



GENERAL DESCRIPTION

The M908-01 is a PLL (Phase Locked Loop) based clock generator that uses an internal VCSO (Voltage Controlled SAW Oscillator) to produce a very low jitter output clock. It is ideal for Gigabit Ethernet. An output clock frequency of 156.25MHz (with the M908-01-156.2500) is provided from eight LVPECL clock output pairs. The accuracy of the output frequency is assured by the internal PLL that phase-locks the internal VCSO to the reference input frequency (25MHz for the M908-01-156.2500). The input reference can either be an external crystal, utilizing the internal crystal oscillator, or a stable external clock source such as a packaged crystal oscillator.



PIN ASSIGNMENT (9 x 9 mm SMT)

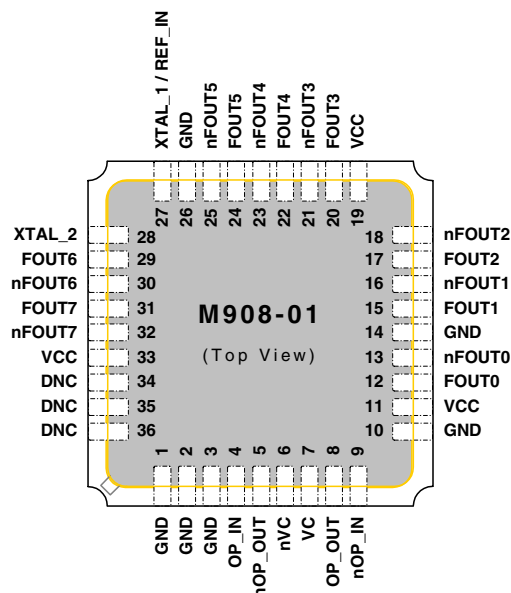


Figure 1: Pin Assignment

FEATURES

- ◆ 156.25MHz output clock frequency (M908-01-156.2500)
- ◆ Eight identical LVPECL output pairs
- ◆ Jitter 0.7ps RMS (over 12kHz-20MHz)
- ◆ Ideal for Gigabit Ethernet clock reference
- ◆ Output-to-output skew < 100ps
- ◆ External XTAL or LVCMOS reference input
- ◆ Integrated SAW (surface acoustic wave) delay line
- ◆ Single 3.3V power supply
- ◆ Small 9 x 9 mm SMT (surface mount) package

Output Frequency Configuration (M908-01-156.25)

Ref Clock Frequency (MHz)	PLL Ratio	Output Frequency (MHz)	Application
25	25/4	156.25	Gigabit Ethernet

Table 1: Output Frequency Configuration (M908-01-156.25)

SIMPLIFIED BLOCK DIAGRAM

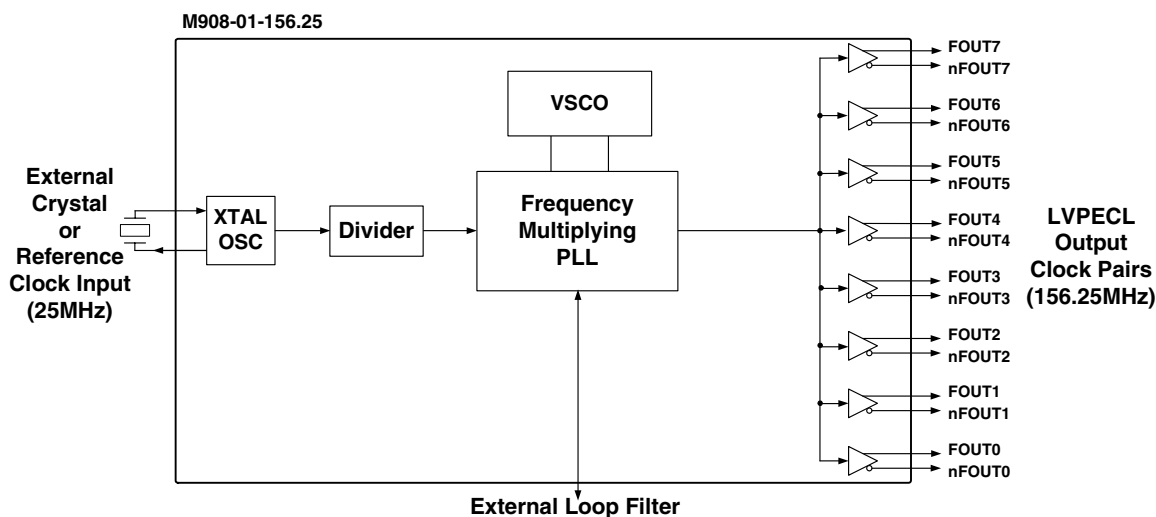


Figure 2: Simplified Block Diagram



DETAILED BLOCK DIAGRAM

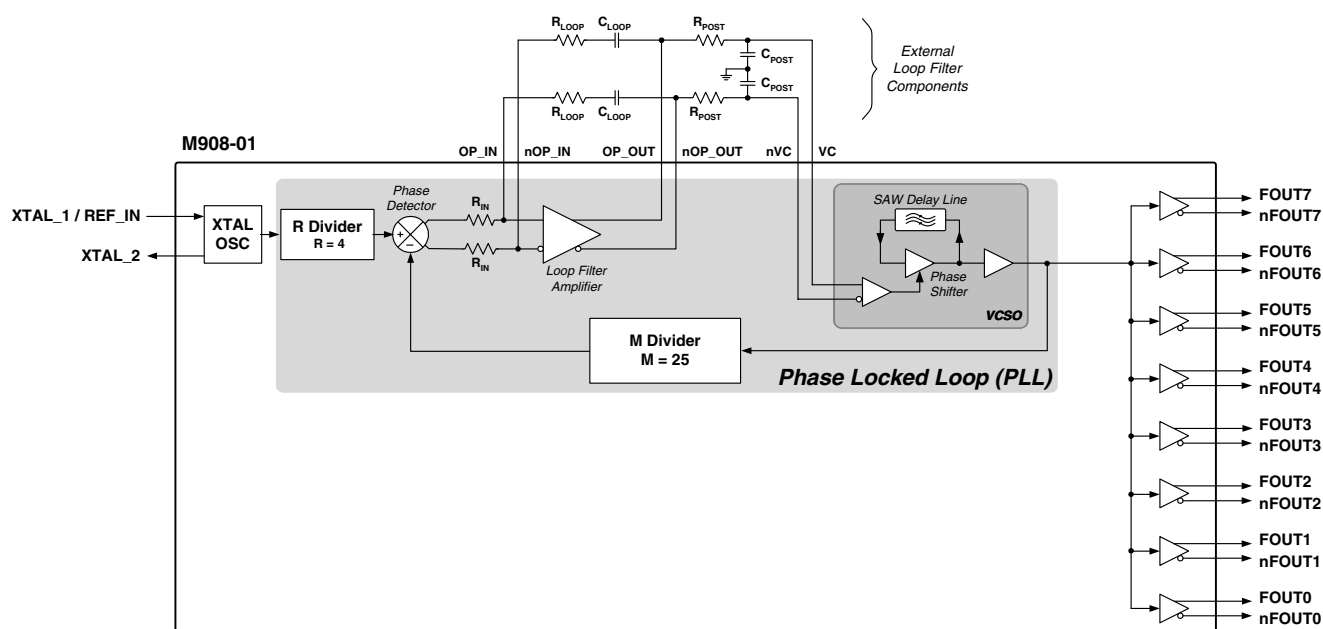


Figure 3: Detailed Block Diagram

PIN DESCRIPTIONS

Number	Name	I/O	Configuration	Description
1,2,3,10,14,26	GND	Ground	—	Power supply ground.
4,9	OP_IN, nOP_IN	Input		
5,8	nOP_OUT, OP_OUT	Output		Used for external loop filter. See Figure 4 .
6, 7	nVC, VC	Input		
11,19,33	VCC	Power		Power supply connection, connect to +3.3V
12,13	FOUT0, nFOUT0	Output	No internal terminator	Clock output pairs, differential LVPECL output (156.25 MHz for the M908-01-156.2500)
15,16	FOUT1, nFOUT1			
17,18	FOUT2, nFOUT2			
20,21	FOUT3, nFOUT3			
22,23	FOUT4, nFOUT4			
24,25	FOUT5, nFOUT5			
29,30	FOUT6, nFOUT6			
31,32	FOUT7, nFOUT7			
27	XTAL_1 / REF_IN	Input		External crystal connection. Also accepts LVCMOS/LVTTL compatible clock source.
28	XTAL_2	Input		External crystal connection. Leave unconnected when driving pin 27 with external clock reference.
34,35,36	DNC			Do Not Connect. Internal test pins.

Table 2: Pin Descriptions



FUNCTIONAL DESCRIPTION

The M908-01 is a PLL (Phase Locked Loop) based clock generator that generates output clocks synchronized to an input reference clock.

The M908-01 combines the flexibility of a VCSO (Voltage Controlled SAW Oscillator) with the stability of a crystal oscillator.

Input Reference

The 25MHz input reference can either be an external, discrete crystal device or a stable external clock source such as a packaged crystal oscillator:

- If an external crystal is used with the on-chip crystal oscillator circuit (XTAL OSC), the external crystal should be a parallel-resonant, fundamental mode crystal. Apply it to the XTAL_1 / REF_IN and XTAL_2 input pins. External crystal load capacitors are also required.
- If an external LVCMOS/LVTTL clock source is used, apply it to the XTAL_1 / REF_IN input pin.

In either case, the reference clock is supplied to the phase detector of the PLL. The M908-01 includes a reference divider that divides the input reference frequency by a fixed value "R" and provides the result to the phase detector.

The PLL

The PLL (Phase Locked Loop) includes the phase detector, the VCSO, a feedback divider (labeled "M Divider"), and a reference divider ("R Divider").

The feedback divider divides the VCSO output frequency by a fixed value "M" to match the reference frequency provided to the phase detector by the reference divider.

By controlling the frequency and phase of the VCSO, the phase detector precisely locks the frequency and phase of the feedback divider output to that of the reference divider output. This creates an output frequency that is a multiple of the reference frequency (which is output from the VCSO).

The relationship between the VCSO output frequency, the M Divider, the R Divider and the input reference frequency is defined as follows:

$$F_{\text{VCSO}} = F_{\text{XTAL}} \times \frac{M}{R}$$

For the M908-01-156.2500 (see "Ordering Information" on pg. 6):

- VCSO output frequency = 156.25MHz
- Input reference frequency = 25MHz
- M=25
- R= 4

Therefore, for the M908-01-156.2500:

$$156.25\text{MHz} = 25\text{MHz} \times \frac{25}{4}$$

The VCSO center output frequency of 156.25MHz enables the product of the input crystal frequency $\times \frac{M}{R}$ to fall within the lock range of the VCSO.

External Loop Filter

To provide stable PLL operation, and thereby a low jitter output clock, the M908-01 requires the use of an external loop filter. This is provided via the provided filter pins (see Figure 4).

Due to the differential signal path design, the implementation requires two identical complementary RC filters as shown here.

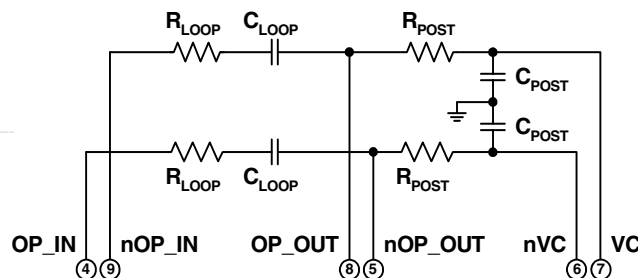


Figure 4: External Loop Filter

External Loop Filter Component Values

PLL Bandwidth	Damping Factor	R loop	C loop	R post	C post
500Hz	2.1	1.5kΩ	4.00μF	50kΩ	3300pF
1.5kHz	3.3	4.7kΩ	1.00μF	50kΩ	1500pF
6.4kHz	4.4	20kΩ	0.10μF	20kΩ	470pF
10.6kHz	4.2	33kΩ	0.033μF	20kΩ	470pF

Table 3: External Loop Filter Component Values

Note 1: Recommended for most applications



ABSOLUTE MAXIMUM RATINGS¹

Symbol	Parameter	Rating	Unit
V_I	Inputs	-0.5 to $V_{CC} + 0.5$	V
V_O	Outputs	-0.5 to $V_{CC} + 0.5$	
V_{CC}	Power Supply Voltage	4.6	
T_S	Storage Temperature	-45 to +100	°C

Table 4: Absolute Maximum Ratings

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These ratings are stress specifications only. Functional operation of product at these conditions or any conditions beyond those listed in [Recommended Conditions of Operation](#), [DC Characteristics](#), or [AC Characteristics](#) is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

RECOMMENDED CONDITIONS OF OPERATION

Symbol	Parameter	Min	Typ	Max	Unit
V_{CC}	Positive Supply Voltage	3.135	3.3	3.465	V
T_A	Ambient Operating Temperature	0		+70	°C

Table 5: Recommended Conditions of Operation



ELECTRICAL SPECIFICATIONS

DC Characteristics

Unless stated otherwise, $V_{CC} = 3.3 \text{ Volts} \pm 5\%$, $T_A = 0^\circ\text{C to } 70^\circ\text{C}$, Output Frequency=156.25MHz¹, Outputs terminated with 50Ω to $V_{CC} - 2V$

	Symbol	Parameter	Min	Typ	Max	Unit
Power Supply	V_{CC}	Positive Supply Voltage	3.135	3.3	3.465	V
	I_{CC}	Power Supply Current		350		mA
Reference Clock Input	V_{IH}	Input High Voltage	$(V_{CC}/2) + 0.5$		$V_{CC} + 0.3$	V
	V_{IL}	Input Low Voltage	-0.3		$(V_{CC}/2) + 0.5$	V
	I_{IH}	Input High Current			150	μA
	I_{IL}	Input Low Current	-5.0			μA
Crystal or Reference Clock Input	C_{IN}	Input Capacitance	XTAL_1 / REF_IN		4	pF
Differential Output	V_{OH}	Output High Voltage	$V_{CC} - 1.4$		$V_{CC} - 1.0$	V
	V_{OL}	Output Low Voltage	$V_{CC} - 2.0$		$V_{CC} - 1.7$	V
	V_{P-P}	Peak to Peak Output Voltage	0.6		0.85	V

Table 6: DC Characteristics

Note 1: For other VCSO center frequencies, contact ICS

AC Characteristics

Unless implied otherwise, $V_{CC} = 3.3 \text{ Volts} \pm 5\%$, $T_A = 0^\circ\text{C to } 70^\circ\text{C}$, Output Frequency=156.25MHz¹, Outputs terminated with 50Ω to $V_{CC} - 2V$

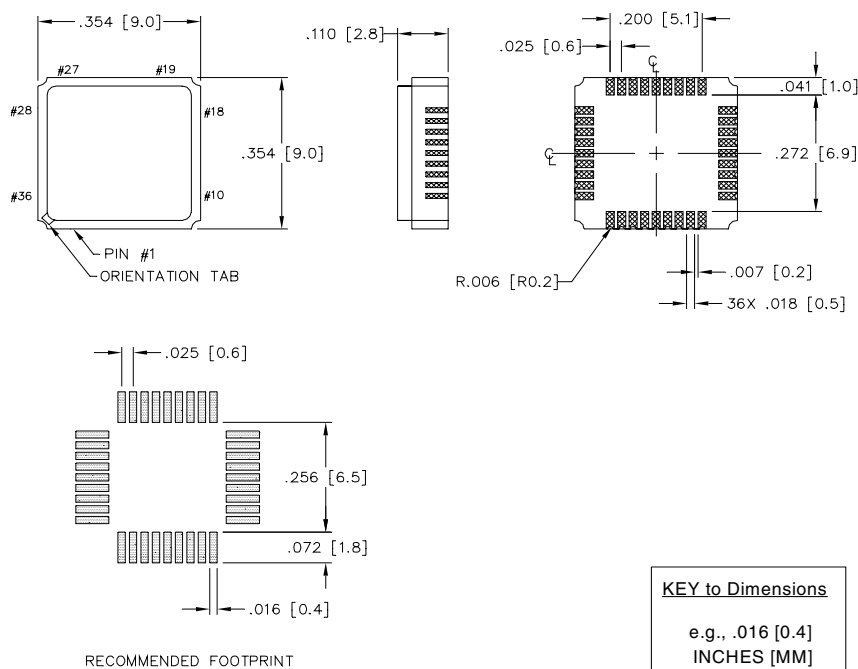
	Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions	
	F _{OUT}	Output Frequency Range	75	156.25	175	MHz		
	F _{IN}	Nominal Input Frequency, XTAL_1 / REF_IN		25		MHz		
	APR	VCSO Pull-Range	±100	±150		ppm		
Φ _n	Single Side Band Phase Noise @156.25MHz	1kHz Offset		-100		dBc/Hz		
		10kHz Offset		-110		dBc/Hz		
		100kHz Offset		-134		dBc/Hz		
	J(t)	Jitter (rms)		0.7	1.0	ps	12kHz to 20MHz	
	t _{DC}	Output Duty Cycle, High Time	45	50	55	%		
	t _R	Output Rise Time	F _{OUT} , nF _{OUT} (0-7)	350	450	550	ps	20% to 80%
	t _F	Output Fall Time	F _{OUT} , nF _{OUT} (0-7)	350	450	550	ps	20% to 80%
	t _S	Output Skew	Between Any Pair		100	ps		

Table 7: AC Characteristics

Note 1: For other VCSO center frequencies, contact ICS



PACKAGE - MECHANICAL DIMENSIONS



ORDERING INFORMATION

For Output Frequencies (MHz)	Order Part Number
156.25	M908-01-156.2500

Table 8: Ordering Information

Consult factory for frequency availability.

While the information presented herein has been checked for both accuracy and reliability, Integrated Circuit Systems (ICS) assumes no responsibility for either its use or for the infringement of any patents or other rights of third parties, which would result from its use. No other circuits, patents, or licenses are implied. This product is intended for use in normal commercial applications. Any other applications such as those requiring extended temperature range, high reliability, or other extraordinary environmental requirements are not recommended without additional processing by ICS. ICS reserves the right to change any circuitry or specifications without notice. ICS does not authorize or warrant any ICS product for use in life support devices or critical medical instruments.