



APPENDIX A

PERFORMANCE-MONITORING EVENTS

This appendix contains list of the performance-monitoring events that can be monitored with the Intel Architecture processors. In the Intel Architecture processors, the ability to monitor performance events and the events that can be monitored are model specific. Section A.1., *P6 Family Processor Performance-Monitoring Events*, lists and describes the events that can be monitored with the P6 family of processors and Section A.2., *Pentium® Processor Performance-Monitoring Events*, lists and describes the events that can be monitored with Pentium processors.

A.1. P6 FAMILY PROCESSOR PERFORMANCE-MONITORING EVENTS

Table A-1 lists the events that can be counted with the performance-monitoring counters and read with the RDPMC instruction for the P6 family of processors. The unit column gives the microarchitecture or bus unit that produces the event; the event number column gives the hexadecimal number identifying the event; the mnemonic event name column gives the name of the event; the unit mask column gives the unit mask required (if any); the description column describes the event; and the comments column gives additional information about the event.

These performance-monitoring events are intended to be used as guides for performance tuning. The counter values reported are not guaranteed to be absolutely accurate and should be used as a relative guide for tuning. Known discrepancies are documented where applicable. All performance events are model specific to the Pentium Pro processor and are not architecturally guaranteed in future versions of the processor. All performance event encodings not listed in Table A-1 are reserved and their use will result in undefined counter results.

See the end of the table for notes related to certain entries in the table.

Table A-1. Events That Can Be Counted with the P6 Family Performance-Monitoring Counters

Unit	Event Num.	Mnemonic Event Name	Unit Mask	Description	Comments
Data Cache Unit (DCU)	43H	DATA_MEM_REFS	00H	All memory references, both cacheable and noncacheable.	
	45H	DCU_LINES_IN	00H	Total lines allocated in the DCU.	
	46H	DCU_M_LINES_IN	00H	Number of M state lines allocated in the DCU.	

Table A-1. Events That Can Be Counted with the P6 Family Performance-Monitoring Counters (Contd.)

Unit	Event Num.	Mnemonic Event Name	Unit Mask	Description	Comments
	47H	DCU_M_LINES_OUT	00H	Number of M state lines evicted from the DCU. This includes evictions via snoop HITM, intervention or replacement.	
	48H	DCU_MISS_OUTSTANDING	00H	Weighted number of cycles while a DCU miss is outstanding.	An access that also misses the L2 is short-changed by 2 cycles (i.e., if counts N cycles, should be N+2 cycles). Subsequent loads to the same cache line will not result in any additional counts. Count value not precise, but still useful.
Instruction Fetch Unit (IFU)	80H	IFU_IFETCH	00H	Number of instruction fetches, both cacheable and noncacheable.	
	81H	IFU_IFETCH_MISS	00H	Number of instruction fetch misses.	
	85H	ITLB_MISS	00H	Number of ITLB misses.	
	86H	IFU_MEM_STALL	00H	Number of cycles that the instruction fetch pipe stage is stalled, including cache misses, ITLB misses, ITLB faults, and victim cache evictions.	
	87H	ILD_STALL	00H	Number of cycles that the instruction length decoder is stalled.	
L2 Cache ¹	28H	L2_IFETCH	MESI 0FH	Number of L2 instruction fetches.	
	29H	L2_LD	MESI 0FH	Number of L2 data loads.	
	2AH	L2_ST	MESI 0FH	Number of L2 data stores.	

Table A-1. Events That Can Be Counted with the P6 Family Performance-Monitoring Counters (Contd.)

Unit	Event Num.	Mnemonic Event Name	Unit Mask	Description	Comments
	24H	L2_LINES_IN	00H	Number of lines allocated in the L2.	
	26H	L2_LINES_OUT	00H	Number of lines removed from the L2 for any reason.	
	25H	L2_M_LINES_INM	00H	Number of modified lines allocated in the L2.	
	27H	L2_M_LINES_OUTM	00H	Number of modified lines removed from the L2 for any reason.	
	2EH	L2_RQSTS	MESI 0FH	Number of L2 requests.	
	21H	L2_ADS	00H	Number of L2 address strobes.	
	22H	L2_DBUS_BUSY	00H	Number of cycles during which the data bus was busy.	
	23H	L2_DBUS_BUSY_RD	00H	Number of cycles during which the data bus was busy transferring data from L2 to the processor.	
External Bus Logic (EBL) ²	62H	BUS_DRDY_CLOCKS	00H (Self) 20H (Any)	Number of clocks during which DRDY is asserted.	Unit Mask = 00H counts bus clocks when the processor is driving DRDY. Unit Mask = 20H counts in processor clocks when any agent is driving DRDY.
	63H	BUS_LOCK_CLOCKS	00H (Self) 20H (Any)	Number of clocks during which LOCK is asserted.	Always counts in processor clocks.
	60H	BUS_REQ_OUTSTANDING	00H (Self)	Number of bus requests outstanding.	Counts only DCU full-line cacheable reads, not RFOs, writes, instruction fetches, or anything else. Counts "waiting for bus to complete" (last data chunk received).
	65H	BUS_TRAN_BRD	00H (Self) 20H (Any)	Number of burst read transactions.	

Table A-1. Events That Can Be Counted with the P6 Family Performance-Monitoring Counters (Contd.)

Unit	Event Num.	Mnemonic Event Name	Unit Mask	Description	Comments
	66H	BUS_TRAN_RFO	00H (Self) 20H (Any)	Number of read for ownership transactions.	
	67H	BUS_TRANS_WB	00H (Self) 20H (Any)	Number of write back transactions.	
	68H	BUS_TRAN_IFETCH	00H (Self) 20H (Any)	Number of instruction fetch transactions.	
	69H	BUS_TRAN_INVALID	00H (Self) 20H (Any)	Number of invalidate transactions.	
	6AH	BUS_TRAN_PWR	00H (Self) 20H (Any)	Number of partial write transactions.	
	6BH	BUS_TRANS_P	00H (Self) 20H (Any)	Number of partial transactions.	
	6CH	BUS_TRANS_IO	00H (Self) 20H (Any)	Number of I/O transactions.	
	6DH	BUS_TRAN_DEF	00H (Self) 20H (Any)	Number of deferred transactions.	
	6EH	BUS_TRAN_BURST	00H (Self) 20H (Any)	Number of burst transactions.	
	70H	BUS_TRAN_ANY	00H (Self) 20H (Any)	Number of all transactions.	
	6FH	BUS_TRAN_MEM	00H (Self) 20H (Any)	Number of memory transactions.	
	64H	BUS_DATA_RCV	00H (Self)	Number of bus clock cycles during which this processor is receiving data.	
	61H	BUS_BNR_DRV	00H (Self)	Number of bus clock cycles during which this processor is driving the BNR pin.	
	7AH	BUS_HIT_DRV	00H (Self)	Number of bus clock cycles during which this processor is driving the HIT pin.	Includes cycles due to snoop stalls.
	7BH	BUS_HITM_DRV	00H (Self)	Number of bus clock cycles during which this processor is driving the HITM pin.	Includes cycles due to snoop stalls.

Table A-1. Events That Can Be Counted with the P6 Family Performance-Monitoring Counters (Contd.)

Unit	Event Num.	Mnemonic Event Name	Unit Mask	Description	Comments
	7EH	BUS_SNOOP_STALL	00H (Self)	Number of clock cycles during which the bus is snoop stalled.	
Floating-Point Unit	C1H	FLOPS	00H	Number of computational floating-point operations retired.	Counter 0 only
	10H	FP_COMP_OPS_EXE	00H	Number of computational floating-point operations executed.	Counter 0 only.
	11H	FP_ASSIST	00H	Number of floating-point exception cases handled by microcode.	Counter 1 only.
	12H	MUL	00H	Number of multiplies.	Counter 1 only.
	13H	DIV	00H	Number of divides.	Counter 1 only.
	14H	CYCLES_DIV_BUSY	00H	Number of cycles during which the divider is busy.	Counter 0 only.
Memory Ordering	03H	LD_BLOCKS	00H	Number of store buffer blocks.	
	04H	SB_DRAINS	00H	Number of store buffer drain cycles.	
	05H	MISALIGN_MEM_REF	00H	Number of misaligned data memory references.	
Instruction Decoding and Retirement	C0H	INST_RETIRED	OOH	Number of instructions retired.	
	C2H	UOPS_RETIRED	00H	Number of UOPs retired.	
	D0H	INST_DECODER	00H	Number of instructions decoded.	
Interrupts	C8H	HW_INT_RX	00H	Number of hardware interrupts received.	
	C6H	CYCLES_INT_MASKED	00H	Number of processor cycles for which interrupts are disabled.	

Table A-1. Events That Can Be Counted with the P6 Family Performance-Monitoring Counters (Contd.)

Unit	Event Num.	Mnemonic Event Name	Unit Mask	Description	Comments
	C7H	CYCLES_INT_PENDING_AND_MASKED	00H	Number of processor cycles for which interrupts are disabled and interrupts are pending.	
Branches	C4H	BR_INST_RETIRED	00H	Number of branch instructions retired.	
	C5H	BR_MISS_PRED_RETIRED	00H	Number of mispredicted branches retired.	
	C9H	BR_TAKEN_RETIRED	00H	Number of taken branches retired.	
	CAH	BR_MISS_PRED_TAKEN_RET	00H	Number of taken mispredictions branches retired.	
	E0H	BR_INST_DECODED	00H	Number of branch instructions decoded.	
	E2H	BTB_MISSES	00H	Number of branches that miss the BTB.	
	E4H	BR_BOGUS	00H	Number of bogus branches.	
	E6H	BACLEARS	00H	Number of time BACLEAR is asserted.	
Stalls	A2	RESOURCE_STALLS	00H	Number of cycles during which there are resource related stalls.	
	D2H	PARTIAL_RAT_STALLS	00H	Number of cycles or events for partial stalls.	
Segment Register Loads	06H	SEGMENT_REG_LOADS	00H	Number of segment register loads.	
Clocks	79H	CPU_CLK_UNHALTED	00H	Number of cycles during which the processor is not halted.	
MMX™ Unit	B0H	MMX_INSTR_EXEC	00H	Number of MMX Instructions Executed.	Available in Pentium® II processor only.
	B1H	MMX_SAT_INSTR_EXEC	00H	Number of MMX Saturating Instructions Executed.	Available in Pentium II processor only.

Table A-1. Events That Can Be Counted with the P6 Family Performance-Monitoring Counters (Contd.)

Unit	Event Num.	Mnemonic Event Name	Unit Mask	Description	Comments
	B2H	MMX_UOPS_EXEC	0FH	Number of MMX UOPS Executed.	Available in Pentium II processor only.
	B3H	MMX_INSTR_TYPE_EXEC	01H 02H 04H 08H 10H 20H	MMX packed multiply instructions executed. MMX packed shift instructions executed. MMX pack operation instructions executed. MMX unpack operation instructions executed. MMX packed logical instructions executed. MMX packed arithmetic instructions executed.	Available in Pentium II processor only.
	CCH	FP_MMX_TRANS	00H 01H	Transitions from MMX instruction to floating-point instructions. Transitions from floating-point instructions to MMX instructions.	Available in Pentium II processor only.
	CDH	MMX_ASSIST	00H	Number of MMX Assists (that is, the number of EMMS instructions executed).	Available in Pentium II processor only.
	CEH	MMX_INSTR_RET	00H	Number of MMX Instructions Retired.	Available in Pentium II processor only.
Segment Register Renaming	D4H	SEG_RENAME_STALLS	01H 02H 04H 08H 0FH	Number of Segment Register Renaming Stalls: Segment register ES Segment register DS Segment register FS Segment register FS Segment registers ES + DS + FS + GS	Available in Pentium II processor only.

Table A-1. Events That Can Be Counted with the P6 Family Performance-Monitoring Counters (Contd.)

Unit	Event Num.	Mnemonic Event Name	Unit Mask	Description	Comments
	D5H	SEG_REG_RENAMES	01H 02H 04H 08H 0FH	Number of Segment Register Renames: Segment register ES Segment register DS Segment register FS Segment register FS Segment registers ES + DS + FS + GS	Available in Pentium II processor only.
	D6H	RET_SEG_RENAMES	00H	Number of segment register rename events retired.	Available in Pentium II processor only.

NOTES:

- Several L2 cache events, where noted, can be further qualified using the Unit Mask (UMSK) field in the PerfEvtSel0 and PerfEvtSel1 registers. The lower 4 bits of the Unit Mask field are used in conjunction with L2 events to indicate the cache state or cache states involved. The P6 family processors identify cache states using the "MESI" protocol and consequently each bit in the Unit Mask field represents one of the four states: UMSK[3] = M (8H) state, UMSK[2] = E (4H) state, UMSK[1] = S (2H) state, and UMSK[0] = I (1H) state. UMSK[3:0] = MESI (FH) should be used to collect data for all states; UMSK = 0H, for the applicable events, will result in nothing being counted.
- All of the external bus logic (EBL) events, except where noted, can be further qualified using the Unit Mask (UMSK) field in the PerfEvtSel0 and PerfEvtSel1 registers. Bit 5 of the UMSK field is used in conjunction with the EBL events to indicate whether the processor should count transactions that are self-generated (UMSK[5] = 0) or transactions that result from any processor on the bus (UMSK[5] = 1).