

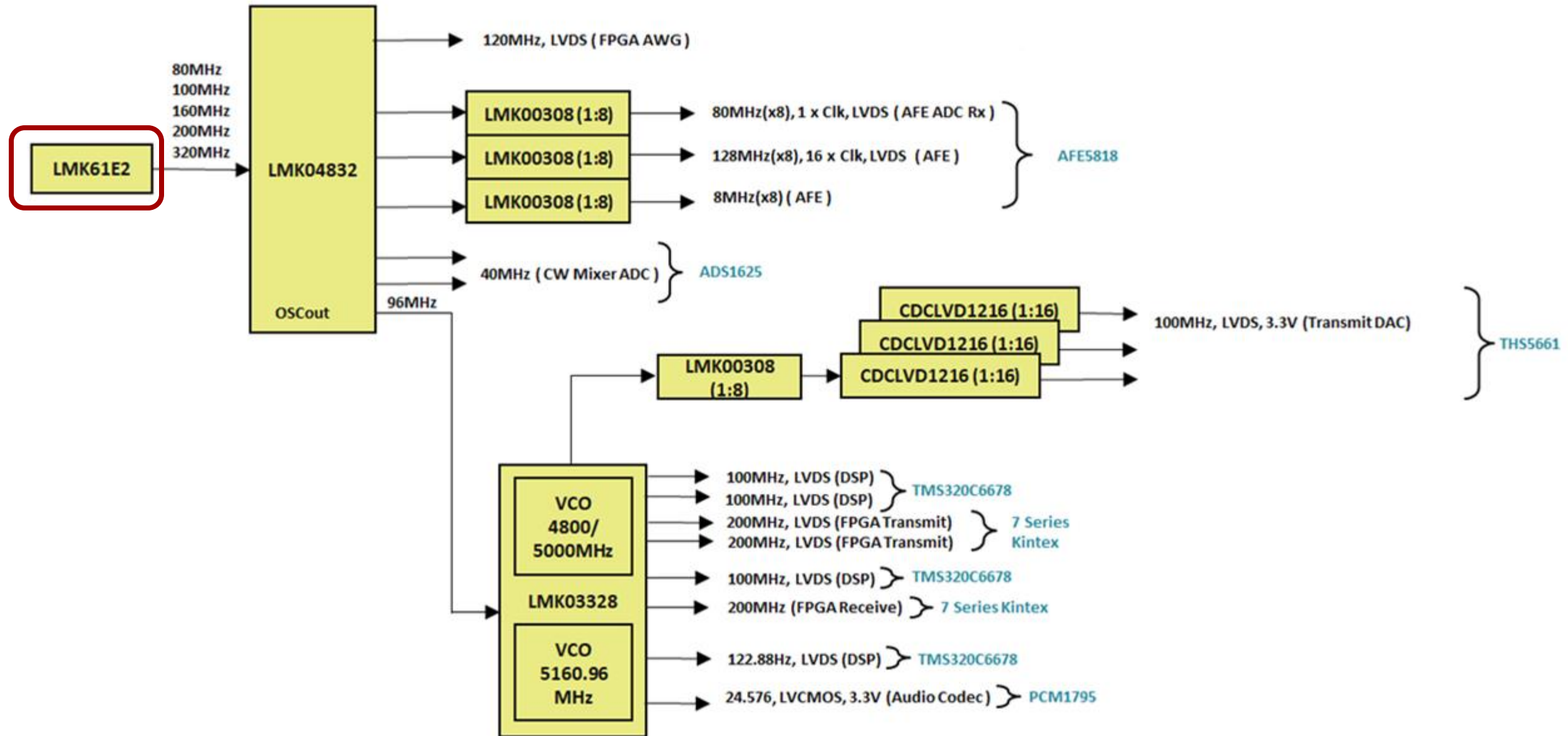
Oscillators: Key parameters and specifications

TI Precision Labs – Oscillators

Presented by Liam Keese

Prepared by Amin Eshraghi

Sample clock tree using an oscillator



Types of oscillators

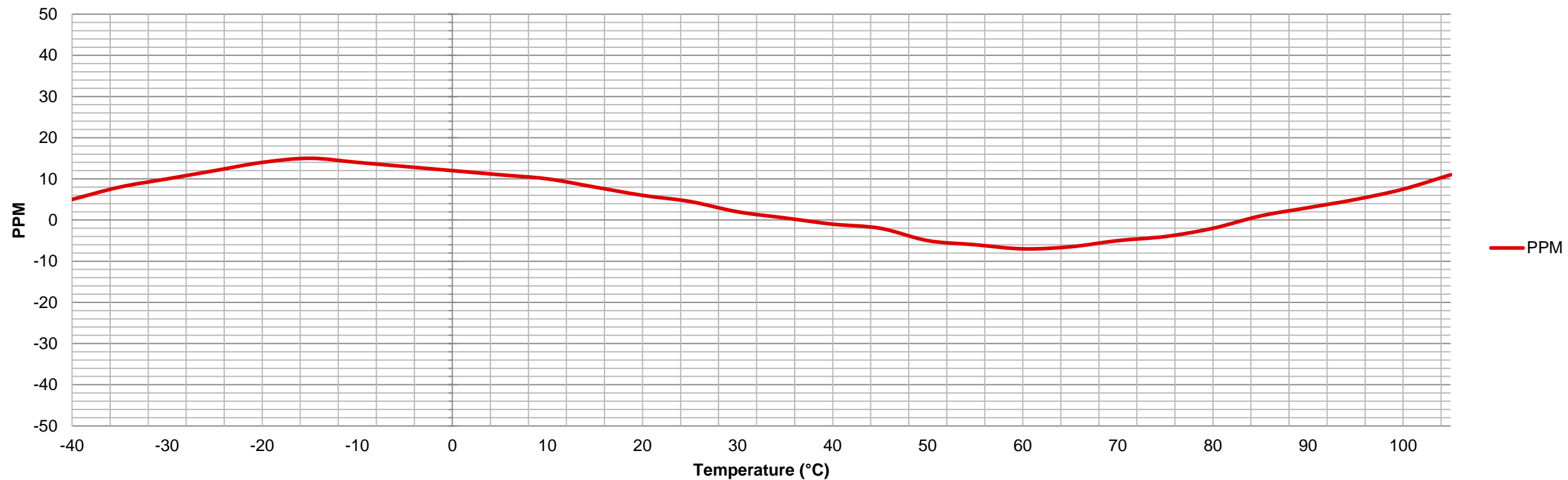
Type	Temperature Range	Typical Frequency Tolerance	Output Waveform	Relative Package Size
XO	0C – 70C -40C – 85C -40C – 105C	+/- 25 ppm to +/- 100 ppm	CMOS, LVDS, LVPECL, most single ended or differential types	Smallest
TCXO (Temp. compensated)	-40C – 85C and beyond	< +/- 2 ppm	Clipped Sinewave, CMOS, other single ended types	Larger
OCXO (Oven compensated)	-40C – 85C and beyond	< +/- 500 ppb	Clipped Sinewave, CMOS, other single ended types	Largest

Key specification – frequency tolerance

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_T Total frequency tolerance	Includes: - Full temperature range - Aging (10 years @ 35C) - Solder reflow	-50		50	PPM

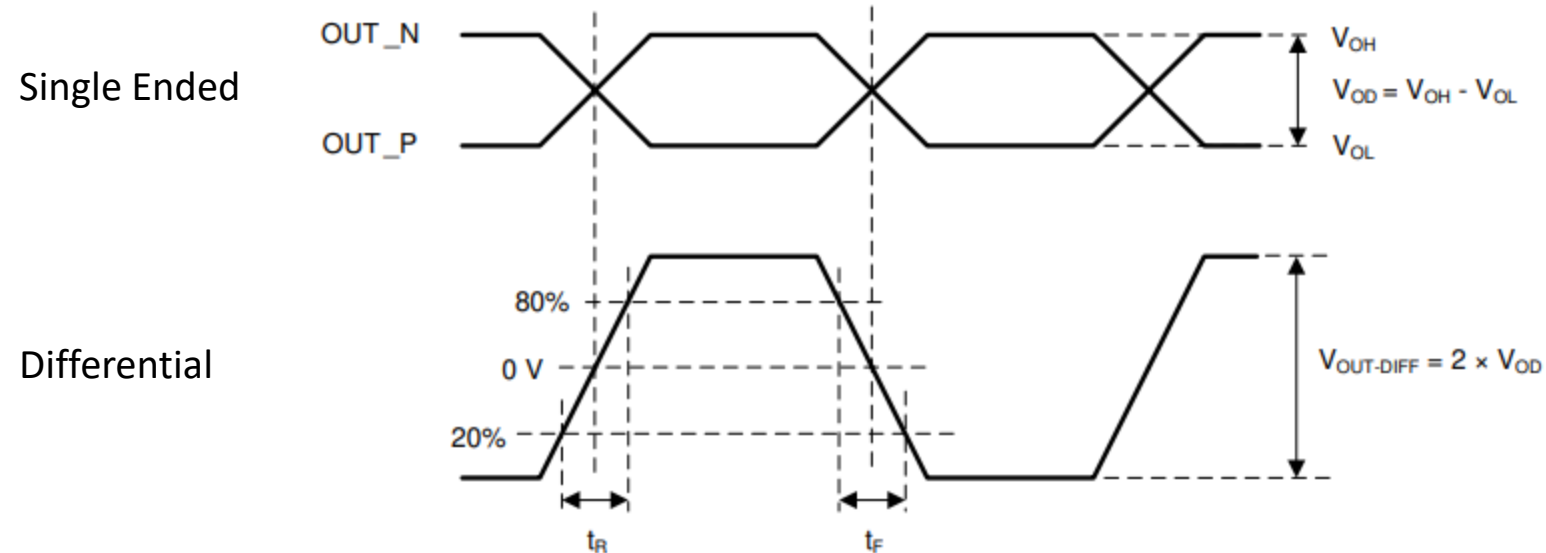
$$\frac{(\text{Measured freq} - \text{Ideal freq})}{\text{Ideal freq}} * 1e6 = \text{PPM offset}$$

Frequency stability over temperature

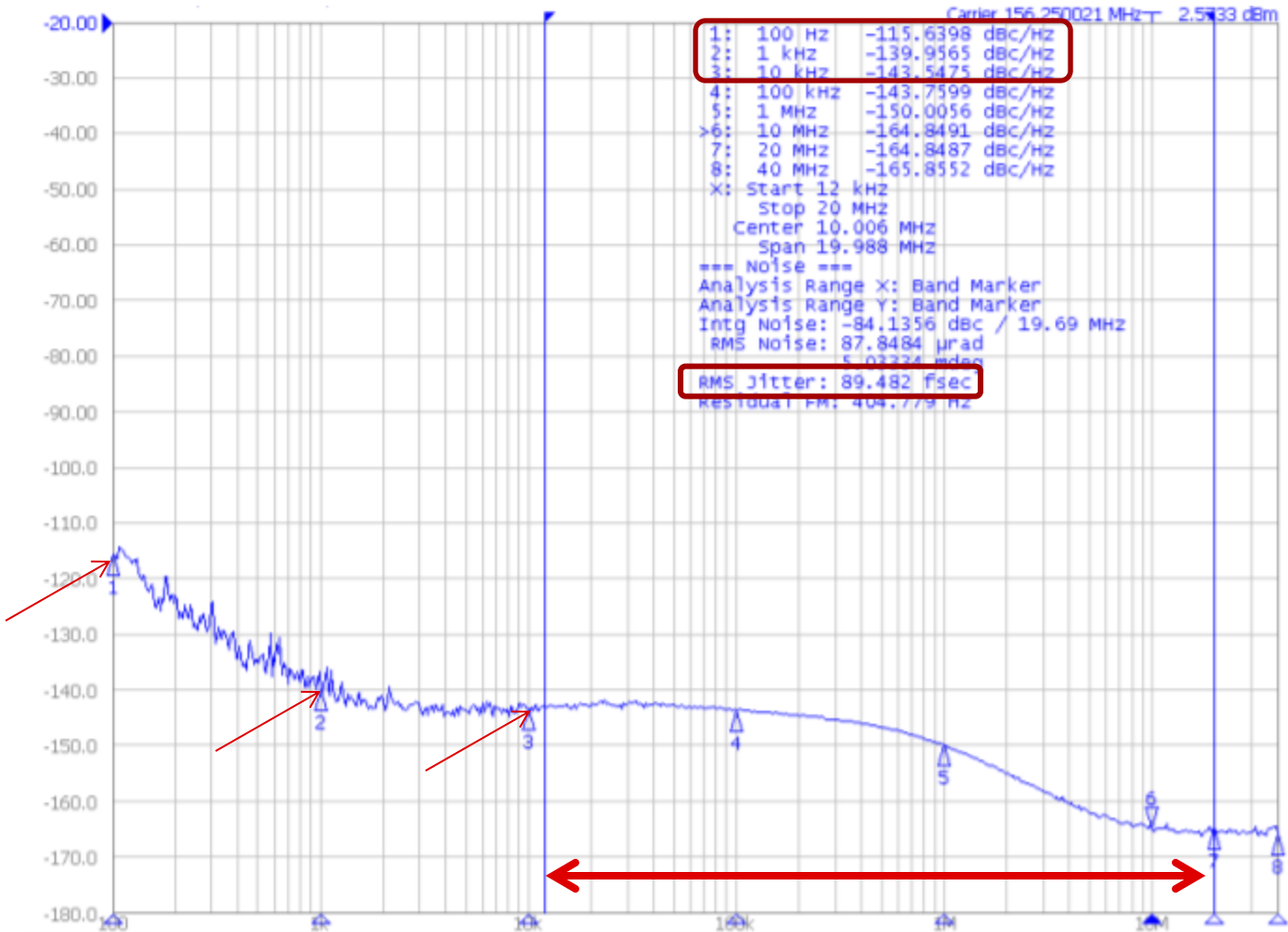


Key specifications – waveform characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{OUT}	Output frequency		10		1000	MHz
V_{OD}	Output voltage swing ($V_{OH} - V_{OL}$) ⁽²⁾		700	800	1200	mV
$V_{OUT, DIFF, PP}$	Differential output peak-to-peak swing			$2 \times V_{OD} $		V
V_{OS}	Output common-mode voltage			$V_{DD} - 1.55$		V
t_R / t_F	Output rise/fall time (20% to 80%)			120	200	ps
PN-Floor	Output phase noise floor ($f_{OFFSET} > 10$ MHz)	156.25 MHz		-165		dBc/Hz
ODC	Output duty cycle		45%		55%	



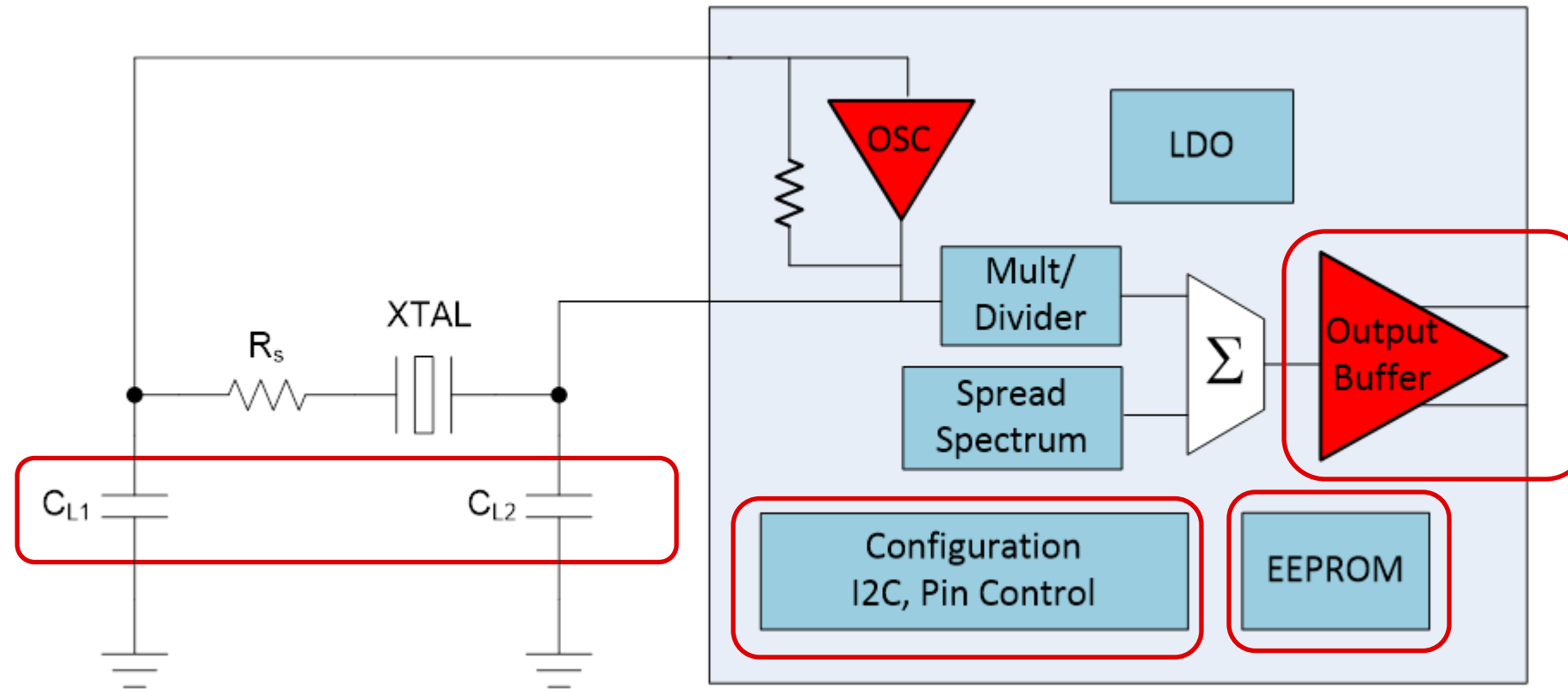
Key specifications – jitter and phase noise



Freq	Jitter 12kHz-20MHz
156.25 MHz	90 fs

Offset	Phase noise
100 Hz	-115 dBc/Hz
1 kHz	-140 dBc/Hz
10 kHz	-144 dBc/Hz

TI oscillator solution block diagram



**To find more oscillators technical
resources and search products, visit
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Oscillators: Key parameters and specifications – Quiz

TI Precision Labs – Clock and Timing

Presented by Liam Keese

Prepared by Amin Eshraghi

Short quiz

1. True or false: Different types of oscillators infer accuracy and stability.
2. True or false: Overall jitter is the only factor for evaluating the phase noise performance of an oscillator.
3. True or false: Total frequency tolerance is frequency stability of an oscillator over temperature.
4. True or false: Output waveform characteristics of an oscillator can be provided in single ended or differential form.
5. True or false: TI's oscillator solution integrates a crystal with a fractional PLL.

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