

# 100325

## Low Power Hex ECL-to-TTL Translator

### General Description

The 100325 is a hex translator for converting F100K logic levels to TTL logic levels. Differential inputs allow each circuit to be used as an inverting, non-inverting or differential receiver. An internal reference voltage generator provides  $V_{BB}$  for single-ended operation, or for use in Schmitt trigger applications. All inputs have 50k $\Omega$  pull-down resistors. When the inputs are either unconnected or at the same potential the outputs will go low.

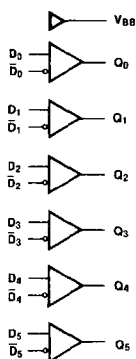
When used in single-ended operation the apparent input threshold of the true inputs is 20mV to 40mV higher (positive) than the threshold of the complementary inputs. The  $V_{EE}$  and  $V_{TTL}$  power may be applied in either order.

### Features

- Pin/function compatible with 100125
- Meets 100125 AC specifications
- 50% power reduction of the 100125
- Differential inputs with built in offset
- Standard FAST® outputs
- 2000V ESD protection
- -4.2V to -5.7V operating range
- Available to industrial grade temperature range
- Available to MIL-STD-883

**Ordering Code:** See Section 6

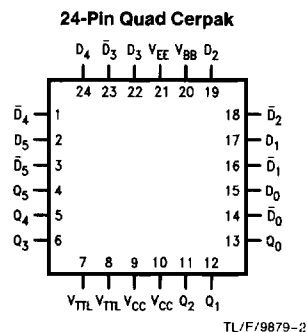
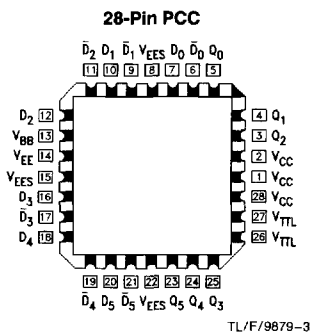
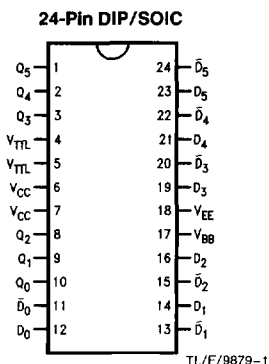
### Logic Diagram



TL/F/9879-4

Pin Names	Description
$D_0-D_5$	Data Inputs
$\bar{D}_0-\bar{D}_5$	Inverting Data Inputs
$Q_0-Q_5$	Data Outputs

### Connection Diagrams



## Absolute Maximum Ratings

Above which the useful life may be impaired. (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Storage Temperature ( $T_{STG}$ )  $-65^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$

Maximum Junction Temperature ( $T_J$ )

Ceramic  $+175^{\circ}\text{C}$   
Plastic  $+150^{\circ}\text{C}$

$V_{EE}$  Pin Potential to Ground Pin  $-7.0\text{V}$  to  $+0.5\text{V}$

$V_{TTL}$  Pin Potential to Ground Pin  $-0.5\text{V}$  to  $+6.0\text{V}$

Input Voltage (DC)  $V_{EE}$  to  $+0.5\text{V}$

Voltage Applied to Output  
in HIGH State (with  $V_{CC} = 0\text{V}$ )  $-0.5\text{V}$  to  $V_{CC}$

Current Applied to Output  
in LOW State (Max) twice the rated  $I_{OL}$  (mA)

ESD (Note 2)  $\geq 2000\text{V}$

**Note 1:** Absolute maximum ratings are those values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

**Note 2:** ESD testing conforms to MIL-STD-883, Method 3015.

## Recommended Operating Conditions

Case Temperature ( $T_C$ )

Commercial  $0^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

Industrial  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

Military  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

Supply Voltage ( $V_{EE}$ )

$-5.7\text{V}$  to  $-4.2\text{V}$

## Truth Table

Inputs		Outputs
$D_n$	$\bar{D}_n$	$Q_n$
L	H	L
H	L	H
L	L	L
H	H	L
Open	Open	L
$V_{EE}$	$V_{EE}$	L
L	$V_{BB}$	L
H	$V_{BB}$	H
$V_{BB}$	L	H
$V_{BB}$	H	L

H = HIGH Voltage Level

L = LOW Voltage Level

## Commercial Version

### DC Electrical Characteristics

$V_{EE} = -4.2\text{V}$  to  $-5.7\text{V}$ ,  $V_{CC} = \text{GND}$ ,  $V_{TTL} = +4.5\text{V}$  to  $5.5\text{V}$ ,  $T_C = 0^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  (Note 3)

Symbol	Parameter	Min	Typ	Max	Units	Conditions
$V_{BB}$	Output Reference Voltage	$-1380$	$-1320$	$-1260$	mV	$I_{V_{BB}} = -2.1\text{mA}$
$V_{IH}$	Single-Ended Input HIGH Voltage	$-1165$		$-870$	mV	Guaranteed HIGH Signal for All Inputs (with One Input Tied to $V_{BB}$ )
$V_{IL}$	Single-Ended Input LOW Voltage	$-1830$		$-1475$	mV	Guaranteed LOW Signal for All Inputs (with One Input Tied to $V_{BB}$ )
$V_{OH}$	Output HIGH Voltage	2.5			V	$I_{OH} = -2.0\text{mA}$
$V_{OL}$	Output LOW Voltage			0.5	V	$I_{OL} = 20\text{mA}$
$V_{DIFF}$	Input Voltage Differential	150			mV	Required for Full Output Swing
$V_{CM}$	Common Mode Voltage	$V_{CC} - 2.0$		$V_{CC} - 0.5$	V	

**Commercial Version** (Continued)**DC Electrical Characteristics** (Continued)
 $V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = GND$ ,  $V_{TTL} = +4.5V$  to  $5.5V$ ,  $T_C = 0^\circ C$  to  $+85^\circ C$  (Note 3)

Symbol	Parameter	Min	Typ	Max	Units	Conditions
$I_{IH}$	Input HIGH Current			350	$\mu A$	$V_{IN} = V_{IH}(\text{Max})$ , $D_0-D_5 = V_{BB}$ , $\bar{D}_0-\bar{D}_5 = V_{IL}(\text{Min})$
$I_{IL}$	Input LOW Current	0.5			$\mu A$	$V_{IN} = V_{IL}(\text{Min})$ , $D_0-D_5 = V_{BB}$
$I_{OS}$	Output Short-Circuit Current	-150		-60	mA	$V_{OUT} = GND^*$
$I_{EE}$	$V_{EE}$ Power Supply Current	-37	-27	-17	mA	$D_0-D_5 = V_{BB}$
$I_{TTL}$	$V_{TTL}$ Power Supply Current		45	65	mA	$D_0-D_5 = V_{BB}$

\*Test one output at a time.

**Note 3:** The specified limits represent the "worst case" value for the parameter. Since these values normally occur at the temperature extremes, additional noise immunity and guardbanding can be achieved by decreasing the allowable system operating ranges. Conditions for testing shown in the tables are chosen to guarantee operation under "worst case" conditions.

**DIP AC Electrical Characteristics**
 $V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = GND$ ,  $V_{TTL} = +4.5V$  to  $+5.5V$ 

Symbol	Parameter	$T_C = 0^\circ C$		$T_C = +25^\circ C$		$T_C = +85^\circ C$		Units	Conditions
		Min	Max	Min	Max	Min	Max		
$t_{PLH}$ $t_{PHL}$	Propagation Delay Data to Output	0.80	3.50	0.90	3.70	1.00	4.00	ns	$C_L = 15\text{ pF}$ Figures 1 and 2
$t_{PLH}$ $t_{PHL}$	Propagation Delay Data to Output	1.60	4.30	1.70	4.50	1.80	4.80	ns	$C_L = 50\text{ pF}$ Figures 1 and 3

**SOIC, PCC and Cerpak AC Electrical Characteristics**
 $V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = GND$ ,  $V_{TTL} = +4.5V$  to  $+5.5V$ 

Symbol	Parameter	$T_C = 0^\circ C$		$T_C = +25^\circ C$		$T_C = +85^\circ C$		Units	Conditions
		Min	Max	Min	Max	Min	Max		
$t_{PLH}$ $t_{PHL}$	Propagation Delay Data to Output	0.80	3.30	0.90	3.50	1.00	3.80	ns	$C_L = 15\text{ pF}$ Figures 1 and 2
$t_{PLH}$ $t_{PHL}$	Propagation Delay Data to Output	1.60	4.10	1.70	4.30	1.80	4.60	ns	$C_L = 50\text{ pF}$ Figures 1 and 3
$t_{OSHL}$	Maximum Skew Common Edge Output-to-Output Variation Data to Output Path		0.65		0.65		0.65	ns	PCC Only (Note 1)
$t_{OSLH}$	Maximum Skew Common Edge Output-to-Output Variation Data to Output Path		0.65		0.65		0.65	ns	PCC Only (Note 1)
$t_{OST}$	Maximum Skew Opposite Edge Output-to-Output Variation Data to Output Path		2.20		2.20		2.20	ns	PCC Only (Note 1)
$t_{PS}$	Maximum Skew Pin (Signal) Transition Variation Data to Output Path		2.10		2.10		2.10	ns	PCC Only (Note 1)

**Note 1:** Output-to-Output Skew is defined as the absolute value of the difference between the actual propagation delay for any outputs within the same packaged device. The specifications apply to any outputs switching in the same direction either HIGH to LOW ( $t_{OSHL}$ ), or LOW to HIGH ( $t_{OSLH}$ ), or in opposite directions both HL and LH ( $t_{OST}$ ). Parameters  $t_{OST}$  and  $t_{PS}$  guaranteed by design.

## Industrial Version

### PCC DC Electrical Characteristics (Note)

$V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = GND$ ,  $T_C = -40^\circ C$  to  $+85^\circ C$

Symbol	Parameter	$T_C = -40^\circ C$		$T_C = 0^\circ C$ to $+85^\circ C$		Units	Conditions
		Min	Max	Min	Max		
$V_{BB}$	Output Reference Voltage	-1395	-1255	-1380	-1260	mV	$I_{V_{BB}} = -2.1$ mA
$V_{IH}$	Single-Ended Input HIGH Voltage	-1170	-870	-1165	-870	mV	Guaranteed HIGH Signal for All Inputs (with One Input Tied to $V_{BB}$ )
$V_{IL}$	Single-Ended Input LOW Voltage	-1830	-1480	-1830	-1475	mV	Guaranteed LOW Signal for All Inputs (with One Input Tied to $V_{BB}$ )
$V_{OH}$	Output HIGH Voltage	2.5		2.5		V	$I_{OH} = -2.0$ mA
$V_{OL}$	Output LOW Voltage	0.5		0.5		V	$I_{OL} = 20$ mA
$V_{DIFF}$	Input Voltage Differential	150		150		mV	Required for Full Output Swing
$V_{CM}$	Common Mode Voltage	$V_{CC} - 2.0$ $V_{CC} - 0.5$		$V_{CC} - 2.0$ $V_{CC} - 0.5$		V	
$I_{IH}$	Input HIGH Current	450		350		$\mu A$	$V_{IN} = V_{IH} (Max)$ , $D_0 - D_5 = V_{BB}$ , $\bar{D}_0 - \bar{D}_5 = V_{IL} (Min)$
$I_{IL}$	Input LOW Current	0.5		0.5		$\mu A$	$V_{IN} = V_{IL} (Min)$ , $D_0 - D_5 = V_{BB}$
$I_{OS}$	Output Short-Circuit Current	-150	-60	-150	-60	mA	$V_{OUT} = GND^*$
$I_{EE}$	$V_{EE}$ Power Supply Current	-37	-15	-37	-17	mA	$D_0 - D_5 = V_{BB}$
$I_{TTL}$	$V_{TTL}$ Power Supply Current	65		65		mA	$D_0 - D_5 = V_{BB}$

\*Test one output at a time.

**Note:** The specified limits represent the "worst case" value for the parameter. Since these values normally occur at the temperature extremes, additional noise immunity and guardbanding can be achieved by decreasing the allowable system operating ranges. Conditions for testing shown in the tables are chosen to guarantee operation under "worst case" conditions.

### PCC AC Electrical Characteristics

$V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = GND$ ,  $V_{TTL} = +4.5V$  to  $+5.5V$

Symbol	Parameter	$T_C = -40^\circ C$		$T_C = +25^\circ C$		$T_C = +85^\circ C$		Units	Conditions
		Min	Max	Min	Max	Min	Max		
$t_{PLH}$ $t_{PHL}$	Propagation Delay Data to Output	0.80	3.30	0.90	3.50	1.00	3.80	ns	$C_L = 15$ pF Figures 1 and 2
$t_{PLH}$ $t_{PHL}$	Propagation Delay Data to Output	1.60	4.10	1.70	4.30	1.80	4.60	ns	$C_L = 50$ pF Figures 1 and 3

## Military Version

### DC Electrical Characteristics

 $V_{EE} = -4.2V \text{ to } -5.7V, V_{CC} = V_{CCA} = GND, T_C = -55^\circ C \text{ to } +125^\circ C, C_L = 50 \text{ pF}, V_{TTL} = +4.5V \text{ to } +5.5V$ 

Symbol	Parameter	Min	Max	Units	$T_C$	Conditions	Notes	
$V_{BB}$	Output Reference Voltage	-1380	-1260	mV	0°C to +125°C	$I_{V_{BB}} = -3 \mu A, V_{EE} = -4.2V$	1, 2, 3	
		-1396	-1260					-55°C
						$V_{EE} = -5.7V$		
$V_{IH}$	Input HIGH Voltage	-1165	-870	mV	-55°C to +125°C	Guaranteed HIGH Signal for All Inputs (with One Input Tied to $V_{BB}$ )	1, 2, 3, 4	
$V_{IL}$	Input LOW Voltage	-1830	-1475	mV	-55°C to +125°C	Guaranteed LOW Signal for All Inputs (with One Input Tied to $V_{BB}$ )	1, 2, 3, 4	
$V_{OH}$	Output HIGH Voltage	2.5		mV	0°C to +125°C	$I_{OH} = -2.0 \text{ mA}$	$V_{IN} = V_{IH} (\text{Max})$ or $V_{IL} (\text{Min})$	1, 2, 3
		2.4			-55°C			
$V_{OL}$	Output LOW Voltage		0.5	mV	-55°C to +125°C	$I_{OL} = 20 \text{ mA}$		
$V_{DIFF}$	Input Voltage Differential	150		mV	-55°C to +125°C	Required for Full Output Swing	1, 2, 3	
$V_{CM}$	Common Mode Voltage	-2000	-500	mV	-55°C to +125°C		1, 2, 3, 4	
$I_{IH}$	Input HIGH Current		350	$\mu A$	0°C to +125°C	$V_{IN} = V_{IH} (\text{Max}), D_0-D_5 = V_{BB},$ $\bar{D}_0-\bar{D}_5 = V_{IL} (\text{Min})$	1, 2, 3	
			500		-55°C			
$I_{IL}$	Input LOW Current	0.50		$\mu A$	-55°C to +125°C	$V_{IN} = V_{IL} (\text{Min}), D_0-D_5 = V_{BB}$	1, 2, 3	
$I_{OS}$	Output Short Circuit Current	-150	-60	mA	-55°C to +125°C	$V_{OUT} = GND$ Test One Output at a Time	1, 2, 3	
$I_{CEX}$	Output HIGH Leakage Current		250	$\mu A$	-55°C to +125°C	$V_{OUT} = 5.5V$	1, 2, 3	
$I_{EE}$	$V_{EE}$ Power Supply Current	-35	-12	mA	-55°C to +125°C	$D_0-D_5 = V_{BB}$	1, 2, 3	
$I_{TTL}$	$V_{TTL}$ Power Supply Current		65	mA	-55°C to +125°C	$D_0-D_5 = V_{BB}$	1, 2, 3	

**Note 1:** F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals -55°C), then testing immediately without allowing for the junction temperature to stabilize due to heat dissipation after power-up. This provides "cold start" specs which can be considered a worst case condition at cold temperatures.

**Note 2:** Screen tested 100% on each device at -55°C, +25°C, and +125°C, Subgroups 1, 2, 3, 7, and 8.

**Note 3:** Sample tested (Method 5005, Table I) on each manufactured lot at -55°C, +25°C, and +125°C, Subgroups A1, 2, 3, 7, and 8.

**Note 4:** Guaranteed by applying specified input condition and testing  $V_{OH}/V_{OL}$ .

### AC Electrical Characteristics

 $V_{EE} = -4.2V \text{ to } -5.7V, V_{CC} = GND, V_{TTL} = +4.5V \text{ to } +5.5V$ 

Symbol	Parameter	$T_C = -55^\circ C$		$T_C = +25^\circ C$		$T_C = +125^\circ C$		Units	Conditions	Notes
		Min	Max	Min	Max	Min	Max			
$t_{PLH}$ $t_{PHL}$	Propagation Delay Data to Output	1.50	5.00	1.60	4.70	1.70	5.70	ns	$C_L = 50 \text{ pF}$ Figures 1 and 3	1, 2, 3

**Note 1:** F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals -55°C), then testing immediately after power-up. This provides "cold start" specs which can be considered a worst case condition at cold temperatures.

**Note 2:** Screen tested 100% on each device at +25°C, temperature only, Subgroup A9.

**Note 3:** Sample tested (Method 5005, Table I) on each manufactured lot at +25°C, Subgroup A9, and at +125°C and -55°C temperatures, Subgroups A10 and A11.

**Note 4:** Not tested at +25°C, +125°C, and -55°C temperature (design characterization data).

### Switching Waveform

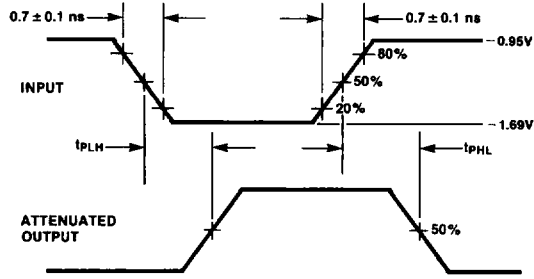
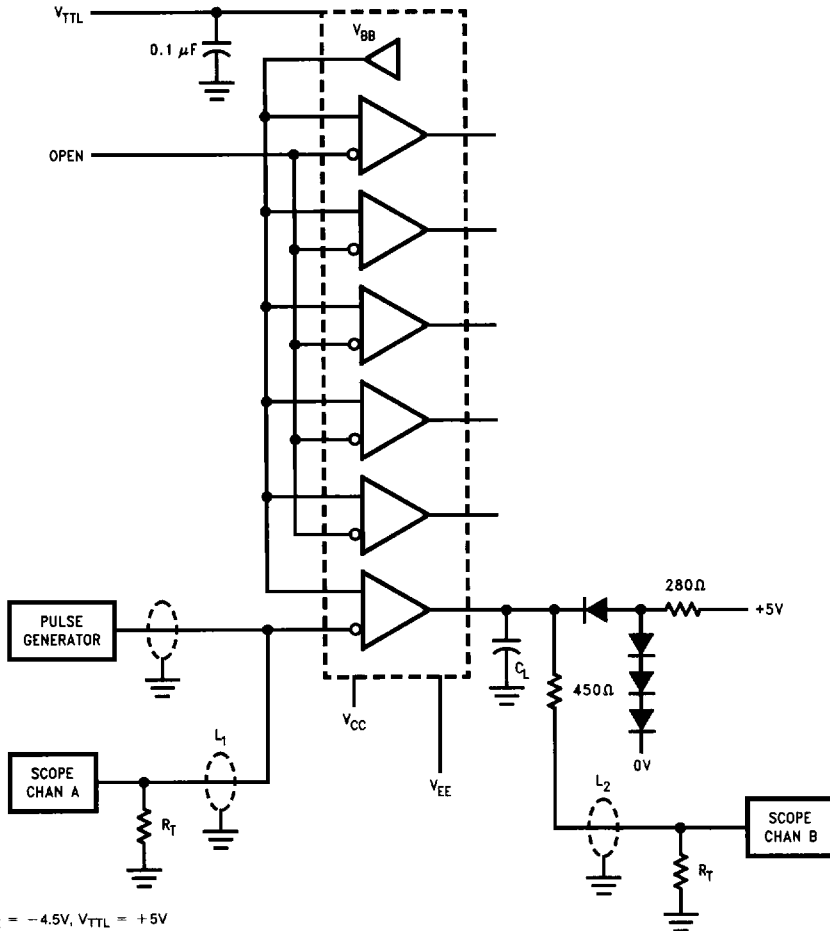


FIGURE 1. Propagation Delay

TL/F/9879-6

### Test Circuits



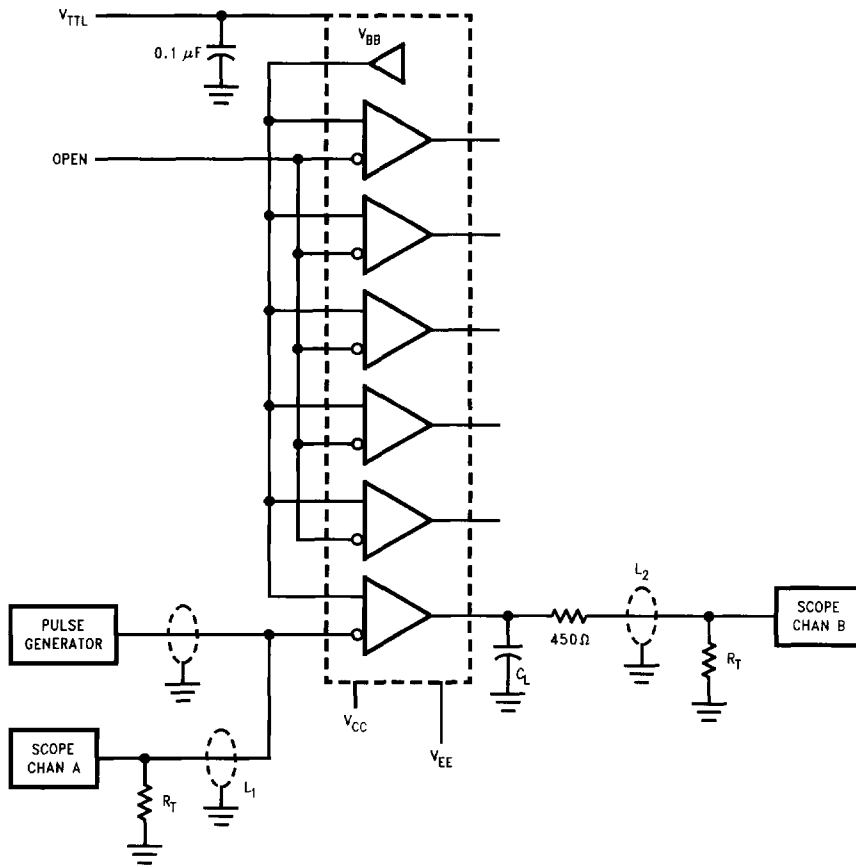
**Notes:**

- $V_{CC} = 0V$ ,  $V_{EE} = -4.5V$ ,  $V_{TTL} = +5V$
- $L1$  and  $L2$  = equal length  $50\Omega$  impedance lines
- $R_T = 50\Omega$  terminator internal to scope
- Decoupling  $0.1 \mu F$  from GND to  $V_{CC}$ ,  $V_{EE}$  and  $V_{TTL}$
- All unused outputs are loaded with  $500\Omega$  to GND
- $C_L$  = Fixture and stray capacitance =  $15 pF$

FIGURE 2. AC Test Circuit for 15 pF Loading

TL/F/9879-5

### Test Circuits (Continued)



TL/F/9879-8

**Notes:**

- $V_{CC} = 0\text{V}$ ,  $V_{EE} = -4.5\text{V}$ ,  $V_{TTL} = +5\text{V}$
- $L_1$  and  $L_2$  = equal length 50  $\Omega$  impedance lines
- $R_T$  = 50  $\Omega$  terminator internal to scope
- Decoupling 0.1  $\mu\text{F}$  from GND to  $V_{CC}$ ,  $V_{EE}$  and  $V_{TTL}$
- All unused outputs are loaded with 500  $\Omega$  to GND
- $C_L$  = Fixture and stray capacitance = 50 pF

**FIGURE 3. AC Test Circuit for 50 pF Loading**