Silicon Labs

Silicon Labs Timing Solutions for Intel FPGAs

Timing Simplified

Silicon Labs offers a broad portfolio of frequency flexible timing products that enable hardware designers to simplify clock generation, distribution, and jitter attenuation. The portfolio includes:

- Network synchronizers
- Jitter attenuating clocks
- Clock generators
- Clock buffers
- PCIe clocks and buffers
- Oscillators (XO/VCXO)

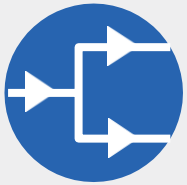
Silicon Labs clocks use proprietary DSPLL and MultiSynth technologies to generate any combination of frequencies with ultra-low jitter, enabling best-in-class clock tree integration. Clock buffers provide low-jitter, low-skew clock distribution with integrated format/voltage level translation. PCIe clocks/buffers combine Gen 1/2/3/4/5 compliance with on-chip series termination, simplifying design. XO/VCXOs are factory- customizable to any frequency, with samples available in one to two weeks.

Oscillators

- Any frequency up to 3 GHz
- Ultra-low jitter: 80 fs RMS
- Short lead times: 1-2 weeks (samples)

Clock Generators

- Any-frequency, any-output
- Ultra-low jitter: 69 fs RMS
- Clock tree on a chip replaces clocks and XOs



Clock Buffers

- Integrated format/level translation
- Ultra-low additive jitter: 50 fs RMS
- PCI Express Gen 1/2/3/4/5 compliant

Jitter Attenuating Clocks/Network Sync

- Any frequency, any output
- Ultra-low jitter: 69 fs RMS
- Clock tree on a chip replaces clocks, XOs, VCXOs

Recommended Timing Solutions vs Intel

*Yes, but without spread spectrum
Note 1: Jitter integration band defined by jitter tolerance mask (receiver CDR) and XCVR PLL multiplying BW (20MHz default)
Note 2: Jitter defined by standard or as budgeted fraction of transmitter eye closure

Industry Standard Interface		Jitter Band [1] (MHz)	Max Jitter[2] (fs rms)	Intel													Silicon Labs											
				Agilex			Stratix				Arria			Cyclone			XO/VCXO				Buffer		Clock Gen				Jitter Atten. Clock	
				F Series	I Series	M Series	10 TX	10 GX/SX	10 MX	V GX/GS	10 GT	10 GX/SX	10 GX	V GX/SX	V GT/ST	Si51x	Si59x	Si54x	Si56x	Si532xx	Si533xx	Si522xx	Si5332	Si5341	Si5391	Si534x/8x	Si539x
OIF	CEI-6G-SR/LR	4-20	630	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	CEI-11G-SR	8-20	380	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓		✓		✓	✓	✓	✓	✓
	CEI-28G-VSR	16-20	150	✓	✓	✓	✓	✓	✓										✓	✓					✓	✓	✓	✓
	CEI-56G-PAM4-MR/LR	4-20	350	✓	✓	✓	✓												✓	✓		✓		✓	✓	✓	✓	✓
	CEI-56G-PAM4-VSR	4-20	240	✓	✓	✓	✓												✓	✓				✓	✓	✓	✓	✓
	CEI-112G-PAM4-VSR	4-20	120(3)		✓	✓													✓	✓						✓		✓
	SFI-5.1	4-20	1300	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	SFI-5.2	4-20	380	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
IEEE 802.3	1000BASE-X (GbE)	0.6-10	3000	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	10GBASE-R	0.6-20	430	✓	✓	✓	✓	✓	✓	✓			✓						✓	✓		✓		✓	✓	✓		✓
	10GBASE-KR	0.6-20	430	✓	✓	✓	✓	✓	✓	✓			✓						✓	✓		✓		✓	✓	✓	✓	✓
	400GAUI-8 C2C	4-20	380	✓	✓	✓	✓												✓	✓		✓		✓	✓	✓	✓	✓
	400GAUI-8 C2M	4-20	275	✓	✓	✓	✓												✓	✓		✓		✓	✓	✓	✓	✓
	CDAUI-16 (400GbE)	4-20	480	✓	✓	✓	✓	✓	✓									✓	✓	✓		✓		✓	✓	✓	✓	✓
	CDAUI-8 (400GbE)	4-20	240	✓	✓	✓	✓												✓	✓				✓	✓	✓	✓	✓
	CAUI-4	1.9-10	280	✓	✓	✓	✓	✓	✓		✓								✓	✓		✓		✓	✓	✓	✓	✓
	CAUI-10	1.9-4	460	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓		✓		✓	✓	✓	✓	✓
	XAUI 10GBASE-X	0.6-20	430	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓			✓	✓		✓		✓	✓	✓	✓	✓
	XLAUI (40GbE)	0.6-20	430	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓			✓	✓		✓		✓	✓	✓	✓	✓
	OTN (OTU/EPON)	0.6-20	430	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓			✓	✓		✓		✓	✓	✓	✓	✓
	SGMII/QSGMII	4-20	1400	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓

*Yes, but without spread spectrum
Note 1: Jitter integration band defined by jitter tolerance mask (receiver CDR) and XCVR PLL multiplying BW (20MHz default)
Note 2: Jitter defined by standard or as budgeted fraction of transmitter eye closure

				Intel												Silicon Labs											
				Agilex			Stratix				Arria		Cyclone			XO/VCXO				Buffer		Clock Gen				Jitter Atten. Clock	
Industry Standard Interface		Jitter Band [1] (MHz)	Max Jitter[2] (fs rms)	F Series	I Series	M Series	10 TX	10 GX/SX	10 MX	V GX/GS	10 GT	10 GX/SX	10 GX	V GX/SX	V GT/ST	Si51x	Si59x	Si54x	Si56x	Si532xx	Si533xx	Si522xx	Si5332	Si5341	Si5391	Si534x/8x	Si539x
Proprietary	RXAUI/DXAUI	1.9-20	950	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
ITU	GPON	0.6-10	1500	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
CPRI	CPRI 10G	various	Various 10G+	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓		✓		✓	✓	✓	✓	✓
	CPRI 12G	various	Various 12G+	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓		✓		✓	✓	✓	✓	✓
	CPRI 24G	various	Various 24G+	✓	✓	✓	✓	✓	✓		✓							✓	✓		✓			✓	✓	✓	✓
INCITS/T11	Fibre Ch – 8G, 16G	0.6-10	240	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓	✓		✓		✓	✓	✓	✓	✓
	Fibre Ch – 32G	0.6-10	130	✓	✓	✓	✓	✓	✓		✓							✓	✓		✓			✓	✓	✓	✓
JEDEC	JESD204B	various	Per DAC/ADC	✓	✓	✓	✓	✓	✓	✓	✓	✓												✓	✓	✓	✓
Intel	Interlaken – 6G	4-20	630	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	Interlaken – 10G	4-20	380	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓		✓		✓	✓	✓	✓	✓
	QPI	Intel	200	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PCI-SIG	PCI Express Gen3	various	1000	✓	✓	✓	✓	✓	✓	✓	✓	✓				*	*	*	*	✓	✓	✓	✓	*	*	*	*
	PCI Express Gen4	various	500	✓	✓	✓										*	*	*	*	✓	✓	✓	✓	*	*	*	*
	PCI Express Gen5	various	150		✓	✓										*	*	*	*	✓	✓	✓	✓	*	*	*	*
CCIX	CCIX-25G	various	350	✓	✓	✓										*	*	*	*	✓	✓		✓	*	*	*	*
SATA-IO	SAS/SATA 6G	2.6-15	780	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	SAS/SATA 12G	2.6-15	390	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓		✓		✓	✓	✓	✓	✓
SMPTE	SDI 3G, 6G	0.1-F/2	800	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	SDI 12G	0.1-F/2	400	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓		✓		✓	✓	✓	✓	✓
	SDI 24G	0.1-F/2	200[3]	✓	✓	✓	✓	✓	✓		✓							✓						✓	✓	✓	✓
RapidIO	RapidIO-1, -2, -3	4-20	410	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	RapidIO-4	1.9-10	290	✓	✓	✓	✓	✓	✓		✓						✓	✓	✓		✓		✓	✓	✓	✓	✓
ITU / Telcordia	SONET/SDH OC-48	1-20	1000	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓		✓	✓	✓	✓	✓
	SONET/SDH OC-192	4-20	240	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓		✓		✓	✓	✓	✓	✓
	SONET/SDH OC-768	16-20	80															✓							✓		✓

Intel FPGA Phase Noise Mask Requirements

Stratix 10 GX/SX Arria 10 GX/SX/GT Stratix V GX/GS/GT Arria V GX/SX		XO			VCXO		Clock Buffer	Clock Generator			Jitter Attenuating Clock		Network Synchronizers (SyncE/1588)
Offset	Phase Noise (156.25 MHz)	Si545	Si540	Si570/ Si53x	Si56x	Si55x	Si5330x	Si5391	Si5341 Si5340	Si5332	Si539x	Si534x	Si5383/48
10 kHz	-112 dBc/Hz	-140 dBc/Hz	-132 dBc/Hz	-128 dBc/Hz	-136 dBc/Hz	-128 dBc/Hz	-140 dBc/Hz	-136 dBc/Hz	-136 dBc/Hz	-126 dBc/Hz	-136 dBc/Hz	-136 dBc/Hz	-137 dBc/Hz
100 kHz	-122 dBc/Hz	-145 dBc/Hz	-139 dBc/Hz	-135 dBc/Hz	-142 dBc/Hz	-133 dBc/Hz	-150 dBc/Hz	-146 dBc/Hz	-141 dBc/Hz	-132 dBc/Hz	-145 dBc/Hz	-141 dBc/Hz	-145 dBc/Hz
1 MHz	-132 dBc/Hz	-152 dBc/Hz	-151 dBc/Hz	-144 dBc/Hz	-150 dBc/Hz	-144 dBc/Hz	-154 dBc/Hz	-149 dBc/Hz	-150 dBc/Hz	-154 dBc/Hz	-150 dBc/Hz	-150 dBc/Hz	-150 dBc/Hz

Arria V GT/ST		XO			VCXO		Clock Buffer	Clock Generator			Jitter Attenuating Clock		Network Synchronizers (SyncE/1588)
Offset	Phase Noise (156.25 MHz)	Si545	Si540	Si570/ Si53x	Si56x	Si55x	Si5330x	Si5391	Si5341 Si5340	Si5332	Si539x	Si534x	Si5383/48
10 kHz	-120 dBc/Hz	-140 dBc/Hz	-132 dBc/Hz	-128 dBc/Hz	-136 dBc/Hz	-128 dBc/Hz	-140 dBc/Hz	-136 dBc/Hz	-136 dBc/Hz	-126 dBc/Hz	-136 dBc/Hz	-136 dBc/Hz	-137 dBc/Hz
100 kHz	-120 dBc/Hz	-145 dBc/Hz	-139 dBc/Hz	-135 dBc/Hz	-142 dBc/Hz	-133 dBc/Hz	-150 dBc/Hz	-146 dBc/Hz	-141 dBc/Hz	-132 dBc/Hz	-145 dBc/Hz	-141 dBc/Hz	-145 dBc/Hz
1 MHz	-130 dBc/Hz	-152 dBc/Hz	-151 dBc/Hz	-144 dBc/Hz	-150 dBc/Hz	-144 dBc/Hz	-154 dBc/Hz	-149 dBc/Hz	-150 dBc/Hz	-154 dBc/Hz	-150 dBc/Hz	-150 dBc/Hz	-150 dBc/Hz

Intel FPGA Phase Noise Mask Requirements

Agilex E-Tile		XO			VCXO		Clock Buffer	Clock Generator			Jitter Attenuating Clock		Network Synchronizers (SyncE/1588)
Offset	Phase Noise (156.25 MHz)	Si545	Si540	Si570/ Si53x	Si56x	Si55x	Si5330x	Si5391	Si5341 Si5340	Si5332	Si539x	Si534x	Si5383/48
10 kHz	-130 dBc/Hz	-140 dBc/Hz	-132 dBc/Hz	-128 dBc/Hz	-136 dBc/Hz	-128 dBc/Hz	-140 dBc/Hz	-136 dBc/Hz	-136 dBc/Hz	-126 dBc/Hz	-136 dBc/Hz	-136 dBc/Hz	-137 dBc/Hz
100 kHz	-138 dBc/Hz	-145 dBc/Hz	-139 dBc/Hz	-135 dBc/Hz	-141 dBc/Hz	-133 dBc/Hz	-150 dBc/Hz	-146 dBc/Hz	-141 dBc/Hz	-132 dBc/Hz	-141 dBc/Hz	-141 dBc/Hz	-145 dBc/Hz
1 MHz	-140 dBc/Hz	-152 dBc/Hz	-151 dBc/Hz	-144 dBc/Hz	-150 dBc/Hz	-144 dBc/Hz	-154 dBc/Hz	-149 dBc/Hz	-160 dBc/Hz	-154 dBc/Hz	-160 dBc/Hz	-160 dBc/Hz	-160 dBc/Hz

For more information, visit **silabs.com/timing**