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1  --
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2  --                               Modulador Digital
3  --
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4  --  Título:                      Digital direct Synthetizer - DDS
5  --
  -----
6  --  Autor:                       Jorge Tonfat
7  --
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8  --  Descripción:                  sintetizador digital directo
9  --
  -----
10 --  Señales de control:
11 --
  -----
12 --  Nombre:                       dds
13 --
  -----
14 --  Fecha de creación:            29/08/2007
15 --  Última modificación:          31/10/2007
16 --
  -----
17
18
19 --
  -----
20 --  Declaración del paquete de componentes
21
22 library ieee;
23 use ieee.std_logic_1164.all;
24 use ieee.std_logic_arith.all;
25 use ieee.std_logic_unsigned.all;
26
27 entity dds is
28
29 generic (
30
31     ancho_palabra_in : natural := 32;
32     ancho_palabra_out : natural := 10;
33     bits_nousados : natural := 24
34 );
35 port (
36     CLOCK_50:      in std_logic;
37     reset_n:       in std_logic;
38     delta_fase:    in std_logic_vector(ancho_palabra_in -1
39 downto 0);
40     salida:        buffer std_logic_vector(ancho_palabra_out
41 -1 downto 0)
```

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40
41     );
42 end dds;
43
44 architecture estructural of dds is
45
46     signal rom_addr : std_logic_vector(ancho_palabra_in -
47     bits_nousados -1 downto 0);
48     signal acc_out : std_logic_vector(ancho_palabra_in -1 downto 0);
49     signal pre_salida: std_logic_vector(ancho_palabra_out -1 downto 0)
50
51
52
53 begin
54
55
56
57     process (CLOCK_50,reset_n)
58     begin
59         if reset_n ='0' then
60             acc_out<=(others=>'0');
61
62             elsif RISING_EDGE (CLOCK_50) then
63
64                 acc_out <= delta_fase + acc_out;
65
66             end if;
67
68     end process;
69
70
71
72     rom_addr <= acc_out(ancho_palabra_in -1 downto (bits_nousados) );
73
74     --reg_salida: process (CLOCK_50, reset_n)
75     --begin
76     -- -- Reset whenever the reset signal goes low, regardless of
77     -- the clock
78     -- if (reset_n = '0') then
79     --     salida <= (others=>'0');
80     -- -- If not resetting, update the register output on the
81     -- clock's falling edge
82     -- elsif (rising_edge(CLOCK_50)) then
83     --     salida <= pre_salida;
84     -- end if;
85     --end process;
86
87     rom_block: process (CLOCK_50) -- generado utilizando MATLAB
88
89     begin
90         IF rising_edge (CLOCK_50) THEN
91             case rom_addr is
92                 when "00000000" => pre_salida <= "0000000000";
93                 when "00000001" => pre_salida <= "0000001100";
94                 when "00000010" => pre_salida <= "0000011001";
95                 when "00000011" => pre_salida <= "0000100101";
```

```
196 when "00000100" => pre_salida <= "0000110010";
197 when "00000101" => pre_salida <= "0000111110";
198 when "00000110" => pre_salida <= "0001001010";
199 when "00000111" => pre_salida <= "0001010111";
200 when "00001000" => pre_salida <= "0001100011";
201 when "00001001" => pre_salida <= "0001101111";
202 when "00001010" => pre_salida <= "0001111100";
203 when "00001011" => pre_salida <= "0010001000";
204 when "00001100" => pre_salida <= "0010010100";
205 when "00001101" => pre_salida <= "0010100000";
206 when "00001110" => pre_salida <= "0010101100";
207 when "00001111" => pre_salida <= "0010110111";
208 when "00010000" => pre_salida <= "0011000011";
209 when "00010001" => pre_salida <= "0011001111";
210 when "00010010" => pre_salida <= "0011011010";
211 when "00010011" => pre_salida <= "0011100101";
212 when "00010100" => pre_salida <= "0011110000";
213 when "00010101" => pre_salida <= "0011111011";
214 when "00010110" => pre_salida <= "0100000110";
215 when "00010111" => pre_salida <= "0100010001";
216 when "00011000" => pre_salida <= "0100011011";
217 when "00011001" => pre_salida <= "0100100110";
218 when "00011010" => pre_salida <= "0100110000";
219 when "00011011" => pre_salida <= "0100111010";
220 when "00011100" => pre_salida <= "0101000100";
221 when "00011101" => pre_salida <= "0101001101";
222 when "00011110" => pre_salida <= "0101010111";
223 when "00011111" => pre_salida <= "0101100000";
224 when "00100000" => pre_salida <= "0101101001";
225 when "00100001" => pre_salida <= "0101110010";
226 when "00100010" => pre_salida <= "0101111010";
227 when "00100011" => pre_salida <= "0110000010";
228 when "00100100" => pre_salida <= "0110001011";
229 when "00100101" => pre_salida <= "0110010010";
230 when "00100110" => pre_salida <= "0110011010";
231 when "00100111" => pre_salida <= "0110100001";
232 when "00101000" => pre_salida <= "0110101000";
233 when "00101001" => pre_salida <= "0110101111";
234 when "00101010" => pre_salida <= "0110110110";
235 when "00101011" => pre_salida <= "0110111100";
236 when "00101100" => pre_salida <= "0111000010";
237 when "00101101" => pre_salida <= "0111001000";
238 when "00101110" => pre_salida <= "0111001101";
239 when "00101111" => pre_salida <= "0111010011";
240 when "00110000" => pre_salida <= "0111011000";
241 when "00110001" => pre_salida <= "0111011100";
242 when "00110010" => pre_salida <= "0111100001";
243 when "00110011" => pre_salida <= "0111100101";
244 when "00110100" => pre_salida <= "0111101000";
245 when "00110101" => pre_salida <= "0111101100";
246 when "00110110" => pre_salida <= "0111101111";
247 when "00110111" => pre_salida <= "0111110010";
248 when "00111000" => pre_salida <= "0111110101";
249 when "00111001" => pre_salida <= "0111110111";
250 when "00111010" => pre_salida <= "0111111001";
251 when "00111011" => pre_salida <= "0111111011";
252 when "00111100" => pre_salida <= "0111111100";
253 when "00111101" => pre_salida <= "0111111101";
254 when "00111110" => pre_salida <= "0111111110";
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```
155 when "00111111" => pre_salida <= "0111111110";
156 when "01000000" => pre_salida <= "0111111111";
157 when "01000001" => pre_salida <= "0111111110";
158 when "01000010" => pre_salida <= "0111111110";
159 when "01000011" => pre_salida <= "0111111101";
160 when "01000100" => pre_salida <= "0111111100";
161 when "01000101" => pre_salida <= "0111111101";
162 when "01000110" => pre_salida <= "0111111100";
163 when "01000111" => pre_salida <= "0111111011";
164 when "01001000" => pre_salida <= "0111111010";
165 when "01001001" => pre_salida <= "0111111001";
166 when "01001010" => pre_salida <= "0111110111";
167 when "01001011" => pre_salida <= "0111110100";
168 when "01001100" => pre_salida <= "0111110100";
169 when "01001101" => pre_salida <= "0111110010";
170 when "01001110" => pre_salida <= "0111110000";
171 when "01001111" => pre_salida <= "0111101110";
172 when "01010000" => pre_salida <= "0111101100";
173 when "01010001" => pre_salida <= "0111101001";
174 when "01010010" => pre_salida <= "0111100110";
175 when "01010011" => pre_salida <= "0111100100";
176 when "01010100" => pre_salida <= "0111100001";
177 when "01010101" => pre_salida <= "0111101110";
178 when "01010110" => pre_salida <= "0111101100";
179 when "01010111" => pre_salida <= "0111101011";
180 when "01011000" => pre_salida <= "0111101000";
181 when "01011001" => pre_salida <= "0111100001";
182 when "01011010" => pre_salida <= "0111100110";
183 when "01011011" => pre_salida <= "0111100100";
184 when "01011100" => pre_salida <= "0111100011";
185 when "01011101" => pre_salida <= "0111100001";
186 when "01011110" => pre_salida <= "0101111010";
187 when "01011111" => pre_salida <= "0101111001";
188 when "01100000" => pre_salida <= "0101110100";
189 when "01100001" => pre_salida <= "0101110000";
190 when "01100010" => pre_salida <= "0101110111";
191 when "01100011" => pre_salida <= "0101110101";
192 when "01100100" => pre_salida <= "0101100010";
193 when "01100101" => pre_salida <= "0100111101";
194 when "01100110" => pre_salida <= "0100111000";
195 when "01100111" => pre_salida <= "0100110011";
196 when "01101000" => pre_salida <= "0100011011";
197 when "01101001" => pre_salida <= "0100011001";
198 when "01101010" => pre_salida <= "0100000110";
199 when "01101011" => pre_salida <= "0011111101";
200 when "01101100" => pre_salida <= "0011111000";
201 when "01101101" => pre_salida <= "0011110010";
202 when "01101110" => pre_salida <= "0011110101";
203 when "01101111" => pre_salida <= "0011110111";
204 when "01110000" => pre_salida <= "0011100011";
205 when "01110001" => pre_salida <= "0010111011";
206 when "01110010" => pre_salida <= "0010101100";
207 when "01110011" => pre_salida <= "0010100000";
208 when "01110100" => pre_salida <= "0010010100";
209 when "01110101" => pre_salida <= "0010001000";
210 when "01110110" => pre_salida <= "0001111100";
211 when "01110111" => pre_salida <= "0001110111";
212 when "01111000" => pre_salida <= "0001100011";
213 when "01111001" => pre_salida <= "0001101011";
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```
214 when "01111010" => pre_salida <= "0001001010";
215 when "01111011" => pre_salida <= "0000111110";
216 when "01111100" => pre_salida <= "0000110010";
217 when "01111101" => pre_salida <= "0000100101";
218 when "01111110" => pre_salida <= "0000011001";
219 when "01111111" => pre_salida <= "0000001100";
220 when "10000000" => pre_salida <= "0000000000";
221 when "10000001" => pre_salida <= "1111110100";
222 when "10000010" => pre_salida <= "1111100111";
223 when "10000011" => pre_salida <= "1111011011";
224 when "10000100" => pre_salida <= "1111001110";
225 when "10000101" => pre_salida <= "1111000010";
226 when "10000110" => pre_salida <= "1110110110";
227 when "10000111" => pre_salida <= "1110101001";
228 when "10001000" => pre_salida <= "1110011101";
229 when "10001001" => pre_salida <= "1110010001";
230 when "10001010" => pre_salida <= "1110000100";
231 when "10001011" => pre_salida <= "1101111000";
232 when "10001100" => pre_salida <= "1101101100";
233 when "10001101" => pre_salida <= "1101100000";
234 when "10001110" => pre_salida <= "1101010100";
235 when "10001111" => pre_salida <= "1101001001";
236 when "10010000" => pre_salida <= "1100111101";
237 when "10010001" => pre_salida <= "1100110001";
238 when "10010010" => pre_salida <= "1100100110";
239 when "10010011" => pre_salida <= "1100011011";
240 when "10010100" => pre_salida <= "1100010000";
241 when "10010101" => pre_salida <= "1100000101";
242 when "10010110" => pre_salida <= "1011111010";
243 when "10010111" => pre_salida <= "1011101111";
244 when "10011000" => pre_salida <= "1011100101";
245 when "10011001" => pre_salida <= "1011011010";
246 when "10011010" => pre_salida <= "1011010000";
247 when "10011011" => pre_salida <= "1011000110";
248 when "10011100" => pre_salida <= "1010111100";
249 when "10011101" => pre_salida <= "1010110011";
250 when "10011110" => pre_salida <= "1010101001";
251 when "10011111" => pre_salida <= "1010100000";
252 when "10100000" => pre_salida <= "1010010111";
253 when "10100001" => pre_salida <= "1010001110";
254 when "10100010" => pre_salida <= "1010000110";
255 when "10100011" => pre_salida <= "1001111110";
256 when "10100100" => pre_salida <= "1001110101";
257 when "10100101" => pre_salida <= "1001110110";
258 when "10100110" => pre_salida <= "1001100110";
259 when "10100111" => pre_salida <= "1001011111";
260 when "10101000" => pre_salida <= "1001011000";
261 when "10101001" => pre_salida <= "1001010001";
262 when "10101010" => pre_salida <= "1001001010";
263 when "10101011" => pre_salida <= "1001000100";
264 when "10101100" => pre_salida <= "1000111110";
265 when "10101101" => pre_salida <= "1000111000";
266 when "10101110" => pre_salida <= "1000110011";
267 when "10101111" => pre_salida <= "1000101101";
268 when "10110000" => pre_salida <= "1000101000";
269 when "10110001" => pre_salida <= "1000100100";
270 when "10110010" => pre_salida <= "1000011111";
271 when "10110011" => pre_salida <= "1000011011";
272 when "10110100" => pre_salida <= "1000011000";
```

```
273 when "10110101" => pre_salida <= "1000010100";
274 when "10110110" => pre_salida <= "1000010001";
275 when "10110111" => pre_salida <= "1000001110";
276 when "10111000" => pre_salida <= "1000001011";
277 when "10111001" => pre_salida <= "1000001001";
278 when "10111010" => pre_salida <= "1000000111";
279 when "10111011" => pre_salida <= "1000000101";
280 when "10111100" => pre_salida <= "1000000100";
281 when "10111101" => pre_salida <= "1000000011";
282 when "10111110" => pre_salida <= "1000000010";
283 when "10111111" => pre_salida <= "1000000010";
284 when "11000000" => pre_salida <= "1000000001";
285 when "11000001" => pre_salida <= "1000000010";
286 when "11000010" => pre_salida <= "1000000010";
287 when "11000011" => pre_salida <= "1000000011";
288 when "11000100" => pre_salida <= "1000000100";
289 when "11000101" => pre_salida <= "1000000101";
290 when "11000110" => pre_salida <= "1000000111";
291 when "11000111" => pre_salida <= "1000001001";
292 when "11001000" => pre_salida <= "1000001011";
293 when "11001001" => pre_salida <= "1000001110";
294 when "11001010" => pre_salida <= "1000010001";
295 when "11001011" => pre_salida <= "1000010100";
296 when "11001100" => pre_salida <= "1000011000";
297 when "11001101" => pre_salida <= "1000011011";
298 when "11001110" => pre_salida <= "1000011111";
299 when "11001111" => pre_salida <= "1000100100";
300 when "11010000" => pre_salida <= "1000101000";
301 when "11010001" => pre_salida <= "1000101101";
302 when "11010010" => pre_salida <= "1000110011";
303 when "11010011" => pre_salida <= "1000111000";
304 when "11010100" => pre_salida <= "1000111110";
305 when "11010101" => pre_salida <= "1001000100";
306 when "11010110" => pre_salida <= "1001001010";
307 when "11010111" => pre_salida <= "1001010001";
308 when "11011000" => pre_salida <= "1001011000";
309 when "11011001" => pre_salida <= "1001011111";
310 when "11011010" => pre_salida <= "1001100110";
311 when "11011011" => pre_salida <= "1001101110";
312 when "11011100" => pre_salida <= "1001110101";
313 when "11011101" => pre_salida <= "1001111110";
314 when "11011110" => pre_salida <= "1010000110";
315 when "11011111" => pre_salida <= "1010001110";
316 when "11100000" => pre_salida <= "1010010111";
317 when "11100001" => pre_salida <= "1010100000";
318 when "11100010" => pre_salida <= "1010101001";
319 when "11100011" => pre_salida <= "1010110011";
320 when "11100100" => pre_salida <= "1010111100";
321 when "11100101" => pre_salida <= "1011000110";
322 when "11100110" => pre_salida <= "1011010000";
323 when "11100111" => pre_salida <= "1011011010";
324 when "11101000" => pre_salida <= "1011100101";
325 when "11101001" => pre_salida <= "1011101111";
326 when "11101010" => pre_salida <= "1011111010";
327 when "11101011" => pre_salida <= "1100000101";
328 when "11101100" => pre_salida <= "1100010000";
329 when "11101101" => pre_salida <= "1100011011";
330 when "11101110" => pre_salida <= "1100100110";
331 when "11101111" => pre_salida <= "1100110001";
```

```
332         when "11110000" => pre_salida <= "1100111101";
333         when "11110001" => pre_salida <= "1101001001";
334         when "11110010" => pre_salida <= "1101010100";
335         when "11110011" => pre_salida <= "1101100000";
336         when "11110100" => pre_salida <= "1101101100";
337         when "11110101" => pre_salida <= "1101111000";
338         when "11110110" => pre_salida <= "1110000100";
339         when "11110111" => pre_salida <= "1110010001";
340         when "11111000" => pre_salida <= "1110011101";
341         when "11111001" => pre_salida <= "1110101001";
342         when "11111010" => pre_salida <= "1110110110";
343         when "11111011" => pre_salida <= "1111000010";
344         when "11111100" => pre_salida <= "1111001110";
345         when "11111101" => pre_salida <= "1111011011";
346         when "11111110" => pre_salida <= "1111100111";
347         when others => pre_salida <= "1111110100";

348         end case;
349     end if;
350 end process rom_block;
351
352
353
354 end estructural;
355
356
357
358
```