DRAM Modules & Form Factors

Overview

Memory modules are the most common way to incorporate DRAM into systems. The use of memory modules has significant benefits to system implementations but also introduces complexity of design, manufacturing, logistics and quality control. While this may be easily managed for personal computers that are built or configured to order and frequently repaired or upgraded in the field, modules use more physical volume, degrade signal integrity and can reduce system reliability by adding a connector instead of a soldered connection. Modules can sometimes give too much latitude to a customer who may choose to 'upgrade' a system for which there is no benefit, or install modules which are not approved for the system.

Nevertheless, high quality memory modules that fully conform to industry standards have controlled Bill-of-Materials (BOM) and are built using robust components with guaranteed long lifetime can provide a memory solution that differentiates products to end-customers.

Each generation of DRAM has developed a set of memory modules for the application requirements of their day. Over time the range of modules types and capabilities have increase to address broader market requirements.

The complete list of Insignis modules is available in Table 1, organized by DRAM type, connection type, and physical dimensions. This datasheet is intended to give an overview of available products.

Module Standards

The JEDEC standards organization specifies both the Mechanical Outline (MO), which is important for physical design, and required connector. The MO documents from JEDEC take precedence over any dimensional information in this datasheet.

Other JEDEC standards apply to the physical design and construction for functional and electrical performance. JESD21-C, JEDEC Configurations for Solid State Memories, is a compilation of some 3000 pages of all memory device standards for solid state memory including DIMM, DRAM, SDRAM, MCP, PROM, and others from September 1989 to present. The document is available from www.jedec.org

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Table 1. Module Form Factors by DRAM Type

DRAM Type	Voltage	Connection Type	Pins	Length	Height	Control Signals	Data path	JEDEC Std. Mechanical Outline	Figure Ref.
DDR3	1.5V / 1.35V	DIMM	240	5.25" (133.35mm)	30.0mm	Unbuffered or registered	x64/x72	MO-269	1
		DIMM - VLP			18.75mm				2
		SODIMM	204	67.6mm	30.0mm	Unbuffered	x64	MO-268	3
		SODIMM ECC				Unbuffered or registered	x72		
		Mini-DIMM	244	82.0mm	30.0mm	Unbuffered or registered	x64/x72	MO-244	4
		Mini-DIMM - VLP			18.75mm				5
		Micro-DIMM	214	54.0mm	30.0mm	Unbuffered	x64	MO-260	6
DDR2	1.8V	DIMM	240	5.25" (133.35mm)	30.0mm	Unbuffered, fully buffered, or registered	x64/x72/FB	MO-237/ MO-256(FB)	7
		DIMM - VLP			0.7" (17.9mm)				8
		SODIMM	200	67.6mm	30.0mm	Unbuffered	x64	MO-224	9
		SO-RDIMM			30.0mm	Registered	x72		10
		Mini-DIMM	244	82.0mm	30.0mm	Registered	x72	MO-244	11
		Mini-DIMM - VLP			18.2mm				12
		Micro-DIMM	172	45.5mm	30.0mm	Unbuffered	x64	n/a	13
DDR1	2.5V	DIMM	184	5.25" (133.35mm)	1.2" (30.48mm)	Unbuffered or registered	x64/x72	MO-206	14
		DIMM LP			1.125" (28.58mm)				15
		SODIMM	200	67.6mm	30.0mm	Unbuffered	x64/x72	MO-224	16
SDR	3.3V	DIMM	168	5.25" (133.35mm)	1.0" to 1.7" (25.4 to 43.18mm)	Unbuffered or registered	x64/x72	MO-161	17
		SODIMM	144	67.6mm	30.0mm	Unbuffered or registered	x64/x72	MO-190	18

Standard 5.25” Length Modules

The 5.25” long module was standardized in the 1990’s and this physical dimension has not changed since. New connector technology with finer pitch has enabled higher pin counts and each module generation is keyed to prevent insertion into a non-compatible socket. This module is most commonly used in computer systems from PC’s to servers due to its large size which can be used to create high capacity DIMMs.

These modules use through hole connector technology which limits the pin pitch on the connector. The greatest variation in these modules is the height, with a typical module around 30mm tall and VLP modules around 18mm. Semi-custom modules which are taller to achieve maximum memory capacity are not uncommon. DIMM connectors most commonly are oriented to be orthogonal to the motherboard, although there are angled connectors available for applications with limited vertical clearance.

Unbuffered DIMMs – Insignis NMxU

Unbuffered DIMM designs support from four, eight or sixteen DRAM on the 64 bit datapath DIMM with no intervening active components in the control signals. These DIMMs are most common for desktop PC applications.

Unbuffered ECC DIMMs – Insignis NMxE

Unbuffered ECC DIMM designs support from five, nine or eighteen DRAM on the 72 bit datapath DIMM with no intervening active components in the control signals. These DIMMs are most common for workstations that are compatible with non-ECC DIMMs.

Registered R DIMMs – Insignis NMxR

Registered DIMM designs support from nine, eighteen, thirty-six, or seventy-two DRAM on the 72 bit datapath DIMM with a clock buffer and register active components on the control signals to drive the higher load of the increased component count. These DIMMs are most common for workstations or servers that require a large memory footprint. These DIMMs are functionally compatible with unbuffered DIMMs, however, the significant differences in signal loading makes designing a single motherboard capable of supporting the entire range of DIMMs impractical.

Load Reduced (LR) DIMMs – Insignis NMxL

Load Reduced DIMMs are similar to registered DIMMs and are intended for very large memory footprints. These DIMMs buffer the datapath signals to reduce loading which in turn enables more DIMM sockets to be placed on a databus. LR-DIMMs are pin compatible with registered DIMMs, although the practical implications of designing a system that can use both types simultaneously has limited value. Typically, a platform can be designed to use more than one DIMM type, but only one type can be installed at any time.

Fully Buffered (DDR2-only) DIMMs – Insignis NMxF

Fully Buffered DIMMs are the predecessor to the Load Reduced DIMM. Used only with DDR2 DRAM, the FB-DIMM had a unique socket and interface which limited only this DIMM type to be used in a platform. Since the more complex DIMMs, like registered, load reduced or fully buffered, add cost and power consumption to the memory subsystem, the market opportunity for a platform that can use only these high-end solutions is reduced. Typical systems can be configurable over a range of target markets and applications.

SODIMMs (Small Outline DIMM)

SODIMMs were designed to fit into notebook PCs and other small systems. The SODIMM's size can restrict the maximum density of the module compared to full-length modules. Common connectors for SO-DIMMs are oriented so the DIMM is parallel to the motherboard. There are other connector options, depending on system level requirements.

(Unbuffered) SODIMMs (Small Outline DIMM) – Insignis NMxS

Unbuffered SODIMM designs support from four, eight or sixteen DRAM on the 64 bit datapath DIMM with no intervening active components in the control signals. These DIMMs are most common for laptop PC applications.

Unbuffered ECC SODIMMs – Insignis NMxT

Unbuffered ECC SODIMM designs support from five, nine or eighteen DRAM on the 72 bit datapath with no intervening active components in the control signals. These DIMMs are used where additional data protection in the form of Error Correcting Codes is required. The small form factor and ECC support make these DIMMs ideal for embedded applications.

Registered SODIMMs – Insignis NMxQ

Registered DIMM designs support from five, nine, eighteen, or thirty-six DRAM on the 72 bit datapath DIMM with a clock buffer and register active components on the control signals to drive the higher load of the increased component count.

Mini-DIMMs

Mini DIMMs were designed to fit into applications that could not use 5.25" DIMMs and also not able to accommodate an SO-DIMM connector technology or orientation. These DIMMs are most commonly used in embedded applications and have the benefit of a limited supply base, which in turn preserves the value of the application and minimizes that risk of a non-approved DIMM being substituted in an application.

Mini DIMMs, as they are known today, began as 100-pin 32b DIMMs for SDR and DDR1 applications built with 32b embedded processors. With the introduction of DDR2, the Mini-DIMM migrated to a 72b datapath supporting ECC for high end embedded applications.

The 100-pin, 32bit mini-DIMM used a smaller version connector of a standard DIMM with the same pin pitch and through hole technology. The newer 244 pin Mini-DIMM for DDR2 and DDR3 uses a much finer pitch on the card edge, and therefore the connector is required to be a surface mount device, similar to the SO-DIMM connector mounting.

(Unbuffered) Mini DIMMs – Insignis NMxV

Unbuffered Mini DIMM designs support from four, eight or sixteen DRAM on the 64 bit datapath DIMM with no intervening active components in the control signals.

ECC Mini DIMMs – Insignis NMxN

Unbuffered ECC Mini DIMM designs support from five, nine or eighteen DRAM on the 72 bit datapath with no intervening active components in the control signals. These DIMMs are used where additional data protection in the form of Error Correcting Codes is required. The small form factor and ECC support make these DIMMs ideal for embedded applications.

Mini Registered DIMMs – Insignis NMxM

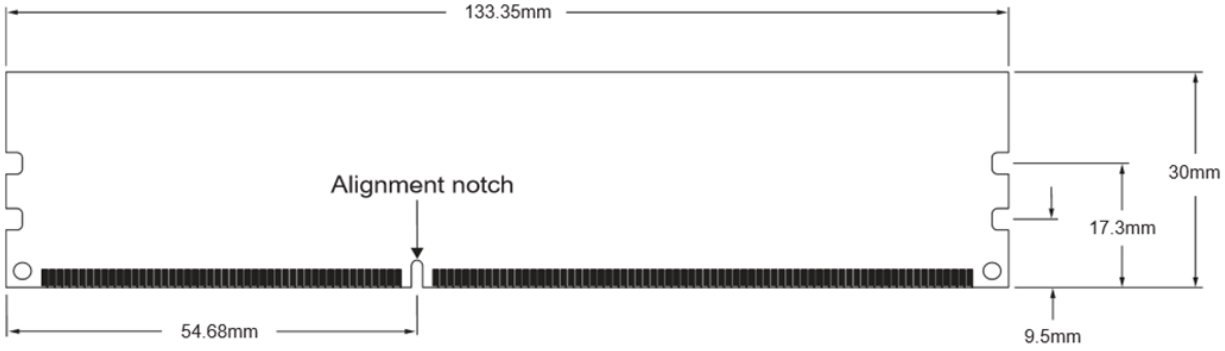
Registered (ECC) Mini DIMM designs support from five, nine or eighteen DRAM on the 72 bit datapath DIMM, with a clock buffer and register active components on the control signals to drive the higher load of the increased component count. These DIMMs are used where additional data protection in the form of Error Correcting Codes is required. The small form factor and ECC support make these DIMMs ideal for embedded applications.

Micro DIMMs – Insignis NMxC

Micro DIMMs were developed for the smallest module form factor for netbook PCs. They are 64b only and unbuffered only, supporting four or eight components. They are the smallest possible module form factor with established connector technology and DIMM designs completed.

Appendix

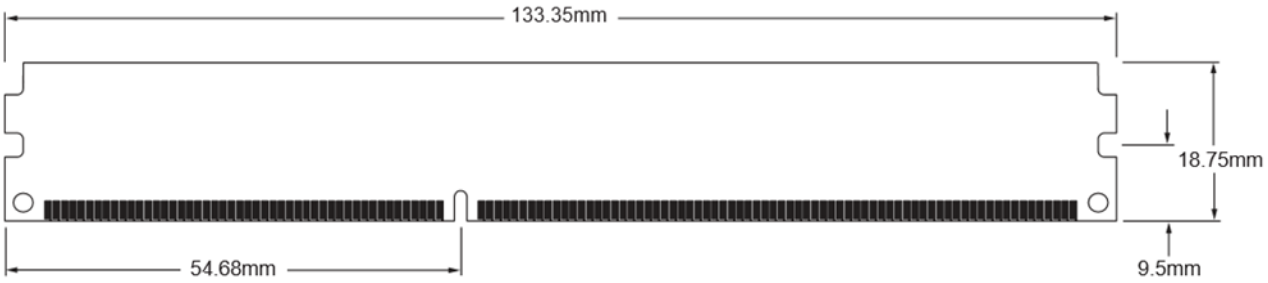
Figure 1: DDR3 DIMM Module



Features

- 30mm x 133.35mm
- 240 pins
- 1.5V/1.35V
- Unbuffered or registered
- x64/x72
- MO-269

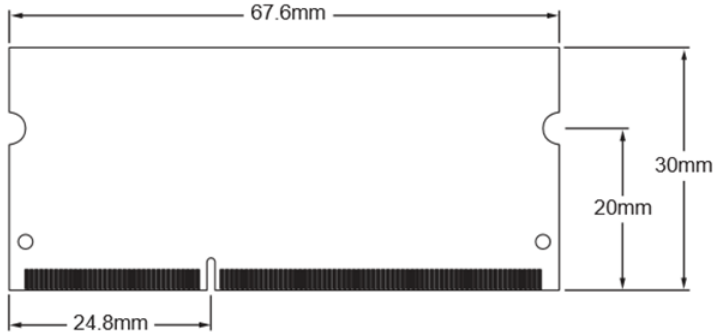
Figure 2: DDR3 VLP Module



Features

- 18.75mm x 133.35mm
- 240 pins
- 1.5V/1.35V
- Unbuffered or registered
- x64/x72
- MO-269

Figure 3: DDR3 SODIMM

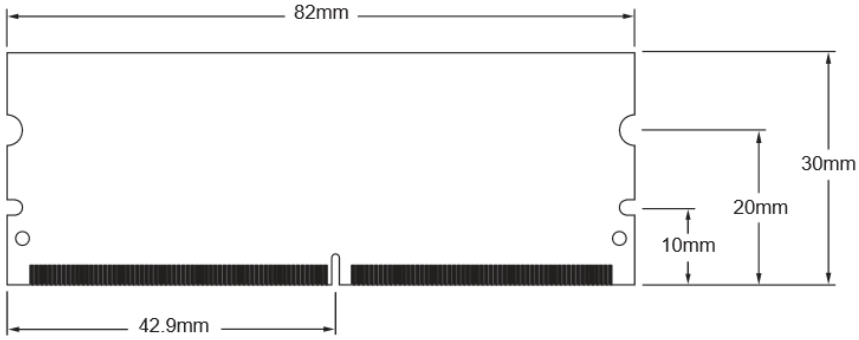


DDR3 SODIMMs have the same 30mm height as standard modules.

Features

- 30mm x 67.6mm
- 204 pins
- 1.5V
- Unbuffered
- x64
- MO-268

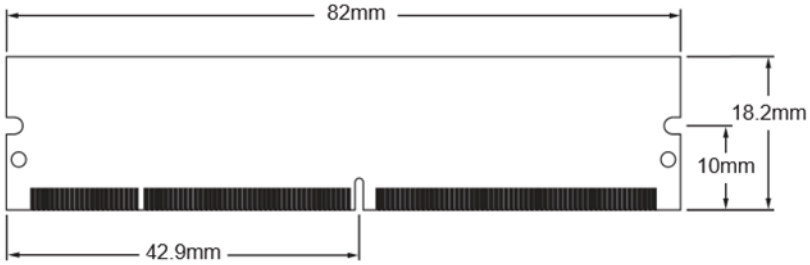
Figure 4: DDR3 Mini-DIMM



Features

- 30mm x 82mm
- 244 pins
- 1.8V
- Unbuffered or Registered
- x72
- MO-244

Figure 5: DDR3 VLP Mini-DIMM

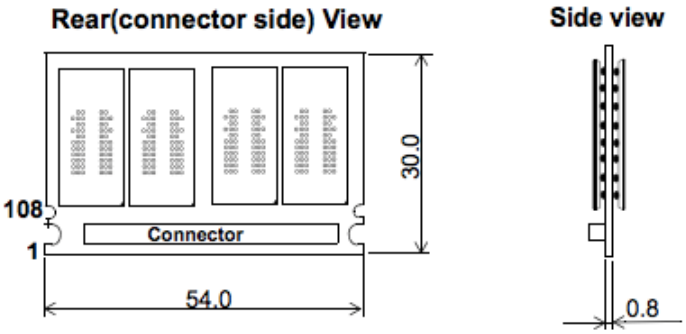


The VLP Mini-DIMM was designed for small systems requiring ECC modules.

Features

- 18.2mm x 82mm
- 244 pins
- 1.8V
- Unbuffered or Registered
- x72
- MO-244 (Height not applicable)

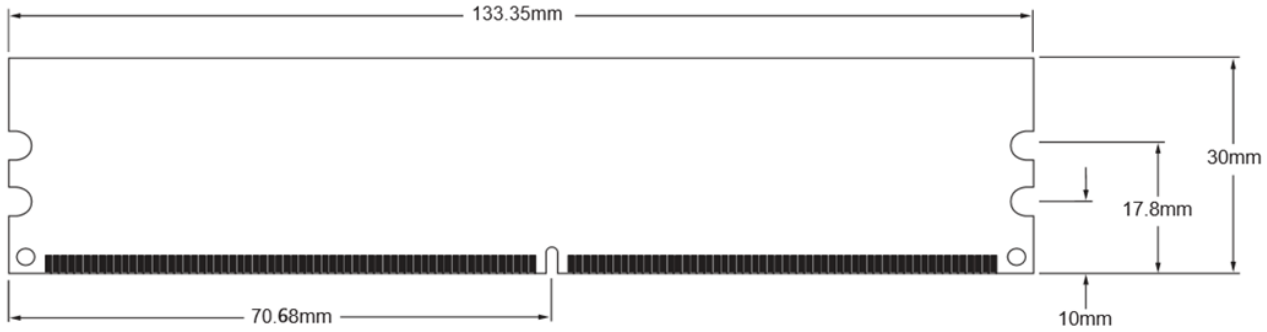
Figure 6: DDR3 Micro-DIMM



Features

- 30.0mm x 54.0mm
- 214 pins
- 1.5V / 1.35V
- Unbuffered or Registered
- x64
- MO-226

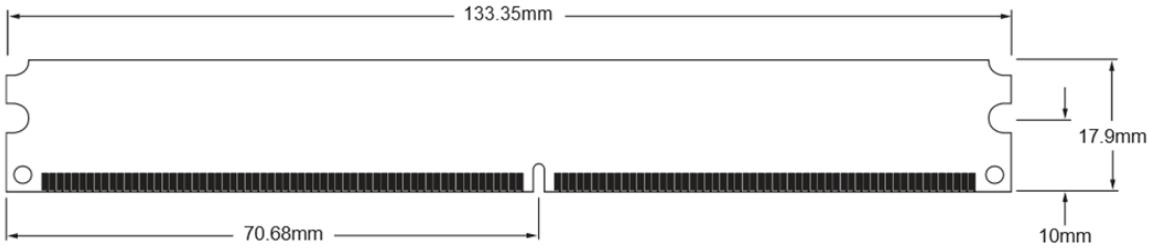
Figure 7: DDR2 DIMM Module



Features

- 30mm x 133.35mm
- 240 pins
- 1.8V
- Unbuffered or registered
- x64/x72
- MO-237

Figure 8: DDR2 VLP Module

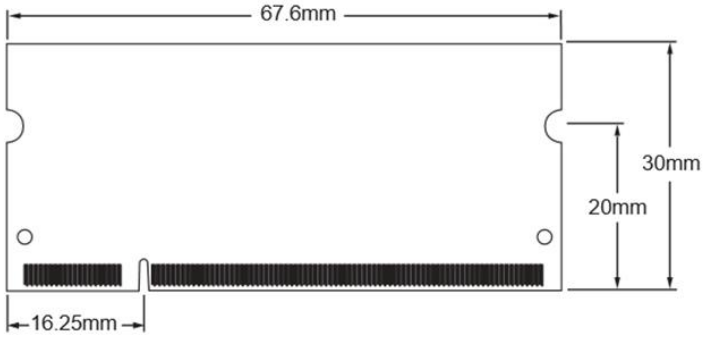


The lowest profile DDR2 module de sign is 17.9mm high. This module is designed for tele-communications equipment that use a low-profile ATCA-compliant chassis.

Features

- 17.9mm x 133.35mm
- 240 pins
- 1.8V
- Unbuffered or registered
- x64/x72
- MO-237 (Height not applicable)

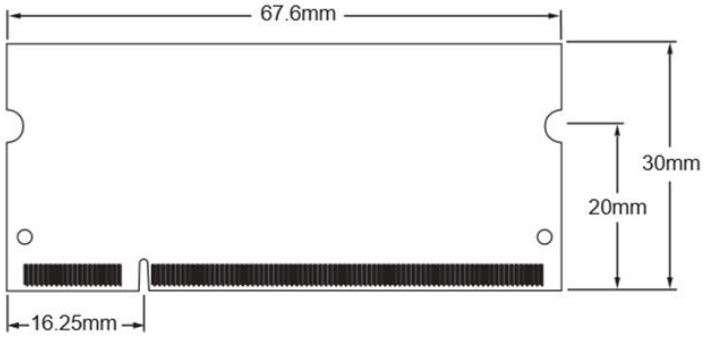
Figure 9: DDR2 SODIMM



Features

- 30mm x 67.6mm
- 200 pins
- 1.8V
- Unbuffered
- x64
- MO-224

Figure 10: DDR2 SORDIMM

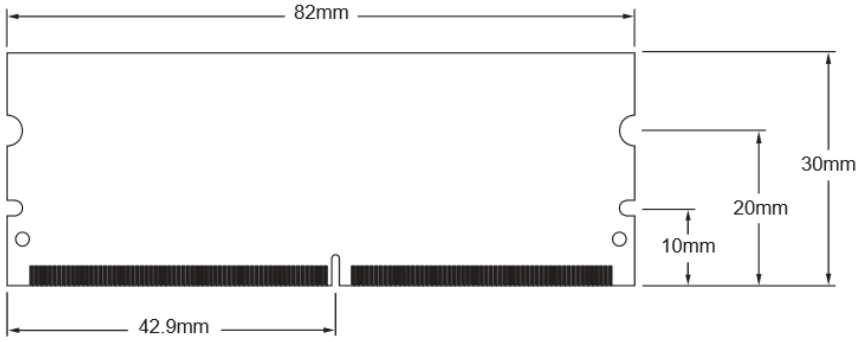


The DDR2 SORDIMM was designed primarily for use in networking hardware such as routers and switches.

Features

- 30.0mm x 67.6mm
- 200 pins
- 1.8V
- Registered
- x72
- MO-224

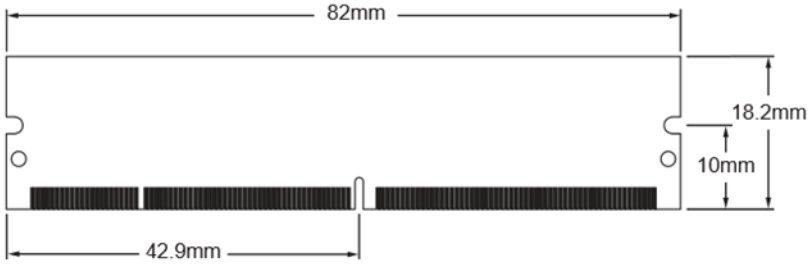
Figure 11: DDR2 Mini-DIMM



Features

- 30mm x 82mm
- 244 pins
- 1.8V
- Registered
- x72
- MO-244

Figure 12: DDR2 VLP Mini-DIMM

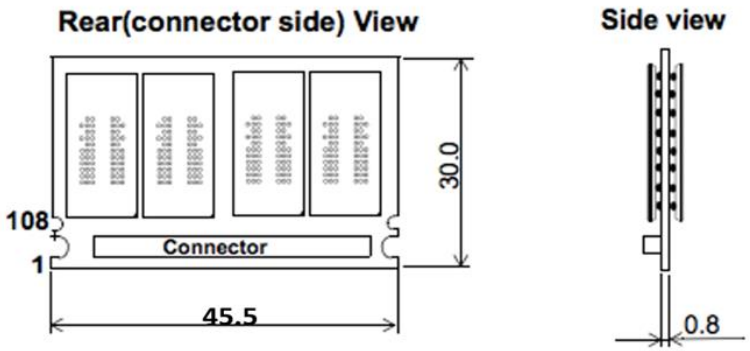


The DDR2 VLP Mini-DIMM was designed for small systems requiring registered modules.

Features

- 18.2mm x 82mm
- 244 pins
- 1.8V
- Registered
- x72
- MO-244 (Height not applicable)

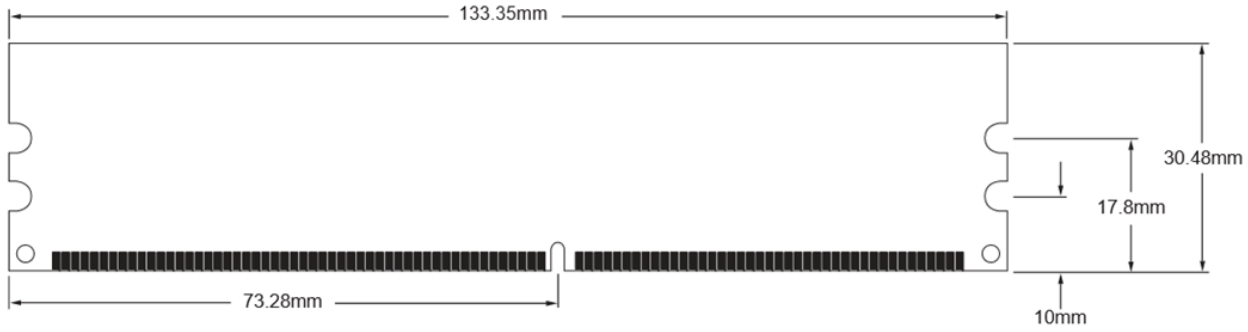
Figure 13: DDR2 Micro DIMM



Features

- 30.0mm x 45.5mm
- 172 pins
- 1.8V
- Unbuffered
- x64
- MO: not applicable

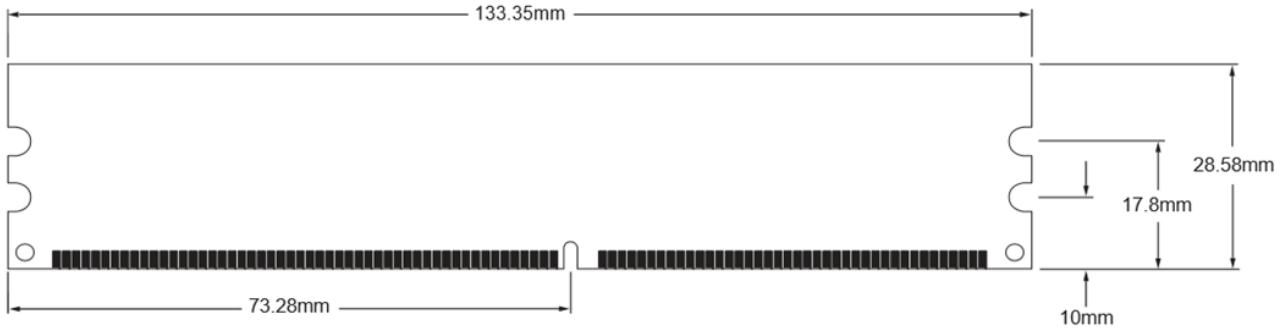
Figure 14: DDR1 DIMM Module



Features

- 30.48mm x 133.35mm
- 184 pins
- 2.5V
- Unbuffered or registered
- x64/x72
- MO-206

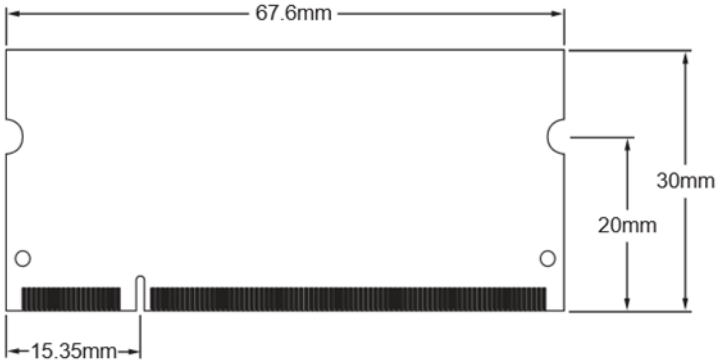
Figure 15: DDR1 LP Module



Features

- 28.58mm x 133.35mm
- 184 pins
- 2.5V
- Unbuffered or registered
- x64/x72
- MO-206

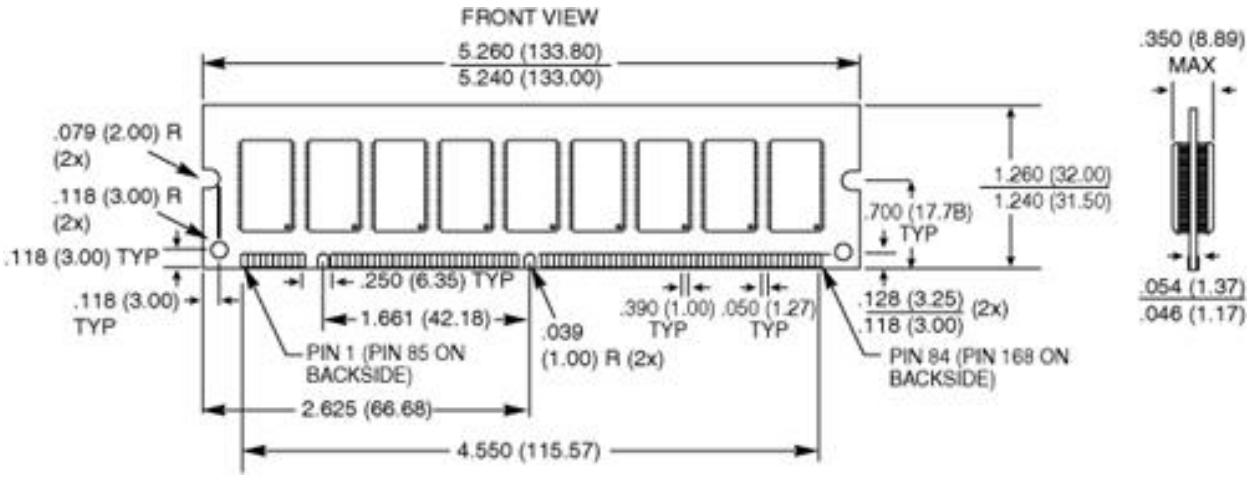
Figure 16: DDR1 SODIMM



Features

- 30mm x 67.6mm
- 200 pins
- 2.5V
- Unbuffered
- x64/x72
- MO-224

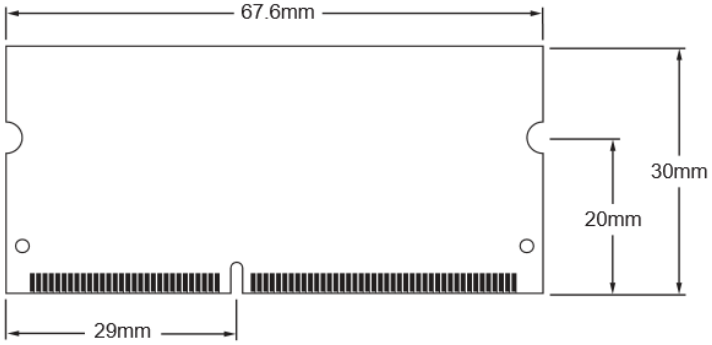
Figure 17: SDR DIMM Module



Features

- 25.4mm to 43.18 mm x 133.35mm
- 168 pins
- 3.3V
- Unbuffered or registered
- x64/x72
- MO-161

Figure 18: SDR SODIMM



Features

- 30mm x 67.6mm
- 144 pins
- 3.3V
- Unbuffered or registered
- x64
- MO-190