

LMX2531LQ1312E Evaluation Board Operating Instructions



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LMX2531LQ1312EFPEB Rev 4.02.2008



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Loop Filter

Loop Bandwidth	7.7 kHz	Κφ	1440 uA (16X)
Phase Margin	61.5 deg	Fcomp	10 MHz
Crystal Frequency	10 MHz	Output Frequency	1268 – 1360 MHz (DIV2=0) 634 - 680 MHz (DIV2=1)
Supply Voltage	3.0 Volts	VCO Gain	3 - 6 MHz/Volt
	CPout Vtune L Vtune S I S V I S V I	20 KΩ 20 KΩ 	

Quick Setup

- Install the CodeLoader software which is available at <u>www.national.com/timing</u>.
- Attach the parallel or USB to parallel, port cable to the computer and the evaluation board.
- Connect 3.0 volts to the Vcc connector
- Connect the *Fout* connector to a spectrum analyzer or phase noise analyzer
- Connect a clean 10 MHz source to the OSCin pin. Typically, the 10 MHz output from the back
 of the RF test equipment is a good source. Signal generators tend to be very noisy and should
 be used with caution. If a signal generator is used, the signal generator phase noise
 contribution can be reduced by setting the signal to 80 MHz and dividing this down to a phase
 detector frequency of 10 MHz.
- Set up the CodeLoader software
 - Select the proper part from the menu as Select Part>PLL+VCO>LMX2531LQ1312E
 - Select the proper mode from the Mode menu
 - Load the part by pressing (Ctrl+L) or selecting Keyboard Controls->Load Device from the menu
- It is recommended to ensure proper communication with the device
 - Click the REG_RST bit on the bits/pins page and observe the current go to 0 mA
 - Unclick the REG_RST bit AND press (Ctrl+L). The current should be approximately 35 mA
 - If device does not respond to this, consult the troubleshooting section
- When using the lower frequency band with divide by 2 enabled (DIV2=1), be aware that the frequency programmed to the VCO is actually twice the output frequency of the device because the VCO frequency is being divided by 2.



Troubleshooting

F	Probl	em		Corrective Actions									
	C		All Mod	des									
	<u>ō</u>		•	Ensure a valid signal is presented to the OSCin connector. If a signal generator is									
	nat			used ensure the RF is ON									
	alı		•	Consult the Codel order instructions for more detailed information on communication									
	ę		•	consult the codecoder instructions for more detailed information on communication									
	e			ada (Laga Parallal Port Cabla)									
	÷			Gue (Uses Parallel Port Cable)									
	ţ		 Ensure that GoueLoader is selected to LPT mode on the Poil Setup tab. Ensure the proper part number is selected (LDT1 LDT2 LDT2). Codel coder dec 										
	ž		Ensure the proper port number is selected (LPT1, LPT2, LPT3). CodeLoader do										
	te		NOT automatically detect this.										
	ca		•	Ensure the LPT cable is securely connected to the computer and board.									
	ïĽ		٠	Try to exit and restart CodeLoader.									
	Ē		•	Ensure the parallel port is in the correct mode									
	Ĕ			 Windows often requires administrative access to write to the parallel port. 									
	ö			 Ensure that the parallel port is set to "Enabled" in windows device manager. 									
	q			 A reboot upon installation of CodeLoader is sometimes necessary to get the 									
	2			parallel port to work.									
	es			• Standard mode is the most reliable. This can be set in the BIOS mode of the									
	b			computer as "Normal". "Output Only". or "AT".									
	ð		USB M	ode (USB to Parallel Port Converter)									
	val val	ŝ	•	On the menu, select USB>Version to verify communication with the board.									
	ť,	a	•	Ensure the Green LEDs are lit on the USB board									
	Ň,	ž	•	Ensure there are no conflicts with other USB devices and reinstall the board									
				Ensure there is a valid signal presented to the OSCin connector. If a signal generator is									
9	5 2	eci	•	used the RE should be set to ON									
sb.	ج ج	L.		If using the lower frequency hand $(DIV/2=1)$, understand that the VCO frequency in									
ŭ.	<u><u> </u></u>	ö	•	I using the lower nequency band (Drvz-T), understand that the VCO nequency in Codel coder should be twice the frequency at the Fourt pip									
sp.	g g	2		CoueLoduel Should be twice the nequency at the Poul pin.									
čě	n an	ŭ	•	Ensure that the VCO FREQUENCY CAL bits on the Bits/Pins tab are correct.									
۲	ายิด	, ňo	•	Ensure the loop filter is optimized if the charge pump current, phase detector frequency,									
Pal	2 g	free		or loop filter values have been changed from their original settings. Ensure the									
_	_ 0			integrated loop filter components on CodeLoader are set to their proper settings.									
Se	э К	≥	•	Ensure the signal presented to OSCin connector is clean. Try another source, or if it is									
na:	ğ	P P		a signal generator, try using a higher frequency and dividing it down to the phase									
d	≥ <u>¤</u>	ŝ		detector frequency.									
	s s	ü	•	Ensure the OSC in signal and cable provides sufficient power level.									
Ŀ.	± 0	cti	•	If the phase detector frequency or charge pump current is lowered from their original									
se-	ő –	Ξž		settings, the in-band phase noise can be degraded, even if the loop filter is re-designed									
ö:	ja l	oa		for the same loop bandwidth. If the loop bandwidth is decreased, in-band phase noise									
þ	⊆≑	ב. ב		can be degraded.									
e,	e c	2	٠	Ensure the measurement equipment noise floor is not limiting the measurement. For									
as	ti S	Q		spectrum analyzers, the noise floor at a particular setting can be measured by removing									
РЧ	ua:	ζ.		the RF input signal.									
	al .	SU	•	If the settings are changed from what the board was designed for. ensure the delta-									
Ŀ	s 9	tio		sigma modulator is not increasing the far-out noise. To know this, tune to an integer									
inc	Ð	p on		channel and set the ORDER bit to "Reset Modulator". The far-out phase noise should									
Ľ.	an	str		not decrease. If it does, try a loop filter with more attenuation or select a lower order									
Ë	₹£	<u>2</u> . ک		delta-sigma modulator.									









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CodeLoader Settings

The CodeLoader program is designed to work with many devices. When CodeLoader is first started, it is necessary to select the correct device.

M LMX2531LQ1312E									
File Keyboard Controls Select Device Options Mode USB Help									
Port Setup VCO +	Bits/Pins	BurstMode	PLL/VC0						
Port Setup PLL - Single Integer PLL - Val Integer PLL - Fractional PLL + VCO Transceiver Clock Conditioners 10 MHz Fin 16 136 Prescaler N Counter	Bits/Pins LMX2502 LMX2505 LMX2505 LMX2512 LMX2515 LMX2515 LMX2522 LMX2525 LMX2525 LMX2525 LMX2531LQ1146E LMX2531LQ1312E LMX2531LQ1515E LMX2531LQ1500E LMX2531LQ1500E LMX2531LQ150E LMX2531LQ170E LMX2531LQ170E LMX2531LQ1770E LMX2531LQ170E LMX2531LQ170E LMX2531LQ170E LMX2531LQ170E LMX2531LQ170E LMX2531LQ150E LMX2531LQ150E LMX2531LQ150E LMX2531LQ150E LMX2531LQ150E LMX2531LQ150E LMX2531LQ150E LMX2531LQ150E LMX2531LQ150E LMX2531LQ1515E	e Charge Pump State	PLLAYCO						
COMM Mode: LPT Selected device: LMX2531LQ13	112E								





There can be different modes defined for a particular part. A mode can be recalled easily from the menu. This restores bit settings and frequencies, but not the Port Setup information. The default reference oscillator used for these instructions was 10 MHz, but there is an alternate mode for a 61.44 MHz oscillator as well. If the bits become scrambled, their original state may be recalled by choosing the appropriate mode. If the internal divide by 2 (DIV2) is enabled, the VCO frequency will not change.



MLMX2531LQ1312E									
File Keyboard Controls Select Device Options Mode USB Help									
Port Setup	Registers	Bits/Pins		BurstMode	PLL/VCO				
INITIALIZATION □ REG_RST VCO OUTPUT □ DIV2 POWER CONTROLS □ EN_PLL □ EN_PLLD01 □ EN_PLLD02 □ EN_PLLD02 □ EN_PLLD02 □ EN_VCO □ EN_VCO □ EN_VCO □ EN_VCO □ EN_VCO □ OSC VCO PN OPTIMIZATION VCO_ACISEL 0 0 0 0 0 0 0 0 0 0 0 0 0	VC0 FREQ XTLMAN XTLMAN LOCKMODE XTLSEL XTLDIV FRACTION FRACTION FRACTION FRACTION FRACTION FRACTION Str	JENCY CAL 2 0 1 2 1 2 2 1 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2		ITERNAL LOOP FILTER EN_LPFLTR 3_4_ADJ 3=100pF, C4=100pF 3_ADJ I Kohm 4_ADJ I Kohm STLOCK CONTROLS C C 0 PFL 1X 4_ADJ_FL Ohm C C DC C C C C C C C C C C C C C	Program Pins CE TRIGGER				
COMM Mode: LPT Selected device: LMX2531LQ1312E									

The Bits/Pins tab displays many of the bits used to program the part. Right mouse click any bit to view more information about what this does.

When the DIV2 bit is enabled, the frequency from the part will be half of that shown on the PLL/VCO tab. The frequency on the PLL/VCO tab does not reflect this because the divide by 2 is actually after the VCO. Also be sure to load the device (Ctrl+L) after changing this bit to allow the VCO to calibrate for optimal phase noise performance.



M LMX2531LQ13	31 2E								
File Keyboard Controls Select Device Options Mode USB Help									
Port Setup	Registers	Bits/Pins	BurstMode	PLL/VC0					
MSB> R5 (INIT1) R5 (INIT2) R12 R9 R8 R7 R6 R4 R3 R2 R1 R0	2 2 2 2 1 1 1 1 1 1 1 3 2 1 0 9 8 7 6 5 4 3 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0	$\begin{array}{c} 1 \ 1 \ 1 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \$	0 0 0 2 1 0 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 0 1	Hex Value INIT1) 0x084 0005 INIT2) 0x080 0005 R5 0x000 0RA9 R12 0x000 0BA9 R3 0x000 0107 R6 0x000 0004 R3 0x06C 0F43 R2 0x043 0012 R1 0x083 A800					
COMM Mode: LPT	Selected device: LMX25311	_Q1312E			1				

The Registers tab shows the literal bits that are being sent to the part. These are the registers every time the PLL is loaded by using the menu command or (Ctrl+L). R5 (INIT1) and R5 (INIT 2) are just the R5 register being used to properly initialize the part. So a single (Ctrl+L) will load the part.





The port setup tells CodeLoader what information goes where. If this is wrong, the part will not program. Although LPT1 is usually correct, CodeLoader does NOT automatically detect the correct port. On some laptops, it may be LPT3. Manually verification is required.







Bill of Materials				LMX2531_LF				Revision 3.28.2008	
Item	QTY	Manufacturer	Part #	Size	Tol	Voltage	Material	Value	Designators
0	20		n/a					Open Capacitors	C1_LF, C2pLF, C2, C3, C4, C5, C9, C11, C14, C17, C18, C19, C21, C24, C100, C101, C102, C103, C104, C105
	7							Open Resistors	R2pLF,R7, R8, R17, R19, R21, R24
	1							Open Miscellaneous	Ftest/LD
1	1	Kemet	C0603C101J5GAC	603	5%	50V	C0G	100pF	C16
2	2	Kemet	C0603C103J5RAC	603	5%	50V	X7R	10nF	C10, C23
3	1	Kemet	C0805C104K5RAC	805	5%	25V	C0G	100nF	C2_LF
4	6	Kemet	C0603C104J3RAC	603	5%	25V	X7R	100nF	C6, C7, C12, C15, C22, C20
5	1	Kemet	C0603C105K4RAC	603	10%	16V	X5R	1uF	C8
6	1	Kemet	C0603C475K9PAC	603	10%	6.3V	X5R	4.7uF	C13
7	1	Kemet	C0805C106K8PAC	805	10%	10V	X5R	10uF	C1
8	1	Vishay	CRCW0603000ZRT1	603	5%	0.1W	Thick Film	0Ω	R20
9	2	Panasonic	P.22AHCT-ND	603	10%	0.1W	Thick Film	0.22Ω	R22, R23
10	2	Vishay	CRCW06033R3JRT1	603	5%	0.1W	Thick Film	3.3Ω	R1, R18
11	4	Vishay	CRCW0603100JRT1	603	5%	0.1W	Thick Film	10Ω	R2, R3, R4, R5
12	1	Vishay	CRCW0603510JRT1	603	5%	0.1W	Thick Film	51Ω	R6
13	1	Vishay	CRCW0603102JRT1	603	5%	0.1W	Thick Film	1KΩ	R2_LF
14	4	Vishay	CRCW0603103JRT1	603	5%	0.1W	Thick Film	10KΩ	R9, R11, R13, R15
15	4	Vishay	CRCW0603123JRT1	603	5%	0.1W	Thick Film	1 2K Ω	R10, R12, R14, R16
16	1	Comm Con Connectors	HTSM3203-8G2	2X4	n/a	n/a	Metal/Plastic	Header	POWER
17	1	FCI Electronics	52601-S10-8	2X5	n/a	n/a	Metal/Plastic	Header	uWire
18	3	Johnson Components	142-0701-851	SMA	n/a	n/a	Metal	SMA	Fout, OSCin, Vcc
10	1	1 National Semiconductor	LMX2531LOEBPCB	n/a	n/a	n/a	FR4	PCB Board	n/a
10			Semiconductor	n/u	n/a	62 mil Thick	1st Layer 10 mils	17/4	
20	1	National Semiconductor	LMX2531	LLP36	n/a	2.7	Silicon	LMX2531	U1
21	4	Com Con Connectors	CCIJ255G	2-Pin	n/a	n/a	Metal/Plastic	Shunt	Place Across:
21 4	· ·		00.02000	2-6111				cun	POWER: 1-2, 3-4, 5-6, 7-8
22	4	SPC Technology	SPCS-8	0.156"	n/a	n/a	Nylon	Nylon Standoffs	Place in 4 Holes in Corners of Board

Bill of Materials



Top Layer





Mid Layer 1 "Ground Plane" (15 Mils Down FR4)





Mid Layer 2 "Power"







Bottom Layer "Signal"

Note: Total Board Thickness = 61 mils



OSCIN Ftest/LD R2 C2 R3 R2_LF R2pLF ● DONER C3 R4 C4 C2_LF 1 R5 C5 C2pLF C9 C10 R17C11 U1 C16 R20 17 Fout **FRI GGER** R uWIRE GND

Top Build Diagram