

# Experiment #3 – Function Generator

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## I. WAVEFORM GENERATOR

### A) Analysis & Synthesis

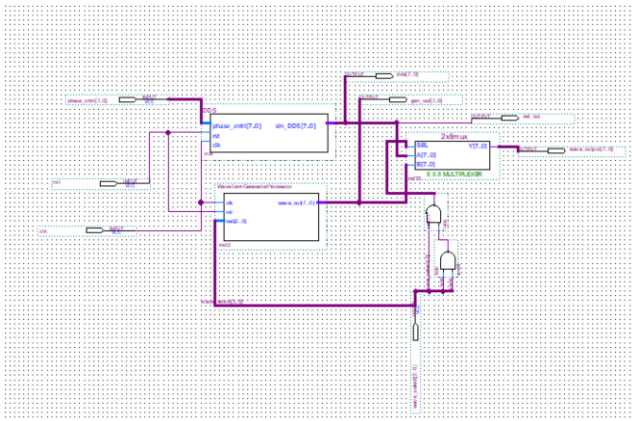


Fig. 1

Flow Summary		
Flow Status		
Flow Status	Successful - Sat May 22 02:38:09 2021	
Flow Settings	Quartus Prime Version	20.1.0 Build 711 06/05/2020 SJ Lite Edition
Flow Non-Default Global Settings	Revision Name	FunctionGenerator
Flow Elapsed Time	Top-level Entity Name	FunctionGenerator
Flow OS Summary	Family	Cyclone IV E
Flow Log	Device	EP4CE6E22C6
Analysis & Synthesis	Timing Models	Final
Fitter	Total Timing Models	265 / 6,272 (4 %)
Assembler	Total registers	79
Timing Analyzer	Total pins	38 / 92 (41 %)
EDA Netlist Writer	Total virtual pins	0
Flow Messages	Total memory bits	2,048 / 276,480 (< 1 %)
Flow Suppressed Messages	Embedded Multiplier 9-bit elements	0 / 30 (0 %)
	Total PLLs	0 / 2 (0 %)

Fig. 2

### B) Function Generator waveforms

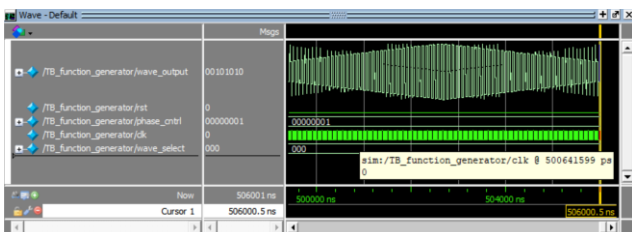


Fig. 3 Rhomboid waveform

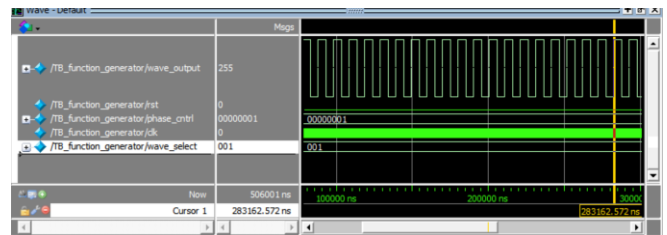


Fig. 4 Square waveform

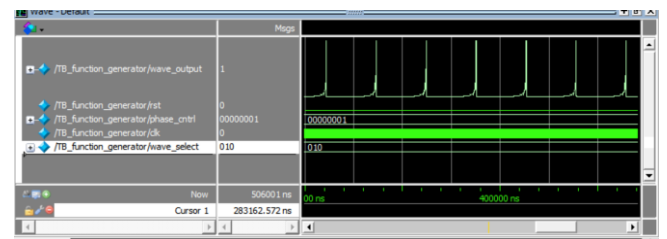


Fig. 5 Reciprocal waveform

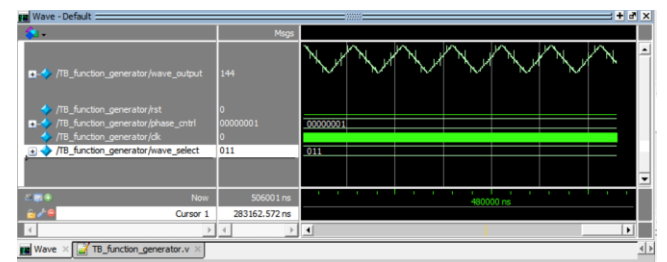


Fig. 6 Triangle waveform

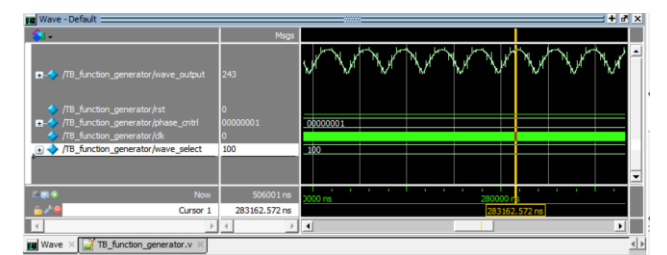


Fig. 7 Full-wave rectified

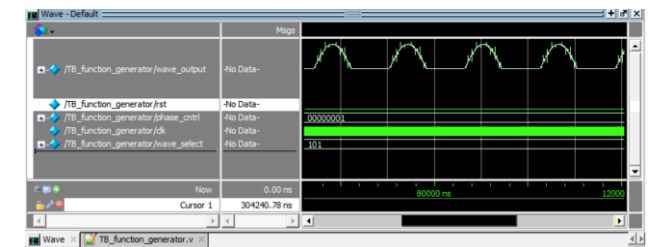


Fig. 8 Half-wave rectified

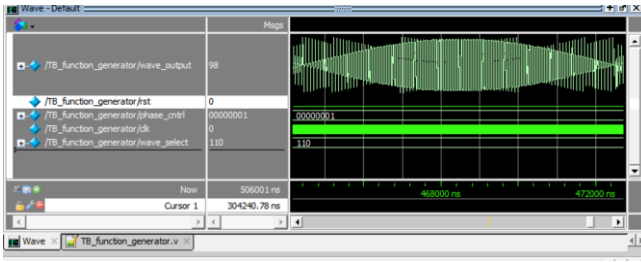


Fig. 9 Sinusoidally modulated square wave

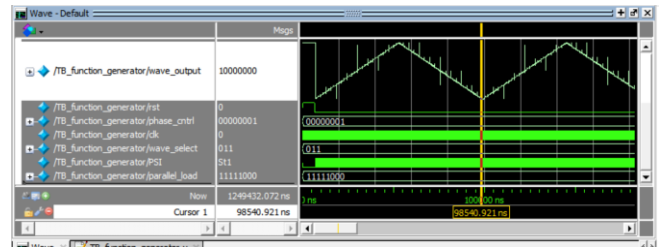


Fig. 13

### B) Different frequencies by phase\_ctrl

1. Phase\_ctrl is 3 and the desired Frequency is 2306Hz and achieved frequency is 1500Hz

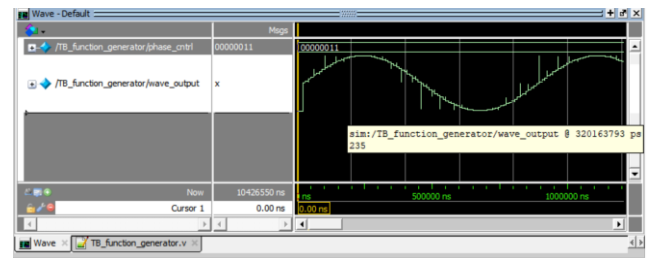


Fig. 14

2. Phase\_ctrl is 7 and the desired Frequency is 5382Hz and achieved frequency is 3356Hz

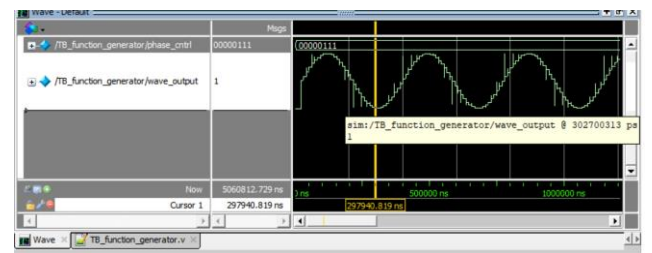


Fig. 15

3. Phase\_ctrl is 15 and the desired Frequency is 11534Hz and achieved frequency is 6067Hz

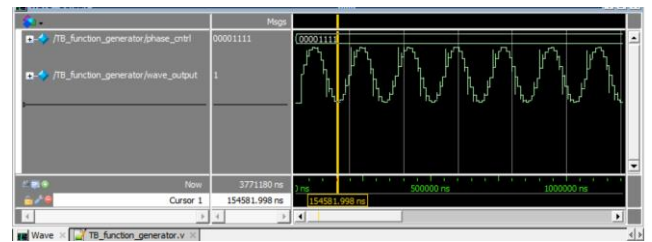


Fig. 16

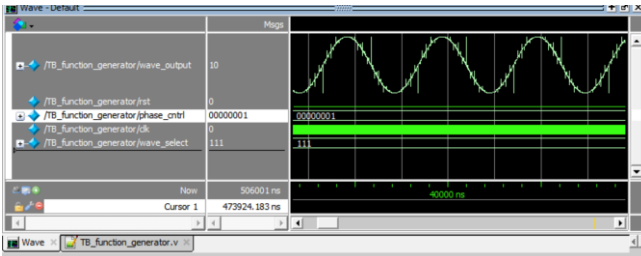


Fig. 10 DDS waveform

## II. FREQUENCY SELECTOR

### A) Different frequencies by clock divider

1. Parallel load is 1 and the desired Frequency is 382Hz and achieved frequency is 384Hz

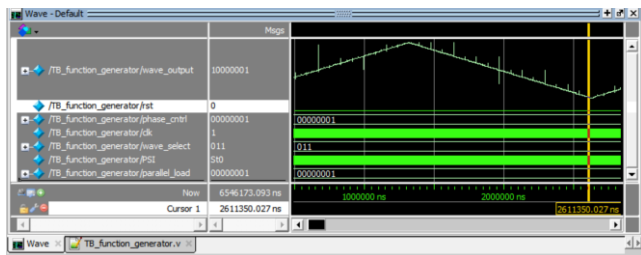


Fig. 11

2. Parallel load is 254 and the desired Frequency is 11kHz and achieved frequency is 12kHz

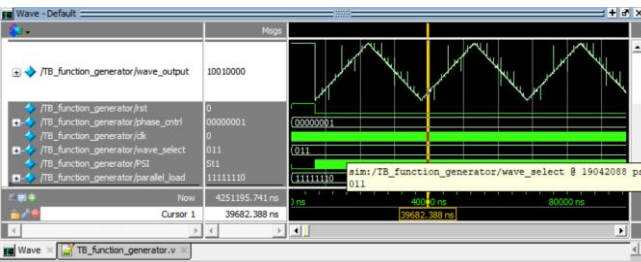


Fig. 12

3. Parallel load is 248 and the desired Frequency is 25kHz and achieved frequency is 32kHz

## III. AMPLITUDE SELECTOR

### A) Whole design

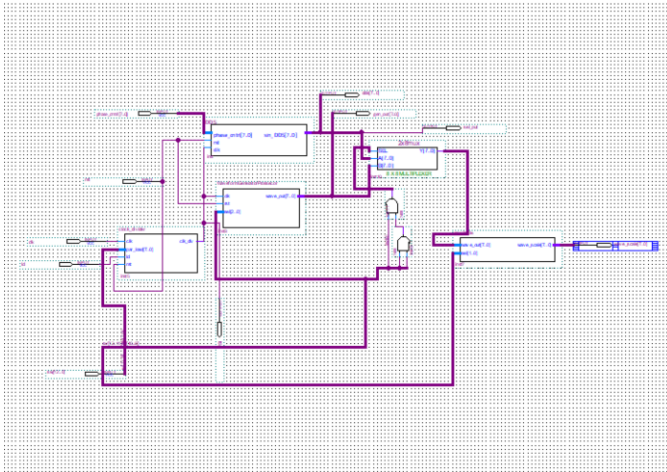


Fig. 17

### B) Different Amplitude waveforms

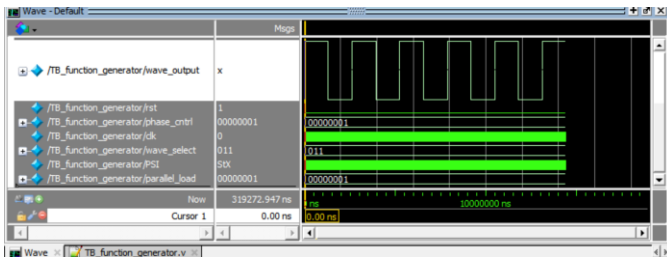


Fig. 18 Amplitude=1

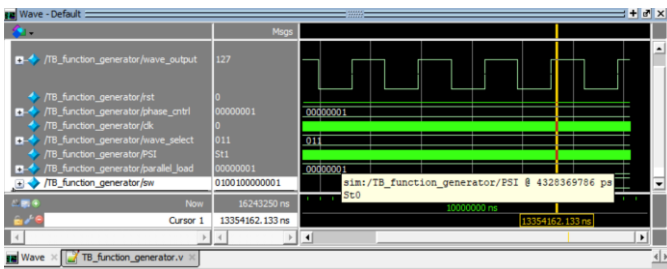


Fig. 19 Amplitude=2

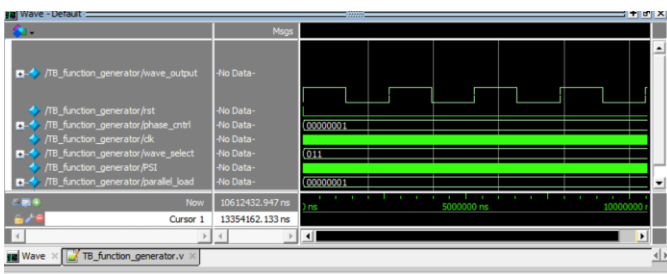


Fig. 20 Amplitude=4

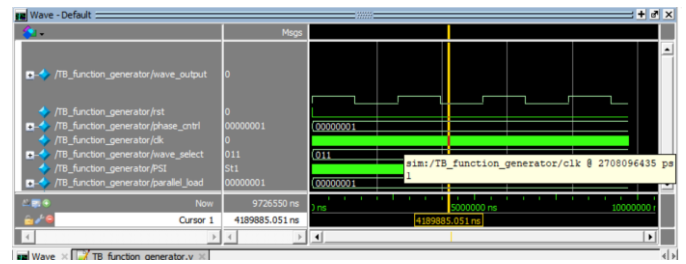


Fig. 21 Amplitude=8