

Approval Sheet

Customer	
Product Number	M2CK-2GMF9CH4-M
Module speed	PC2-4200
Pin	240 Pin
CL-tRCD-tRP	4-4-4
Operating Temp	0°C ~ 85°C
Date	9th June 2020

**The Total Solution For
Industrial Flash Storage**

Rev 1.1

1. Features

Key Parameter

Industry Nomenclature	Speed Grade	Data Rate MT/s			CL	tRCD	tRP
		CL=4	CL=5	CL=6			
PC2-4200	H	533	-	-	4	4	4

- JEDEC Standard 240-pin Dual In-Line Memory Module
- Intend for 266MHz applications
- Inputs and Outputs are SSTL-18 compatible
- VDD=VDDQ= 1.8 Volt ± 0.1
- Differential clock input
- All inputs are sampled at the positive going edge of the system clock
- Bi-Directional data strobe with one clock cycle preamble and one-half clock post-amble
- Address and control signals are fully synchronous to positive clock edge.
- Self Refresh Modes support.
- Serial Presence Detect with EEPROM
- Automatic and controlled precharge commands.
- 14/10/2 Addressing (row/column/rank)-2GB
- Auto & self refresh 7.8µs (Tc ≤ +85°C)
- ECC function
- Gold Plating Thickness 30µ"
- Programmable Device Operation:
 - Burst Type: Sequential or Interleave
 - Operation: Burst Read and Write
 - Device CAS# Latency: 3,4,5
 - Burst Length: 4, 8
- RoHS Compliant (Section 13)

2. Ordering Information

DDR2 ECC UDIMM						
Part Number	Density	Speed	DIMM Organization	Number of DRAM	Number of rank	ECC
M2CK-2GMF9CH4-M	2GB	PC2-4200	256M x72	18	2	Y

3. Pin Configurations (Front side/Back side) -x72 UDIMM

Front								Back							
Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name
1	VREF	31	DQ19	61	A4	91	VSS	121	VSS	151	VSS	181	VDDQ	211	DM5
2	VSS	32	VSS	62	VDDQ	92	/DQ55	122	DQ4	152	DQ28	182	A3	212	NC
3	DQ0	33	DQ24	63	A2	93	DQ55	123	DQ5	153	DQ29	183	A1	213	VSS
4	DQ1	34	DQ25	64	VDD	94	VSS	124	VSS	154	VSS	184	VDD	214	DQ46
5	VSS	35	VSS	65	VSS	95	DQ42	125	DM0	155	DM3	185	CK0	215	DQ47
6	/DQ50	36	/DQ53	66	VSS	96	DQ43	126	NC	156	NC	186	/CK0	216	VSS
7	DQ50	37	DQ53	67	VDD	97	VSS	127	VSS	157	VSS	187	VDD	217	DQ52
8	VSS	38	VSS	68	NC	98	DQ48	128	DQ6	158	DQ30	188	A0	218	DQ53
9	DQ2	39	DQ26	69	VDD	99	DQ49	129	DQ7	159	DQ31	189	VDD	219	VSS
10	DQ3	40	DQ27	70	A10	100	VSS	130	VSS	160	VSS	190	BA1	220	CK2
11	VSS	41	VSS	71	BA0	101	SA2	131	DQ12	161	NC	191	VDDQ	221	/CK2
12	DQ8	42	NC	72	VDDQ	102	NC	132	DQ13	162	NC	192	/RAS	222	VSS
13	DQ9	43	NC	73	/WE	103	VSS	133	VSS	163	VSS	193	/50	223	DM6
14	VSS	44	VSS	74	/CAS	104	/DQ56	134	DM1	164	NC	194	VDDQ	224	NC
15	/DQ51	45	NC	75	VDD	105	DQ56	135	NC	165	NC	195	ODT0	225	VSS
16	DQ51	46	NC	76	NC	106	VSS	136	VSS	166	VSS	196	NC/A13	226	DQ54
17	VSS	47	VSS	77	NC	107	DQ50	137	CK1	167	NC	197	VDD	227	DQ55
18	NC	48	NC	78	VDDQ	108	DQ51	138	/CK1	168	NC	198	VSS	228	VSS
19	NC	49	NC	79	VSS	109	VSS	139	VSS	169	VSS	199	DQ36	229	DQ60
20	VSS	50	VSS	80	DQ32	110	DQ56	140	DQ14	170	VDDQ	200	DQ37	230	DQ61
21	DQ10	51	VDDQ	81	DQ33	111	DQ57	141	DQ15	171	NC	201	VSS	231	VSS
22	DQ11	52	CKE0	82	VSS	112	VSS	142	VSS	172	VDD	202	DM4	232	DM7
23	VSS	53	VDD	83	/DQ54	113	/DQ57	143	DQ20	173	NC	203	NC	233	NC
24	DQ16	54	NC/BA2	84	DQ54	114	DQ57	144	DQ21	174	NC/A14	204	VSS	234	VSS
25	DQ17	55	NC	85	VSS	115	VSS	145	VSS	175	VDDQ	205	DQ38	235	DQ62
26	VSS	56	VDDQ	86	DQ34	116	DQ58	146	DM2	176	A12	206	DQ39	236	DQ63
27	/DQ52	57	A11	87	DQ35	117	DQ59	147	NC	177	A9	207	VSS	237	VSS
28	DQ52	58	A7	88	VSS	118	VSS	148	VSS	178	VDD	208	DQ44	238	VDDSPD
29	VSS	59	VDD	89	DQ40	119	SDA	149	DQ22	179	A8	209	DQ45	239	SA0
30	DQ18	60	A5	90	DQ41	120	SCL	150	DQ23	180	A6	210	VSS	240	SA1

4. Architecture

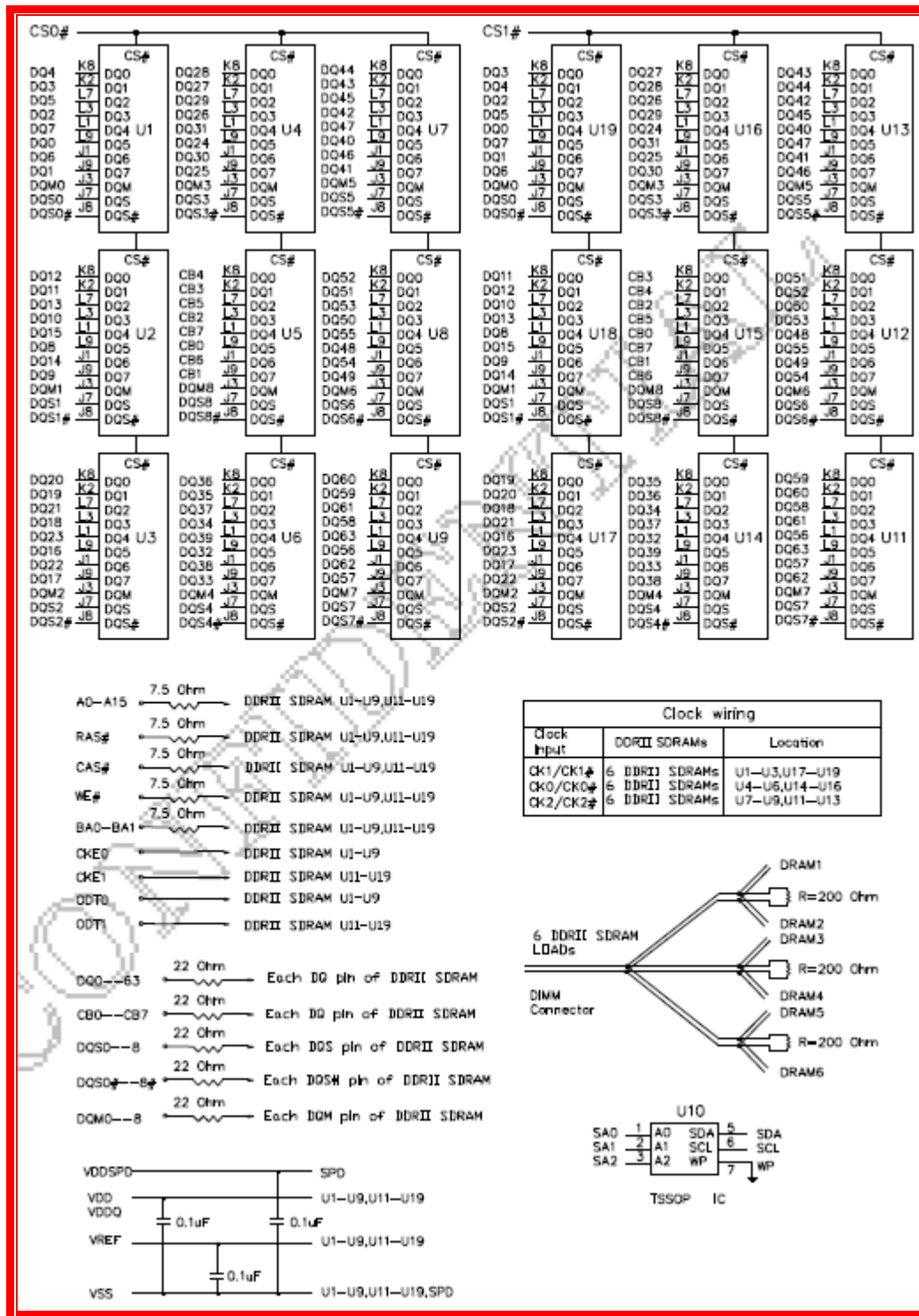
Pin Definition

Pin Name	Description	Pin Name	Description
A0–A15	SDRAM address bus	CK0–CK2	SDRAM clocks (positive line of differential pair)
BA0–BA2	SDRAM bank select	/CK0–/CK2	SDRAM clocks (negative line of differential pair)
/RAS	SDRAM row address strobe	SCL	I ² C serial bus clock for EEPROM
/CAS	SDRAM column address strobe	SDA	I ² C serial bus data line for EEPROM
/WE	SDRAM write enable	SA0-SA2	I ² C slave address select for EEPROM
/S0-/S1	DIMM Rank Select Lines	V _{DD} *	SDRAM core power supply
CKE0–CKE1	SDRAM clock enable lines	V _{DDQ} *	SDRAM I/O Driver power supply
ODT0–ODT1	On-die termination control lines	V _{REF}	SDRAM I/O reference supply
DQ0–DQ63	DIMM memory data bus	V _{SS}	Power supply return (ground)
CB0–CB7	DIMM ECC check bits	V _{DDSPD}	Serial EEPROM positive power supply
DQS0–DQS8	SDRAM data strobes (positive line of differential pair)	NC	Spare pins (no connect)
/DQS0–/DQS8	SDRAM data strobes (negative line of differential pair)	TEST	Used by memory bus analysis tools (unused on memory DIMMs)
DM0–DM8	SDRAM data masks/high data strobes (x8-based x72 DIMMs)	RESET	Not used on UDIMM
*The V _{DD} and V _{DDQ} pins are tied common to a single power-plane on these designs.			

5. Input/Output Functional Description

Symbol	Type	Polarity	Function
CK0 - CK2 /CK0 - /CK2	SSTL	Differential crossing	CK and /CK are differential clock inputs. All the DDR2 SDRAM addr/cntl inputs are sampled on the crossing of positive edge of CK and negative edge of /CK. Output (read) data is reference to the crossing of CK and /CK (Both directions of crossing)
CKE0 - CKE1	SSTL	Active High	Activates the SDRAM CK signal when high and deactivates the CK signal when low. By deactivating the clocks, CKE low initiates the Power Down mode, or the Self Refresh mode
/S0 - /S1	SSTL	Active High	Enables the associated SDRAM command decoder when low and disables the command decoder when high. When the command decoder is disabled, new commands are ignored but previous operations continue. This signal provides for external rank selection on systems with multiple ranks
/RAS, /CAS, /WE	SSTL	Active High	/RAS, /CAS, and /WE (ALONG WITH /S) define the command being entered.
ODT0 - ODT1	SSTL	Active High	When high, termination resistance is enabled for all DQ, DQS, /DQS and DM pins, assuming this function is enabled in the Extended Mode Register Set (EMRS).
V _{REF}	Supply		Reference voltage for SSTL18 inputs.
V _{DD}	Supply		Power supply for the DDR2 SDRAM output buffers to provide improved noise immunity. For all current DDR2 unbuffered DIMM designs, V _{DD} shares the same power plane as V _{DDQ} pins.
BA0 - BA2	SSTL	—	Selects which SDRAM bank of eight is activated.
A0 - A15	SSTL		During a Bank Activate command cycle, Address input defines the row address (RA0-RA15) During a Read or Write command cycle, Address input defines the column address. In addition to the column address, AP is used to invoke autoprecharge operation at the end of the burst read or write cycle. If AP is high, autoprecharge is selected and BA0, BA1, BA2 defines the bank to be precharged. If AP is low, autoprecharge is disabled. During a Precharge command cycle, AP is used in conjunction with BA0, BA1, BA2 to control which bank(s) to precharge. If AP is high, all banks will be precharged regardless of the state of BA0, BA1 or BA2. If AP is low, BA0, BA1 and BA2 are used to define which bank to precharge.
DQ0 - DQ63, CB0 - CB7	SSTL		Data and Check Bit Input/Output pins.
DM0 - DM8	SSTL	Active High	DM is an input mask signal for write data. Input data is masked when DM is sampled High coincident with that input data during a write access. DM is sampled on both edges of DQS. Although DM pins are input only, the DM loading matches the DQ and DQS loading.
V _{DD} , V _{SS}	Supply		Power and ground for the DDR2 SDRAM input buffers, and core logic. V _{DD} and V _{DDQ} pins are tied to V _{DD} /V _{DDQ} planes on these modules.
DQS0 - DQS8 /DQS0 - /DQS8	SSTL	Differential crossing	Data strobe for input and output data. For Rawcards using x16 organized DRAMs, DQ0-7 connect to the LDQS pin of the DRAMs and DQ8-15 connect to the UDQS pin of the DRAM
SA0 - SA2		—	These signals are tied at the system planar to either V _{SS} or V _{DDSPD} to configure the serial SPD EEPROM address range.
SDA		—	This bidirectional pin is used to transfer data into or out of the SPD EEPROM. An external resistor must be connected from the SDA bus line to V _{DDSPD} to act as a pullup on the system board.
SCL		—	This signal is used to clock data into and out of the SPD EEPROM. An external resistor may be connected from the SCL bus line to V _{DDSPD} to act as a pullup on the system board.
V _{DDSPD}	Supply		Power supply for SPD EEPROM. This supply is separate from the V _{DD} /V _{DDQ} power plane. EEPROM supply is operable from 1.7V to 3.6V.

6. Function Block Diagram:
- (2 Rank, 128Mx8 DDR2 base SDRAM Module)



7. Absolute Maximum Ratings

Symbol	Parameter	Rating	Units	NOTE
V _{DD}	Voltage on V _{DD} pin relative to V _{SS}	-1.0V~2.3V	V	1
V _{DDQ}	Voltage on V _{DDQ} pin relative to V _{SS}	-0.5V~2.3V	V	1
V _{DDL}	Voltage on V _{DDL} pin relative to V _{SS}	-0.5V~2.3V	V	1
V _{IN} , V _{OUT}	Voltage on any pin relative to V _{SS}	-0.5V~2.3V	V	1
T _{STG}	Storage Temperature	-55 to +100	°C	1,2

NOTE:

1. Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

2. Storage Temperature is the case surface temperature on the center/top side of the DRAM. For the measurement conditions, please refer to JESD51-2 standard.

3. V_{DD} and V_{DDQ} must be within 300mV of each other at all times; and V_{REF} must be not greater than 0.6 x V_{DDQ}.

When V_{DD} and V_{DDQ} and V_{DDL} are less than 500mV, V_{REF} may be equal to or less than 300mV.

4. Voltage on any input or I/O may not exceed voltage on V_{DDQ}.

8. AC & DC Operating Conditions

8.1 Recommended DC operating Conditions

Symbol	Parameter	Rating			Units	NOTE
		Min.	Typ.	Max.		
V _{DD}	Supply Voltage	1.7	1.8	1.9	V	
V _{DDL}	Supply Voltage for DLL	1.7	1.8	1.9	V	4
V _{DDQ}	Supply Voltage for Output	1.7	1.8	1.9	V	4
V _{REF}	Input Reference Voltage	0.49*V _{DDQ}	0.50*V _{DDQ}	0.51*V _{DDQ}	mV	1,2
V _{TT}	Termination Voltage	V _{REF} -0.04	V _{REF}	V _{REF} +0.04	V	3

NOTE : There is no specific device V_{DD} supply voltage requirement for SSTL-1.8 compliance. However under all conditions V_{DDQ} must be less than or equal to V_{DD}.

- The value of V_{REF} may be selected by the user to provide optimum noise margin in the system. Typically the value of V_{REF} is expected to be about 0.5 x V_{DDQ} of the transmitting device and V_{REF} is expected to track variations in V_{DDQ}.
- Peak to peak AC noise on V_{REF} may not exceed +/-2% V_{REF}(DC).
- V_{TT} of transmitting device must track V_{REF} of receiving device.
- AC parameters are measured with V_{DD}, V_{DDQ} and V_{DDL} tied together.

8.2 DRAM Operating Temperature Condition

Symbol	Parameter		Rating	Units	Note
T _{OPER}	Operating Temperature Range	Normal Temperature	0 to 85	°C	1,2

Note:

- Operating Temperature T_{OPER} is the case surface temperature on the center/top side of the DRAM.
- T_{CASE} > 85°C → T_{REF1} = 3.9μs. All DRAM specification only support 0°C < T_{CASE} < 85°C

9. Operating, Standby, and Refresh Currents

- 2GB ECC UDIMM (2Rank, 128Mx8 DDR2 SDRAMs)

Symbol	Parameter/Condition	PC2-4200	Unit
I _{DD0}	Operating Current: one bank; active/precharge; t _{RC} = t _{RC} (MIN); t _{CK} = t _{CK} (MIN); DQ, DM, and DQS inputs changing twice per clock cycle; address and control inputs changing once per clock cycle	1080	mA
I _{DD1}	Operating Current: one bank; active/read/precharge; Burst = 2; t _{RC} = t _{RC} (MIN); CL=2.5; t _{CK} = t _{CK} (MIN); I _{OUT} = 0mA; address and control inputs changing once per clock cycle	1260	mA
I _{DD2P}	Precharge Power-Down Standby Current: all banks idle; power-down mode; CKE ≤ V _{IL} (MAX); t _{CK} = t _{CK} (MIN)	180	mA
I _{DD2N}	Idle Standby Current: CS ≥ V _{IH} (MIN); all banks idle; CKE ≥ V _{IH} (MIN); t _{CK} = t _{CK} (MIN); address and control inputs changing once per clock cycle	432	mA
I _{DD2Q}	Precharge Quiet Standby Current: All banks idle; CS is HIGH; CKE is HIGH; t _{CK} = t _{CK} (MIN); Other control and address inputs are stable, Data bus inputs are floating.	432	mA
I _{DD3PF}	Active Power-Down Current: All banks open; t _{CK} = t _{CK} (MIN), CKE is LOW; Other control and address inputs are STABLE, Data bus inputs are floating. MRS A12 bit is set to low (Fast Power-down Exit).	504	mA
I _{DD3PS}	Active Power-Down Current: All banks open; t _{CK} = t _{CK} (MIN), CKE is LOW; Other control and address inputs are STABLE, Data bus inputs are floating. MRS A12 bit is set to high (Slow Power-down Exit).	360	mA
I _{DD3N}	Active Standby Current: one bank; active/precharge; CS ≥ V _{IH} (MIN); CKE ≥ V _{IH} (MIN); t _{RC} = t _{RAS} (MAX); t _{CK} = t _{CK} (MIN); DQ, DM, and DQS inputs changing twice per clock cycle; address and control inputs changing once per clock cycle	540	mA
I _{DD4W}	Operating Current: one bank; Burst = 2; writes; continuous burst; address and control inputs changing once per clock cycle; DQ and DQS inputs changing twice per clock cycle; CL=2.5; t _{CK} = t _{CK} (MIN)	2070	mA
I _{DD4R}	Operating Current: one bank; Burst = 2; reads; continuous burst; address and control inputs changing once per clock cycle; DQ and DQS outputs changing twice per clock cycle; CL = 2.5; t _{CK} = t _{CK} (MIN); I _{OUT} = 0mA	1980	mA
I _{DD5}	Auto-Refresh Current: t _{RC} = t _{RFC} (MIN)	2700	mA
I _{DD6}	Self-Refresh Current: CKE ≤ 0.2V	126	mA
I _{DD7}	Operating Current: four bank; four bank interleaving with BL = 4, address and control inputs randomly changing; 50% of data changing at every transfer; t _{RC} = t _{RC} (min); I _{OUT} = 0mA.	3330	mA

Reference only, the actual will be lower than it.

10. AC Timing Specifications

Symbol	Parameter	PC2-4200		Unit
		Min.	Max.	
tAC	DQ output access time from CK/CK#	-0.50	+0.50	ns
tdQSCK	DQS output access time from CK/CK#	-0.45	+0.45	ns
tCH	CK high-level width	0.48	0.52	tCK
tCL	CK low-level width	0.48	0.52	tCK
tHP	Minimum half clk period for any given cycle; defined by clk high (tCH) or clk low (tCL) time	tCH/L min	-	tCK
tCK	Clock Cycle Time	3.75	8	ns
tDS	DQ and DM input setup time(differential data strobe)	100	-	ps
tDH	DQ and DM input hold time(differential data strobe)	225	-	ps
tIPW	Input pulse width	0.6	-	tCK
tDIPW	DQ and DM input pulse width (each input)	0.35	-	tCK
tHZ	Data-out high-impedance time from CK/XK	-	tACmax	ns
tLZ(DQ)	DQ low-impedance time from CK/XK	2*tAC min	tAC max	ns
tdQSQ	DQS-DQ skew (DQS & associated DQ signals)	-	0.3	ns
tQHS	Data hold Skew Factor	-	0.4	ns
tQH	Data output hold time from DQS	tHP - tQHS	-	ns
tdQSS	Write command to 1st DQS latching transition	-0.25	+0.25	tCK
tdQSL(H)	DQS input low (high) pulse width (write cycle)	0.35	-	tCK
tdSS	DQS falling edge to CK setup time (write cycle)	0.2	-	tCK
tdSH	DQS falling edge hold time from CK (write cycle)	0.2	-	tCK
tMRD	Mode register set command cycle time	2	-	tCK
tWPST	Write postamble	0.40	0.60	tCK
tWPRE	Write preamble	0.35	-	tCK

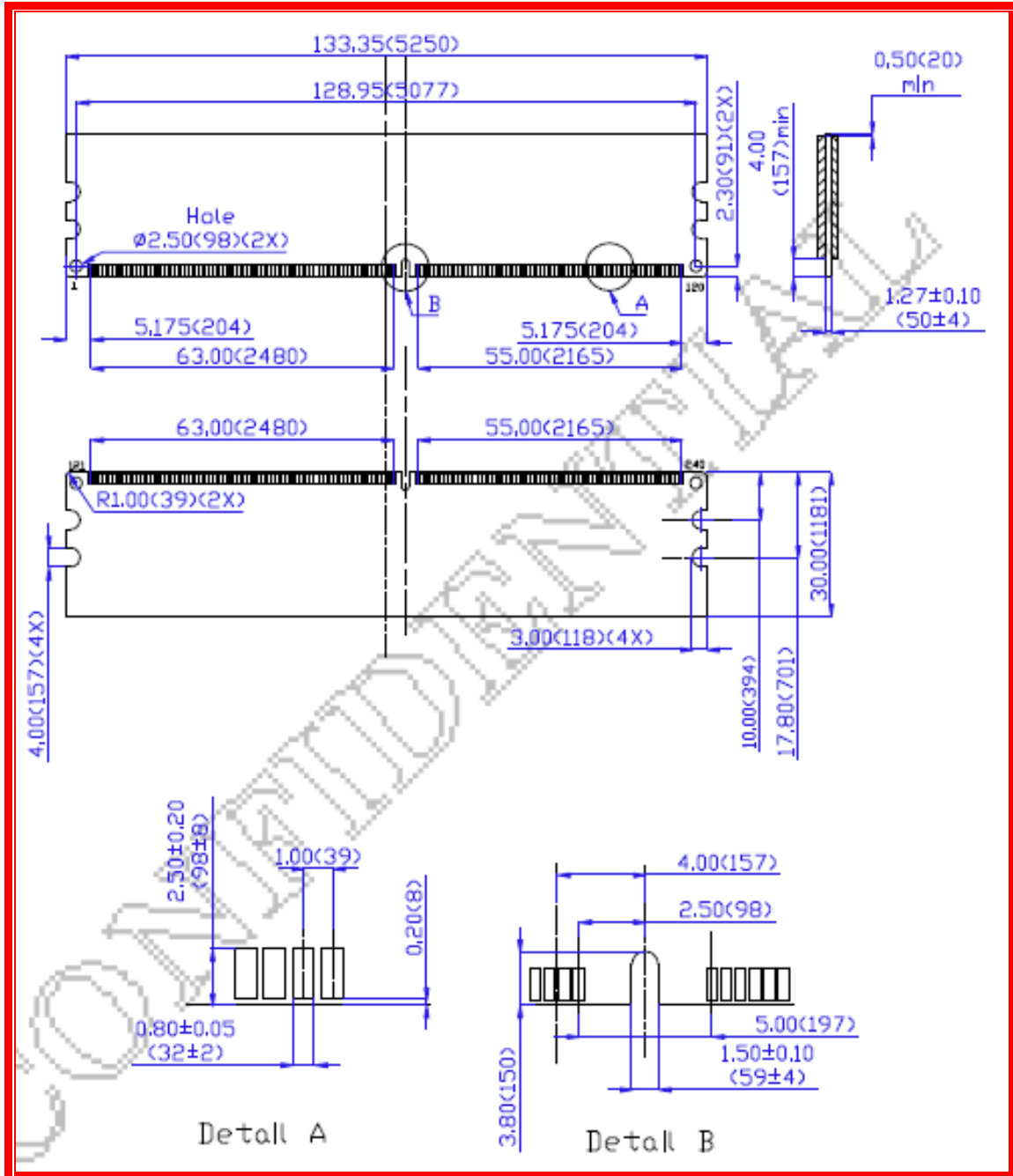
tIH	Address and control input hold time	375	-	ps
tIS	Address and control input setup time	250	-	ps
tRPRE	Read preamble	0.90	1.10	tCK
tRPST	Read postamble	0.40	0.60	tCK
tRRD	Active bank A to Active bank B command	7.5	-	ns
tDelay	Minimum time clocks remains ON after CKE asynchronously drops Low	tIS + tCK + tIH	-	ns
tREFI	Average Periodic Refresh Interval (85°C < T _{CASE} ≤ 95°C)	3.9		μs
	Average Periodic Refresh Interval (0°C ≤ T _{CASE} ≤ 85°C)	7.8		μs
tCCD	CAS# to CAS# delay	2		tCK
tWR	Write recovery time without Auto-Precharge	15	-	ns
tDAL	Auto precharge write recovery + precharge time	WR+tRP	-	tCK
tWTR	Internal write to read command delay	7.5	-	ns
tRTP	Internal read to precharge command delay	7.5		ns
tXSNR	Exit self refresh to a Non-read command	tRFC+10		ns
tXSRD	Exit self refresh to a Read command	200		tCK
tXP	Exit precharge power down to any Non- read command	2	-	tCK
tXARD	Exit active power down to read command	2	-	tCK
tXARDS	Exit active power down to read command	6-AL		tCK
tCKE	CKE minimum pulse width	3		tCK
tAOND	ODT turn-on delay	2	2	tCK
tAON	ODT turn-on	tAC (min)	tAC (max) +1	ns
tAONPD	ODT turn-on (Power down mode)	tAC (min) +2	2tCK + tAC(max) +1	ns
tAOFD	ODT turn-off delay	2.5	2.5	tCK
tAOF	ODT turn-off	tAC(min)	tAC(max) +0.6	ns
tAOFPD	ODT turn-off (Power down mode)	tAC (min)+2	2.5tCK + tAC(max) +1	ns

tANPD	ODT to power down entry latency	3		tCK
tAXPD	ODT power down exit latency	8		tCK

11. Speed Grade Definition

Symbol	Parameter	PC2-4200		Unit
		Min	Max	
tRAS	Row Active Time	40	70,000	ns
tRC	Row Cycle Time	55	-	ns
tRCD	RAS to CAS delay	15	-	ns
tRP	Row Precharge Time	15	-	ns

12. Physical Dimension



Note: All dimensions are in millimeters (mils) and should be kept within a tolerance of ± 0.15 (6), unless otherwise specified

13. RoHS Declaration

innodisk

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RoHS 自我宣告書 (RoHS Declaration of Conformity)

Manufacturer Product: All Innodisk EM Flash and Dram products

- 一、 宜鼎國際股份有限公司 (以下稱本公司) 特此保證售予貴公司之所有產品, 皆符合歐盟 2011/65/EU 及 (EU) 2015/863 關於 RoHS 之規範要求。
Innodisk Corporation declares that all products sold to the company, are complied with European Union RoHS Directive (2011/65/EU) and (EU) 2015/863 requirement.
- 二、 本公司同意因本保證書或與本保證書相關事宜有所爭議時, 雙方宜友好協商, 達成協議。
Innodisk Corporation agrees that both parties shall settle any dispute arising from or in connection with this Declaration of Conformity by friendly negotiations.
- 三、 本公司聲明我們的產品符合 RoHS 指令的附件中 (7a)、(7c-1) 允許豁免。
We declare, our products permitted by the following exemptions specified in the Annex of the RoHS directive.
- ※ (7a) Lead in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead).
- ※ (7C-1) Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectric devices, or in a glass or ceramic matrix compound.

Name of hazardous substance	Limited of RoHS ppm (mg/kg)
鉛 (Pb)	< 1000 ppm
汞 (Hg)	< 1000 ppm
鎘 (Cd)	< 100 ppm
六價鉻 (Cr 6+)	< 1000 ppm
多溴聯苯 (PBBs)	< 1000 ppm
多溴二苯醚 (PBDEs)	< 1000 ppm
鄰苯二甲酸二(2-乙基己基)酯 (DEHP)	< 1000 ppm
鄰苯二甲酸丁酯苯甲酯 (BBP)	< 1000 ppm
鄰苯二甲酸二丁酯 (DBP)	< 1000 ppm
鄰苯二甲酸二異丁酯 (DIBP)	< 1000 ppm

立保證書人 (Guarantor)

Company name 公司名稱: Innodisk Corporation 宜鼎國際股份有限公司Company Representative 公司代表人: Randy Chien 簡川勝Company Representative Title 公司代表人職稱: Chairman 董事長Date 日期: 2018 / 07 / 01

14. Revision Log

Rev	Date	Modification
0.1	11 st December 2018	Preliminary Edition
1.0	11 st December 2018	Official Release
1.1	9 th June 2020	Updated RoHS