

# Memory Devices on DE2-115

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數位電路實驗

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# Storage Devices of DE2-115

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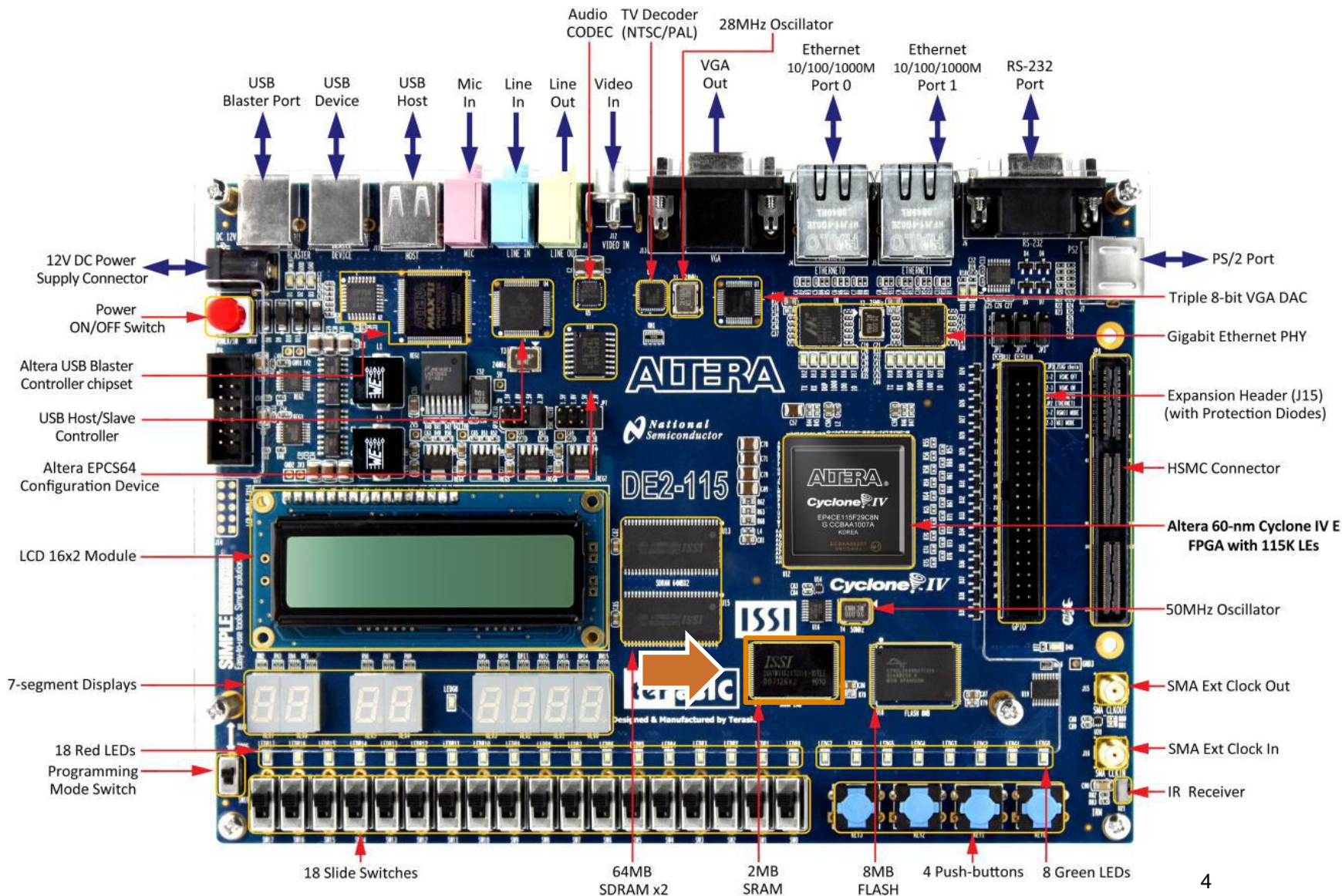
- SRAM - Very easy to use!
- SDRAM
- FLASH
- EEPROM
- SD Card



# SRAM

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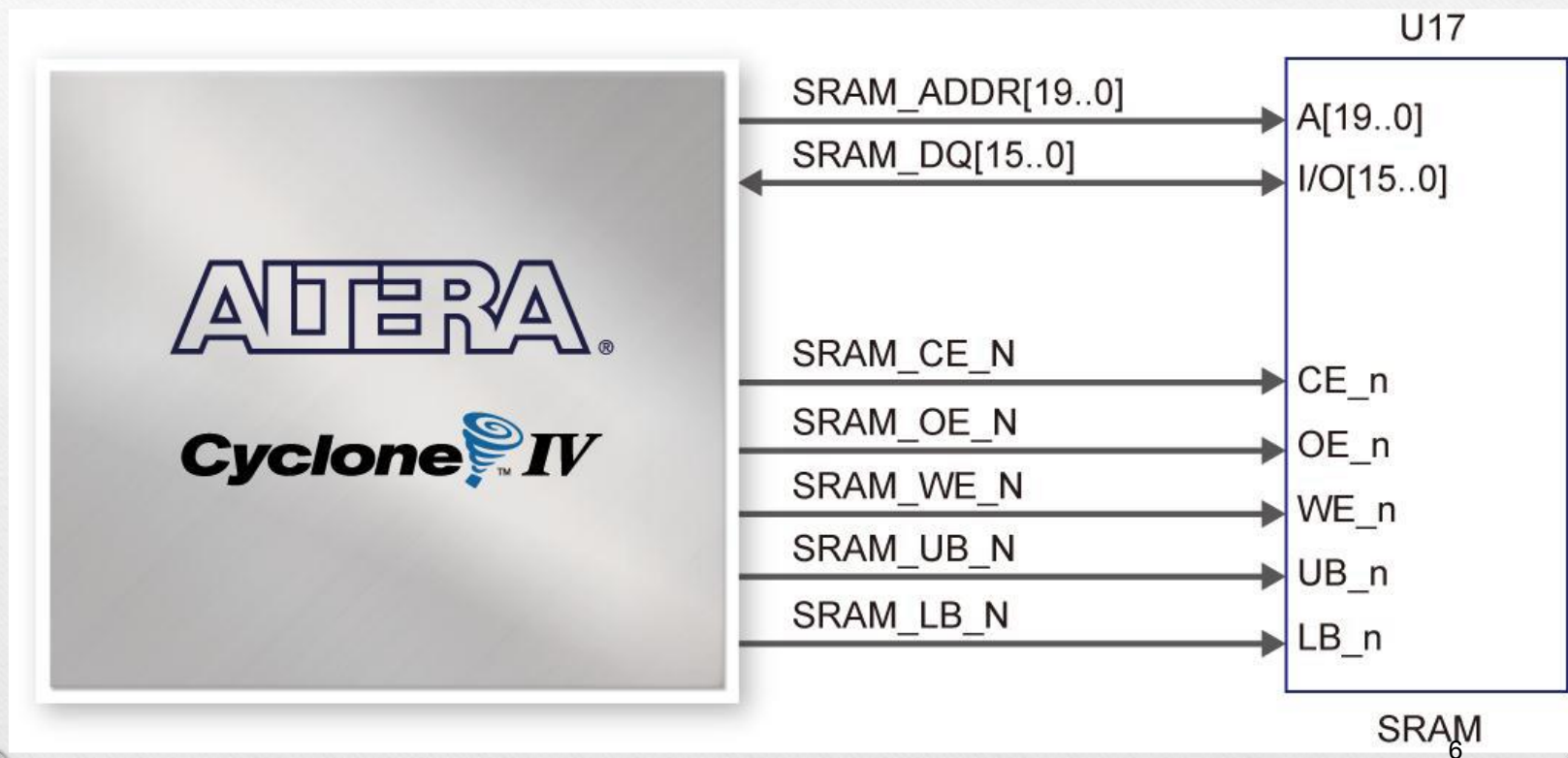
# Features

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- 16M-bit (2MB) static RAMs
- 1M words by 16 bits/word
- High-speed access times:
  - speed = 20ns for VDD 1.65V to 2.2V
  - speed = 10ns for VDD 2.4V to 3.6V
  - speed = 8ns for VDD 3.3V + 5%

Quite enough since the DE2\_115 default clock is 50MHz

# Schematic Diagram





# SRAM Pin Assignments

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Signal Name	Description
SRAM_ADDR[19:0]	SRAM Address port
SRAM_DQ[15:0]	SRAM Data port
SRAM_OE	SRAM Output Enable
SRAM_WE	SRAM Write Enable
SRAM_CE	SRAM Chip Enable
SRAM_LB	SRAM Lower Byte Control
SRAM_UB	SRAM Upper Byte Control

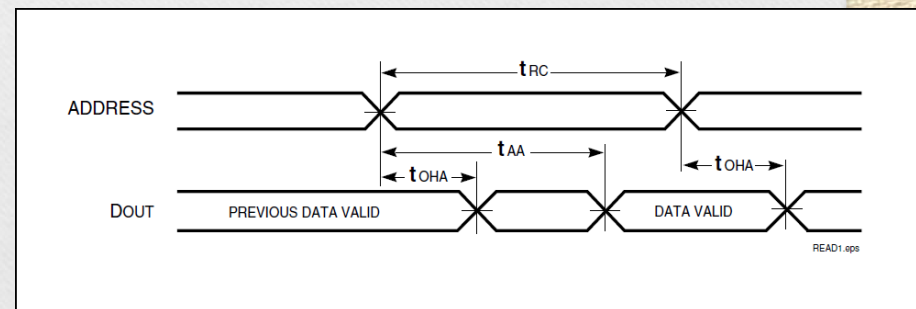
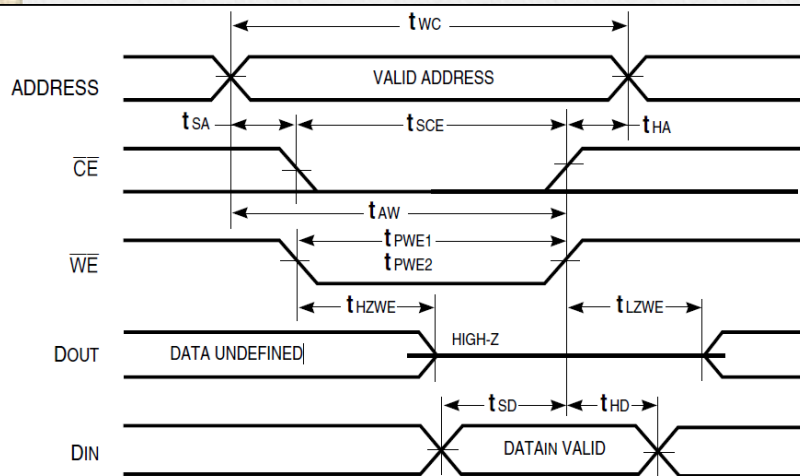
# Truth Table

Mode	$\overline{WE}$	$\overline{OE}$	$\overline{OE}$	$\overline{LB}$	$\overline{UB}$	I/O PIN		$V_{DD}$ Current
						I/O0-I/O7	I/O8-I/O15	
Not Selected	X	H	X	X	X	High-Z	High-Z	$I_{SB1}, I_{SB2}$
Output Disabled	H	L	H	X	X	High-Z	High-Z	$I_{CC}$
	X	L	X	H	H	High-Z	High-Z	
Read	H	L	L	L	H	DOUT	High-Z	$I_{CC}$
	H	L	L	H	L	High-Z	DOUT	
	H	L	L	L	L	DOUT	DOUT	
Write	L	L	X	L	H	DIN	High-Z	$I_{CC}$
	L	L	X	H	L	High-Z	DIN	
	L	L	X	L	L	DIN	DIN	



# Timing Diagram

- Min. R/W cycle time  $t_{RC} = 8\text{ns}$
- Imagine you are using
  - `logic [15:0] sram_data_r [1048576];`



# The End.

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Any question?



# Reference

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1. "DE2-115 User Manual" by Terasic.
2. "DE2-115\_MB.pdf" by Terasic.
3. "61WV102416ALL(ISSI\_1M x 16\_SRAM).pdf" by ISSI.