



3.3V, 180-MHz, Multi-Output Clock Driver

Product Features

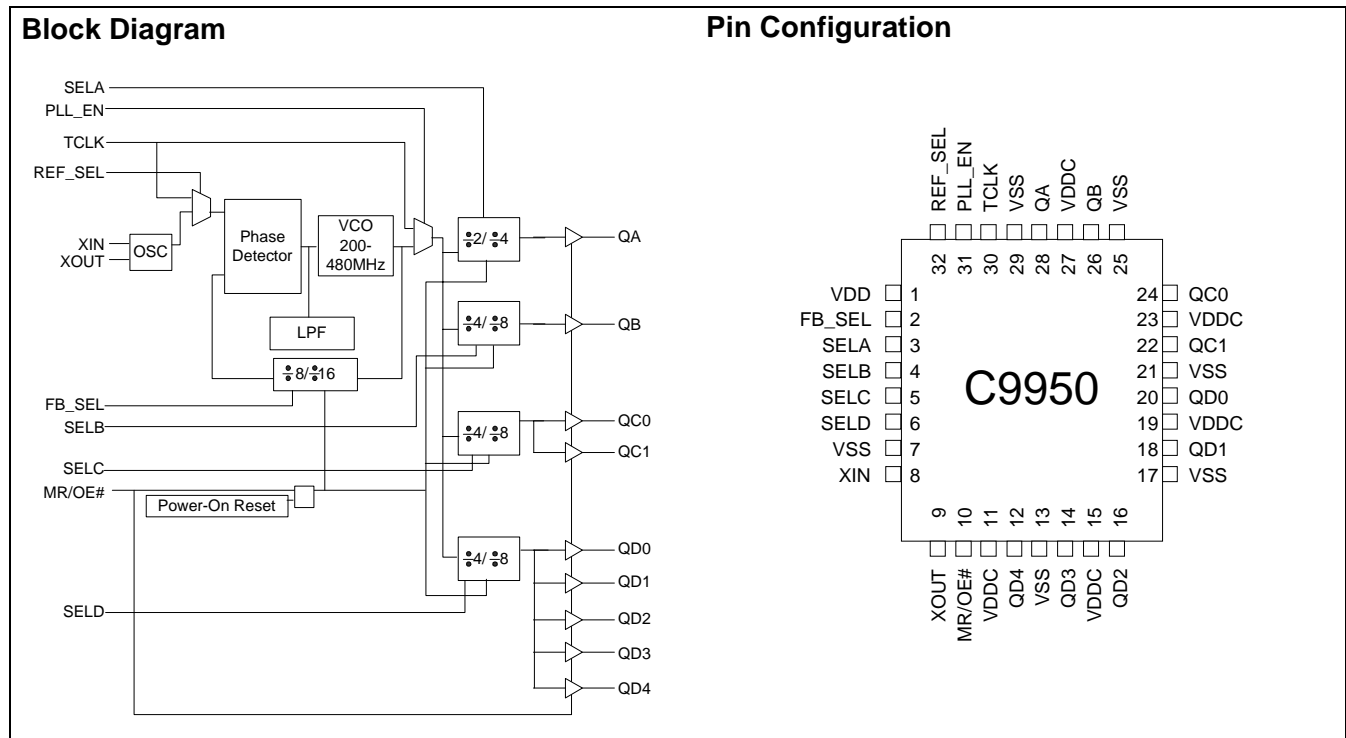
- 180-MHz Clock Support
- Supports PowerPC™, Intel®, and RISC Processors
- 9 Clock Outputs: Frequency Configurable
- Oscillator or Crystal Reference Input
- Output Disable Control
- Spread Spectrum Compatible
- Pin Compatible with MPC950
- Industrial Temp. Range: -40°C to +85°C
- 32-Pin TQFP Package

Table 1. Frequency Table^[1]

SEL (A:D)	FB_SEL = 1				FB_SEL = 1			
	QA	QB	QC (0,1)	QD (0:4)	QA	QB	QC (0,1)	QD (0:4)
0000	4x	2x	2x	2x	8x	4x	4x	4x
0001	4x	2x	2x	x	8x	4x	4x	2x
0010	4x	2x	x	2x	8x	4x	2x	4x
0011	4x	2x	x	x	8x	4x	2x	2x
0100	4x	x	2x	2x	8x	2x	4x	4x
0101	4x	x	2x	x	8x	2x	4x	2x
0110	4x	x	x	2x	8x	2x	2x	4x
0111	4x	x	x	x	8x	2x	2x	2x
1000	2x	2x	2x	2x	4x	4x	4x	4x
1001	2x	2x	2x	x	4x	4x	4x	2x
1010	2x	2x	x	2x	4x	4x	2x	4x
1011	2x	2x	x	x	4x	4x	2x	2x
1100	2x	x	2x	2x	4x	2x	4x	4x
1101	2x	x	2x	x	4x	2x	4x	2x
1110	2x	x	x	2x	4x	2x	2x	4x
1111	2x	x	x	x	4x	2x	2x	2x

Note:

1. x = is the reference input frequency



Pin Description^[2]

Pin	Name	PWR	I/O	Type	Description
8	XIN		I		Oscillator Input. Connect to a crystal.
9	XOUT		O		Oscillator Output. Connect to a crystal.
30	TCLK		I		External Test Clock Input.
28	QA	VDDC	O		Clock Output. See Frequency Table.
26	QB	VDDC	O		Clock Output. See Frequency Table.
22, 24	QC(1,0)	VDDC	O		Clock Outputs. See Frequency Table.
12, 14, 16, 18, 20	QD(4:0)	VDDC	O		Clock Outputs. See Frequency Table.
2	FB_SEL		I	PD	Feedback Select Input. If FB_SEL = 1, then the (+8) counter is selected in the PLL feedback loop. If FB_SEL = 0, then the (+16) counter is selected in the PLL feedback loop.
10	MR/OE#		I		Master Reset/Output Enable Input. When asserted HIGH, resets all of the internal flip-flops and also disables all of the outputs. When pulled LOW, releases the internal flip-flops from reset and enables all of the outputs.
31	PLL_EN		I		PLL Enable Input. When asserted HIGH, PLL is enabled. And when set LOW, PLL is bypassed.
32	REF_SEL		I		Reference Select Input. When HIGH, TCLK is the reference clock and when LOW, the crystal oscillator is selected.
3, 4, 5, 6	SEL(A:D)		I		Frequency Select Inputs. See Frequency Table. If SEL_ = 1, then QA divider = +4, QB:D divider = +8 If SEL_ = 0, then QA divider = +2, QB:D divider = +4
11, 15, 19, 23, 27	VDDC				3.3V Power Supply for Output Clock Buffers.
1	VDD				3.3V Power Supply for PLL
7, 13, 17, 21, 25, 29	VSS				Common Ground

Note:

2. PD = Internal Pull-Down, PU = Internal Pull-Up.

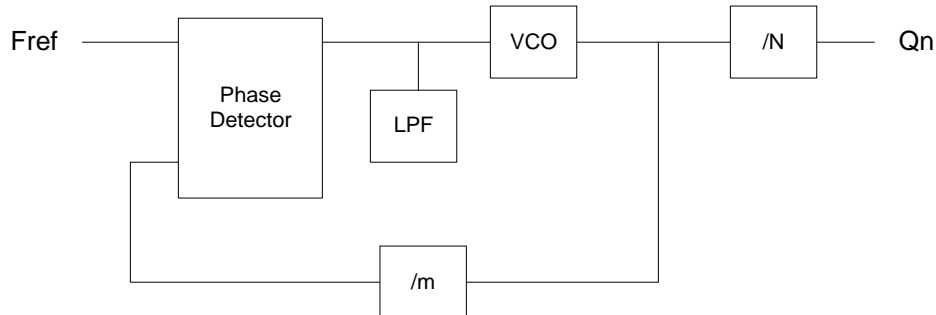
Description

The C9950 has an integrated PLL that provides low skew and low jitter clock outputs for high-performance microprocessors. The PLL is ensured stable operation given that the VCO is configured to run between 200 MHz and 480 MHz. This allows a wide range of output frequencies from 25 MHz to 180 MHz. The internal VCO frequency is divided by 8 or 16 and compared to the input reference clock. These selectable dividers allow for input reference clock flexibility. The internal VCO is running at 2x or 4x the high speed output (QA), and 4x or 8x

the outputs Q(B:D) depending on the configuration (see *Table 2*). The use of even dividers ensures that the output duty cycle remains at 50%.

Output Frequency

The C9950 generates outputs with programmable frequency relationships. As a result, the input reference frequency is a function of the desired output frequency (*Table 1*). The following block diagram illustrates the corresponding parameters that are needed to calculate the output frequency.


Figure 1.

$$F_{ref} = F_{VCO}/m, F_{VCO} = F_{Qn} \times N$$

$$F_{ref} = (F_{Qn} \times N) / m$$

Where $m = 8$ ($FB_SEL = 1$) or $m = 16$ ($FB_SEL = 0$), and $N = 2, 4, \text{ or } 8$ depending on $SEL_$ as shown in *Table 1*.

Table 2.

INPUTS				OUTPUTS			
SELA	SELB	SELC	SELD	QA	QB	QC	QD
0	0	0	0	VCO/2	VCO/4	VCO/4	VCO/4
0	0	0	1	VCO/2	VCO/4	VCO/4	VCO/8
0	0	1	0	VCO/2	VCO/4	VCO/8	VCO/4
0	0	1	1	VCO/2	VCO/4	VCO/8	VCO/8
0	1	0	0	VCO/2	VCO/8	VCO/4	VCO/4
0	1	0	1	VCO/2	VCO/8	VCO/4	VCO/8
0	1	1	0	VCO/2	VCO/8	VCO/8	VCO/4
0	1	1	1	VCO/2	VCO/8	VCO/8	VCO/8
1	0	0	0	VCO/4	VCO/4	VCO/4	VCO/4
1	0	0	1	VCO/4	VCO/4	VCO/4	VCO/8
1	0	1	0	VCO/4	VCO/4	VCO/8	VCO/4
1	0	1	1	VCO/4	VCO/4	VCO/8	VCO/8
1	1	0	0	VCO/4	VCO/8	VCO/4	VCO/4
1	1	0	1	VCO/4	VCO/8	VCO/4	VCO/8
1	1	1	0	VCO/4	VCO/8	VCO/8	VCO/4
1	1	1	1	VCO/4	VCO/8	VCO/8	VCO/8

Table 3. Suggested Oscillator Crystal Parameters

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
T _C	Frequency Tolerance	Note 1	-	-	±100	PPM
T _S	Frequency Temperature Stability	(T _A -10 to +60°C) ^[3]	-	-	±100	PPM
T _A	Aging	(first 3 years @ 25°C) ^[3]	-	-	5	PPM/Yr
C _L	Load Capacitance	The crystal's rated load ^[3]	-	20	-	pF
R _{ESR}	Effective Series Resistance (ESR)	Note 4	-	40	80	Ohms

Notes:

3. For best performance and accurate frequencies from this device, It is recommended but not mandatory that the chosen crystal meets or exceeds these specifications
4. Larger values may cause this device to exhibit oscillator startup problems

Maximum Ratings^[5]

Maximum Input Voltage Relative to V_{SS} : $V_{SS} - 0.3V$
 Maximum Input Voltage Relative to V_{DD} : $V_{DD} + 0.3V$
 Storage Temperature: $-65^{\circ}C$ to $+150^{\circ}C$
 Operating Temperature: $-40^{\circ}C$ to $+85^{\circ}C$
 Maximum ESD protection 2 KV
 Maximum Power Supply: 5.5V
 Maximum Input Current: ± 20 mA

This device contains circuitry to protect the inputs against damage due to high static voltages or electric field; however, precautions should be taken to avoid application of any voltage higher than the maximum rated voltages to this circuit. For proper operation, V_{in} and V_{out} should be constrained to the range:

$$V_{SS} < (V_{in} \text{ or } V_{out}) < V_{DD}$$

Unused inputs must always be tied to an appropriate logic voltage level (either V_{SS} or V_{DD}).

DC Parameters: $V_{DD} = V_{DDC} = 3.3V \pm 5\%$, $T_A = -40^{\circ}C$ to $+85^{\circ}C$

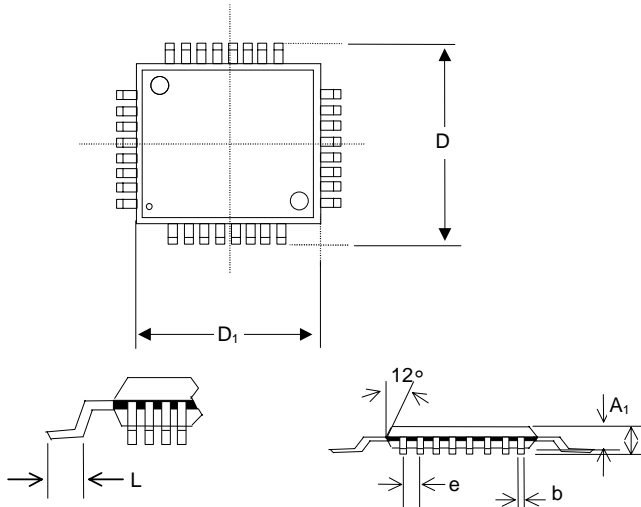
Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
V_{IL}	Input Low Voltage				0.8	V
V_{IH}	Input High Voltage		2.0			V
I_{IL}	Input Low Current (@ $V_{IL} = V_{SS}$)	Note 6			-120	μA
I_{IH}	Input High Current (@ $V_{IL} = V_{DD}$)	Note 6			120	μA
V_{OL}	Output Low Voltage	$I_{OL} = 40$ mA, Note 7			0.5	V
V_{OH}	Output High Voltage	$I_{OH} = -40$ mA, Note 7	2.4			V
I_{DDC}	Quiescent Supply Current	All V_{DDC} and V_{DD}		15	20	mA
I_{DD}	PLL Supply Current	V^{DD} only		15	20	mA
C_{in}	Input Capacitance				4	pF

AC Parameters^[8]: $V_{DD} = V_{DDC} = 3.3V \pm 5\%$, $T_A = -40^{\circ}C$ to $+85^{\circ}C$

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
Tr/Tf	TCLK Input Rise/Fall				3.0	ns
Fref	Reference Input Frequency		Note 9		Note 2	MHz
Fxtal	Crystal Oscillator Frequency	See Table 3 for details	10		25	MHz
FrefDC	Reference Input Duty Cycle		25		75	%
Fvco	PLL VCO Lock Range		200		480	MHz
Tlock	Maximum PLL lock Time				10	ms
Tr/Tf	Output Clocks Rise/Fall Time ^[10]	0.8V to 2.0V	0.10		1.0	ns
Fout	Maximum Output Frequency	QA = ($\div 2$) QA/QB = ($\div 4$) QB = ($\div 8$)			180 120 60	MHz
FoutDC	Output Duty Cycle		TCYCLE/2 - 1		TCYCLE/2 + 1	ns
tpZL, tpZH	Output enable time (all outputs)				6	ns
tpLZ, tpHZ	Output disable time (all outputs)				7	ns
TCCJ	Cycle to Cycle Jitter (peak to peak) ^[10]			± 100		ps
TSKEW0	Any Output to Any Output Skew ^[10]			200	350	ps

Notes:

5. The voltage on any input or I/O pin cannot exceed the power pin during power-up. Power supply sequencing is NOT required.
6. Inputs have internal pull-up/pull-down resistors that affect input current.
7. Driving series or parallel terminated 50 Ω (or 50 Ω to $V_{DD}/2$) transmission. Output buffers are dual staged to control drive strength in order to reduce over / under shoot.
8. Parameters are guaranteed by design and characterization. Not 100% tested in production.
9. Maximum and minimum input reference is limited by the VCO lock range.
10. Outputs loaded with 30 pF each.

Package Drawing and Dimensions

32-Pin TQFP Outline Dimensions

Symbol	Inches			Millimeters		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.000	1.100	1.200	0.039	0.043	0.047
A ₁	0.950	1.000	1.050	0.037	0.039	0.041
D	8.950	9.000	9.050	0.352	0.354	0.356
D ₁	6.95	7.000	7.050	0.274	0.276	0.278
b	0.30	0.37	0.45	0.012	0.015	0.018
e	0.80 BSC			0.031 BSC		
L	0.45	0.600	0.75	0.018	0.024	0.030

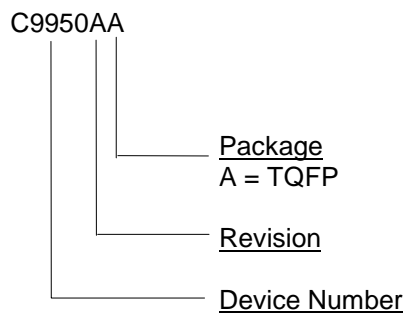
Ordering Information

Part Number ^[11]	Package Type	Production Flow
C9950AA	32-Pin TQFP	Industrial, -40°C to +85°C

Note:

11. The ordering part number is formed by a combination of device number, device revision, package style, and screening as shown below.

Marking: Example: Cypress
C9950AA
Date Code, Lot #



Document Title: C9950 3.3V, 180-MHz, Multi-Output Clock Driver				
Document Number: 38-07072				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	107108	06/11/01	IKA	Convert from IMI to Cypress
*A	108125	07/03/01	NDP	Delete Pull Down in Pin 10, 30, & 32 and Pull Up in Pin 3, 4, 4, 5, 6, & 31(See page 2)
*B	109802	02/08/02	DSG	Convert from Word to Frame
*C	122757	12/22/02	RBI	Add power up requirements to maximum ratings information