 5.

1.4.2 Recommended Operating Conditions

Supply Voltage: V_{CC} 74FCT 4.75 V to 5.25 V

54FCT 4.5 V to 5.5 V

Input Voltage: V_I 0.0 V to V_{CC}

Output Voltage: V_O 0.0 V to V_{CC}

Operating Temperature 74FCT 0°C to $+70^\circ\text{C}$

54FCT -55°C to $+125^\circ\text{C}$

Input Rise and Fall Time: t_r and t_f (10% to 90% of 0 V to 3.0 V) ≤ 20 ns

1.4.3 Output Capabilities

For 54/74FCTXXX and 54/74FCTXXXT, the output specification is derived from the drive tables below. Refer to Section 3 for device types.

Table 1-1
Output LOW Drive at $V_{CC} = \text{MIN}$

TYPE	I_{OL} (mA) 74/54	V_{OL} (max)
1	8/6	0.5 V
2	16/12	0.5 V
3	24/20	0.5 V
4	32/24	0.5 V
5	48/32	0.5 V
6	64/48	0.55 V

Table 1-2
Output HIGH Drive

TYPE	I_{OH} (mA)	V_{OH} (V)	I_{OS} (min) mA
	74/54	$V_{CC} = \text{min}$	$V_{CC} = \text{max}$
1	-8/-6	2.4	-30
2	-15/-12	2.4	-60
3	-24/-20	2.4	-75

1.4.4 DC Specifications

Table 1-3
Operating Temperature and Supply voltage For DC Characteristics

TYPE	Operating Temperature		Supply Voltage	
	Min	Max	Min	Max
74FCTXXX & 74FCTXXXT	0°C	+70°C	4.75 V	5.25 V
54FCTXXX & 54FCTXXXT	-55°C	+125°C	4.5 V	5.5 V

Table 1-4
DC Electrical Characteristics

SYMBOL	PARAMETER	TEST CONDITION (Note 1)		MIN	MAX	UNITS
V _{IH}	High-level Input Voltage			2.0	-	V
V _{IL}	Low-level Input Voltage			-	0.8	V
I _{IH}	High-level Input Current	V _{CC} = Max	V _I = V _{CC}	-	20	μA
			V _I = 2.7 V	-	5	
I _{IL}	Low-level Input Current	V _{CC} = Max	V _I = 0.5 V	-	-5	μA
			V _I = Gnd	-	-10	
V _{OH}	High-level Output Voltage	V _{CC} = Min, I _{OH} = Note 2 V _I = V _{IH} or V _{IL}		2.4	-	V
		I _{OH} = -300 μA (FCTXXXXT only)		3.0	V _{CC} -0.5V	V
V _{OL}	Low-level Output Voltage	V _{CC} = Min., I _{OL} = Note 3 V _I = V _{IH} or V _{IL}		-	Note 3	V
V _{IK}	Input Clamp Voltage	V _{CC} = Min, I _I = -18 mA (Note 4)		-	-1.2	V
I _{OS}	Short Circuit Output Current (Note 5)	V _{CC} = Max, V _O = Gnd V _I = V _{CC} or Gnd		Note 6	-	mA
I _{OZH}	High-impedance Output Current	V _{CC} = Max	V _I = V _{CC}	-	20	μA
			V _I = 2.7 V	-	10	
I _{OZL}	High-impedance Output Current	V _{CC} = Max	V _I = 0.5 V	-	-10	μA
			V _I = Gnd	-	-20	
I _{IH}	High-level Input Current for Common I/O Pins	V _{CC} = Max	V _I = V _{CC}	-	40	μA
			V _I = 2.7 V	-	15	
I _{IL}	Low-level Input Current for Common I/O Pins	V _{CC} = Max	V _I = 0.5 V	-	-15	μA
			V _I = Gnd	-	-30	

NOTE 1. For conditions shown as MIN or MAX, use appropriate value based on temperature range.

NOTE 2. The values for I_{OH} and V_{OH} are as specified in Table 1-2.

NOTE 3. The values for V_{OL} and I_{OL} are as specified in Table 1-1.

NOTE 4. This parameter is pulse tested.

NOTE 5. Not more than one output should be shorted at one time. Duration of the short circuit test should not exceed 100 milliseconds.

NOTE 6. The value for I_{OS} (MIN) is as specified in Table 1-2.

Table 1-5

Power Supply Characteristics

SYMBOL	PARAMETER	TEST CONDITIONS Note 1	MIN	MAX	UNIT
I_{CC}	Quiescent Power Supply Current	$V_{CC} = \text{Max}$ $V_I = V_{CC} \text{ or } V_I = \text{Gnd}$ $f_{CK} = f_i = 0$	—	1.5	mA
ΔI_{CC}	Quiescent Power Supply Current (Inputs HIGH)	$V_{CC} = \text{Max}$ $V_I = 3.4\text{V}$ Note 2	—	2.5	mA
Q_{CCD}	Dynamic Power Supply Current per MHz	$V_{CC} = \text{Max}$ Outputs open & enabled Notes 3 & 4	—	0.4	mA/MHz
I_C	Total Power Supply Current	Note 5	—	—	mA
C_{PD}	Power Dissipation Capacitance	Note 6	—	—	pF

NOTE 1: For conditions shown as MIN or MAX., use appropriate value specified under DC Specifications in Table 1 - 4.

NOTE 2: Per TTL driven input ($V_I = 3.4\text{ V}$); all other inputs at V_{CC} or Gnd.

NOTE 3: See section 6

NOTE 4: $I_C = I_{\text{Quiescent}} + I_{\text{Inputs}} + I_{\text{Dynamic}}$

$I_C = I_{CC} + \Delta I_{CC} D_H N_T + Q_{CCD} (f_{CK}/2 + f_i N_i)$

$I_{CC} =$ Quiescent Current

$\Delta I_{CC} =$ Power Supply Current for a TTL High Input ($V_I = 3.4\text{ V}$)

$D_H =$ Duty Cycle for each TTL Input High

$N_T =$ Number of TTL Inputs at D_H

$Q_{CCD} =$ Dynamic Charge moved by an Input Pulse (HLH or LHL)

$f_{CK} =$ Clock Frequency for Clocked Devices (Zero for non-Clocked Devices)

$f_i =$ Input Frequency of the i-th input

$N_i =$ Number of Inputs at f_i

All currents are in milliamperes and all frequencies are in MHz.

See section 6 for the definition of Q_{CCD} .

NOTE 5: Actual values of I_C are optional. If present, it is recommended that a frequency of 10 MHz be used.

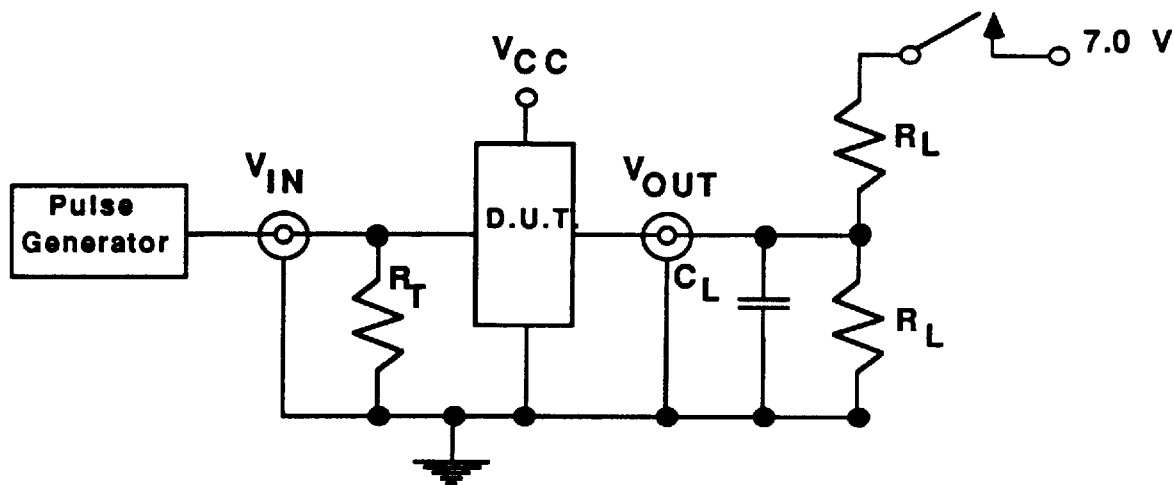
NOTE 6: C_{PD} in pF is calculated from Q_{CCD} measurements by using the formula:

$$C_{PD} = (Q_{CCD} / V_{CC})$$

where Q_{CCD} is expressed in $\mu\text{A}/\text{MHz}$.

2. SWITCHING WAVEFORMS FOR 54/74FCTXXX & 54/74FCTXXXT

Shown below is the test circuit for measurement of switching parameters. A Thevenin equivalent may be used for output loading.



Test	Switch
t_{PLZ}	Closed
t_{PZL}	Closed
Open Drain	Closed
All Other	Open

DEFINITIONS:

C_L = 50 pF or equivalent (Includes jig and probe capacitance)

R_L = 500 Ω or equivalent

R_T = Termination should be equal to Z_{OUT} of the pulse generator. (Typically 50 Ω)

V_{IN} = 0 V to 3.0 V

INPUT: $t_r = t_f = 2.5$ ns (10% to 90%) unless otherwise specified

Figure 2 - 1
Test Circuit

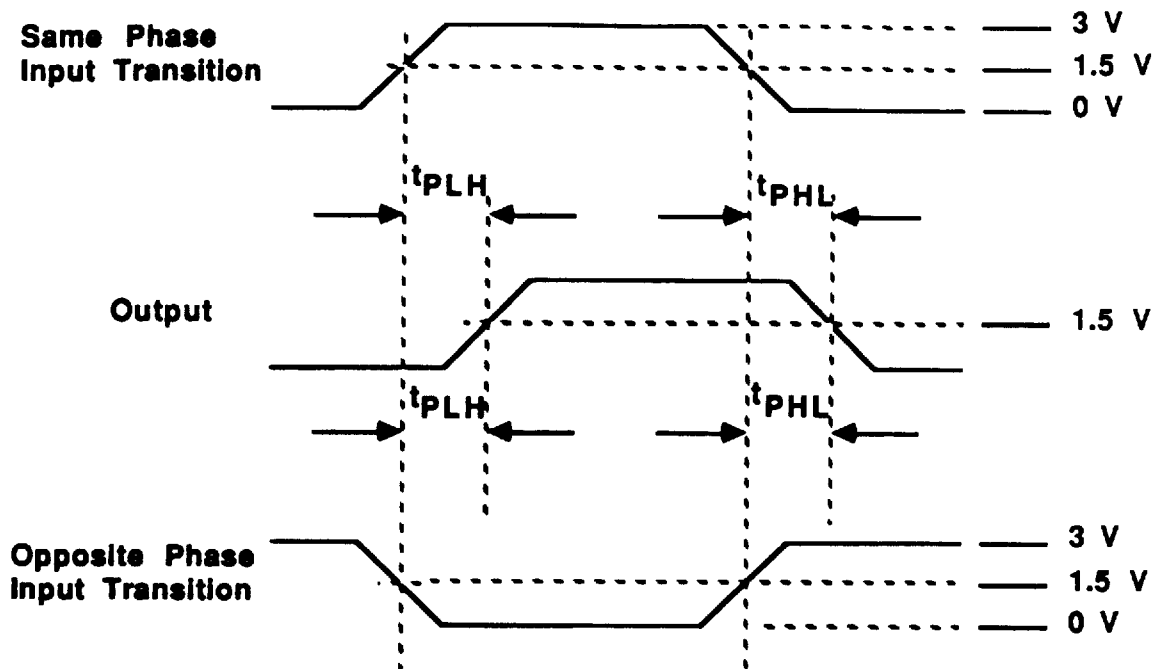
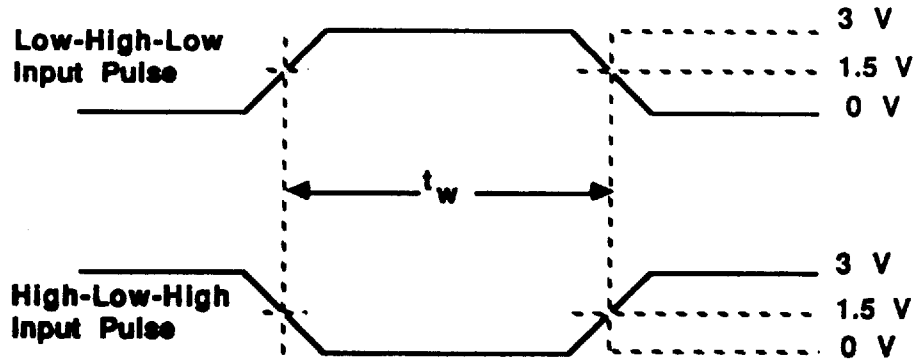


Figure 2 - 2
Propagation Delay Waveforms



Output Requirement: Device must follow truth table

$$V_{OL} \leq 0.5 \text{ V}$$

$$V_{OH} \geq 2.4 \text{ V}$$

Input Condition: $t_r = t_f \leq 2.5 \text{ ns}$ (10% to 90%) or as fast as required

Standard Output Loading: $R_L = 500 \Omega$
 $C_L = 50 \text{ pF}$

Figure 2 - 3
Input Pulse Duration Waveforms

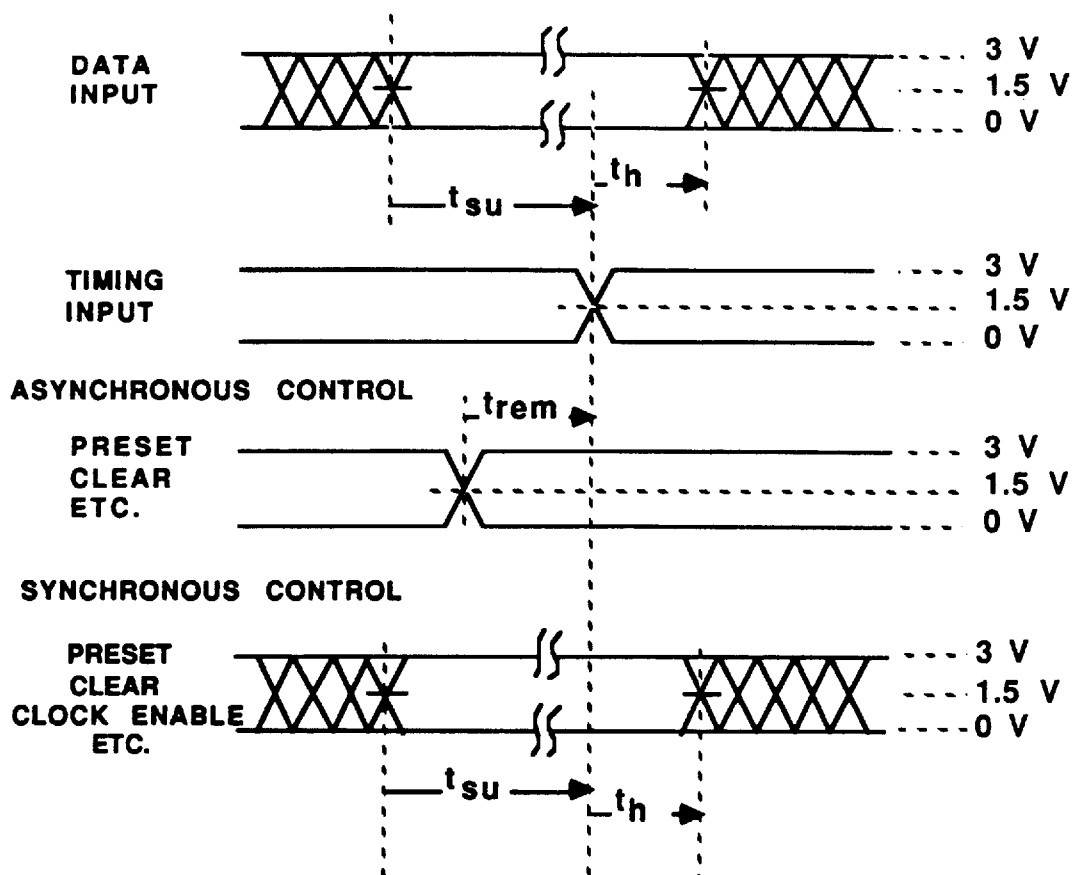
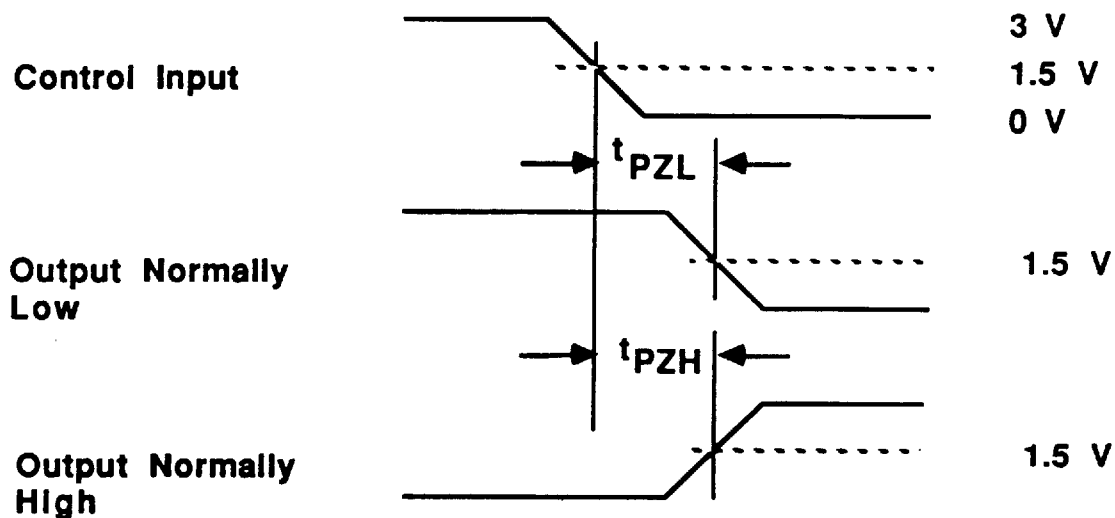


Figure 2 - 4
Set-up, Hold and Removal Time Waveforms

ENABLE TIMES



DISABLE TIMES

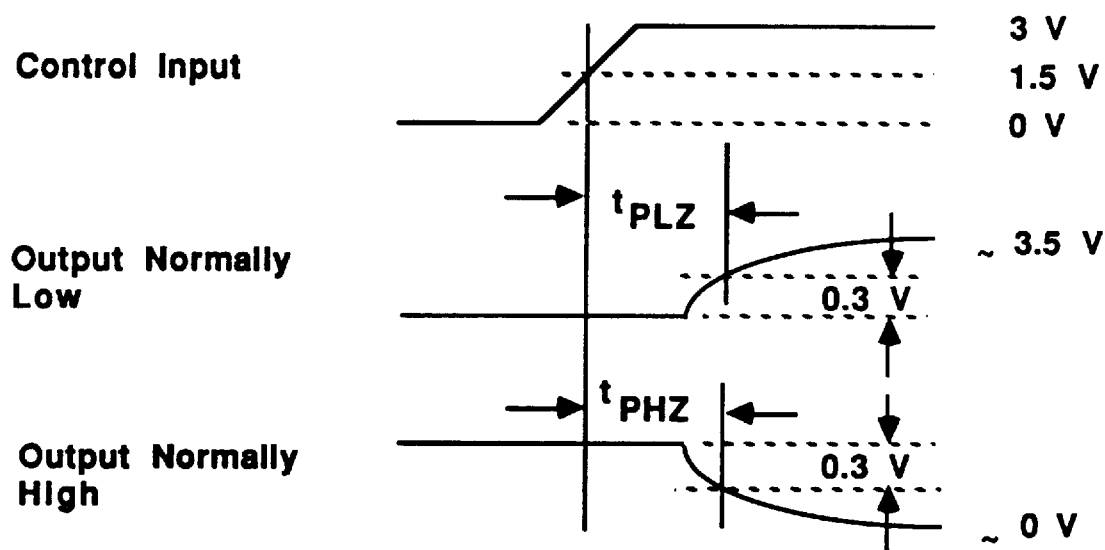


Figure 2 - 5
Enable and Disable Time Waveforms