LMX2594 Global Delay and Skew

Conclusion

The delay specifications for the LMX2594 based on four parts below are as follows:

Metric	Min	Typ	Max	Unit
Average Delay		3670		ps
Variation over Devices		60		ps
Temperature Gradient		2.4		ps/C

The average delay is based on a 100 MHz input and 100 MHz output. The variation of devices was measured with 4 specially designed solder down boards, but also a similar result was obtained with the socketed board. The temperature gradient is positive. In other words, heating the part increases the delay.

Absolute Delay

Using the setup in the appendix, the delay was measured for a few different conditions on four different boards. The variation was found by taking the maximum of the 4 averages minus the minimum of the 4 averages

Board 95											
Fosc	OSC2X	PRER	Mult	PLL_R	CPG	Fpd	Fvco	VCODIV	Fout	Measure	Delay
100	0	1	1	2	6.25 mA	50	9600	96	100	6235	3765
100	0	1	1	2	1.25 mA	50	9600	96	100	6278	3722
100	0	2	1	1	6.25 mA	50	9600	96	100	6398	3602
Average											3696.333
Board 93											
Fosc	OSC2X	PRER	Mult	PLL_R	CPG	Fpd	Fvco	VCODIV	Fout	Measure	Delay
100	0	1	1	2	6.25 mA	50	9600	96	100	6257	3743
100	0	1	1	2	1.25 mA	50	9600	96	100	6335	3665
100	0	2	1	1	6.25 mA	50	9600	96	100	6407	3593
										Average	3667
Board 97											
Fosc	OSC2X	PRER	Mult	PLL_R	CPG	Fpd	Fvco	VCODIV	Fout	Measure	Delay
100	0	1	1	2	6.25 mA	50	9600	96	100	6250	3750
100	0	1	1	2	1.25 mA	50	9600	96	100	6282	3718
100	0	2	1	1	6.25 mA	50	9600	96	100	6460	3540
Average											3669.333
Board 33											
Fosc	OSC2X	PRER	Mult	PLL_R	CPG	Fpd	Fvco	VCODIV	Fout	Measure	Delay
100	0	1	1	2	6.25 mA	50	9600	96	100	6212	3788
100	0	1	1	2	1.25 mA	50	9600	96	100	6481	3519
100	0	2	1	1	6.25 mA	50	9600	96	100	6399	3601

Average	3636

Temperature Variation

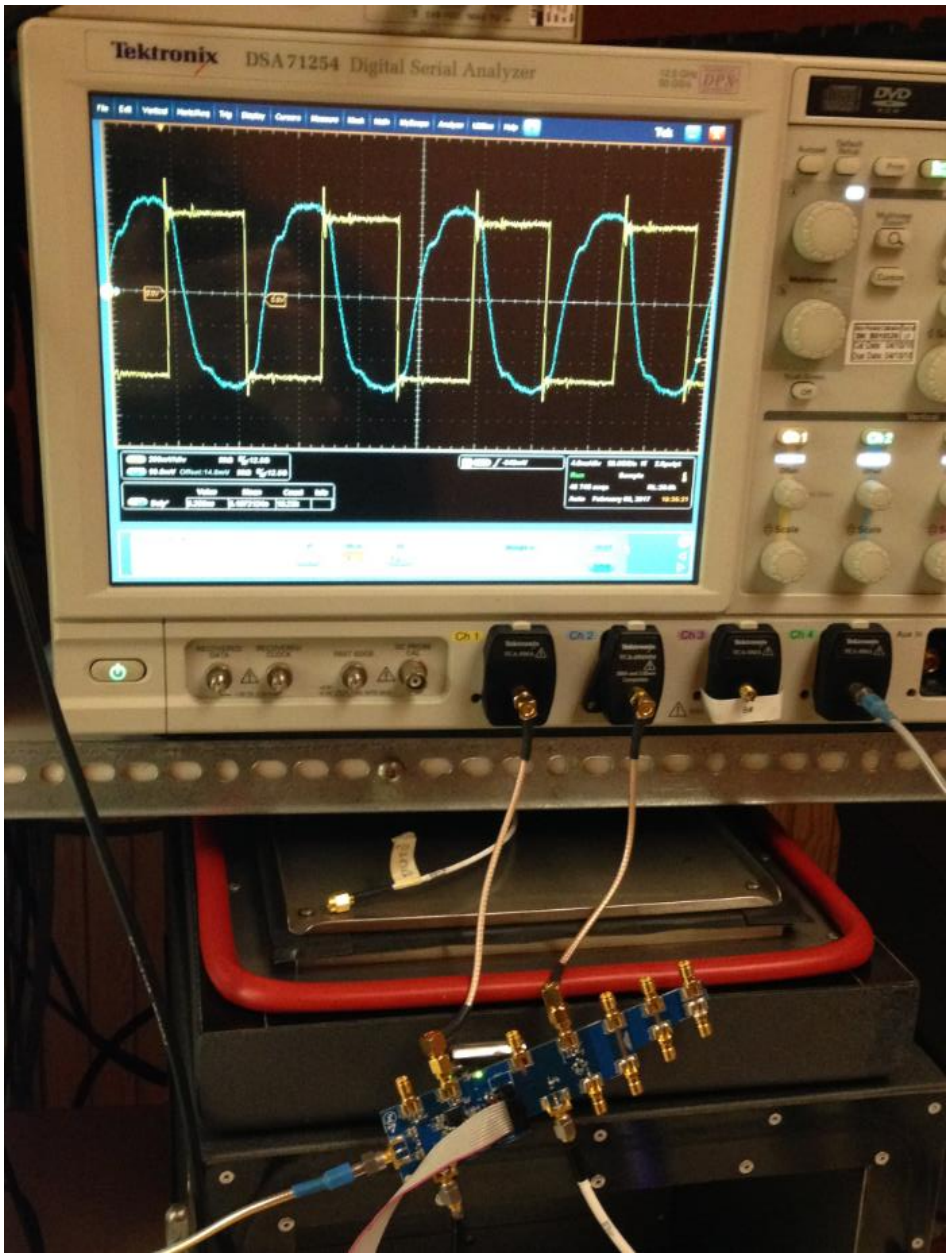
The general strategy was to use a specialize board that had two paths. One path went through the LMX2594, and another path had no LMX2594, but had the same trace length. A 100 MHz input frequency was used and the LMX2594 output was set to 100 MHz. In this way, the LMX2594 delay could be measured accurately.

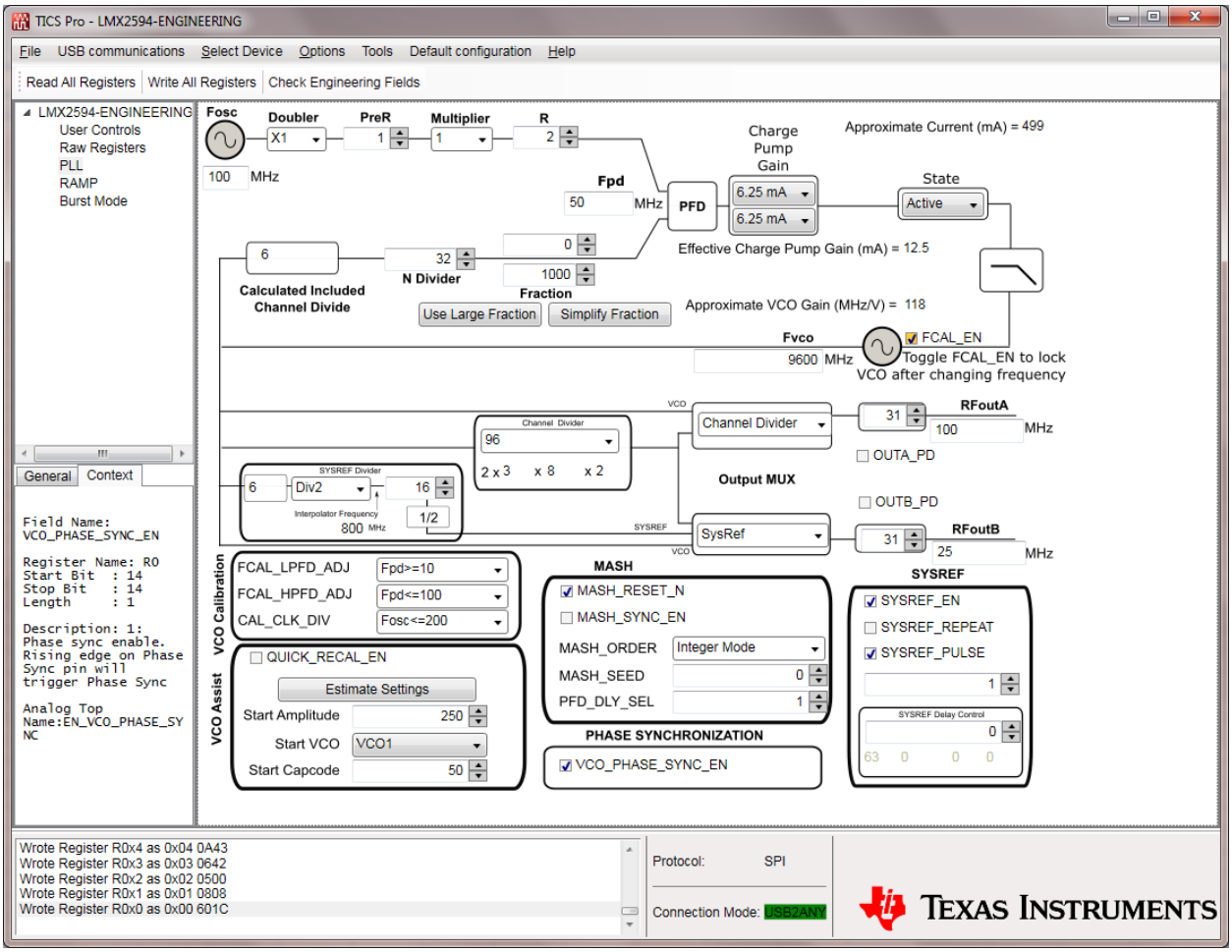
Temperature	Delay	dT/dC
-40	3421.5	-0.35
-30	3418	3.183333
0	3513.5	2.72
25	3581.5	2.42
50	3642	3.8
65	3699	2.375
85	3746.5	

For the temperature variation test, long cables were used to allow for the temperature chamber. These cables were the same length, but certainly a source of error. For this reason, the experiment was run twice by swapping the cables and taking an average. In this way, the hope was to reduce any temperature variation due to the cables.

Setup

The general strategy was to use a specialized board that had two paths. One path went through the LMX2594, and another path had no LMX2594, but had the same trace length. A 100 MHz input frequency was used and the LMX2594 output was set to 100 MHz. In this way, the LMX2594 delay could be measured accurately. The oscilloscope was de-skewed and the 100 MHz input signal was compared to 100 MHz output signal on an oscilloscope.


Tektronix
DSA71254 Digital Serial Analyzer


TICS Pro - LMX2594-ENGINEERING
File USB communications Select Device Options Tools Default configuration Help
Read All Registers Write All Registers Check Engineering Fields
LMX2594-ENGINEERING
User Controls
Raw Registers
PLL
RAMP
Burst Mode
General Context
Field Name:
VCO_PHASE_SYNC_EN
Register Name: R0
Start Bit : 14
Stop Bit : 14
Length : 1
Description: 1:
Phase sync enable.
Rising edge on Phase
Sync pin will
trigger Phase Sync
Analog Top
Name:EN_VCO_PHASE_SYNC
Fosc
Doubler
PreR
Multiplier
R
X1
1
1
2
100 MHz
Fpd
50 MHz
PFD
Charge Pump Gain
6.25 mA
6.25 mA
Approximate Current (mA) = 499
State
Active
Effective Charge Pump Gain (mA) = 12.5
6
Calculated Included Channel Divide
32
N Divider
0
1000
Fraction
Use Large Fraction
Simplify Fraction
Approximate VCO Gain (MHz/V) = 118
Fvco
9600 MHz
FCAL_EN
Toggle FCAL_EN to lock VCO after changing frequency
VCO
Channel Divider
96
2 x 3 x 8 x 2
Channel Divider
31
RFoutA
100 MHz
OUTA_PD
OUTB_PD
Output MUX
SYSREF Divider
6
Div2
16
Interpolator Frequency
800 MHz
1/2
SYSREF
SysRef
31
RFoutB
25 MHz
VCO Calibration
FCAL_LPFD_ADJ
Fpd>=10
FCAL_HPFD_ADJ
Fpd<=100
CAL_CLK_DIV
Fosc<=200
VCO Assist
QUICK_RECAL_EN
Estimate Settings
Start Amplitude
250
Start VCO
VCO1
Start Capcode
50
MASH
MASH_RESET_N
MASH_SYNC_EN
MASH_ORDER
Integer Mode
MASH_SEED
0
PFD_DLY_SEL
1
PHASE SYNCHRONIZATION
VCO_PHASE_SYNC_EN
SYSREF
SYSREF_EN
SYSREF_REPEAT
SYSREF_PULSE
1
SYSREF Delay Control
0
63 0 0 0
Wrote Register R0x4 as 0x04 0A43
Wrote Register R0x3 as 0x03 0642
Wrote Register R0x2 as 0x02 0500
Wrote Register R0x1 as 0x01 0808
Wrote Register R0x0 as 0x00 601C
Protocol: SPI
Connection Mode: USB2ANY
Texas Instruments