تمرین سری پنجم DSD

متین باقری **402105727**

از آنجا که در pdf تمرین توضیحات کامل درمورد کارکرد sram و controller و همچنین نحوه کارکرد تست‌بنچ ها داده شده، در این گزارش نتیجه تست‌بنچ ها قرار دارد. همچنین در میان کد ها توضیحاتی درمورد نحوه پیاده سازی انجام شده، قرار داده شده است تا ابهامی درمورد نحوه کارکرد کد وجود نداشته باشد. فایل‌های vcd. موجود هستند. یک مدل اضافه تر با نام simpleDelaySram.v نیز وجود دارد که پیاده سازی sram با تاخیر های ساده گفته شده در pdf است، اما دیگر فایل های اصلی با در نظر گرفتن دقیق تاخیر های استخراج شده از datasheet sram هستند.

SRAM_tb result:

```
# --- Writing lower byte = addr to addresses 0-9 ---
#
# --- Writing upper byte = $clog2(addr) to addresses 10-19 ---
#
# --- Writing random 16-bit values to addresses 20-29 ---
#
# --- Reading addresses 0-29 and comparing ---
# Read @  0 = 0x0000
#   MATCH
# Read @  1 = 0x0001
#   MATCH
# Read @  2 = 0x0002
#   MATCH
# Read @  3 = 0x0003
#   MATCH
# Read @  4 = 0x0004
#   MATCH
# Read @  5 = 0x0005
#   MATCH
# Read @  6 = 0x0006
#   MATCH
# Read @  7 = 0x0007
#   MATCH
# Read @  8 = 0x0008
#   MATCH
# Read @  9 = 0x0009
#   MATCH
# Read @ 10 = 0x0400
#   MATCH
# Read @ 11 = 0x0400
#   MATCH
# Read @ 12 = 0x0400
#   MATCH
# Read @ 13 = 0x0400
#   MATCH
# Read @ 14 = 0x0400
#   MATCH
# Read @ 15 = 0x0400
#   MATCH
# Read @ 16 = 0x0400
#   MATCH
# Read @ 17 = 0x0500
#   MATCH
# Read @ 18 = 0x0500
#   MATCH
# Read @ 19 = 0x0500
#   MATCH
# Read @ 20 = 0x3524
#   MATCH
# Read @ 21 = 0x5e81
#   MATCH
# Read @ 22 = 0xd609
#   MATCH
# Read @ 23 = 0x5663
#   MATCH
# Read @ 24 = 0x7b0d
#   MATCH
# Read @ 25 = 0x998d
#   MATCH
# Read @ 26 = 0x8465
#   MATCH
# Read @ 27 = 0x5212
#   MATCH
# Read @ 28 = 0xe301
#   MATCH
# Read @ 29 = 0xcd0d
#   MATCH
#
# --- Entering standby (CE = 1), trying write to address 0 ---
#
# --- Trying to read @0 in standby mode (expect zzzz) ---
# Read (standby) @0 = z
#    Correct: bus is Hi-Z in standby
#
# --- Leaving standby (CE = 0) and reading @0 again (expect original
0x0000) ---
# Read @  0 = 0x0000
# Expected original value: 0x0000
#    Correct: standby write was ignored (memory kept original value)
#
# --- Testbench complete ---
```

در controller از FSM استفاده کردیم که در انتهای کد آن قابل مشاهده است.

CONTROLLER_tb_10Mhz result:

```
# [10MHz] --- WRITING 10 random 32-bit values ---
# [10MHz] Wrote @addr=0/1 -> 0x12153524
# [10MHz] Wrote @addr=2/3 -> 0xc0895e81
# [10MHz] Wrote @addr=4/5 -> 0x8484d609
# [10MHz] Wrote @addr=6/7 -> 0xb1f05663
# [10MHz] Wrote @addr=8/9 -> 0x06b97b0d
# [10MHz] Wrote @addr=10/11 -> 0x46df998d
# [10MHz] Wrote @addr=12/13 -> 0xb2c28465
# [10MHz] Wrote @addr=14/15 -> 0x89375212
# [10MHz] Wrote @addr=16/17 -> 0x00f3e301
# [10MHz] Wrote @addr=18/19 -> 0x06d7cd0d
#
# [10MHz] --- READING back and comparing ---
# [10MHz]  MATCH    @addr=0/1: 0x12153524
# [10MHz]  MATCH    @addr=2/3: 0xc0895e81
# [10MHz]  MATCH    @addr=4/5: 0x8484d609
# [10MHz]  MATCH    @addr=6/7: 0xb1f05663
# [10MHz]  MATCH    @addr=8/9: 0x06b97b0d
# [10MHz]  MATCH    @addr=10/11: 0x46df998d
# [10MHz]  MATCH    @addr=12/13: 0xb2c28465
# [10MHz]  MATCH    @addr=14/15: 0x89375212
# [10MHz]  MATCH    @addr=16/17: 0x00f3e301
# [10MHz]  MATCH    @addr=18/19: 0x06d7cd0d
#
# [10MHz] done.
```

CONTROLLER_tb_200Mhz result:

```
# [200MHz] --- WRITING 10 random 32-bit values ---
# [200MHz] Wrote @addr=0/1 -> 0x12153524
# [200MHz] Wrote @addr=2/3 -> 0xc0895e81
# [200MHz] Wrote @addr=4/5 -> 0x8484d609
# [200MHz] Wrote @addr=6/7 -> 0xb1f05663
# [200MHz] Wrote @addr=8/9 -> 0x06b97b0d
# [200MHz] Wrote @addr=10/11 -> 0x46df998d
# [200MHz] Wrote @addr=12/13 -> 0xb2c28465
# [200MHz] Wrote @addr=14/15 -> 0x89375212
# [200MHz] Wrote @addr=16/17 -> 0x00f3e301
# [200MHz] Wrote @addr=18/19 -> 0x06d7cd0d
#
# [200MHz] --- READING back and comparing ---
# [200MHz]  MATCH    @addr=0/1: 0x12153524
# [200MHz]  MATCH    @addr=2/3: 0xc0895e81
# [200MHz]  MATCH    @addr=4/5: 0x8484d609
# [200MHz]  MATCH    @addr=6/7: 0xb1f05663
# [200MHz]  MATCH    @addr=8/9: 0x06b97b0d
# [200MHz]  MATCH    @addr=10/11: 0x46df998d
# [200MHz]  MATCH    @addr=12/13: 0xb2c28465
# [200MHz]  MATCH    @addr=14/15: 0x89375212
# [200MHz]  MATCH    @addr=16/17: 0x00f3e301
# [200MHz]  MATCH    @addr=18/19: 0x06d7cd0d
#
# [200MHz] done.
```