Electronic Organ

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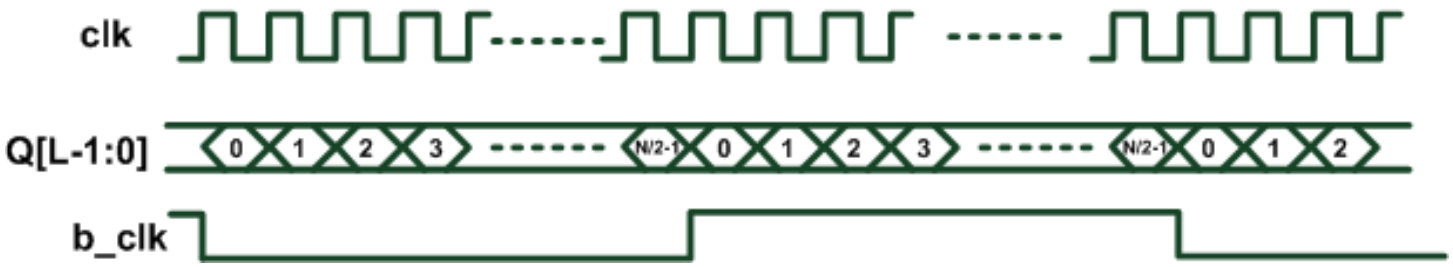
Note Generation

- The buzzer frequency is obtained by dividing crystal frequency 40MHz by N.
- The buzzer clock (b_clk) is periodically inverted for every N/2 clock cycles. (***determine the sound***)
- Note frequency
  - Mid Do: 261 Hz
  - Mid Re: 293 Hz
  - Mid Mi: 330 Hz



Note Frequency Table

Tone	Do	Re	Me	Fa	So	La	Si
Low (Hz)						220	245
Mid (Hz)	261	293	330	349	392	440	494
High (Hz)	524	588	660	698	784	880	988

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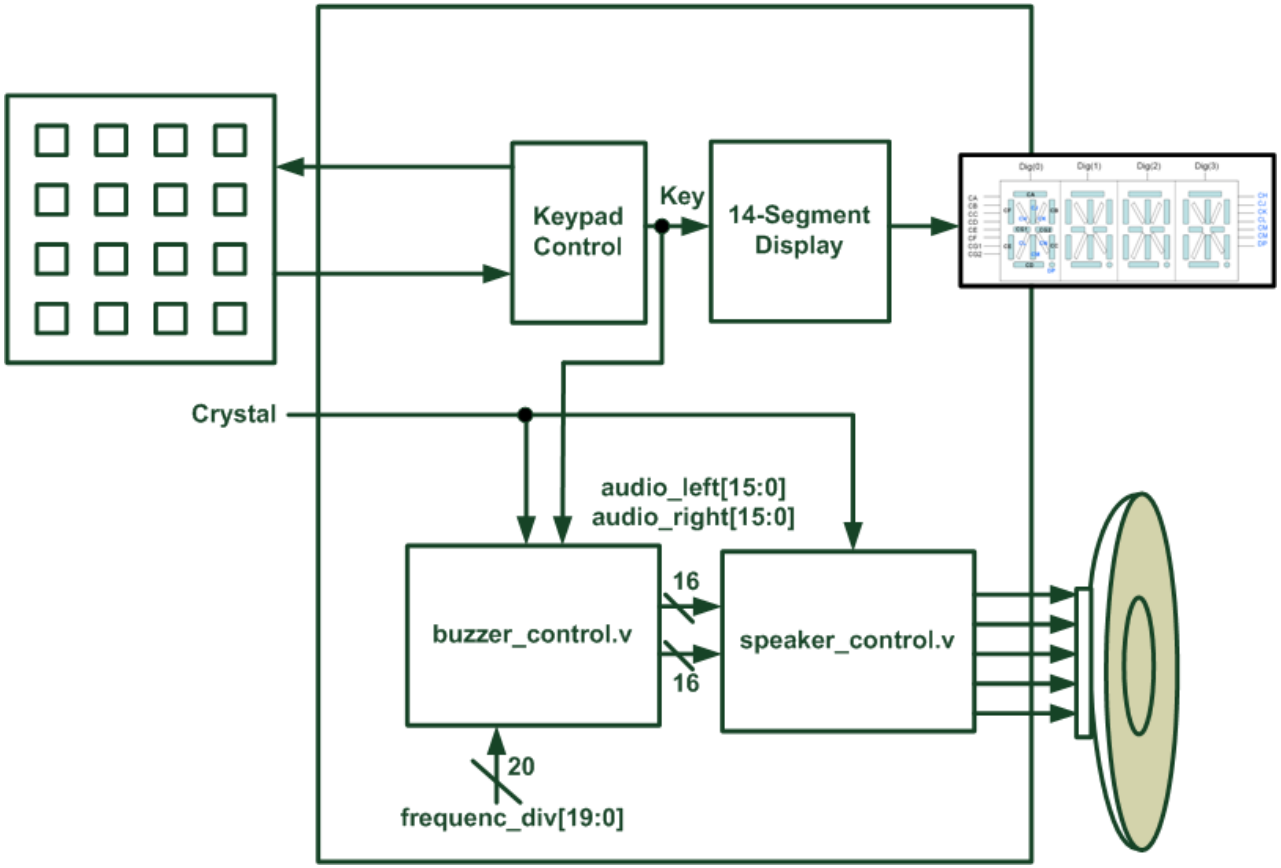

Buzzer Control

```
module buzzer_control(
  clk, // clock from crystal
  rst_n, // active low reset
  note_div, // div for note generation
  audio_left, // left sound audio
  audio_right // right sound audio
);

// I/O declaration
input clk; // clock from crystal
input rst_n; // active low reset
input [19:0] note_div; // div for note generation
output [15:0] audio_left; // left sound audio
output [15:0] audio_right; // right sound audio

// Declare internal signals
reg [19:0] clk_cnt_next, clk_cnt;
reg b_clk, b_clk_next;
```

```
// Note frequency generation
always @(posedge clk or negedge rst_n)
  if (~rst_n)
  begin
    clk_cnt <= 20'd0;
    b_clk <= 1'b0;
  end
  else
  begin
    clk_cnt <= clk_cnt_next;
    b_clk <= b_clk_next;
  end
always @*
  if (clk_cnt == note_div)
  begin
    clk_cnt_next = 20'd0;
    b_clk_next = ~b_clk;
  end
  else
  begin
    clk_cnt_next = clk_cnt + 1'b1;
    b_clk_next = b_clk;
  end

// Assign the amplitude of the note
assign audio_left = (b_clk == 1'b0) ? 16'h4000 : 16'h3FFF;
assign audio_right = (b_clk == 1'b0) ? 16'h4000 : 16'h3FFF;


endmodule
```