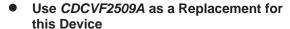
CDC2509A 3.3-V PHASE-LOCK LOOP CLOCK DRIVER

SCAS603C - APRIL 1998 - REVISED DECEMBER 2004



- Spread Spectrum Clock Compatible
- 100-MHz Maximum Frequency
- Available in Plastic 24-Pin TSSOP
- Phase-Lock Loop Clock Distribution for Synchronous DRAM Applications
- Distributes One Clock Input to One Bank of Five and One Bank of Four Outputs
- Separate Output Enable for Each Output Bank
- External Feedback (FBIN) Pin Is Used to Synchronize the Outputs to the Clock Input
- On-Chip Series Damping Resistors
- No External RC Network Required
- Operates at 3.3-V V_{CC}

PW PACKAGE (TOP VIEW) **AGND** CLK 24 AV_{CC} V_{CC} 🛭 2 23 1Y0 🛮 3 1Y1 1Y2 **GND** 2Y3 CORAL FROM 15 □ v_{cc} 2G 14 13 **∏** FBIN

description

The CDC2509A is a high-performance, lowestew, lowester, phase-lock loop (PLL) clock driver. It uses a PLL to precisely align, in both frequency and as use, the feedback (FBOUT) output to the clock (CLK) input signal. It is specifically designed for use with synchronic support DRAMs. The CDC2509A operates at 3.3-V V_{CC} and provides integrated series-damping resistors that make it ideal for driving point-to-point loads.

One bank of five outputs and one bank of four outputs provide nine low-skew, low-jitter copies of CLK. Output signal duty cycles are adjusted to 50 percent, independent of the duty cycle at CLK. Each bank of outputs can be enabled or disabled stogrately on the control (1G and 2G) inputs. When the G inputs are high, the outputs switch in phase and frequency with CLK; when the G inputs are low, the outputs are disabled to the logic-low state.

Unlike many products containing PLLs, the CDC2509A does not require external RC networks. The loop filter for the PLL is included on-chip, minimizing component count, board space, and cost.

Because it is based on PLL circuitry, the CDC2509A requires a stabilization time to achieve phase lock of the feedback signal to the reference signal. This stabilization time is required, following power up and application of a fixed-frequency, fixed-phase signal at CLK, and following any changes to the PLL reference or feedback signals. The PLL can be bypassed for test purposes by strapping AV_{CC} to ground.

The CDC2509A is characterized for operation from 0°C to 70°C.



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FUNCTION TABLE OUTPUTS INPUTS NO JEE CONTRIBETOR AS A REPLACE INTERVIOR OF THE PLACE INTERVIOR OF 1Y 1**G** 2G CLK **FBOUT** (0:4)(0:3)functional block diagram CLK ______ PLL 16 2Y3 FBIN 13 12 FBOUT AVCC -**AVAILABLE OPTIONS PACKAGE** T_{A} SMALL OUTLINE (PW) 0°C to 70°C CDC2509APWR



SCAS603C - APRIL 1998 - REVISED DECEMBER 2004

Terminal Functions

TERMINAL			
NAME	NO.	TYPE	DESCRIPTION
CLK	24	_	Clock input. CLK provides the clock signal to be distributed by the CDC2509A clock driver. CLK is used to provide the reference signal to the integrated PLL that generates the clock output signals. CLK must have a fixed frequency and fixed phase for the PLL to obtain phase lock. On the the circuit is powered up and a valid CLK signal is applied, a stabilization time is requires to the PLL to phase lock the feedback signal to its reference signal.
FBIN	13	I	Feedback input. FBIN provides the feedback signal to the internal PLL following must be hard-wired to FBOUT to complete the PLL. The integrated PLL synchronizes CLX and FBIN so that there is nominally zero phase error between CLK and FBIN.
1G	11	I	Output bank enable. 1G is the output enable for outputs 1 (0:4). When 1G is low, outputs 1Y(0:4) are disabled to a logic-low state. When 1G is high, all viouts 1 (0:4), are enabled and switch at the same frequency as CLK.
2G	14	I	Output bank enable. 2G is the output enable to outputs 2 (0:3). When 2G is low, outputs 2Y(0:3) are disabled to a logic low state. When 2G is high, all purputs 2Y(0:3) are enabled and switch at the same frequency as CLK.
FBOUT	12	0	Feedback output. FBOUT is dedicated for external leedback. It switches at the same frequency as CLK. When externally wired to FBK $^{\prime}$ FBOUT co. spletes the feedback loop of the PLL. FBOUT has and integrated 25- $^{\circ}$ 0 series-damping vesistic.
1Y (0:4)	3, 4, 5, 8, 9	0	Clock outputs. These cutputs provide low-skew copies of CLK. Output bank 1Y(0:4) is enabled via the 1G input. These outputs can be disabled to a logic-low state by deasserting the 1G control input. Each output has an introduct d $25-\Omega$ series-damping resistor.
2Y (0:3)	16, 17, 20, 21	0	Clock outputs: It goes outputs provide low-skew copies of CLK. Output bank 2Y(0:3) is enabled via the 2G input. These outputs are be disabled to a logic-low state by deasserting the 2G control input. Each output $K > 0$ integrate 1 25- Ω series-damping resistor.
AVCC	23	Power	Analysis by English AVCC provides the power reference for the analog circuitry. In addition, AVCC can be sed to typically the PLL for test purposes. When AVCC is strapped to ground, PLL is bypassed and is by fered directly to the device outputs.
AGND	1	Ground	anal g ground. AGND provides the ground reference for the analog circuitry.
Vcc	2, 10, 15, 22	PIME	Fow r supply
GND	6, 7, 18, 19	Ground	Ground



SCAS603C - APRIL 1998 - REVISED DECEMBER 2004

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage range, AV _{CC} (see Note 1)	
Input voltage range, V _I (see Note 2)	
Voltage range applied to any output in the high or low state,	Ca
V _O (see Notes 2 and 3)	6 5 V to V _{CC} + 0.5 V
Input clamp current, I_{IK} ($V_I < 0$)	–50 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$)	±50 mA
Continuous output current, $I_{O}(V_{O} = 0 \text{ to } V_{CC})$	±50 mA
Continuous current through each V_{CC} or GND	±100 mA
Maximum power dissipation at $T_A = 55^{\circ}C$ (in still air) (see Note 4)	0.7 W
Storage temperature range, T _{stq}	€ –65°C to 150°C

[†] Stresses beyond those listed under "absolute maximum ratings" may cause permanent dam to to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicate to der "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect devices elso lity.

- NOTES: 1. AV_{CC} must not exceed V_{CC}.
 - put clamp-current ratings are observed. 2. The input and output negative-voltage ratings may be exceeded in
 - 3. This value is limited to 4.6 V maximum.
 - This value is limited to 4.0 V maximum.
 The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.
 For more information, refer to the Package Thermal Considerations application note in the ABT Advanced BiCMOS Technology Data
 Book, literature number SCBD002.

recommended operating conditions (see

	MIN	MAX	UNIT
Supply voltage, V _{CC} , AV _{CC}	3	3.6	V
High-level input voltage, VIH	2		V
Low-level input voltage, V _{IL}		0.8	V
Input voltage, V _I	0	VCC	V
High-level output current, IOH		-12	mA
Low-level output current, IOL		12	mA
Operating free-air temperature TA	0	70	°C

or low to prevent them from floating. NOTE 5: Unused inputs m



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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST C	ONDITIONS	V _{CC} , AV _{CC}	MIN	TYP‡	MAX	UNIT
VIK	I _I = -18 mA		3 V			-1.2	V
	I _{OH} = -100 μA		MIN to MAX	V _{CC} -0.2	•		
VOH	$I_{OH} = -12 \text{ mA}$		3 V	2.1	9		V
	$I_{OH} = -6 \text{ mA}$		3 V	2,4	~		
	I _{OL} = 100 μA		MIN to MAX		7,	0.2	
VOL	I _{OL} = 12 mA		3 V	0		8.0	V
	I _{OL} = 6 mA		34	1		0.55	
lj	$V_I = V_{CC}$ or GND		3.6			±5	μΑ
I _{CC} §	$V_I = V_{CC}$ or GND,	$I_O = 0$, Outputs: low or high	3.6 V			10	μΑ
ΔlCC	One input at V _{CC} – 0.6 V,	Other inputs at V _{CC} or GND	33 V to 36 v			500	μΑ
C _i	$V_I = V_{CC}$ or GND	7	3.4		4		pF
Co	$V_O = V_{CC}$ or GND		3.3 V		6		pF

For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

timing requirements over recommended ranges of supply voltage and operating free-air temperature

		NO.	MIN	MAX	UNIT
fclk	Clock frequency	(1,20)	80	100	MHz
	Input clock duty cycle	10, 20	40%	60%	
	Stabilization time†	W. J.		1	ms

[†] Time required for the integrated PLL circuit o obtain chase lock of its feedback signal to its reference signal. For phase lock to be obtained, a fixed-frequency, fixed-phase reference signal must be present at CLK. Until phase lock is obtained, the specifications for propagation delay, skew, and jitter parameters given in the solitioning characteristics table are not applicable. This parameter does not apply for input modulation under SSC application.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_1=30$ pt (see Note 6 and Figures 1 and 2)^{\ddagger}

PARAMETER	FROM	TO	V _{CC} , AV _{CC} = 3.3 V ± 0.165 V			V _{CC} ,	UNIT		
	(INPUT)/CONDITION	(OUTPUT)	MIN	TYP	MAX	MIN	TYP	MAX	
t _{phase error} , reference (see Note 7, Figure 3)	80 MHz < CLKIN↑ ≤ 100 MHz	FBIN↑				-700		-300	ps
tphase error, – jitter (see Note 8)	CLKIN↑ = 100 MHz	FBIN↑	-750		-350		-540		ps
t _{sk(o)} §	Any Y or FBOUT	Any Y or FBOUT						200	ps
Jitter _(pk-pk) (see Figure 4)	Clkin = 100 MHz	Any Y or FBOUT				-150		150	ps
Duty cycle	F(clkin > 80 MHz)	Any Y or FBOUT				45%		55%	
t _r		Any Y or FBOUT		1.3	1.9	0.8		2.1	ns
t _f		Any Y or FBOUT		1.7	2.5	1.2		2.7	ns

[‡]These parameters are not production tested.

^{8.} Phase error does not include jitter. The total phase error is –900 ps to –200 ps for the 5% V_{CC} range.



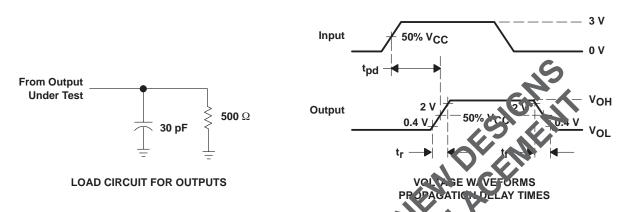
[§] For ICC of AVCC, see Figure 5.

[§] The t_{Sk(O)} specification is only valid for equal loading of all outputs.

NOTES: `6. The specifications for parameters in this table are applicable only after any appropriate stabilization time has elapsed.

^{7.} This is considered as static phase error.

PARAMETER MEASUREMENT INFORMATION



NOTES: A. C_L includes probe and jig capacitance.

- B. All input pulses are supplied by generators having the following characters 00 MHz, $Z_O = 50 \Omega$, $t_r \le 1.2$ ns, $t_f \le 1.2$ ns.
- C. The outputs are measured one at a time with one transition per n

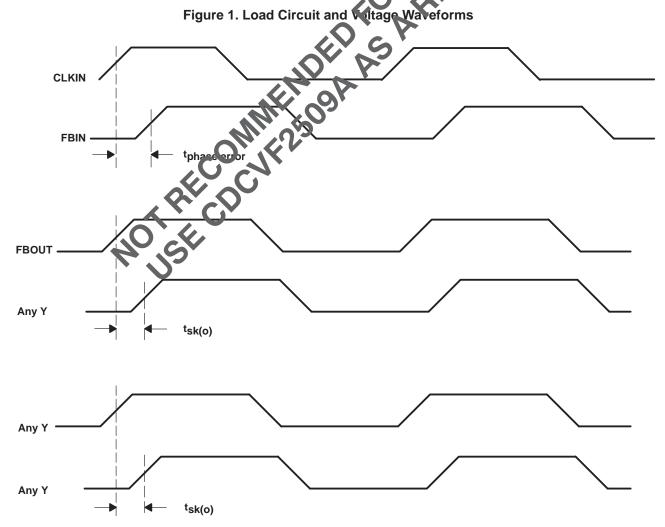
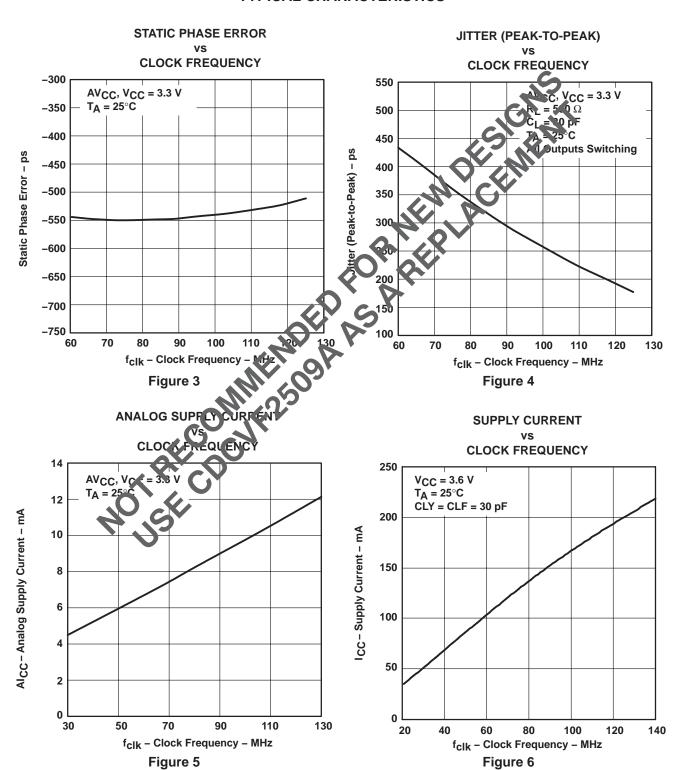


Figure 2. Phase Error and Skew Calculations



TYPICAL CHARACTERISTICS





PACKAGE OPTION ADDENDUM

16-Jul-2010

PACKAGING INFORMATION

www.ti.com

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/ Ball Finish	MSL Peak Temp ⁽³⁾	Samples (Requires Login)
CDC2509APWR	NRND	TSSOP	PW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Samples Not Available
CDC2509APWRG4	NRND	TSSOP	PW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Samples Not Available

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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TAPE AND REEL INFORMATION





A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device		Package Drawing			Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CDC2509APWR	TSSOP	PW	24	2000	330.0	16.4	6.95	8.3	1.6	8.0	16.0	Q1





*All dimensions are nominal

ĺ	Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
	CDC2509APWR	TSSOP	PW	24	2000	346.0	346.0	33.0

PW (R-PDSO-G24)

PLASTIC SMALL OUTLINE



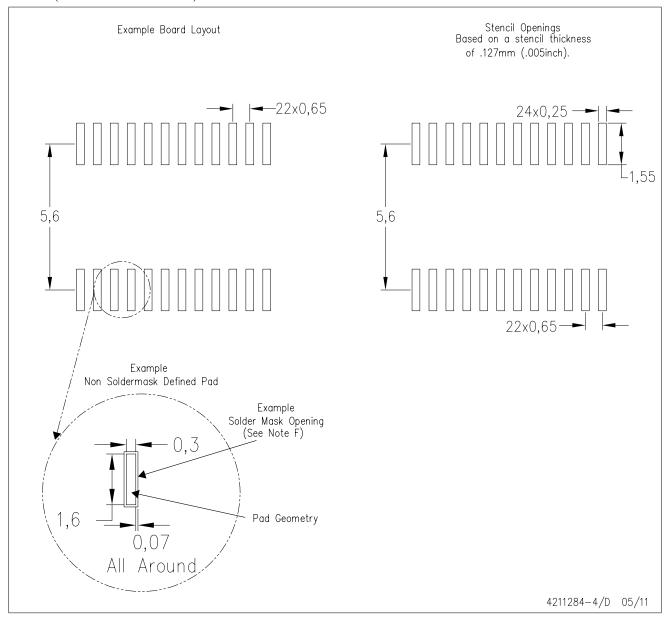
NOTES:

- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M—1994.
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
- E. Falls within JEDEC MO-153



PW (R-PDSO-G24)

PLASTIC SMALL OUTLINE



NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate design.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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