

# *Abanob Evram*

## *SPI-Slave with Single Port RAM*



## 1-The Implementation (Timing report) for seq encoding:

State	New Encoding	Previous Encoding
IDLE	000	000
CHK_CMD	001	001
WRITE	010	010
READ_ADD	011	011
READ_DATA	100	100

INFO: [Synth 8-3354] encoded FSM with state register 'cs\_reg' using encoding 'sequential' in module 'SPI'

### Design Timing Summary

Setup	Hold	Pulse Width
Worst Negative Slack (WNS): 4.795 ns	Worst Hold Slack (WHS): 0.102 ns	Worst Pulse Width Slack (WPWS): 4.500 ns
Total Negative Slack (TNS): 0.000 ns	Total Hold Slack (THS): 0.000 ns	Total Pulse Width Negative Slack (TPWS): 0.000 ns
Number of Failing Endpoints: 0	Number of Failing Endpoints: 0	Number of Failing Endpoints: 0
Total Number of Endpoints: 205	Total Number of Endpoints: 205	Total Number of Endpoints: 99

All user specified timing constraints are met.

## 2-The Implementation (Timing report) for one\_hot encoding:

State	New Encoding	Previous Encoding
IDLE	00001	000
CHK_CMD	00010	001
WRITE	00100	010
READ_ADD	01000	011
READ_DATA	10000	100

INFO: [Synth 8-3354] encoded FSM with state register 'cs\_reg' using encoding 'one-hot' in module 'SPI'

### Design Timing Summary

Setup	Hold	Pulse Width
Worst Negative Slack (WNS): 4.042 ns	Worst Hold Slack (WHS): 0.052 ns	Worst Pulse Width Slack (WPWS): 4.500 ns
Total Negative Slack (TNS): 0.000 ns	Total Hold Slack (THS): 0.000 ns	Total Pulse Width Negative Slack (TPWS): 0.000 ns
Number of Failing Endpoints: 0	Number of Failing Endpoints: 0	Number of Failing Endpoints: 0
Total Number of Endpoints: 207	Total Number of Endpoints: 207	Total Number of Endpoints: 101

All user specified timing constraints are met.

### 3-The Implementation (Timing report) for gray encoding:

State	New Encoding	Previous Encoding
IDLE	000	000
CHK_CMD	001	001
WRITE	011	010
READ_ADD	010	011
READ_DATA	111	100

INFO: [Synth 8-3354] encoded FSM with state register 'cs\_reg' using encoding 'gray' in module 'SPI'

Setup	Hold	Pulse Width
Worst Negative Slack (WNS): 4.861 ns	Worst Hold Slack (WHS): 0.075 ns	Worst Pulse Width Slack (WPWS): 4.500 ns
Total Negative Slack (TNS): 0.000 ns	Total Hold Slack (THS): 0.000 ns	Total Pulse Width Negative Slack (TPWS): 0.000 ns
Number of Failing Endpoints: 0	Number of Failing Endpoints: 0	Number of Failing Endpoints: 0
Total Number of Endpoints: 205	Total Number of Endpoints: 205	Total Number of Endpoints: 99
All user specified timing constraints are met.		

Then the best encoding is hot\_encoding

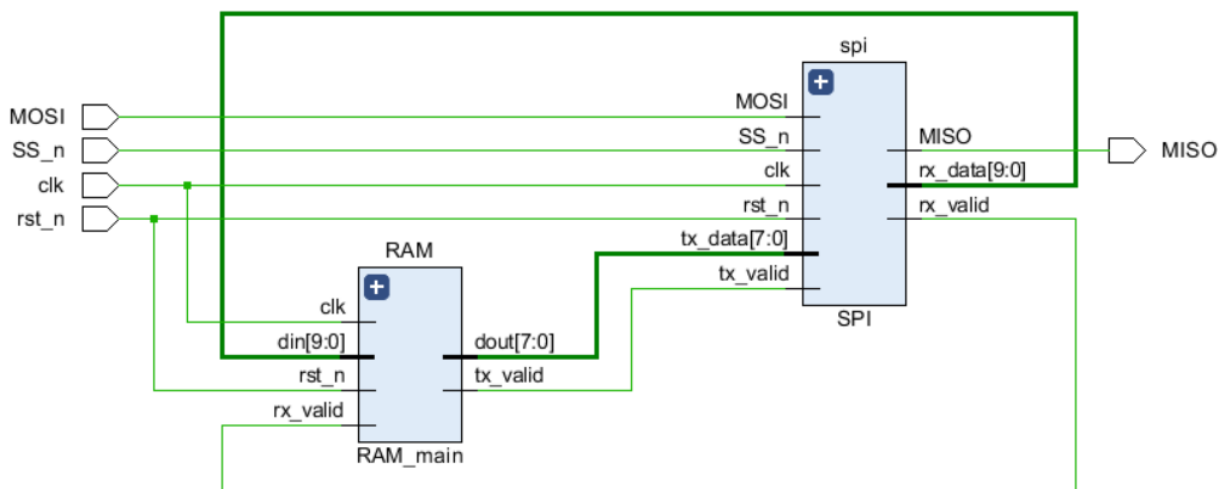
Because it's the best time

## 1-The elaboration (message) for one\_hot encoding:

Search | Filter | Sort | View | Info (5) | Status (9) | Show All

- ▼ Vivado Commands (3 infos)
  - ▼ General Messages (3 infos)
    - [IP\_Flow 19-234] Refreshing IP repositories
    - [IP\_Flow 19-1704] No user IP repositories specified
    - [IP\_Flow 19-2313] Loaded Vivado IP repository 'D:/Nivado/Nivado/2018.2/data/ip'.
  - ▼ Elaborated Design (2 infos)
    - ▼ General Messages (2 infos)
      - [Project 1-570] Preparing netlist for logic optimization
      - [Opt 31-138] Pushed 0 inverter(s) to 0 load pin(s).

## 2-The elaboration (schematic) for one\_hot encoding:

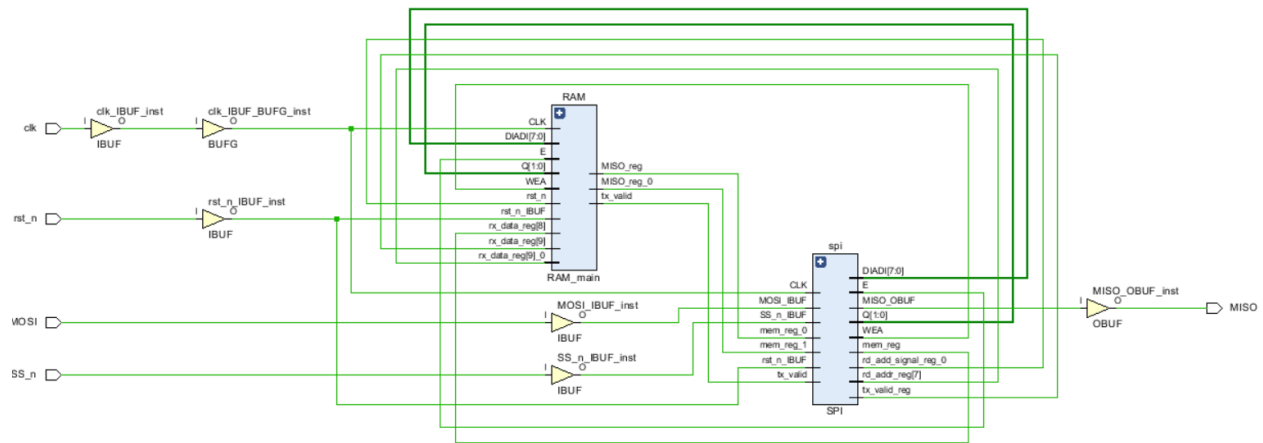


## 3-The synthesis (message) for one\_hot encoding:

▼ Synthesis (1 warning)

- [Constraints 18-5210] No constraint will be written out.

#### 4-The synthesis (schematic) for one\_hot encoding:



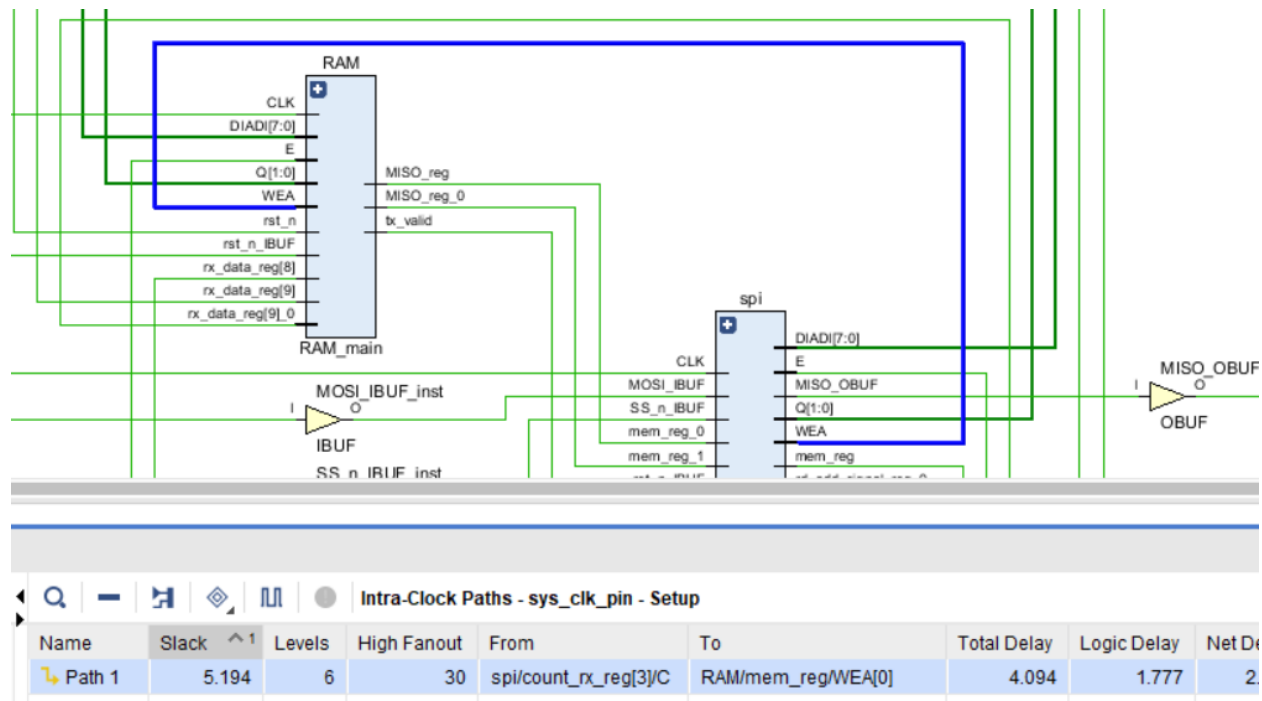
#### 5-The synthesis (report) for one\_hot encoding:

92	State	New Encoding	Previous Encoding
93			
94	IDLE	00001	000
95	CHK_CMD	00010	001
96	WRITE	00100	010
97	READ_ADD	01000	011
98	READ_DATA	10000	100

#### 6-The synthesis (Timing report) for one\_hot encoding:

Setup	Hold	Pulse Width
Worst Negative Slack (WNS): 5.194 ns	Worst Hold Slack (WHS): 0.149 ns	Worst Pulse Width Slack (WPWS): 4.500 ns
Total Negative Slack (TNS): 0.000 ns	Total Hold Slack (THS): 0.000 ns	Total Pulse Width Negative Slack (TPWS): 0.000 ns
Number of Failing Endpoints: 0	Number of Failing Endpoints: 0	Number of Failing Endpoints: 0
Total Number of Endpoints: 206	Total Number of Endpoints: 206	Total Number of Endpoints: 101

## 7-The synthesis (critical path) for one\_hot encoding:



## 8-The Implementation (message) for one\_hot encoding:



## 9-The Implementation (Utilization report) for one\_hot encoding:

Name	Slice LUTs (20800)	Slice Registers (41600)	F7 Muxes (16300)	Slice (815 0)	LUT as Logic (20800)	LUT as Memory (9600)	LUT Flip Flop Pairs (20800)	Block RAM Tile (50)	Bonded IOB (106)	BUFGCTRL (32)	BSCAN2 (4)
Maindesign	1415	2014	10	676	1307	108	808	1	5	2	1
> dbg_hub (dbg_hub)	475	727	0	243	451	24	306	0	0	1	1
RAM (RAM_main)	2	17	0	6	2	0	0	0.5	0	0	0
spi (SPI)	174	81	0	57	174	0	81	0	0	0	0
> u_lla_0 (u_lla_0)	764	1189	10	377	680	84	420	0.5	0	0	0

## 10-The Implementation (Timing report) for one\_hot encoding:

Tcl Console

Messages

Log

Reports

Design Runs

DRC

Power

Methodology

Timing x

Q

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Design Timing Summary

General Information

Timer Settings

Design Timing Summary

Clock Summary (2)

> Check Timing (4)

> Intra-Clock Paths

> Inter-Clock Paths

> Other Path Groups

Timing Summary - impl\_1 (saved)

Setup

Hold

Pulse Width

Worst Negative Slack (WNS): 3.345 ns

Worst Hold Slack (WHS): 0.049 ns

Worst Pulse Width Slack (WPWS): 3.750 ns

Total Negative Slack (TNS): 0.000 ns

Total Hold Slack (THS): 0.000 ns

Total Pulse Width Negative Slack (TPWS): 0.000 ns

Number of Failing Endpoints: 0

Number of Failing Endpoints: 0

Number of Failing Endpoints: 0

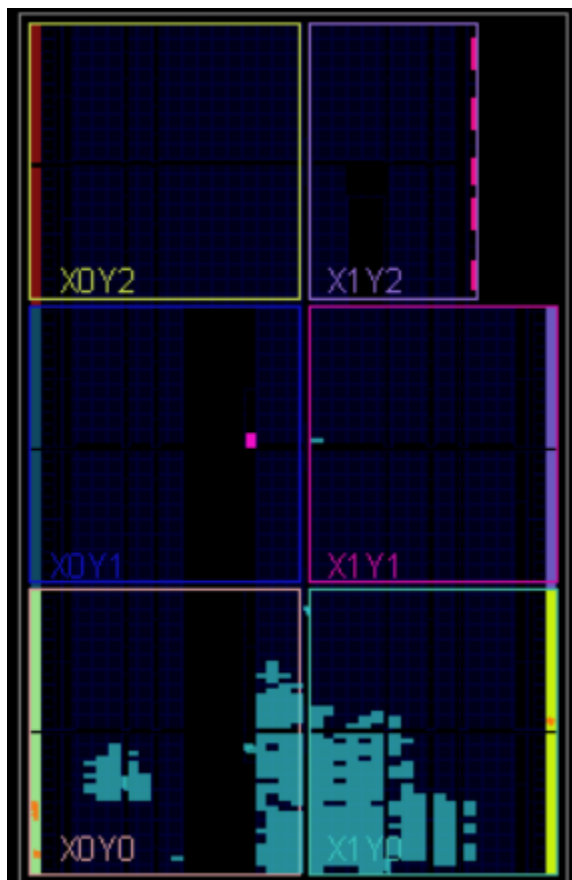
Total Number of Endpoints: 3991

Total Number of Endpoints: 3975

Total Number of Endpoints: 2201

All user specified timing constraints are met.

## 11-The Implementation (device) for one\_hot encoding:





## Snippets from the waveforms captured from QuestaSim:





```

# Activate reset
# MOSI = 0, MISO = x, SS_n = 1
# MOSI = 0, MISO = 0, SS_n = 1
# Case1 :Test Write Address
# MOSI = 0, MISO = 0, SS_n = 0
# MOSI = 1, MISO = 0, SS_n = 0
# MOSI = 0, MISO = 0, SS_n = 0
# MOSI = 1, MISO = 0, SS_n = 0
# rx_data = 0011100111
# MOSI = 1, MISO = 0, SS_n = 1
-
# Case3 :Test Read Address
# MOSI = 1, MISO = 0, SS_n = 0
# MOSI = 0, MISO = 0, SS_n = 0
# MOSI = 1, MISO = 0, SS_n = 0
# rx_data = 1000000011
# MOSI = 1, MISO = 0, SS_n = 1
# Case4 :Test Read data
# MOSI = 1, MISO = 0, SS_n = 0
# MOSI = 0, MISO = 0, SS_n = 0
# MOSI = 1, MISO = 0, SS_n = 0
# MOSI = 0, MISO = 0, SS_n = 0
# MOSI = 1, MISO = 0, SS_n = 0
# MOSI = 0, MISO = 0, SS_n = 0
# MOSI = 1, MISO = 0, SS_n = 0
# MOSI = 1, MISO = 1, SS_n = 0
# tx_data = 11111110
# MOSI = 1, MISO = 1, SS_n = 1
# MOSI = 1, MISO = 0, SS_n = 1

# Case2 :Test Write Data
# MOSI = 1, MISO = 0, SS_n = 0
# MOSI = 0, MISO = 0, SS_n = 0
# MOSI = 1, MISO = 0, SS_n = 0
# MOSI = 0, MISO = 0, SS_n = 0
# MOSI = 1, MISO = 0, SS_n = 0
# MOSI = 0, MISO = 0, SS_n = 0
# MOSI = 1, MISO = 0, SS_n = 0
# MOSI = 0, MISO = 0, SS_n = 0
# MOSI = 1, MISO = 0, SS_n = 0
# MOSI = 0, MISO = 0, SS_n = 0
# MOSI = 1, MISO = 0, SS_n = 0
# rx_data = 0101010101
# MOSI = 1, MISO = 0, SS_n = 1

```