

3.3 V Differential ECL/PECL PLL Clock Generator

The MPC9992 is a 3.3 V compatible, PLL based PECL clock driver. Using SiGe technology and a fully differential design ensures optimum skew and PLL jitter performance. The performance of the MPC9992 makes the device ideal for workstation, mainframe computer and telecommunication applications. With output frequencies up to 400 MHz and output skews less than 100 ps the device meets the needs of the most demanding clock applications. The MPC9992 offers a differential PECL input and a crystal oscillator interface. All control signals are LVCMOS compatible.

Features

- 7 differential outputs, PLL based clock generator
- SiGe technology supports minimum output skew (max. 100 ps)
- Supports up to two generated output clock frequencies with a maximum clock frequency up to 400 MHz
- Selectable crystal oscillator interface and PECL compatible clock input
- SYNC pulse generation
- PECL compatible differential clock inputs and outputs
- Single 3.3 V (PECL) supply
- Ambient temperature range 0°C to +70°C
- Standard 32 lead LQFP package
- Pin and function compatible to the MPC992
- 32-lead Pb-free Package Available

Functional Description

The MPC9992 utilizes PLL technology to frequency lock its outputs onto an input reference clock. The reference clock frequency and the divider for the feedback path determine the VCO frequency. Both must be selected to match the VCO frequency range. The MPC9992 features frequency programmability between the three output banks outputs as well as the output to input relationships. Output frequency ratios of 2:1, 3:1, 3:2 and 5:2 can be realized. The two banks of outputs and the feedback frequency divider can be programmed by the FSEL[2:0] pins of the device. The VCO_SEL pin provides an extended PLL input reference frequency range.

The SYNC pulse generator monitors the phase relationship between the QA[3:0] and QB[2:0] output banks. The SYNC generator output signals the coincident edges of the two output banks. This feature is useful for non binary relationships between output frequencies.

The REF_SEL pin selects the differential PECL compatible input pair or crystal oscillator interface as the reference clock signal. The PLL_EN control selects the PLL bypass configuration for test and diagnosis. In this configuration, the selected input reference clock is routed directly to the output dividers bypassing the PLL. The PLL bypass is fully static and the minimum clock frequency specification and all other PLL characteristics do not apply.

The MPC9992 requires an external reset signal for start-up and for PLL recovery in case the reference input is interrupted. Assertion of the reset signal forces all outputs to the logic low state.

The MPC9992 is fully 3.3 V compatible and requires no external loop filter components. The differential clock input (PCLK) is PECL compatible and all control inputs accept LVCMOS compatible signals while the outputs provide PECL compatible levels with the capability to drive terminated 50 Ω transmission lines.

The device is pin and function compatible to the MPC992 and is packaged in a 32-lead LQFP package.

MPC9992

**3.3 V DIFFERENTIAL
ECL/PECL
CLOCK GENERATOR**



**FA SUFFIX
32-LEAD LQFP PACKAGE
CASE 873A-04**



**AC SUFFIX
32-LEAD LQFP PACKAGE
Pb-FREE PACKAGE
CASE 873A-04**

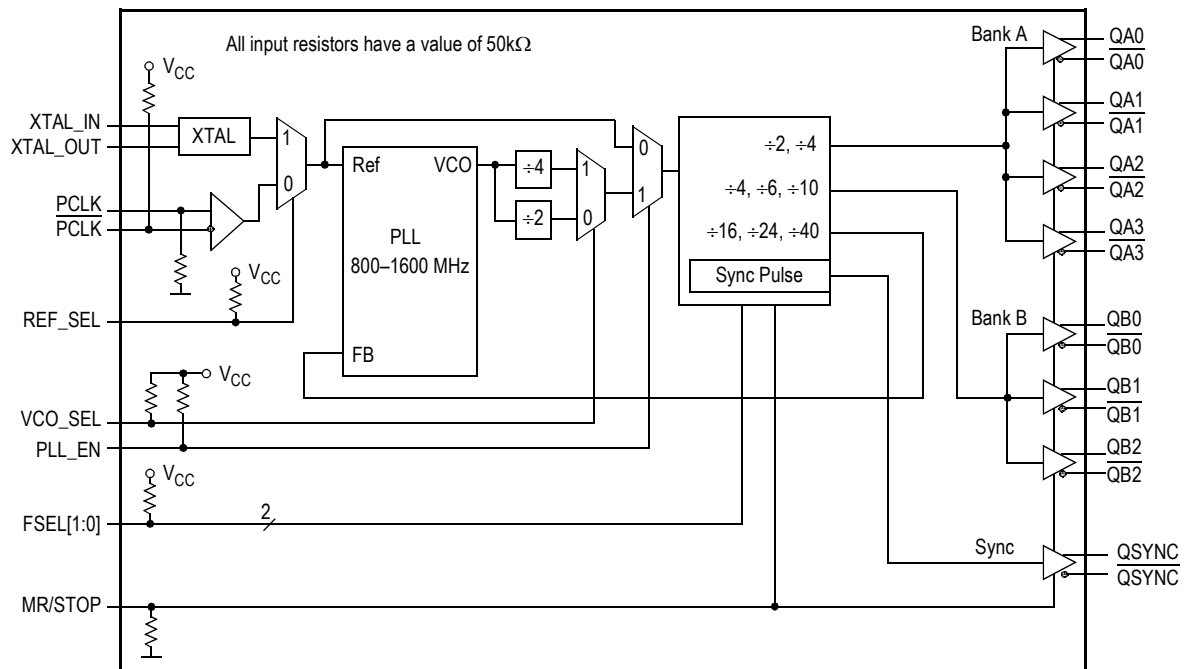


Figure 1. MPC9992 Logic Diagram

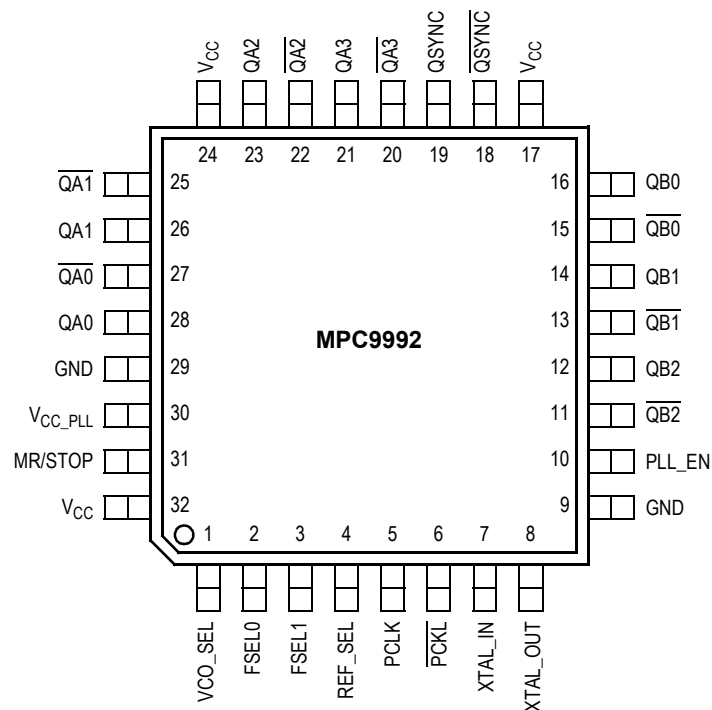


Figure 2. MPC9992 32-Lead Package Pinout (Top View)

Table 1. MPC9992 PLL Configurations

VCO_SEL	FSEL_0	FSEL_1	f _{REF} (MHz)	QA[3:0] (N _A)	QB[2:0] (N _B)	Frequency Ratio QA to QB	Internal Feedback (M · VCO_SEL)
0	0	0	16.6–33.3	VCO÷8 (6 · f _{REF})	VCO÷12 (4 · f _{REF})	3÷2	VCO÷48
0	0	1	25–50	VCO÷4 (8 · f _{REF})	VCO÷8 (4 · f _{REF})	2÷1	VCO÷32
0	1	0	10–20	VCO÷8 (10 · f _{REF})	VCO÷20 (4 · f _{REF})	5÷2	VCO÷80
0	1	1	16.6–33.3	VCO÷4 (12 · f _{REF})	VCO÷12 (4 · f _{REF})	3÷1	VCO÷48
1	0	0	8.3–16.6	VCO÷16 (6 · f _{REF})	VCO÷24 (4 · f _{REF})	3÷2	VCO÷96
1	0	1	12.5–25	VCO÷8 (8 · f _{REF})	VCO÷16 (4 · f _{REF})	2÷1	VCO÷64
1	1	0	5–10	VCO÷16 (10 · f _{REF})	VCO÷40 (4 · f _{REF})	5÷2	VCO÷160
1	1	1	8.3–16.6	VCO÷8 (12 · f _{REF})	VCO÷24 (4 · f _{REF})	3÷1	VCO÷96

Table 2. Function Table (Configuration Controls)

Control	Default	0	1
REF_SEL	1	Selects PCLK, PCLK as PLL references signal input	Selects the crystal oscillator as PLL reference signal input
VCO_SEL	1	Selects VCO÷2. The VCO frequency is scaled by a factor of 2 (high input frequency range)	Selects VCO÷4. The VCO frequency is scaled by a factor of 4 (low input frequency range).
PLL_EN	1	Test mode with the PLL bypassed. The reference clock is substituted for the internal VCO output. MPC9992 is fully static and no minimum frequency limit applies. All PLL related AC characteristics are not applicable.	Normal operation mode with PLL enabled.
MR/STOP	0	Normal operation	Reset of the device and output disable (output clock stop). The outputs are stopped in logic low state: Qx=L, Qx=H. The minimum reset period should be greater than one reference clock cycle.

VCO_SEL and FSEL[1:0] control the operating PLL frequency range and input/output frequency ratios.

See Table 1 for the device frequency configuration.

Table 3. Pin Configuration

Pin	I/O	Type	Function
PCLK, PCLK	Input	PECL	Differential reference clock signal input
XTAL_IN, XTAL_OUT		Analog	Crystal oscillator interface
VCO_SEL	Input	LVC MOS	VCO operating frequency select
PLL_EN	Input	LVC MOS	PLL Enable/Bypass mode select
REF_SEL	Input	LVC MOS	PLL reference signal input select
MR/STOP	Input	LVC MOS	Device reset and output clock disable (stop in logic low state)
FSEL[1:0]	Input	LVC MOS	Output and PLL feedback frequency divider select
QA[0-3], QA[0-3]	Output	PECL	Differential clock outputs (bank A)
QB[0-2], QB[0-2]	Output	PECL	Differential clock outputs (bank B)
QSYNC, QSYNC	Output	PECL	Differential clock outputs (bank C)
GND	Supply	GND	Negative power supply
V _{CC}	Supply	V _{CC}	Positive power supply. All V _{CC} pins must be connected to the positive power supply for correct DC and AC operation
V _{CC_PLL}	Supply	V _{CC}	PLL positive power supply (analog power supply). It is recommended to use an external RC filter for the analog power supply pin V _{CC_PLL} . Please see applications section for details

Table 4. Absolute Maximum Ratings⁽¹⁾

Symbol	Characteristics	Min	Max	Unit	Condition
V _{CC}	Supply Voltage	−0.3	3.9	V	
V _{IN}	DC Input Voltage	−0.3	V _{CC} +0.3	V	
V _{OUT}	DC Output Voltage	−0.3	V _{CC} +0.3	V	
I _{IN}	DC Input Current		±20	mA	
I _{OUT}	DC Output Current		±50	mA	
T _S	Storage Temperature	−65	125	°C	

1. Absolute maximum continuous ratings are those maximum values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation at absolute-maximum-rated conditions is not implied.

Table 5. General Specifications

Symbol	Characteristics	Min	Typ	Max	Unit	Condition
V _{TT}	Output Termination Voltage		V _{CC} − 2		V	
MM	ESD Protection (Machine Model)	175			V	
HBM	ESD Protection (Human Body Model)	2000			V	
CDM	ESD Protection (Charged Device Model)	1000			V	
LU	Latch-Up Immunity	200			mA	
C _{IN}	Input Capacitance		4.0		pF	Inputs
θ _{JA}	Thermal Resistance Junction to Ambient JESD 51-3, single layer test board		83.1 73.3 68.9 63.8 57.4	86.0 75.4 70.9 65.3 59.6	°C/W	Natural convection 100 ft/min 200 ft/min 400 ft/min 800 ft/min
	JESD 51-6, 2S2P multilayer test board		59.0 54.4 52.5 50.4 47.8	60.6 55.7 53.8 51.5 48.8	°C/W	Natural convection 100 ft/min 200 ft/min 400 ft/min 800 ft/min
θ _{JC}	Thermal Resistance Junction to Case		23.0	26.3	°C/W	MIL-SPEC 883E Method 1012.1
T _J	Operating Junction Temperature ⁽¹⁾ (continuous operation) MTBF = 9.1 years	0		110	°C	

1. Operating junction temperature impacts device life time. Maximum continuous operating junction temperature should be selected according to the application life time requirements (See application note AN1545 for more information). The device AC and DC parameters are specified up to 110°C junction temperature allowing the MPC9992 to be used in applications requiring industrial temperature range. It is recommended that users of the MPC9992 employ thermal modeling analysis to assist in applying the junction temperature specifications to their particular application.

Table 6. DC Characteristics ($V_{CC} = 3.3 \text{ V} \pm 5\%$, $GND = 0\text{V}$, $T_A = 0^\circ\text{C}$ to 70°C)

Symbol	Characteristics	Min	Typ	Max	Unit	Condition
Differential PECL Clock Inputs (\overline{PCLK} , \overline{PCLK}) ⁽¹⁾						
V_{PP}	AC Differential Input Voltage ⁽²⁾	0.2		1.3	V	Differential operation
V_{CMR}	Differential Cross Point Voltage ⁽³⁾	1.0		$V_{CC}-0.3$	V	Differential operation
I_{IN}	Input Current ⁽⁴⁾			± 120	μA	$V_{IN} = V_{CC}$ or GND
LVCMOS Control Inputs (VCO_SEL , PLL_EN , $MR/STOP$, REF_SEL , $FSEL[1:0]$)						
V_{IH}	Input High Voltage	2.0		$V_{CC} + 0.3$	V	LVCMOS
V_{IL}	Input Low Voltage			0.8	V	LVCMOS
I_{IN}	Input Current ⁽⁴⁾			± 120	μA	$V_{IN} = V_{CC}$ or GND
PECL Clock Outputs ($QA[3:0]$, $\overline{QA}[3:0]$, $QB[2:0]$, $\overline{QB}[2:0]$, $QSYNC$, \overline{QSYNC})						
V_{OH}	Output High Voltage	$V_{CC}-1.025$		$V_{CC}-0.880$	V	$I_{OH} = -30 \text{ mA}$
V_{OL}	Output Low Voltage	$V_{CC}-1.920$		$V_{CC}-1.620$	V	$I_{OL} = -5 \text{ mA}$
Supply Current and Voltage						
V_{CC_PLL}	PLL Supply Voltage	2.955		V_{CC}	V	V_{CC_PLL} pin
I_{CC_PLL}	Maximum PLL Supply Current		9.0	12	mA	V_{CC_PLL} pin
$I_{GND}^{(5)}$	Maximum Supply Current		80	110	mA	GND pins

1. V_{PP} (DC) is the minimum differential input voltage swing required to maintain device functionality.
2. V_{CMR} (DC) is the crosspoint of the differential input signal. Functional operation is obtained when the crosspoint is within the V_{CMR} (DC) range and the input swing lies within the V_{PP} (DC) specification.
3. Inputs have pull-down resistors affecting the input current.
4. Equivalent to a termination of 50Ω to V_{TT} .
5. Does not include output drive current which is dependant on output termination methods.

Table 7. AC Characteristics ($V_{CC} = 3.3 \text{ V} \pm 5\%$, $\text{GND} = 0 \text{ V}$, $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$)⁽¹⁾

Symbol	Characteristics	Min	Typ	Max	Unit	Condition
f_{ref}	Input Reference Frequency $\div 32$ feedback	25.0		50.0	MHz	PLL locked
	$\div 48$ feedback	16.67		33.3	MHz	
	$\div 64$ feedback	12.5		25.0	MHz	
	$\div 80$ feedback	10.0		20.0	MHz	
	$\div 96$ feedback	8.33		16.67	MHz	
	$\div 160$ feedback	5.0		10.0	MHz	
	Input Reference Frequency in PLL Bypass Mode ⁽²⁾			400	MHz	PLL bypass
f_{XTAL}	Crystal Interface Frequency Range ⁽³⁾	10		20	MHz	
f_{VCO}	VCO Frequency Range ⁽⁴⁾	800		1600	MHz	
f_{MAX}	Output Frequency $\div 4$ output	200.0		400.0	MHz	PLL locked
	$\div 8$ output	100.0		200.0	MHz	
	$\div 12$ output	66.6		133.3	MHz	
	$\div 16$ output	50.0		100.0	MHz	
	$\div 20$ output	40.0		80.0	MHz	
	$\div 24$ output	33.3		66.6	MHz	
	$\div 48$ output	16.6		33.3	MHz	
V_{PP}	Differential Input Voltage ⁽⁵⁾ (peak-to-peak)	0.3		1.3	V	
V_{CMR}	Differential Input Crosspoint Voltage ⁽⁶⁾ (PCLK)	1.2		$V_{\text{CC}} - 0.3$	V	
$V_{\text{O(P-P)}}$	Differential Output Voltage (peak-to-peak) (PCLK)	0.6	0.8		V	
$t_{\text{PW,MIN}}$	Input Reference Pulse Width ⁽⁷⁾	2.0			ns	
$t_{\text{sk(O)}}$	Output-to-Output Skew			100	ps	
DC	Output Duty Cycle ⁽⁸⁾	48	50	52	%	
$t_{\text{JIT(CC)}}$	Cycle-to-Cycle Jitter ⁽⁹⁾		30	79	ps	
$t_{\text{JIT(PER)}}$	Period Jitter ⁽⁹⁾		43	106	ps	
$t_{\text{JIT}(\varnothing)}$	I/O Phase Jitter ⁽⁹⁾ RMS (1σ) ⁽¹⁰⁾		86	212	ps	
BW	PLL Closed Loop Bandwidth ⁽¹¹⁾	$\div 32$ feedback	0.60-1.5		MHz	
		$\div 48$ feedback	0.40-1.2		MHz	
		$\div 64$ feedback	0.30-1.0		MHz	
		$\div 80$ feedback	0.30-0.8		MHz	
		$\div 96$ feedback	0.20-0.7		MHz	
		$\div 160$ feedback	0.15-0.4		MHz	
t_{LOCK}	Maximum PLL Lock Time			10	ms	
t_r, t_f	Output Rise/Fall Time	0.05		1.0	ns	20% to 80%

- AC characteristics apply for parallel output termination of 50Ω to V_{TT} .
- In bypass mode, the MPC9992 divides the input reference clock.
- The crystal frequency range must both meet the interface frequency range and VCO lock range divided by the feedback divider ratio:
 $f_{\text{XTAL}(\text{min, max})} = f_{\text{VCO}(\text{min, max})} \div (M \cdot \text{VCO_SEL})$ and $10 \text{ MHz} \leq f_{\text{XTAL}} \leq 20 \text{ MHz}$.
- The input reference frequency must match the VCO lock range divided by the total feedback divider ratio: $f_{\text{ref}} = f_{\text{VCO}} \div (M \cdot \text{VCO_SEL})$
- V_{PP} is the minimum differential input voltage swing required to maintain AC characteristics.
- V_{CMR} (AC) is the crosspoint of the differential input signal. Normal AC operation is obtained when the crosspoint is within the V_{CMR} (AC) range and the input swing lies within the V_{PP} (AC) specification.
- Calculation of reference duty cycle limits: $\text{DC}_{\text{REF,MIN}} = t_{\text{PW,MIN}} \cdot f_{\text{REF}} \cdot 100\%$ and $\text{DC}_{\text{REF,MAX}} = 100\% - \text{DC}_{\text{REF,MIN}}$. E.g. at $f_{\text{REF}} = 50 \text{ MHz}$ the input duty cycle range is $10\% < \text{DC} < 90\%$.
- Output duty cycle for QAx and QBx outputs. The pulse width for the QSYNC output is equal to one QAx output period $t_{\text{QA}} \pm 5\%$.
- Jitter data is valid $f_{\text{ref}} = 25 \text{ MHz}$.
- See application section for a jitter calculation for other confidence factors than 1σ .
- 3 dB point of PLL transfer characteristics.

APPLICATIONS INFORMATION

SYNC Output Description

The MPC9992 has a system synchronization pulse output QSYNC. In configurations with the output frequency relationships are not integer multiples of each other QSYNC provides a signal for system synchronization purposes. The MPC9992 monitors the relationship between the A bank and

the B bank of outputs. The QSYNC output is asserted (logic high) one QA period in duration. The placement of the pulse is dependent on the QA and QB output frequencies ratio. [Figure 3](#) shows the waveforms for the QSYNC output. The QSYNC output is defined for all possible combinations of the bank A and bank B outputs.

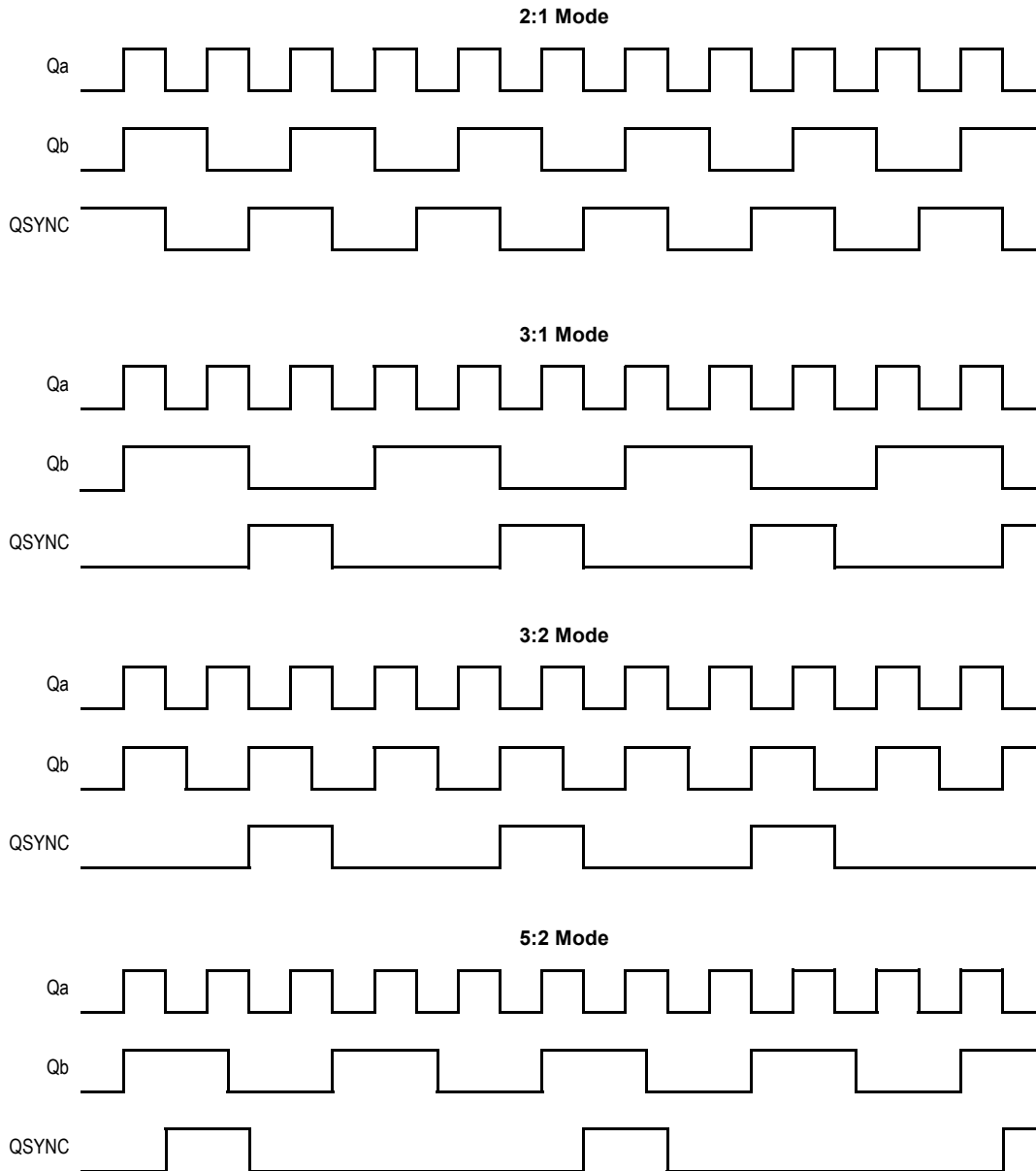


Figure 3. QSYNC Timing Diagram

Power Supply Filtering

The MPC9992 is a mixed analog/digital product. Its analog circuitry is naturally susceptible to random noise, especially if this noise is seen on the power supply pins. Random noise on the V_{CC_PLL} power supply impacts the device characteristics, for instance I/O jitter. The MPC9992 provides separate power supplies for the output buffers (V_{CC}) and the phase-locked loop (V_{CC_PLL}) of the device. The purpose of this design technique is to isolate the high switching noise digital outputs from the relatively sensitive internal analog phase-locked loop. In a digital system environment where it is more difficult to minimize noise on the power supplies a second level of isolation may be required. The simple but effective form of isolation is a power supply filter on the V_{CC_PLL} pin for the MPC9992. [Figure 4](#) illustrates a typical power supply filter scheme. The MPC9992 frequency and phase stability is most susceptible to noise with spectral content in the 100 kHz to 20 MHz range. Therefore the filter should be designed to target this range. The key parameter that needs to be met in the final filter design is the DC voltage drop across the series filter resistor R_F . From the data sheet the I_{CC_PLL} current (the current sourced through the V_{CC_PLL} pin) is typically 9 mA (12 mA maximum), assuming that a minimum of 2.955 V must be maintained on the V_{CC_PLL} pin. The resistor R_F shown in [Figure 4](#) must have a resistance of 10-15 Ω to meet the voltage drop criteria.

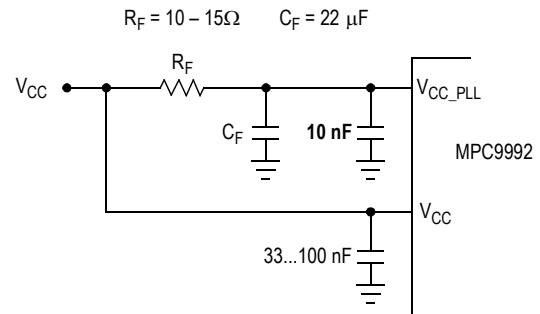


Figure 4. V_{CC_PLL} Power Supply Filter

The minimum values for R_F and the filter capacitor C_F are defined by the required filter characteristics: the RC filter should provide an attenuation greater than 40 dB for noise whose spectral content is above 100 kHz. In the example RC filter shown in [Figure 4](#), the filter cut-off frequency is around 3-5 kHz and the noise attenuation at 100 kHz is better than 42 dB.

As the noise frequency crosses the series resonant point of an individual capacitor its overall impedance begins to look inductive and thus increases with increasing frequency. The parallel capacitor combination shown ensures that a low impedance path to ground exists for frequencies well above the bandwidth of the PLL. Although the MPC9992 has several design features to minimize the susceptibility to power supply noise (isolated power and grounds and fully differential PLL) there still may be applications in which overall performance is being degraded due to system power supply noise. The power supply filter schemes discussed in this section should be adequate to eliminate power supply noise related problems in most designs.

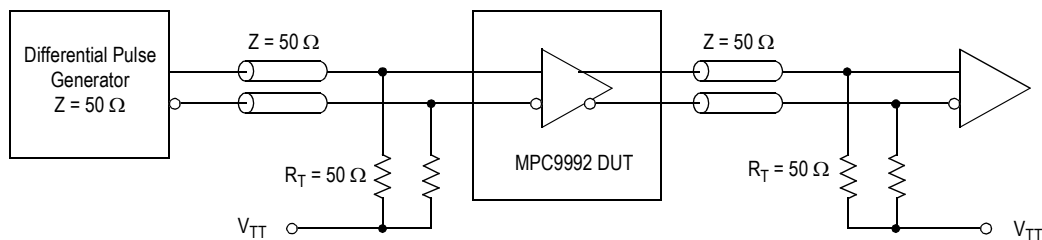
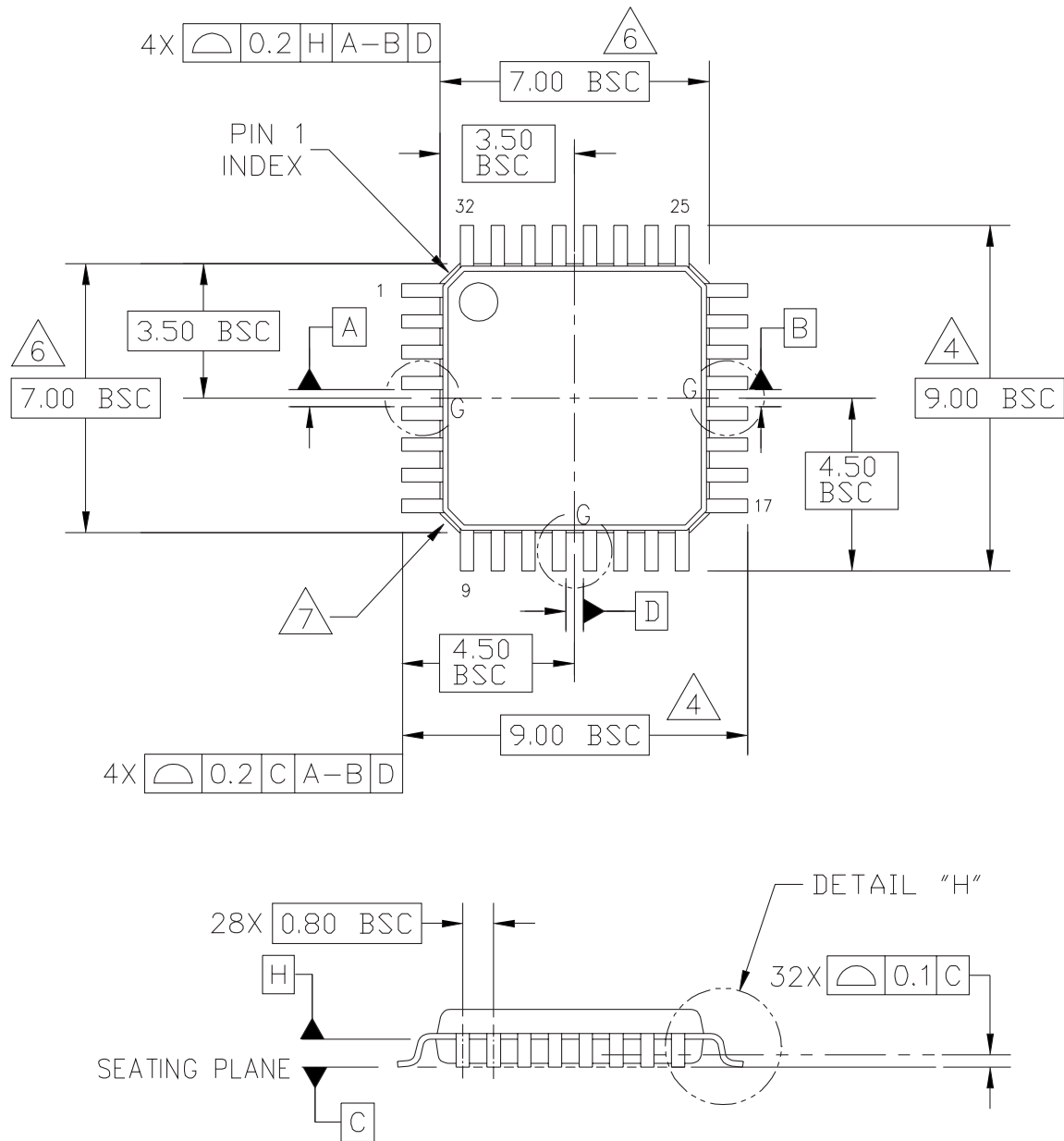


Figure 5. MPC9992 AC Test Reference

PACKAGE DIMENSIONS



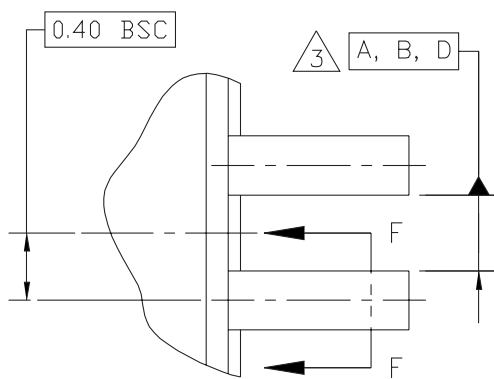
© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE
TITLE: LOW PROFILE QUAD FLAT PACK (LQFP) 32 LEAD, 0.8 PITCH (7 X 7 X 1.4)	DOCUMENT NO: 98ASH70029A	REV: C
	CASE NUMBER: 873A-04	01 APR 2005
	STANDARD: JEDEC MS-026 BBA	

PAGE 1 OF 3

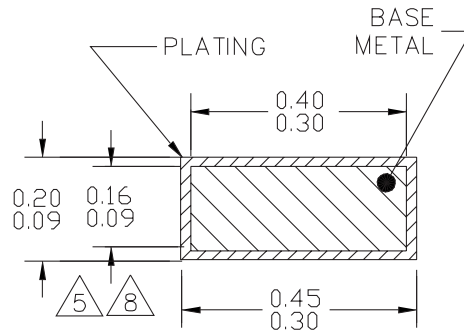
**CASE 873A-04
ISSUE C
32-LEAD LQFP PACKAGE**

MPC9992

PACKAGE DIMENSIONS

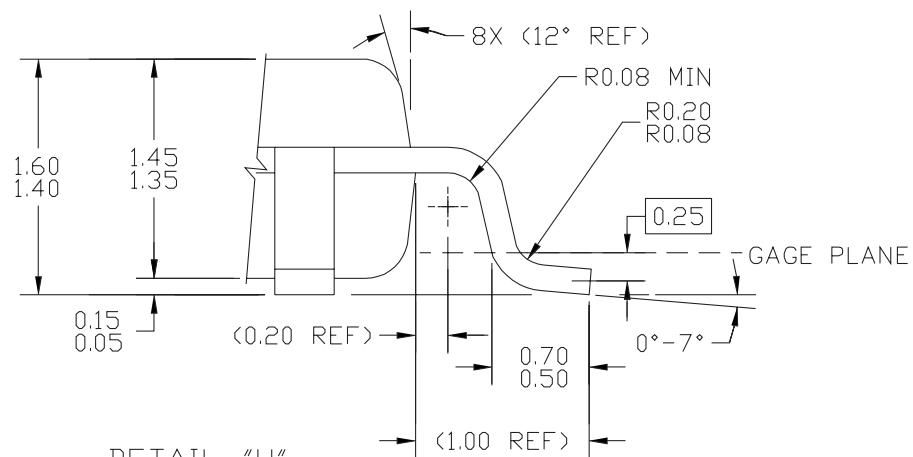


DETAIL G



$\oplus 0.2 \text{ (M)} \text{ C A-B D}$

SECTION F-F
ROTATED 90°CW
32 PLACES



DETAIL "H"

© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: LOW PROFILE QUAD FLAT PACK (LQFP) 32 LEAD, 0.8 PITCH (7 X 7 X 1.4)	DOCUMENT NO: 98ASH70029A		REV: C
	CASE NUMBER: 873A-04		01 APR 2005
	STANDARD: JEDEC MS-026 BBA		

PAGE 2 OF 3

**CASE 873A-04
ISSUE C
32-LEAD LQFP PACKAGE**

PACKAGE DIMENSIONS

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5–1994.
3. DATUMS A, B, AND D TO BE DETERMINED AT DATUM PLANE H.
4. DIMENSIONS TO BE DETERMINED AT SEATING PLANE DATUM C.
5. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED THE MAXIMUM DIMENSION BY MORE THAN 0.08 MM. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSION AND ADJACENT LEAD OR PROTRUSION: 0.07 MM.
6. DIMENSIONS DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25 MM PER SIDE. DIMENSIONS ARE MAXIMUM PLASTIC BODY SIZE DIMENSIONS INCLUDING MOLD MISMATCH.
7. EXACT SHAPE OF EACH CORNER IS OPTIONAL.
8. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.1 MM AND 0.25 MM FROM THE LEAD TIP.

© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: LOW PROFILE QUAD FLAT PACK (LQFP) 32 LEAD, 0.8 PITCH (7 X 7 X 1.4)	DOCUMENT NO: 98ASH70029A		REV: C
	CASE NUMBER: 873A-04		01 APR 2005
	STANDARD: JEDEC MS-026 BBA		

PAGE 3 OF 3

**CASE 873A-04
ISSUE C
32-LEAD LQFP PACKAGE**

MPC9992

How to Reach Us:

Home Page:

www.freescale.com

E-mail:

support@freescale.com

USA/Europe or Locations Not Listed:

Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
+1-800-521-6274 or +1-480-768-2130
support@freescale.com

Europe, Middle East, and Africa:

Freescale Halbleiter Deutschland GmbH
Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
+44 1296 380 456 (English)
+46 8 52200080 (English)
+49 89 92103 559 (German)
+33 1 69 35 48 48 (French)
support@freescale.com

Japan:

Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064
Japan
0120 191014 or +81 3 5437 9125
support.japan@freescale.com

Asia/Pacific:

Freescale Semiconductor Hong Kong Ltd.
Technical Information Center
2 Dai King Street
Tai Po Industrial Estate
Tai Po, N.T., Hong Kong
+800 2666 8080
support.asia@freescale.com

For Literature Requests Only:

Freescale Semiconductor Literature Distribution Center
P.O. Box 5405
Denver, Colorado 80217
1-800-441-2447 or 303-675-2140
Fax: 303-675-2150
LDCForFreescaleSemiconductor@hibbertgroup.com

Information in this document is provided solely to enable system and software implementers to use Freescale Semiconductor products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits or integrated circuits based on the information in this document.

Freescale Semiconductor reserves the right to make changes without further notice to any products herein. Freescale Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in Freescale Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals", must be validated for each customer application by customer's technical experts. Freescale Semiconductor does not convey any license under its patent rights nor the rights of others. Freescale Semiconductor products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Freescale Semiconductor product could create a situation where personal injury or death may occur. Should Buyer purchase or use Freescale Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold Freescale Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Freescale Semiconductor was negligent regarding the design or manufacture of the part.

Freescale™ and the Freescale logo are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.

© Freescale Semiconductor, Inc. 2005. All rights reserved.

