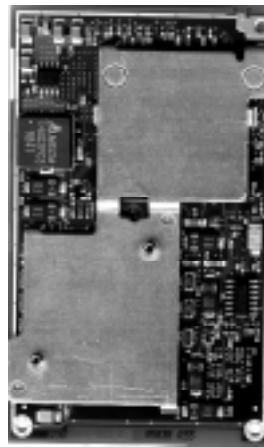
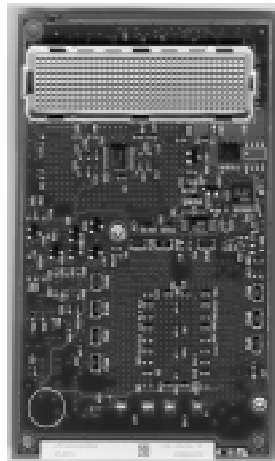




INTEL® PENTIUM® II PROCESSOR MOBILE MODULE: MOBILE MODULE CONNECTOR 2 (MMC-2)

- Intel® Mobile Pentium II® Processor with core frequency running at 366 MHz, 333 MHz, 300PE MHz, and 266PE MHz
- On-die 2nd level cache, (256K)
- Processor core voltage regulation supports input voltages from 5V to 21V
 - Above 80 percent peak efficiency
- Integrated Active Thermal Feedback (ATF) system
 - ACPI Rev. 1.0 compliant
 - Internal A/D – digital signaling (SMBus) across the module interface
 - Programmable trip point interrupt or poll mode for temperature reading
- Support single AGP 66 MHz 3.3V device
- Thermal transfer plate for heat dissipation
- Intel® 443BX Host Bridge system controller
 - DRAM controller supports EDO and SDRAM at 3.3V
 - Supports PCI CLKRUN# protocol
 - SDRAM clock enable support and self refresh of EDO or SDRAM during Suspend mode
 - 3.3V only PCI bus control, Rev 2.1 compliant

The Intel® Pentium® II processor mobile module connector 2 (MMC-2) is a highly integrated assembly containing an Intel Pentium II mobile processor and its immediate system-level support.





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1.0. INTRODUCTION

This document provides the technical information for integrating the Pentium® II Processor Mobile Module Connector 2 (MMC-2) into the latest notebook systems for today's notebook market.

Building around the Pentium II processor mobile module design gives the system manufacturer these advantages:

- Avoids complexities associated with designing high-speed processor core logic boards.
- Provides an upgrade path from previous Intel mobile modules for notebook designs using a standard interface.

2.0. ARCHITECTURE OVERVIEW

The Pentium® II processor mobile module is a highly integrated assembly containing the mobile Pentium II processor core with an on-die L2 cache, the Intel® 443BX Host Bridge system controller, and system level support. Speeds of the Pentium II processor mobile module include: 366 MHz, 333 MHz, 300PE MHz, 266PE MHz, with a 66-MHz system bus speed.

The PIIX4E/M PCI/ISA Bridge is one of two large-scale integrated devices of the Intel® 440BX AGPset. A notebook's system electronics must include a PIIX4E/M device to connect to the Pentium II processor mobile module. The PIIX4E/M provides extensive power management capabilities and supports the second integrated device, the 443BX Host Bridge. Key features of the Intel 443BX Host Bridge include the DRAM controller, which

supports EDO at 3.3V with a burst read at 7-2-2-2 (60 ns) or SDRAM at 3.3V with a burst read at 8-1-1-1 (66 MHz, CL=2). The 443BX Host Bridge also provides a PCI CLKRUN# signal to request PIIX4E/M to regulate the PCI clock on the PCI bus. The 82443Bx clock enables Self Refresh mode of EDO or SDRAM during Suspend mode, and is compatible with SMRAM (C_SMRAM) and Extended SMRAM (E_SMRAM) modes of power management. E_SMRAM mode supports write-back cacheable SMRAM up to 1 MB.

A thermal transfer plate (TTP) on the 443BX Host Bridge and the mobile Pentium II processor provides heat dissipation and a standard thermal attach point for the notebook manufacturer's thermal solution.

An on-board voltage regulator converts the system DC voltage to the processor's core and I/O voltage. Isolating the processor voltage requirements allows the system manufacturer to incorporate different processor variants into a single notebook system.

Supporting input voltages from 5V to 21V, the processor core voltage regulator enables an above 80 percent peak efficiency and decouples processor voltage requirements from the system.

The Pentium II processor mobile module also incorporates Active Thermal Feedback (ATF) sensing, compliant to the ACPI Rev 1.0 specification. A system management bus (SMBus), which is thermal sensor compliant, supports the internal and external temperature sensing with programmable trip points.

Figure 1 illustrates the block diagram of the Pentium II processor mobile module.

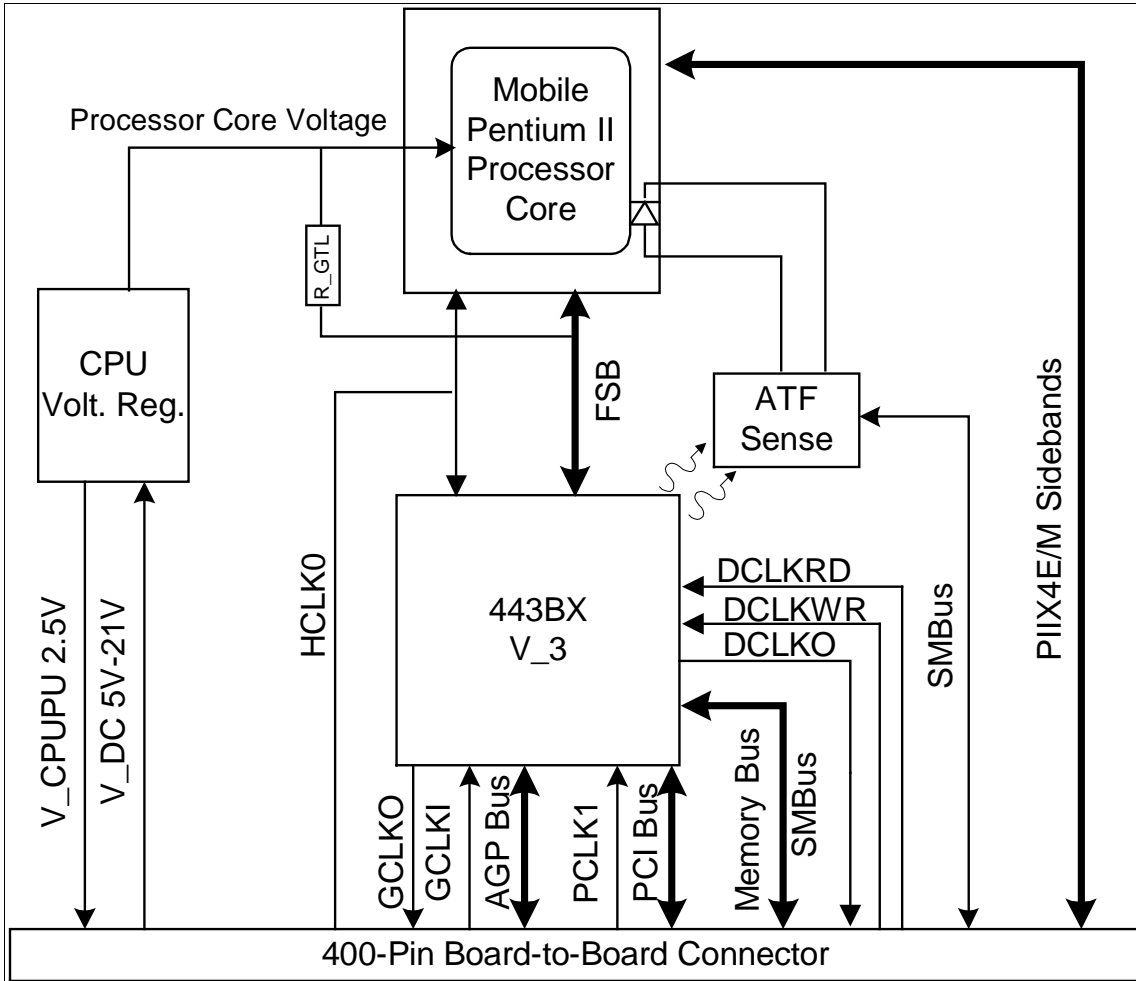


Figure 1. Block Diagram of the Pentium II Processor Mobile Module



3.0. MODULE CONNECTOR INTERFACE

Table 1 provides a list of signals by category and the corresponding number of signals in each category.

3.1 Signal Definitions

For proper signal termination, please contact your Intel sales representative for further information.

The signals are variably defined for compatibility with future Intel mobile modules.

Table 1. Connector Signal Summary

Signal Group	Number
Memory	109
AGP	60
PCI	58
Processor/PIIX4E/M Sideband	8
Geyserville Technology	4
Power Management	7
Clocks	9
Voltage: V_DC	20
Voltage: V_3S	9
Voltage: V_5	3
Voltage: V_3	16
Voltage: VCCAGP	4
Voltage: V_CPUPU	1
Voltage: V_CLK	1
ITP/JTAG	9
Module ID	4
Ground	45
Reserved	33
Total	400

3.1.1. Signal List

The following notations are used to denote the signal type:

I	Input pin
O	Output pin
O D	Open Drain Output pin. This pin requires a pull up resistor.
I D	Open Drain Input pin. This pin requires a pull up resistor.
I/O D	Input / Open Drain Output pin. This pin requires a pull up resistor.
I/O	Bi-directional Input / Output pin

The signal description also includes the type of buffer used for a particular signal:

GTL+	Open Drain GTL+ interface signal.
PCI	PCibus interface signals.
AGP	AGPbus interface signals.
CMOS	The CMOS buffers are Low Voltage TTL compatible signals. They are also 3.3V outputs with 5.0V tolerant inputs.



3.1.2. Memory (109 Signals)

Table 2 lists the memory interface signals.

Table 2. Memory Signal Descriptions

Name	Type	Voltage	Description
MECC[7:0]	I/O CMOS	V ₃	Memory ECC Data: These signals carry Memory ECC data during access to DRAM. These pins are implemented on the MMC-2.
RASA[5:0]# or CSA[5:0]#	O CMOS	V ₃	Row Address Strobe (EDO): These pins select the DRAM row. Chip Select (SDRAM): These pins activate the SDRAMs. SDRAM accepts any command when its CS# pin is active low.
CASA[7:0]# or DQMA[7:0]	O CMOS	V ₃	Column Address Strobe (EDO): These pins select the DRAM column. Input/Output Data Mask (SDRAM): These pins act as synchronized output enables during a read cycle and as a byte mask during a write cycle.
MAB[9:0]# MAB[10] MAB[12:11]# MAB[13]	O CMOS	V ₃	Memory Address (EDO/SDRAM): This is the row and column address for DRAM. The 443BX Host Bridge system controller has two identical sets of address lines (MAA and MAB#). The Pentium® II processor mobile module supports only the MAB set of address lines. For additional addressing features, please refer to the <i>Intel® 440BX AGPset Datasheet</i> .
MWEA#	O CMOS	V ₃	Memory Write Enable (EDO/SDRAM): MWEA# should be used as the write enable for the memory data bus.
SRASA#	O CMOS	V ₃	SDRAM Row Address Strobe (SDRAM): When active low, this signal latches Row Address on the positive edge of the clock. This signal also allows Row access and pre-charge.
SCASA#	O CMOS	V ₃	SDRAM Column Address Strobe (SDRAM): When active low, this signal latches Column Address on the positive edge of the clock. This signal also allows Column access.
CKE[5:0]	O CMOS	V ₃	SDRAM Clock Enable (SDRAM): SDRAM clock enable pin. When these signals are deasserted, SDRAM enters power-down mode. Each row is individually controlled by its own clock enable.
MD[63:0]	I/O CMOS	V ₃	Memory Data: These signals are connected to the DRAM data bus. They are not terminated on the Pentium® II processor mobile module.

3.1.3. AGP (60 Signals)

Table 3 lists the AGP interface signals.

Table 3. AGP Signal Descriptions

Name	Type	Voltage	Description
GAD[31:0]	I/O AGP	V ₃	AGP Address/Data: The standard AGP address and data lines. This bus functions in the same way as the PCI AD[31:0] bus. The address is driven with FRAME# assertion, and data is driven or received in following clocks.
GC/BE[3:0]#	I/O AGP	V ₃	AGP Command/Byte Enable: This bus carries the command information during AGP cycles when PIPE# is used. During an AGP write, this bus contains byte enable information. The command is driven with FRAME# assertion, and byte enables corresponding to supplied or requested data are driven on the following clocks.
GFRAME#	I/O AGP	V ₃	AGP Frame: Not used during AGP transactions. Remains deasserted by an internal pullup resistor. Assertion indicates the address phase of a PCI transfer. Negation indicates that the cycle initiator desires one more data transfer.
GDEVSEL#	I/O AGP	V ₃	AGP Device Select: Same function as PCI DEVSEL#. Not used during AGP transactions. The 443BX Host Bridge system controller drives this signal when a PCI initiator is attempting to access DRAM. DEVSEL# is asserted at medium decode time.
GIRDY#	I/O AGP	V ₃	AGP Initiator Ready: Indicates the AGP compliant target is ready to provide ALL write data for the current transaction. Asserted when the initiator is ready for a data transfer.
GTRDY#	I/O AGP	V ₃	AGP Target Ready: Indicates the AGP compliant master is ready to provide ALL write data for the current transaction. Asserted when the target is ready for a data transfer.
GSTOP#	I/O AGP	V ₃	AGP Stop: Same function as PCI STOP#. Not used during AGP transactions. Asserted by the target to request the master to stop the current transaction.
GREQ#	I AGP	V ₃	AGP Request: AGP master requests for AGP.
GGNT#	O AGP	V ₃	AGP Grant: Same function as on PCI. Additional information is provided on the ST[2:0] bus. PCI Grant: Permission is given to the master to use PCI.
GPAR	I/O AGP	V ₃	AGP Parity: A single parity bit is provided over GAD[31:0] and GC/BE[3:0]. This signal is not used during AGP transactions.
PIPE#	I AGP	V ₃	Pipelined Request: Asserted by the current master to indicate a full width address that is to be queued by the target. The master queues one request each rising clock edge while PIPE# is asserted.
SBA[7:0]	I AGP	V ₃	Sideband Address: This bus provides an additional conduit to pass address and commands to the 443BX Host Bridge System Controller from the AGP master.
RBF#	I AGP	V ₃	Read Buffer Full: Indicates if the master is ready to accept previously requested, low priority read data.
ST[2:0]	O AGP	V ₃	Status Bus: Provides information from the arbiter to an AGP Master on what it may do. These bits only have meaning when GGNT is asserted.

ADSTB[B:A]	I/O AGP	V_3	AD Bus Strobes: Provide timing for double-clocked data on the GAD bus. The agent that is providing data drives these signals. These are identical copies of each other.
SBSTB	I AGP	V_3	Sideband Strobe: Provides timing for a sideband bus. The sideband strobe is always driven by the AGP master or SBA[7:0].

3.1.4. PCI (58 Signals)

Table 4 lists the PCI interface signals.

Table 4. PCI Signal Descriptions

Name	Type	Voltage	Description
AD[31:0]	I/O PCI	V ₃	Address/Data: The standard PCI address and data lines. The address is driven with FRAME# assertion and data is driven or received in the following clocks.
C/BE[3:0]#	I/O PCI	V ₃	Command/Byte Enable: The command is driven with FRAME# assertion and byte enables corresponding to supplied or requested data are driven on the following clocks.
FRAME#	I/O PCI	V ₃	Frame: Assertion indicates the address phase of a PCI transfer. Negation indicates that the cycle initiator desires one more data transfer.
DEVSEL#	I/O PCI	V ₃	Device Select: the 443BX Host Bridge drives This signal when a PCI initiator is attempting to access DRAM. DEVSEL# is asserted at medium decode time.
IRDY#	I/O PCI	V ₃	Initiator Ready: Asserted when the initiator is ready for data transfer.
TRDY#	I/O PCI	V ₃	Target Ready: Asserted when the target is ready for a data transfer.
STOP#	I/O PCI	V ₃	Stop: Asserted by the target to request the master to stop the current transaction.
PLOCK#	I/O PCI	V ₃	Lock: Indicates an exclusive bus operation and may require multiple transactions to complete. When LOCK# is asserted, non-exclusive transactions may proceed. The 443BX supports lock for CPU initiated cycles only. PCI initiated locked cycles are not supported.
REQ[4:0]#	I PCI	V ₃	PCI Request: PCI master requests for PCI.
GNT[4:0]#	O PCI	V ₃	PCI Grant: Permission is given to the master to use PCI.
PHOLD#	I PCI	V ₃	PCI Hold: This signal comes from the expansion bridge; it is the bridge request for PCI. The 443BX Host Bridge will drain the DRAM write buffers, drain the processor-to-PCI posting buffers, and acquire the host bus before granting the request via PHLDA#. This ensures that GAT timing is met for ISA masters. The PHOLD# protocol has been modified to include support for passive release.
PHLDA#	O PCI	V ₃	PCI Hold Acknowledge: This signal is driven by the 443BX Host Bridge to grant PCI to the expansion bridge. The PHLDA# protocol has been modified to include support for passive release.
PAR	I/O PCI	V ₃	Parity: A single parity bit is provided over AD[31:0] and C/BE[3:0]#.
SERR#	I/O PCI	V ₃	System Error: The 443BX asserts this signal to indicate an error condition. Please refer to the <i>Intel® 440BX AGPset Datasheet</i> for further information.
CLKRUN#	I/O D PCI	V ₃	Clock Run: An open-drain output and input. The 443BX Host Bridge requests the central resource (PIIX4E/M) to start or maintain the PCI clock by asserting CLKRUN#. The 443BX Host Bridge tri-states CLKRUN# upon deassertion of Reset (since CLK is running upon deassertion of Reset).
PCI_RST#	I CMOS	V ₃	Reset: When asserted, this signal asynchronously resets the 443BX Host Bridge. The PCI signals also tri-state, compliant with PCI Rev 2.1 specifications.

3.1.5. Geyserville (4 Signals)

Table 5 lists the Geyserville signal definitions.

Table 5. Geyserville Descriptions

Name	Type	Voltage	Description
G_LO/HI#	I CMOS	V_3	Geyserville State Transition: Generated by the PIIX4E/M, this signal defines a Geyserville state change to the Geyserville state machine. This signal is not implemented on the current Pentium® II processor mobile modules, and is defined for future upgrade purposes only.
G_CPU_STP#	I CMOS	V_3	Geyserville CPU_STP#: The CPU_STP# signal gated by the Geyserville state machine becomes G_CPU_STP#. This signal is not implemented on the current Pentium® II processor mobile modules, and is defined for future upgrade purposes only.
VRChngng#	O CMOS	V_3	Voltage Changing: A Geyserville state machine signal that indicates that the actual state change is in progress – the VR setpoint has changed and the VR is settling. When this signal deasserts, the new state is sent to the processor. System electronics will use this signal to generate an SCI to force a transition out of deep sleep. This signal is not implemented on the current Pentium® II processor mobile modules, and is defined for upgrade purposes only.
G_SUS_STAT1#	O CMOS	V_3	G_SUS_STAT1#: The SUS_STAT1# signal gated by the Geyserville control logic. G_SUS_STAT1# should be used in place of the SUS_STAT1# signal in the system electronics design. This signal is not implemented on the current Pentium® II processor mobile modules, and is defined for upgrade purposes only.

3.1.6. Processor/PIIX4E/M Sideband (8 Signals)

The voltage level for these signals is determined by V_CPUPU, which is supplied by the Pentium II processor mobile module.

Table 6 lists the mobile Pentium® II processor and PIIX4E/M sideband signals at the connector interface.

Table 6. Processor/PIIX4E/M Sideband Signal Descriptions

Name	Type	Voltage	Description
FERR#	O CMOS	V_CPUPU	Numeric Coprocessor Error: This pin functions as a FERR# signal supporting coprocessor errors. This signal is tied to the coprocessor error signal on the processor and is driven by the processor to the PIIX4E/M.
IGNNE#	I D CMOS	V_CPUPU	Ignore Error: This open drain signal is connected to the ignore error pin on the processor and is driven by the PIIX4E/M.
INIT#	I D CMOS	V_CPUPU	Initialization: INIT# is asserted by the PIIX4E/M to the processor for system initialization. This signal is an open drain.
INTR	I D CMOS	V_CPUPU	Processor Interrupt: INTR is driven by the PIIX4E/M to signal the processor that an interrupt request is pending and needs to be serviced. This signal is an open drain.
NMI	I D CMOS	V_CPUPU	Non-Maskable Interrupt: NMI is used to force a non-maskable interrupt to the processor. The PIIX4E/M ISA bridge generates an NMI when either SERR# or IOCHK# is asserted, depending on how the NMI Status and Control Register is programmed. This signal is an open drain.
A20M#	I D CMOS	V_CPUPU	Address Bit 20 Mask: When enabled, this open drain signal causes the processor to emulate the address wraparound at one MB, which occurs on the Intel 8086 processor.
SMI#	I D CMOS	V_CPUPU	System Management Interrupt: SMI# is an active low synchronous output from the PIIX4E/M that is asserted in response to one of many enabled hardware or software events. The SMI# open drain signal can be an asynchronous input to the processor. However, in this chip set SMI# is synchronous to PCLK.
STPCLK#	I D CMOS	V_CPUPU	Stop Clock: STPCLK# is an active low synchronous open drain output from the PIIX4E/M that is asserted in response to one of many hardware or software events. STPCLK# connects directly to the processor and is synchronous to PCICLK. When the processor samples STPCLK# asserted, it responds by entering a low power state (Quick Start). The processor will only exit this mode when this signal is deasserted.



3.1.7. Power Management (7 Signals)

the digital thermal sensor, the SMBus contains serial addresses for future use. See section 4.9 for more details.

Table 7 lists the power management signals. The SM_CLK and SM_DATA signals refer to the two-wire serial SMBus interface. Although this interface is currently used solely for

Table 7. Power Management Signal Descriptions

Name	Type	Voltage	Description
SUS_STAT1#	I CMOS	V_3ALWAYS (See Note)	Suspend Status: This signal connects to the SUS_STAT1# output of PIIX4E/M. It provides information on host clock status and is asserted during all suspend states.
VR_ON	I CMOS	V_3S	VR_ON: Voltage regulator ON. This 3.3V (5V tolerant) signal controls the operation of the voltage regulator. VR_ON should be generated as a function of the PIIX4E/M SUSB# signal which is used for controlling the "Suspend State B" voltage planes. This signal should be driven by a digital signal with a rise/fall time of less than or equal to 1us. See Figure 5 in section 4.7.2.1. of this document for proper sequencing of VR_ON. (VIL (max)=0.4V, VIH (min)=3.0V).
VR_PWRGD	O	V_3	VR_PWRGD: This signal is driven high by the Pentium® II processor mobile module to indicate that the voltage regulator is stable. The signal is pulled low using a 100K resistor when inactive. It can be used in some combination to generate the system PWRGOOD signal.
BXPWROK	I CMOS	V_3	Power OK to BX: This signal must go active 1 mS after the V_3 power rail is stable, and 1 ms prior to deassertion of PCIRST#.
SM_CLK	I/O D CMOS	V_3	Serial Clock: This clock signal is used on the SMBus interface to the digital thermal sensor.
SM_DATA	I/O D CMOS	V_3	Serial Data: Open-drain data signal on the SMBus interface to the digital thermal sensor.
ATF_INT#	O D CMOS	V_3	ATF Interrupt: This signal is an open-drain output signal of the digital thermal sensor.

NOTE:

V_3ALWAYS: 3.3V voltage supply. It is generated whenever V_DC is available and supplied to PIIX4E/M resume well.

3.1.8. Clock (9 Signals)

Table 8 lists the clock signals.

Table 8. Clock Signal Descriptions

Name	Type	Voltage	Description
PCLK	I PCI	V_3	PCI Clock In: PCLK, an input to the Pentium® II processor mobile module, is one of the system's PCI clocks. This clock is used by all of the 443BX Host Bridge logic in the PCI clock domain. This clock is stopped when the PIIX4E/M PCI_STP# signal is asserted and/or during all suspend states.
HCLK[1:0]	I CMOS	V_CLK	Host Clock In: These clocks are inputs to the Pentium® II processor mobile module from the CK97-M clock source (p. 30). The processor and the 443BX Host Bridge system controller use HCLK[0]. This clock is stopped when the PIIX4E/M CPU_STP# signal is asserted and/or during all suspend states.
DCLKO	O CMOS	V_3	SDRAM Clock Out: 66 MHz SDRAM clock reference generated internally by the 443BX Host Bridge system controller onboard PLL. It feeds an external buffer that produces multiple copies for the SODIMMs.
DCLKRD	I CMOS	V_CLK	SDRAM Read Clock: Feedback reference from the SDRAM clock buffer. The 443BX Host Bridge System Controller uses this clock when reading data from the SDRAM array. This signal is not implemented on the Pentium II processor mobile module.
DCLKWR	I CMOS	V_CLK	SDRAM Write Clock: Feedback reference from the SDRAM clock buffer. The 443BX Host Bridge system controller uses this clock when writing data to the SDRAM array.
GCLKIN	I CMOS	V_3	AGP Clock In: The GCLKIN input is a feedback reference from the GCLKO signal.
GCLKO	O CMOS	V_3	AGP Clock Out: This signal is generated by the 443BX Host Bridge system controller onboard PLL from the HCLK0 host clock reference. The frequency of GCLKO is 66MHz. The GCLKO output is used to feed both the PLL reference input pins on the 443BX Host Bridge system controller and the AGP device. The board layout must maintain complete symmetry on loading and trace geometry to minimize AGP clock skew.
FQS	O CMOS	V_3S	Frequency Select: This output indicates the desired host clock frequency for the Pentium® II processor mobile module. FQS=0 indicates 66 MHz FQS=1 indicates 100 MHz (for future Intel mobile modules)

3.1.9. Voltages (54 Signals)

Table 9 lists the voltage signal definitions.

Table 9. Voltage Descriptions

Name	Type	Number of Pins	Description
V_DC	I	20	DC Input: 5V – 21V
V_3S	I	9	SUSB# controlled 3.3V: Power-managed 3.3V supply. An output of the voltage regulator on the system electronics. This rail is off during STR, STD, and Soff. This rail is not used on the Pentium® II processor mobile module.
V_5	I	3	SUSC# controlled 5V: Power-managed 5V supply. An output of the voltage regulator on the system electronics. This rail is off during STD and Soff.
V_3	I	16	SUSC# controlled 3.3V: Power-managed 3.3V supply. An output of the voltage regulator on the system electronics. This rail is off during STD and Soff.
VCCAGP	I	4	AGP I/O Voltage: This voltage rail is not implemented on the current Pentium II processor mobile modules, and is defined for upgrade purposes only. We recommend that this voltage rail be connected to V_3 on the system electronics.
V_CPUPU	O	1	Processor I/O Ring: Driven by the Pentium® II processor mobile module to power processor interface signals such as the PIIX4E/M open-drain pullups for the processor/PIIX4E/M sideband signals.
V_CLK	O	1	Processor Clock Rail: Driven by the Pentium® II processor mobile module to power CK100-M VDDCPU rail.

3.1.10. ITP/JTAG (9 Signals)

Table 10 lists the ITP/JTAG signals, which the system manufacturer can use to implement a JTAG chain and ITP port if desired.

Table 10. ITP/JTAG Pins

Name	Type	Voltage	Description
TDO	O	V_CPUPU	JTAG Test Data Out: Serial output port. TAP instructions and data are shifted out of the processor from this port.
TDI	I	V_CPUPU	JTAG Test Data In: Serial input port. TAP instructions and data are shifted into the processor from this port.
TMS	I	V_CPUPU	JTAG Test Mode Select: Controls the TAP controller change sequence.
TCLK	I	V_CPUPU	JTAG Test Clock: Testability clock for clocking the JTAG boundary scan sequence.
TRST#	I	V_CPUPU	JTAG Test Reset: Asynchronously resets the TAP controller in the processor.
FS_RESET#	O	GTL+	Processor Reset: Processor reset status to the ITP.
VTT	O	V_Core	GTL+ Termination Voltage: Used by the POWERON pin on the ITP debug port to determine when target system is on. POWERON pin is pulled up using a 1KΩ resistor to VTT.
FS_PREQ#	I	V_CPUPU	Debug Mode Request: Driven by the ITP – makes request to enter debug mode.
FS_PRDY#	O	GTL+	Debug Mode Ready: Driven by the processor – informs the ITP that the processor is in debug mode.

NOTE:

Recommendation: DBRESET# (reset target system) on the ITP debug port can be "logically ANDed" with VR_PWRGD TO PIIX4E/M's PWROK.

3.1.11 Miscellaneous (82 Signals)

Table 11 lists the Pentium® II processor mobile module miscellaneous signal pins.

Table 11. Miscellaneous Pins

Name	Type	Number	Description
Module ID[3:0]	O CMOS	4	Module Revision ID: These pins track the revision level of the Pentium® II processor mobile module. A 100K-pullup resistor to V_3S is required to be placed on the system electronics for these signals.
Ground	I	45	Ground.
Reserved	RSVD	33	Unallocated Reserved pins and should not be connected.

3.2. Connector Pin Assignments

Table 12 lists the signals for each pin of the MMC-2 to the system electronics. Refer to Section 3.3 for the pin assignments of the pads on the connector.

Table 12. Connector Pin Assignments

Pin#	Row A	Row B	Row C	Row D	Row E
1	SBA5	ADSTBB	Gnd	GAD31	SBA7
2	GAD25	GAD24	SBA6	SBA4	SBA0
3	GAD30	GAD29	GAD26	GAD27	Gnd
4	Gnd	VCCAGP	GAD4	GAD6	GAD8
5	RBF#	GAD1	GAD3	GAD5	GC/BE0#
6	BXPWROK	Reserved	GAD2	ADSTBA	Gnd
7	MD0	MD1	V_3	CLKRUN#	GAD7
8	MD2	MD33	Gnd	MD32	GAD0
9	MD36	MD4	MD3	MD35	MD34
10	MD7	MD38	MD37	MD6	MD5
11	MD41	MD42	MD40	MD39	MD8
12	MD43	MD11	Gnd	MD10	MD9
13	MD14	MD45	MD44	MD13	MD12
14	MECC4	MECC0	MD15	MD47	MD46
15	SCASA#	WEA#	MECC5	Reserved	Gnd
16	Gnd	MID1	DQMA0	DQMA1	Reserved
17	V_3	DQMA4	MID0	DQMA5	CSA0#
18	CSA1#	CSA2#	CSA4#	CSA3#	Gnd
19	SRASA#	CSA5#	MAB0#	MAB1#	Reserved
20	Reserved	Reserved	MAB2#	Reserved	MAB3#
21	Reserved	MAB4#	Gnd	Reserved	MAB6#
22	Reserved	Reserved	MAB5#	Reserved	MAB7#
23	MAB8#	Reserved	Reserved	MAB9#	MAB10
24	Reserved	MAB11#	MAB12#	Reserved	DCLKO
25	MAB13	V_3	Gnd	CKE0	DCLKRD
26	CKE1	MID2	CKE3	CKE4	Gnd
27	CKE5	CKE2	MID3	G_CPU_STP#	VRChng#
28	Reserved	G_LO/HI#	DQMA2	DCLKWR	Gnd
29	Gnd	VTT	Reserved	FS_PREQ#	DQMA3
30	FS_RESET#	V_3	MD26	Gnd	MD25
31	FS_PRDY#	Gnd	MD58	MD57	MD60

Pin#	Row A	Row B	Row C	Row D	Row E
32	G_SUS_STAT1#	SMCLK	TDO	TCLK	FERR#
33	Reserved	SMDAT	TDI	TMS	IGNNE#
34	Reserved	FQS	Reserved	TRST#	ATF_INT#
35	Reserved	V_5	V_3S	V_3S	V_3S
36	V_CPUPU	V_5	V_3S	V_3S	V_3S
37	V_CLK	V_5	V_3S	V_3S	V_3S
38	Reserved	Reserved	Reserved	Reserved	Reserved
39	V_DC	V_DC	V_DC	V_DC	V_DC
40	V_DC	V_DC	V_DC	V_DC	V_DC

Pin#	Row F	Row G	Row H	Row J	Row K
1	GREQ#	Gnd	PIPE#	SBA3	Gnd
2	ST0	ST1	SBA1	SBSTB	GCLKI
3	GGNT#	ST2	SBA2	Gnd	GCLKO
4	GAD13	GSTOP#	GAD16	GAD20	GAD23
5	GAD12	GPAR	GAD18	GAD17	GC/BE3#
6	GAD10	GAD15	GFRAME#	Gnd	GAD22
7	GAD11	GC/BE1#	GTRDY#	GC/BE2#	GAD21
8	GAD9	GAD14	GDEVSEL#	GIRDY#	GAD19
9	Gnd	VCCAGP	Gnd	VCCAGP	GAD28
10	AD0	AD4	AD2	AD3	AD1
11	Gnd	C/BE0#	AD6	Gnd	AD5
12	VCCAGP	AD10	AD7	AD8	AD9
13	MECC1	AD13	Gnd	AD12	AD11
14	SERR#	PAR	AD15	C/BE1#	AD14
15	AD16	TRDY#	STOP#	DEVSEL#	PLOCK#
16	AD19	Gnd	AD17	Gnd	AD18
17	AD23	AD30	AD24	C/BE2#	AD21
18	AD27	AD22	C/BE3#	AD26	PCLK
19	PCI_RST#	Gnd	AD20	AD28	Gnd
20	Reserved	PHOLD#	AD31	AD29	AD25
21	IRDY#	FRAME#	Gnd	REQ1#	REQ0#
22	Gnd	GNT2#	REQ2#	REQ3#	GNT3#
23	GNT1#	GNT4#	GNT0#	REQ4#	Gnd
24	Gnd	PHLDA#	Gnd	V_3	MD59

Pin#	Row F	Row G	Row H	Row J	Row K
25	DQMA6	MECC7	MD50	MD51	MD54
26	MECC2	MD48	MD18	MD52	MD24
27	DQMA7	MD16	MD19	Gnd	MD23
28	MECC6	MD17	MD21	MD53	MD55
29	MECC3	MD49	MD20	MD22	MD56
30	MD27	MD28	Gnd	MD62	MD63
31	Gnd	MD29	MD61	MD30	MD31
32	SMI#	INTR	VR_ON	Gnd	Gnd
33	NMI	SUS_STAT1#	VR_PWRGD	Gnd	HCLK0
34	A20M#	STPCLK#	INIT#	Gnd	Gnd
35	V_3	V_3	V_3	Gnd	HCLK1
36	V_3	V_3	V_3	Gnd	Gnd
37	V_3	V_3	V_3	V_3	V_3
38	Reserved	Reserved	Reserved	Reserved	Reserved
39	V_DC	V_DC	V_DC	V_DC	V_DC
40	V_DC	V_DC	V_DC	V_DC	V_DC

3.3. Pin and Pad Assignments

The MMC-2 is a 400-pin, 1.27mm pitch, and BGA style surface mount connector. MMC-2 has three different sized mating receptacles. Refer to section 5.1.4, *Height Requirements*, for size information.

Figure 2 shows the pad assignments from the secondary side of the Pentium® II processor mobile module.

**400-Pin Connector
OEM Pad Assignments
(Viewed from Secondary Side)**

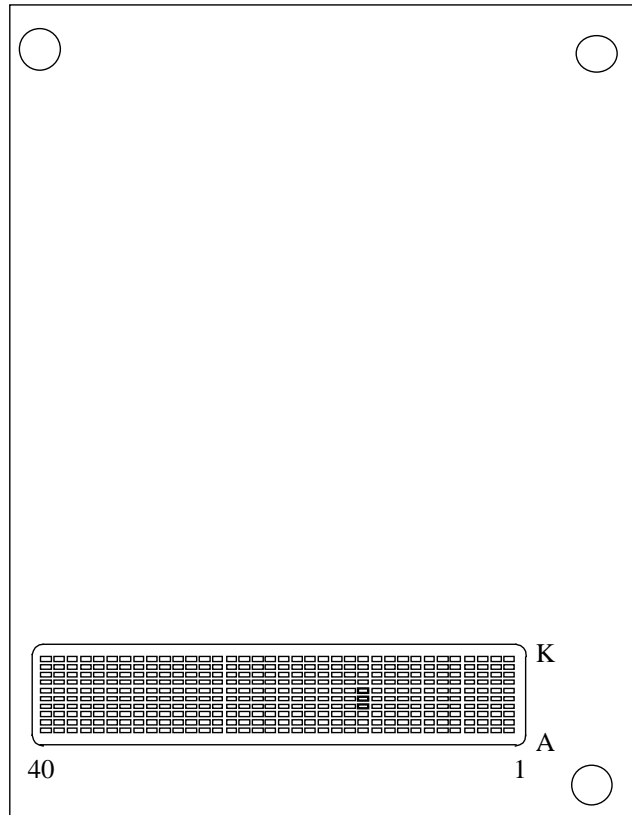


Figure 2. 400-Pin Connector Footprint Pad Numbers, Module Secondary Side



Table 13 summarizes some of the key specifications for the connector.

Table 13. Connector Specifications

Parameter	Condition	Specification
Material	Contact	Copper Alloy
	Housing	Thermo Plastic Molded Compound: LCP
Electrical	Current	0.5A
	Voltage	50 VAC
	Insulation Resistance	100 MΩ min. at 500 VDC
	Termination Resistance	10 mΩ
	Capacitance	5 pF max. per contact
Mechanical	Mating Cycles	50 cycles
	Connector Mating Force	2.0 oz max. per contact
	Contact Un-mating Force	1.5 oz min. per contact

4.0. FUNCTIONAL DESCRIPTION

4.1. Pentium® II Processor Mobile Module

The Pentium® II processor mobile module supports the mobile Pentium II Processor core with on-die L2 cache running at 366 MHz, 333 MHz, 300PE MHz, 266PE MHz, with a system bus speed of 66 MHz.

implemented in all Intel PCI chipsets. E_SMRAM is a new feature that supports write-back cacheable SMRAM space up to 1 MB. To minimize power consumption while the system is idle, the internal 443BX Host Bridge clock is turned off (gated off) when there is no processor and PCI activity. This is accomplished by setting the G_CLK enable bit in the power management register in the 443BX through the system BIOS.

4.2. L2 Cache

The mobile Pentium® II processor has 256K of on-die L2 cache that is 4-way set associative and runs at the speed of the processor core.

4.3.1. Memory Organization

The memory interface of the 443BX Host Bridge, supporting standard mode memory configurations and modes of operation, is available at MMC-2. This allows the memory interface to support the following:

4.3. The 443BX Host Bridge System Controller

Intel's® 443BX Host Bridge system controller is a highly integrated device that combines the mobile Pentium® II processor bus controller, the DRAM controller, and the PCI bus controller into one component. The 443BX Host Bridge has multiple power management features designed specifically for notebook systems such as:

- One set of memory control signals, sufficient to support up to three SO_DIMM sockets, and six banks of SDRAM at 66 MHz.
- One CKE signal for each bank.

- CLKRUN#, a feature that enables controlling of the PCI clock on or off.
- The 443BX Host Bridge suspend modes which include Suspend-to-RAM (STR), Suspend-to-Disk (STD), and Powered-On-Suspend (POS).
- System Management RAM (SMRAM) power management modes which include Compatible SMRAM (C_SMRAM) and Extended SMRAM (E_SMRAM). C_SMRAM is the traditional SMRAM feature

Memory features not supported by the 443BX Host Bridge system controller standard MMC-2 Mode are:

- Support for 8 banks of memory.
- Second set of memory address lines (MAA[13:0]).
- 100 MHz SDRAM (and PSB).

DRAM technologies supported by the 443BX Host Bridge system controller include EDO and SDRAM. These memory types should not be mixed in the system, so that all DRAM in all rows (RAS[5:0]#) must be the same technology. The 443BX Host Bridge system controller targets 60 ns EDO DRAMs and 66 MHz SDRAMs.

The Pentium® II processor mobile module's clocking architecture supports the use of SDRAM. Due to the tight timing requirements of 66 MHz SDRAM clocks, the clocking mode for SDRAM or system manufacturer custom memory configurations allows all host and SDRAM clocks to be generated from the same OEM clocking architecture. For complete details about using SDRAM memory, and for trace length guidelines, refer to the *Mobile Pentium® II processor / 82443BX AGPset Advanced Platform Recommended Design and Debug Practices*. For details on memory device

support, organization, size and addressing refer to the *Intel® 440BX AGPset Datasheet*.

4.3.2. Reset Strap Options

Several strap options on the memory address bus define the behavior of the Pentium® II processor mobile module after reset. Other straps are allowed to override the default settings. Table 14 shows the straps and their implementation.

Table 14. Configuration Straps for the 443BX Host Bridge System Controller

Signal	Function	Module Default Setting	Optional Override on System Electronics
MAB[12]#	Host Frequency Select	No strap. (66 MHz default).	None.
MAB[11]#	In order queue depth	No strap. (Maximum Queue Depth is set for example 8).	None.
MAB[10]	Quick Start Select	Strapped high on the module for Quick Start mode.	None.
MAB[9]#	AGP disable	No strap. AGP is enabled.	Pull up this signal to disable AGP interface.
MAB[7]#	MM Config	No strap. Standard (MMC-2) mode.	None.
MAB[6]#	Host Bus Buffer Mode Select	Strapped high on the module for mobile FSB buffers.	None.

4.3.3. PCI Interface

The PCI interface of the 443BX Host Bridge is available at the MMC-2. The 443BX Host Bridge supports the PCI Clockrun protocol for PCI bus power management. In this protocol, PCI devices assert the CLKRUN# open-drain signal when they require the use of the PCI interface. Refer to the *PCI Mobile Design Guide* for complete details on the PCI Clockrun protocol.

The 443BX Host Bridge is responsible for arbitrating the PCI bus. With MMC-2, the 443BX Host Bridge can only support up to five PCI bus masters. There are five PCI Request/Grant pairs, REQ[4:0]# and GNT[4:0]#, available on the MMC-2 to the manufacturer's system electronics.

The PCI interface on MMC2 is 3.3V only. 5V PCI devices are not supported, specifically all devices, which drive outputs to a 5 Vt nominal Voh level.

The 443BX Host Bridge system controller is compliant with the PCI 2.1 specification, which improves the worst case PCI bus access latency from earlier PCI specifications. The 443BX Host Bridge supports only Mechanism #1 for accessing PCI configuration space, as detailed in the PCI specification. This implies that signals AD[31:11] are available for PCI IDSEL signals. However, since the 443BX Host Bridge is always device #0, AD11 will never be asserted during PCI configuration cycles as an IDSEL. The 443BX reserves AD12 for the AGPbus. Thus, AD13 is the first available address line usable as an IDSEL. Intel recommends that AD18 be used by the PIIX4E/M.

4.3.4. AGP Interface

The 443BX Host Bridge system controller complies with the AGP Rev 1.0 specification, supporting only an asynchronous AGP interface coupling to the 443BX core frequency. The AGP interface can reach a ~500 MB/sec transfer rate by using AGP 2X/133 devices. The actual bandwidth will be limited by the capability of the 443BX memory subsystem.

4.4. Power Management

4.4.1. Clock Control Architecture

The Pentium® II processor mobile module clock control architecture (Figure 3) is optimal for notebook designs.

The Auto Halt state provides a low power clock state that can be controlled through the software execution of the HLT instruction. The Quick Start state provides a very low power, low exit latency clock state that can be used for hardware controlled "idle" computer states. The Deep Sleep state provides an extremely low power state that can be used for "Power-on Suspend" computer states, which is an alternative to shutting off the processor's power. Compared to the Pentium processor mobile module's exit latency of 1 msec, the exit latency of the Deep Sleep state has been reduced to

30 μ sec in the Pentium II processor mobile module. The Stop Grant and Sleep states shown in Figure 3 are intended for use in “Deep Green” desktop and server systems – not in mobile systems. Performing state transitions not shown in Figure 3 is neither recommended nor supported.

The clock control architecture consists of seven different clock states: Normal, Stop Grant, Auto Halt, Quick Start, HALT/Grant Snoop, Sleep, and Deep Sleep states. The Stop Grant and Quick Start clock states are mutually exclusive, for example a strapping option on signal A15# chooses

which state is entered when the STPCLK# signal is asserted. Strapping the A15# signal enables the Quick Start state to ground at Reset. Otherwise, asserting the STPCLK# signal puts the processor into the Stop Grant state. The Stop Grant state has a higher power level than the Quick Start state and is designed for SMP platforms. The Quick Start state has a much lower power level, but it can only be used in uniprocessor (UP) platforms.

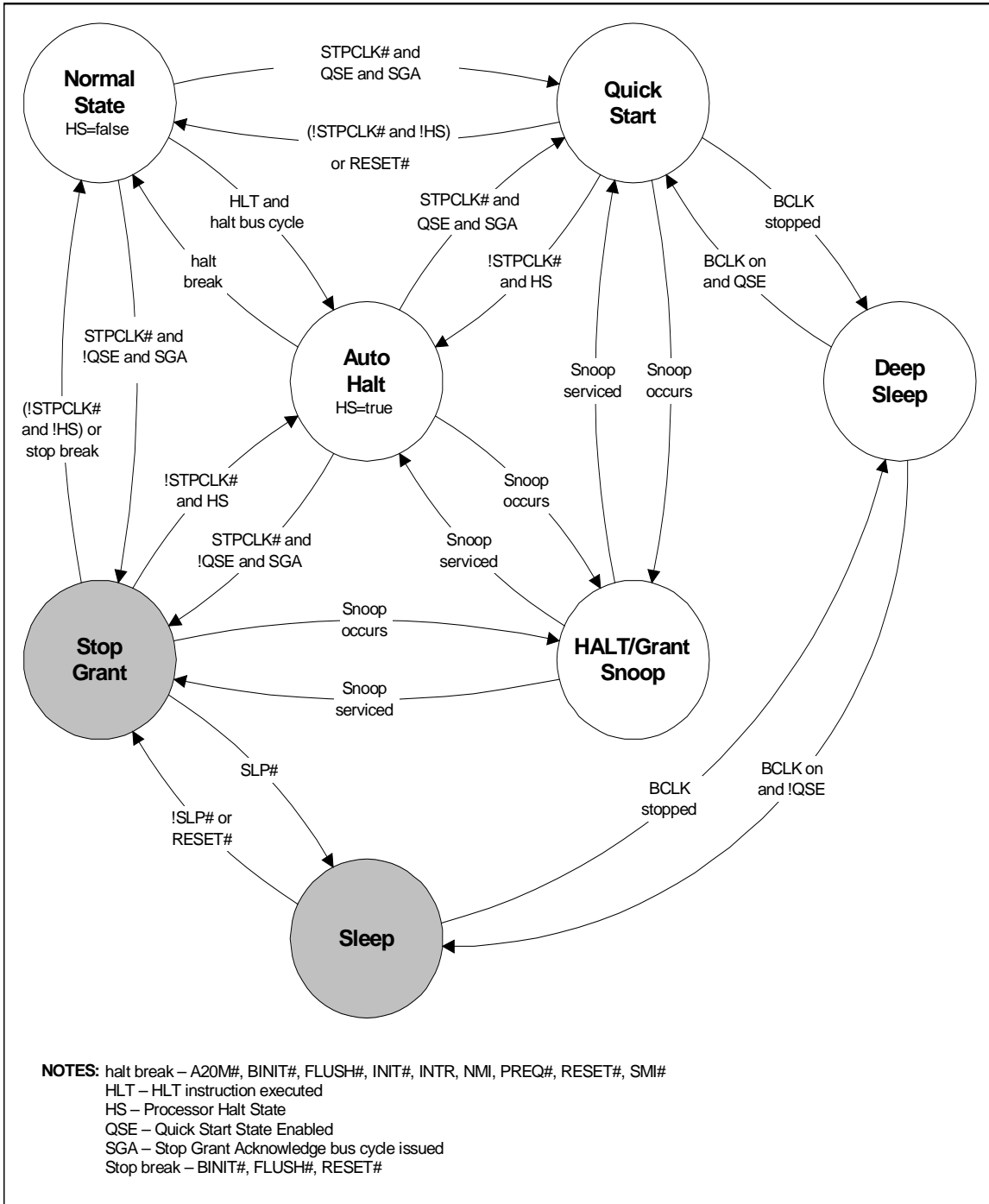


Figure 3. Mobile Pentium® II Processor Clock Control States



4.4.2. Normal State

Normal state is the normal operating mode where the mobile Pentium II processor's core clock is running and the processor is actively executing instructions.

4.4.3. Auto Halt State

This is a low power mode entered by the processor through the execution of the HLT instruction. The power level of this mode is similar to the Stop Grant state. A transition to the Normal state is made by a halt break event (one of the following signals going active: NMI, INTR, BINIT#, INIT#, RESET#, FLUSH#, or SMI#).

Asserting the STPCLK# signal while in the Auto Halt state will cause the processor to transition to the Stop Grant or Quick Start state, where a Stop Grant Acknowledge bus cycle will be issued. Deasserting STPCLK# will cause the processor to return to the Auto Halt state without issuing a new Halt bus cycle.

The SMI# (System Management Interrupt) is recognized in the Auto Halt state. The return from SMI handler can be to either the Normal state or the Auto Halt state. See the *Intel® Architecture Software Developer's Manual, Volume III: System Programmer's Guide* for more information. No Halt bus cycle is issued when returning to the Auto Halt state from System Management Mode (SMM).

The FLUSH# signal is serviced in the Auto Halt state. After flushing the on-chip, the processor will return to the Auto Halt state without issuing a Halt bus cycle. Transitions in the A20M# and PREQ# signals are recognized while in the Auto Halt state.

4.4.4. Stop Grant State

The processor enters this mode with the assertion of the STPCLK# signal when it is configured for Stop Grant state (via the A15# strapping option). The processor is still able to respond to snoop requests and latch interrupts. Latched interrupts will be serviced when the processor returns to the Normal state. Only one occurrence of each interrupt event will be latched. A transition back to the Normal state can be made by the deassertion of the STPCLK# signal or the occurrence of a stop break event (a BINIT#, FLUSH#, or RESET# assertion).

The processor will return to the Stop Grant state after the completion of a BINIT# bus initialization unless STPCLK# has been deasserted. RESET# assertion will cause the processor to immediately initialize itself. However, the processor will stay in the Stop Grant state after initialization until STPCLK# is deasserted. If the FLUSH# signal is asserted, the processor will flush the on-chip caches and return to the Stop Grant state. A transition to the Sleep state can be made by the assertion of the SLP# signal.

While in the Stop Grant state assertions of SMI#, INIT#, INTR, and NMI (or LINT[1:0]) will be latched by the processor. These latched events will not be serviced until the

processor returns to the Normal state. Only one of each event will be recognized upon return to the Normal state.

This state is not available in the Pentium® II processor mobile module.

4.4.5. Quick Start State

This is a mode entered by the processor with the assertion of the STPCLK# signal when it is configured for the Quick Start state (via the A15# strapping option). In the Quick Start state the processor is only capable of acting on snoop transactions generated by the system bus priority device. Because of its snooping behavior, Quick Start can only be used in UP configuration.

A transition to the Deep Sleep state can be made by stopping the clock input to the processor. A transition back to the Normal state (from the Quick Start state) is made only if the STPCLK# signal is deasserted.

While in this state the processor is limited in its ability to respond to input. The processor is incapable of latching any interrupts servicing snoop transactions from symmetric bus masters or responding to FLUSH# and BINIT# assertions. The processor will not respond properly to any input signal other than STPCLK#, RESET#, or BPRM#. If any other input signal changes, then the processor behavior will be unpredictable. No serial interrupt messages may begin or be in progress while the processor is in the Quick Start state.

RESET# assertion will cause the processor to immediately initialize itself. However, the processor will stay in the Quick Start state after initialization until STPCLK# is deasserted.

4.4.6. HALT/Grant Snoop State

The processor will respond to snoop transactions on the system bus while in the Auto Halt, Stop Grant, or Quick Start state. When a snoop transaction is presented on the system bus the processor will enter the HALT/Grant Snoop state. The processor will remain in this state until the snoop has been serviced and the system bus is quiet. After the snoop has been serviced, the processor will return to its previous state. If the HALT/Grant Snoop state is entered from the Quick Start state, then the input signal restrictions of the Quick Start state still apply in the HALT/Grant Snoop state (except for those signal transitions that are required to perform the snoop).

4.4.7. Sleep State

The Sleep state is a very low power state in which the processor maintains its context and the phase locked loop (PLL) maintains phase lock. The Sleep state can only be entered from the Stop Grant state. After entering the Stop Grant state the SLP# signal can be asserted, causing the processor to enter the Sleep state. The SLP# signal is not recognized in the Normal state or the Auto Halt state. The processor can be reset by the RESET# signal while in the Sleep state. If RESET# is driven active while the processor is in the Sleep state, then SLP# and STPCLK#

must immediately be driven inactive. Driving these signals inactive ensures that the processor correctly initializes itself.

Input signals (other than RESET#) may not change while the processor is in the Sleep state or transitioning into or out of the Sleep state. Input signal changes at these times will cause unpredictable behavior. Thus, the processor is incapable of snooping or latching any events in the Sleep state.

While in the Sleep state the processor can enter its lowest power state, the Deep Sleep state. Removing the processor's input clock puts the processor in the Deep Sleep state. PICCLK may be removed in the Sleep state.

This state is not available in the Pentium® II processor mobile module.

4.4.8. Deep Sleep State

The Deep Sleep state is the lowest power mode the processor can enter while maintaining its context. Stopping the BCLK input to the processor while in the Sleep state or the Quick Start state, enters the Deep Sleep state. For proper operation, the BCLK input should be stopped in the low state.

The processor will return to the Sleep or Quick Start state from the Deep Sleep state when the BCLK input is restarted. Due to the PLL lock latency, there is a 30-msec delay after the clocks have started and before this state transition happens. PICCLK may be removed in the Deep Sleep state. PICCLK should be designed to turn on when BCLK turns on when transitioning out of the Deep Sleep state.

The input signal restrictions for the Deep Sleep state are the same as for the Sleep state, except that RESET# assertion will result in unpredictable behavior.

Table 15. Mobile Pentium II Processor Clock State Characteristics

Clock State	Exit Latency	Processor Power	Snooping ?	System Uses
Normal	N/A	Varies	Yes	Normal program execution.
Auto Halt	Approximately 10 bus clocks	1.2W	Yes	S/W controlled entry idle mode.
Stop Grant	10 bus clocks	1.2W	Yes	H/W controlled entry/exit mobile throttling.
Quick Start	Through snoop, to HALT/Grant Snoop state: immediate Through STPCLK#, to Normal state: 10 bus clocks	0.5W	Yes	H/W controlled entry/exit mobile throttling.
HALT/Grant Snoop	A few bus clocks after the end of snoop activity.	Not specified	Yes	Supports snooping in the low power states.
Sleep	To Stop Grant state 10 bus clocks	0.5W	No	H/W controlled entry/exit desktop idle mode support.
Deep Sleep	30 msec	150 mW	No	H/W controlled entry/exit mobile powered-on suspend support.

NOTE:
Not 100% tested. Specified at 50°C by design/characterization.

4.5. Typical POS/STR Power

The Pentium® II processor MMC-2 supports both power on POS and suspend to STR features. Typical power during these states is shown in Table 16.

Table 16. Mobile Pentium® II Processor POS/STR Power

State	Typical MMC2 Power
POS	0.475A
STR	0.018A

NOTE:



4.6.1. DC Requirements
4.6. Electrical Requirements

Please refer to Table 17 for power supply design criteria to ensure compliance with DC power requirements.

The following section provides information on the DC requirements for the Pentium® II processor mobile module.

Table 17. Pentium® II Processor Mobile Module Power Specifications 1

Symbol	Parameter	Min	Nom	Max	Unit	Notes
V _{DC}	DC Input Voltage	5.0	12.0	21.0	V	
I _{DC}	DC Input Current	0.1	0.9	3.5	A	2,3
I _{DC-Surge}	Maximum Surge Current for V _{DC}			17.3	A	
I _{DC-Leakage}	Typical Leakage Current for V _{DC}		4.0		μA	(At 25°C), 4
V ₅	Power Managed 5V Voltage Supply	4.75	5.0	5.25	V	
I ₅	Power Managed 5V Current	17	32	60	mA	
I _{5-Surge}	Maximum Surge Current for V ₅			0.6	mA	
I _{5-Leakage}	Typical Leakage Current for V ₅		1.0		μA	
V ₃	Power Managed 3.3V Voltage Supply	3.135	3.3	3.465	V	
I ₃	Power Managed 3.3V Current	0.8	1.2	2.0	A	
I _{3-Surge}	Maximum Surge Current for V ₃			2.8	A	
I _{3-Leakage}	Typical Leakage Current for V ₃		1.1		mA	
V _{CPUPU}	Processor I/O Ring Voltage	2.375	2.5	2.625	V	±0.125
I _{CPUPU}	Processor I/O Ring Current	0	10	20	mA	5
V _{CLK}	Processor Clock Rail Voltage	2.375	2.5	2.625	V	±0.125
I _{CLK}	Processor Clock Rail Current	24.0	35.0	80	mA	5

NOTES:

1. Unless otherwise noted, all specifications in this table apply to all Intel mobile processor frequencies.
2. V_{DC} is set for 12V in order to determine typical V_{DC} current.
3. V_{DC} is set for 5V in order to determine maximum V_{DC} current.
4. Leakage current that can be expected when VR_ON is deactivated and V_{DC} is still applied.
5. These values are system dependent.

4.6.2. AC Requirements

Table 18 shows the BCLK AC requirements for the Pentium® II processor mobile module.

Table 18. Pentium® II Processor Mobile Module AC Specifications (BCLK) at the Processor Core Pins 1, 2, 3

T#	Parameter	Min	Nom	Max	Unit	Figure	Notes
	System Bus Frequency		66.67		MHz		All processor core frequencies ⁴
T1:	BCLK Period		15.0		ns		4, 5
T2:	BCLK Period Stability			±250	ps		6, 7, 8
T3:	BCLK High Time	5.3			ns		At >1.8V
T4:	BCLK Low Time	5.3			ns		At <0.7V
T5:	BCLK Rise Time	0.175		0.875	ns		(0.9V-1.6V) ⁸
T6:	BCLK Fall Time	0.175		0.875	ns		(1.6V-0.9V) ⁸

NOTES:

1. Unless otherwise noted, all specifications in this table apply to all Intel mobile modules.
2. All AC timings for the GTL+ signals are referenced to the BCLK rising edge at 1.25V at the processor core pin. All GTL+ signal timings (address bus, data bus, etc.) are referenced at 1.00V at the processor core pins.
3. All AC timings for the CMOS signals are referenced to the BCLK rising edge at 1.25V at the processor core pin. All CMOS signal timings (compatibility signals, etc.) are referenced at 1.25V at the processor core pins.
4. The internal core clock frequency is derived from the system bus clock. The system bus clock to core clock ratio is determined during initialization as described and is predetermined by the Pentium II processor mobile module.
5. The BCLK period allows a +0.5 ns tolerance for clock driver variation. See the *CK97 Clock Synthesizer/Driver Specification* for further information.
6. Measured on the rising edge of adjacent BCLKs at 1.25V. The jitter present must be accounted for as a component of BCLK skew between devices.
7. The clock driver's closed loop jitter bandwidth must be set low to allow any PLL-based device to track the jitter created by the clock driver. The -20 dB attenuation point, as measured into a 10 to 20 pF load, should be less than •500 kHz. This specification may be ensured by design characterization and/or measured with a spectrum analyzer. See the *CK97 Clock Synthesizer/Driver Specification* for further details.
8. Not 100% tested. Specified by design characterization as a clock driver requirement.

4.6.2.1 System Bus Clock (BCLK) Signal Quality Specifications and Measurement Guidelines

Table 19 describes the signal quality specifications at the processor core for the BCLK signal. Figure 4 describes the

signal quality waveform for the BCLK signal at the processor core pins.



Table 19. BCLK Signal Quality Specifications at the Processor Core 1

T#	Parameter	Min	Nom	Max	Unit	Figure	Notes
V1:	BCLK V_{IL}			0.7	V	4	2
V2:	BCLK V_{IH}	1.8			V	4	2
V3:	V_{IN} Absolute Voltage Range	-0.8		3.5	V	4	3
V4:	Rising Edge Ringback	1.8			V	4	4
V5:	Falling Edge Ringback			0.7	V	4	4
	BCLK rising/falling slew rate	0.8		4	V/ns		

NOTES:

1. Unless otherwise noted, all specifications in this table apply Intel mobile modules.
2. BCLK must rise/fall monotonically between $V_{IL,BCLK}$ and $V_{IH, BCLK}$.
3. This is the system bus clock's overshoot and undershoot specification for the 66MHz system bus operation.
4. The rising and falling edge ringback voltage specified is the minimum (rising) or maximum (falling) absolute voltage the BCLK signal can dip back to after passing the V_{IH} (rising) or V_{IL} (falling) voltage limits.
5. For proper signal termination, refer to the Clocking Guidelines in the *Mobile Pentium® II Processor / 440BX AGPset Advanced Platform Recommend Design and Debug Practices*.

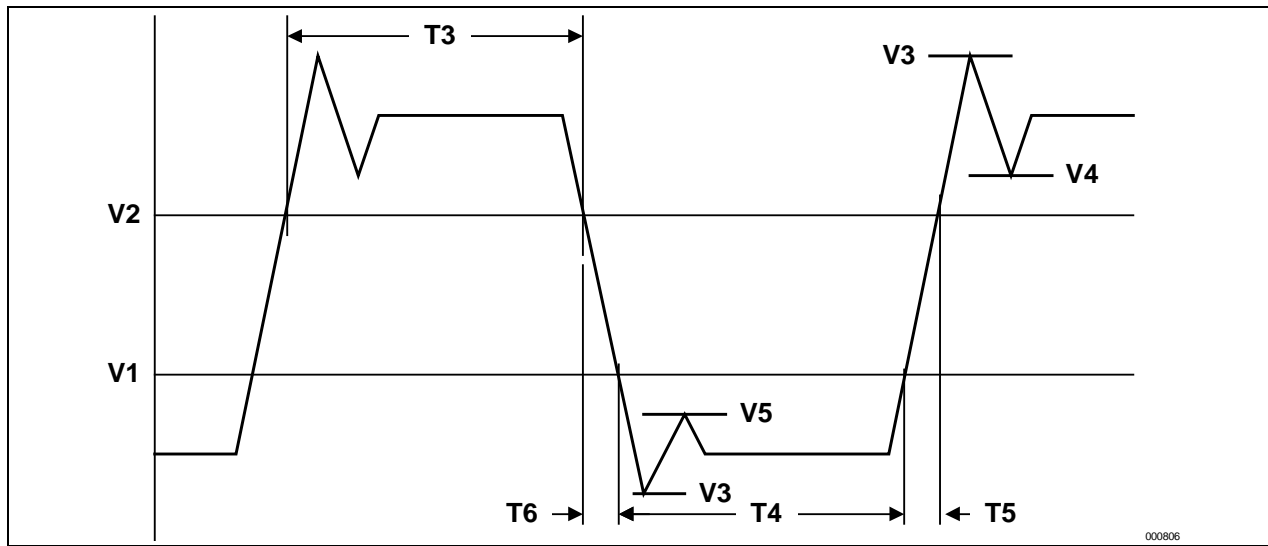


Figure 4. BCLK, TCK, PICCLK Generic Clock Waveform at the Processor Core Pins

4.7. The Voltage Regulator

The DC voltage regulator (DC/DC converter) provides the appropriate core voltage, the I/O ring voltage, and the sideband signal pullup voltage for the Pentium II processor mobile module. The voltage range is 5V – 21V.

4.7.1. Voltage Regulator Efficiency

Table 18 lists the voltage regulator efficiencies.

Table 20. Typical Voltage Regulator Efficiency

I _{core} , A ³	V _{DC} , V	I _{DC} , A ²	Efficiency ¹
1	5.0	0.370	82.8%
2	5.0	0.702	88.8%
3	5.0	1.044	89.8%
4	5.0	1.404	89.7%
5	5.0	1.762	88.1%
6	5.0	2.144	86.4%
7	5.0	2.528	85.0%
1	12.0	0.159	79.7%
2	12.0	0.295	87.0%
3	12.0	0.438	87.8%
4	12.0	0.584	87.3%
5	12.0	0.736	86.1%
6	12.0	0.890	84.9%
7	12.0	1.043	83.8%
1	21.0	0.091	79.3%
2	21.0	0.170	86.0%
3	21.0	0.253	87.3%
4	21.0	0.340	85.3%
5	21.0	0.429	84.1%
6	21.0	0.519	82.9%
7	21.0	0.617	80.7%

NOTES:

1. These efficiencies will change with future voltage regulators that accommodate wider ranges of input voltages.
2. With V_{DC} applied and the voltage regulator off, typical leakage is 0.3 mA with a maximum of 0.7 mA.
3. I_{core} indicates the CPU core current being drawn during test and measurement.

4.7.2. Control of the Voltage Regulator

The VR_ON pin turns the DC voltage regulator on or off. The VR_ON pin should be controlled as a function of the SUSB#, which controls the system's power planes. VR_ON should switch high only when the following conditions are met: V_{5(s)} => 4.5V, and V_{DC} => 4.75V.

CAUTION- Turning on VR_ON prior to meeting these conditions will severely damage the Pentium® II processor mobile module.

The VR_PWRGD signal indicates that the voltage regulator power is operating at a stable voltage level. Use VR_PWRGD on the system electronics to control power inputs and to gate PWROK to the PIIX4E/M.

Table 21 lists the voltage signal definitions and sequences, and Figure 5 shows the signal sequencing and the voltage planes sequencing required for normal operation of the Pentium II processor mobile module.



4.7.2.1. Voltage Signal Definition and Sequencing

Table 21. Voltage Signal Definitions and Sequences

Signal	Source	Definitions and Sequences
V_DC	System Electronics	V_DC is required to be between 5V and 21V DC and is driven by the system electronics' power supply. V_DC powers the Pentium® II processor mobile module's DC-to-DC converter for processor core and I/O voltages. The Pentium II processor mobile module cannot be hot inserted or removed while V_DC is powered on.
V_3	System Electronics	V_3 is supplied by the system electronics for the 443BX.
V_5	System Electronics	V_5 is supplied by the system electronics for the 443BX's reference voltage and the Pentium® II processor mobile module's voltage regulator.
VR_ON	System Electronics	VR_ON is a 3.3V (5V tolerant) signal that enables the Pentium® II processor mobile module's voltage regulator circuit. When driven active high the voltage regulator circuit is activated. The signal driving VR_ON should be a digital signal with a rise/fall time of less than or equal to 1 μ s. (VIL (max)=0.4V, VIH (min)=3.0V). See notes below.
V_CORE (also used as host bus GTL+ termination voltage VTT)	Pentium® II processor mobile module only; not on module interface.	A result of VR_ON being asserted. V_CORE is an output of the DC-DC regulator on the Pentium® II processor mobile module and is driven to the core voltage of the processor. It is also used as the host bus GTL+ termination voltage, known as VTT.
VR_PWRGD	Pentium® II processor mobile module	Upon sampling the voltage level of V_CORE (minus tolerances for ripple), VR_PWRGD is driven active high. If VR_PWRGD is not sampled active within 1 sec. of the assertion of VR_ON, then the system electronics should deassert VR_ON. After Vcore is stabilized, VR_PWRGD will assert to logic high (3.3V). This signal <i>must not be pulled up</i> by the system electronics. VR_PWRGD should be "ANDed" with V_3s to generate the PIIX4E/M input signal, PWROK. The system electronics should monitor VR_PWRGD to verify it is asserted high prior to the active high assertion of PIIX4E/M PWROK.
V_CPUPU	Pentium II processor mobile module	V_CPUPU is 2.5V. The system electronics uses this voltage to power the PIIX4E/M-to-processor interface circuitry.
V_CLK	Pentium II processor mobile module	V_CLK is 2.5V. The system electronics uses this voltage to power the HCLK [0:1] drivers for the processor clock.

NOTES:

1. The VR_ON signal may only be asserted to a logical high by a digital signal only after V_DC \geq 4.7V, V_5 \geq 4.5V, and V_3 \geq 3.0V.
2. The rise time and fall time of VR_ON must be less than or equal to 1 μ s when it goes through its Vil to Vih.
3. VR_ON has its Vil (max) = +0.4V and Vih (min) = + 3.0V.
4. VR_ON needs to rise monotonically through its Vil to Vih points.
5. VR_ON needs to provide an instantaneous in-rush current to the module with the following values: an instantaneous max. of 41 mA with a typical of 0.2 mA; a DC operating max. of 0.1 μ A with a typical of 0.0.
6. In going from a valid on to valid off and then back on, VR_ON must be low for 1 ms. In addition, the original voltage level requirements for turn-on always need to be met before assertion of VR_ON (i.e. V_DC \geq 4.7V, V5 \geq 4.5V, V_3 \geq 3.0V).

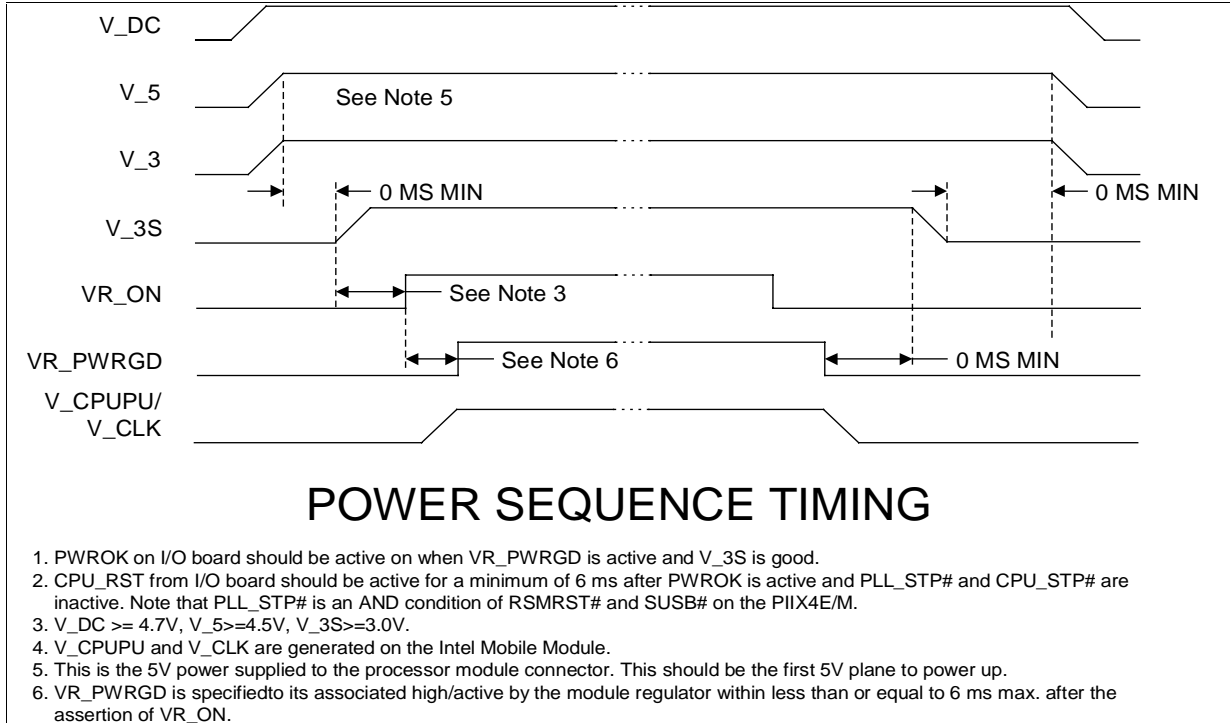


Figure 5. Power-On Sequence Timing

In the power-on process, Intel recommends that the higher voltage power plane is raised first (V_DC), followed by the lower power planes (V_5 and V_3), and finally the assertion of VR_ON. In the power-off process, the reverse applies so that first VR_ON is deasserted, followed by the lower power planes, and finally the higher power plane.

amount of bulk capacitance is supplied on the Pentium® II processor mobile module. However, in order to achieve proper filtering additional capacitance should be placed on the system electronics.

Table 22 details the bulk capacitance requirements for the system electronics

4.7.3. Power Planes: Bulk Capacitance Requirements

To provide adequate filtering and in-rush current protection or any system design, bulk capacitance is required. A small

Table 22. Capacitance Requirement per Power Plane

Power Plane	Capacitance Requirements	ESR	Ripple Current	Rating
V_DC	100 uf, 0.1 uf, 0.01 uf ¹	20 mΩ	1-3.5A ³	20% tolerance at 35V
V_5	100 uf, 0.1 uf, 0.01 uf ¹	100 mΩ	1A	20% tolerance at 10V
V_3	470 uf, 0.1 uf, 0.01 uf ¹	100 mΩ	1A	20% tolerance at 6V
V_3S	100 uf, 0.1 uf, 0.01 uf ¹	100 mΩ	N/A	20% tolerance at 6V
VCC_AGP	22 uf, 0.1 uf, 0.01 uf ¹	100 mΩ	1A	20% tolerance at 6V
V_CPUPU	2.2 uf, 8200 pf ¹	n/a	n/a	20% tolerance at 6V
V_CLK	10uf, 8200pf ²	n/a	n/a	20% tolerance at 6V

NOTES:

1. Placement of above capacitance requirements should be located near the MMC-2.
2. V_CLK filtering should be located next to the system clock synthesizer.
3. Ripple current specification depends on V_DC input. For 5.0V V_DC, a 3.5A device is required. For V_DC at 18V or higher, 1A is sufficient.

4.7.4. Surge Current Guidelines

This section provides the results of a worst case, surge current analysis. The analysis determines the maximum amount of surge current that the Pentium® II processor mobile module can manage.

In the analysis, the Pentium II processor mobile module has two 4.7 μf with an ESR of 0.15 Ω total. The MMC-2 is approximately 30 m Ω of series resistance, for a total series resistance of .18 Ω . If the user powers the system with the A/C adapter (18V), the amount of surge current on the module would be approximately 100A. This information is

also used to develop I/O bulk capacitance requirements (See Table 22).

NOTE: Depending on the system electronics design, different impedances may yield different results. The OEM should perform a thorough analysis to understand the implications of surge current on their system.

Figure 6 shows an electrical model used when analyzing instantaneous power-on conditions. Figure 7 illustrates the results with a SPICE simulation.

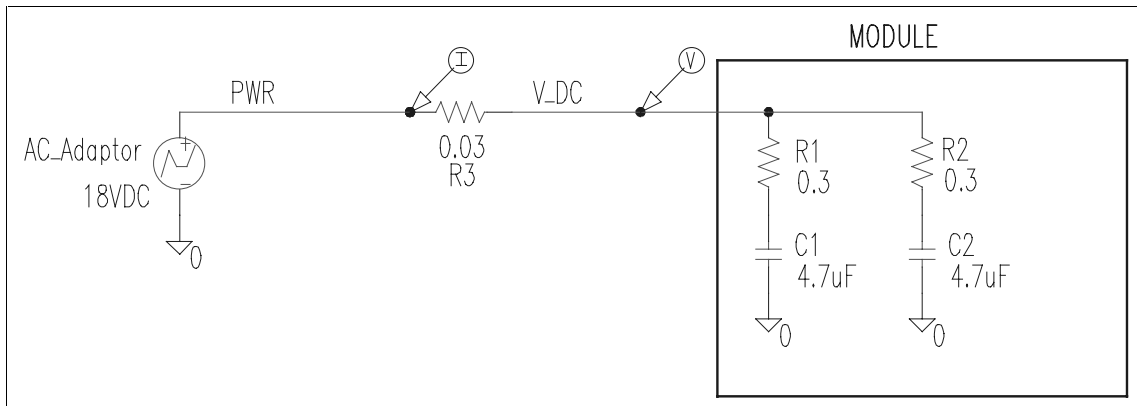


Figure 6. Instantaneous In-Rush Current Model

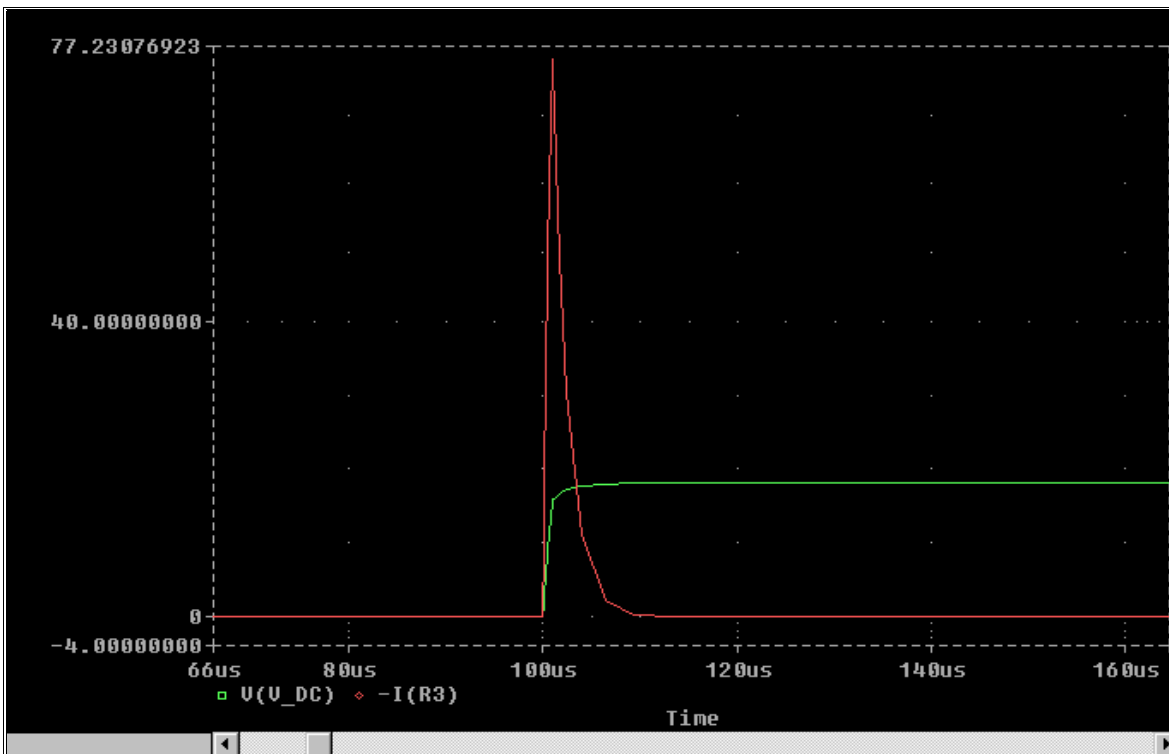


Figure 7. Instantaneous In-Rush Current

Due to component height requirements ($\leq 4\text{mm}$) of the Pentium II processor mobile module, Polymerized Organic Semiconductor capacitors must be used as input bulk capacitance in the voltage regulator circuit. Because of the capacitor's susceptibility to high in-rush current, special care

must be taken. One way to soften the in-rush current and provide over voltage/over current protection is to ramp up V_{DC} slowly using a circuit similar to the one shown in Figure 8.

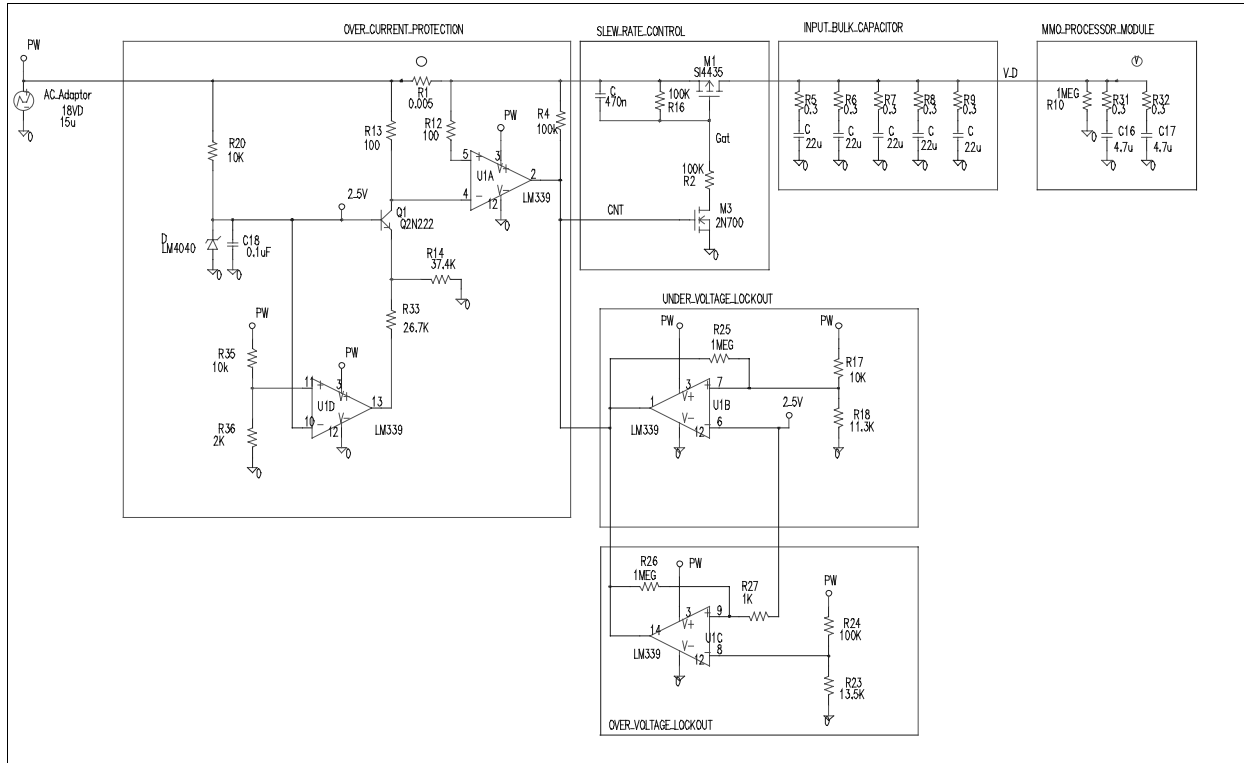


Figure 8. Over-Current Protection Circuit

NOTE:

Values shown are for reference only.

4.7.4.1. Slew-Rate Control: Circuit Description

In Figure 8, PWR is the voltage generated by applying the AC Adaptor or Battery. M1 is a low RDS (on) P-Channel MOSFET such as a Siliconix® S14435DY. When the voltage on PWR is applied and increased to over 4.75V, the UNDER_VOLTAGE_LOCKOUT circuit allows R4 to pull up

the gate of M3 to start a turn-on sequence. M3 pulls its drain toward ground forcing current to flow through R2. M1 will not start to source any current until after t_{delay} with t_{delay} defined as:

$$t_{\text{delay}} := -R2 \cdot C9 \cdot \ln \left(1 - \frac{V_t}{V_{\text{pwr}} - V_{\text{gs_max}}} \right)$$

$$V_{\text{gs_max}} = \frac{R16}{R16 + R2} \cdot V_{\text{pwr}}$$

The system manufacturer's $V_{\text{gs_max}}$ specification of 20V must never be exceeded. However, $V_{\text{gs_max}}$ must be high enough to keep the RDS (on) of the device as low as

possible. After the initial t_{delay} , M1 will begin to source current and V_{DC} will start to ramp up. The ramp up time, t_{ramp} , is defined as:

$$t_{\text{ramp}} := -R2 \cdot C9 \ln\left(1 - \frac{V_{\text{sat}}}{V_{\text{gs_max}}}\right) - t_{\text{delay}}$$

Maximum current during the voltage ramping is:

$$I = C_{\text{total}} \frac{V_{\text{pwr}}}{t_{\text{ramp}}}$$

With the circuit shown in Figure 8, $t_{\text{delay}} = 5.53 \text{ ms}$, $t_{\text{tran}} = 14.0 \text{ ms}$, and $I_{\text{max}} = 146 \text{ mA}$. Figure 9 shows a SPICE simulation of the circuit in Figure 8. To increase the reliability of tantalum capacitors, use a slew rate control circuit described in Figure 8 and voltage-derate the capacitor about 50 percent. That is, for a maximum input voltage of 18V, use a 35V, low ESR capacitor with high ripple current capability. Place five 22- $\mu\text{F}/35\text{V}$ capacitors on the baseboard, directly at the V_{DC} pins of the processor module connector.

Finally, the Slew Rate Control circuit should be applied to every input power source to the system V_{DC} to provide the most protection. A potential problem still exists if all power sources are OR'ed together at the PWR node. For example, if a 3X3 Li-Ion battery pack is powering the system (12V at PWR), and the AC Adaptor (18V) is plugged into the system, it will immediately source current to the PWR node and V_{DC} rapidly. This is because the Slew Rate Control is already ON. Therefore, the slew rate control must be applied to every input power source to provide the most protection.

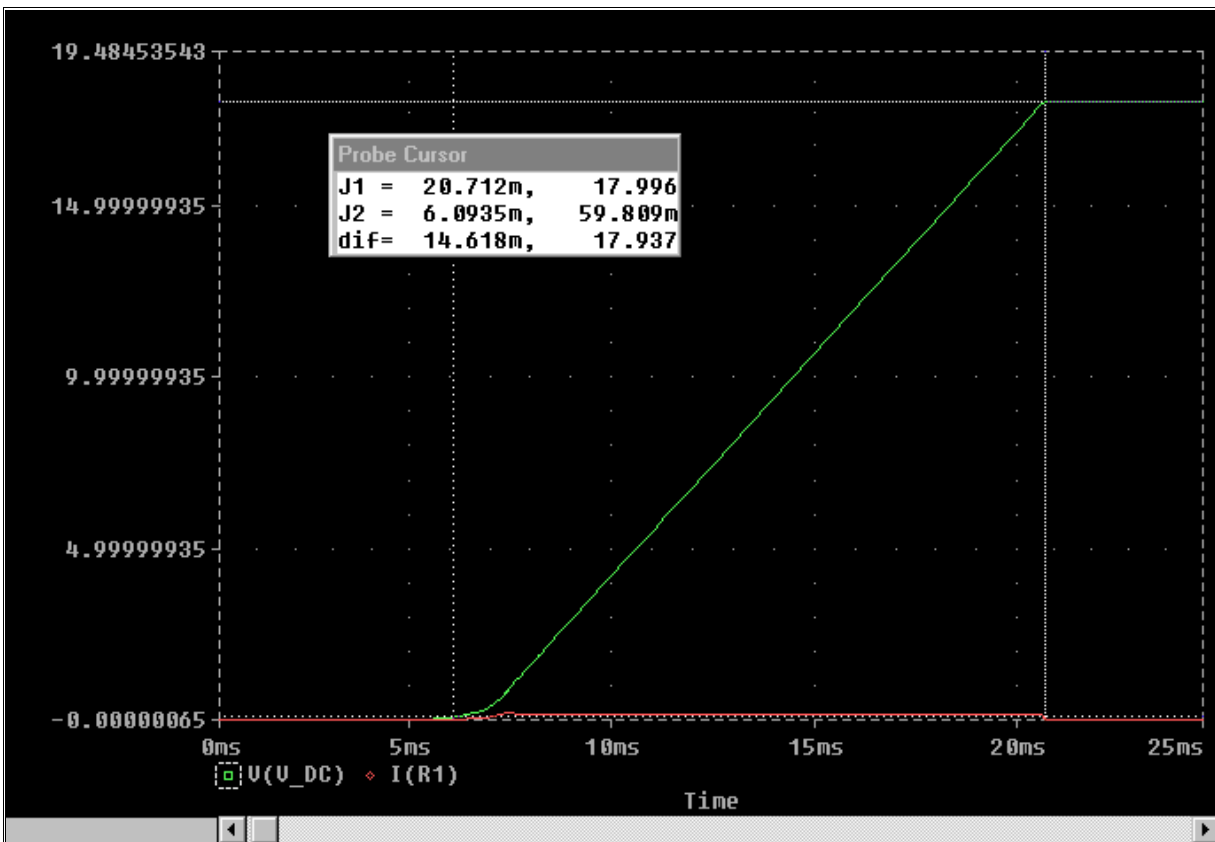


Figure 9. Spice Simulation Using In-Rush Protection (Example Only)

4.7.4.2. Under-Voltage Lockout: Circuit Description ($V_{\text{uv_lockout}}$)

The circuit shown in Figure 8 provides an under-voltage protection and locks out the applied voltage to the Pentium® II processor mobile module to prevent an accidental turn-on at low voltage. The output of this circuit, pin 1 of the LM339

comparator, is an open-collector output. It is low when the applied voltage at PWR is less than 4.75V. This voltage can be calculated with the following equation with the voltage across D7 as 2.5V (D7 is a 2.5-V reference generator).

$$V_{uv_lockout} := V_{ref} \left[1 + \frac{R17}{\left(\frac{R18 \cdot R25}{R18 + R25} \right)} \right]$$

$$V_{uv_lockout} = 4.757 \cdot \text{volt}$$

4.7.4.3. Over-Voltage Lockout: Circuit Description (V_{ov_lockout})

The Pentium® II processor mobile module is specified to operate with a maximum input voltage of 21V. This circuit locks out the input voltage if it exceeds the maximum 21V. The output of this circuit, Pin 14 of the LM339 comparator, is

an open-collector output. It is low when the applied voltage at PWR is more than 21V. This voltage can be calculated with the following equation:

$$V_{ov_lockout} := V_{ref} \left(\frac{R26}{R26 + R27} \right) \cdot \left(1 + \frac{R24}{R23} \right)$$

$$V_{ov_lockout} = 20.998 \cdot \text{volt}$$

4.7.4.4. Over-Current Protection: Circuit Description

Figure 8 shows that the circuit detects an over-current condition and cuts off the input voltage applied to the Pentium® II processor mobile module. This circuit has two different current limit trip points, which accounts for the different maximum current drain by the Pentium II processor

mobile module at different input voltages. Assuming the AC Adaptor voltage is 18V and the battery is a 3x3 Li-Ion configuration with a minimum voltage of 7.5V, the maximum current for the above circuit can be calculated using the following expression:

With AC Adaptor (I_{wAdaptor}):

$$I_{wAdaptor} := \frac{V_{ref} - V_{be_Q1}}{R14} \cdot \frac{R13}{R1}$$

$$I_{wAdaptor} = 0.989 \cdot \text{amp}$$

Without AC Adaptor (I_{woAdaptor}):

$$I_{woAdaptor} := \frac{V_{ref} - V_{be_Q1}}{\left(\frac{R14 \cdot R33}{R14 + R33} \right)} \cdot \frac{R13}{R1}$$

$$I_{woAdaptor} = 2.375 \cdot \text{amp}$$

4.8. Active Thermal Feedback

Table 23 identifies the address allocated for the SMBus thermal sensor used on the Pentium® II processor mobile module.

Table 23. Thermal Sensor SMBus Address Table

Function	Fixed Address AD Bits (6:4)	Selectable Address AD Bits (3:0)
Thermal Sensor	100	1110
Reserved	010	1010
Reserved	010	1011

NOTE:

The thermal sensor used is compliant with SMBus addressing. Please refer to the *Pentium® II processor Thermal Sensor Interface Specification*.

4.9 Thermal Sensor Configuration Register

The configuration register of the thermal sensor controls the operating mode (Auto-convert vs. Standby) of the device. Since the processor temperature varies dynamically during normal operation, auto-convert mode should be used exclusively to monitor processor temperature. Table 24 shows the format of the configuration register. If the RUN/STOP bit is low, then the thermal sensor enters auto-conversion mode. If the RUN/STOP bit is set high, then the thermal sensor immediately stops converting and enters

Standby mode. The thermal sensor will still perform temperature conversions in Standby mode when it receives a one-shot command. However, the result of a one-shot command during auto-convert mode is not guaranteed. Intel does not recommend using the one-shot command to monitor temperature when the processor is active, only auto-convert mode should be used. Refer to *Mobile Pentium® II Processor and Pentium® II Processor Mobile Module Thermal Sensor Interface Specifications*, Rev.1.0.

Table 24. Thermal Sensor Configuration Register

Bit	Name	Reset State	Function
7 MSB	MASK	0	Masks SMBALERT# when high.
6	RUN/STOP	0	Standby mode control bit. If low, the device enters auto-convert mode. If high, the device immediately stops converting, and enters standby mode where the one-shot command can be performed.
5 – 0	RFU	0	Reserved for future use.

NOTE:

All RFU bits should be written as “0” and read as “don’t care” for programming purposes.

5.0. MECHANICAL SPECIFICATION

5.1.1. Board Area

5.1. Module Dimensions

Figure 10 shows the board dimensions and the MMC-2 orientation.

This section provides the physical dimensions for the Pentium® II processor mobile module MMC-2.



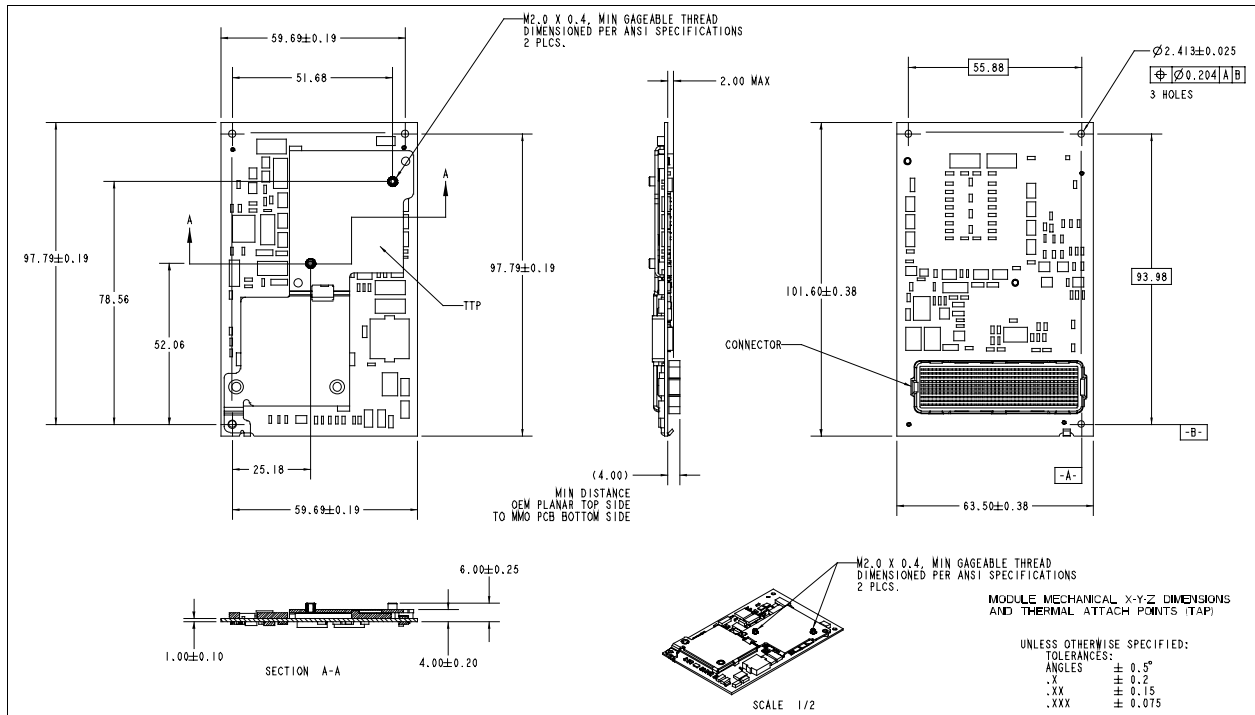


Figure 10. Board Dimensions with 400-Pin Connector Orientation

5.1.2. MMC-2 Pin 1 Location

Figure 11 shows the location of pin 1 of the 400-pin MMC-2 connector as referenced to the adjacent mounting hole.

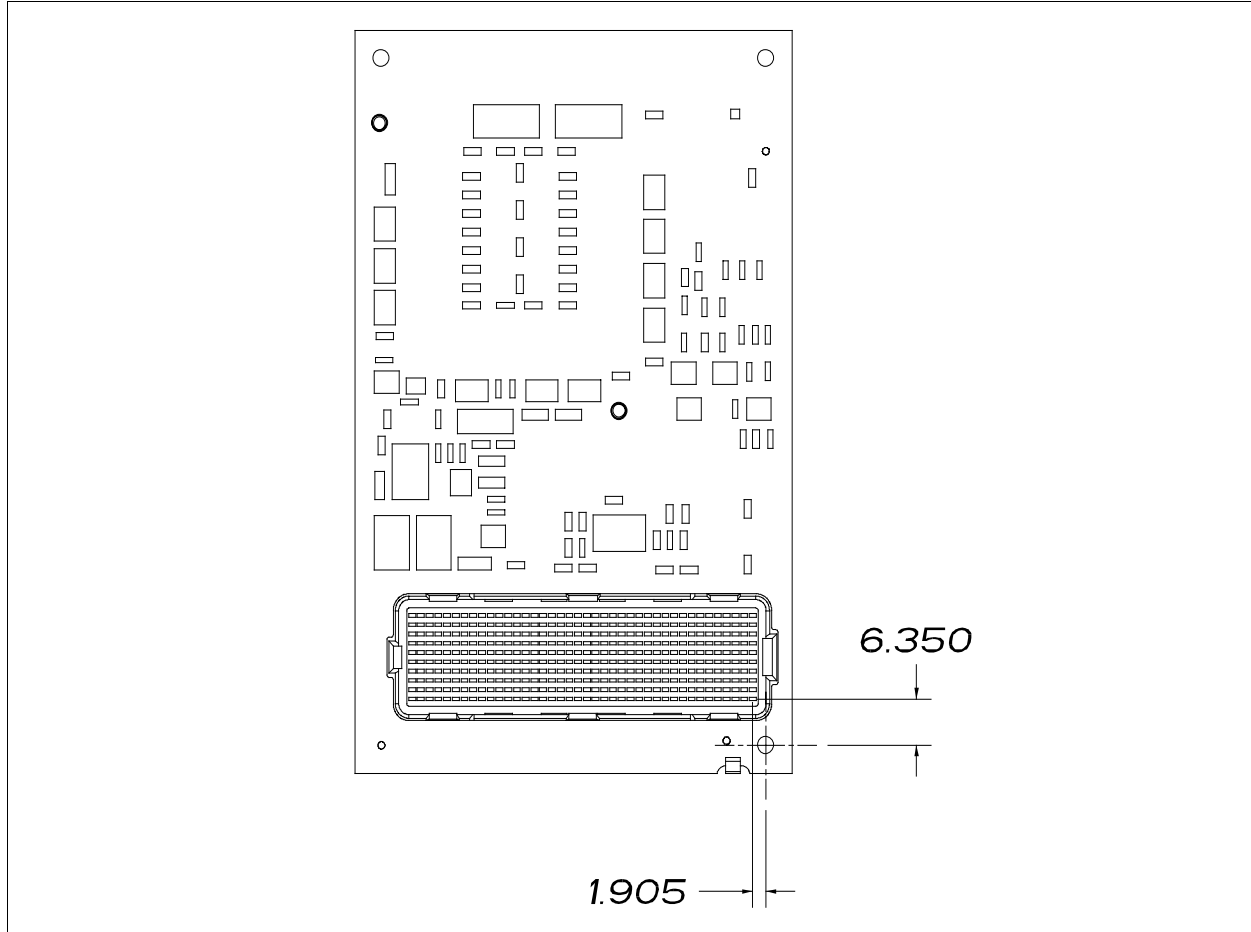


Figure 11. Board Dimensions with the 400-Pin Connector- Pin 1 Orientation

5.1.3. Printed Circuit Board Thickness

Figure 12 shows the Pentium® II processor mobile module profile and the associated minimum and maximum thickness of the printed circuit board (PCB). The range of PCB thickness allows for different PCB technologies to be used with current and future Intel mobile modules.

NOTE: The system manufacturer must ensure that the mechanical restraining method and/or system-level EMI contacts are able to support this range of PCB thickness ensuring compatibility with future Intel mobile models.

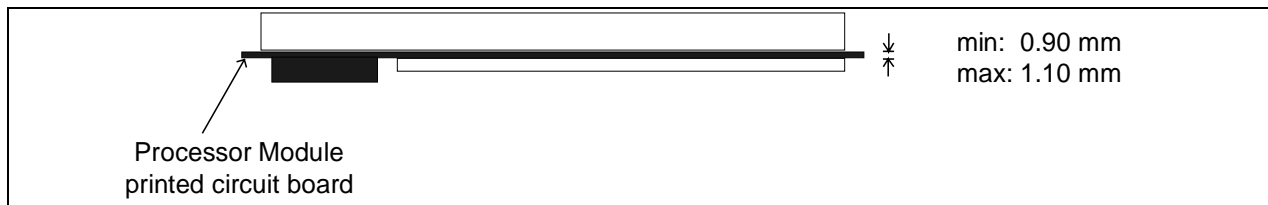


Figure 12. Printed Circuit Board Thickness

5.1.4. Height Restrictions

Figure 13 shows the mechanical stackup and associated component clearance requirements. This is the module keep-out zone and should not be entered or altered. The system manufacturer establishes board-to-board clearance between the Pentium® II processor mobile module

and the system electronics by using one of the 4 mm, 6 mm, or 8 mm mating connectors. The three sizes provide flexibility in choosing the system electronics components between the two boards. Information on these connectors can be obtained from your local Intel representative.

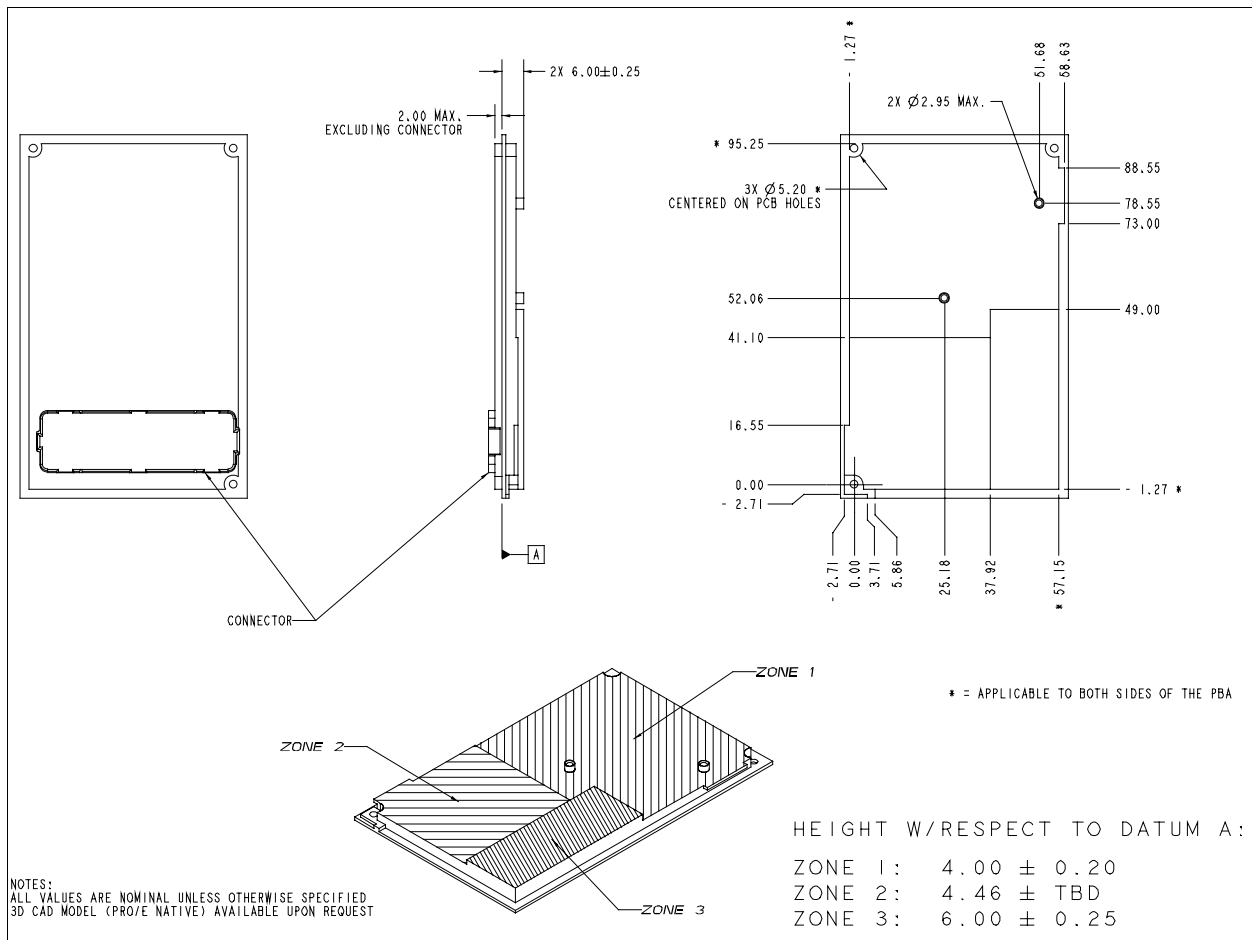


Figure 13. Pentium® II Processor Mobile Module 3-D Keep-out Zone

NOTE:

The topside component clearance is independent of the PCB thickness.

5.2. Thermal Transfer Plate

A thermal transfer plate (TTP) on the processor and the 443BX provides for heat dissipation across the notebook system. The TTP may vary on different generations of Intel mobile modules.

The TTP provides the thermal attach point, where a system manufacturer can use a heat pipe, a heat spreader plate, or a thermal solution to transfer heat through the notebook

system. Attachment dimensions for the OEM thermal interface block to the TTP are provided in the following figure 14 and figure 15. The system manufacturer should use the exact dimensions for maximum contact area to the TTP while ensuring that no warpage of the TTP occurs. If warpage occurs, the thermal resistance of the Pentium® II mobile module could be adversely affected.

When attaching the mating block to the module TTP, a thermal elastimer or thermal grease should be used. This material reduces the thermal resistance. The OEM thermal interface block should be secured with 2.0 mm screws using a maximum torque of 1.5 – 2.0 Kg*cm (equivalent to 0.147 - .197 N*m). The thread length of the 2.00-mm screws should be 2.25-mm gageable thread (2.25-mm minimum to 2.80-mm maximum).

The TTP thermal resistance between the processor core to the system interface (top of the TTP) is less than 1°C per Watt.

The following figures 14 and 15 detail the mechanical dimensions of the TTP and the thermal attach point.

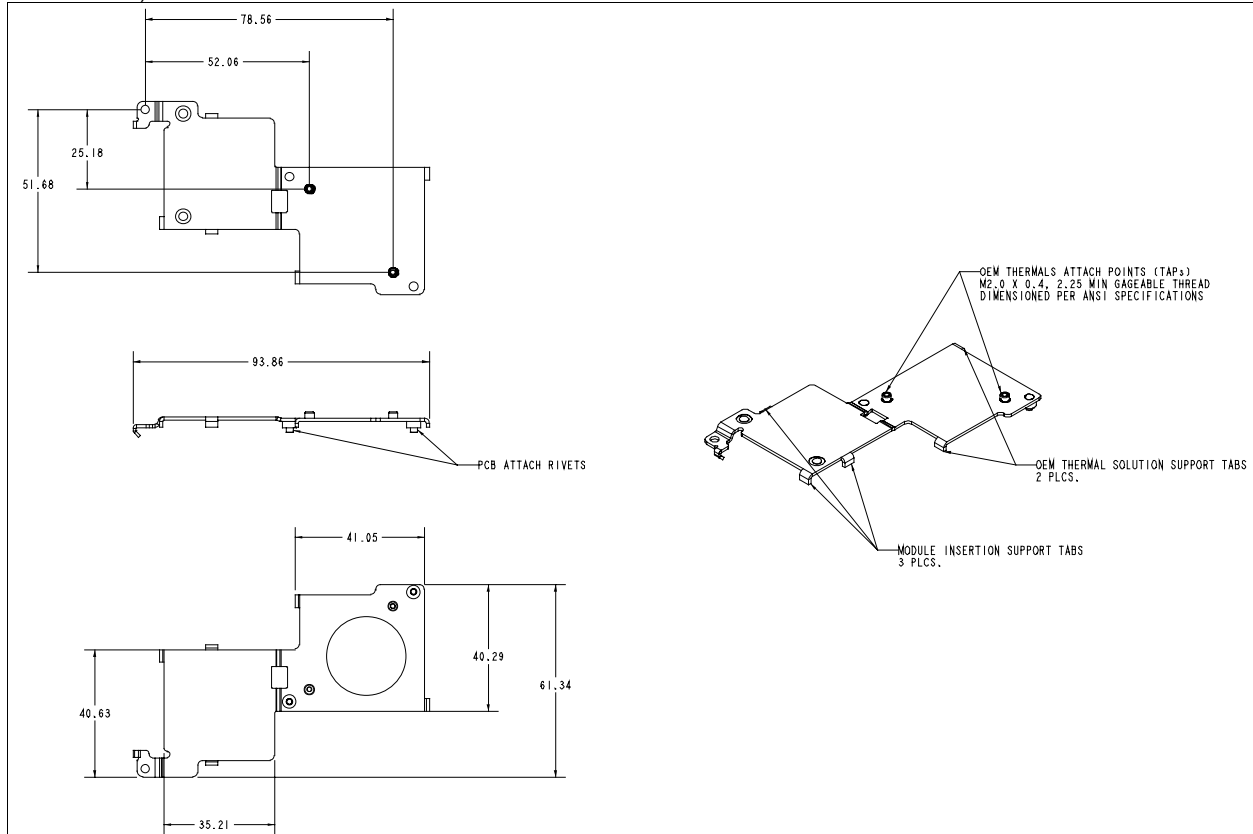


Figure 14. Pentium® II Processor Mobile Module Thermal Transfer Plate

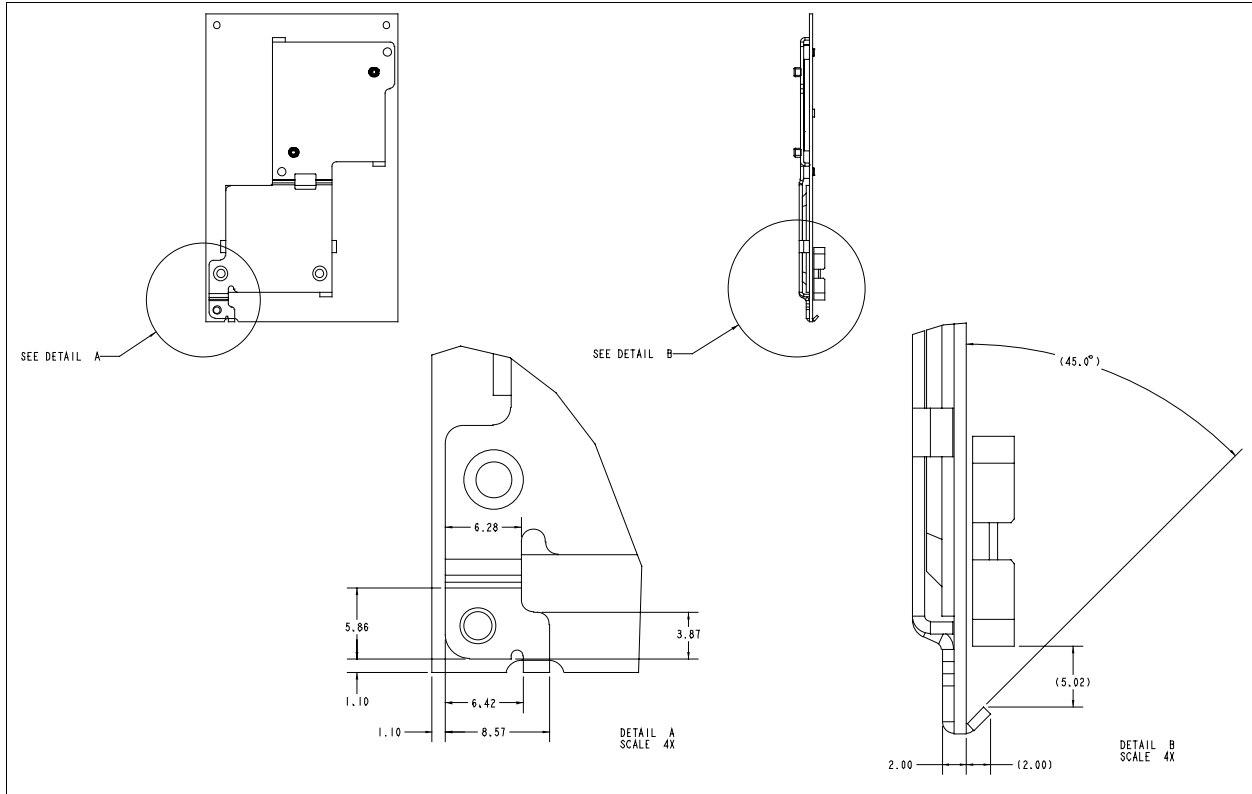


Figure 15. Pentium® II Processor Mobile Module Thermal Transfer Plate

5.3. Module Physical Support

Figure 16 shows the Pentium® II processor mobile module standoff support hole pattern, the board edge clearance, the dimensions of the EMI containment ring, and the keep-out area. These hole locations and board edge clearances will remain fixed for all Intel mobile modules.

5.3.1. Module Mounting Requirements

Three mounting holes secure the Intel mobile module to the system base or the system electronics. See Figure 11 for mounting hole locations. The OEM should utilize all three of the mounting holes to ensure long term mechanical and EMI integrity of the system. The board edge clearance includes a 0.762 mm (0.030 in) width EMI containment ring around the perimeter of the module. This ring is on each layer of the module PCB and is grounded. On the surface of the module, the metal is exposed for EMI shielding purposes. The hole patterns also have a plated surrounding ring to use as a

metal standoff for EMI shielding purposes. Standoffs should be used to provide support for the installed Pentium® II processor mobile module. The distance from the bottom of the module PCB to the top of the OEM system electronics board with the connectors mated is 4.0 mm + 0.16 mm / - 0.13 mm. However, the warpage of the baseboard can vary and should be calculated into the final dimensions of the standoffs used. All calculations can be made with the Intel MMC-2 Standoff/Receptacle Height Spreadsheet. Information on this spreadsheet can be obtained from your local Intel representative.

5.3.2. Module Weight

The weight of the Pentium® II processor mobile module is approximately 50g.

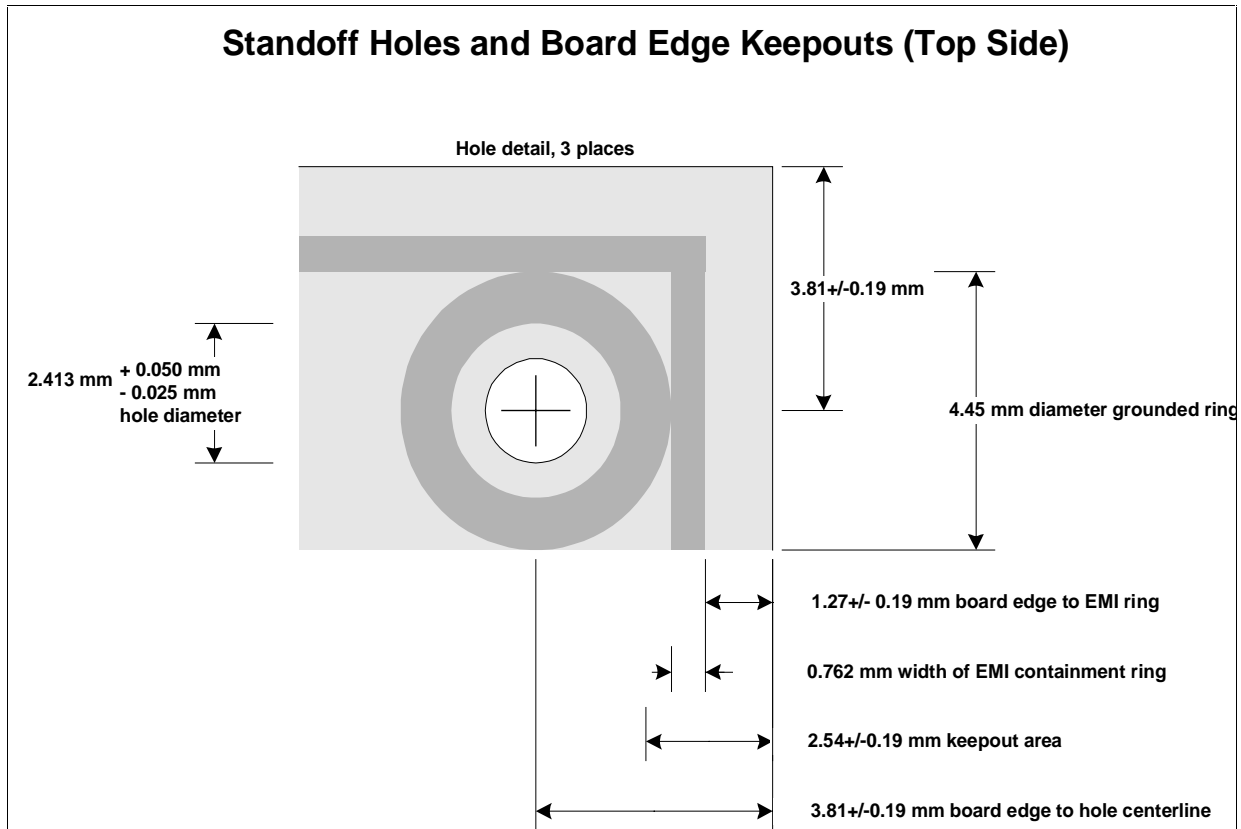


Figure 16. Standoff Holes, Board Edge Clearance, and EMI Containment Ring

6.0. THERMAL SPECIFICATION

6.1. Thermal Design Power

If the system does not incorporate a thermal feedback fail-safe mechanism, the OEM should design the system to the maximum thermal design power as shown in Table 25. The maximum thermal design power is the total power dissipation under normal operating conditions at nominal Vcc, worst case temperature, while executing the worst case power instruction mix. This includes the power dissipated by *all* of the relevant components of the Pentium® II processor mobile module.

The use of nominal Vcc in this measurement accounts for the thermal time constant of the package/system. The power supply must be centered at nominal Vcc, such that during transients the Vcc levels stay within the Vcc +/- Vcc_Delta

(%) range. The duration of surges to Vcc + Vcc_Delta (%) are less than the thermal time constant.

During all operating environments, the processor case temperature, T_{PROC}, must be within the specified range of 0°C to 100°C.

6.2 Thermal Sensor Setpoint

The thermal sensor in the Pentium® II processor mobile module implements the SMBALERT# signal described in the SMBus specification. SMBALERT# is always asserted when the temperature of the processor core thermal diode or the thermal sensor internal temperature exceeds either the upper or lower temperature thresholds. SMBALERT# may also be asserted if the measured temperature equals either the upper or the lower threshold.

Table 25. Pentium® II Processor MMC-2 Maximum Power Specifications

Symbol	Parameter	Min	Typ	Max ¹	Unit	Notes
TDP _{MMC-2}	Thermal Design Power (MMC-2 module)		—	TBD	W	Module (core, 443BX, and voltage regulator)
T _{PROC}	Processor Case Temperature	0		100	°C	

NOTE:

TDP_{MAX} is a specification of the total power dissipation of the worst case processor, worst case 443BX, and worst case voltage regulator while executing a worst case instruction mix under normal operating conditions at nominal voltages. Not 100% tested. Specified by design/characterization.



7.0. LABELING INFORMATION

The Pentium® II processor mobile is tracked in two ways. The first is by the Product Tracking Code (PTC). Intel uses the PTC to determine the assembly level of the module. The

PTC label is on the secondary side of the module as shown in Figure 17 and provides the following information:

- The Product Tracking code consists of 13 characters as identified in the above example and can be broken down as follows:

Example: **PMG36602001AA**

- Definition:

AA	-	Processor Module = PM
B	-	Pentium II processor mobile module = G
CCC	-	Speed Identity = 366, 333, 300PE, 266PE
DD	-	Cache Size = 02 (256KB)
EEE	-	Notifiable Design Revision (Start at 001)
FF	-	Notifiable Processor Revision (Start at AA)

- Note: For other Intel mobile modules, the second field (B) is:

Pentium® II processor mobile module (MMC-1)	= F
Celeron processor mobile module (MMC-1)	= H
Celeron processor mobile module (MMC-2)	= I

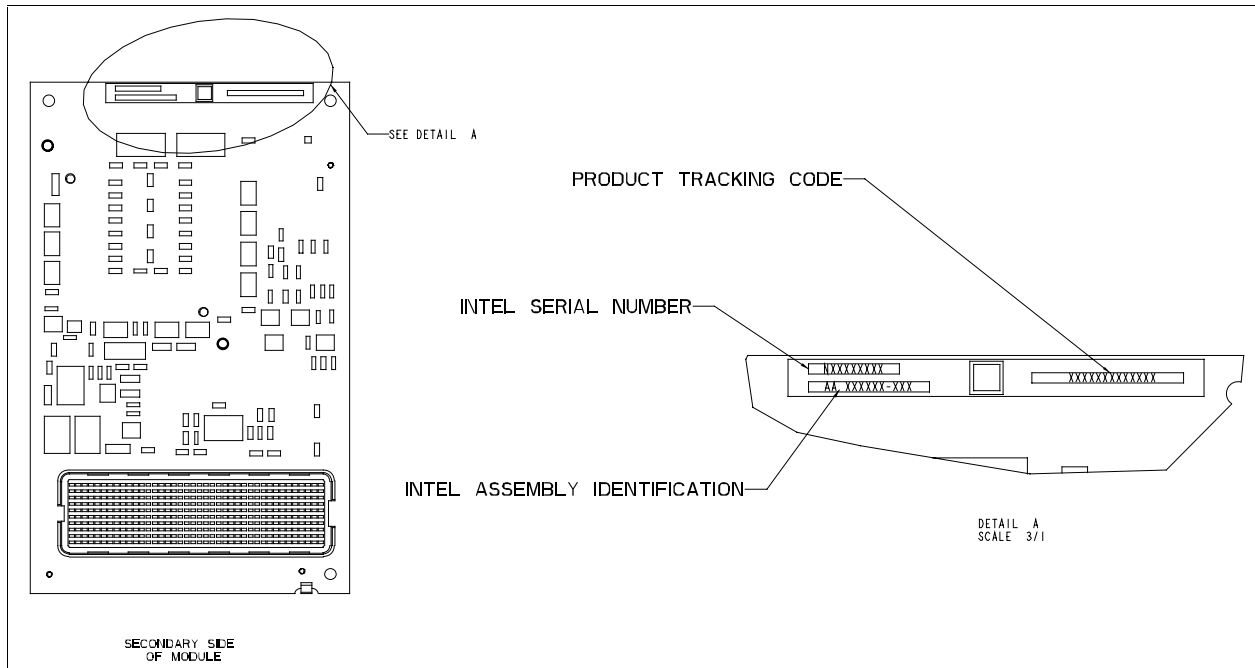


Figure 17. Pentium® II Processor Mobile Module Product Tracking Information

The second tracking method is by OEM generated software utility. Four strapping resistors located on the Pentium II processor mobile module determine its production level. If connected and terminated properly, up to 16-module revision levels can be determined. An OEM generated software utility can then read these ID bits with CPU IDs and stepping IDs

to provide a complete module manufacturing revision level. For current PTC and module ID bit information, please refer to the latest Pentium II processor mobile module Product Change Notification letter which can be obtained from your local Intel sales representative.

8.0. ENVIRONMENTAL STANDARDS

The environmental standards for the Pentium® II processor mobile module are defined in Table 26.

Table 26. Environmental Standards

Parameter	Condition	Specification
Temperature	Non-Operating	-40°C to 85°C
	Operating	0°C to 55°C
Humidity	Unbiased	85% relative humidity at 55 °C
Voltage	V ₅	5V +/- 5%
	V ₃	3.3V +/- 5%
Shock	Non-Operating	Half Sine, 2G, 11 msec
	Unpackaged	Trapezoidal, 50G, 11 msec
	Packaged	Inclined Impact at 5.7 ft/s
	Packaged	Half Sine, 2 msec at 36 in. Simulated Free Fall
Vibration	Unpackaged	5 Hz to 500 Hz 2.2 gRMS random
	Packaged	10 Hz to 500 Hz 1.0 gRMS
	Packaged	11,800 impacts 2 Hz to 5 Hz (low frequency)
ESD	Human Body Model	0 to 2 kV (no detectable err)



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