

**750kHz – 800MHz Low Phase Noise VCXO (for 12 – 25MHz Crystals)**

**FEATURES**

- 750kHz to 800MHz output range.
- Low phase noise output (@ 10kHz frequency offset, -142dBc/Hz for 19.44MHz, -125dBc/Hz for 155.52MHz, -115dBc/Hz for 622.08MHz).
- Selectable CMOS, PECL and LVDS output.
- Selectable High Drive or Standard CMOS.
- 12 to 25MHz crystal input.
- No external load capacitor or varicap required.
- Output Enable selector.
- Wide pull range (+/-200ppm)
- 3.3V operation.
- Available in DIE (65 mil x 62 mil).

**DESCRIPTION**

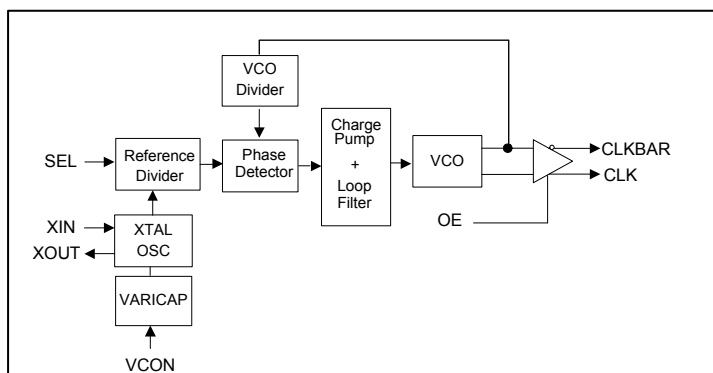
The PLL502-30 is a monolithic low jitter and low phase noise (-142dBc/Hz @ 10kHz offset) VCXO IC Die, with CMOS, LVDS and PECL output, covering the 750kHz to 800MHz output range. It allows the control of the output frequency with an input voltage (VCON), using a low cost crystal.

The same die can be used as a VCXO with output frequencies ranging from  $F_{XIN} / 16$  to  $F_{XIN} \times 32$  thanks to frequency selector pads. This makes the PLL502-30 ideal as a universal die for applications ranging from ADSL to SONET.

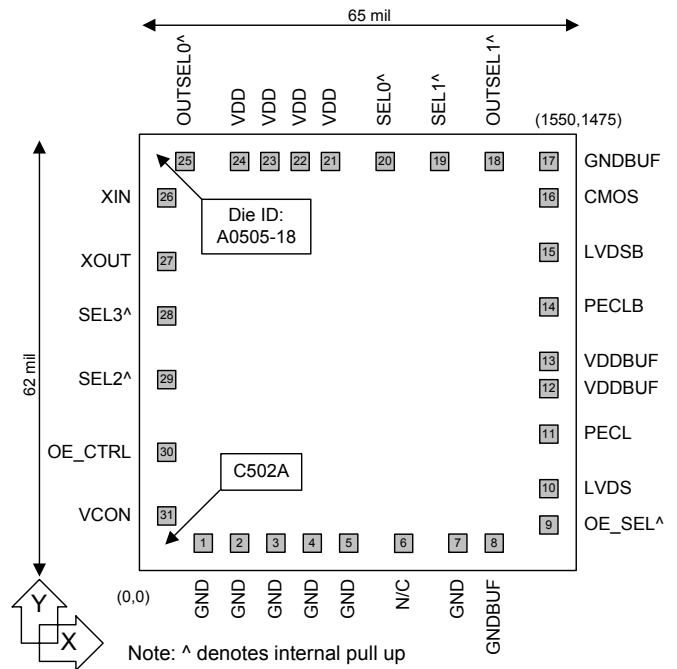
**DIE SPECIFICATIONS**

Name	Value
Size	62 x 65 mil
Reverse side	GND
Pad dimensions	80 micron x 80 micron
Thickness	10 mil

**BLOCK DIAGRAM**



**DIE CONFIGURATION**



**OUTPUT SELECTION AND ENABLE**

OUTSEL1 (Pad #18)	OUTSEL0 (Pad #25)	Selected Output
0	0	High Drive CMOS
0	1	Standard CMOS
1	0	PECL
1	1	LVDS

OE_SELECT (Pad #9)	OE_CTRL (Pad #30)	State
0	0 (Default)	Output enabled
	1	Tri-state
1 (Default)	0	Tri-state
	1 (Default)	Output enabled

Pad #9: Bond to GND to set to "0", bond to VDD to set to "1"

Pad #30: Logical states defined by PECL levels if OE\_SELECT is "0"  
Logical states defined by CMOS levels if OE\_SELECT is "1"

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**FREQUENCY SELECTION TABLE**

SEL3 (Pad #28)	SEL2 (Pad #29)	SEL1 (Pad #19)	SEL0 (Pad #20)	Selected Multiplier
0	0	0	0	Reserved
0	0	0	1	Reserved
0	0	1	0	Reserved
0	0	1	1	Fin x 32
0	1	0	0	Reserved
0	1	0	1	Reserved
0	1	1	0	Fin / 8
0	1	1	1	Fin x 2
1	0	0	0	Reserved
1	0	0	1	Fin / 2
1	0	1	0	Fin / 16
1	0	1	1	Fin x 4
1	1	0	0	Fin / 4
1	1	0	1	Fin x 8
1	1	1	0	Fin x 16
1	1	1	1	No multiplication

All pads have internal pull-ups (default value is 1). Bond to GND to set to 0.

**ELECTRICAL SPECIFICATIONS**
**1. Absolute Maximum Ratings**

PARAMETERS	SYMBOL	MIN.	MAX.	UNITS
Supply Voltage	$V_{DD}$		4.6	V
Input Voltage, dc	$V_I$	-0.5	$V_{DD}+0.5$	V
Output Voltage, dc	$V_O$	-0.5	$V_{DD}+0.5$	V
Storage Temperature	$T_S$	-65	150	°C
Ambient Operating Temperature*	$T_A$	-40	85	°C
Junction Temperature	$T_J$		125	°C
Lead Temperature (soldering, 10s)			260	°C
ESD Protection, Human Body Model			2	kV

Exposure of the device under conditions beyond the limits specified by Maximum Ratings for extended periods may cause permanent damage to the device and affect product reliability. These conditions represent a stress rating only, and functional operations of the device at these or any other conditions above the operational limits noted in this specification is not implied.

\* **Note:** Operating Temperature is guaranteed by design for all parts (COMMERCIAL and INDUSTRIAL), but tested for COMMERCIAL grade only.

## 750kHz – 800MHz Low Phase Noise VCXO (for 12 – 25MHz Crystals)

### 2. Crystal Specifications

PARAMETERS	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Crystal Resonator Frequency	$F_{XIN}$	Parallel Fundamental Mode	12		25	MHz
Crystal Loading Rating	$C_L (x_{tal})$	at $V_{CON} = 1.65V$		9.5		pF
Crystal Pullability	$C_0/C_1 (x_{tal})$	AT cut			250	-
Recommended ESR	$R_E$	AT cut			30	$\Omega$

**Note:** Crystal Loading rating: 9.5pF is the loading the crystal sees from the VCXO chip at  $V_{CON} = 1.65V$ . It is assumed that the crystal will be at nominal frequency at this load. If the crystal requires more load to be at nominal frequency, the additional load must be added externally. This however may reduce the pull range.

### 3. Voltage Control Crystal Oscillator

PARAMETERS	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
VCXO Stabilization Time *	$T_{VCXOSTB}$	From power valid			10	ms
VCXO Tuning Range		$F_{XIN} = 12 - 25MHz$ ; XTAL $C_0/C_1 < 250$ $0V \leq V_{CON} \leq 3.3V$		500		ppm
CLK output pullability		$V_{CON} = 1.65V, \pm 1.65V$	$\pm 200$			ppm
VCXO Tuning Characteristic				150		ppm/V
Pull range linearity					10	%
$V_{CON}$ pin input impedance			2000			k $\Omega$
$V_{CON}$ modulation BW		$0V \leq V_{CON} \leq 3.3V, -3dB$	25			kHz

**Note:** Parameters denoted with an asterisk (\*) represent nominal characterization data and are not production tested to any specific limits.

### 4. General Electrical Specifications

PARAMETERS	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	
Supply Current, Dynamic (with Loaded Outputs)	$I_{DD}$	PECL/LVDS/CMOS	$F_{out} < 24MHz$			60/28/15	mA
			$24MHz < F_{out} < 96MHz$			65/45/30	
			$96MHz < F_{out} < 700MHz$			100/80/40	
Operating Voltage	$V_{DD}$		2.97		3.63	V	
Output Clock Duty Cycle		@ 50% $V_{DD}$ (CMOS)	45	50	55	%	
		@ 1.25V (LVDS)	45	50	55		
		@ $V_{DD} - 1.3V$ (PECL)	45	50	55		
Short Circuit Current				$\pm 50$		mA	

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**5. Jitter Specifications**

PARAMETERS	CONDITIONS	FREQUENCY	MIN.	TYP.	MAX.	UNITS
Period jitter RMS <sup>1</sup>	With capacitive decoupling between VDD and GND. Over 10,000 cycles.	19.44MHz		2.2		ps
		77.76MHz		3.5		
		155.52MHz		4.3		
		622.08MHz		5.0		
Period jitter Peak-to-Peak <sup>1</sup>	With capacitive decoupling between VDD and GND. Over 10,000 cycles.	19.44MHz		17		ps
		77.76MHz		25		
		155.52MHz		27		
		622.08MHz		35		
Integrated jitter RMS <sup>2</sup>	Integrated 12 kHz to 20 MHz	155.52MHz		2.6	4	ps
		622.08MHz		2.5	4	

**6. Phase Noise Specifications**

PARAMETERS	FREQUENCY	@10Hz	@100Hz	@1kHz	@10kHz	@100kHz	UNITS
Phase Noise <sup>2</sup> relative to carrier (typical)	19.44MHz	-80	-108	-132	-142	-150	dBc/Hz
	77.76MHz	-72	-103	-122	-130	-125	
	155.52MHz	-65	-95	-120	-125	-121	
	622.08MHz	-55	-85	-109	-115	-110	

Note: Phase Noise measured at VCON = 0V

**7. CMOS Electrical Characteristics**

PARAMETERS	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Output drive current (High Drive)	I <sub>OH</sub>	V <sub>OH</sub> = V <sub>DD</sub> -0.4V, V <sub>DD</sub> =3.3V	30			mA
	I <sub>OL</sub>	V <sub>OL</sub> = 0.4V, V <sub>DD</sub> = 3.3V	30			mA
Output drive current (Standard Drive)	I <sub>OH</sub>	V <sub>OH</sub> = V <sub>DD</sub> -0.4V, V <sub>DD</sub> =3.3V	10			mA
	I <sub>OL</sub>	V <sub>OL</sub> = 0.4V, V <sub>DD</sub> = 3.3V	10			mA
Output Clock Rise/Fall Time (Standard Drive)		0.3V ~ 3.0V with 15 pF load		2.4		ns
Output Clock Rise/Fall Time (High Drive)		0.3V ~ 3.0V with 15 pF load		1.2		

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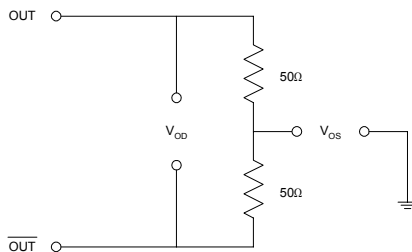
**8. LVDS Electrical Characteristics**

PARAMETERS	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Output Differential Voltage	$V_{OD}$	$R_L = 100\ \Omega$ (see figure)	247	355	454	mV
$V_{DD}$ Magnitude Change	$\Delta V_{OD}$		-50		50	mV
Output High Voltage	$V_{OH}$			1.4	1.6	V
Output Low Voltage	$V_{OL}$		0.9	1.1		V
Offset Voltage	$V_{OS}$		1.125	1.2	1.375	V
Offset Magnitude Change	$\Delta V_{OS}$		0	3	25	mV
Power-off Leakage	$I_{OXD}$	$V_{out} = V_{DD}$ or GND $V_{DD} = 0V$		$\pm 1$	$\pm 10$	$\mu A$
Output Short Circuit Current	$I_{OSD}$			-5.7	-8	mA

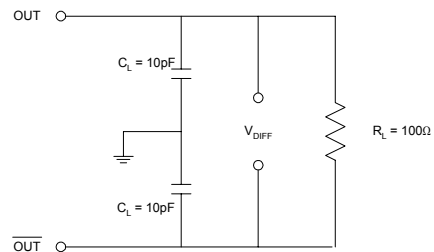
**9. LVDS Switching Characteristics**

PARAMETERS	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Differential Clock Rise Time	$t_r$	$R_L = 100\ \Omega$ $C_L = 10\ pF$ (see figure)	0.2	0.7	1.0	ns
Differential Clock Fall Time	$t_f$		0.2	0.7	1.0	ns

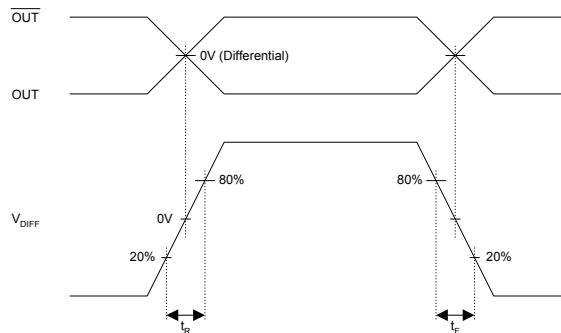
LVDS Levels Test Circuit



LVDS Switching Test Circuit



LVDS Transition Time Waveform



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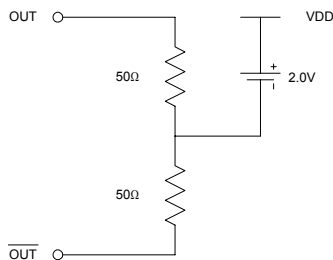
**10. PECL Electrical Characteristics**

PARAMETERS	SYMBOL	CONDITIONS	MIN.	MAX.	UNITS
Output High Voltage	$V_{OH}$	$R_L = 50 \Omega$ to $(V_{DD} - 2V)$ (see figure)	$V_{DD} - 1.025$		V
Output Low Voltage	$V_{OL}$			$V_{DD} - 1.620$	V

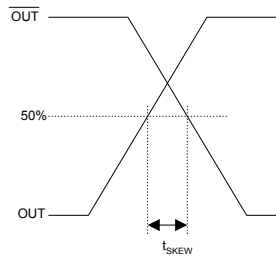
**11. PECL Switching Characteristics**

PARAMETERS	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Clock Rise Time	$t_r$	@20/80% - PECL		0.6	1.5	ns
Clock Fall Time	$t_f$	@80/20% - PECL		0.5	1.5	ns

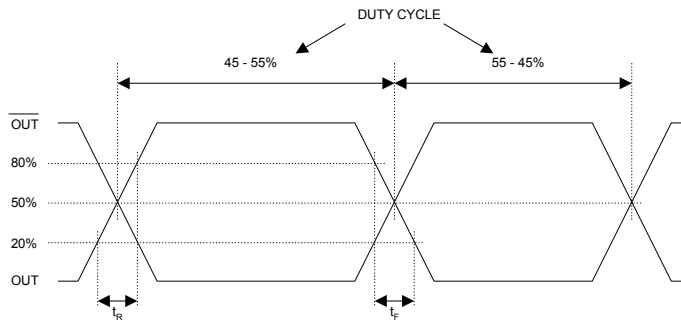
PECL Levels Test Circuit



PECL Output Skew



PECL Transition Time Waveform



**750kHz – 800MHz Low Phase Noise VCXO (for 12 – 25MHz Crystals)**
**PAD ASSIGNMENT**

Pad #	Name	X (μm)	Y (μm)	Description
1	GND	248	109	Ground.
2	GND	361	109	Ground.
3	GND	473	109	Ground.
4	GND	587	109	Ground.
5	GND	702	109	Ground.
6	N/C	874	109	No Connection.
7	GND	1042	109	Ground.
8	GNDBUF	1171	109	Ground, buffer circuitry.
9	OE_SELECT	1400	125	Used to select between PECL or CMOS logic states for OE. Internal pull up.
10	LVDS	1400	259	LVDS Output.
11	PECL	1400	476	PECL Output.
12	VDDBUF	1400	616	3.3V power supply, Buffer circuitry.
13	VDDBUF	1400	716	3.3V power supply, Buffer circuitry.
14	PECLB	1400	871	Complementary PECL Output.
15	LVDSB	1400	1089	Complementary LVDS Output.
16	CMOS	1400	1227	CMOS Output.
17	GNDBUF	1389	1365	Ground, buffer circuitry.
18	OUTSEL1	1232	1365	Used to select CMOS, PECL or LVDS output type. Internal pull up.
19	SEL1	1042	1365	Used to select multiplication factor. Internal pull up.
20	SEL0	854	1365	Used to select multiplication factor. Internal pull up.
21	VDD	659	1365	3.3V power supply.
22	VDD	559	1365	3.3V power supply.
23	VDD	459	1365	3.3V power supply.
24	VDD	358	1365	3.3V power supply.
25	OUTSEL0	194	1365	Used to select CMOS, PECL or LVDS output type. Internal pull up.
26	XIN	109	1223	Crystal input. See crystal specification page 3.
27	XOUT	109	1017	Crystal output. See crystal specification page 3.
28	SEL3	109	858	Used to select multiplication factor. Internal pull up.
29	SEL2	109	646	Used to select multiplication factor. Internal pull up.
30	OE_CTRL	109	397	Used to enable/disable the output(s). See Output Selection and Enable table on page 1.
31	VCON	109	181	Voltage Control Input. 0V to 3.3V.

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**ORDERING INFORMATION**

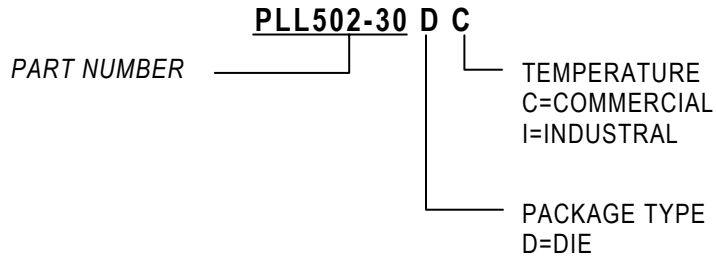
**For part ordering, please contact our Sales Department:**

47745 Fremont Blvd., Fremont, CA 94538, USA

Tel: (510) 492-0990 Fax: (510) 492-0991

**PART NUMBER**

The order number for this device is a combination of the following:  
Device number, Package type and Operating temperature range



<u>Order Number</u>	<u>Marking</u>	<u>Package Option</u>
PLL502-30DC	P502-30DC	Die (Waffle Pack)

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