

RTD cpuModule LX-Series Migration Guide



RTD Embedded Technologies, Inc.

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Rev. D

Revision History

Rev. A	02/29/2007	Preliminary Draft
Rev. B	06/23/2008	Added information about the Ethernet controller Added several connector differences not previously mentioned Added information about the ability to underclock the CPU Clarified several sections based on customer feedback Removed “Preliminary” designation
Rev. C	07/30/2008	Added information about CN6 Pin 26 (now +5V) Added information about CN18 Pins 3 & 5 (Monitor DDC) Minor improvements to the Connector Differences section Added information about ISA DMA Performance Clarified the SSD Socket section Added information about nonstandard serial port baud rates
Rev. D	04/07/2010	Added more specific information about RTD control registers Added information about dual Ethernet Interfaces Added information about aDIO Added AS9100 Formatting Changes

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Background

RTD's legacy Geode GX/HX/CX series of cpuModules was based on the AMD Geode GX1/5530A chipset. RTD's newer LX-series of cpuModules is based on the AMD Geode LX chipset. The new series of cpuModules offers better performance, improved power efficiency, and additional features.

When migrating to the LX-series, there are several differences that customers should be aware of. This document describes those differences. If you have additional questions about any of the differences listed in this document, please contact techsupport@rtd.com.

Physical Differences

Connectors & Pinout

The newer LX-series of cpuModules has several connector-related differences, which are summarized below. Complete information about the cpuModules connections (including connector pinouts) are documented in Chapter 3 of the LX-series board manual.

RTD also offers an updated cpuModule cable kit for the LX-series. It is recommended that all customers migrating to the LX-series purchase at least one cable kit for initial compatibility testing.

NOTE: *Connecting the cpuModule incorrectly may damage or destroy it! Before connecting a new LX-series cpuModule to an existing cable setup, it is **strongly** recommended that you read the Chapter 3 of the board manual and thoroughly study the pinouts of all relevant connectors.*

New Connectors

The LX-series cpuModule introduces some new I/O features that were not present on previous Geode GX1 cpuModules. Those features include some extra connectors, such as:

- LVDS Flat Panel (CME136 only)
- Secondary Ethernet (CME136 only)
- IDE

Depending on the enclosure and cabling configuration, the new connectors may interfere with current systems. If necessary, RTD can offer a custom version of the LX-series with connectors removed. Contact sales@rtd.com for more information.

PS/2 Mouse Connector Is Removed

On the LX-series, the PS/2 Mouse no longer has its own connector. The PS/2 Mouse signals are now part of the Utility Connector (CN5).

For customers with a legacy compatibility requirement, RTD can offer a custom version of the LX-series with a dedicated PS/2 Mouse connector. Contact sales@rtd.com for more information.

CN3 - Auxiliary Power Connector New Signals

On the LX-series, CN3 has a different pinout. It now includes ATX control signals (+5V Standby and PSON#). This allows the LX-series to support ATX power supplies with Soft-Off.

CN5 - Utility Connector New Signals

The Utility Connector of the LX-series is different than previous GX1 cpuModules. In particular, the new Utility Connector now includes the PS/2 Mouse signals as well as an ATX Soft Power Button.

CN6 - RTD multiPort Pin 26

The LX-series features the RTD multiPort. This feature allows CN6 to function as a Parallel Port, a Floppy Port, or Advanced Digital I/O (aDIO). This feature was also present on some GX1 cpuModules.

To accommodate the multiPort feature, pin 26 of CN6 is now +5V. In some older GX1 cpuModules, this pin was Ground. Before connecting an existing cable harness to CN6, please verify that it does not ground pin 26.

CN7 & CN8 - Serial Port Connector 2-Port Mode

By default, the serial ports of the LX-series have the same pinout as previous RTD cpuModules. However, the LX-series optionally supports a new “2-Port” mode, which enables two serial ports per connector (up to 4 total). If 2-Port mode is enabled, the pinout of the serial connector is different. Consult the board manual for more information.

CN16 - PCI-104 Connector New Signals (CME137 Only)

As mentioned previously, the LX-series adds support for ATX power supplies. The PCI connector of the CME137686LX includes the ATX control signals. This allows for a simple stackthrough interface to PC/104-Plus ATX power supply modules.

The CME137686LX also adds the PME# signal to the PCI connector. This allows peripheral cards to wake the system from a low-power state (OS/driver support required).

These pins were previously unused on the PCI-104 connector, and should not interfere with existing peripheral cards. However, RTD can offer a custom version of the board without these signals connected. Contact sales@rtd.com for more information.

CN18 - SVGA Video DDC Pins

The SVGA connector includes two pins for DDC Monitor Communication (pins 3 & 5). Some older VGA cabling does not utilize these pins and grounds them.

On older cpuModules, grounding these pins had no adverse effects. However, on the Geode LX, grounding these pins may prevent the cpuModule from booting. Before connecting an existing SVGA cable to CN18, please verify that it does not ground pins 3 or 5.

CN20 & CN30 - Ethernet Connector Pinout Change

The Ethernet connector of the LX-series uses the same pinout as the CME26 and CME27 family of cpuModules. Customers migrating from these cpuModules should be able to use the same Ethernet cabling.

However, the Ethernet pinout is different than RTD’s older GX1 cpuModules (CML16, CML27, and CMX27). If migrating from one of these cpuModules, the Ethernet cabling must be changed to accommodate the LX-series.

Heatsink & Cooling Differences

The LX-series has a different placement for the Processor/Northbridge. As a result, any custom-built heatsinks must be redesigned to accommodate the LX-series.

In most situations, the Geode LX consumes less power than the Geode GX1, while providing better performance. The amount of cooling provided for a GX1 board should be sufficient for the LX.

Functional Differences

Processor Speed

The clock speed of the Geode GX1 is typically 200-333MHz. The Geode LX runs at a higher clock speed (typically 500MHz). This may affect application timing and performance. Any software timing loops that have a fixed assumption of the processor speed must be updated accordingly.

RTD can provide sample C code to detect the processor speed, which may be incorporated into customer application software. In general, it is recommended that an application should not make fixed assumptions about processor clock speed.

It is possible to adjust the processor and memory clock speeds via the BIOS setup screens. It is possible to underclock the Geode LX processor to the same speed as the Geode GX1. However, due to internal architectural differences between the GX1 and the LX, the LX-series will have different performance characteristics, even at the same clock speed.

USB Interface

The Geode LX supports USB 2.0. The Geode GX1 only supported USB 1.1. The USB interface of the Geode LX is significantly faster than previous cpuModules.

To enable USB 2.0 transfer rates, you must install the appropriate EHCI drivers. Windows XP Service Pack 2 has USB 2.0 support built into the OS. Most modern versions of Linux support USB 2.0 as well. If USB 2.0 is not supported by the operating system, USB 1.1 should continue to function.

Video Memory

The Geode LX's video controller claims some of the cpuModule's onboard RAM. This memory is unavailable for user applications. The amount of memory allocated to the video controller may be adjusted in the BIOS setup.

This behavior is the same as previous Geode GX1 cpuModules with onboard video. However, for customers migrating from cpuModules *without* onboard video (e.g. CMC16 and CML16), this behavior may be unexpected.

SSD Socket

The LX-series features the same ATA/IDE Disk Chip socket found on the CX-series of cpuModules. This replaces the legacy SSD socket from the HX/GX series of cpuModules.

Note that legacy SSD devices such as the M-Systems DiskOnChip or Atmel SSD will not work with the Geode LX. If you are currently using one of these devices, you must transition to the ATA Disk Chip. For more information, refer to the *CX Migration Guide*, publication SWM-640000022.

IDE Interface

The Geode LX chipset (AMD 5536 Southbridge) has only one IDE channel. It is the Primary IDE channel. The chipset does not have a Secondary IDE channel. This means only two IDE devices may be attached to the cpuModule (a Master and a Slave). If the ATA Disk Chip is installed, only one IDE peripheral may be attached (e.g. a CD-ROM drive).

Additionally, the IDE controller in the AMD 5536 Southbridge supports high-speed UltraDMA transfer modes that were not supported on the Geode GX1. In many cases, IDE performance on the LX-series will be significantly better than the GX1.

The IDE controller of the AMD 5536 Southbridge is a standard PCI IDE controller. It is natively supported by all popular operating systems. Windows and Linux will both automatically detect and enable UltraDMA support.

Software Differences

Chipset and Super I/O Register Map Differences

Since the LX-Series cpuModule uses a different Chipset and Super I/O, the register map of the board is significantly different. Most users will probably not need to be concerned with this, since the BIOS handles board configuration. However, users that are directly configuring the Chipset and Super I/O (bypassing the BIOS) will be affected. Refer to the component datasheets for more information.

RTD Control Register Differences

The cpuModule includes several RTD-specific “control” registers for RTD special features such as:

- Watchdog Timer
- Setting Serial Port signaling levels (RS-232/422/485)
- aDIO/multiPort Setup and Control

The locations of these registers are different on the LX-series. If you directly access these registers in your software application, it will have to be updated to accommodate the new board. RTD can provide assistance with software changes.

PCI Device List Differences

The Geode LX’s list of onboard PCI devices is different. Any applications that make fixed assumptions about the PCI devices present in the system must be changed. For a list of PCI devices present on the LX-series, consult the board manual.

Graphics Engine Differences

The Geode LX has a different graphics engine than the GX1. It requires different graphics drivers. If you have an existing software build that uses graphics drivers for the GX1, you must replace them with the corresponding drivers for the Geode LX.

Graphics drivers are provided for Windows XP (Service Pack 2 or later), XP Embedded, and Vista. If you are using an older version of Windows, you must use the non-accelerated Standard VGA driver.

For Linux, recent versions of XFree86 and X.Org include support for the Geode LX graphics engine.

For other software platforms, contact your operating system vendor to verify that the Geode LX graphics engine is supported. If it is not supported, it may be necessary to use a generic non-accelerated “frame buffer” driver.

Ethernet Controller Differences

Geode GX1-based cpuModules use the Intel 82559ER or 82551IT Ethernet controller. The newer LX-series cpuModules use the Intel 82551QM Ethernet controller. The 82551QM controller offers new features such as PXE Network Boot.

The Intel 82551QM has a very similar register map to the older 82559ER/82551IT. However, the new controller has a different PCI Device ID than the previous one (0x1229 vs 0x1209). Since the PCI device ID is different, it may be necessary to install updated Ethernet drivers.

cpuModule Series	Ethernet Controller	PCI Vendor ID	PCI Device ID
Geode GX1	Intel 82559ER / 82551IT	0x8086	0x1209

(CML16, CMX27, CME26, CME27)			
Geode LX (CME136, CME137)	Intel 82551QM	0x8086	0x1229

RTD provides an updated Windows Ethernet driver for the 82551QM. In the case of DOS and Linux, the existing Ethernet drivers should fully support both the old and new Ethernet controllers. For other platforms, you should contact your operating system vendor to confirm that the Intel 82551QM is supported.

Dual Ethernet Concerns for CME136686LX

The CME136686LX has dual Ethernet interfaces (CN20 & CN30). Previous GX1-based cpuModules only had one Ethernet interface. If you are migrating to the CME136686LX, the second Ethernet interface can be a source of confusion.

It is difficult to predict how the operating system will enumerate the Ethernet interfaces (CN20 vs CN30). For example, you may have connected the Ethernet cable to CN20, but your application is using the CN30 interface. If your application requires only one Ethernet port, it is recommended that you disable the other Ethernet controller in the BIOS setup.

Serial Port Nonstandard Baud Rate Differences

Geode GX1-based cpuModules supported nonstandard serial port baud rate via the Prescaler feature of the Super I/O. The Geode LX has a similar feature. On the LX-series, baud rates of up to 230K (RS-232) or 1.5M (RS-422/485) are supported.

On the LX-series, the nonstandard baud rates may be enabled by a BIOS option. This is different than the GX1, where it was necessary to directly access the Super I/O configuration registers.

For more information on using the nonstandard baud rates, consult the board manual.

BIOS/Firmware Differences

RTD's Geode LX-based cpuModules use an AMI BIOS 8.00.14. The GX1-based cpuModules used Award BIOS v4.51. Any software that assumes an Award BIOS may require modifications to work on the Geode LX.

The newer AMI BIOS also offers some compelling features not found on the previous GX1 processor family, including:

- USB Boot and USB Mass Storage Support
- PXE Network Boot
- ACPI Power Management

However, this newer BIOS does not contain support for some legacy peripheral interfaces:

- ISA Floppy Controllers (e.g. CM102, CMT6107) are not supported.
- ISA Hard Drive Controllers (e.g. CMT6107, CMT6104, CMT6118) are not supported.
- ISA Video Controllers (e.g. CM110 and CM112) are not supported.

If you have an existing PC/104 stack which contains one or more of the cards listed above, it will be necessary to change the stack. In most cases, the onboard features of the cpuModule can be used to replace the peripheral cards.

ISA Bus Decode Differences

Unlike the GX1, the Geode LX chipset does not have native support for the ISA bus. Therefore, a PCI-to-ISA Bridge (ITE IT8888) is used onboard to provide ISA support. This bridge positively decodes the specified addresses.

On the LX-series, you must explicitly specify the resources that will be used by the ISA bus (I/O, Memory, Interrupts, and DMA). The PCI-to-ISA Bridge is configured via the BIOS setup.

If the bridge is not configured correctly, your ISA peripherals will not function. For more information on configuring the PCI-to-ISA Bridge, refer to the LX-series board manual.

NOTE: Some ISA peripherals are not compatible with the Geode LX BIOS. Refer to the section labeled BIOS/Firmware Differences.

ISA DMA Performance Differences

On the Geode LX, any I/O reads/writes to the legacy 8237 ISA DMA controller are virtualized. They are emulated in software via SMI routines in the BIOS. Any time the 8237 DMA controller is accessed from software (e.g. `inp()` and `outp()` functions), the SMI routines are invoked. These routines redirect the I/O access to the Distributed DMA controller in the PCI-to-ISA Bridge.

SMI virtualized I/O allows software drivers for ISA boards to function on the Geode LX without any modification. However, the virtualization introduces some CPU overhead.

If the software application/driver accesses the 8237 DMA controller infrequently (e.g. only at initialization), the CPU overhead may be very minor. However, if the DMA controller is accessed frequently (e.g. after every DMA transfer), the CPU overhead may be considerable. This may cause performance problems with a customer application.

To mitigate these effects, RTD recommends that customers do the following:

1. Use the 500MHz version of the Geode LX. (A slower CPU magnifies the issue.)
2. Configure the 8237 DMA controller for auto-initialize. (Reduce I/O accesses to the DMA controller.)
3. Bypass the 8237 DMA controller and access the Distributed DMA controller directly.

RTD has example C source code available that implements recommendations #2 and #3. To obtain copies of this code, please contact techsupport@rtd.com.

Advanced Digital I/O (aDIO) Differences

The LX-series features the same Advanced Digital I/O (aDIO) interface that was found on previous `cpuModules`. The aDIO interface is mapped to I/O ports 0x450-0x453, exactly as it was on previous boards. Most software that uses aDIO interface should continue to work unmodified on the new board.

However, there are some points for consideration:

1. The RTD aDIO driver packages for DOS and Linux auto-detect the chipset of the `cpuModule`. If you are using an older version of the aDIO drivers, it will be unable to detect the Geode LX chipset. If you are using the RTD aDIO drivers for DOS or Linux, it is recommended that you use the following versions:
 - For DOS, v04.00.00 (SWP-700010001 rev G) or later
 - For Linux, v02.02.00 (SWP-700010042 rev F) or later
2. The aDIO control/setup registers are different on the LX-series. If you have an application that accesses these registers, it will have to be updated. Note that this **does not** refer to the aDIO runtime registers that most applications use. This only affects applications that bypass the BIOS

configuration of the aDIO interface (e.g. IRQ number) and configure it directly. If you have additional questions about this, please contact techsupport@rtd.com.