

Approval Sheet

| | |
|----------------------|-----------------------------|
| Customer | |
| Product Number | M3CW-4GSS1L0C-D |
| Module speed | PC3-12800 |
| Pin | 240 pin |
| CI-tRCD-tRP | 11-11-11 |
| SDRAM Operating Temp | 0°C ~85°C |
| Date | 22 nd April 2014 |

Approval by Customer

P/N:

Signature:

Date:

Sales: _____

Sr. Technical Manager: John Hsieh

Rev 1.0

1. Features

Key Parameter

| Industry Nomenclature | Speed Grade | Data Rate MT/s | | | tAA (ns) | tRCD (ns) | tRP (ns) | tRC (ns) |
|--------------------------|----------------|----------------|------|-------|-------------|--------------|-------------|-------------|
| | | CL=7 | CL=9 | CL=11 | | | | |
| PC3-12800 | P | 1066 | 1333 | 1600 | 13.125 | 13.125 | 13.125 | 48.125 |

- JEDEC Standard 240-pin Dual In-Line Memory Module
- Intend for PC3-12800 applications
- Inputs and Outputs are SSTL-15 compatible
- VDD=VDDQ= 1.35 Volt (- 0.067/+0.1V)
- Bi-directional Differential Data Strobe
- DLL aligns DQ and DQS transition with CK transition
- SDRAMs have 8 internal banks for concurrent operation
- Normal and Dynamic On-Die Termination support.
- SDRAMs are 78-ball BGA Package
- Support ECC function
- 8 bit pre-fetch
- Two different termination values (Rtt_Nom & Rtt_WR)
- Auto & self refresh 7.8 μ s ($T_A \leq +85^{\circ}\text{C}$)
- 16/10/1 Addressing (row/column/rank)-4GB
- SDRAM operating temperature range $0^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$
- Programmable Device Operation:
 - Burst Type: Sequential or Interleave
 - Device CAS# Latency: 7, 9, 11
 - Burst Length: switch on-the-fly: BL=8 or BC 4
- RoHS Compliant (*Section 14*)

2. Environmental Requirements

iDIMM are intended for use in standard office environments that have limited capacity for heating and air conditioning.

| Symbol | Parameter | Rating | Units | Notes |
|--------|---|-------------|----------|-------|
| TOPR | Operating Temperature (ambient) | 0 to +55 | °C | 1 |
| TSTG | Storage Temperature | -50 to +100 | °C | |
| HOPR | Operating Humidity (relative) | 10 to 90 | % | |
| HSTG | Storage Humidity (without condensation) | 5 to 95 | % | |
| PBAR | Barometric Pressure (operating & storage) | 105 to 69 | K Pascal | 1,2 |

1. The component maximum case temperature (Tcase) shall not exceed the value specified in the DDR DRAM component specification.
2. Up to 9850 ft.

3. DRAM Parameters by device density

| RTT_Nom Setting | Parameter | 2Gb | Units |
|-----------------|-------------------------------------|--|-------------------|
| tRFC | REF command ACT or REF command time | 160 | ns |
| tREFI | Average periodic refresh interval | $0^{\circ}\text{C} \leq \text{Tcase} \leq 85^{\circ}\text{C}$ | 7.8 μs |
| | | $85^{\circ}\text{C} \leq \text{Tcase} \leq 95^{\circ}\text{C}$ | 3.9 μs |

4. Ordering Information

| DDR3L UDIMM/wECC | | | | | | |
|------------------|---------|-----------|-------------------|----------------|----------------|-----|
| Part Number | Density | Speed | DIMM Organization | Number of DRAM | Number of rank | ECC |
| M3CW-4GSS1L0C-D | 4GB | PC3-12800 | 512Mx72 | 9 | 1 | Y |

5. Pin Configurations (Front side/Back side)

X72 UDIMM/wECC

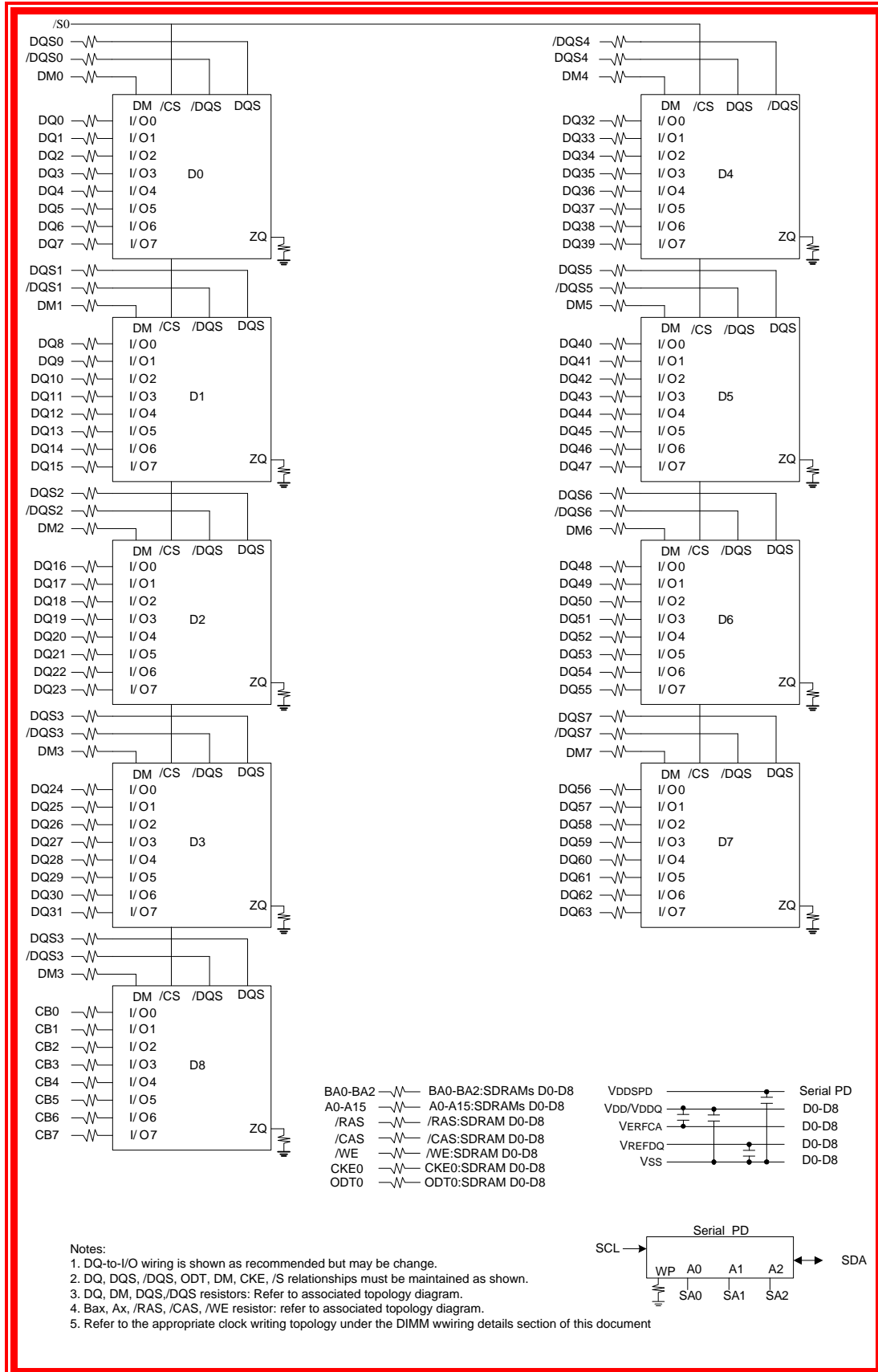
| DDR3L-240pins DIMM Front | | | | | | | | DDR3L-240pins DIMM Back | | | | | | | |
|--------------------------|--------|-----|--------------|-----|---------|-----|-------|-------------------------|------|-----|------------|-----|------|-----|--------|
| Pin | Name | Pin | Name | Pin | Name | Pin | Name | Pin | Name | Pin | Name | Pin | Name | Pin | Name |
| 1 | VREFDQ | 31 | DQ26 | 61 | A2 | 91 | DQ41 | 121 | VSS | 161 | VSS | 181 | A1 | 211 | VSS |
| 2 | VSS | 32 | VSS | 62 | VDD | 92 | VSS | 122 | DQ4 | 162 | DM3 | 182 | VDD | 212 | DM6 |
| 3 | DQ0 | 33 | /DQ33 | 63 | CK1/NC | 93 | /DQ35 | 123 | DQ6 | 163 | NC | 183 | VDD | 213 | NC |
| 4 | DQ1 | 34 | DQ33 | 64 | /CK1/NC | 94 | DQ35 | 124 | VSS | 164 | VSS | 184 | CK0 | 214 | VSS |
| 5 | VSS | 35 | VSS | 65 | VDD | 95 | VSS | 125 | DM0 | 165 | DQ30 | 185 | /CK0 | 215 | DQ48 |
| 6 | /DQ30 | 36 | DQ28 | 66 | VDD | 96 | DQ42 | 126 | NC | 166 | DQ31 | 186 | VDD | 216 | DQ47 |
| 7 | DQ30 | 37 | DQ27 | 67 | VREFCA | 97 | DQ43 | 127 | VSS | 167 | VSS | 187 | NC | 217 | VSS |
| 8 | VSS | 38 | VSS | 68 | NC | 98 | VSS | 128 | DQ6 | 168 | CB4 | 188 | A0 | 218 | DQ52 |
| 9 | DQ2 | 39 | CB0 | 69 | VDD | 99 | DQ48 | 129 | DQ7 | 169 | CB5 | 189 | VDD | 219 | DQ53 |
| 10 | DQ3 | 40 | CB1 | 70 | A10 | 100 | DQ49 | 130 | VSS | 180 | VSS | 190 | BA1 | 220 | VSS |
| 11 | VSS | 41 | VSS | 71 | BA0/BA1 | 101 | VSS | 131 | DQ12 | 181 | DM8 | 191 | VDD | 221 | DM8 |
| 12 | DQ8 | 42 | NC, /DQ38 | 72 | VDD | 102 | /DQ38 | 132 | DQ13 | 182 | NC | 192 | RA3 | 222 | NC |
| 13 | DQ9 | 43 | NC DQ38 | 73 | WE | 103 | DQ38 | 133 | VSS | 183 | VSS | 193 | C30 | 223 | VSS |
| 14 | VSS | 44 | VSS | 74 | CA3 | 104 | VSS | 134 | DM1 | 184 | CB8 | 194 | VDD | 224 | DQ54 |
| 15 | /DQ31 | 45 | CB2 | 75 | VDD | 105 | DQ50 | 135 | NC | 185 | CB7 | 195 | ODT0 | 225 | DQ56 |
| 16 | DQ31 | 46 | CB3 | 76 | CS1 | 106 | DQ51 | 136 | VSS | 186 | VSS | 196 | A13 | 226 | VSS |
| 17 | VSS | 47 | VSS | 77 | ODT1 | 107 | VSS | 137 | DQ14 | 187 | NC,TEST | 197 | VDD | 227 | DQ60 |
| 18 | DQ10 | 48 | NC | 78 | VDD | 108 | DQ58 | 138 | DQ15 | 188 | RESET | 198 | NC | 228 | DQ61 |
| 19 | DQ11 | 49 | NC | 79 | NC/SA2 | 109 | DQ57 | 139 | VSS | 189 | NC CKE1 | 199 | VSS | 229 | VSS |
| 20 | VSS | 50 | CKE0 | 80 | VSS | 110 | VSS | 140 | DQ20 | 170 | VDD | 200 | DQ38 | 230 | DM7 |
| 21 | DQ16 | 51 | VDD | 81 | DQ32 | 111 | /DQ37 | 141 | DQ21 | 171 | A15/BA3 | 201 | DQ37 | 231 | NC |
| 22 | DQ17 | 52 | BA2 | 82 | DQ33 | 112 | DQ37 | 142 | VSS | 172 | A14 | 202 | VSS | 232 | VSS |
| 23 | VSS | 53 | NC | 83 | VSS | 113 | VSS | 143 | DM2 | 173 | VDD | 203 | DM4 | 233 | DQ62 |
| 24 | /DQ32 | 54 | VDD | 84 | /DQ34 | 114 | DQ58 | 144 | NC | 174 | A12/NC | 204 | NC | 234 | DQ63 |
| 25 | DQ32 | 55 | A11 | 85 | DQ34 | 115 | DQ59 | 145 | VSS | 175 | A9 | 205 | VSS | 235 | VSS |
| 26 | VSS | 56 | A7 | 86 | VSS | 116 | VSS | 146 | DQ22 | 176 | VDD | 206 | DQ38 | 236 | VDD3PD |
| 27 | DQ18 | 57 | VDD | 87 | DQ34 | 117 | SA0 | 147 | DQ23 | 177 | A8 | 207 | DQ39 | 237 | SA1 |
| 28 | DQ19 | 58 | A6 | 88 | DQ36 | 118 | SCL | 148 | VSS | 178 | A8 | 208 | VSS | 238 | SDA |
| 29 | VSS | 59 | A4 | 89 | VSS | 119 | VSS | 149 | DQ28 | 179 | VDD | 209 | DQ44 | 239 | VSS |
| 30 | DQ24 | 60 | VDD | 90 | DQ40 | 120 | VTT | 150 | DQ29 | 180 | A3 | 210 | DQ45 | 240 | VTT |

6. Architecture

Pin Definition

| Pin Name | Description | Pin Name | Description |
|----------------------------|-----------------------------|--------------------|--|
| A0 - A13 (A14 or A15) | SDRAM address bus | SCL | Serial Presence Detect Clock Input |
| BA0 - BA1 (or BA2) | SDRAM Bank Address Inputs | SDA | Serial Presence Detect Data input/output |
| /RAS | SDRAM row address strobe | SA0 – SA2 | Serial Presence Detect Address Inputs |
| /CAS | SDRAM column address strobe | V _{DD} | Power Supply |
| /WE | SDRAM write enable | V _{DDID} | V _{DD} Identification Flag |
| /S0 - /S1 | DIMM Rank Select Lines | V _{DDQ} | SDRAM I/O Driver power supply |
| CK0 – CKE1 | SDRAM clock enable lines | V _{REFDQ} | SDRAM I/O Reference supply |
| DQ0 – DQ63 | DIMM memory data bus | V _{REFCA} | SDRAM Command/address reference supply. |
| CB0 – CB7 | DIMM ECC check bit | V _{SS} | Ground |
| DQS0 – DQS8 /DQS0-/DQS8 | SDRAM data strobes | V _{DDSPD} | Serial EEPROM positive power supply |
| DM0 – DM8 | SDRAM data masks | NC | Spare Pin |
| ODT0-ODT1 | Spare Pin | /Reset | Reset enable |
| CK0 – CK1 /CK0 - /CK1 | Differential SDRAM Clocks | Event# | Reserved for optional temperature-sensing hardware |
| RSVD | Reserved for future use. | V _{TT} | SDRAM I/O termination supply. |

7. Function Block Diagram: - (4GB, 1Rank, 512Mx8 DDR3L SDRAMs)



8. SDRAM Absolute Maximum Ratings

| Symbol | Parameter | Rating | Units | Note | |
|------------------------------------|--|--------------------------|----------|------|-----|
| T _{OPER} | Operation Temperature | Normal Operating Temp. | 0 to 85 | °C | 1,2 |
| | | Extended Temp.(optional) | 85 to 95 | °C | 1,3 |
| T _{STG} | Storage Temperature | -50 to 100 | °C | 4,5 | |
| V _{IN} , V _{OUT} | Voltage on any pins relative to V _{ss} | -0.4 to +1.975 | V | 4 | |
| V _{DD} | Voltage on VDD supply relative to V _{ss} | -0.4 to +1.975 | V | 4,6 | |
| V _{DDQ} | Voltage on VDDQ supply relative to V _{ss} | -0.4 to +1.975 | V | 4,6 | |

Note:

- Operating Temperature T_{OPER} is the case surface temperature on the center / top side of the DRAM.
For measurement conditions, please refer to the JEDEC document JESD51-2.
- The Normal Temperature Range specifies the temperatures where all DRAM specifications will be supported. During operation, the DRAM case temperature must be maintained between 0 to 85 °C under all operating conditions.
- Some applications require operation of the DRAM in the Extended Temperature Range between 85 °C and 95 °C case temperature. Full specifications are supported in this range, but the following additional conditions apply:
 - Refresh commands must be doubled in frequency, therefore reducing the Refresh interval tREFI to 3.9 μs. It is also possible to specify a component with 1X refresh (tREFI to 7.8μs) in the Extended Temperature Range. Please refer to supplier data sheet and/or the DIMM SPD for option availability.
 - If Self-Refresh operation is required in the Extended Temperature Range, then it is mandatory to either use the Manual Self-Refresh mode with Extended Temperature Range capability (MR2 A6 =0b and MR2 A7 = 1b) or enable the optional Auto Self-Refresh mode (MR2 A6 = 1b and MR2 A7 =0b). Please refer to the supplier data sheet and/or the DIMM SPD for Auto Self-Refresh option availability, Extended Temperature Range support and tREFI requirements in the Extended Temperature Range.
- Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is 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.
- 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.
- V_{DD} and V_{DDQ} must be within 300 mV of each other at all times;and VREF must be not greater than 0.6 x V_{DDQ}, When V_{DD} and V_{DDQ} are less than 500 mV; VREF may be equal to or less than 300 mV

9. DRAM AC & DC Operating

| Symbol | Parameter | Min | Typ. | Max | Units | Notes |
|--|--|-------------------|-------------------------------|-------------------|-------|-------|
| Recommended DC Operating Conditions | | | | | | |
| V_{DD} | Supply Voltage | 1.283 | 1.35 | 1.45 | V | 1,2 |
| V_{DDQ} | Supply Voltage | 1.283 | 1.35 | 1.45 | V | 1,2 |
| Single Ended AC/DC Input Levels | | | | | | |
| V_{IH} (DC) | DC Input High (Logic1) Voltage | $V_{REF} + 0.1$ | - | V _{DD} | V | 3 |
| V_{IL} (DC) | DC Input Low (Logic 0) Voltage | V _{SS} | - | $V_{REF} - 0.1$ | V | 3 |
| V_{IH} (AC) | AC Input High (Logic1) Voltage | $V_{REF} + 0.175$ | - | - | V | 3 |
| V_{IL} (AC) | AC Input Low (Logic 0) Voltage | - | - | $V_{REF} - 0.175$ | V | 3 |
| V_{REFDQ} (DC) | Reference Voltage for DQ, DM inputs | $0.49V_{DDQ}$ | $0.5V_{DDQ}$ | $0.51V_{DDQ}$ | V | 4,5 |
| V_{REFCA} (DC) | Reference Voltage for ADD,CMD inputs | $0.49V_{DDQ}$ | $0.5V_{DDQ}$ | $0.51V_{DDQ}$ | V | 4,5 |
| Single Ended AC/DC output Levels | | | | | | |
| V_{OH} (DC) | DC output high measurement level (for IV curve linearity) | - | $0.8 \times V_{DDQ}$ | - | V | |
| V_{OM} (DC) | DC output mid measurement level (for IV curve linearity) | - | $0.5 \times V_{DDQ}$ | - | V | |
| V_{OL} (DC) | DC output low measurement level (for IV curve linearity) | - | $0.2 \times V_{DDQ}$ | - | V | |
| V_{OH} (AC) | AC output high measurement level (for output SR) | - | $V_{TT} + 0.1 \times V_{DDQ}$ | - | V | 6 |
| V_{OL} (AC) | AC output low measurement level (for output SR) | - | $V_{TT} - 0.1 \times V_{DDQ}$ | - | V | 6 |

| Symbol | Parameter | Min | Typ. | Max | Units | Notes |
|--|---|------------------------|--------------|-------------------------|-------|-------|
| Differential AC/DC Input Levels | | | | | | |
| VIHdiff | Differential Input high | +0.2 | - | Note 9 | V | 7 |
| VILdiff | Differential Input logic Low | Note 9 | - | -0.2 | V | 7 |
| VIHdiff(ac) | Differential Input high ac | 2* (VIH (AC)- VREF) | - | Note 9 | V | 8 |
| VILdiff(ac) | Differential Input logic Low ac | Note 9 | - | 2* (VREF- VIL (AC)) | V | 8 |
| Differential AC and DC Output Levels | | | | | | |
| VOHdiff(AC) | AC differential output high measurement level (for output SR) | - | + 0.2 x VDDQ | - | V | 10 |
| VOLDiff(AC) | AC differential output low measurement level (for output SR) | - | - 0.2 x VDDQ | - | V | 10 |
| Note: | | | | | | |
| <ol style="list-style-type: none"> Under all conditions VDDQ must be less than or equal to VDD. VDDQ tracks with VDD. AC parameters are measured with VDD and VDDQ tied together. For DQ and DM, Vref = VrefDQ. For input only pins except RESET#, Vref = VrefCA. The ac peak noise on VRef may not allow VRef to deviate from VRef(DC) by more than +/-1% VDD (for reference: approx. +/- 15 mV). For reference: approx. VDD/2 +/- 15 mV. The swing of $\pm 0.1 \times VDDQ$ is based on approximately 50% of the static single-ended output high or low swing with a driver impedance of 40Ω and an effective test load of 25Ω to $VTT = VDDQ/2$ Used to define a differential signal slew-rate. For CK - CK# use VIH/VIL(ac) of ADD/CMD and VREFCA; for DQS - DQS#, DQSL, DQSL#, DQSU , DQSU# use VIH/VIL(ac) of DQs and VREFDQ; if a reduced ac-high or ac-low level is used for a signal group, then the reduced level applies also here. These values are not defined, however the single-ended signals CK, CK#, DQS, DQS#, DQSL, DQSL#, DQSU, DQSU# need to be within the respective limits (VIH(dc) max, VIL(dc)min) for single- ended signals as well as the limitations for overshoot and undershoot. The swing of $\pm 0.2 \times VDDQ$ is based on approximately 50% of the static single-ended output high or low swing with a driver impedance of 40Ω and an effective test load of 25Ω to $VTT = VDDQ/2$ at each of the differential outputs. | | | | | | |

10. Operating, Standby, and Refresh Currents

- 4GB UDIMM/wECC (1 Rank, 512Mx8 DDR3L SDRAMs $T_{CASE} = 0\text{ }^{\circ}\text{C} \sim 70\text{ }^{\circ}\text{C}$)

| Symbol | Parameter/Condition | | PC3-12800 | Unit |
|---------|--|-----------|-----------|------|
| I DD0 | One bank; Active - Precharge | | 500 | mA |
| I DD1 | One bank; Active - Read - Precharge | | 590 | mA |
| I DD2N | Precharge Standby Current | | 300 | mA |
| IDD2NT | Precharge Standby ODT Current | | 350 | mA |
| I DD2P | Precharge Power Down Current | Fast Mode | 220 | mA |
| | Precharge Power Down Current | Slow Mode | 200 | mA |
| I DD2Q | Precharge Quiet Standby Current | | 295 | mA |
| I DD3N | Active Standby Current | | 350 | mA |
| I DD3P | Active Power-Down Current | | 250 | mA |
| I DD4R | Operating Current Burst Read | | 1235 | mA |
| I DD4W | Operating Current Burst Write | | 1380 | mA |
| I DD5B | Burst Refresh Current | | 1435 | mA |
| I DD6 | Self-Refresh Current: Normal Temperature Range | | 200 | mA |
| I DD6ET | Self-Refresh Current: Extended Temperature Range | | 220 | mA |
| I DD6TC | Auto Self-Refresh Current | | 220 | mA |
| I DD7 | Operating Bank Interleave Read Current | | 1780 | mA |

11. Timing Parameters

($T_{CASE} = 0\text{ }^{\circ}\text{C} \sim 70\text{ }^{\circ}\text{C}$; $V_{DDQ} = V_{DD}$, See AC Characteristics)

| Symbol | Parameter | PC3-12800 | | Unit |
|---------------------|---|---------------------------------------|---|-----------|
| | | Min. | Max. | |
| Clock Timing | | | | |
| tCK (DLL-Off) | Minimum Clock Cycle Time | 8 | - | ns |
| tCK (avg) | Average Clock Period | 1.5 | 3.3 | ns |
| tCH (avg) | Average high pulse width | 0.47 | 0.53 | tCK (avg) |
| tCL (avg) | Average low pulse width | 0.47 | 0.53 | tCK (avg) |
| tCK (abs) | Absolute Clock Period | tCK(avg) min + tJIT(per) min | tCK(avg) max + tJIT(per) max - | Ps |
| tCH (abs) | Absolute high pulse width | 0.43 | - | tCK (avg) |
| tCL (abs) | Absolute low pulse width | 0.43 | - | tCK (avg) |
| JIT (per) | Clock Period Jitter | -70 | 70 | Ps |
| TJIT (per, lck) | Clock Period Jitter during DLL locking period. | -60 | 60 | Ps |
| JIT (CC) | Cycle to Cycle Period Jitter | 140 | | Ps |
| TJIT (CC, lck) | Cycle to Cycle Period Jitter during DLL locking period. | 120 | | Ps |
| TJIT (duty) | | - | - | Ps |
| TERR (2per) | Cumulative error across 2 cycle | -103 | 103 | Ps |
| TERR (3per) | Cumulative error across 3 cycle | -122 | 122 | Ps |
| TERR (4per) | Cumulative error across 4 cycle | -136 | 136 | Ps |
| TERR (5per) | Cumulative error across 5 cycle | -147 | 147 | Ps |
| TERR (6per) | Cumulative error across 6 cycle | -155 | 155 | Ps |
| TERR (7per) | Cumulative error across 7 cycle | -163 | 163 | Ps |
| TERR (8per) | Cumulative error across 3 cycle | -169 | 169 | Ps |
| TERR (9per) | Cumulative error across 4 cycle | -175 | 175 | Ps |
| TERR (10per) | Cumulative error across 5 cycle | -180 | 180 | Ps |

| TERR (11per) | Cumulative error across 6 cycle | -184 | 184 | Ps |
|---------------------------|---|--|------|----------|
| TERR (12per) | Cumulative error across 7 cycle | -188 | 188 | Ps |
| TERR (nper) | Cumulative error across 13~50 cycle | $tERR(nper)min = (1 + 0.68ln(n)) *$ $tJIT(per)min$ $tERR(nper)max = (1 + 0.68ln(n)) *$ $tJIT(per)max$ | | Ps |
| Data Timing | | | | |
| Symbol | Parameter | Min. | Max. | Unit |
| tDSQ | DQS, DQS# to DQ skew, per group, per access | - | 100 | Ps |
| tQH | DQ output hold time from DQS, DQS# | 0.38 | - | tCK(avg) |
| tLZ (DQ) | DQ low-impedance time from CK, CK# | -450 | 225 | Ps |
| tHZ(DQ) | DQ high impedance time from CK, CK# | - | 225 | Ps |
| tDS(base) AC150 | Data setup time to DQS, DQS# referenced to Vih(ac) / Vil(ac) levels | 10 | - | Ps |
| tDH(base) DC 100 | Data hold time from DQS, DQS# referenced to Vih(dc) / Vil(dc) levels | 45 | - | Ps |
| Data Strobe Timing | | | | |
| Symbol | Parameter | Min. | Max. | Unit |
| tRPRE | DQS,DQS# differential READ Preamble | 0.9 | | tCK(avg) |
| tRPST | DQS, DQS# differential READ Postamble | 0.3 | | tCK(avg) |
| tQSH | DQS, DQS# differential output high time | 0.4 | | tCK(avg) |
| tQSL | DQS, DQS# differential output low time | 0.4 | | tCK(avg) |
| tWPRE | DQS, DQS# differential WRITE Preamble | 0.9 | | tCK(avg) |
| tWPST | DQS, DQS# differential WRITE Postamble | 0.3 | | tCK(avg) |
| tDQSK | DQS, DQS# rising edge output access time from rising CK, CK# | -225 | 225 | Ps |

| tLZ(DQS) | DQS and DQS# low-impedance time (Referenced from RL - 1) | -450 | 225 | Ps |
|-----------------------------------|---|------------------|------|----------|
| tHZ(DQS) | DQS and DQS# high-impedance time (Referenced from RL + BL/2) | - | 225 | Ps |
| tDQSL | DQS, DQS# differential input low pulse width | 0.45 | 0.55 | tCK(avg) |
| tDQSH | DQS, DQS# differential input high pulse width | 0.45 | 0.55 | tCK(avg) |
| tDQSS | DQS, DQS# rising edge to CK, CK# rising edge | -0.27 | 0.27 | tCK(avg) |
| tDSS | DQS, DQS# falling edge setup time to CK, CK# rising edge | 0.18 | - | tCK(avg) |
| tDSH | DQS, DQS# falling edge hold time from CK, CK# rising edge | 0.18 | - | tCK(avg) |
| Command and Address Timing | | | | |
| Symbol | Parameter | Min. | Max. | Unit |
| tDLLK | DLL locking time | 512 | - | nCK |
| tRTP | Internal READ Command to PRECHARGE Command delay | max(4nCK, 7.5ns) | - | |
| tWTR | Delay from start of internal write transaction to Internal read command | max(4nCK, 7.5ns) | - | |
| tWR | WRITE recovery time | 15 | - | ns |
| tMRD | Mode Register Set command cycle time | 4 | - | nCK |
| tMOD | Mode Register Set command update delay | max(12nCK, 15ns) | - | |
| tRCD | Refer to Section 1 Feature | | | |
| tRP | Refer to Section 1 Feature | | | |
| tRC | Refer to Section 1 Feature | | | |
| tCCD | | 4 | - | nCK |

| | | | | |
|---------------------------|--|--|-------------|-------------|
| tDAL (min) | Auto precharge write recovery + precharge time | WR + roundup(t_{RP} / $t_{CK(avg)}$) | | nCK |
| tMPRR | Multi-Purpose Register Recovery Time | 1 | - | nCK |
| tRAS | ACTIVE to PRECHARGE command period | 35 | 9 tREFI | ns |
| tRRD | ACTIVE to ACTIVE command period for 1KB page size | max(4nCK, 6ns) | - | |
| tRRD | ACTIVE to ACTIVE command period for 2KB page size | max(4nCK, 7.5ns) | - | |
| tFAW | Four activate window for 1KB page size | 30 | - | ns |
| tFAW | Four activate window for 2KB page size | 40 | - | ns |
| tIS (base) | Command and Address setup time to CK, CK#, referenced to Vih(ac) / Vil(ac) levels. | 45 | | ns |
| tIH(base) | Command and Address hold time from CK, CK# referenced to Vih(dc) / Vil(dc) levels | 170 | | ps |
| tIS(base) AC150 | Command and Address setup time to CK, CK# referenced to Vih(ac) / Vil(ac) levels | 120 | | ps |
| Calibration Timing | | | | |
| Symbol | Parameter | Min. | Max. | Unit |
| tZQinit | Power-up and RESET calibration time | Max. (512nCK, 640ns) | - | nCK |
| tZQoper | Normal operation Full calibration time | Max. (256nCK, 320ns) | - | nCK |
| tZQCS | Normal operation Short calibration time | Max. (64nCK, 80ns) | - | nCK |

| Reset Timing | | | | |
|----------------------|--|------------------------------|------|------|
| Symbol | Parameter | Min. | Max. | Unit |
| tXPR | Exit Reset from CKE HIGH to a valid command | max(5nCK, tRFC(min) + 10ns) | - | |
| Self Refresh Timings | | | | |
| Symbol | Parameter | Min. | Max. | Unit |
| tXS | Exit Self Refresh to commands not requiring a locked DLL | Max(5nCK), tRFC(min) + 10ns) | | |
| tXSDLL | Exit Self Refresh to commands requiring a locked DLL. | tDLL(min) | - | nCK |
| tCKESR | Minimum CKE low width for Self Refresh entry to exit timing. | tCKE9min) + 1nCK | - | |
| tCKSRE | Valid Clock Requirement after Self Refresh Entry (SRE) or Power-Down Entry (PDE) | Max(5nCK, 10ns) | - | |
| tCKSRX | Valid Clock Requirement before Self Refresh Exit (SRX) or Power-Down Exit (PDX) or Reset Exit | Max(5nCK, 10ns) | - | |
| Power Down Timings | | | | |
| Symbol | Parameter | Min. | Max. | Unit |
| tXP | Exit Power Down with DLL on to any valid command; Exit Precharge Power Down with DLL frozen to commands not requiring a locked DLL | max(3nCK, 6ns) | - | |
| tXPDLL | Exit Precharge Power Down with DLL frozen to commands requiring a locked DLL | max(10nCK, 24ns) | - | |

| | | | | |
|--------------------|--|---------------------------|-------------|-------------|
| tCKE | CKE minimum pulse width | max(3nCK, 5ns) | - | |
| tCPDED | Command pass disable delay | 1 | - | nCK |
| tPD | Power Down Entry to Exit Timing | tCK(min) | 9*tREFI | |
| tACTPDEN | Timing of ACT command to Power Down entry | 1 | - | nCK |
| tPRPDEN | Timing of PRE or PREA command to Power Down entry | 1 | - | nCK |
| tRDPDEN | Timing of RD/RDA command to Power Down entry | RL+4+1 | - | nCK |
| tWRPDEN | Timing of WR command to Power Down entry (BL8OTF, BL8MRS, BC4OTF) | WL + 4 + (tWR / tCK(avg)) | - | nCK |
| tWRAPDEN | Timing of WRA command to Power Down entry (BL8OTF, BL8MRS, BC4OTF) | WL + 4 + WR + 1 | - | nCK |
| tWRPDEN | Timing of WR command to Power Down entry (BC4MRS) | WL + 2 + (tWR / tCK(avg)) | - | nCK |
| tWRAPDEN | Timing of WRA command to Power Down entry (BC4MRS) | WL + 2 + WR + 1 | - | nCK |
| tREFPDEN | Timing of REF command to Power Down entry | 1 | - | nCK |
| tMRSPDEN | Timing of MRS command to Power Down entry | tMOD(min) | - | nCK |
| ODT Timings | | | | |
| Symbol | Parameter | Min. | Max. | Unit |
| ODTH4 | ODT high time without write command or with write command and BC4 | 4 | - | nCK |
| ODTH8 | ODT high time with Write command and BL8 | 6 | - | nCK |

| | | | | |
|--------|--|------|-----|----------|
| tAONPD | Asynchronous RTT turn-on delay (Power-Down with DLL frozen) | 2 | 8.5 | ns |
| tAOFPD | Asynchronous RTT turn-off delay (Power-Down with DLL frozen) | 2 | 8.5 | ns |
| tAON | RTT-turn-on | -225 | 225 | ps |
| tAOF | RTT_Nom and RTT_WR turn-off time from ODTLoff reference | 0.3 | 0.7 | tCK(avg) |
| tADC | RTT dynamic change skew | 0.3 | 0.7 | tCK(avg) |

12. SPD Serial Presence Detect – (4GB)

1 RANK UNBUFFERED DDR3 UDIMM/Ecc based on 512Mx8, 8Banks, 8K Refresh, DDR3 SDRAMs with SPD

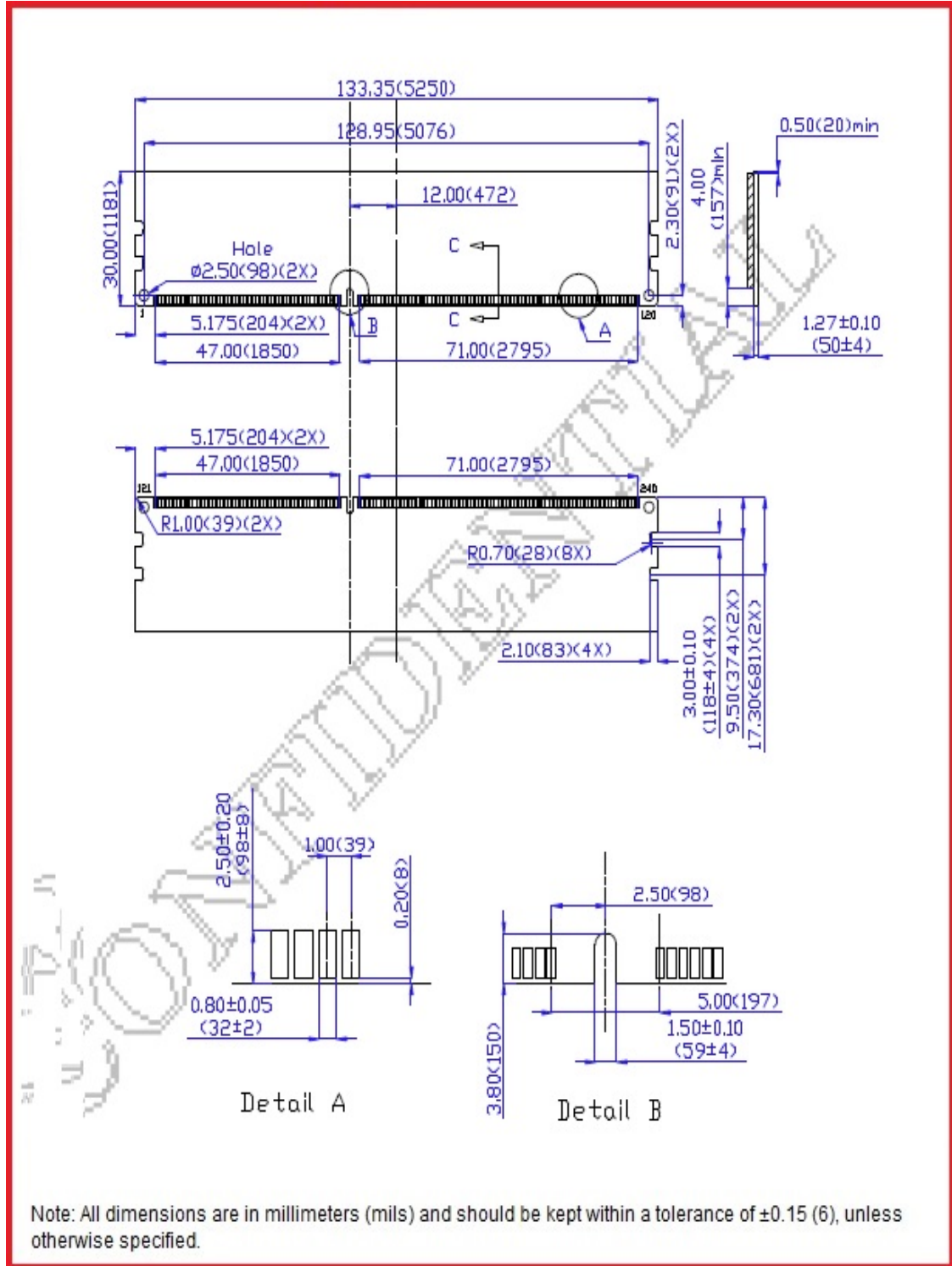
| Byte | Description | Serial PD Data Entry (Hexadecimal) | Note |
|------|---|---------------------------------------|------|
| 0 | Number of Serial PD Bytes Written during Production | 92 | |
| 1 | SPD Revision | 11 | |
| 2 | Key Byte/DRAM Device Type | 0B | |
| 3 | Key Byte/Module type | 02 | |
| 4 | SDRAM Density and Banks | 04 | |
| 5 | SDRAM Address | 21 | |
| 6 | Reserve | 02 | |
| 7 | Module Organization | 01 | |
| 8 | Module Memory Bus Width | 0B | |
| 9 | Fine Timebase (FTB) Dividend/Divisor | 52 | |
| 10 | Medium Timebase (MTB) Dividend | 01 | |
| 11 | Medium Timebase (MTB) Divisor | 08 | |
| 12 | SDRAM Minimum Cycle Time (tCKmin) | 0A | |
| 13 | Reserve | 00 | |
| 14 | CAS latency, least Significant Byte | FC | |
| 15 | CAS latency, most Significant Byte | 00 | |
| 16 | Minimum CAS Latency Time (tAAmin) | 69 | |
| 17 | Minimum Write Recovery Time (tWRmin) | 78 | |

| Byte | Description | Serial PD Data Entry (Hexadecimal) | Note |
|------|--|---------------------------------------|------|
| 18 | Minimum RAS# to CAS# Delay Time (tRCDmin) | 69 | |
| 19 | Minimum Row Active to Row Active Delay Time (tRRDmin) | 30 | |
| 20 | Minimum Row Precharge Delay Time (tRPmin) | 69 | |
| 21 | Upper Nibbles for tRAS and tRC | 11 | |
| 22 | Minimum Active to Precharge Delay Time (tRASmin), Least Significant Byte | 18 | |
| 23 | Minimum Active to Active/Refresh Delay Time (tRCmin), Least Significant Byte | 81 | |
| 24 | Minimum Refresh Recovery Delay Time (tRFCmin), Least Significant Byte | 20 | |
| 25 | Minimum Refresh Recovery Delay Time (tRFCmin), Most Significant Byte | 08 | |
| 26 | Minimum Internal Write to Read Command Delay Time (tWTRmin) | 3C | |
| 27 | Minimum Internal Read to Precharge Command Delay Time (tRTPmin) | 3C | |
| 28 | Upper Nibble for tFAW | 00 | |
| 29 | Minimum Four Activate Window Delay Time (tFAWmin) | F0 | |
| 30 | SDRAM Optional Features | 83 | |
| 31 | SDRAM Thermal and Refresh Options | 0D | |
| 32 | Module Thermal Sensor | 00 | |
| 33 | SDRAM Device Type | 00 | |

| | | | |
|---------|--|-------------|--|
| 34-59 | Reserve | 00 | |
| 60-63 | Module Type Specific Section, | 0F 11 04 01 | |
| 64-117 | Reserve | 00 | |
| 117-118 | Module ID: Module Manufacturer's JEDEC ID Code | 86 F1 | |
| 119 | Module ID: Module Manufacturing Location | 02 | |
| 120-121 | Module ID: Module Manufacturing Date | 09 2E | |
| 122-125 | reserve | - | |
| 126-127 | CRC code | D3 9A | |
| 122-255 | reserve | - | |

13. PACKAGE DIMENSION

- (4GB, 1 Rank, 512Mx8 DDR3L base ECC UDIMM)



14. RoHS Declaration

innodisk

Declaration of Conformity

We, InnoDisk Co., Ltd, here declare the product M3CW-4GSS1L0C/-(X) complies with the requirement of RoHS directives 2011/65/EU and 2006/12/EC.

Innodisk ensures the above product meets RoHS requirements of six restricted substances. This declaration is based on vendor supplied analysis/MSDS, material certifications, and/ or 3rd party test reports of the component/ raw materials used in the manufacture of products.

| Name of hazardous substance | Limited of RoHS ppm (mg/kg) |
|----------------------------------|-----------------------------|
| Cd | < 100 ppm |
| Pb | < 1000 ppm |
| Hg | < 1000 ppm |
| Chromium VI (Cr+6) | < 1000 ppm |
| Polybromodiphenyl ether (PBDE) | < 1000 ppm |
| Polybrominated Biphenyls (PBB) | < 1000 ppm |
| Perfluorooctane Sulfonate (PFOS) | Not Contained |

Date issued: 2013/01/22

Manufacturer: : InnoDisk Co., Ltd.
 Address : 9F, No. 100, Sec.1 Xintai 5th Rd.,
Xizhi City, Taipei 221, Taiwan

Authorized Signature :

QA Dept. Director - *Ryan Tsai*

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Revision Log

| Rev | Date | Modification |
|-----|-----------------------------|---------------------|
| 0.1 | 17 th April 2014 | Preliminary Edition |
| 1.0 | 17 th April 2014 | Official released. |