



# 106.25MHz/212.5MHz/425MHz Clock Oscillators

**DS4106/DS4212/DS4425**

## General Description

The DS4106, DS4212, and DS4425 ceramic surface-mount crystal oscillators are part of Maxim's DS4-XO series crystal oscillators family. These devices offer output frequencies at 106.25MHz, 212.5MHz, and 425MHz. The clock oscillators are suited for systems with tight tolerances because of the jitter, phase noise, and stability performance. The small package provides a format made for applications where PCB space is critical.

These clock oscillators are crystal based and use a fundamental crystal with PLL technology to provide the final output frequencies. Each device is offered with LVDS or LVPECL output types. The output enable pin is active-high logic.

These clock oscillators have very low phase jitter and phase noise. Typical phase jitter is < 0.9psRMS from 12kHz to 20MHz. The devices are designed to operate with a 3.3V  $\pm$ 5% supply voltage, and are available in a 5.0mm x 3.2mm x 1.49mm, 10-pin LCCC surface-mount ceramic package.

## Applications

Fibre Channel Hard Disk Drives  
Host Bus Adapters  
Raid Controllers  
Fibre Channel Switches

**Pin Configuration and Selector Guide appear at end of data sheet.**

## Features

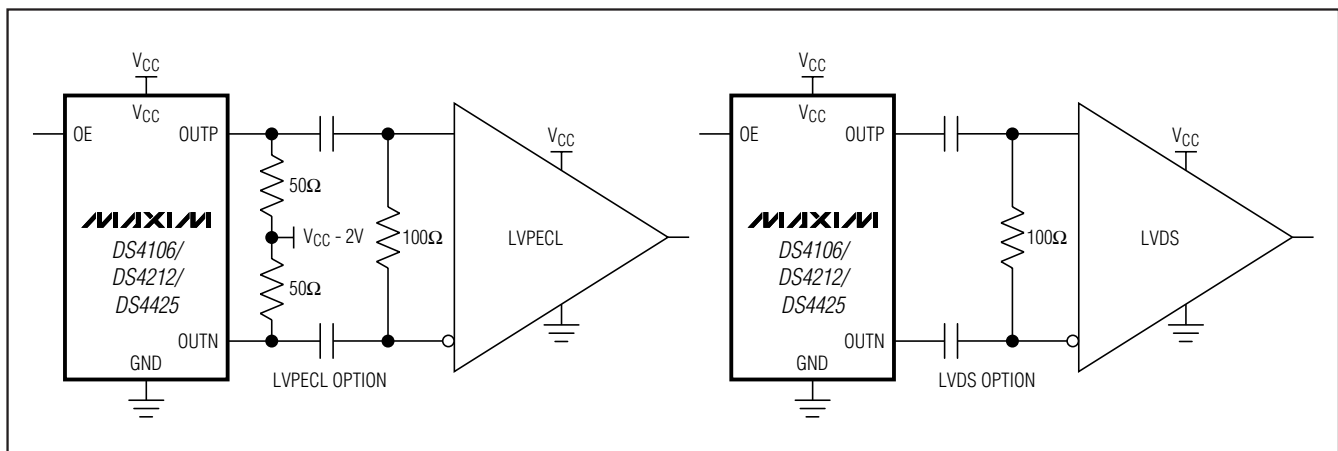
- ◆ **Clock Output Frequencies:**  
DS4106: 106.25MHz  
DS4212: 212.50MHz  
DS4425: 425.00MHz
- ◆ **Phase Jitter (RMS): 0.9ps Typical**
- ◆ **LVPECL or LVDS Output**
- ◆ **Supply Current:**  
50mA (Typical, Unloaded) at +3.3V Supply (LVPECL)  
53mA (Typical) at +3.3V Supply (LVDS)
- ◆ **-40°C to +85°C Temperature Range**
- ◆ **Output Disable**

## Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
DS4106AN+	-40°C to +85°C	10 LCCC
DS4106BN+	-40°C to +85°C	10 LCCC
DS4212AN+	-40°C to +85°C	10 LCCC
DS4212BN+	-40°C to +85°C	10 LCCC
DS4425AN+	-40°C to +85°C	10 LCCC
DS4425BN+	-40°C to +85°C	10 LCCC

+Denotes a lead-free package. The lead finish is JESD97 category e4 (Au over Ni) and is compatible with both lead-based and lead-free soldering processes.

## Typical Operating Circuits



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## ABSOLUTE MAXIMUM RATINGS

V<sub>CC</sub>, GND, OE, OUTP, OUTN .....-0.3V, +4V  
 Operating Temperature Range .....-40°C to +85°C  
 Junction Temperature .....+150°C

Storage Temperature Range .....-40°C to +125°C  
 Soldering Temperature Profile  
 (3 passes max) .....See IPC/JEDEC J-STD-020  
 Specification

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

## ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub> = 3.0V to 3.6V, T<sub>A</sub> = -40°C to +85°C, typical values are at V<sub>CC</sub> = +3.3V and T<sub>A</sub> = +25°C, unless otherwise noted.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V <sub>CC</sub>	(Note 2)	3.0	3.3	3.6	V
Supply Current	I <sub>CC</sub>	LVPECL (Note 3)		50	65	mA
		LVDS		53	67	
TTL Control Input-Voltage High (OE)	V <sub>IH</sub>	(Note 2)	2			V
TTL Control Input-Voltage Low (OE)	V <sub>IL</sub>	(Note 2)			0.8	V
Input Leakage Current	I <sub>IL</sub>		-50		+10	μA
<b>LVPECL OUTPUTS (Note 4)</b>						
Output High Voltage	V <sub>OH</sub>	(Note 2)	V <sub>CC</sub> - 1.085		V <sub>CC</sub> - 0.88	V
Output Low Voltage	V <sub>OL</sub>	(Note 2)	V <sub>CC</sub> - 1.825		V <sub>CC</sub> - 1.62	V
Output Leakage Current (Absolute)	I <sub>OL</sub>	OE = V <sub>IL</sub>		100		μA
<b>LVDS OUTPUTS (Figure 2)</b>						
LVDS Output High Voltage	V <sub>OH</sub>	(Note 2)			1.475	V
LVDS Output Low Voltage	V <sub>OL</sub>	(Note 2)	0.925			V
LVDS Differential Output Voltage	V <sub>OD</sub>		250		400	mV
LVDS Change in V <sub>OD</sub> for Complementary States	Δ V <sub>OD</sub>				25	
LVDS Offset Output Voltage (Output Common-Mode Voltage)	V <sub>OS</sub>	(Note 5)	1.125		1.275	V

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DS4106/DS4212/DS4425

## ELECTRICAL CHARACTERISTICS (continued)

(V<sub>CC</sub> = 3.0V to 3.6V, T<sub>A</sub> = -40°C to +85°C, typical values are at V<sub>CC</sub> = +3.3V and T<sub>A</sub> = +25°C, unless otherwise noted.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
LVDS Change in V <sub>OS</sub> for Complementary States	$\Delta V_{OS} $				150	mV
LVDS Differential Output Impedance	R <sub>OLVDSO</sub>		80		140	$\Omega$
LVDS Output Current	I <sub>LVDSO</sub>	Outputs shorted together		12		mA
Output Current	I <sub>VSSLVDSO</sub>	Short to ground			40	mA
<b>CLOCK OUTPUT</b>						
Clock Output Frequency	f <sub>o</sub>	DS4106		106.2		MHz
		DS4212		212.5		
		DS4425		425.0		
Frequency Stability Total	$\Delta f / f_o$	Temperature, aging, load, and supply	-39		+39	ppm
Initial Frequency Tolerance	f <sub>TOL</sub>	+25°C, ±3°C, V <sub>CC</sub> = 3.3V		±20		ppm
Frequency Stability vs. Temperature	$\Delta f / f_o  T_A$		-30		+30	ppm
Frequency Stability vs. V <sub>CC</sub>	$\Delta f / f_o  V$	V <sub>CC</sub> = 3.3V ±10%	-3		+3	ppm/V
Frequency Stability vs. Load	$\Delta f / f_o  I_{LOAD}$	±10% variation in termination resistance		±1		ppm
Aging (15 Years)	f <sub>AGING</sub>		-7		+7	ppm
Phase Jitter (RMS)	PJ <sub>RMS</sub>	12kHz to 20MHz		0.9		ps
Accumulated Deterministic Jitter Due to Reference Spurs (P-P)		10kHz		3		ps
		100kHz		27		
		200kHz		15		
		1MHz		7		
Clock Output Edge Speeds	t <sub>R</sub> , t <sub>F</sub>	20% to 80%	LVPECL		200	ps
			LVDS		175	
Clock Output Duty Cycle		+25°C	45		55	%
Oscillation Startup Time		(Note 6)		10		ms

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## ELECTRICAL CHARACTERISTICS (continued)

(V<sub>CC</sub> = 3.0V to 3.6V, T<sub>A</sub> = -40°C to +85°C, typical values are at V<sub>CC</sub> = +3.3V and T<sub>A</sub> = +25°C, unless otherwise noted.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Clock Output SSB Phase Noise		DS4106 at 106.25MHz	100Hz		-90	dBC/Hz
			1kHz		-112	
			10kHz		-115	
			100kHz		-123	
			1MHz		-142	
			10MHz		-147	
		DS4212 at 212.50MHz	100Hz		-82	
			1kHz		-106	
			10kHz		-109	
			100kHz		-117	
			1MHz		-136	
			10MHz		-141	
		DS4425 at 425.00MHz	100Hz		-76	
			1kHz		-100	
			10kHz		-103	
			100kHz		-111	
			1MHz		-130	
			10MHz		-135	

**Note 1:** Limits at -40°C are guaranteed by design and are not production tested.

**Note 2:** Voltage referenced to ground.

**Note 3:** Outputs are enabled and unloaded.

**Note 4:** When the LVPECL output is disabled, the typical output off current is < 100µA for nominal LVPECL signal levels at the output.

**Note 5:** AC parameters are guaranteed by design and characterization.

**Note 6:** Including oscillator startup time and PLL acquisition time, measured after V<sub>CC</sub> reaches 3.0V from power-on.

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## Pin Description

PIN	NAME	FUNCTION
1	OE	Output Enable. On-chip pullup resistor. Connect OE to logic-high, V <sub>CC</sub> , or leave open to enable the output clock. Connect OE to logic-low or GND to disable the output clock. The LVPECL output clock is set to high impedance when disabled. The LVDS output clock is latched to a differential high when disabled.
2, 7-10	N.C.	No Connection
3	GND	Ground
4	OUTP	Positive Clock Output, LVPECL or LVDS
5	OUTN	Negative Clock Output, LVPECL or LVDS
6	V <sub>CC</sub>	+3.3V Supply
—	EP	Exposed Paddle. The exposed pad must be used for thermal relief. This pad can be connected to ground.

## Detailed Description

The DS4106/DS4212/DS4425 combine a crystal and an IC to form a precision clock. Figure 1 shows a functional diagram of the devices. The IC consists of a crystal oscillator, a low-noise PLL, selectable clock-divider circuitry, and an output buffer. The PLL consists of a digital phase/frequency detector (PFD) and low-jitter generation VCO. The VCO signal is scaled by a clock-divider circuit and applied to the output buffer.

## Output Drivers

All devices are available with either LVPECL (DS4106A/DS4212A/DS4425A) or LVDS (DS4106B/DS4212B/DS4425B) output buffers. When not needed, the output buffers can be disabled. When disabled, the LVPECL output buffer goes to a high-impedance state. However, the LVDS outputs go to a differential logic one (OUTP latched high and OUTN latched low) when the outputs are disabled.

## Additional Information

For more available frequencies, refer to the DS4125 data sheet at [www.maxim-ic.com/DS4125](http://www.maxim-ic.com/DS4125).

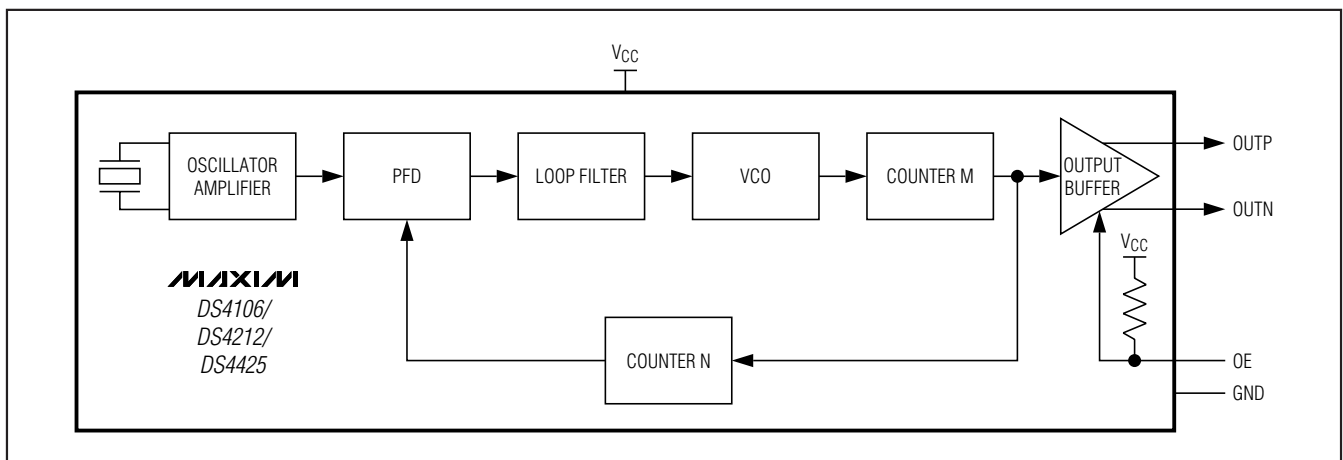


Figure 1. Functional Diagram

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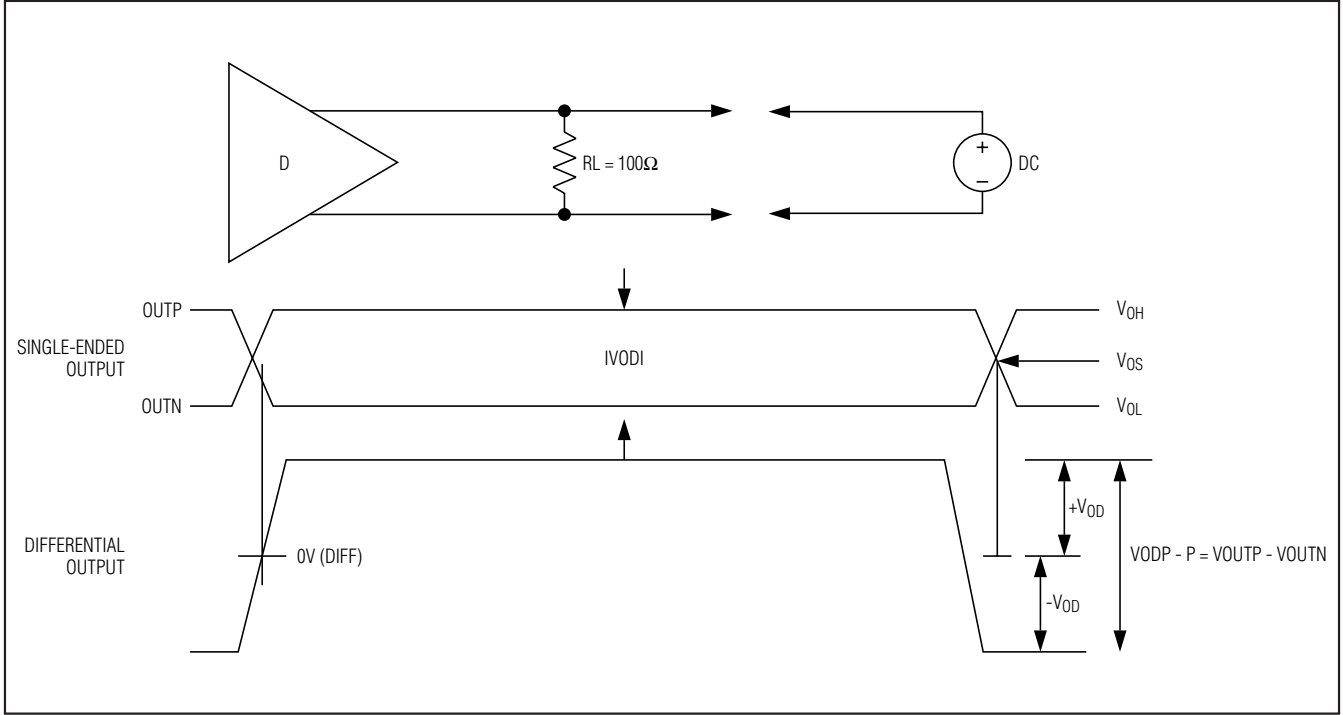


Figure 2. LVDS Level Definitions

## Selector Guide

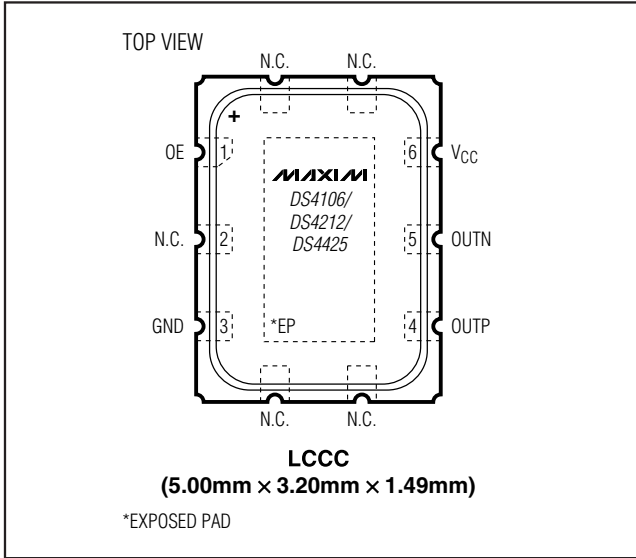
PART	OUTPUTS	FREQUENCY (MHz)	TOP MARK
DS4106AN+	LVPECL	106.25	06A
DS4106BN+	LVDS	106.25	06B
DS4212AN+	LVPECL	212.50	12A
DS4212BN+	LVDS	212.50	12B
DS4425AN+	LVPECL	425.00	42A
DS4425BN+	LVDS	425.00	42B

+Denotes a lead-free package. The lead finish is JESD97 category e4 (Au over Ni) and is compatible with both lead-based and lead-free soldering processes.

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**DS4106/DS4212/DS4425**

## Pin Configuration



## Thermal Information

THETA-JA (°C/W)
90

## Package Information

(For the latest package outline information go to [www.maxim-ic.com/DallasPackInfo](http://www.maxim-ic.com/DallasPackInfo).)

PACKAGE TYPE	DOCUMENT NO.
10 LCCC	56-G5032-002

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