4Gb (x16/x32) Mobile LPDDR4/LPDDR4X

ADVANCED INFORMATION
APRIL 2019

FEATURES

- Configuration:
  - 256Mb x16 x 1 channel
  - 128Mb x16 x 2 channels
  - 8 internal banks per each channel
- Low-voltage Core and I/O Power Supplies
  VDD1 = 1.70-1.95V
  VDD2 = 1.06-1.17V
  VDDQ = 1.06-1.17V (LPDDR4)
  VDDQ = 0.57-0.65V (LPDDR4X)
- LVSTL(Low Voltage Swing Terminated Logic) I/O Interface
- Internal VREF and VREF Training
- Dynamic ODT :
  DQ ODT :VSSQ Termination
  CA ODT :VSS Termination
- Max. Clock Frequency : 1.6GHz (3.2Gbps)
- 16n Pre-fetch DDR architecture
- Single data rate (multiple cycles) command/ address bus
- Bidirectional/differential data strobe per byte of data (DQS/DQS#)
- Programmable burst lengths (16 or 32)
- ZQ Calibration
- Operation Temperature
  Industrial (T_C = -40°C to 85°C)
  Automotive, A1 (T_C = -40°C to 85°C)
  Automotive, A2 (T_C = -40°C to 105°C)
- Clock-Stop capability

DESCRIPTION

The IS43/46LQ16256A/AL and IS43/46LQ32128A/AL are 4Gbit CMOS LPDDR4 SDRAM. The device is organized as 1/2 channels per device, and individual channel is 8-banks and 16-bits. This product uses a double-data-rate architecture to achieve high-speed operation. The double data rate architecture is essentially a 16N prefetch architecture with an interface designed to transfer two data words per clock cycle at the I/O pins. This product offers fully synchronous operations referenced to both rising and falling edges of the clock. The data paths are internally pipelined and 16n bits prefetched to achieve very high bandwidth.

- On-chip temperature sensor whose status can be read from MR4
- 200-ball x16/x32 Discrete Package (0.80mm x 0.65mm)

ADDRESS TABLE *

Parameter		
# of Channel	1	2
Row Addresses	R0-R14	R0-R13
Column Addresses	C0-C9	
Bank Addresses	BA0-BA2	

Note: Address information is per channel base.

KEY TIMING PARAMETERS

Speed Grade	Freq. (MHz)	Data Rate (Mb/s)	Write Latency		Read Latency	
			Set A	Set B	DBI OFF	DBI ON
-062	1600	3200	14	26	28	32
-075	1333	2666	12	22	24	28
-093	1066	2133	10	18	20	22

Note: Other clock frequencies/data rates supported; please refer to AC timing tables.

1. BALL ASSIGNMENTS AND DESCRIPTIONS (for x16)

200-ball x16 Discrete Package, 0.80mm x 0.65mm using MO-311

	1	2	3	4	5	6	7	8	9	10	11	12
A	DNU	DNU	VSS	VDD2	ZQ0	0.80mm Pitch		NC	VDD2	VSS	DNU	DNU
B	DNU	DQ0_A	VDDQ	DQ7_A	VDDQ			VDDQ	DQ15_A	VDDQ	DQ8_A	DNU
C	VSS	DQ1_A	DMI0_A	DQ6_A	VSS			VSS	DQ14_A	DMI1_A	DQ9_A	VSS
D	VDDQ	VSS	DQS0_T_A	VSS	VDDQ			VDDQ	VSS	DQS1_T_A	VSS	VDDQ
E	VSS	DQ2_A	DQS0_C_A	DQ5_A	VSS			VSS	DQ13_A	DQS1_C_A	DQ10_A	VSS
F	VDD1	DQ3_A	VDDQ	DQ4_A	VDD2			VDD2	DQ12_A	VDDQ	DQ11_A	VDD1
G	VSS	ODT_CA_A	VSS	VDD1	VSS			VSS	VDD1	VSS	NC	VSS
H	VDD2	CA0_A	NC	CS0_A	VDD2			VDD2	CA2_A	CA3_A	CA4_A	VDD2
J	VSS	CA1_A	VSS	CKE0_A	NC			CK_t_A	CK_c_A	VSS	CA5_A	VSS
K	VDD2	VSS	VDD2	VSS	NC			NC	VSS	VDD2	VSS	VDD2
L												
M												
N	VDD2	VSS	VDD2	VSS	NC			NC	VSS	VDD2	VSS	VDD2
P	VSS	NC	VSS	NC	NC			NC	NC	VSS	NC	VSS
R	VDD2	NC	NC	NC	VDD2			VDD2	NC	NC	NC	VDD2
T	VSS	NC	VSS	VDD1	VSS			VSS	VDD1	VSS	RESET_N	VSS
U	VDD1	NC	VDDQ	NC	VDD2			VDD2	NC	VDDQ	NC	VDD1
V	VSS	NC	NC	NC	VSS			VSS	NC	NC	NC	VSS
W	VDDQ	VSS	NC	VSS	VDDQ			VDDQ	VSS	NC	VSS	VDDQ
Y	VSS	NC	NC	NC	VSS			VSS	NC	NC	NC	VSS
AA	DNU	NC	VDDQ	NC	VDDQ			VDDQ	NC	VDDQ	NC	DNU
AB	DNU	DNU	VSS	VDD2	VSS			VSS	VDD2	VSS	DNU	DNU

0.65mm Pitch

NOTE 1 0.8mm pitch (X-axis), 0.65mm pitch (Y-axis), 22 rows.

NOTE 2 Top View, A1 in top left corner.

NOTE 3 Die pad VSS and VSSQ signals are combined to VSS package balls.

2. BALL ASSIGNMENTS AND DESCRIPTIONS (for x32)

200-ball x32 Discrete Package, 0.80mm x 0.65mm using MO-311

0.80mm Pitch

	1	2	3	4	5	6	7	8	9	10	11	12
A	DNU	DNU	VSS	VDD2	ZQ0			NC	VDD2	VSS	DNU	DNU
B	DNU	DQ0_A	VDDQ	DQ7_A	VDDQ			VDDQ	DQ15_A	VDDQ	DQ8_A	DNU
C	VSS	DQ1_A	DMI0_A	DQ6_A	VSS			VSS	DQ14_A	DMI1_A	DQ9_A	VSS
D	VDDQ	VSS	DQS0_T_A	VSS	VDDQ			VDDQ	VSS	DQS1_T_A	VSS	VDDQ
E	VSS	DQ2_A	DQS0_C_A	DQ5_A	VSS			VSS	DQ13_A	DQS1_C_A	DQ10_A	VSS
F	VDD1	DQ3_A	VDDQ	DQ4_A	VDD2			VDD2	DQ12_A	VDDQ	DQ11_A	VDD1
G	VSS	ODT_CA_A (3)	VSS	VDD1	VSS			VSS	VDD1	VSS	NC	VSS
H	VDD2	CA0_A	NC	CS0_A	VDD2			VDD2	CA2_A	CA3_A	CA4_A	VDD2
J	VSS	CA1_A	VSS	CKE0_A	NC			CK_t_A	CK_c_A	VSS	CA5_A	VSS
K	VDD2	VSS	VDD2	VSS	NC			NC	VSS	VDD2	VSS	VDD2
L												
M												
N	VDD2	VSS	VDD2	VSS	NC			NC	VSS	VDD2	VSS	VDD2
P	VSS	CA1_B	VSS	CKE0_B	NC			CK_T_B	CK_C_B	VSS	CA5_B	VSS
R	VDD2	CA0_B	NC	CS0_B	VDD2			VDD2	CA2_B	CA3_B	CA4_B	VDD2
T	VSS	ODT_CA_B (3)	VSS	VDD1	VSS			VSS	VDD1	VSS	RESET_N	VSS
U	VDD1	DQ3_B	VDDQ	DQ4_B	VDD2			VDD2	DQ12_B	VDDQ	DQ11_B	VDD1
V	VSS	DQ2_B	DQS0_C_B	DQ5_B	VSS			VSS	DQ13_B	DQS1_C_B	DQ10_B	VSS
W	VDDQ	VSS	DQS0_T_B	VSS	VDDQ			VDDQ	VSS	DQS1_T_B	VSS	VDDQ
Y	VSS	DQ1_B	DMI0_B	DQ6_B	VSS			VSS	DQ14_B	DMI1_B	DQ9_B	VSS
AA	DNU	DQ0_B	VDDQ	DQ7_B	VDDQ			VDDQ	DQ15_B	VDDQ	DQ8_B	DNU
AB	DNU	DNU	VSS	VDD2	VSS			VSS	VDD2	VSS	DNU	DNU

0.65mm Pitch

NOTE 1 0.8mm pitch (X-axis), 0.65mm pitch (Y-axis), 22 rows.

NOTE 2 Top View, A1 in top left corner.

NOTE 3 The ODT_CA pin is ignored by LPDDR4X devices.

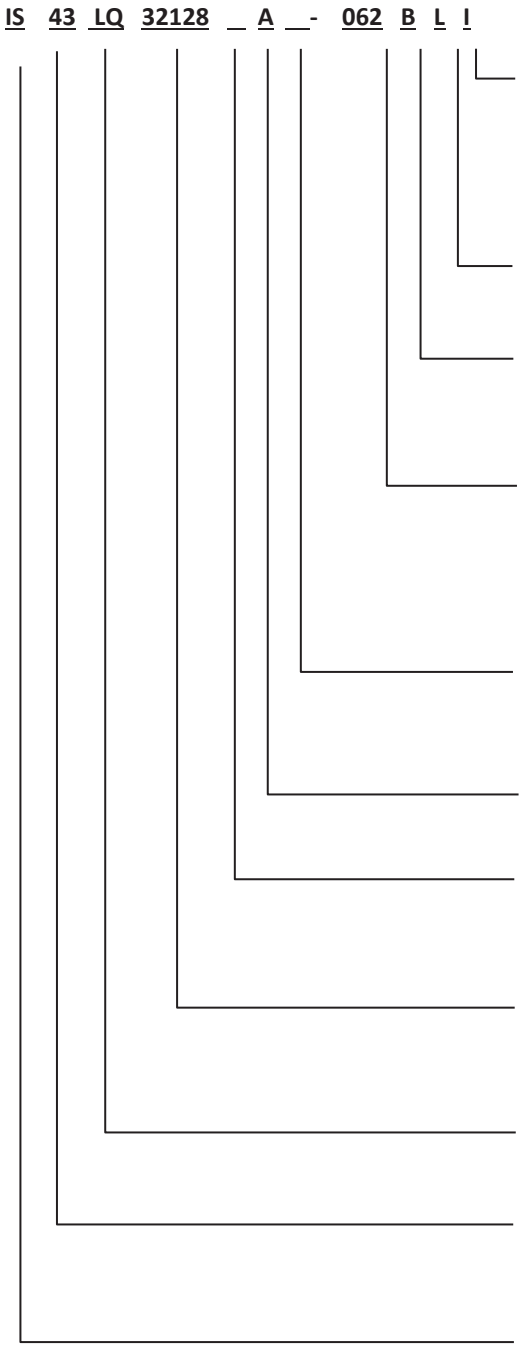
2. INPUT/OUTPUT FUNTIONAL DESCRIPTION

2.1 PAD DEFINITION AND DESCRIPTION

Table 2.1 — Pad Definition and Description

Symbol	Type	Description
CK_t_A, CK_c_A, CK_t_B, CK_c_B	Input	**Clock:** CK_t and CK_c are differential clock inputs. All address, command, and control input signals are sampled on the crossing of the positive edge of CK_t and the negative edge of CK_c. AC timings for CA parameters are referenced to CK. Each channel (A & B) has its own clock pair.
CKE_A CKE_B	Input	**Clock Enable:** CKE HIGH activates and CKE LOW deactivates the internal clock circuits, input buffers, and output drivers. Power-saving modes are entered and exited via CKE transitions. CKE is part of the command code. Each channel (A & B) has its own CKE signal.
CS_A CS_B	Input	**Chip Select:** CS is part of the command code. Each channel (A & B) has its own CS signal.
CA[5:0]_A CA[5:0]_B	Input	**Command/Address Inputs:** CA signals provide the Command and Address inputs according to Table 63 — Command Truth Table. Each channel (A&B) has its own CA signals.
ODT_CA_A ODT_CA_B	Input	**CA ODT Control:** The ODT_CA pin is used in conjunction with the Mode Register to turn on/off the On-Die-Termination for CA pins.
DQ[15:0]_A, DQ[15:0]_B	I/O	**Data Input/Output:** Bi-direction data bus.
DQS[1:0]_t_A, DQS[1:0]_c_A, DQS[1:0]_t_B, DQS[1:0]_c_B	I/O	**Data Strobe:** DQS_t and DQS_c are bi-directional differential output clock signals used to strobe data during a READ or WRITE. The Data Strobe is generated by the DRAM for a READ and is edge-aligned with Data. The Data Strobe is generated by the Memory Controller for a WRITE and must arrive prior to Data. Each byte of data has a Data Strobe signal pair. Each channel (A & B) has its own DQS strobes.
DMI[1:0]_A, DMI[1:0]_B	I/O	**Data Mask Inversion:** DMI is a bi-directional signal which is driven HIGH when the data on the data bus is inverted, or driven LOW when the data is in its normal state. Data Inversion can be disabled via a mode register setting. Each byte of data has a DMI signal. Each channel (A & B) has its own DMI signals.
ZQ	Reference	**Calibration Reference:** Used to calibrate the output drive strength and the termination resistance. There is one ZQ pin per die. The ZQ pin shall be connected to $V_{DD}Q$ through a 240Ω ± 1% resistor.
$V_{DD}Q$, $V_{DD}1$, $V_{DD}2$	Supply	**Power Supplies:** Isolated on the die for improved noise immunity.
V_{SS}, $V_{SS}Q$	GND	**Ground Reference:** Power supply ground reference
RESET_n	Input	**RESET:** When asserted LOW, the RESET_n signal resets both channels of the die.

ORDERING INFORMATION – Valid Part Numbers



TEMPERATURE RANGE
I = Industrial (-40°C to +85°C)
A1 = Automotive A1 Grade (-40°C to +85°C)
A2 = Automotive A2 Grade (-40°C to +105°C)

PACKAGING CONTENT
L = **RoHS compliant**

Package Type
B **=** 200-ball BGA

Speed Grade
093 = 1066MHz
075 = 1333MHz
062 = 1600MHz

VDDQ
Blank = Regular VDDQ
L = Low VDDQ (LPDDR4X)

Die Generation
A = 1st Generation

ECC support
Blank = No ECC

Density
16256 = 256Mb x 16 (4Gb)
32128 = 128Mb x 32 (4Gb)

Device Type
LQ = LPDDR4 DRAM

Product Family
43 = DDR DRAM
46 = Automotive DDR DRAM

ISSI Prefix
IS = Integrated Silicon Solution Inc.

ORDERING INFORMATION, 256Mb x 16 LPDDR4

256Mb x 16 - Industrial Range: T_c = -40°C to +85°C

Clock	Speed Grade	Order Part No.	Package
1066 MHz	-093	IS43LQ16256A-093BLI	200 ball FBGA, lead free
1333 MHz	-075	IS43LQ16256A-075BLI	200 ball FBGA, lead free
1600 MHz	-062	IS43LQ16256A-062BLI	200 ball FBGA, lead free

256Mb x 16- Automotive, A1 Range: T_c = -40°C to +85°C

Clock	Speed Grade	Order Part No.	Package
1066 MHz	-093	IS46LQ16256A-093BLA1	200 ball FBGA, lead free
1333 MHz	-075	IS46LQ16256A-075BLA1	200 ball FBGA, lead free
1600 MHz	-062	IS46LQ16256A-062BLA1	200 ball FBGA, lead free

256Mb x 16- Automotive, A2 Range: T_c = -40°C to +105°C

Clock	Speed Grade	Order Part No.	Package
1066 MHz	-093	IS46LQ16256A-093BLA2	200 ball FBGA, lead free
1333 MHz	-075	IS46LQ16256A-075BLA2	200 ball FBGA, lead free
1600 MHz	-062	IS46LQ16256A-062BLA2	200 ball FBGA, lead free

ORDERING INFORMATION, 256Mb x 16 LPDDR4X

Industrial Range: T_c = -40°C to +85°C

Clock	Speed Grade	Order Part No.	Package
1066 MHz	-093	IS43LQ16256AL-093BLI	200 ball FBGA, lead free
1333 MHz	-075	IS43LQ16256AL-075BLI	200 ball FBGA, lead free
1600 MHz	-062	IS43LQ16256AL-062BLI	200 ball FBGA, lead free

Automotive, A1 Range: T_c = -40°C to +85°C

Clock	Speed Grade	Order Part No.	Package
1066 MHz	-093	IS46LQ16256AL-093BLA1	200 ball FBGA, lead free
1333 MHz	-075	IS46LQ16256AL-075BLA1	200 ball FBGA, lead free
1600 MHz	-062	IS46LQ16256AL-062BLA1	200 ball FBGA, lead free

Automotive, A2 Range: T_c = -40°C to +105°C

Clock	Speed Grade	Order Part No.	Package
1066 MHz	-093	IS46LQ16256AL-093BLA2	200 ball FBGA, lead free
1333 MHz	-075	IS46LQ16256AL-075BLA2	200 ball FBGA, lead free
1600 MHz	-062	IS46LQ16256AL-062BLA2	200 ball FBGA, lead free

ORDERING INFORMATION, 128Mb x 32 LPDDR4

T_C = -40°C to +85°C

Clock	Speed Grade	Order Part No.	Package
1066 MHz	-093	IS43LQ32128A-093BLI	200 ball FBGA, lead free
1333 MHz	-075	IS43LQ32128A-075BLI	200 ball FBGA, lead free
1600 MHz	-062	IS43LQ32128A-062BLI	200 ball FBGA, lead free

Automotive, A1 Range: T_C = -40°C to +85°C

Clock	Speed Grade	Order Part No.	Package
1066 MHz	-093	IS46LQ32128A-093BLA1	200 ball FBGA, lead free
1333 MHz	-075	IS46LQ32128A-075BLA1	200 ball FBGA, lead free
1600 MHz	-062	IS46LQ32128A-062BLA1	200 ball FBGA, lead free

Automotive, A2 Range: T_C = -40°C to +105°C

Clock	Speed Grade	Order Part No.	Package
1066 MHz	-093	IS46LQ32128A-093BLA2	200 ball FBGA, lead free
1333 MHz	-075	IS46LQ32128A-075BLA2	200 ball FBGA, lead free
1600 MHz	-062	IS46LQ32128A-062BLA2	200 ball FBGA, lead free

ORDERING INFORMATION, 128Mb x 32 LPDDR4X

Industrial Range: T_c = -40°C to +85°C

Clock	Speed Grade	Order Part No.	Package
1066 MHz	-093	IS43LQ32128AL-093BLI	200 ball FBGA, lead free
1333 MHz	-075	IS43LQ32128AL-075BLI	200 ball FBGA, lead free
1600 MHz	-062	IS43LQ32128AL-062BLI	200 ball FBGA, lead free

Automotive, A1 Range: T_c = -40°C to +85°C

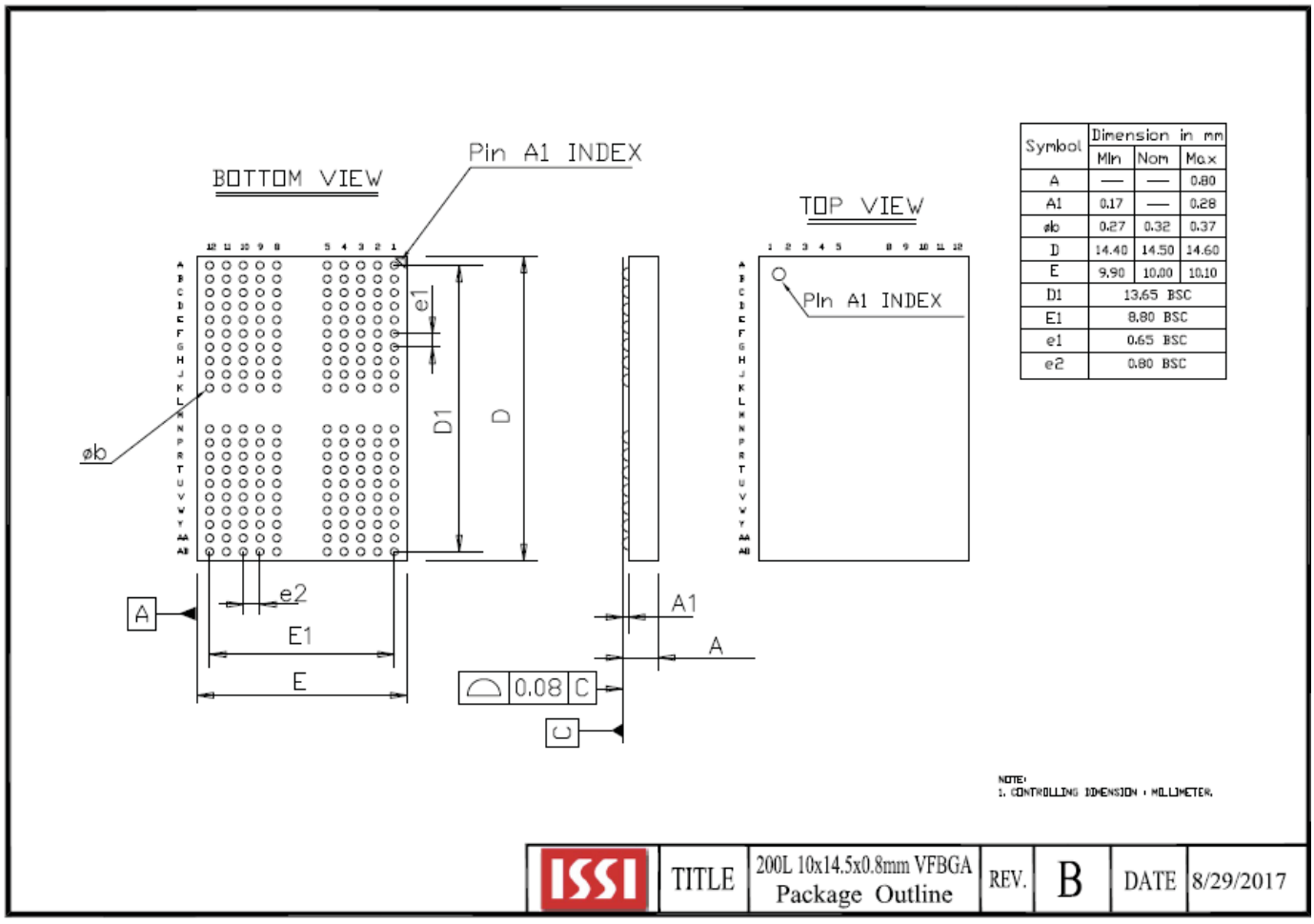
Clock	Speed Grade	Order Part No.	Package
1066 MHz	-093	IS46LQ32128AL-093BLA1	200 ball FBGA, lead free
1333 MHz	-075	IS46LQ32128AL-075BLA1	200 ball FBGA, lead free
1600 MHz	-062	IS46LQ32128AL-062BLA1	200 ball FBGA, lead free

Automotive, A2 Range: T_c = -40°C to +105°C

Clock	Speed Grade	Order Part No.	Package
1066 MHz	-093	IS46LQ32128AL-093BLA2	200 ball FBGA, lead free
1333 MHz	-075	IS46LQ32128AL-075BLA2	200 ball FBGA, lead free
1600 MHz	-062	IS46LQ32128AL-062BLA2	200 ball FBGA, lead free

PACKAGE INFORMATION

200-ball FBGA



Symbol	Dimension in mm		
	Min	Nom	Max
A	—	—	0.80
A1	0.17	—	0.28
øb	0.27	0.32	0.37
D	14.40	14.50	14.60
E	9.90	10.00	10.10
D1	13.65 BSC		
E1	8.80 BSC		
e1	0.65 BSC		
e2	0.80 BSC		