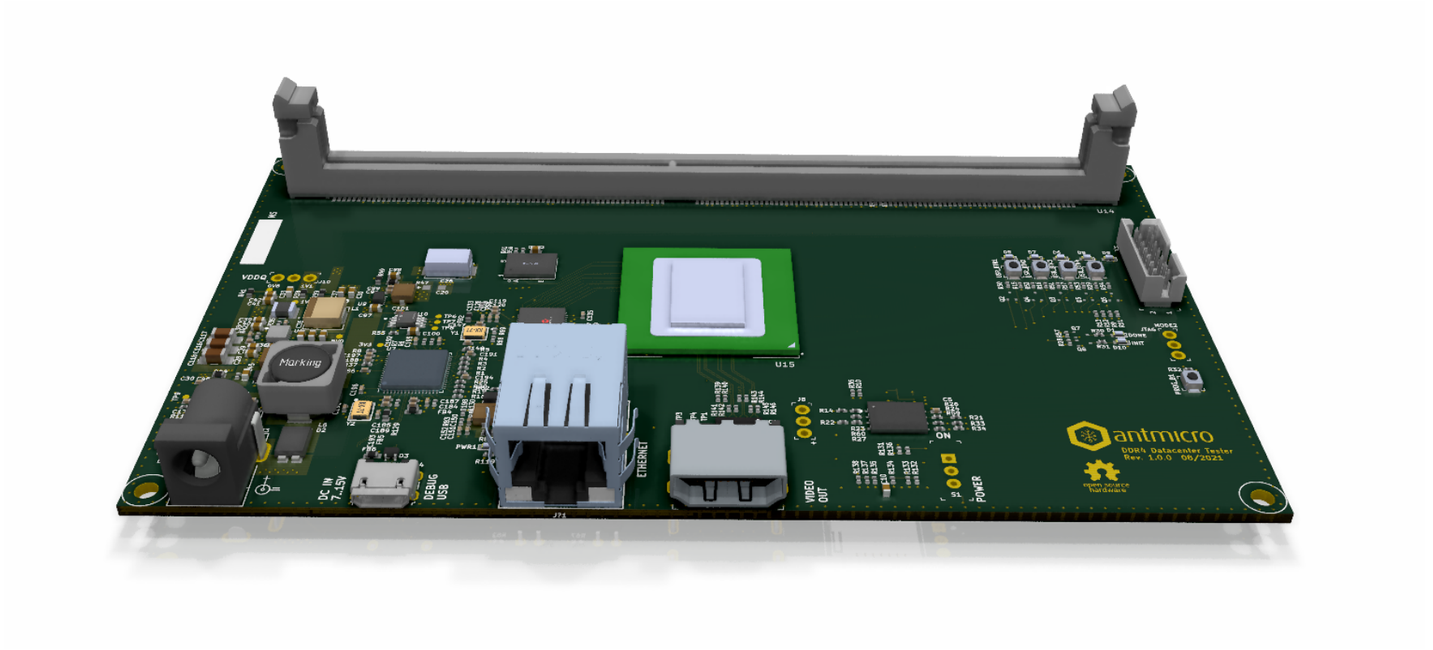
Data Center DRAM Tester



Sheet: HyperRAM
File: hyperram.sch

Sheet: DDR4
File: DDR4.sch

Sheet: Interfaces
File: interfaces.sch

Sheet: Ethernet
File: ethernet.sch

Sheet: Supply
File: supply.sch

Sheet: Config SPI flash
File: config-spi.sch

Sheet: FPGA power
File: fpga-power.sch

Sheet: FPGA banks 12-15
File: fpga-banks-12-15.sch

Sheet: FPGA banks 16-34
File: fpga-banks-16-34.sch

Logo N1 oshw_logo

Logo N2 antmicro_logo

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Sheet: /
File: data-center-dram-tester.sch

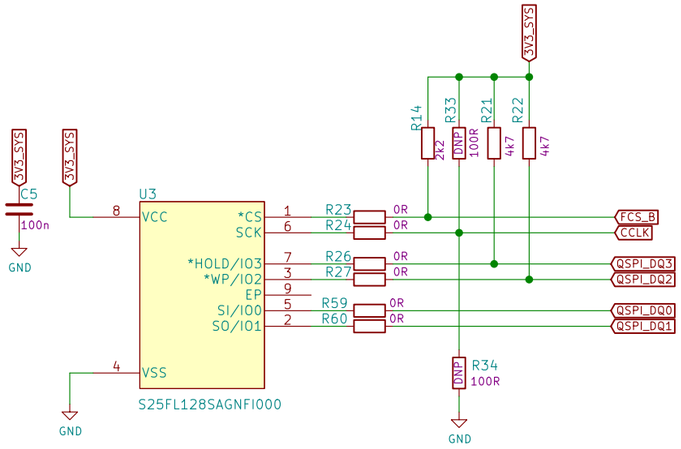
Title: Data Center DRAM Tester

Size: A3	Date: 2021-11	**Rev: 1.1.0**
KiCad E.D.A.	eeschema 5.1.9+dfsg1-1	Id: 1/10

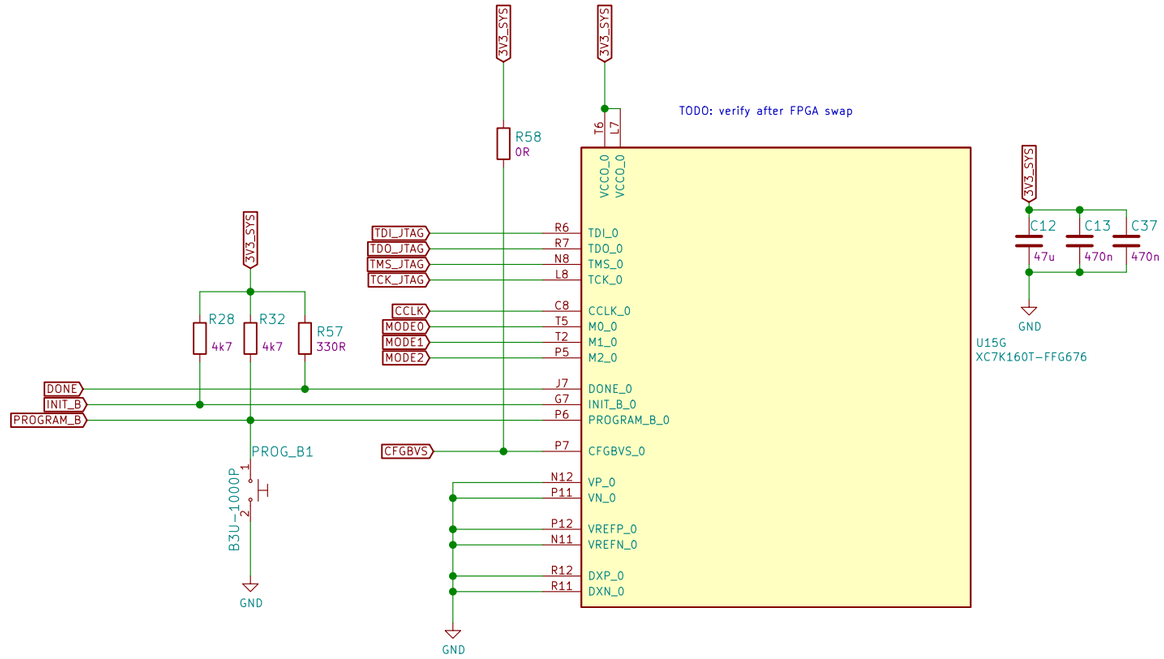
Master SPI Quad (x4) configuration scheme

Follows Figure 2–14 7 Series FPGAs Configuration User Guide
UG470 (v1.13.1)

(Q)SPI flash

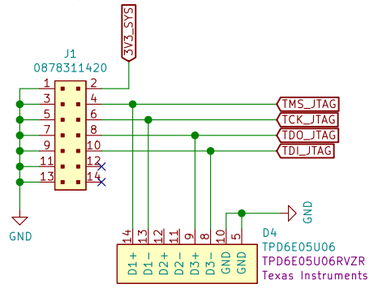


FPGA BANK 0

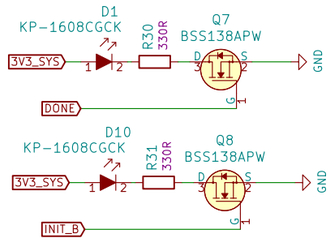


JTAG Connector

Compatible with Xilinx Platform Cable

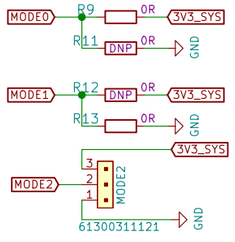


STATUS LEDs



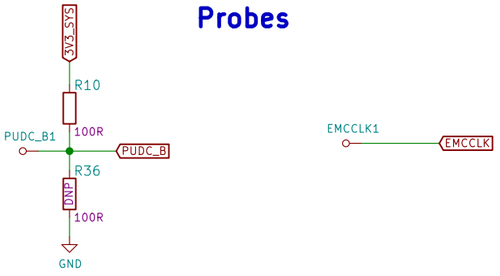
Configuration Modes

For details, see UG470 p. 21



Config. mode	MODE[2:0]
Master Serial	000
Master SPI	001
Master BPI	010
Master SelectMAP	100
JTAG	101
Slave SelectMAP	110
Slave Serial	111

Probes



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Sheet: /Config SPI flash/
File: config-spi.sch

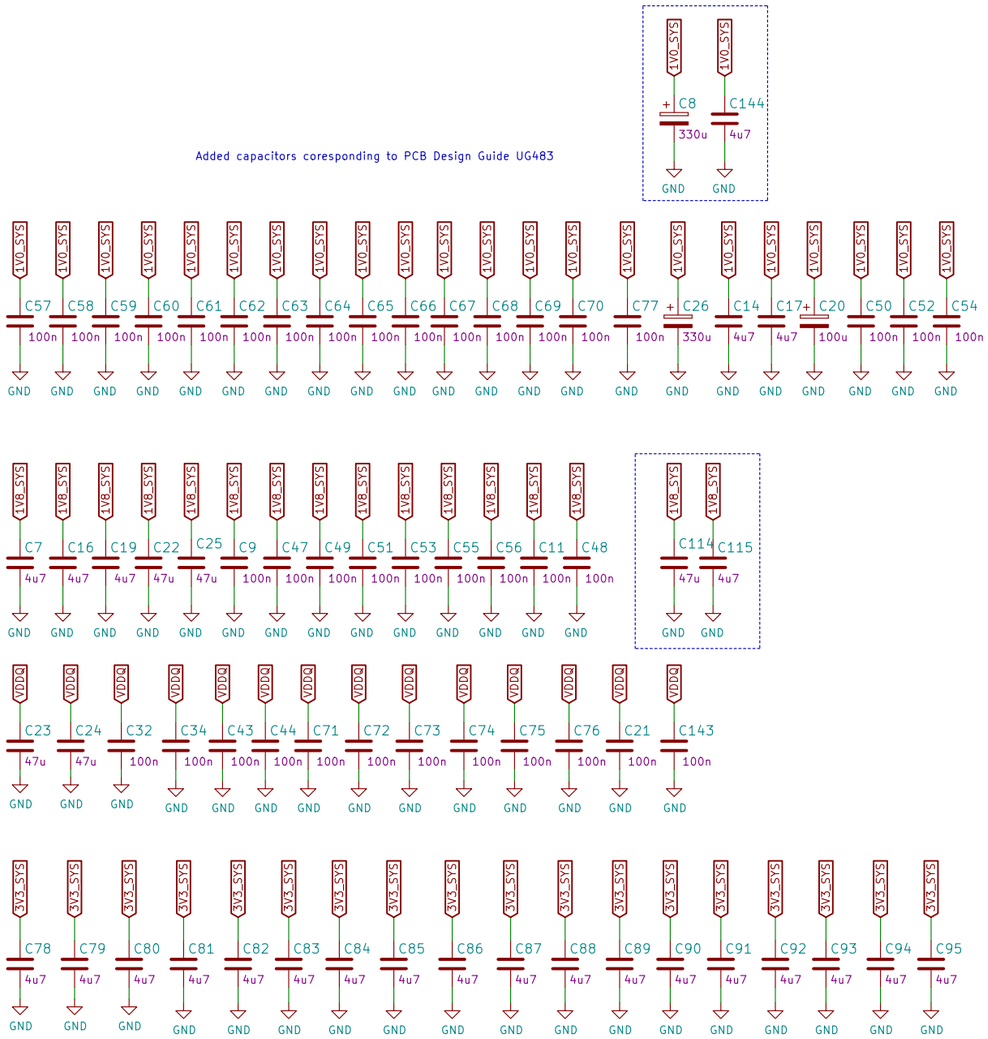
Title: Data Center DRAM Tester

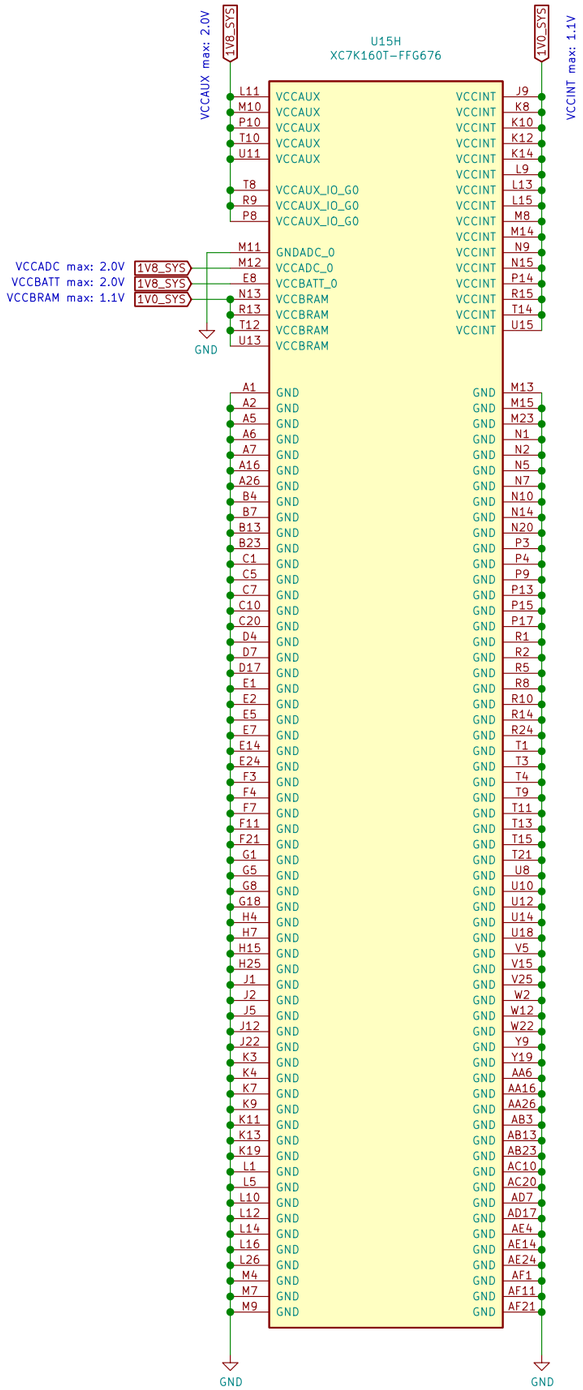
Size: A3	Date: 2021-11	**Rev: 1.1.0**
KiCad E.D.A. eeschema 5.1.9+dfsg1-1		Id: 2/10

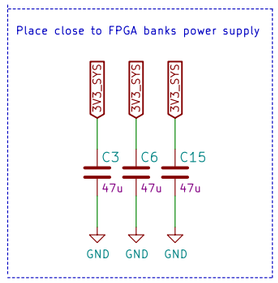
POWER RAILS

Decoupling referenced from 7 Series FPGAs
PCB Design Guide UG483
TODO: verify!

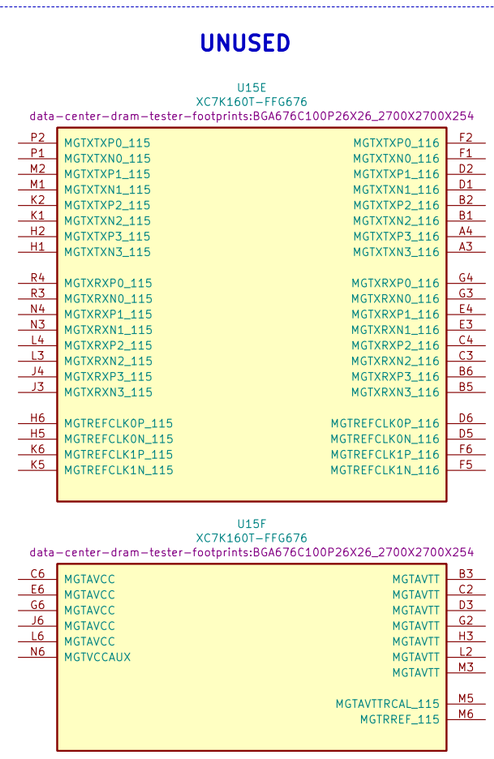
Added capacitors coresponding to PCB Design Guide UG483







UNUSED



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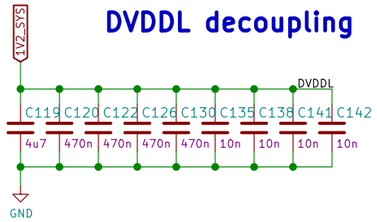
Sheet: /FPGA power/
File: fpga-power.sch

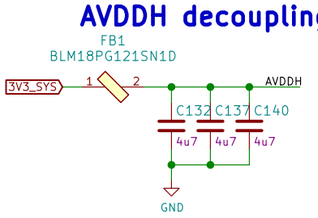
Title: Data Center DRAM Tester

Size: A3	Date: 2021-11	**Rev: 1.1.0**
KiCad E.D.A.	eeschema 5.1.9+dfsg1-1	Id: 3/10

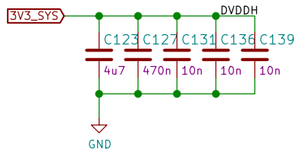
DVDDL decoupling



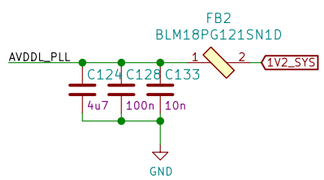
AVDDH decoupling



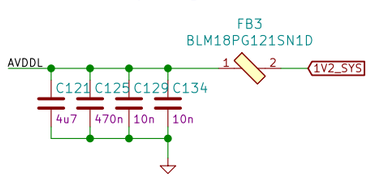
DVDDH decoupling



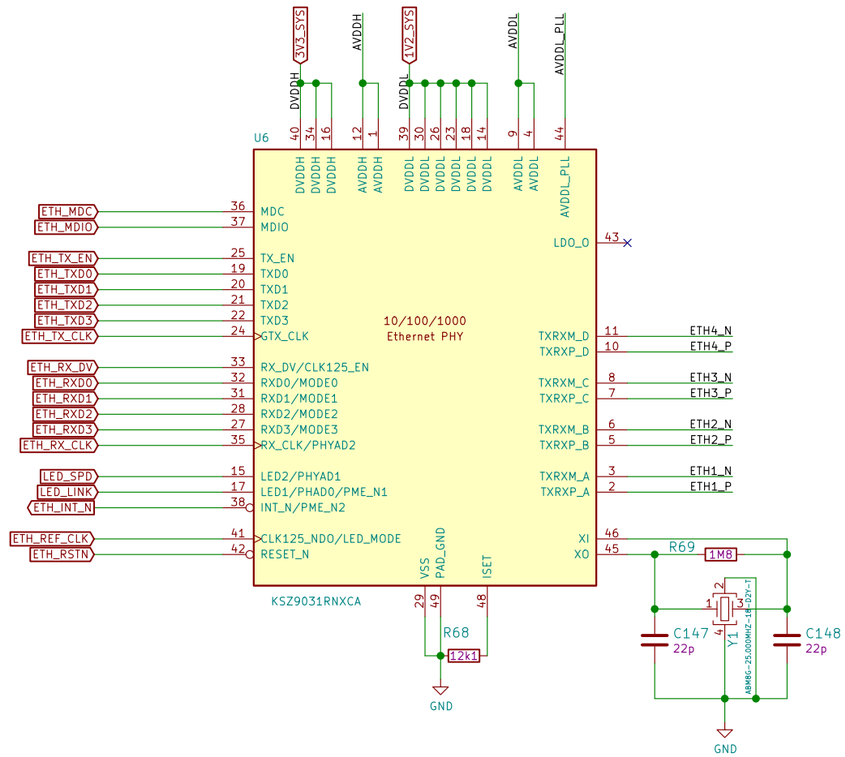
AVDDL_PLL decoupling



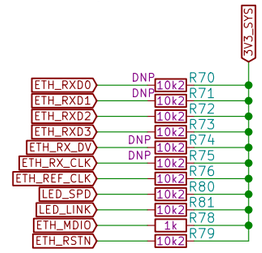
AVDDL decoupling



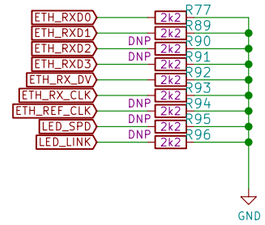
PHY



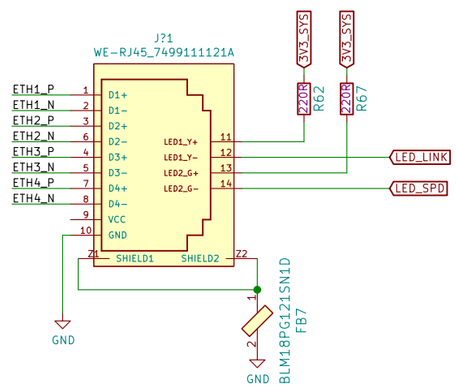
Pull up resistors



Pull down resistors



RJ45 Connector



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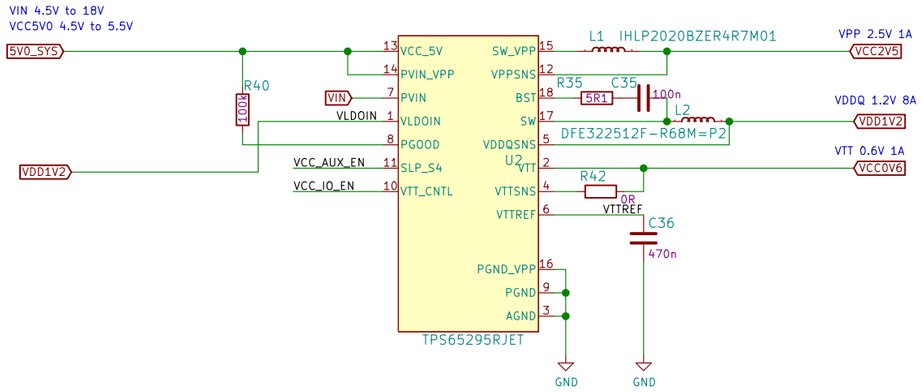
Sheet: /Ethernet/
File: ethernet.sch

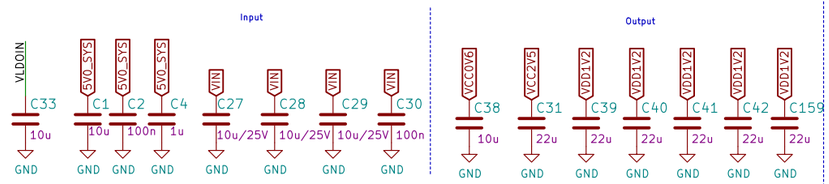
Title: Data Center DRAM Tester

Size: A3	Date: 2021-11	**Rev: 1.1.0**
KiCad E.D.A.	eeschema 5.1.9+dfsg1-1	Id: 4/10

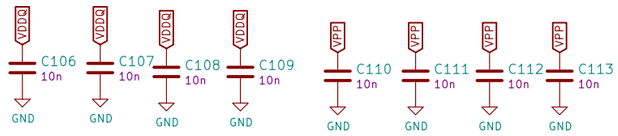
DDR4 PMIC



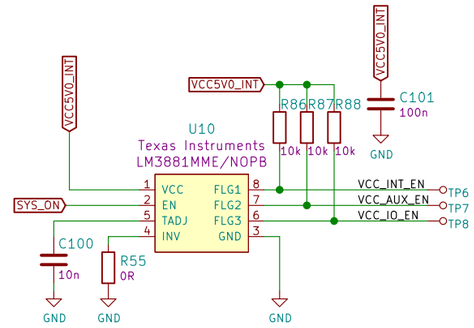
Filtering



Plane Decoupling

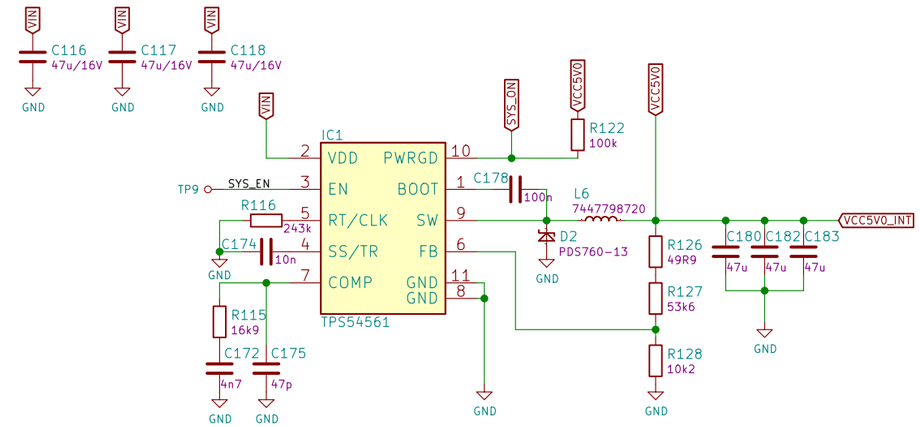


Power sequencer

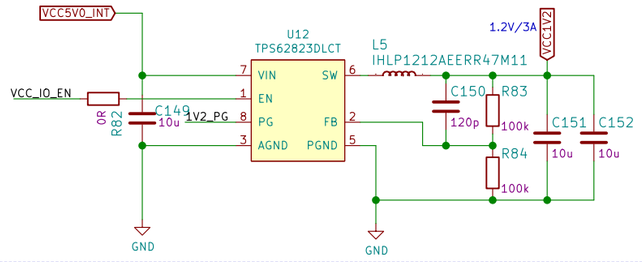


STEP1 – VCCINT (1.0V) for FPGA
STEP2 – VCCAUX (1.8V, 2.5V, 1.2V) for FPGA and DDR
STEP3 – VCCIO (3.3V, 1.2V, 0.6V) for FPGA, PHY and DDR

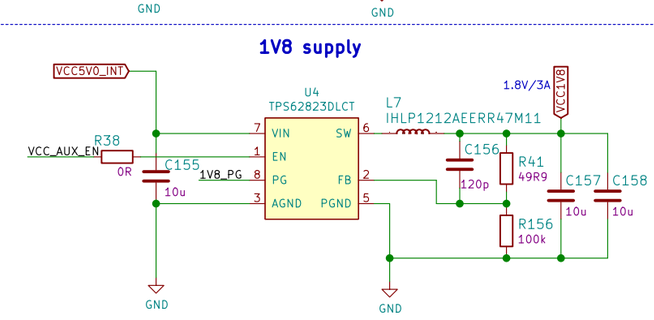
Main supply (5V 5A)



1V2 supply

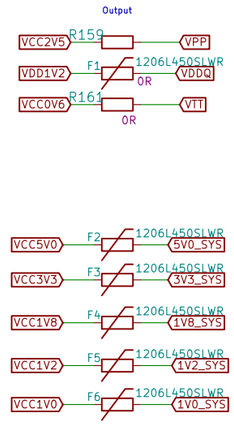


1V8 supply

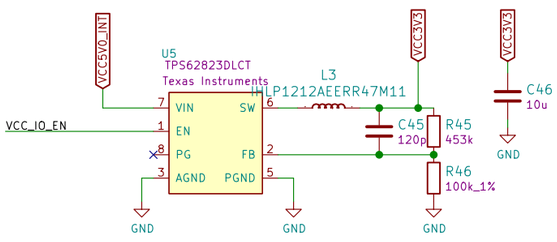


Probes

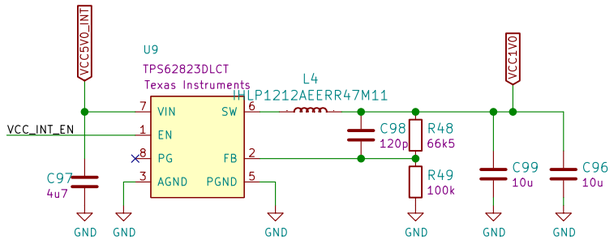
Shunt resistors



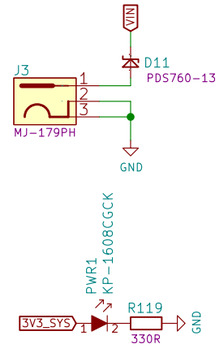
3V3 supply (2A)



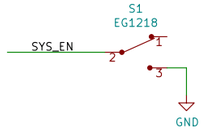
VCCINT (1.0V 2A)



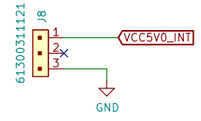
Input power connector



Power switch



Optional FAN connector



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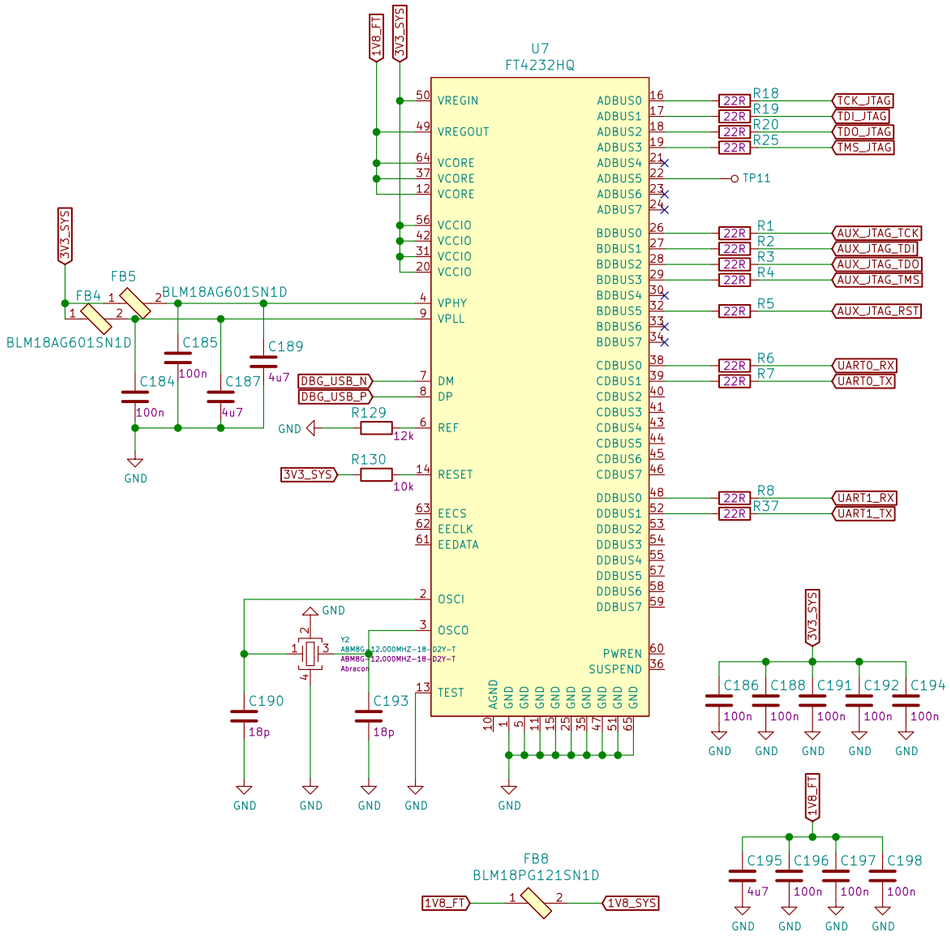
Sheet: /Supply/
File: supply.sch

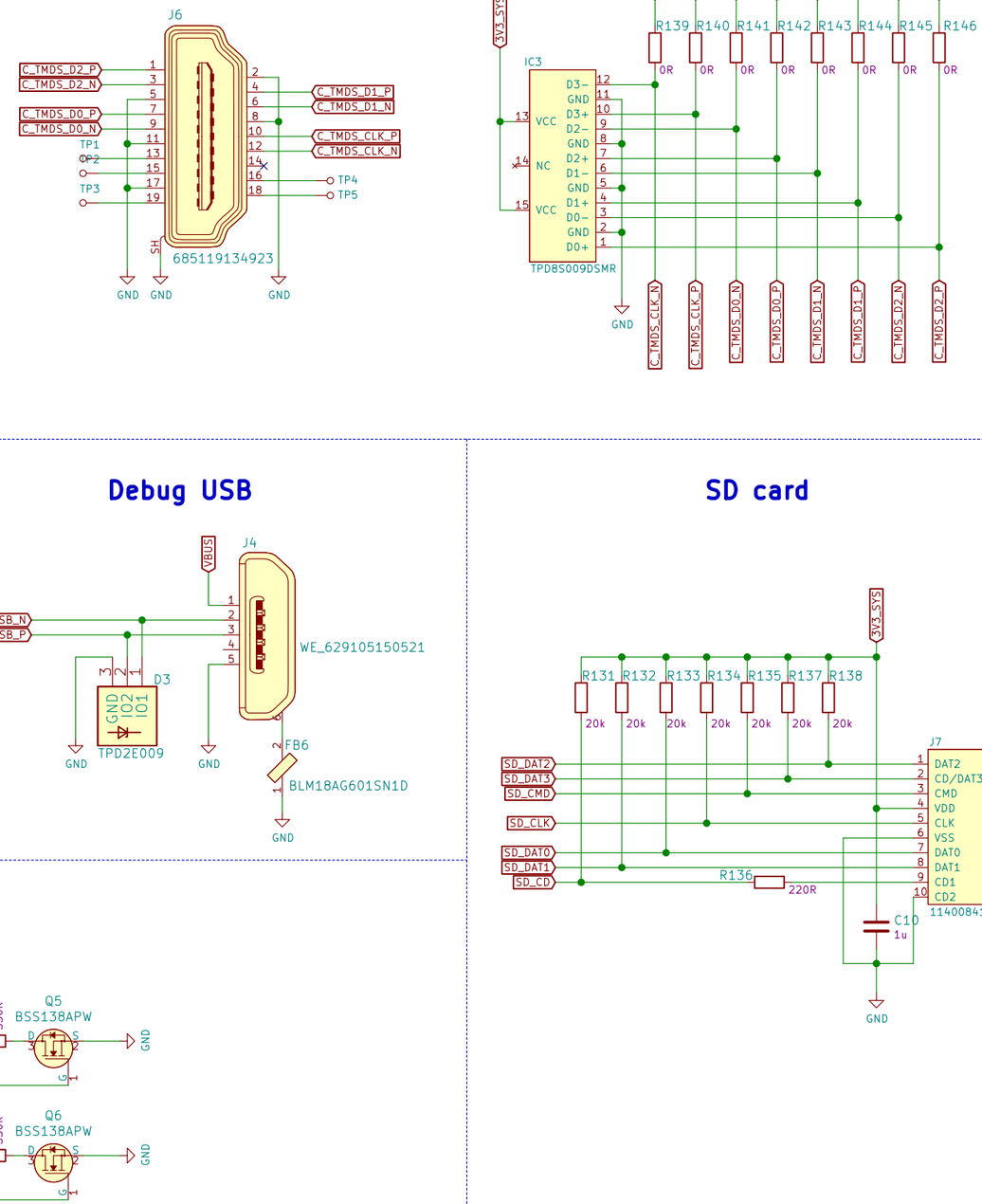
Title: Data Center DRAM Tester

Size: A3	Date: 2021-11	**Rev: 1.1.0**
KiCad E.D.A. eeschema 5.1.9+dfsg1-1		Id: 5/10

Debug UART



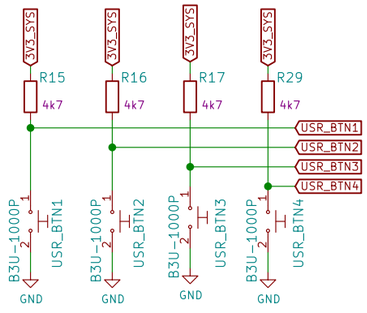
HDMI



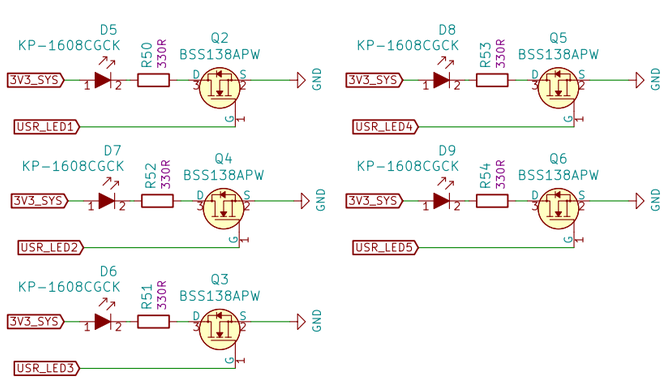
Debug USB

SD card

User buttons



User LEDs



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Sheet: /Interfaces/
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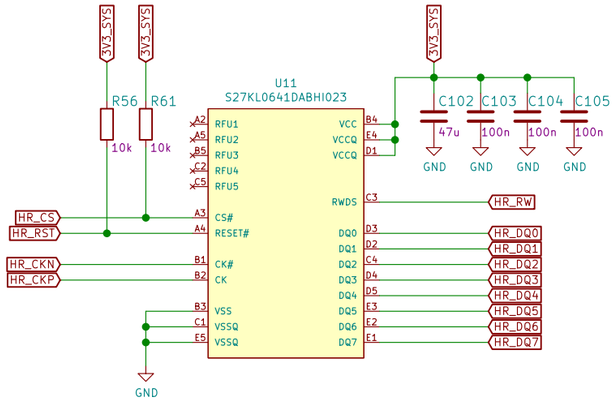
Title: Data Center DRAM Tester

Size: A3	Date: 2021-11	**Rev: 1.1.0**
KiCad E.D.A.	eeschema 5.1.9+dfsg1-1	Id: 6/10

HyperRAM



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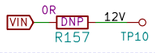
Sheet: /HyperRAM/
File: hyperram.sch

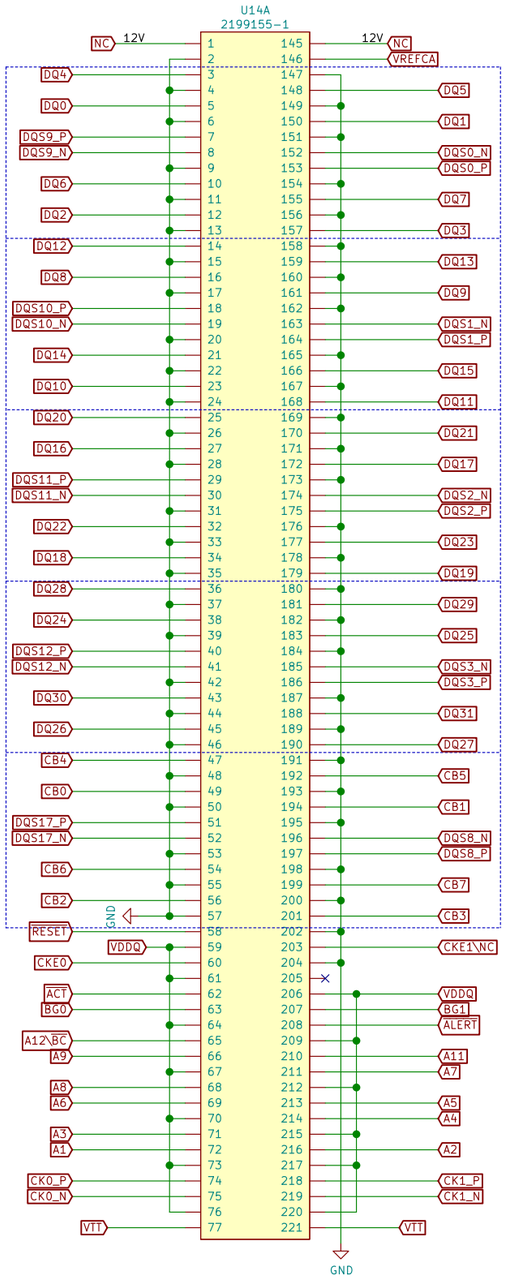
Title: Data Center DRAM Tester

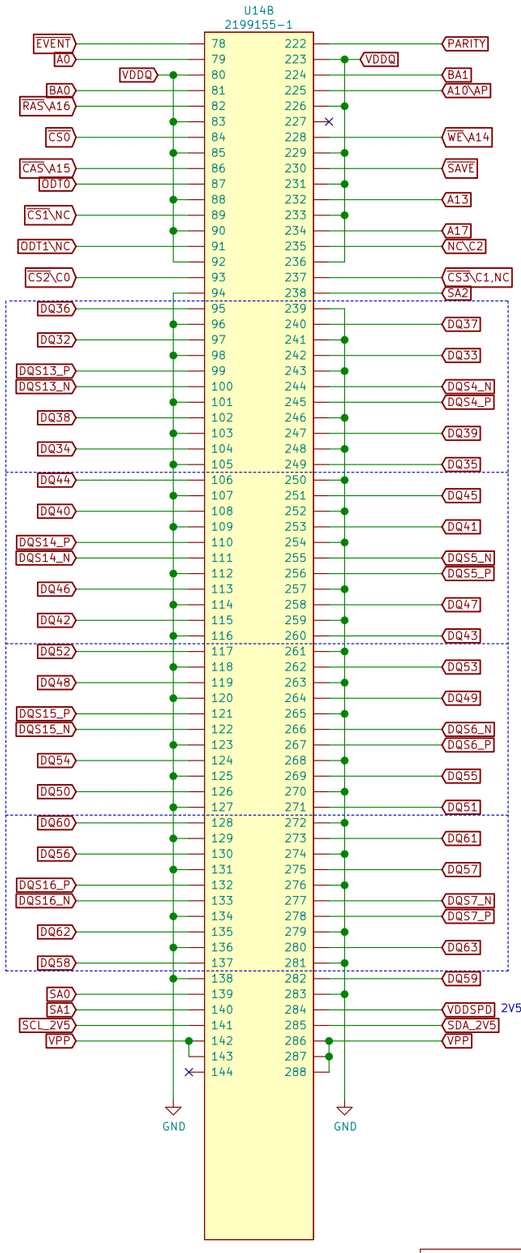
Size: A3	Date: 2021-11	**Rev: 1.1.0**
KiCad E.D.A. eeschema 5.1.9+dfsg1-1		Id: 7/10

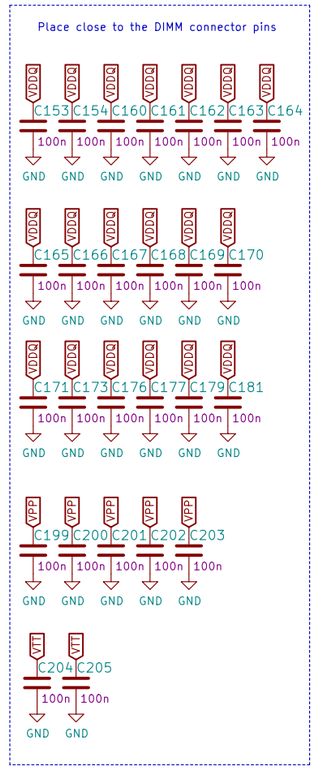
DDR4 RDIMM connector

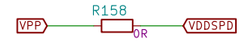
NVRDIMM Backup voltage











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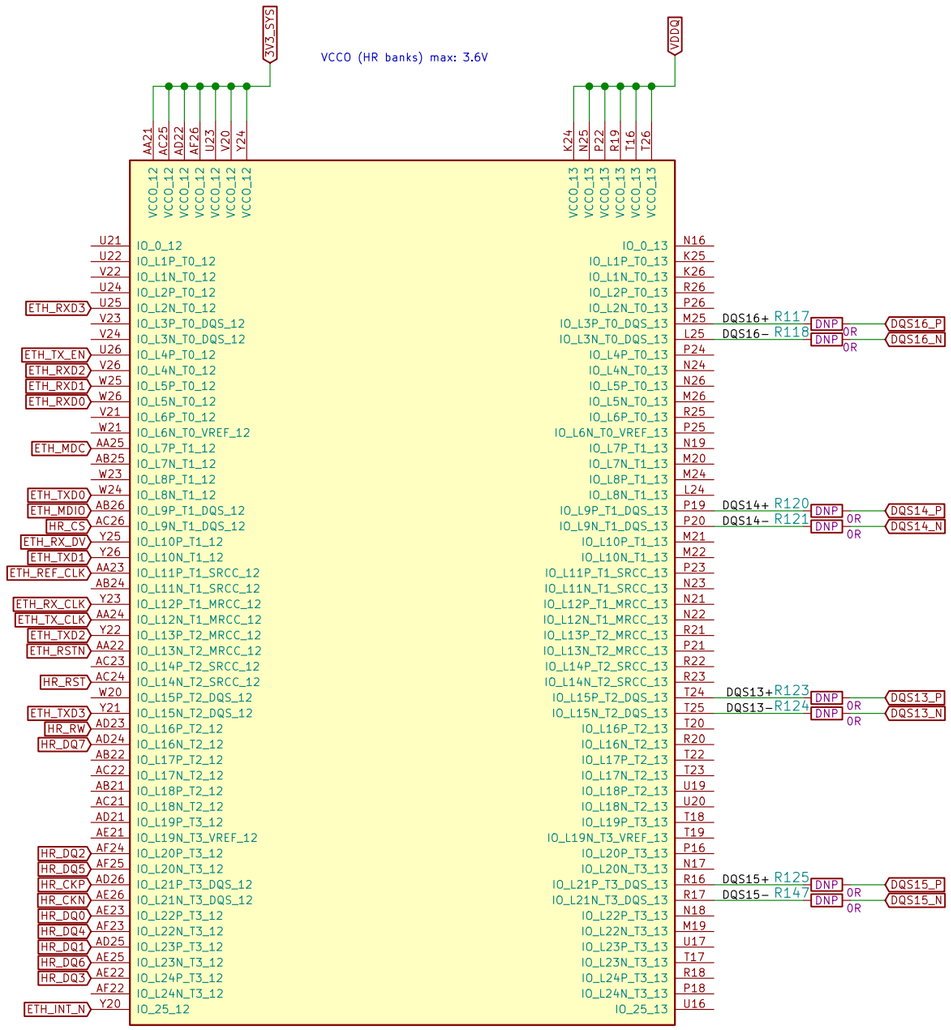
Title: Data Center DRAM Tester	
Size: A3 | Date: 2021-11 KiCad E.D.A. eeschema 5.1.9+dfsg1-1	**Rev: 1.1.0** Id: 8/10

BANK 12

BANK 13



U15A
XC7K160T-FFG676
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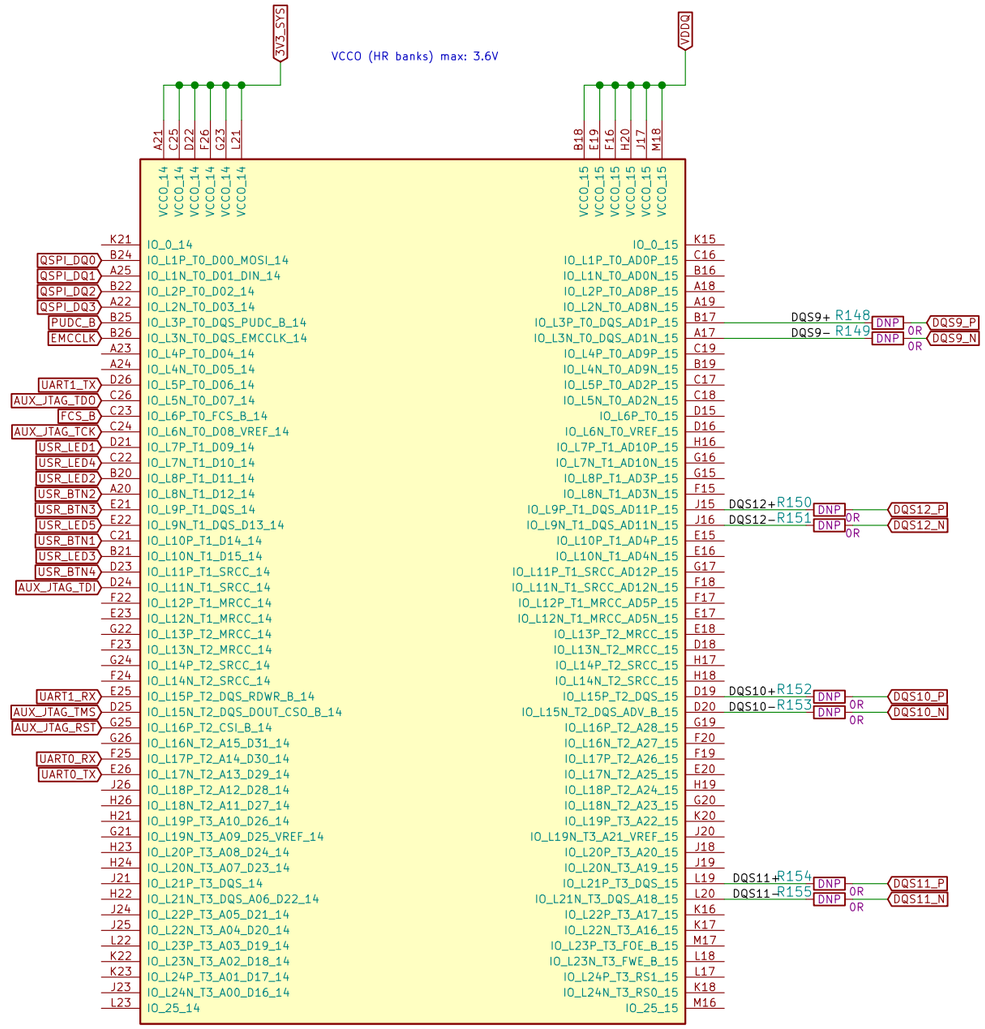
BANK 14

BANK 15



U15B
XC7K160T-FFG676
data-center-dram-tester-footprints:BGA676C100P26X26_2700X2700X254

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Sheet: /FPGA banks 12-15/
File: fpga-banks-12-15.sch

Title: Data Center DRAM Tester

Size: A3	Date: 2021-11	**Rev: 1.1.0**
KiCad E.D.A.	eeschema 5.1.9+dfsg1-1	Id: 9/10

BANK 16

VCCO (HR banks) max: 3.6V

3V3_SYS

A11 B8 C15 D12 E9 G13 H10

VCCO_16 ×7

J8	IO_0_16	
H9	IO_L1P_T0_16	
H8	IO_L1N_T0_16	
G10	IO_L2P_T0_16	
G9	IO_L2N_T0_16	
J13	IO_L3P_T0_DQS_16	
H13	IO_L3N_T0_DQS_16	
J11	IO_L4P_T0_16	
J10	IO_L4N_T0_16	
H14	IO_L5P_T0_16	
G14	IO_L5N_T0_16	
H12	IO_L6P_T0_16	
H11	IO_L6N_T0_VREF_16	
F9	IO_L7P_T1_16	SD_CD
F8	IO_L7N_T1_16	SD_DAT1
D9	IO_L8P_T1_16	SD_DAT3
D8	IO_L8N_T1_16	SD_CMD
A9	IO_L9P_T1_DQS_16	
A8	IO_L9N_T1_DQS_16	
C9	IO_L10P_T1_16	SD_DAT2
B9	IO_L10N_T1_16	
G11	IO_L11P_T1_SRCC_16	
F10	IO_L11N_T1_SRCC_16	
E10	IO_L12P_T1_MRCC_16	SD_DAT0
D10	IO_L12N_T1_MRCC_16	SD_CLK
C12	IO_L13P_T2_MRCC_16	GCLK100
C11	IO_L13N_T2_MRCC_16	
E11	IO_L14P_T2_SRCC_16	
D11	IO_L14N_T2_SRCC_16	
F14	IO_L15P_T2_DQS_16	
F13	IO_L15N_T2_DQS_16	
G12	IO_L16P_T2_16	
F12	IO_L16N_T2_16	
D14	IO_L17P_T2_16	
D13	IO_L17N_T2_16	
E13	IO_L18P_T2_16	
E12	IO_L18N_T2_16	
C14	IO_L19P_T3_16	
C13	IO_L19N_T3_VREF_16	
B12	IO_L20P_T3_16	
B11	IO_L20N_T3_16	
B14	IO_L21P_T3_DQS_16	TMDS_D0_P
A14	IO_L21N_T3_DQS_16	TMDS_D0_N
B10	IO_L22P_T3_16	TMDS_D2_P
A10	IO_L22N_T3_16	TMDS_D2_N
B15	IO_L23P_T3_16	TMDS_CLK_P
A15	IO_L23N_T3_16	TMDS_CLK_N
A13	IO_L24P_T3_16	TMDS_D1_P
A12	IO_L24N_T3_16	TMDS_D1_N
J14	IO_25_16	

BANK 32

VDDQ

AB18 AC15 AE19 AF16 W17 Y14

VCCO_32 ×7

V13	IO_0_VRN_32	
AE17	IO_L1P_T0_32	DQ41
AF17	IO_L1N_T0_32	DQ40
AF14	IO_L2P_T0_32	R163 10k EVENT
AF15	IO_L2N_T0_32	CS3\C1_NC
AE18	IO_L3P_T0_DQS_32	DQS5_P
AF18	IO_L3N_T0_DQS_32	DQS5_N
AD15	IO_L4P_T0_32	
AE15	IO_L4N_T0_32	DQ44
AF19	IO_L5P_T0_32	DQ46
AF20	IO_L5N_T0_32	DQ42
AD16	IO_L6P_T0_32	DQ37
AE16	IO_L6N_T0_VREF_32	DQ45
AA14	IO_L7P_T1_32	CS1\NC
AA15	IO_L7N_T1_32	DQ53
AC14	IO_L8P_T1_32	CS2\C0
AD14	IO_L8N_T1_32	NC\C2
Y15	IO_L9P_T1_DQS_32	DQS7_P
Y16	IO_L9N_T1_DQS_32	DQS7_N
AB14	IO_L10P_T1_32	ODT1\NC
AB15	IO_L10N_T1_32	DQ36
AA17	IO_L11P_T1_SRCC_32	DQ61
AA18	IO_L11N_T1_SRCC_32	DQ56
AB16	IO_L12P_T1_MRCC_32	DQ34
AC16	IO_L12N_T1_MRCC_32	DQ32
AC18	IO_L13P_T2_MRCC_32	DQ38
AD18	IO_L13N_T2_MRCC_32	DQ47
AB17	IO_L14P_T2_SRCC_32	DQ60
AC17	IO_L14N_T2_SRCC_32	DQ33
AD20	IO_L15P_T2_DQS_32	DQS4_P
AE20	IO_L15N_T2_DQS_32	DQS4_N
AA19	IO_L16P_T2_32	DQ35
AA20	IO_L16N_T2_32	DQ52
AC19	IO_L17P_T2_32	DQ39
AD19	IO_L17N_T2_32	DQ43
AB19	IO_L18P_T2_32	DQ57
AB20	IO_L18N_T2_32	
Y17	IO_L19P_T3_32	DQ49
Y18	IO_L19N_T3_VREF_32	DQ48
V16	IO_L20P_T3_32	DQ58
V17	IO_L20N_T3_32	DQ63
W18	IO_L21P_T3_DQS_32	DQS6_P
W19	IO_L21N_T3_DQS_32	DQS6_N
W15	IO_L22P_T3_32	DQ59
W16	IO_L22N_T3_32	DQ55
V18	IO_L23P_T3_32	DQ54
V19	IO_L23N_T3_32	DQ62
V14	IO_L24P_T3_32	DQ51
W14	IO_L24N_T3_32	DQ50
W13	IO_25_VRP_32	CS0

U15C
XC7K160T-FFG676
data-center-dram-tester-footprints:BGA676C100P26X26_2700X2700X254

BANK 33

VCCO (HP banks) max: 2.0V

VDDQ

AA11 AB8 AD12 AE9 V10 W7

VCCO_33 ×6

U9	IO_0_VRN_33	VRN
V11	IO_L1P_T0_33	DQ4
W11	IO_L1N_T0_33	DQ0
V8	IO_L2P_T0_33	DQ6
V7	IO_L2N_T0_33	DQ2
W10	IO_L3P_T0_DQS_33	DQS0_P
W9	IO_L3N_T0_DQS_33	DQS0_N
Y8	IO_L4P_T0_33	ACT
Y7	IO_L4N_T0_33	DQ3
Y11	IO_L5P_T0_33	DQ1
Y10	IO_L5N_T0_33	SAVE
V9	IO_L6P_T0_33	DQ5
W8	IO_L6N_T0_VREF_33	DQ7
AE7	IO_L7P_T1_33	A9
AF7	IO_L7N_T1_33	A7
AA8	IO_L8P_T1_33	CKE0
AA7	IO_L8N_T1_33	CKE1\NC
AC8	IO_L9P_T1_DQS_33	R160 DNP DQS17+ DQS17_P
AD8	IO_L9N_T1_DQS_33	R162 DNP 0R DQS17- DQS17_N
AB7	IO_L10P_T1_33	A12\BC
AC7	IO_L10N_T1_33	A11
AA9	IO_L11P_T1_SRCC_33	BG0
AB9	IO_L11N_T1_SRCC_33	A6
AC9	IO_L12P_T1_MRCC_33	A4
AD9	IO_L12N_T1_MRCC_33	A5
AB11	IO_L13P_T2_MRCC_33	BA0
AC11	IO_L13N_T2_MRCC_33	A1
AA10	IO_L14P_T2_SRCC_33	
AB10	IO_L14N_T2_SRCC_33	BA1
AB12	IO_L15P_T2_DQS_33	CK1_P
AC12	IO_L15N_T2_DQS_33	CK1_N
AA13	IO_L16P_T2_33	WE\A14
AA12	IO_L16N_T2_33	RAS\A16
AC13	IO_L17P_T2_33	A17
AD13	IO_L17N_T2_33	A13
Y13	IO_L18P_T2_33	ODT0
Y12	IO_L18N_T2_33	A10\AP
AD11	IO_L19P_T3_33	A2
AE11	IO_L19N_T3_VREF_33	VREF_33
AD10	IO_L20P_T3_33	A3
AE10	IO_L20N_T3_33	ALERT
AE12	IO_L21P_T3_DQS_33	CK0_P
AF12	IO_L21N_T3_DQS_33	CK0_N
AE8	IO_L22P_T3_33	A8
AF8	IO_L22N_T3_33	
AE13	IO_L23P_T3_33	PARITY
AF13	IO_L23N_T3_33	CAS\A15
AF10	IO_L24P_T3_33	A0
AF9	IO_L24N_T3_33	BG1
V12	IO_25_VRP_33	VRP

BANK 34

VDDQ

AA1 AC5 AD2 AE6 U3 Y4

VCCO_34 ×6

U4	IO_0_VRN_34	DQ13
U6	IO_L1P_T0_34	
U5	IO_L1N_T0_34	DQ12
U2	IO_L2P_T0_34	DQ8
U1	IO_L2N_T0_34	
W6	IO_L3P_T0_DQS_34	DQS1_P
W5	IO_L3N_T0_DQS_34	DQS1_N
V3	IO_L4P_T0_34	DQ28
W3	IO_L4N_T0_34	DQ14
U7	IO_L5P_T0_34	
V6	IO_L5N_T0_34	DQ9
V4	IO_L6P_T0_34	DQ29
W4	IO_L6N_T0_VREF_34	DQ24
Y3	IO_L7P_T1_34	DQ11
Y2	IO_L7N_T1_34	DQ10
V2	IO_L8P_T1_34	DQ20
V1	IO_L8N_T1_34	
AB1	IO_L9P_T1_DQS_34	DQS2_P
AC1	IO_L9N_T1_DQS_34	DQS2_N
W1	IO_L10P_T1_34	DQ21
Y1	IO_L10N_T1_34	DQ15
AB2	IO_L11P_T1_SRCC_34	DQ17
AC2	IO_L11N_T1_SRCC_34	DQ23
AA3	IO_L12P_T1_MRCC_34	DQ25
AA2	IO_L12N_T1_MRCC_34	DQ16
AA4	IO_L13P_T2_MRCC_34	
AB4	IO_L13N_T2_MRCC_34	DQ30
AC4	IO_L14P_T2_SRCC_34	DQ27
AC3	IO_L14N_T2_SRCC_34	DQ31
AA5	IO_L15P_T2_DQS_34	DQS3_P
AB5	IO_L15N_T2_DQS_34	DQS3_N
AB6	IO_L16P_T2_34	RESET
AC6	IO_L16N_T2_34	CB3
Y6	IO_L17P_T2_34	SDA_1V2
Y5	IO_L17N_T2_34	SCL_1V2
AD6	IO_L18P_T2_34	CB2
AD5	IO_L18N_T2_34	CB7
AD4	IO_L19P_T3_34	
AD3	IO_L19N_T3_VREF_34	DQ26
AD1	IO_L20P_T3_34	DQ22
AE1	IO_L20N_T3_34	DQ18
AF5	IO_L21P_T3_DQS_34	DQS8_P
AF4	IO_L21N_T3_DQS_34	DQS8_N
AE3	IO_L22P_T3_34	CB5
AE2	IO_L22N_T3_34	DQ19
AE6	IO_L23P_T3_34	CB6
AE5	IO_L23N_T3_34	CB1
AF3	IO_L24P_T3_34	CB0
AF2	IO_L24N_T3_34	CB4
T7	IO_25_VRP_34	

U15D
XC7K160T-FFG676
data-center-dram-tester-footprints:BGA676C100P26X26_2700X2700X254

Clock source

3V3_SYS

IC2 U1 ASFLMB-100.000MHZ-XY-T

STDB 1 · GND 2 · VDD 4 · OUT 3 → GCLK100

C145 100n

GND GND

DQS routing

DQS9_P	R97 0R	DQS0_P
DQS9_N	R98 0R	DQS0_N
DQS10_P	R99 0R	DQS1_P
DQS10_N	R100 0R	DQS1_N
DQS11_P	R101 0R	DQS2_P
DQS11_N	R102 0R	DQS2_N
DQS12_P	R103 0R	DQS3_P
DQS12_N	R104 0R	DQS3_N
DQS13_P	R105 0R	DQS4_P
DQS13_N	R106 0R	DQS4_N
DQS14_P	R107 0R	DQS5_P
DQS14_N	R108 0R	DQS5_N
DQS15_P	R109 0R	DQS6_P
DQS15_N	R110 0R	DQS6_N
DQS16_P	R111 0R	DQS7_P
DQS16_N	R112 0R	DQS7_N
DQS17_P	R113 0R	DQS8_P
DQS17_N	R114 0R	DQS8_N

VREF

VDDQ

R65 1k · R66 1k

C18 100n · C146 100n

VREF_33

GND GND GND

R63 120R VRN — VDDQ

R64 120R VRP — GND

Serial adress select

Default 000

VDDSPD

R164 DNP · R166 DNP · R168 DNP

SA0 SA1 SA2

R165 0R · R167 0R · R169 0R

GND GND GND

I2C logic translator

VDDQ

R170 4k7

EVENT — Open drain pin

U8 PCA9517ADMR2G

VDDQ → R171 4k7 · R172 4k7

SCL_1V2 · SDA_1V2

Vref1 1 · SCL1 2 · SDA1 3 · GND 4

Vref2 8 · SCL2 7 · SDA2 6 · EN 5

VDDSPD → R173 4k7 · R174 4k7

SCL_2V5 · SDA_2V5

TP12

GND

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Title: Data Center DRAM Tester

Size: A3	Date: 2021-11	**Rev: 1.1.0**
KiCad E.D.A. eeschema 5.1.9+dfsg1-1		Id: 10/10