IDT CLOCKS FOR ALTERA'S STRATIX V AND ARRIA V/X FPGAS

INTRODUCTION

IDT's family of high-performance jitter attenuator and clock generator solutions optimize our customers' applications in key markets. These products are part of a portfolio specifically designed with ultra-low phase noise and jitter performance in mind. This makes them ideal for meeting the stringent timing requirements for Altera's Stratix® V and Arria® V/Arria X FPGAs used in communications, data center, industrial and broadcast video applications.

MEETING TOUGH PHASE NOISE REQUIREMENTS

Tables 1 through 4, below, show the phase noise mask and corresponding RMS phase jitter requirements for the SERDES Transmitter Ref Clock required by the different Altera® FPGAs (Arria V/X and Stratix V). In table 1, the spec shown for Arria 5 GT/ST/GX/SX Ref Clock is the same for all frequencies. Tables 2, 3 and 4 summarize the 622 MHz ref clock specification for the rest of the Altera transceiver offerings and calculates the requirements at different frequencies by adjusting the specified value at 622 MHz by an amount equal to 20*log (f/622).

Table 1

Arria V GT/ST/GX/SX REFCLK Phase Noise Mask						
Frequency	622 MHz	312.5 MHz	200 MHz	156.25 MHz	125 MHz	100 MHz
Phase Noise @ Offset	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)
10 Hz	-50	-50	-50	-50	-50	-50
100 Hz	-80	-80	-80	-80	-80	-80
1 KHz	-110	-110	-110	-110	-110	-110
10 KHz	-120	-120	-120	-120	-120	-120
100 KHz	-120	-120	-120	-120	-120	-120
1 MHz	-130	-130	-130	-130	-130	-130
Corresponding RMS Phase Jitter	2.57 pS (10 Hz to 1 MHz)	5.11 pS (10 Hz to 1 MHz)	7.99 pS (10 Hz to 1 MHz)	10.22 pS (10 Hz to 1 MHz)	12.78 pS (10 Hz to 1 MHz)	15.97 pS (10 Hz to 1MHz)

Table 2

Stratix V Transmitter REFCLK Phase Noise Mask						
Frequency	622 MHz	312.5 MHz	200 MHz	156.25 MHz	125 MHz	100 MHz
Phase Noise @ Offset	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)
100 Hz	-70	-75.98	-79.86	-81.99	-83.94	-85.87
1 KHz	-90	-95.98	-99.86	-101.99	-103.94	-105.87
10 KHz	-100	-105.98	-109.86	-111.99	–113.94	-115.87
100 KHz	-110	-115.98	-119.86	-121.99	-123.94	-125.87
1 MHz	-120	-125.98	-129.86	-131.99	-133.94	-135.87
Corresponding RMS Phase Jitter	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1MHz)

Table 3

Arria 10 Transmitter REFCLK Phase Noise Mask						
Frequency	622 MHz	312.5 MHz	200 MHz	156.25 MHz	125 MHz	100 MHz
Phase Noise @ Offset	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)
100 Hz	-70	-75.98	-79.86	-81.99	-83.94	-85.87
1 KHz	-90	-95.98	-99.86	-101.99	-103.94	–105.87
10 KHz	-100	-105.98	-109.86	-111.99	-113.94	-115.87
100 KHz	-110	-115.98	-119.86	-121.99	-123.94	-125.87
1 MHz	-120	-125.98	-129.86	-131.99	-133.94	-135.87
Corresponding RMS Phase Jitter	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)

Table 4

Arria V GZ Transmitter REFCLK Phase Noise Mask						
Frequency	622 MHz	312.5 MHz	200 MHz	156.25 MHz	125 MHz	100 MHz
Phase Noise @ Offset	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)	Phase Noise (dBc/Hz)
100 Hz	-70	-75.98	-79.86	-81.99	-83.94	-85.87
1 KHz	-90	-95.98	-99.86	-101.99	-103.94	-105.87
10 KHz	-100	-105.98	-109.86	-111.99	–113.94	-115.87
100 KHz	-110	-115.98	-119.86	-121.99	-123.94	-125.87
1 MHz	-120	-125.98	-129.86	-131.99	-133.94	-135.87
Corresponding RMS Phase Jitter	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)	1.44 pS (100 Hz to 1 MHz)

IDT's Third Generation Universal Frequency Translator FemtoClock® NG jitter attenuators and synthesizers, as well as VersaClock® 5 and VersaClock® 6 programmable clocks and XU crystal oscillators, are a perfect fit to meet the requirements set forth for these FPGAs.

Our portfolio includes devices which offer:

- Translations from virtually any input frequency to any output frequency
- Up to eight independently-programmable clocking outputs with the flexibility to generate eight different frequencies
- Ultra-low phase jitter of less than 100 fs RMS (12 kHz to 20 MHz)

These industry-leading, stand-alone devices deliver reliable, solid jitter performance in many different applications and provide jitter attenuation and consistent phase noise performance at any loop bandwidth setting. Table 5 shows select IDT devices that exceed Altera's specification requirements.

Table 5

	RMS Phase Jitter (typ)	Tr/Tf (max)	Inputs	Input Freq (MHz)	Outputs	Output Type	Output Voltage (V)	Output Frequency (MHz)	Jitter Attenuator Mode
8T49NS010	84 fs	130 ps	XTAL or REF	25 to 100	10	LVPECL	3.3	100 to 2500	
8T49N00X	228 fs	400 ps	XTAL or REF	10 to 312.5	4, 6, 8	LVPECL or LVDS	2.5, 3.3	15.16 to 1250	
8T49N285 8T49N286 8T49N287	<300 fs	400 ps (LVDS)	XTAL or REF (2)	0.008 to 875	8	LVDS, LVPECL, HCSL, LVCMOS	3.3, 2.5	0.008 to 1000	✓
8T49N241 8T49N242	<350 fs	350 ps	XTAL or REF (2)	0.008 to 875	4	LVDS, LVPECL, HCSL, LVCMOS	3.3, 2.5	0.008 to 1000	✓
5P49V5901	750 fs	400 ps typ	XTAL or REF	1 to 200	4	LVDS, LVPECL, HCSL, LVCMOS	3.3, 2.5, or 1.8	1 to 350	
5P49V6901	500 fs	400 typ	XTAL or REF	1 to 350	4	LVDS, LVPECL, HCSL, LVCMOS	3.3, 2.5, or 1.8	1 to 350	
XUP, XUL Oscillators	300 fs	400 fs	NA	NA	1	LVDS, LVPECL,	3.3, 2.5, or 1.8	0.016 to 1500	

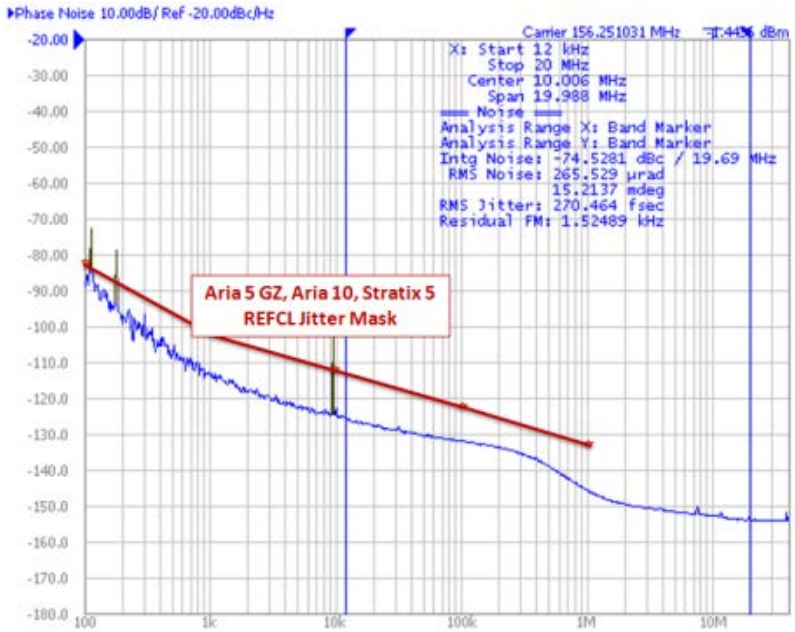
Table 6, following, highlights a direct comparison of the devices in table 5 vs. the specifications for the Stratix V/Arria X and Arria V FPGAs at 156.25 MHz. Figures 1, 2 and 3 show the overall jitter performance of IDT's solution against the specific jitter mask required for each Altera FPGA. These results clearly show that IDT's line of jitter attenuators and clock generators not only meets the requirements, but greatly exceed the requirements in all cases.

Table 6

Summary of Requirements and IDT Solutions for 156.25 MHz			Universal Frequency Translator 3G	FemtoClock NG Universal Frequency Translator	Universal Synth.	Differential Synth.	VersaClock 5	VersaClock 6	IDT XU Crystal Oscillator Family
PHASE NOISE	Arria V GT/ST GX/SX (dBc/Hz)	Arria V GZ Arria 10 Stratix V (dBc/Hz)	8T49N28x 8 Outputs 72/56-QFN	8T49N24x 4 Outputs 40-QFN	8T49N00x 4/6/8 outputs 32/40/40-QFN	8T49NS010 10 outputs 32/40/40-QFN	5P49V5901 9 output pins 24-QFN	5P49V6901 9 output pins 24-QFN	IDT XU 6-pin 5032, 7050
10 Hz	-50	not spec.			-68	-77			
100 Hz	-80	-81.99	-88	-88	-97	-106			
1 KHz	-110	-101.99	-113	-113	-121	-124	-113	-117	
10 KHz	-120	-111.99	-125	-125	-130	-136	-121	-124	-129
100 KHz	-120	-121.99	-134	-134	-136	-143	-127	-130	-133
1 MHz	-130	-131.99	-147	-147	-140	-156	-137	-136	-147
RMS PHASE JITTER (100 Hz to 1 MHz)	1,319 fs	1,443 fs	512 fs	512 fs	258 fs	102 fs			
RMS PHASE JITTER (1 KHz to 1 MHz)	844 fs	951 fs	223 fs	223 fs	195fs	71 fs	434 fs	351 fs	
RMS PHASE JITTER (10 KHz to 1 MHz)	815 fs	777 fs	175 fs	175 fs	184 fs	58 fs	397 fs	331 fs	169 fs

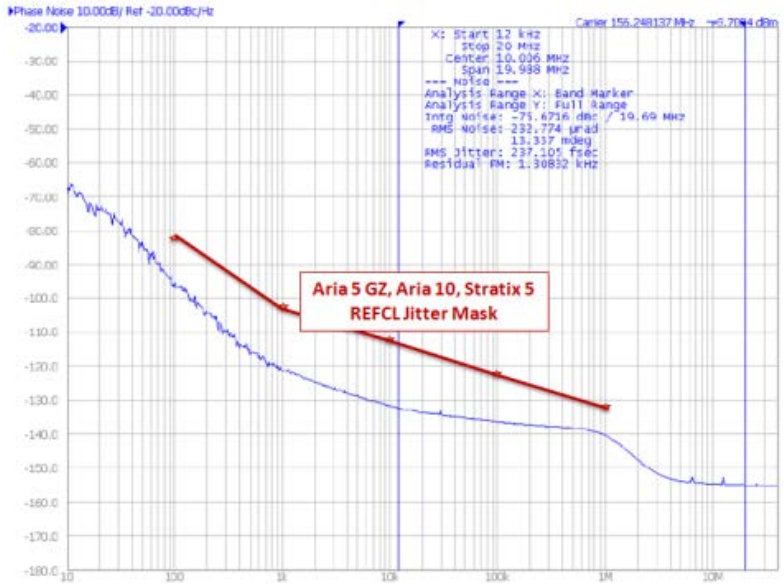
IDT Performance @ 156.25 MHz vs Altera Defined Mask

Figure 1



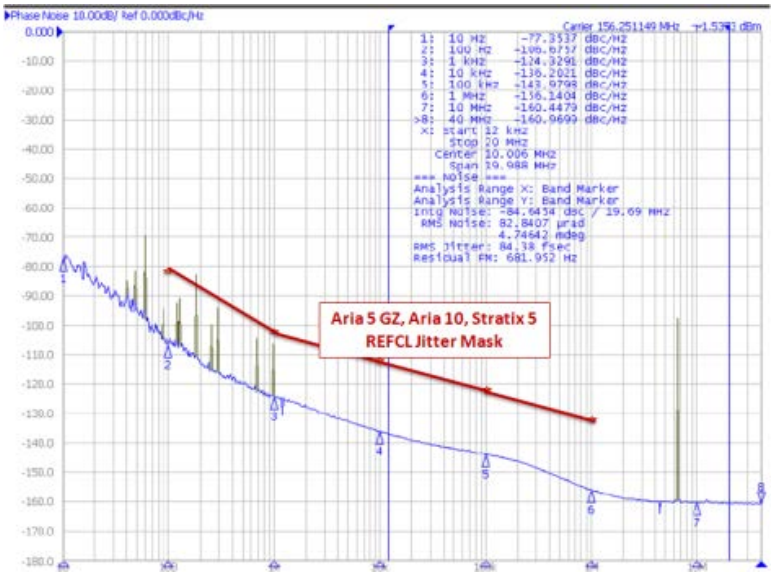
Universal Frequency Translator 3G @156.25 MHz

Figure 2



8T49N00X @ 156.25 MHz

Figure 3



8T49NS010 @ 156.25 MHz

CONCLUSION

IDT is the world leader in silicon timing solutions boasting the largest portfolio of devices with mixed I/Os, voltage levels and frequencies. IDT's broad portfolio of timing devices satisfies timing budget requirements when designing around an FPGA. The Third Generation Universal Frequency Translator, Femtoclock NG, VersaClock 5, VersaClock 6 and XU crystal oscillator families of devices delivers the reliable, solid jitter performance required by Altera's line of Stratix and Arria FPGAs. The high performance APLL design implemented in these devices not only helps meet, but also helps customers exceed the requirements in most cases, adding margin and reliability to their design. This allows designers to worry less about the timing portion of their design, freeing up their time to focus attention on other areas of concern. This is just another reason why IDT consistently delivers extraordinary value to its customers.