

**KVR667D2D4F5/4G**  
**4GB 512M x 72-Bit PC2-5300**  
**CL5 ECC 240-Pin FBDIMM**

## Description:

This document describes ValueRAM's 4GB (512M x 72-bit) PC2-5300 CL5 SDRAM (Synchronous DRAM) "fully buffered" ECC "dual rank" memory module. This module is based on eighteen stacked 512M x 4-bit (thirty-six 256M x 4-bit) 667MHz DDR2 FBGA components. The module also includes an AMB device (Advanced Memory Buffer). The electrical and mechanical specifications are as follows:

## Feature:

- FBDIMM Module: 240-pin
- JEDEC Standard: R/C H or E
- Memory Organization: 2 rank of x4 devices
- DDR2 DRAM Interface: SSTL\_18
- DDR2 Speed Grade: 667 Mbps
- CAS Latency: 5-5-5
- Module Bandwidth: 5.3 GB/s
- DRAM: VDD = VDDQ = 1.8V
- AMB: VCC = VCCFBD = 1.5V
- EEPROM: VDDSPD = 3.3V (typical)
- Heat Spreader: Full DIMM Heat Spreader (FDHS)
- PCB Height: 30.35mm, double-side
- RoHS Compliant

## DDR2 240-pin FBDIMM Pinout:

Pin #	Front Side	Pin #	Back Side	Pin #	Front Side	Pin #	Back Side	Pin #	Front Side	Pin #	Back Side	Pin #	Front Side	Pin #	Back Side
1	V <sub>DD</sub>	121	V <sub>DD</sub>	31	PN3	151	SN3	61	PN9	181	SN9	91	PS9	211	SS9
2	V <sub>DD</sub>	122	V <sub>DD</sub>	32	PN3	152	SN3	62	V <sub>SS</sub>	182	V <sub>SS</sub>	92	V <sub>SS</sub>	212	V <sub>SS</sub>
3	V <sub>DD</sub>	123	V <sub>DD</sub>	33	V <sub>SS</sub>	153	V <sub>SS</sub>	63	PN10	183	SN10	93	PS5	213	SS5
4	V <sub>SS</sub>	124	V <sub>SS</sub>	34	PN4	154	SN4	64	PN10	184	SN10	94	PS5	214	SS5
5	V <sub>DD</sub>	125	V <sub>DD</sub>	35	PN4	155	SN4	65	V <sub>SS</sub>	185	V <sub>SS</sub>	95	V <sub>SS</sub>	215	V <sub>SS</sub>
6	V <sub>DD</sub>	126	V <sub>DD</sub>	36	V <sub>SS</sub>	156	V <sub>SS</sub>	66	PN11	186	SN11	96	PS6	216	SS6
7	V <sub>DD</sub>	127	V <sub>DD</sub>	37	PN5	157	SN5	67	PN11	187	SN11	97	PS6	217	SS6
8	V <sub>SS</sub>	128	V <sub>SS</sub>	38	PN5	158	SN5	68	V <sub>SS</sub>	188	V <sub>SS</sub>	98	V <sub>SS</sub>	218	V <sub>SS</sub>
9	V <sub>CC</sub>	129	V <sub>CC</sub>	39	V <sub>SS</sub>	159	V <sub>SS</sub>	KEY				99	PS7	219	SS7
10	V <sub>CC</sub>	130	V <sub>CC</sub>	40	PN13	160	SN13	69	V <sub>SS</sub>	189	V <sub>SS</sub>	100	PS7	220	SS7
11	V <sub>SS</sub>	131	V <sub>SS</sub>	41	PN13	161	SN13	70	PS0	190	SS0	101	V <sub>SS</sub>	221	V <sub>SS</sub>
12	V <sub>CC</sub>	132	V <sub>CC</sub>	42	V <sub>SS</sub>	162	V <sub>SS</sub>	71	PS0	191	SS0	102	PS8	222	SS8
13	V <sub>CC</sub>	133	V <sub>CC</sub>	43	V <sub>SS</sub>	163	V <sub>SS</sub>	72	V <sub>SS</sub>	192	V <sub>SS</sub>	103	PS8	223	SS8
14	V <sub>SS</sub>	134	V <sub>SS</sub>	44	RFU*	164	RFU*	73	PS1	193	SS1	104	V <sub>SS</sub>	224	V <sub>SS</sub>
15	V <sub>TT</sub>	135	V <sub>TT</sub>	45	RFU*	165	RFU*	74	PS1	194	SS1	105	RFU**	225	RFU**
16	VID1	136	VID0	46	V <sub>SS</sub>	166	V <sub>SS</sub>	75	V <sub>SS</sub>	195	V <sub>SS</sub>	106	RFU**	226	RFU**
17	RESET	137	DNU/M_Test	47	V <sub>SS</sub>	167	V <sub>SS</sub>	76	PS2	196	SS2	107	V <sub>SS</sub>	227	V <sub>SS</sub>
18	V <sub>SS</sub>	138	V <sub>SS</sub>	48	PN12	168	SN12	77	PS2	197	SS2	108	V <sub>DD</sub>	228	SCK
19	RFU**	139	RFU**	49	PN12	169	SN12	78	V <sub>SS</sub>	198	V <sub>SS</sub>	109	V <sub>DD</sub>	229	SCK
20	RFU**	140	RFU**	50	V <sub>SS</sub>	170	V <sub>SS</sub>	79	PS3	199	SS3	110	V <sub>SS</sub>	230	V <sub>SS</sub>
21	V <sub>SS</sub>	141	V <sub>SS</sub>	51	PN6	171	SN6	80	PS3	200	SS3	111	V <sub>DD</sub>	231	V <sub>DD</sub>
22	PN0	142	SN0	52	PN6	172	SN6	81	V <sub>SS</sub>	201	V <sub>SS</sub>	112	V <sub>DD</sub>	232	V <sub>DD</sub>
23	PN0	143	SN0	53	V <sub>SS</sub>	173	V <sub>SS</sub>	82	PS4	202	SS4	113	V <sub>DD</sub>	233	V <sub>DD</sub>
24	V <sub>SS</sub>	144	V <sub>SS</sub>	54	PN7	174	SN7	83	PS4	203	SS4	114	V <sub>SS</sub>	234	V <sub>SS</sub>
25	PN1	145	SN1	55	PN7	175	SN7	84	V <sub>SS</sub>	204	V <sub>SS</sub>	115	V <sub>DD</sub>	235	V <sub>DD</sub>
26	PN1	146	SN1	56	V <sub>SS</sub>	176	V <sub>SS</sub>	85	V <sub>SS</sub>	205	V <sub>SS</sub>	116	V <sub>DD</sub>	236	V <sub>DD</sub>
27	V <sub>SS</sub>	147	V <sub>SS</sub>	57	PN8	177	SN8	86	RFU*	206	RFU*	117	V <sub>TT</sub>	237	V <sub>TT</sub>
28	PN2	148	SN2	58	PN8	178	SN8	87	RFU*	207	RFU*	118	SA2	238	VDDSPD
29	PN2	149	SN2	59	V <sub>SS</sub>	179	V <sub>SS</sub>	88	V <sub>SS</sub>	208	V <sub>SS</sub>	119	SDA	239	SA0
30	V <sub>SS</sub>	150	V <sub>SS</sub>	60	PN9	180	SN9	89	V <sub>SS</sub>	209	V <sub>SS</sub>	120	SCL	240	SA1
								90	PS9	210	SS9				

RFU = Reserved Future Use.

\* These pin positions are reserved for forwarded clocks to be used in future module implementations

\*\* These pin positions are reserved for future architecture flexibility

1) The following signals are CRC bits and thus appear out of the normal sequence: PN12/PN12, SN12/SN12, PN13/PN13, SN13/SN13, PS9/PS9, SS9/SS9

## DIMM Connector Pin Description:

Pin Name	Pin Description	Count
SCK	System Clock Input, positive line <sup>1</sup>	1
$\overline{\text{SCK}}$	System Clock Input, negative line <sup>1</sup>	1
PN[13:0]	Primary Northbound Data, positive lines	14
$\overline{\text{PN}}$ [13:0]	Primary Northbound Data, negative lines	14
PS[9:0]	Primary Southbound Data, positive lines	10
$\overline{\text{PS}}$ [9:0]	Primary Southbound Data, negative lines	10
SN[13:0]	Secondary Northbound Data, positive lines	14
$\overline{\text{SN}}$ [13:0]	Secondary Northbound Data, negative lines	14
SS[9:0]	Secondary Southbound Data, positive lines	10
$\overline{\text{SS}}$ [9:0]	Secondary Southbound Data, negative lines	10
SCL	Serial Presence Detect (SPD) Clock Input	1
SDA	SPD Data Input / Output	1
SA[2:0]	SPD Address Inputs, also used to select the DIMM number in the AMB	3
VID[1:0]	Voltage ID: These pins must be unconnected for DDR2-based Fully Buffered DIMMs VID[0] is $V_{DD}$ value: OPEN = 1.8 V, GND = 1.5 V; VID[1] is $V_{CC}$ value: OPEN = 1.5 V, GND = 1.2 V	2
$\overline{\text{RESET}}$	AMB reset signal	1
RFU	Reserved for Future Use <sup>2</sup>	16
$V_{CC}$	AMB Core Power and AMB Channel Interface Power (1.5 Volt)	8
$V_{DD}$	DRAM Power and AMB DRAM I/O Power (1.8 Volt)	24
$V_{TT}$	DRAM Address/Command/Clock Termination Power ( $V_{DD}/2$ )	4
$V_{DDSPD}$	SPD Power	1
$V_{SS}$	Ground	80
DNU/M_Test	The DNU/M_Test pin provides an external connection on R/Cs A-D for testing the margin of $V_{ref}$ which is produced by a voltage divider on the module. It is not intended to be used in normal system operation and must not be connected (DNU) in a system. This test pin may have other features on future card designs and if it does, will be included in this specification at that time. 1	1
Total		240

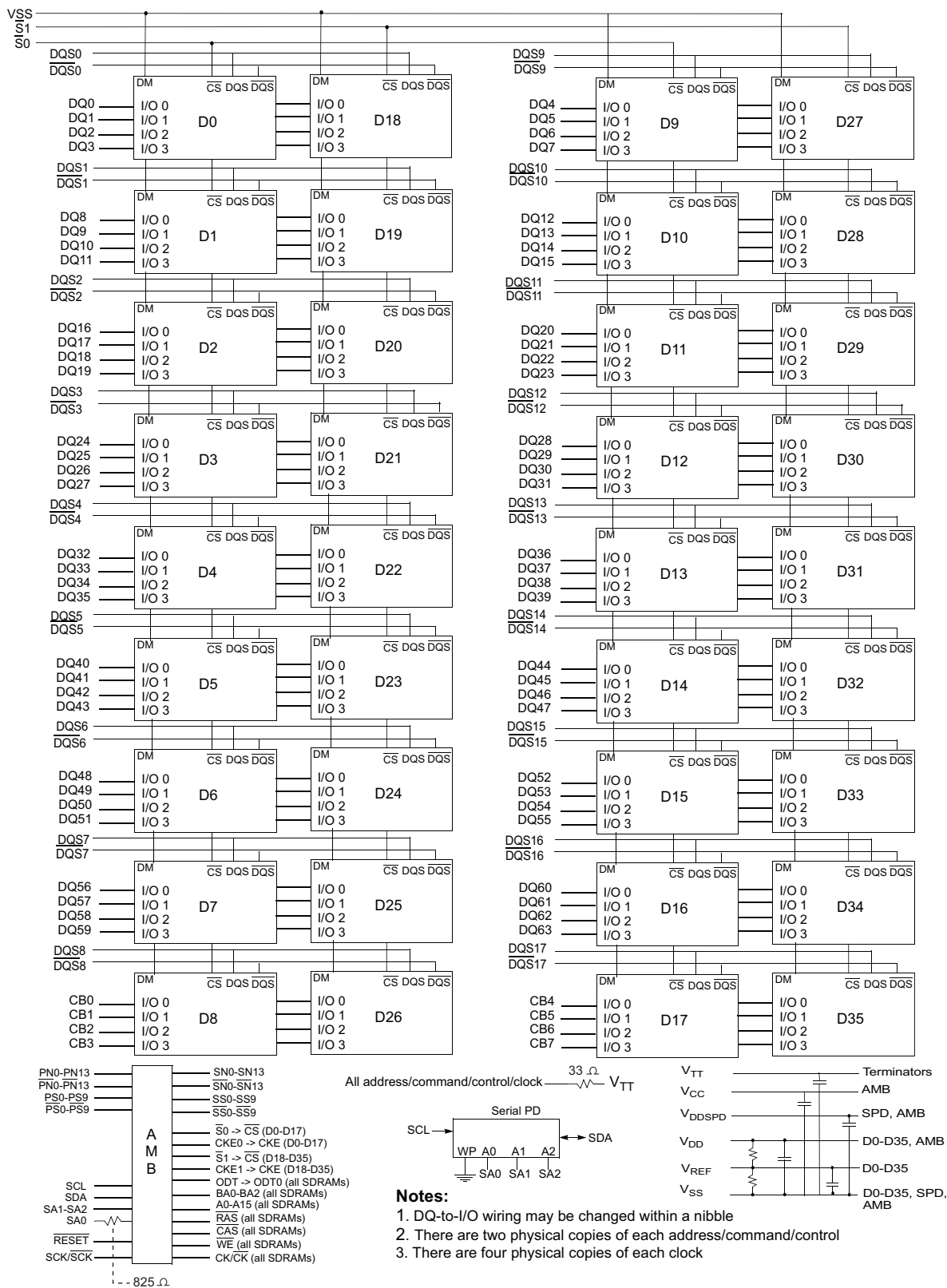
1. System Clock Signals SCK and  $\overline{\text{SCK}}$  switch at one half the DRAM CK/ $\overline{\text{CK}}$  frequency  
2. Eight pins reserved for forwarded clocks, eight pins reserved for future architecture flexibility

## Absolute Maximum Ratings

Symbol	Parameter	MIN	MAX	Units
$V_{IN}, V_{OUT}$	Voltage on any pin relative to $V_{SS}$	-0.3	1.75	V
$V_{CC}$	Voltage on $V_{CC}$ pin relative to $V_{SS}$	-0.3	1.75	V
$V_{DD}$	Voltage $V_{DD}$ pin relative to $V_{SS}$	-0.5	2.3	V
$V_{TT}$	Voltage on $V_{TT}$ pin relative to $V_{SS}$	-0.5	2.3	V
$T_{STG}$	Storage temperature	-55	100	°C
$T_{CASE}$	DDR2 SDRAM device operating temperature (Ambient)	0	95 <sup>(1)</sup>	°C
	AMB device operating temperature (Ambient)	0	110	°C

**Note:** (1) Above 85°C DRAM case temperature the Auto-Refresh command interval has to be reduced to  $t_{REFI} = 3.9 \mu s$ .

# Functional Block Diagram:



## Architecture:

### Advanced Memory Buffer Pin Description:

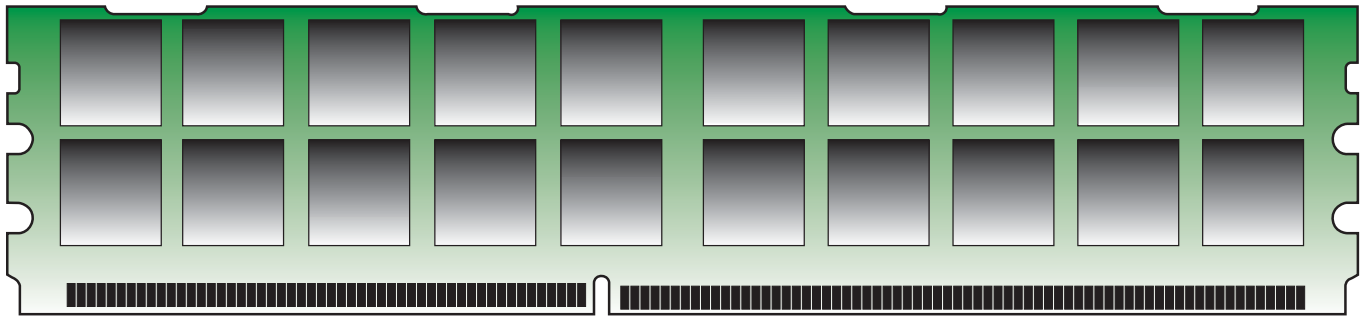
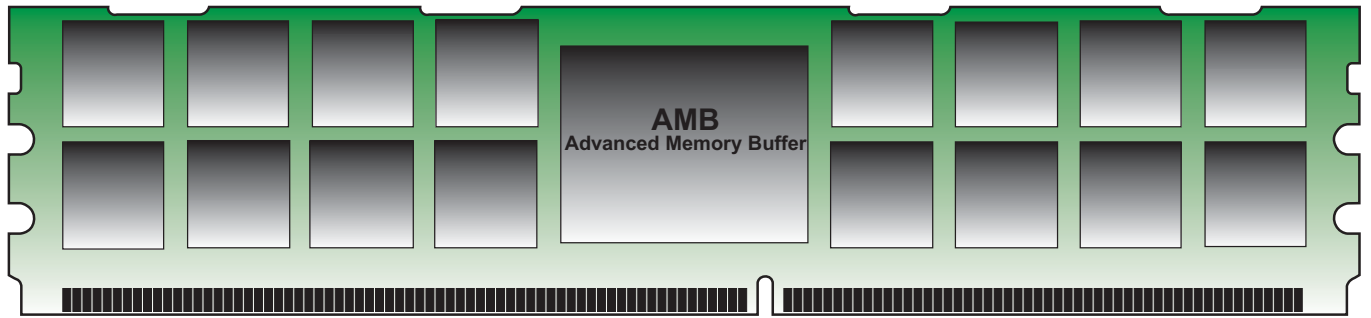
Pin Name	Pin Description	Count
<b>FB-DIMM Channel Signals</b>		<b>99</b>
SCK	System Clock Input, positive line	1
$\overline{\text{SCK}}$	System Clock Input, negative line	1
PN[13:0]	Primary Northbound Data, positive lines	14
$\overline{\text{PN}}$ [13:0]	Primary Northbound Data, negative lines	14
PS[9:0]	Primary Southbound Data, positive lines	10
$\overline{\text{PS}}$ [9:0]	Primary Southbound Data, negative lines	10
SN[13:0]	Secondary Northbound Data, positive lines	14
$\overline{\text{SN}}$ [13:0]	Secondary Northbound Data, negative lines	14
SS[9:0]	Secondary Southbound Data, positive lines	10
$\overline{\text{SS}}$ [9:0]	Secondary Southbound Data, negative lines	10
FBDRES	To an external precision calibration resistor connected to Vcc	1
<b>DDR2 Interface Signals</b>		<b>175</b>
DQS[8:0]	Data Strobes, positive lines	9
$\overline{\text{DQS}}$ [8:0]	Data Strobes, negative lines	9
DQS[17:9]/DM[8:0]	Data Strobes (x4 DRAM only), positive lines. These signals are driven low to x8 DRAM on writes.	9
$\overline{\text{DQS}}$ [17:9]	Data Strobes (x4 DRAM only), negative lines	9
DQ[63:0]	Data	64
CB[7:0]	Checkbits	8
A[15:0]A, A[15:0]B	Addresses. A10 is part of the pre-charge command	32
BA[2:0]A, BA[2:0]B	Bank Addresses	6
$\overline{\text{RASA}}$ , $\overline{\text{RASB}}$	Part of command, with $\overline{\text{CAS}}$ , $\overline{\text{WE}}$ , and $\overline{\text{CS}}$ [1:0].	2
$\overline{\text{CASA}}$ , $\overline{\text{CASB}}$	Part of command, with $\overline{\text{RAS}}$ , $\overline{\text{WE}}$ , and $\overline{\text{CS}}$ [1:0].	2
$\overline{\text{WEA}}$ , $\overline{\text{WEB}}$	Part of command, with $\overline{\text{RAS}}$ , $\overline{\text{CAS}}$ , and $\overline{\text{CS}}$ [1:0].	2
ODTA, ODTB	On-die Termination Enable	2
CKE[1:0]A, CKE[1:0]B	Clock Enable (one per rank)	4
$\overline{\text{CS}}$ [1:0]A, $\overline{\text{CS}}$ [1:0]B	Chip Select (one per rank)	4
CLK[3:0]	CLK[1:0] used on 9 and 18 device DIMMs, CLK[3:0] used on 36 device DIMMs. CLK[3:2] should be output disabled when not in use.	4
$\overline{\text{CLK}}$ [3:0]	Negative lines for CLK[3:0]	4
DDRC_C14	DDR Compensation: Common return pin for DDRC_B18 and DDRC_C18.	1
DDRC_B18	DDR Compensation: Resistor connected to common return pin DDRC_C14	1
DDRC_C18	DDR Compensation: Resistor connected to common return pin DDRC_C14	1
DDRC_B12	DDR Compensation: Resistor connected to V <sub>SS</sub>	1
DDRC_C12	DDR Compensation: Resistor connected to V <sub>DD</sub>	1

## Advanced Memory Buffer Pin Description:

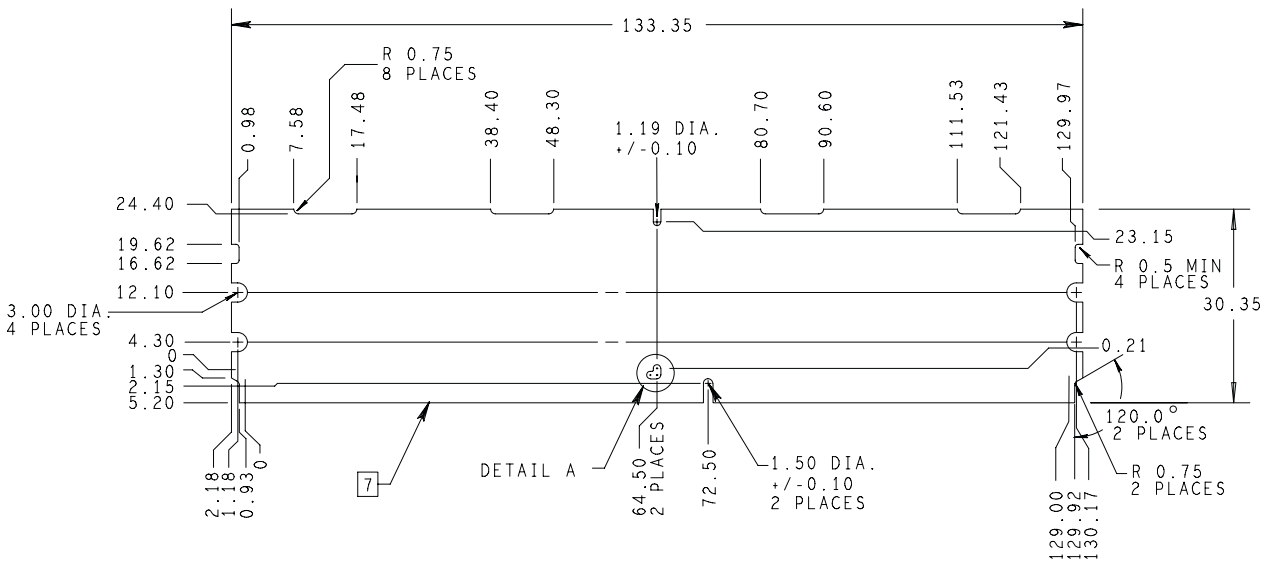
SPD Bus Interface Signals		5
SCL	Serial Presence Detect (SPD) Clock Input	1
SDA	SPD Data Input / Output	1
SA[2:0]	SPD Address Inputs, also used to select the DIMM number in the AMB	3
Miscellaneous Signals		163
PLLTSTO	PLL Clock Observability Output	1
VCCAPLL	Analog VCC for the PLL. Tied with low pass filter to VCC.	1
VSSAPLL	Analog VSS for the PLL. Tied to ground on the AMB die. Do not tie to ground on the DIMM.	1
TEST_pin#	Leave floating on the DIMM	6
TESTLO_pin#	Tie to ground on the DIMM <sup>2</sup>	5
BFUNC	Tie to ground to set functionality as "buffer on DIMM."	1
$\overline{\text{RESET}}$	AMB reset signal	1
NC	No connect. Many NC are connected to VDD on the DIMM, to lower the impedance of the VDD power islands.	129
RFU	Reserved for Future Use	18
Power/Ground Signals		213
V <sub>CC</sub>	AMB Core Power (1.5 Volt)	24
V <sub>CCFBD</sub>	AMB Channel I/O Power (1.5 Volt)	8
V <sub>DD</sub>	AMB DRAM I/O Power (1.8 Volt)	24
V <sub>DDSPD</sub>	SPD Power (3.3 Volt)	1
V <sub>SS</sub>	Ground	156
<b>Total</b>		<b>655</b>

1. System Clock Signals SCK and  $\overline{\text{SCK}}$  switch at one half the DRAM CK/ $\overline{\text{CK}}$  frequency.  
2. TESTLO\_AB20 and TESTLO\_AC20 should be configured for debug purposes on prototype DIMMs: each pin should have a zero ohm resistor pulldown to ground, and an unpopulated resistor pullup to VCC. These resistors can be replaced on production DIMMs with a direct connection to ground.

# Package Dimensions:



(Units = millimeters)



Units: inches (millimeters)

