FAIRCHILD SEMICONDUCTOR™

February 1990
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100311
Low Skew 1:9 Differential Clock Driver

General Description

The 100311 contains nine low skew differential drivers, designed for generation of multiple, minimum skew differential clocks from a single differential input (CLKIN, $\overline{\text{CLKIN}}$). If a single-ended input is desired, the V_{BB} output pin may be used to drive the remaining input line. A HIGH on the enable pin ($\overline{\text{EN}}$) will force a LOW on all of the CLK_n outputs and a HIGH on all of the $\overline{CLK}_n$ output pins. The 100311 is ideal for distributing a signal throughout a system without worrying about the original signal becoming too corrupted by undesirable delays and skew.

Features

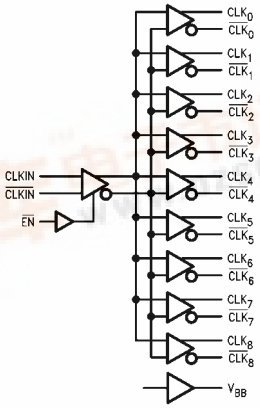
- Low output-to-output skew
- 2000V ESD protection
- 1:9 low skew clock driver
- Differential inputs and outputs
- Available to industrial grade temperature range (PLCC package only)

Ordering Code:

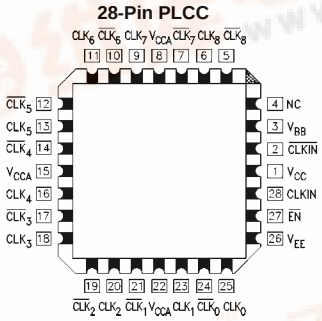
Order Number	Package Number	Package Description
100311QC	V28A	28-Lead Plastic Lead Chip Carrier (PLCC), JEDEC MO-047, 0.450 Square
100311QI	V28A	28-Lead Plastic Lead Chip Carrier (PLCC), JEDEC MO-047, 0.450 Square Industrial Temperature Range (–40°C to +85°C)

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Logic Symbol



Connection Diagram



Pin Descriptions

Pin Names	Description
CLKIN, $\overline{\text{CLKIN}}$	Differential Clock Inputs
$\overline{\text{EN}}$	Enable
$CLK_{0–8}$, $\overline{CLK}_{0–8}$	Differential Clock Outputs
V_{BB}	V_{BB} Output
NC	No Connect

Truth Table

CLKIN	$\overline{\text{CLKIN}}$	$\overline{\text{EN}}$	CLK_n	$\overline{CLK}_n$
L	H	L	L	H
H	L	L	H	L
X	X	H	L	H

Absolute Maximum Ratings (Note 1)

Storage Temperature (T_{STG})	−65°C to +150°C
Maximum Junction Temperature (T_J)	+150°C
Pin Potential to Ground Pin (V_{EE})	−7.0V to +0.5V
Input Voltage (DC)	V_{EE} to +0.5V
Output Current (DC Output HIGH)	−50 mA
ESD (Note 2)	≥2000V

Recommended Operating Conditions

Case Temperature (T_C)	
Commercial	0°C to +85°C
Industrial	−40°C to +85°C
Supply Voltage (V_{EE})	−5.7V to −4.2V

Note 1: 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 tables are not guaranteed at the absolute maximum rating. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

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

Commercial Version

DC Electrical Characteristics (Note 3)

V_{EE} = −4.2V to −5.7V, V_{CC} = V_{CCA} = GND, T_C = 0°C to +85°C

Symbol	Parameter	Min	Typ	Max	Units	Conditions	
V_{OH}	Output HIGH Voltage	−1025	−955	−870	mV	V_{IN} = V_{IH} (Max)	Loading with
V_{OL}	Output LOW Voltage	−1830	−1705	−1620	mV	or V_{IL} (Min)	50Ω to −2.0V
V_{OHC}	Output HIGH Voltage	−1035			mV	V_{IN} = V_{IH}	Loading with
V_{OLC}	Output LOW Voltage			−1610	mV	or V_{IL} (Max)	50Ω to −2.0V
V_{BB}	Output Reference Voltage	−1380	−1320	−1260	mV	I_{VBB} = −300 µA	
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		
V_{IH}	Input HIGH Voltage	−1165		−870	mV	Guaranteed HIGH Signal for All Inputs	
V_{IL}	Input LOW Voltage	−1830		−1475	mV	Guaranteed LOW Signal for All Inputs	
I_{IL}	Input LOW Current	0.50			µA	V_{IN} = V_{IL} (Min)	
I_{IH}	Input HIGH Current					V_{IN} = V_{IH} (Max)	
	CLKIN, $\overline{\text{CLKIN}}$			100	µA		
	$\overline{\text{EN}}$			250			
I_{CBO}	Input Leakage Current	−10			µA	V_{IN} = V_{EE}	
I_{EE}	Power Supply Current	−115		−57	mA	Inputs Open	

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.

Commercial Version (Continued)
AC Electrical Characteristics

V_{EE} = −4.2V to −5.7V, V_{CC} = V_{CCA} = GND

Symbol	Parameter	T_C = 0°C			T_C = +25°C			T_C = +85°C			Units	Conditions
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
f_{MAX}	Max Toggle Frequency CLKIN to Q_n	750			750			750			MHz	(Note 4)
t_{PLH} t_{PHL}	Propagation Delay, $CLKIN_n$ to CLK_n											
	Differential	0.75	0.84	0.95	0.75	0.86	0.95	0.84	0.93	1.04	ns	Figure 3
	Single-Ended	0.65	0.90	1.05	0.67	0.93	1.17	0.74	1.06	1.24		
t_{PLH} t_{PHL}	Propagation Delay SEL to Output	0.75	1.03	1.20	0.80	1.05	1.25	0.85	1.12	1.35	ns	Figure 2
t_{PS}	LH–HL Skew		10	30		10	30		10	30	ps	(Note 5)(Note 8)
t_{OSLH}	Gate–Gate Skew LH		20	50		20	50		20	50		(Note 6)(Note 8)
t_{OSHL}	Gate–Gate Skew HL		20	50		20	50		20	50		(Note 6)(Note 8)
t_{OST}	Gate–Gate LH–HL Skew		30	60		30	60		30	60		(Note 7)(Note 8)
t_S	Setup Time EN_n to $CLKIN_n$	250			250			300			ps	
t_H	Hold Time EN_n to $CLKIN_n$	0			0			0			ps	
t_R	Release Time EN_n to $CLKIN_n$	300			300			300			ps	
t_{TLH} t_{THL}	Transition Time 20% to 80%, 80% to 20%	275	500	750	275	480	750	275	460	750	ps	Figure 4

Note 4: f_{MAX} = the highest frequency at which output V_{OL}/V_{OH} levels still meet V_{IN} specifications. The F311 will function @ 1 GHz.

Note 5: t_{PS} describes opposite edge skews, i.e. the difference between the delay of a differential output signal pair's LOW-to-HIGH and HIGH-to-LOW propagation delays. With differential signal pairs, a LOW-to-HIGH or HIGH-to-LOW transition is defined as the transition of the true output or input pin.

Note 6: t_{OSLH} describes in-phase gate-to-gate differential propagation skews with all differential outputs going LOW-to-HIGH; t_{OSHL} describes the same conditions except with the outputs going HIGH-to-LOW.

Note 7: t_{OST} describes the maximum worst case difference in any of the t_{PS}, t_{OSLH} or t_{OST} delay paths combined.

Note 8: The skew specifications pertain to differential I/O paths.

Industrial Version

DC Electrical Characteristics (Note 9)

V_{EE} = −4.2V to −5.7V, V_{CC} = V_{CCA} = GND, T_C = −40°C to +85°C

Symbol	Parameter	T_C = −40°C		T_C = 0°C to +85°C		Units	Conditions	
		Min	Max	Min	Max			
V_{OH}	Output HIGH Voltage	−1085	−870	−1025	−870	mV	V_{IN} = V_{IH} (Max)	Loading with
V_{OL}	Output LOW Voltage	−1830	−1575	−1830	−1620	mV	or V_{IL} (Min)	50Ω to −2.0V
V_{OHC}	Output HIGH Voltage	−1095		−1035		mV	V_{IN} = V_{IH}	Loading with
V_{OLC}	Output LOW Voltage		−1565		−1610	mV	or V_{IL} (Min)	50Ω to −2.0V
V_{BB}	Output Reference Voltage	−1395	−1255	−1380	−1260	mV	I_{VBB} = −300 µA	
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		
V_{IH}	Input HIGH Voltage	−1170	−870	−1165	−870	mV	Guaranteed HIGH Signal for All Inputs	

Industrial Version (Continued)

DC Electrical Characteristics (Note 9)

V_{EE} = −4.2V to −5.7V, V_{CC} = V_{CCA} = GND

Symbol	Parameter	T_C = −40°C		T_C = 0°C to +85°C		Units	Conditions
		Min	Max	Min	Max		
V_{IL}	Input LOW Voltage	−1830	−1480	−1830	−1475	mV	Guaranteed LOW Signal for All Inputs
I_{IL}	Input LOW Current	0.50		0.50		µA	V_{IN} = V_{IL} (Min)
I_{IH}	Input HIGH Current						V_{IN} = V_{IH} (Max)
	CLKIN, $\overline{\text{CLKIN}}$		100		100	µA	
	$\overline{\text{EN}}$		250		250		
I_{CBO}	Input Leakage Current	−10		−10		µA	V_{IN} = V_{EE}
I_{EE}	Power Supply Current	−115	−57	−115	−57	mA	Inputs Open
V_{PP}	Minimum Input Swing	150		150		mV	
V_{CMR}	Common Mode Range	V_{CC}−2.0	V_{CC}−0.5	V_{CC}−2.0	V_{CC}−0.5	V	

Note 9: 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.

AC Electrical Characteristics

V_{EE} = −4.2V to −5.7V, V_{CC} = V_{CCA} = GND

Symbol	Parameter	T_C = −40°C			T_C = +25°C			T_C = +85°C			Units	Conditions
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
f_{MAX}	Max Toggle Frequency CLKIN to Q_n	750			750			750			MHz	(Note 10)
t_{PLH} t_{PHL}	Propagation Delay, $CLKIN_n$ to CLK_n											
	Differential	0.72	0.81	0.92	0.77	0.86	0.95	0.84	0.93	1.04	ns	Figure 3
	Single-Ended	0.62	0.89	1.02	0.67	0.93	1.17	0.74	1.06	1.24		
t_{PLH} t_{PHL}	Propagation Delay SEL to Output	0.70	0.97	1.20	0.80	1.05	1.25	0.85	1.12	1.35	ns	Figure 2
t_{PS}	LH–HL Skew		10	30		10	30		10	30		(Note 11)(Note 14)
t_{OSLH}	Gate–Gate Skew LH		20	50		20	50		20	50	ps	(Note 12)(Note 14)
t_{OSHL}	Gate–Gate Skew HL		20	50		20	50		20	50		(Note 12)(Note 14)
t_{OST}	Gate–Gate LH–HL Skew		30	60		30	60		30	60		(Note 13)(Note 14)
t_S	Setup Time EN_n to $CLKIN_n$	250			250			300			ps	
t_H	Hold Time EN_n to $CLKIN_n$	0			0			0			ps	
t_R	Release Time EN_n to $CLKIN_n$	300			300			300			ps	
t_{TLH} t_{THL}	Transition Time 20% to 80%, 80% to 20%	275	500	750	275	480	750	275	460	750	ps	Figure 4

Note 10: f_{MAX} = the highest frequency of which output V_{OL}/V_{OH} levels still meet V_{IN} specifications. The F311 will function @ 1 GHz

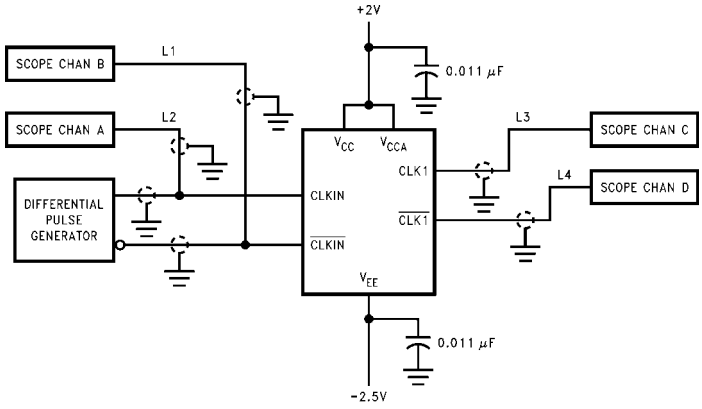
Note 11: t_{PS} describes opposite edge skews, i.e. the difference between the delay of a differential output signal pair's LOW-to-HIGH and HIGH-to-LOW propagation delays. With differential signal pairs, a LOW-to-HIGH or HIGH-to-LOW transition is defined as the transition of the true output or input pin.

Note 12: t_{OSLH} describes in-phase gate differential propagation skews with all differential outputs going LOW-to-HIGH; t_{OSHL} describes the same conditions except with the outputs going HIGH-to-LOW.

Note 13: t_{OST} describes the maximum worst case difference in any of the t_{PS}, t_{OSLH} or t_{OST} delay paths combined.

Note 14: The skew specifications pertain to differential I/O paths.

Test Circuit



Note:

Shown for testing CLKIN to CLK1 in the differential mode.

L1, L2, L3 and L4 = equal length 50Ω impedance lines.

All unused inputs and outputs are loaded with 50Ω in parallel with ≤ 3 pF to GND.

Scope should have 50Ω input terminator internally.

FIGURE 1. AC Test Circuit

Switching Waveforms

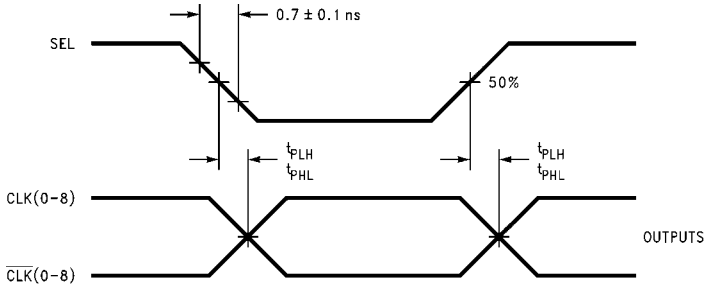


FIGURE 2. Propagation Delay, $\overline{EN}$ to Outputs

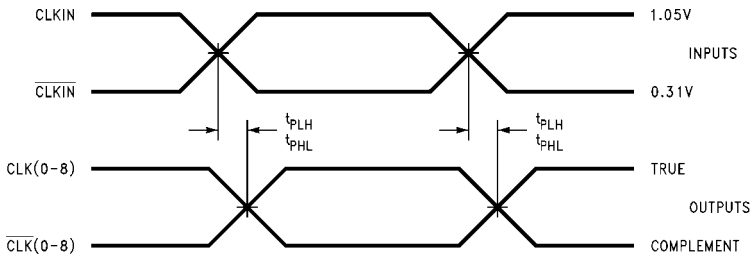


FIGURE 3. Propagation Delay, CLKIN/CLKIN to Outputs

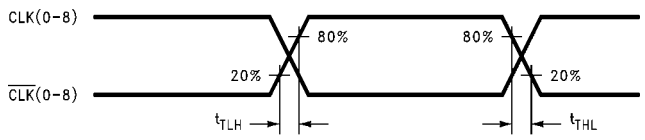
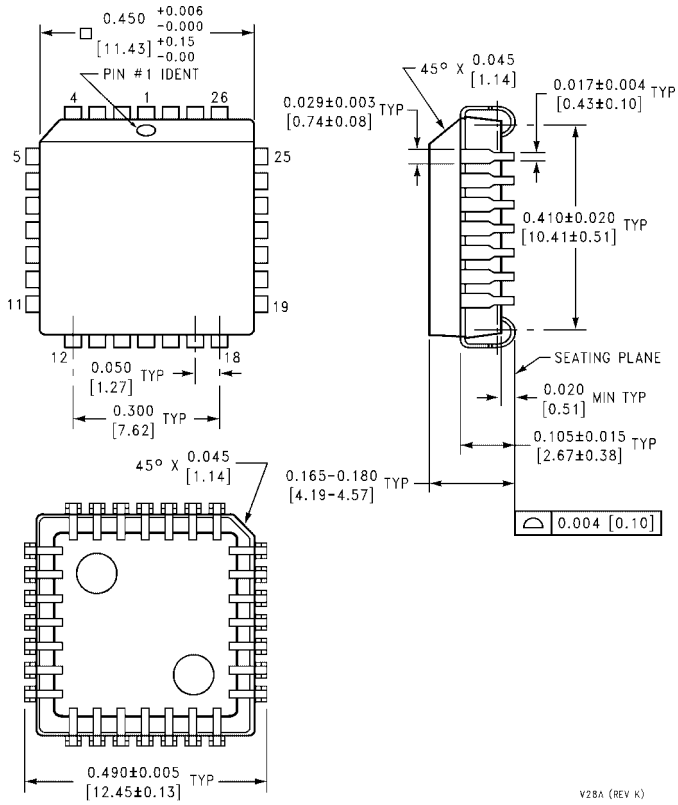


FIGURE 4. Transition Times

Physical Dimensions inches (millimeters) unless otherwise noted



28-Lead Plastic Lead Chip Carrier (PLCC), JEDEC MO-047, 0.450 Square
Package Number V28A