

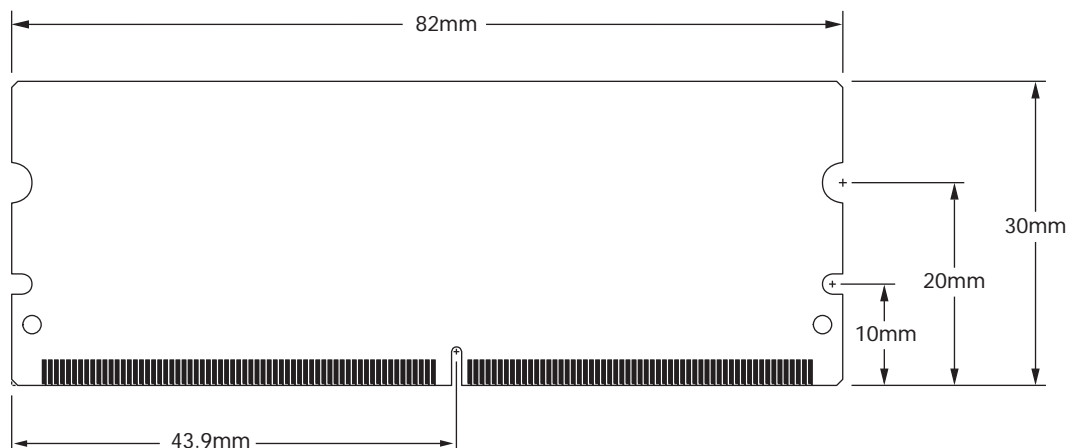
Technical Note

DDR3 Mini-DIMMs – Register Not Always Required

Introduction

Mini-DIMMs were developed specifically for systems that require a high-density, small form factor DRAM solution that won't compromise reliability or performance. Measuring 51mm shorter than standard full-length DDR2 and DDR3 modules, Mini-DIMMs provide robust power delivery with the same number of power and ground pins as standard-length DIMMs. Data reliability is also ensured through ECC bits that support error handling and correction.

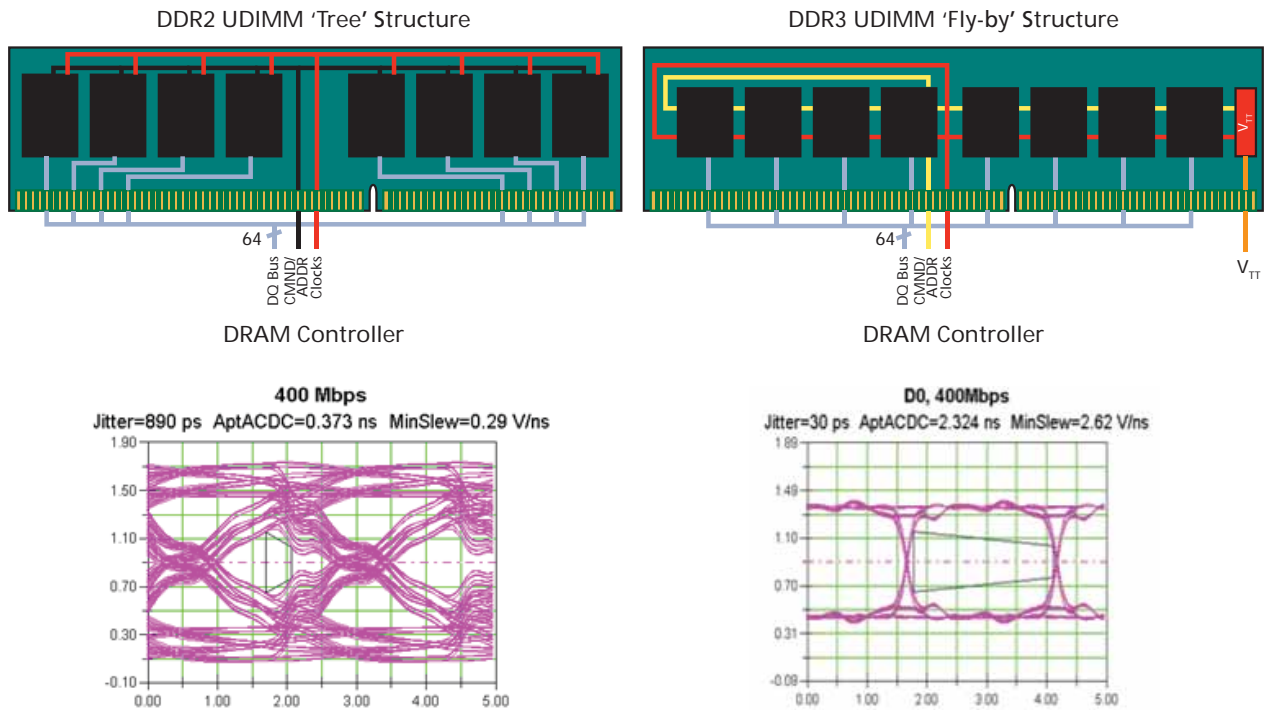
Figure 1: DDR3 Mini-DIMM



DDR2 and DDR3 Mini-DIMM Standards

There is one JEDEC-defined DDR2 Mini-DIMM solution, and it includes a register that buffers the address and command signals and a PLL that buffers the clock signals. These components are critical in ensuring excellent signal integrity on the Mini-DIMM because of the standardized DDR2 module tree topology. Fly-by topology, which was introduced on JEDEC-based DDR3 modules, dramatically improves signal integrity of the address, command, and clock cycles.

Figure 2: DDR2 Tree Topology and DDR3 Fly-By Topology and Associated Address Eyes

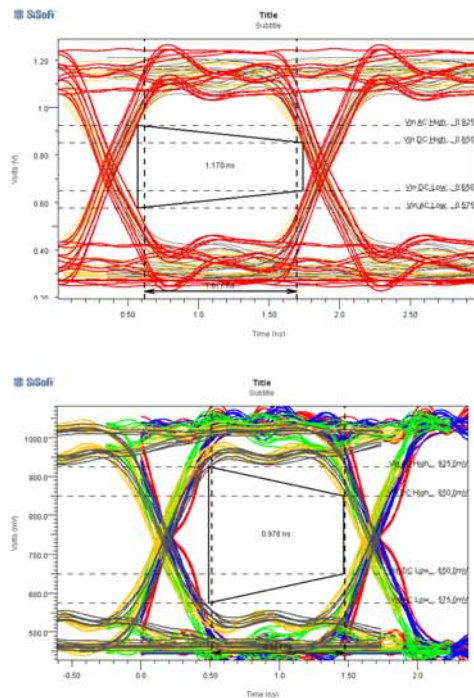


Registered or Unbuffered

Because the fly-by topology on DDR3 Mini-DIMMs enables such clean address, command, control, and clock signaling, many system memory needs can be met with an unbuffered DDR3 Mini-DIMM. Given the benefits associated with using unbuffered modules, Micron's recommendation is to analyze and model system requirements to determine if a register is necessary. (Note that if address parity is a requirement, the Mini-RDIMM is recommended as this feature is available only on a registered module.) Loading and operating speeds will vary from system to system, which is why Micron offers both unbuffered and registered DDR3 Mini-DIMMs (Mini-UDIMMs and Mini-RDIMMs, respectively).

In general, it is our opinion that a Mini-UDIMM can be an effective solution in systems that operate with two or fewer ranks. Systems requiring three or four ranks may also be able to use Mini-UDIMMs, but we suggest verifying with simulation.

Figure 3: One Dual-Rank vs. Two Single-Rank Mini-UDIMMs at DDR3-1333



Benefits of Unbuffered Modules

If system requirements allow the use of a DDR3 Mini-UDIMM rather than an equivalent Mini-RDIMM, designers will see the following benefits:

- **Less Power.** ~0.75W can be saved per module.
- **Lower Latency.** Because command and address signals are not buffered, READ and WRITE latency are reduced by one clock cycle.
- **Accurate De-Skew with Lookup Table.** With the skew between the DQS and CK signals inherent to the fly-by topology, some method of de-skew training must be adhered to. In systems that de-skew DQS signals through a simple lookup table, users can expect more accurate results from Mini-UDIMMs. Because Mini-RDIMMs may yield less precise results with a lookup table due to the potential variation in delay among register vendors, it would be better to use write leveling and MPR features for de-skewing.

Conclusion

The improved signal integrity of the DDR3 fly-by topology makes Mini-UDIMMs an effective memory solution for lightly loaded systems. Systems requiring three or four ranks may also be able to use Mini-UDIMMs, and those can be verified with simulation. Micron provides both IBIS and HSpice models of our Mini-UDIMM product line, and we can recommend a solution based on your specific requirements.

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