IDX110M00 (Barefoot)
IDX110M01 (Barefoot ECO)
IDX110M02 (Barefoot Plus)
&
IDX100M00 (Amigos)
IDX100M01 (Amigos ECO)

Solid State Drive Controller

NAND/SDRAM Support List &
Indilinx support for sample manufacturing

Version 1.10

INDILINX Co., Ltd.

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IDX Document Revision History

Revision	Date	Description
1.0	January 15, 2009	Initial Release
1.1	January 21, 2009	Added Firmware version 1000. Release date (1/12/09) Added the following: IDX110M00 (Barefoot) - 64GB Samsung K9WBG SLC IDX100M00 (Amigos) - 32GB Samsung K9HCG08U1M MLC IDX100M00 (Amigos) - 16GB Micron MT29F32G08QAA MLC Elpida 256Mbit SDRAM EDS2532EGBH Elpida 512Mbit SDRAM EDS51321CBH-6DTT-F
1.2	February 27, 2009	NAND Placement Change
1.3	April 7, 2009	Removal of untested NANDs and addition of newly tested NANDs.
1.4	May 1, 2009	Changed picture/link address and corrected typo. SDRAM clock speed is added.
1.5	June 2, 2009	NAND support list update
1.6	June 3, 2009	Warning for Samsung 4x nm NAND is included.
1.7	November 19, 2009	Added new NAND support
1.8	November 30, 2009	Added ECO support
1.9	December 1, 2009	Corrected typo of Toshiba NAND part numbers
1.10	December 6, 2010	Removal of unsupported NANDs and addition of newly tested NANDs.

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1. Indilinx support plan for customer's sample build

Thanks for your interest in Indilinx Barefoot/Amigos products. In this chapter, it is described how Indilinx supports customers to build SSD samples with Barefoot/Amigos products.

1.1 What you will get

Once you decided to build samples with Barefoot/Amigos, Indilinx will provides reference design. Currently, 2.5 inch reference designs are available for both Barefoot and Amigos. Hoof25 is the code name of Barefoot 2.5 inch reference design. Also, Amigos half slim type SSD (54mm module type) reference design is available too. Hoof54 is the code name of half slim type SSD reference design. Each Indilinx Reference design consists of:

- Schematic (PDF and ORCAD files)
- PCB Allegro layout file
- PCB Gerber file
- PCB stack-up information (Excel file)
- BOM

Reference design will be accompanied by:

- Datasheet
- NAND/SDRAM support list (This document)
- NAND stuffing guide
- Firmware update howto
- Test report of compatibility/performance/power consumption

Many customers are using Hoof25 and Hoof54 without circuit modification. In such case, PCB outline may need to be modified for customer's existing SSD case. Indilinx supports PCB outline modification for free. In this case, please provide Indilinx with following things.

- SATA connector datasheet with drawing
- DXF file of your case
- DXF file of your target PCB

If you need further modification or special PCB changes, please contact sales representatives.

Some customers decided to design their own PCB from the scratch. In such case, PCB CAD file and PCB design guide can be supported. (Allegro and PADS)

1.2 Where to download these documents

Indilinx has Customer Support Website to deliver priceless information with customers. To get an account on it, please contact sales representative.

Once you got ID and password, use following URL. Previously, there was Partner pages, but now we are using Documents pages. (http://support.indilinx.com:8001/Documents/default.aspx) If your company firewall is blocking 8001 port, please contact your company's network/security administrator.

From this main page, click Documents in the upper menu bar. And clicking your company name will take you to your company's page. You will find all the documents listed in section 1.1.

For more information on Indilinx Customer Support Site, please refer to user's manual at the end of Documents page.

1.3 Where is F/W and MPTool?

Indilinx F/W doesn't have flexible architecture. So F/W for customer A is not suitable for customer B. Each customer needs to use different F/W. Customer will need to get additional F/W from Indilinx whenever following things are changed.

- F/W revision
- NAND type: For example, 16 x K9HCG 128GB SSD and 8 x K8HCG 64GB SSD will need different F/Ws. Also, 128GB SSD using Samsung NANDs and 128GB SSD using Micron NANDs will need different F/Ws.
- SDRAM: 16MB/32MB/64MB SDRAM will need different F/W respectively. But NAND die change usually doesn't need new firmware.
- NAND stuffing: Please refer to chapter 4 for optimal NAND stuffing options when you use 4 or 8 NANDs. When using 8 NANDs, for example, a few options are possible and each stuffing option will need different F/W.

So it is a good practice to notify your NAND usage to Indilinx to get correct F/W. Please list up your NAND/SDRAM configuration and send this information to Indilinx to get correct F/W.

Vender	NAND Type	Density	Num of packages	Nand part Num	SDRAM density
Hynix	MLC	16GB	4pcs	H27UBG8U5MTR	16MB
		16GB	4pcs	H27UBG8U5MTR	16MB
		16GB	4pcs	H27UBG8U5MTR	32MB

1.4 F/W support flow

When your sample build SMT schedule is fixed, you will need F/W for samples. Probably, you will build 10 or so SSD samples to verify Indilinx controller and its design. We recommend following procedure.

1. When your SMT schedule is fixed, please let us know what NAND/SDRAM you will use. Please make a simple table to list up all of your sample configuration.
2. Indilinx will provide you with F/W for all configuration. It is not a GUI MPTool, but it is a Windows console type application. It has:
   - Default clock speed
   - Default timing values for SDRAM access. These timing values should be tuned with real samples. In most cases, default timing will work well.
   - Target PCB is assumed to be Indilinx reference board. In most cases, default timing will work well.
3. You test your samples with this default F/W. If there is no serious issue, it should work. Then please send samples to Indilinx. These samples will be used to
   - Tune SDRAM/NAND timing
   - Check power/clock integrity
   - Other necessary routine check
4. After routine check, Indilinx will provide tuned F/W for maximum performance/reliability to customers. New F/W will be GUI MPTool for customer's MP. GUI MPTool has:
   - Optimal clock speed
   - Optimal timing values for SDRAM access.
   - Your PCB will be registered as new PCB target

1.5 Where to send samples?

Please refer to the following shipping information.

DHL account No. : **950335227**

Company name : INDILINX Co.,Ltd.

Delivery Address :
607 C-dong Bundang Techno Park, 145 Yatap-dong, Bundang-gu, Seongnam-si, Gyeonggi-do

Postcode/Zip code : 463-760

Country : Republic of Korea

1.6 F/W performance

For Barefoot, 4 channel 8 way/4 way/2 way/1 way is possible. And 2 channel 8 way/4 way/2 way/1 way is also possible, but it is exactly the same to Amigos configuration, so 2 channel on Barefoot is meaningless except on special circumstances.

Barefoot performance is almost proportional to the number of channels and ways. (Exception is, 4 channel 8 way performance is almost the same to 4 channel 4 way.) If Samsung K9GAG08U0M NAND is used, then 32GB capacity is possible with 4 channel 2 way configuration when sixteen NANDs were used. If K9HCG08U1M NAND is used to make 32GB SSD, then four K9HCG08 NAND is needed and it will make 2 channel 2 way configuration. In this case, Sixteen K9GAG08U0M performance will be better than four K9HCG08U1M performance.

When sixteen K9HCG08U1M is used, then the capacity will be 128GB and it will be 4 channel 4 way configuration. If sixteen K9LBG08U0M is used (or 8 K9HCG08U1M is used), then the capacity will be 64GB and it will be 4 channel 2 way configuration. Because of the difference between 4 way and 2 way, 64GB performance is lower than 128GB performance. Sixteen K9GAG08U0M 32GB performance should be almost the same to 64GB performance because those are identical 4 channel 2 way.

The relationship between 32/64GB and 128/256GB is roughly,

Read : 32/64GB performance (4ch/2way) is about 70% of 128/256GB performance (4ch/4way)
Write : 32/64Gb performance (4ch/2way) is about 50% of 128/256GB performance (4ch/4way)

When performance matters, NAND selection will be the key.

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2. NAND Flash Support List

Following is NAND support list of 5x nm technology.

Vendor	NAND Flash Type			Barefoot / Amigos	Barefoot ECO / Amigos ECO	Barefoot Plus
Samsung	SLC	1Gx8bit	K9K8G08U0A *	O	O	O
		2Gx8bit	K9WAG08U1A *	O	O	O
		2Gx8bit	K9KAG08U0M	O	O	O
		4Gx8bit	K9WBG08U1M	O	O	O
		8Gx8bit	K9NCG08U5M	O	O	O
	MLC	1Gx8bit	K9G8G08U0A	O	O	O
		2Gx8bit	K9GAG08U0M	O	O	O
		2Gx8bit	K9LAG08U0M	O	O	O
		4Gx8bit	K9HBG08U1M	O	O	O
		4Gx8bit	K9LBG08U0M	O	O	O
		4Gx8bit	K9LBG08U1M	O	O	O
		8Gx8bit	K9HCG08U1M	O	O	O
		8Gx8bit	K9HCG08U5M	O	O	O
		16Gx8bit	K9MDG08U5M	O	O	O
Toshiba	SLC	2Gx8bit	TH58NVG4S0DTG20 *	O	O	O
		4Gx8bit	TH58NVG5S0DTG20 *	O	O	O
	MLC	2Gx8bit	TC58NVG4D1DTG00	O	O	O
		4Gx8bit	TH58NVG5D1DTG20	O	O	O
		8Gx8bit	TH58NVG6D1DTG20	O	O	O
Intel	SLC	1Gx8bit	JS29F08G08AANC1	O	O	O
		2Gx8bit	JS29F16G08CANC1	O	O	O
		4Gx8bit	JS29F32G08FANC1	O	O	O
	MLC	2Gx8bit	JS29F16G08AAMC1	O	O	O
		4Gx8bit	JS29F32G08CAMC1	O	O	O
		8Gx8bit	JS29F64G08FAMC1	O	O	O
		16Gx8bit	JS29F16B08JAMC1	O	O	O
Micron	SLC	2Gx8bit	MT29F16G08FAA	O	O	O
		2Gx8bit	MT29F16G08DAA	O	O	O
		4Gx8bit	MT29F32G08FAA	O	O	O
		8Gx8bit	MT29F64G08JAA	O	O	O
	MLC	2Gx8bit	MT29F16G08MAA	O	O	O
		4Gx8bit	MT29F32G08QAA	O	O	O
		4Gx8bit	MT29F32G08TAA	O	O	O
		4Gx8bit	MT29F32G08MAA	O	O	O
		8Gx8bit	MT29F64G08TAA	O	O	O
Hynix	MLC	2Gx8bit	H27UAG8T2MTR	O	O	O
		4Gx8bit	H27UBG8U5MTR	O	O	O
		8Gx8bit	H27UCG8V5MTR	O	O	O
		8Gx8bit	H27UCG8VFMTR	O	O	O

* Barefoot/Amigos can't use 2 plane mode with 4 SLC in red color. Write performance will be quite lower than expected. So its use is not recommended.

Following is NAND support list of 4x nm and 3x nm technology.

Vendor			NAND Flash Type	Barefoot / Amigos	Barefoot ECO / Amigos ECO	Barefoot Plus
Samsung 42nm	MLC	2Gx8bit	K9GAG08U0D	O	O	O
		4Gx8bit	K9LBG08U0D	O	O	O
		4Gx8bit	K9LBG08U1D	O	O	O
		8Gx8bit	K9HCG08U1D	O	O	O
		8Gx8bit	K9HCG08U5D	O	O	O
		16Gx8bit	K9MDG08U5D	O	O	O
Samsung 35nm	MLC	4Gx8bit	K9GBG08U0M			O
		8Gx8bit	K9LCG08U1M			O
		16Gx8bit	K9HDG08U5M			O
		32Gx8bit	K9PFG08U5M			O
Toshiba 43nm	MLC	2Gx8bit	TC58NVG4D2ETA00	O	O	O
		4Gx8bit	TH58NVG5D2ETA20	O	O	O
		8Gx8bit	TH58NVG6D2ETA20	O	O	O
		4Gx8bit	TC58NVG5D2ELA48	O	O	O
		8Gx8bit	TH58NVG6D2ELA48	O	O	O
		16Gx8bit	TH58NVG7D2ELA48	O	O	O
	SLC					
Micron 34nm	MLC	4Gx8bit	MT29F32G08CBAAA		O	O
		8Gx8bit	MT29F64G08CFAAA		O	O
		16Gx8bit	MT29F128G08CJAAA		O	O
		4Gx8bit	MT29F32G08CBABA		O	O
		8Gx8bit	MT29F64G08CFABA		O	O
		16Gx8bit	MT29F128G08CJABA		O	O
	SLC	2Gx8bit	MT29F16G08ABABA		O	O
		4Gx8bit	MT29F32G08AFABA		O	O
		8Gx8bit	MT29F64G08AJABA		O	O
Hynix 41nm	MLC	2Gx8bit	H27UAG8T2ATR	O	O	O
		4Gx8bit	H27UBG8U5ATR	O	O	O
		8Gx8bit	H27UCG8VFATR	O	O	O
	SLC					
Intel 34nm	MLC	4Gx8bit	JS29F32G08AAMD1		O	O
		8Gx8bit	JS29F64G08CAMD1		O	O
		16Gx8bit	JS29F16B08JAMD1		O	O
		4Gx8bit	JS29F32G08AAMD2		O	O
		8Gx8bit	JS29F64G08CAMD2		O	O
		16Gx8bit	JS29F16B08JAMD2		O	O
		4Gx8bit	JS29F32G08AAMDB		O	O
		8Gx8bit	JS29F64G08CAMDB		O	O
		16Gx8bit	JS29F16B08JAMDB		O	O
	SLC	2Gx8bit	JS29F16G08AAND2		O	O
		4Gx8bit	JS29F32G08CAND2		O	O
		8Gx8bit	JS29F64G08JAND2		O	O

For readiness of specific NAND support, please contact gyhong@indilinx.com

Barefoot family does not support Hynix 41nm LGA (TSOP is supported), Hynix 32nm and any toggle NAND.

3. SDRAM Support List

Recommended:

Mobile SDRAM
1.8V IO
90ball package
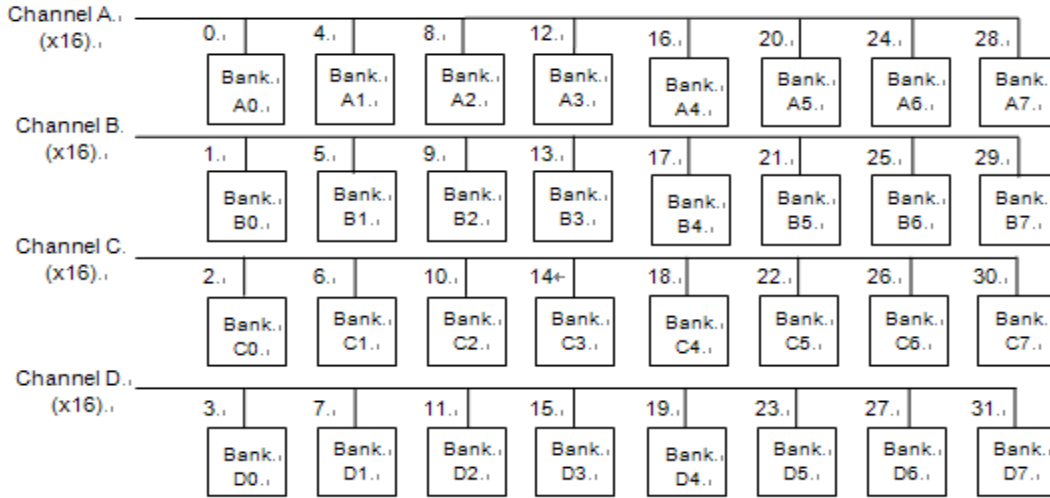166MHz

Following is the tested SDRAM parts.

Vendor	Capacity	Part Number
Hynix	128Mbit	H55S1222EFP-60M (166MHz)
	256Mbit	HY5S5B2CLFP-6E (166MHz) H55S2622JFR-60M (166MHz)
	512Mbit	HY5S7B2ALFP-6E (166MHz) HY5S5B2CLFP-6E (166MHz) H55S5122DFR-60M (166MHz)
Samsung	512Mbit	K4M51323PG-HG60 (166MHz) K4M51323PG-HG75 (133MHz)
Elpida	256Mbit	EDS2532EGBH-6DTT-F (166MHz) EDS2532EEBH-75 (133MHz) EDS12322GBH-7BTT-F (133MHz)
	512Mbit	EDS51321CBH-6DTT-F (166MHz) EDS51321DBH-5ATS (180MHz)
Hanamicron	512Mbit	HMMS5242D-BG6 (166MHz)
ZMOS	512Mbit	ZK5242D-AE (166MHz)

SDRAM die will be changed at least once a year. Usually, this change should do no harm, but please contact Indilinx for SDRAM test availability.
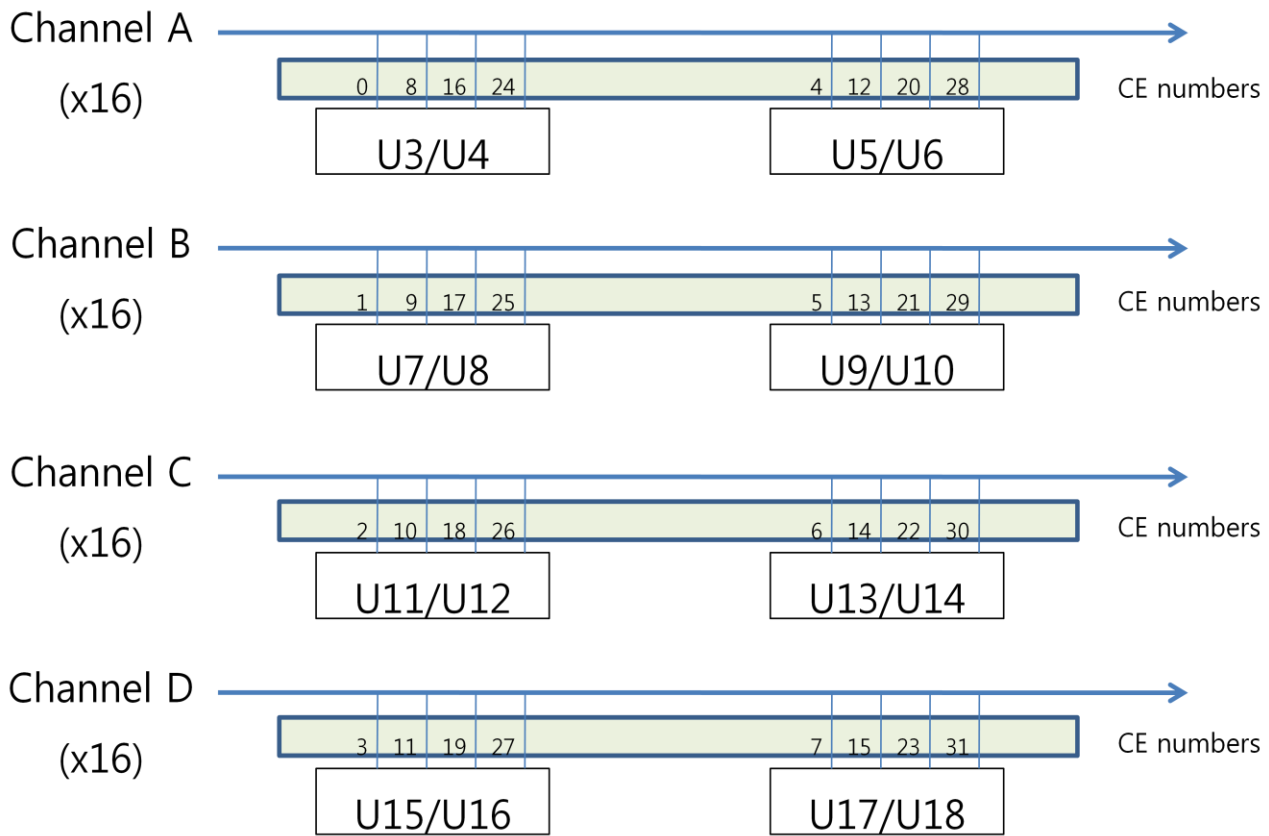
133MHz SDRAM will degrade Barefoot/Amigos performance because SDRAM and Barefoot/Amigos use the same clock. Please purchase 166MHz SDRAM for better performance.

4. NAND Stuffing

Following diagram explains how Barefoot channels are organized and how NAND CE pins are connected. Amigos only has channel A & B.

Channel A. (x16).	0. Bank. A0.	4. Bank. A1.	8. Bank. A2.	12. Bank. A3.	16. Bank. A4.	20. Bank. A5.	24. Bank. A6.	28. Bank. A7.
Channel B. (x16).	1. Bank. B0.	5. Bank. B1.	9. Bank. B2.	13. Bank. B3.	17. Bank. B4.	21. Bank. B5.	25. Bank. B6.	29. Bank. B7.
Channel C. (x16).	2. Bank. C0.	6. Bank. C1.	10. Bank. C2.	14. Bank. C3.	18. Bank. C4.	22. Bank. C5.	26. Bank. C6.	30. Bank. C7.
Channel D. (x16).	3. Bank. D0.	7. Bank. D1.	11. Bank. D2.	15. Bank. D3.	19. Bank. D4.	23. Bank. D5.	27. Bank. D6.	31. Bank. D7.

5.1 IDX110M00 (Barefoot) Placement

Channel A
(x16)

| | | | | | | | | |
|0|8|16|24| |4|12|20|28|

CE numbers

U3/U4   U5/U6

Channel B
(x16)

|1|9|17|25| |5|13|21|29|

CE numbers

U7/U8   U9/U10

Channel C
(x16)

|2|10|18|26| |6|14|22|30|

CE numbers

U11/U12   U13/U14

Channel D
(x16)

|3|11|19|27| |7|15|23|31|

CE numbers

U15/U16   U17/U18

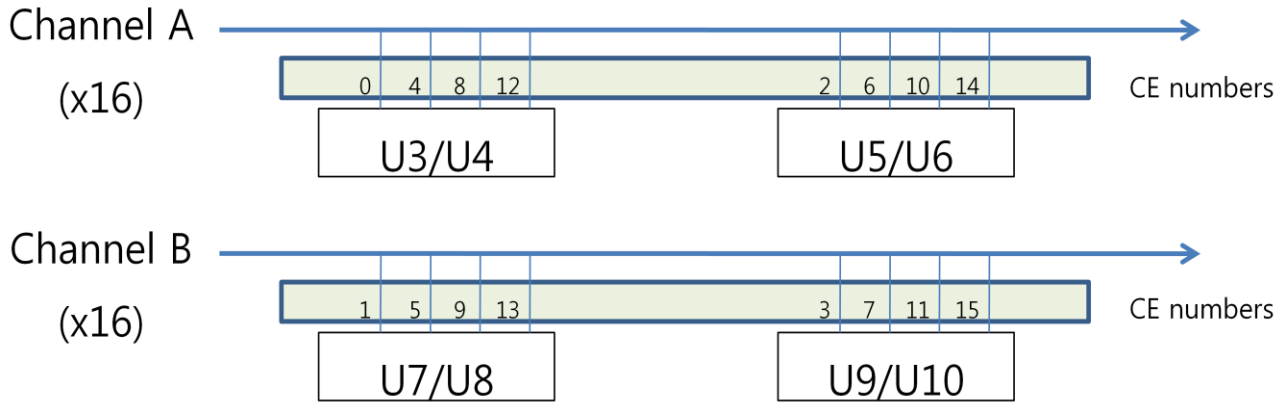Here is the basic rule to stuff NANDs on Barefoot 2.5" customer reference board.

- U3/4/5/6/7/8/9/10/11/12/13/14/15/16/17/18 is the names used in Hoof25 (Indilinx Barefoot 2.5 inch reference board) schematic.
- Barefoot has 16 bit data bus, so NAND packages should be stuffed as a pair, for example U3/U4. In this case U3 is the low chip (Data bit 0:7) and U4 is the high chip. (Data bit 8:15)
- When 4 NAND packages are stuffed, U3/U4/U7/U8 is the recommended/possible configuration. U3/U7/U11/U15 is not possible.
- For example, CE 0,8,16,24 are connected to U3/U4. It means U3 (low chip) and U4 (high chip) share CE0, CE8, CE16 and CE24.

IDX110M00 (Barefoot) has four channels. To get the maximum performance, it is recommended utilizing all channels. Following is the recommended compositions for Indilinx Reference Design. Refer to U numbers from schematic.

- 4 NAND composition   : U3 U4 U7 U8
- 8 NAND composition   : U3 U4 U7 U8 U11 U12 U15 U16
- 16 NAND composition   : All 16 NANDs
- 32 NAND composition   : All 16 NANDs

4 NAND composition with Barefoot is not recommended, because it will have the same performance to Amigos 4 NAND composition. 32 NAND composition is possible when using DSP, such as Samsung K9MDG08 or K9NCG08.

5.2 IDX100M00 (Amigos) Placement

Channel A
(x16)

| 0 | 4 | 8 | 12 | | 2 | 6 | 10 | 14 | CE numbers

U3/U4   U5/U6

Channel B
(x16)

| 1 | 5 | 9 | 13 | | 3 | 7 | 11 | 15 | CE numbers

U7/U8   U9/U10

Here is the basic rule to stuff NANDs on Barefoot 2.5" customer reference board.

- U3/4/5/6/7/8/9/10 is the names used in Sabaton25 (Indilinx Amigos 2.5 inch reference board) schematic.
- Amigos also has 16 bit data bus, so NAND packages should be stuffed as a pair, for example U3/U4. In this case U3 is the low chip (Data bit 0:7) and U4 is the high chip. (Data bit 8:15)
- When 4 NAND packages are stuffed, U3/U4/U7/U8 is the recommended/possible configuration. U3/U5/U7/U9 is not possible..
- For example, CE 0,4,8,12 are connected to U3/U4. It means U3 (low chip) and U4 (high chip) share CE0, CE4, CE8 and CE12.

IDX100M00 (Amigos) has two channels.(channel A & B) To get the maximum performance, it is recommended utilizing all channels. Following is the recommended compositions for Indilinx Reference Design. Refer to U numbers from schematic.

- 4 NAND composition   : U3 U4 U7 U8
- 8 NAND composition   : U3 U4 U5 U6 U7 U8 U9 U10
- 16 NAND composition   : U3 U4 U5 U6 U7 U8 U9 U10

16 NAND composition is possible when using DSP, such as Samsung K9MDG08 or K9NCG08.