



## Direct Rambus™ Clock Generator

### Features

- Differential clock source for Direct Rambus™ memory subsystem for up to 800-MHz data transfer rate
- Provide synchronization flexibility: the Rambus® Channel can optionally be synchronous to an external system or processor clock
- Power managed output allows Rambus Channel clock to be turned off to minimize power consumption for mobile applications
- Works with Cypress CY2210, W133, W158, W159, W161, and W167 to support Intel® architecture platforms
- Low-power CMOS design packaged in a 24-pin, 150-mil SSOP package

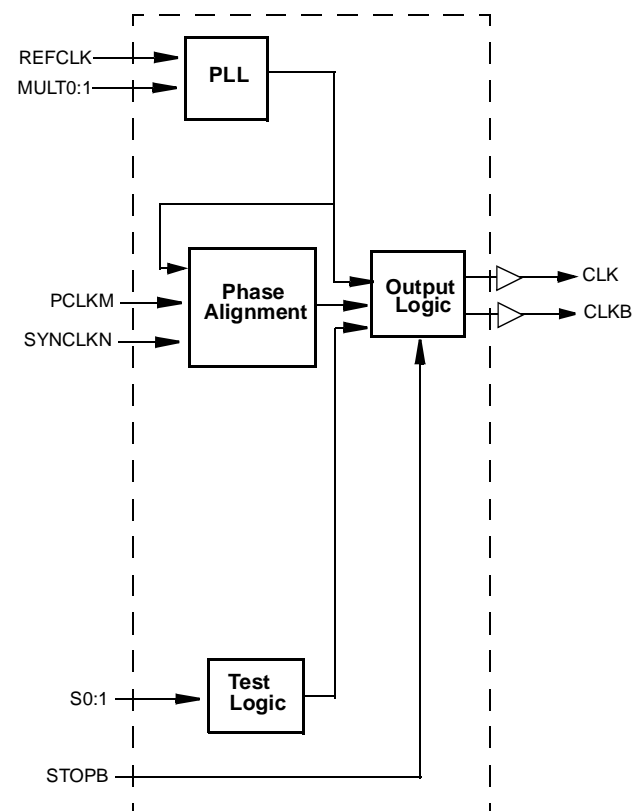
### Overview

The Cypress W134M/W134S provides the differential clock signals for a Direct Rambus memory subsystem. It includes signals to synchronize the Direct Rambus Channel clock to an external system clock but can also be used in systems that do not require synchronization of the Rambus clock.

### Key Specifications

Supply Voltage:.....  $V_{DD} = 3.3V \pm 0.165V$   
 Operating Temperature: .....  $0^{\circ}C$  to  $+70^{\circ}C$   
 Input Threshold: ..... 1.5V typical  
 Maximum Input Voltage: .....  $V_{DD} + 0.5V$   
 Maximum Input Frequency: ..... 100 MHz  
 Output Duty Cycle: ..... 40/60% worst case  
 Output Type: ..... Rambus signaling level (RSL)

### Block Diagram



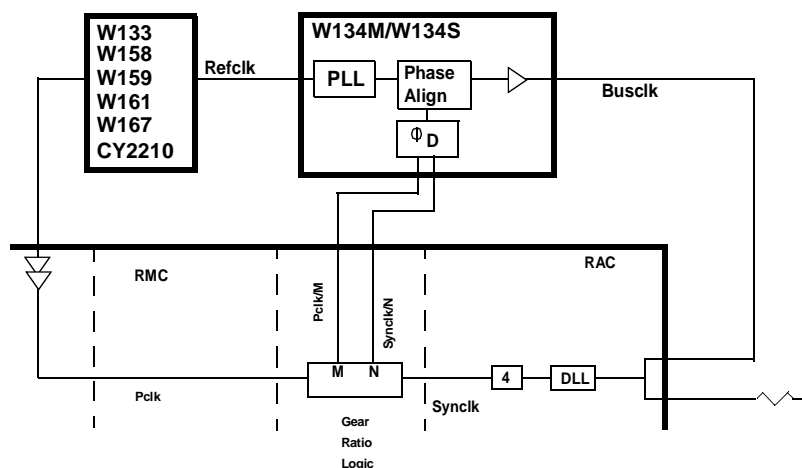
### Pin Configuration

VDDIR	1	24	S0
REFCLK	2	23	S1
VDD	3	22	VDD
GND	4	21	GND
GND	5	20	CLK
PCLKM	6	19	NC
SYNCLKN	7	18	CLKB
GND	8	17	GND
VDD	9	16	VDD
VDDIPD	10	15	MULT0
STOPB	11	14	MULT1
PWRDNB	12	13	GND

Direct Rambus is a trademark and Rambus is a registered trademark of Rambus Inc.  
 Intel is a registered trademark of Intel Corporation.

**Pin Definitions**

Pin Name	Pin No.	Pin Type	Pin Description
REFCLK	2	I	<b>Reference Clock Input:</b> Reference clock input, normally supplied by a system frequency synthesizer (Cypress W133).
PCLKM	6	I	<b>Phase Detector Input:</b> The phase difference between this signal and SYNCLKN is used to synchronize the Rambus Channel Clock with the system clock. Both PCLKM and SYNCLKN are provided by the Gear Ratio Logic in the memory controller. If Gear Ratio Logic is not used, this pin would be connected to Ground.
SYNCLKN	7	I	<b>Phase Detector Input:</b> The phase difference between this signal and PCLKM is used to synchronize the Rambus Channel Clock with the system clock. Both PCLKM and SYNCLKN are provided by the Gear Ratio Logic in the memory controller. If Gear Ratio Logic is not used, this pin would be connected to Ground.
STOPB	11	I	<b>Clock Output Enable:</b> When this input is driven to active LOW, it disables the differential Rambus Channel clocks.
PWRDNB	12	I	<b>Active LOW Power-Down:</b> When this input is driven to active LOW, it disables the differential Rambus Channel clocks and places the W134M/W134S in power-down mode.
MULT 0:1	15, 14	I	<b>PLL Multiplier Select:</b> These inputs select the PLL prescaler and feedback dividers to determine the multiply ratio for the PLL for the input REFCLK. <div><div>MULT0MULT1W134M PLL/REFCLKW134S PLL/REFCLK004.5400166188105.3335.333</div></div>
CLK, CLKB	20, 18	O	<b>Complementary Output Clock:</b> Differential Rambus Channel clock outputs.
S0, S1	24, 23	I	<b>Mode Control Input:</b> These inputs control the operating mode of the W134M/W134S. <div><div>S0S1MODE00Normal01Output Enable Test10Bypass11Test</div></div>
NC	19	-	<b>No Connect</b>
VDDIR	1	RefV	<b>Reference for REFCLK:</b> Voltage reference for input reference clock.
VDDIPD	10	RefV	<b>Reference for Phase Detector:</b> Voltage reference for phase detector inputs and StopB.
VDD	3, 9, 16, 22	P	<b>Power Connection:</b> Power supply for core logic and output buffers. Connected to 3.3V supply.
GND	4, 5, 8, 13, 17, 21	G	<b>Ground Connection:</b> Connect all ground pins to the common system ground plane.



**Figure 1. DDLL System Architecture**

## DDLL System Architecture and Gear Ratio Logic

Figure 1 shows the Distributed Delay Lock Loop (DDLL) system architecture, including the main system clock source, the Direct Rambus clock generator (DRCG), and the core logic that contains the Rambus Access Cell (RAC), the Rambus Memory Controller (RMC), and the Gear Ratio Logic. (This diagram abstractly represents the differential clocks as a single Busclk wire.)

The purpose of the DDLL is to frequency-lock and phase-align the core logic and Rambus clocks (Pclk and Sync/N) at the RMC/RAC boundary in order to allow data transfers without incurring additional latency. In the DDLL architecture, a PLL is used to generate the desired Busclk frequency, while a distributed loop forms a DLL to align the phase of Pclk and Sync/N at the RMC/RAC boundary.

The main clock source drives the system clock (Pclk) to the core logic, and also drives the reference clock (Refclk) to the DRCG. For typical Intel architecture platforms, Refclk will be half the CPU front side bus frequency. A PLL inside the DRCG multiplies Refclk to generate the desired frequency for Busclk, and Busclk is driven through a terminated transmission line (Rambus Channel). At the mid-point of the channel, the RAC senses Busclk using its own DLL for clock alignment, followed by a fixed divide-by-4 that generates Sync/N.

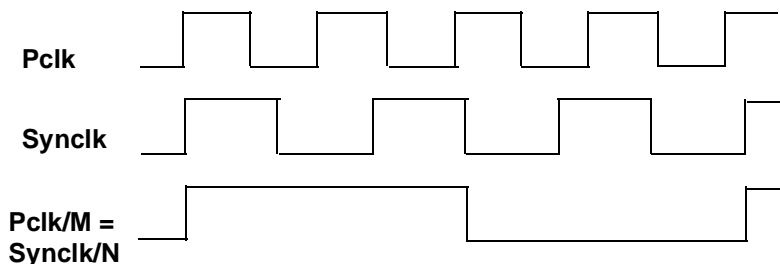
Pclk is the clock used in the memory controller (RMC) in the core logic, and Sync/N is the clock used at the core logic inter-

face of the RAC. The DDLL together with the Gear Ratio Logic enables users to exchange data directly from the Pclk domain to the Sync/N domain without incurring additional latency for synchronization. In general, Pclk and Sync/N can be of different frequencies, so the Gear Ratio Logic must select the appropriate M and N dividers such that the frequencies of Pclk/M and Sync/N are equal. In one interesting example, Pclk=133 MHz, Sync/N=100 MHz, and M=4 while N=3, giving Pclk/M=Sync/N=33 MHz. This example of the clock waveforms with the Gear Ratio Logic is shown in Figure 2.

The output clocks from the Gear Ratio Logic, Pclk/M, and Sync/N, are output from the core logic and routed to the DRCG Phase Detector inputs. The routing of Pclk/M and Sync/N must be matched in the core logic as well as on the board.

After comparing the phase of Pclk/M vs. Sync/N, the DRCG Phase Detector drives a phase aligner that adjusts the phase of the DRCG output clock, Busclk. Since everything else in the distributed loop is fixed delay, adjusting Busclk adjusts the phase of Sync/N and thus the phase of Sync/N. In this manner the distributed loop adjusts the phase of Sync/N to match that of Pclk/M, nulling the phase error at the input of the DRCG Phase Detector. When the clocks are aligned, data can be exchanged directly from the Pclk domain to the Sync/N domain.

Table 1 shows the combinations of Pclk and Busclk frequencies of greatest interest, organized by Gear Ratio.



**Figure 2. Gear Ratio Timing Diagram**



	Gear Ratio and Busclk			
Pclk	2.0	1.5	1.33	1.0
67 MHz				267 MHz
100 MHz			300 MHz	400 MHz
133 MHz	267 MHz	356 MHz	400 MHz	
150 MHz		400 MHz		
200 MHz	400 MHz			



Table 3 shows the logic for enabling the clock outputs, using the StopB input signal. When StopB is HIGH, the DRCG is in its normal mode, and Clk and ClkB are complementary outputs following the Phase Aligner output (PAClk). When StopB is LOW, the DRCG is in the Clk Stop mode, the output clock drivers are disabled (set to Hi-Z), and the Clk and ClkB settle to the DC voltage  $V_{X,STOP}$  as given in Table 14. The level of  $V_{X,STOP}$  is set by an external resistor network.

**Table 3. Clock Stop Mode Selection**

Mode	StopB	Clk	ClkB
Normal	1	PAclk	PAclkB
Clk Stop	0	V <sub>X,STOP</sub>	V <sub>X,STOP</sub>

Table 4 shows the logic for selecting the Bypass and Test modes. The select bits, S0 and S1, control the selection of these modes. The Bypass mode brings out the full-speed PLL output clock, bypassing the Phase Aligner. The Test mode brings the Refclk input all the way to the output, bypassing both the PLL and the Phase Aligner. In the Output Test mode (OE), both the Clk and ClkB outputs are put into a high-impedance state (Hi-Z). This can be used for component testing and for board-level testing.

**Table 4. Bypass and Test Mode Selection**

Mode	S0	S1	Bypclk (int.)	Clk	ClkB
Normal	0	0	Gnd	PAclk	PAclkB
Output Test (OE)	0	1	-	Hi-Z	Hi-Z
Bypass	1	0	PLLclk	PLLclk	PLLclkB
Test	1	1	Refclk	Refclk	RefclkB

Table 5 shows the logic for selecting the Power-down mode, using the PwrDnB input signal. PwrDnB is active LOW (enabled when 0). When PwrDnB is disabled, the DRCG is in its normal mode. When PwrDnB is enabled, the DRCG is put into a powered-off state, and the Clk and ClkB outputs are three-stated.

**Table 5. Power-down Mode Selection**

Mode	PwrDnB	Clk	ClkB
Normal	1	PAclk	PAclkB
Power-down	0	GND	GND

**Table of Frequencies and Gear Ratios**

Table 6 shows several supported Pclk and Busclk frequencies, the corresponding A and B dividers required in the DRCG PLL, and the corresponding M and N dividers in the gear ratio logic. The column Ratio gives the Gear Ratio as defined Pclk/Synclk (same as M and N). The column F@PD gives the divided down frequency (in MHz) at the Phase Detector, where  $F@PD = Pclk/M = Synclk/N$ .

#### State Transitions

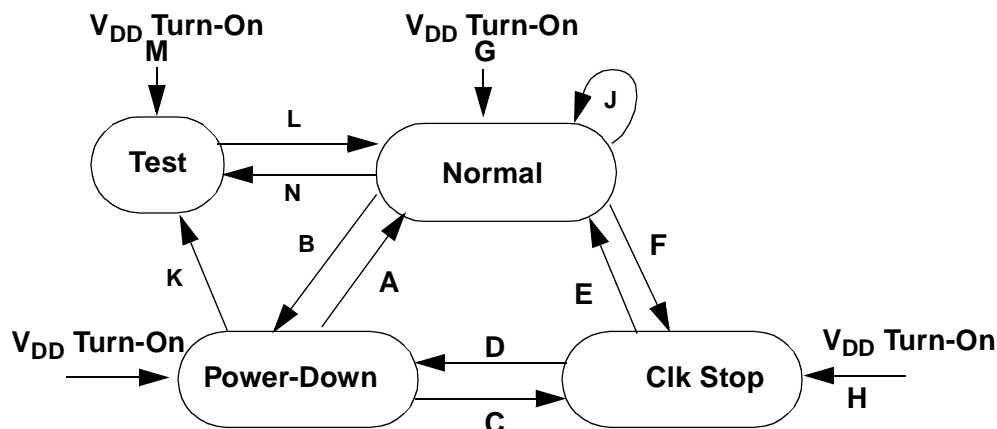
The clock source has three fundamental operating states. Figure 4 shows the state diagram with each transition labelled A through H. Note that the clock source output may NOT be glitch-free during state transitions.

Upon powering up the device, the device can enter any state, depending on the settings of the control signals, PwrDnB and StopB.

In Power-down mode, the clock source is powered down with the control signal, PwrDnB, equal to 0. The control signals S0 and S1 must be stable before power is applied to the device, and can only be changed in Power-down mode (PwrDnB=0). The reference inputs, V<sub>DDR</sub> and V<sub>DDPD</sub>, may remain on or may be grounded during the Power-down mode.

**Table 6. Examples of Frequencies, Dividers, and Gear Ratios**

Pclk	Refclk	Busclk	Synclk	A	B	M	N	Ratio	F@PD
67	33	267	67	8	1	2	2	1.0	33
100	50	300	75	6	1	8	6	1.33	12.5
100	50	400	100	8	1	4	4	1.0	25
133	67	267	67	4	1	4	2	2.0	33
133	67	400	100	6	1	8	6	1.33	16.7


**Figure 4. Clock Source State Diagram**

The control signals Mult0 and Mult1 can be used in two ways. If they are changed during Power-down mode, then the Power-down transition timings determine the settling time of the DRCG. However, the Mult0 and Mult1 control signals can also be changed during Normal mode. When the Mult control signals are “hot swapped” in this manner, the Mult transition timings determine the settling time of the DRCG.

In Clock Stop mode, the clock source is on, but the output is disabled (StopB asserted). The  $V_{DDP}$  reference input may remain on or may be grounded during the Clk Stop mode. The  $V_{DDR}$  reference input must remain on during the Clock Stop mode.

In Normal mode, the clock source is on, and the output is enabled.

Table 7 lists the control signals for each state.

**Table 7. Control Signals for Clock Source States**

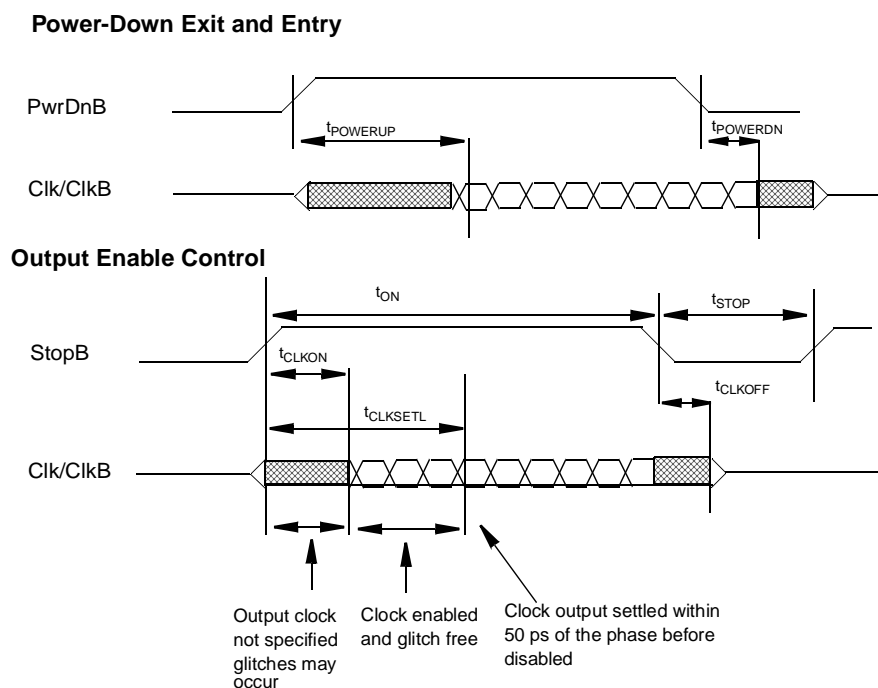
State	PwrDnB	StopB	Clock Source	Output Buffer
Power-down	0	X	OFF	Ground
Clock Stop	1	0	ON	Disabled
Normal	1	1	ON	Enabled

Figure 5 shows the timing diagrams for the various transitions between states, and Table 8 specifies the latencies of each state transition. Note that these transition latencies assume the following:

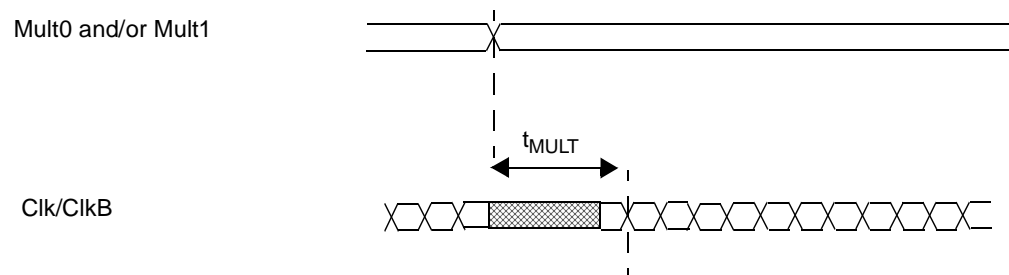
- Refclk input has settled and meets specification shown in Table 13.
- Mult0, Mult1, S0 and S1 control signals are stable.

## Timing Diagrams

**Figure 5. State Transition Timing Diagrams**



**Figure 6. Multiply Transition Timing**



**Table 8. State Transition Latency Specifications**

Transition	From	To	Transition Latency		Description
			Symbol	Max.	
A	Power-down	Normal	$t_{\text{POWERUP}}$	3 ms	Time from PwrDnB to Clk/ClkB output settled (excluding $t_{\text{DISTLOCK}}$ ).
C	Power-down	Clk Stop	$t_{\text{POWERUP}}$	3 ms	Time from PwrDnB until the internal PLL and clock has turned ON and settled.
K	Power-down	Test	$t_{\text{POWERUP}}$	3 ms	Time from PwrDnB to Clk/ClkB output settled (excluding $t_{\text{DISTLOCK}}$ ).
G	$V_{\text{DD}}$ ON	Normal	$t_{\text{POWERUP}}$	3 ms	Time from $V_{\text{DD}}$ is applied and settled until Clk/ClkB output settled (excluding $t_{\text{DISTLOCK}}$ ).
H	$V_{\text{DD}}$ ON	Clk Stop	$t_{\text{POWERUP}}$	3 ms	Time from $V_{\text{DD}}$ is applied and settled until internal PLL and clock has turned ON and settled.
M	$V_{\text{DD}}$ ON	Test	$t_{\text{POWERUP}}$	3 ms	Time from $V_{\text{DD}}$ is applied and settled until internal PLL and clock has turned ON and settled.
J	Normal	Normal	$t_{\text{MULT}}$	1 ms	Time from when Mult0 or Mult1 changed until Clk/ClkB output resettled (excluding $t_{\text{DISTLOCK}}$ ).
E	Clk Stop	Normal	$t_{\text{CLKON}}$	10 ns	Time from StopB until Clk/ClkB provides glitch-free clock edges.
E	Clk Stop	Normal	$t_{\text{CLKSETL}}$	20 cycles	Time from StopB to Clk/ClkB output settled to within 50 ps of the phase before CLK/CLKB was disabled.
F	Normal	Clk Stop	$t_{\text{CLKOFF}}$	5 ns	Time from StopB $\Phi$ to Clk/ClkB output disabled.
L	Test	Normal	$t_{\text{CTL}}$	3 ms	Time from when S0 or S1 is changed until CLK/CLKB output has resettled (excluding $t_{\text{DISTLOCK}}$ ).
N	Normal	Test	$t_{\text{CTL}}$	3 ms	Time from when S0 or S1 is changed until CLK/CLKB output has resettled (excluding $t_{\text{DISTLOCK}}$ ).
B,D	Normal or Clk Stop	Power-down	$t_{\text{POWERDN}}$	1 ms	Time from PwrDnB $\Phi$ to the device in Power-down.

Figure 5 shows that the Clk Stop to Normal transition goes through three phases. During  $t_{\text{CLKON}}$ , the clock output is not specified and can have glitches. For  $t_{\text{CLKON}} < t < t_{\text{CLKSETL}}$ , the clock output is enabled and must be glitch-free. For  $t > t_{\text{CLKSETL}}$ , the clock output phase must be settled to within

50 ps of the phase before the clock output was disabled. At this time, the clock output must also meet the voltage and timing specifications of Table 14. The outputs are in a high-impedance state during the Clk Stop mode.

**Table 9. Distributed Loop Lock Time Specification**

Symbol	Min.	Max.	Units	Description
$t_{DISTLOCK}$		5	ms	Time from when Clk/ClkB output is settled to when the phase error between SyncclkN and PclkM falls within the $t_{ERR,PD}$ spec in Table 14.

**Table 10. Supply and Reference Current Specification**

Parameter	Description	Min.	Max.	Unit
$I_{POWERDOWN}$	“Supply” current in Power-down state (PwrDnB=0)	--	250	$\mu A$
$I_{CLKSTOP}$	“Supply” current in Clk Stop state (StopB=0)	--	65	mA
$I_{NORMAL}$	“Supply” current in Normal state (StopB=1, PwrDnB=1)	--	100	mA
$I_{REF,PWDN}$	Current at VDDIR or VDDIPD reference pin in Power-down state (PwrDnB=0)	--	50	$\mu A$
$I_{REF,NORM}$	Current at VDDIR or VDDIPD reference pin in Normal or Clk Stop state (PwrDnB=1)	--	2	mA

Table 11 represents stress ratings only, and functional operation at the maximums is not guaranteed.

**Table 11. Absolute Maximum Ratings**

Parameter	Description	Min.	Max.	Unit
$V_{DD, ABS}$	Max. voltage on $V_{DD}$ with respect to ground	-0.5	4.0	V
$V_{I, ABS}$	Max. voltage on any pin with respect ground	-0.5	$V_{DD}+0.5$	V

Table 12 gives the nominal values of the external components and their maximum acceptable tolerance, assuming  $Z_{CH}=28\Omega$ .

**Table 12. External Component Values**

Parameter	Description	Min.	Max.	Unit
$R_S$	Serial Resistor	39	$\pm 5\%$	$\Omega$
$R_P$	Parallel Resistor	51	$\pm 5\%$	$\Omega$
$C_F$	Edge Rate Filter Capacitor	4–15 <sup>[1]</sup>	$\pm 10\%$	pF
$C_{MID}$	AC Ground Capacitor	470 pF	0.1 $\mu F$	$\pm 20\%$

**Note:**

1. Do not populate  $C_F$ . Leave pads for future use.



**Table 13. Operating Conditions**

Parameter	Description	Min.	Max.	Unit
$V_{DD}$	Supply Voltage	3.135	3.465	V
$T_A$	Ambient Operating Temperature	0	70	°C
$t_{CYCLE,IN}$	Refclk Input Cycle Time	10	40	ns
$t_{J,IN}$	Input Cycle-to-Cycle Jitter <sup>[2]</sup>	-	250	ps
$DC_{IN}$	Input Duty Cycle over 10,000 Cycles	40	60	% $t_{CYCLE}$
$FM_{IN}$	Input Frequency of Modulation	30	33	kHz
$PM_{IN}$ <sup>[3]</sup>	Modulation Index for Triangular Modulation	--	0.6	%
	Modulation Index for Non-Triangular Modulation	--	0.5 <sup>[5]</sup>	%
$t_{CYCLE,PD}$	Phase Detector Input Cycle Time at PclkM & SyncN	30	100	ns
$t_{ERR,INIT}$	Initial Phase error at Phase Detector Inputs	-0.5	0.5	$t_{CYCLE,PD}$
$DC_{IN,PD}$	Phase Detector Input Duty Cycle over 10,000 Cycles	25	75	$t_{CYCLE,PD}$
$t_{I,SR}$	Input Slew Rate (measured at 20%-80% of input voltage) for PclkM, SyncN, and Refclk	1	4	V/ns
$C_{IN,PD}$	Input Capacitance at PclkM, SyncN, and Refclk <sup>[4]</sup>	-	7	pF
$\Delta C_{IN,PD}$	Input Capacitance matching at PclkM and SyncN <sup>[4]</sup>	-	0.5	pF
$C_{IN,CMOS}$	Input Capacitance at CMOS pins (excluding PclkM, SyncN, and Refclk) <sup>[4]</sup>	-	10	pF
$V_{IL}$	Input (CMOS) Signal Low Voltage	-	0.3	VDD
$V_{IH}$	Input (CMOS) Signal High Voltage	0.7	-	VDD
$V_{IL,R}$	Refclk input Low Voltage	-	0.3	$V_{DDIR}$
$V_{IH,R}$	Refclk input High Voltage	0.7	-	$V_{DDIR}$
$V_{IL,PD}$	Input Signal Low Voltage for PD Inputs and StopB	-	0.3	$V_{DDIPD}$
$V_{IH,PD}$	Input Signal High Voltage for PD Inputs and StopB	0.7	-	$V_{DDIPD}$
$V_{DDIR}$	Input Supply Reference for Refclk	1.235	3.465	V
$V_{DDIPD}$	Input Supply Reference for PD Inputs	1.235	2.625	V

**Notes:**

- Refclk jitter measured at  $V_{DDIR}$  (nom)/2.
- If input modulation is used: input modulation is allowed but not required.
- Capacitance measured at Freq=1 MHz, DC bias=0.9V and  $V_{AC}<100$  mV.
- The amount of allowed spreading for any non-triangular modulation is determined by the induced downstream tracking skew, which cannot exceed the skew generated by the specified 0.6% triangular modulation. Typically, the amount of allowed non-triangular modulation is about 0.5%.

**Table 14. Device Characteristics**

Parameter	Description	Min.	Max.	Unit
$t_{\text{CYCLE}}$	Clock Cycle Time	2.5	3.75	ns
$t_{\text{J}}$	Cycle-to-Cycle Jitter at Clk/ClkB <sup>[6]</sup>	-	60	ps
	Total Jitter over 2, 3, or 4 Clock Cycles <sup>[6]</sup>	-	100	ps
	266-MHz Cycle-to-Cycle Jitter <sup>[7]</sup>	-	100	ps
	266-MHz Total Jitter over 2, 3, or 4 Clock Cycles <sup>[7]</sup>	-	160	ps
$t_{\text{STEP}}$	Phase Aligner Phase Step Size (at Clk/ClkB)	1	-	ps
$t_{\text{ERR,PD}}$	Phase Detector Phase Error for Distributed Loop Measured at PclkM-SynclkN (rising edges) (does not include clock jitter)	-100	100	ps
$t_{\text{ERR,SSC}}$	PLL Output Phase Error when Tracking SSC	-100	100	ps
$V_{\text{X,STOP}}$	Output Voltage during Clk Stop (StopB=0)	1.1	2.0	V
$V_{\text{X}}$	Differential Output Crossing-Point Voltage	1.3	1.8	V
$V_{\text{COS}}$	Output Voltage Swing (p-p single-ended) <sup>[8]</sup>	0.4	0.6	V
$V_{\text{OH}}$	Output High Voltage	-	2.0	V
$V_{\text{OL}}$	Output Low voltage	1.0	-	V
$r_{\text{OUT}}$	Output Dynamic Resistance (at pins) <sup>[9]</sup>	12	50	$\Omega$
$I_{\text{OZ}}$	Output Current during Hi-Z (S0 = 0, S1 = 1)	-	50	$\mu\text{A}$
$I_{\text{OZ,STOP}}$	Output Current during Clk Stop (StopB = 0)	-	500	$\mu\text{A}$
DC	Output Duty Cycle over 10,000 Cycles	40	60	% $t_{\text{CYCLE}}$
$t_{\text{DC,ERR}}$	Output Cycle-to-Cycle Duty Cycle Error	-	50	ps
$t_{\text{R}}, t_{\text{F}}$	Output Rise and Fall Times (measured at 20%–80% of output voltage)	250	500	ps
$t_{\text{CR,CF}}$	Difference between Output Rise and Fall Times on the Same Pin of a Single Device (20%–80%)	-	100	ps

**Notes:**

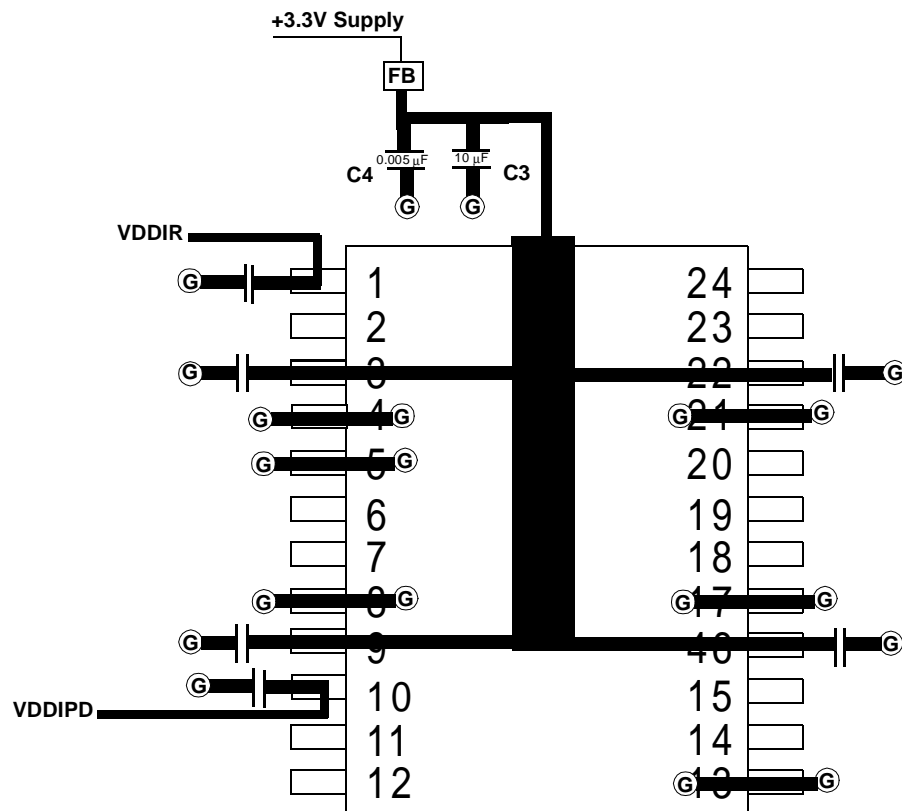
6. Output Jitter spec measured at  $t_{\text{CYCLE}} = 2.5$  ns.
7. Output Jitter Spec measured at  $t_{\text{CYCLE}} = 3.75$  ns.
8.  $V_{\text{COS}} = V_{\text{OH}} - V_{\text{OL}}$ .
9.  $r_{\text{OUT}} = \Delta V_{\text{O}} / \Delta I_{\text{O}}$ . This is defined at the output pins.

**Ordering Information**

Ordering Code	Package Name	Package Type
W134M/W134S	H	24-pin SSOP (150 mils)

Document #: 38-00822-A

## Layout Example



### Internal Power Supply Plane

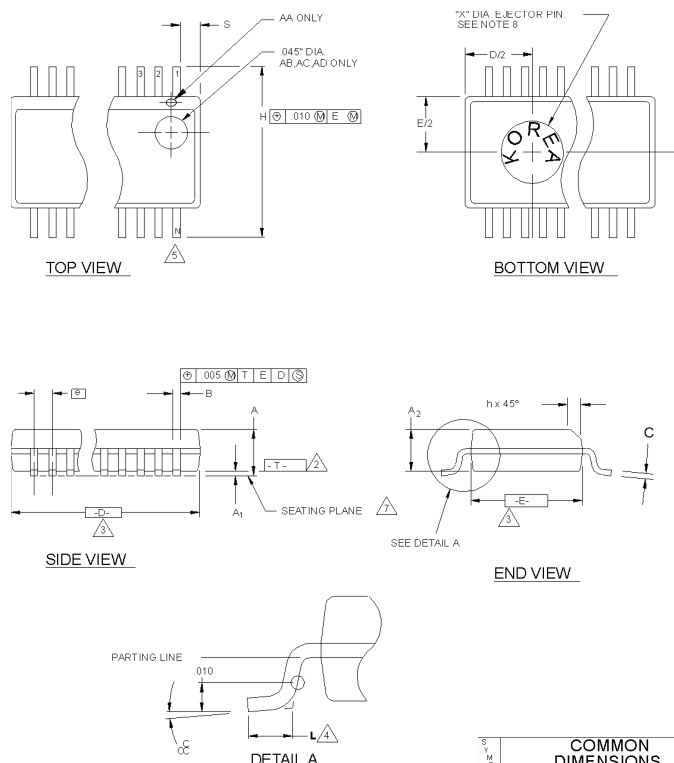
FB = Dale ILB1206 - 300 ( $300\Omega$  @ 100 MHz)

ⓐ = VIA to GND plane layer

All Bypass cap = 0.1 Ceramic XR7

## Package Diagram

### 24-Pin Small Shrink Outline Package (SSOP, 150 mils)



#### NOTES:

1. DIMENSIONING & TOLERANCES PER ANSI Y14.5M - 1982.
2. "T" IS A REFERENCE DATUM.
3. "D" & "E" ARE REFERENCE DATUMS AND DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS, BUT DOES INCLUDE MOLD MISMATCH AND ARE MEASURED AT THE MOLD PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006 INCHES PER SIDE.
4. "L" IS THE LENGTH OF TERMINAL FOR SOLDERING TO A SUBSTRATE.
5. "N" IS THE NUMBER OF TERMINAL POSITIONS.
6. TERMINAL POSITIONS ARE SHOWN FOR REFERENCE ONLY.
7. FORMED LEADS SHALL BE PLANAR WITH RESPECT TO ONE ANOTHER WITHIN .003 INCHES AT SEATING PLANE.
8. COUNTRY OF ORIGIN LOCATION AND EJECTOR PIN ON PACKAGE BOTTOM IS OPTIONAL AND DEPENDS ON ASSEMBLY LOCATION.
9. CONTROLLING DIMENSION: INCHES.
10. MAXIMUM DIE THICKNESS ALLOWABLE WITHOUT DIE COAT IS .016.

#### THIS TABLE IN INCHES

SYMBOL	COMMON DIMENSIONS			NOTE VARIATIONS	3 D			S			5 N
	MIN.	NOM.	MAX.		MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	
A	.061	.064	.068	AA	.189	.194	.196	.0020	.0045	.0070	16
A	.004	.006	.0098	AB	.337	.342	.344	.0500	.0525	.0550	20
A	.055	.058	.061	AC	.337	.342	.344	.0250	.0275	.0300	24
B	.008	.010	.012	AD	.386	.391	.393	.0250	.0280	.0300	28
C	.0075	.008	.0098								
D	SEE VARIATIONS										
E	.150	.155	.157								
e		.025 BSC									
H	.230	.236	.244								
h	.010	.013	.016								
L	.016	.025	.035								
N	SEE VARIATIONS										
S	SEE VARIATIONS										
α	0°	5°	8°								
X	.085	.093	.100								

#### THIS TABLE IN MILLIMETERS

SYMBOL	COMMON DIMENSIONS			NOTE VARIATIONS	3 D			S			5 N
	MIN.	NOM.	MAX.		MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	
A	1.55	1.63	1.73	AA	4.80	4.93	4.98	0.05	0.11	0.18	16
A	0.127	0.15	0.25	AB	8.56	8.69	8.74	1.27	1.33	1.40	20
A	1.40	1.47	1.55	AC	8.56	8.69	8.74	0.64	0.70	0.76	24
B	0.20	0.25	0.31	AD	9.80	9.93	9.98	0.64	0.71	0.76	28
C	0.19	0.20	0.25								
D	SEE VARIATIONS										
E	3.81	3.94	3.99								
e		0.635 BSC									
H	5.84	5.99	6.20								
h	0.25	0.33	0.41								
L	0.41	0.64	0.89								
N	SEE VARIATIONS										
S	SEE VARIATIONS										
α	0°	5°	8°								
X	2.16	2.36	2.54								