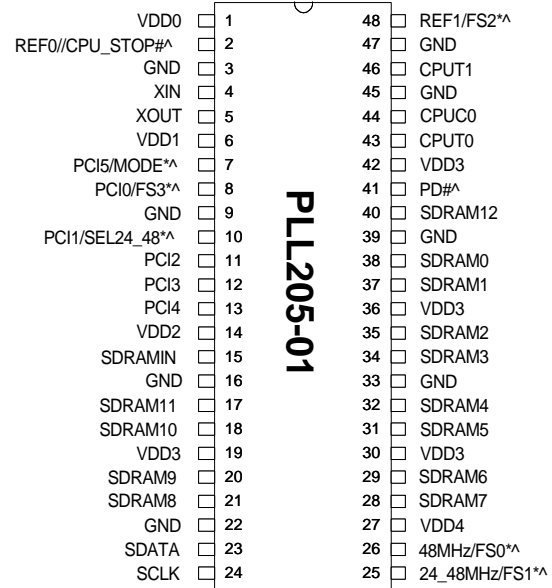


Motherboard Clock Generator for AMD - K7

FEATURES

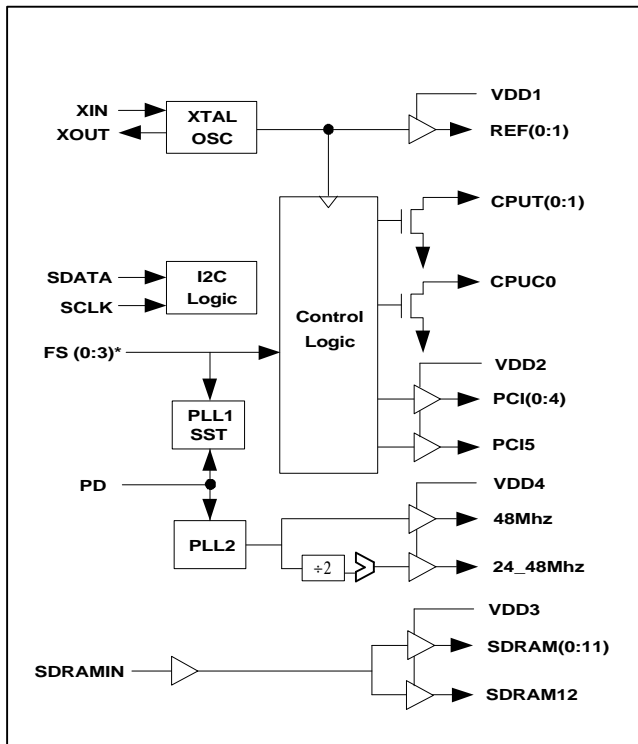
- Generates all clock frequencies for VIA K7 chip sets requiring multiple CPU clocks and high speed SDRAM buffers.
- Support one pair of differential CPU clocks, one open-drain CPU, 6 PCI and 13 high-speed SDRAM buffers for 3-DIMM applications.
- One 24_48MHz clock and one 48MHz clock.
- Two 14.318MHz reference clocks.
- Power management control to stop CPU, and Power down Mode from I2C programming.
- Support 2-wire I2C serial bus interface with built-in Vendor ID, Device ID and Revision ID.
- Single byte micro-step linear Frequency Programming via I2C with Glitch free smooth switching.
- Spread Spectrum $\pm 0.25\%$ center spread, 0 to -0.5% downspread.
- 50% duty cycle with low jitter.
- Available in 300 mil 48 pin SSOP.

PIN CONFIGURATION



Note: [^]: Pull up, #: Active Low
*: Bi-directional latched at power-up

BLOCK DIAGRAM



I/O MODE CONFIGURATION

MODE (Pin 7)	PIN 2
1 (OUTPUT)	REF0
0 (INPUT)	CPU_STOP

POWER GROUP

- VDD0: PLL CORE
- VDD1: REF(0:1), XIN, XOUT
- VDD2: PCI(0:5)
- VDD3: SDRAM(0:12)
- VDD4: 48MHz, 24_48MHz

KEY SPECIFICATIONS

- CPU Cycle to Cycle jitter: 250ps.
- PCI to PCI output skew: 500ps.
- CPU to CPU output skew: ± 175 ps
- SDRAM to SDRAM output skew: 250ps.
- CPU to PCI skew (CPU leads): 0 ~ 3 ns.

Motherboard Clock Generator for AMD - K7

PIN DESCRIPTIONS

Name	Number	Type	Description
VDD0	1	P	Power supply for PLL CORE.
VDD1	6	P	Power supply for REF0, REF1, and crystal oscillator.
VDD2	14	P	Power supply for PCI (0:5).
VDD3	19,30,36,42	P	Power supply for SDRAM (0:12).
VDD4	27	P	Power supply for 24_48MHz and 48MHz.
GND	3,9,16,22, 33,39,45,47	P	Ground.
XIN	4	I	14.318MHz crystal input that has internal loads cap (36pF) and feedback resistor from XOUT.
XOUT	5	O	14.318MHz crystal output. It has internal load cap (36pF).
REF0//CPU_STOP	2	B	Multiplexed pin controlled by MODE signal. When CPU_STOP is low, it will halt CPUT (0:1), CPUC0 and SDRAM (0:11) outputs. In output mode, this pin will generate buffered reference clock output.
PCI5/MODE	7	B	At power-up, MODE function will be activated. When MODE is Low, Pin 2 is input for CPU_STOP. When high, Pin 2 is output for REF0. After input data latched, this pin will generate PCI bus clock.
PCI0/FS3	8	B	At power-up, this pin is input pin and will determine CPU clock frequency. After input sampling, this pin will generate output clocks. FS3 has internal pull up (high by default).
PCI1/SEL24_48	10	B	At power-up, this pin will select 24MHz (when high) or 48MHz (when low) for pin25 output. After input sampling, this pin is PCI output. It has internal pull up resistor.
PCI(2:4)	11,12,13	O	PCI clock outputs.
SDRAMIN	15	I	Buffer input pin: The signal provided to this input pin is buffered to 13 SDRAM outputs.
SDRAM(0:11)	17,18,20,21,28, 29,31,32,34,35, 37,38	O	SDRAM clock outputs, Fan-out Buffer outputs from SDRAMIN pin.
SDATA	23	B	Serial data inputs for serial interface port.
SCLK	24	I	
24_48MHz/FS1, 24MHz/FS0	25,26	B	At power-up, these pins are input pins and will determine the CPU clock frequency. FS0, FS1 have internal pull up (high by default).
SDRAM12	40	O	When CPU_STOP is low, this pin is still free running. When the power down is low, this SDRAM will be stopped.
PD#	41	I	When low, it will stop all clock outputs. It has internal pull-up resistor.
CPUT(0:1)	43,46	O	"True" clocks of differential pair open-drain CPU outputs.
CPUC0	44	O	"Complementary" clocks of differential pair open-drain CPU outputs.
REF1/FS2	48	B	Buffered reference clock output after input data latched during power-up.

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FREQUENCY (MHz) SELECTION TABLE

I2C Byte0 Bit2	FS3	FS2	FS1	FS0	CPU	PCI	Spread Spectrum Modulation
0 default	0	0	0	0	124.0	41.3	±0.25%
	0	0	0	1	75.0	37.5	±0.25%
	0	0	1	0	83.3	41.7	±0.25%
	0	0	1	1	66.8	33.4	±0.25%
	0	1	0	0	103.0	34.3	±0.25%
	0	1	0	1	112.0	37.3	±0.25%
	0	1	1	0	133.3	44.4	±0.25%
	0	1	1	1	100.0	33.3	±0.25%
	1	0	0	0	120.0	40.0	±0.25%
	1	0	0	1	115.0	38.3	±0.25%
	1	0	1	0	110.0	36.7	±0.25%
	1	0	1	1	105.0	35.0	±0.25%
	1	1	0	0	140.0	35.0	±0.25%
	1	1	0	1	150.0	37.5	±0.25%
	1	1	1	0	124.0	31.0	±0.25%
	1	1	1	1	133.3	33.3	±0.25%
1	0	0	0	0	90.0	30.0	±0.25%
	0	0	0	1	92.5	30.8	±0.25%
	0	0	1	0	95.0	31.7	±0.25%
	0	0	1	1	97.5	32.5	±0.25%
	0	1	0	0	101.5	33.8	±0.25%
	0	1	0	1	127.0	42.3	±0.25%
	0	1	1	0	136.5	34.1	±0.25%
	0	1	1	1	100.0	33.3	0 to -0.5%
	1	0	0	0	120.0	40.0	0 to -0.5%
	1	0	0	1	117.5	39.2	±0.25%
	1	0	1	0	122.0	40.7	±0.25%
	1	0	1	1	107.5	35.8	±0.25%
	1	1	0	0	145.0	36.3	±0.25%
	1	1	0	1	155.0	38.7	±0.25%
	1	1	1	0	130.0	32.5	±0.25%
	1	1	1	1	133.3	33.3	0 to -0.5%

POWER MANAGEMENT

CPU_STOP	CPUC0	CPUT (0:1)	SDRAM (0:11)	SDRAM12	CRYSTAL	VCO
0	Stopped Low	Stopped Low	Stopped Low	Running	Running	Running
1	Running	Running	Running	Running	Running	Running

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POWER MANAGEMENT (Continued)

PD	CPUC0	CPUT (0:1)	SDRAM (0:11)	SDRAM12	CRYSTAL	VCO
0	Stopped Low	Stopped Low	Stopped Low	Stopped Low	Stopped	Stopped
1	Running	Running	Running	Running	Running	Running

I2C BUS CONFIGURATION SETTING

Address Assignment	A6	A5	A4	A3	A2	A1	A0	R/W
	1	1	0	1	0	0	1	-
Slave Receiver/Transmitter	Provides both slave write and readback functionality							
Data Transfer Rate	Standard mode at 100kbts/s							
Serial Bits Reading	The serial bits will be read or sent by the clock driver in the following order Byte 0 – Bits 7, 6, 5, 4, 3, 2, 1, 0 Byte 1 – Bits 7, 6, 5, 4, 3, 2, 1, 0 - Byte N – Bits 7, 6, 5, 4, 3, 2, 1, 0							
Data Protocol	This serial protocol is designed to allow both blocks write and read from the controller. The bytes must be accessed in sequential order from lowest to highest byte. Each byte transferred must be followed by 1 acknowledge bit. A byte transferred without acknowledged bit will terminate the transfer. The write or read block both begins with the master sending a slave address and a write condition (0xD2) or a read condition (0xD3). Following the acknowledge of this address byte, in Write Mode : the Command Byte and Byte Count Byte must be sent by the master but ignored by the slave, in Read Mode : the Byte Count Byte will be read by the master then all other Data Byte . Byte Count Byte default at power-up is = (0x09).							

I2C CONTROL REGISTERS

1. BYTE 0: Functional and Frequency Select Clock Register (1=Enable, 0=Disable)

Bit	Pin#	Default	Description
Bit 7	8	0	FS3 (see Frequency selection Table)
Bit 6	48	1	FS2 (see Frequency selection Table)
Bit 5	25	0	FS1 (see Frequency selection Table)
Bit 4	26	0	FS0 (see Frequency selection Table)
Bit 3	-	0	Frequency selection control bit 1=Via I2C, 0=Via External jumper
Bit 2	-	0	FS4 (see Frequency selection Table)
Bit 1	-	1	0=Normal 1=Spread Spectrum enable
Bit 0	-	0	0=Normal 1=Tristate Mode for all outputs

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BYTE 1: CPU Clock Register (1=Enable, 0=Disable)

Bit	Pin#	Default	Description
Bit 7	-	1	Reserved
Bit 6	-	1	Reserved
Bit 5	-	1	Reserved
Bit 4	-	1	Reserved
Bit 3	40	1	SDRAM12 (Active/Inactive)
Bit 2	-	1	Reserved
Bit 1	43,44	1	CPUT0, CPUC0 (Active/Inactive)
Bit 0	46	1	CPUT1 (Active/Inactive)

3. BYTE 2: PCI Clock Register (1=Enable, 0=Disable)

Bit	Pin#	Default	Description
Bit 7	-	1	Reserved
Bit 6	7	1	PCI5 (Active/Inactive)
Bit 5	-	1	Reserved
Bit 4	13	1	PCI4 (Active/Inactive)
Bit 3	12	1	PCI3 (Active/Inactive)
Bit 2	11	1	PCI2 (Active/Inactive)
Bit 1	10	1	PCI1 (Active/Inactive)
Bit 0	8	1	PCI0 (Active/Inactive)

4. BYTE 3: SDRAM Clock Register (1=Enable, 0=Disable)

Bit	Pin#	Default	Description
Bit 7	-	1	Reserved
Bit 6	-	1	Reserved
Bit 5	26	1	48MHz (Active/Inactive)
Bit 4	25	1	24_48MHz (Active/Inactive)
Bit 3	17	1	SDRAM11 (Active/Inactive)
Bit 2	18	1	SDRAM10 (Active/Inactive)
Bit 1	20	1	SDRAM9 (Active/Inactive)
Bit 0	21	1	SDRAM8 (Active/Inactive)

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5. BYTE 4: SDRAM Clock Register (1=Enable, 0=Disable)

Bit	Pin#	Default	Description
Bit 7	28	1	SDRAM7 (Active/Inactive)
Bit 6	29	1	SDRAM6 (Active/Inactive)
Bit 5	31	1	SDRAM5 (Active/Inactive)
Bit 4	32	1	SDRAM4 (Active/Inactive)
Bit 3	34	1	SDRAM3 (Active/Inactive)
Bit 2	35	1	SDRAM2 (Active/Inactive)
Bit 1	37	1	SDRAM1 (Active/Inactive)
Bit 0	38	1	SDRAM0 (Active/Inactive)

6. BYTE 5: Peripheral Clock Register (1=Enable, 0=Disable)

Bit	Pin#	Default	Description
Bit 7	-	X	Inverted Power-up latched FS3 value (Read only)
Bit 6	-	X	Inverted Power-up latched FS2 value (Read only)
Bit 5	-	X	Inverted Power-up latched FS1 value (Read only)
Bit 4	-	X	Inverted Power-up latched FS0 value (Read only)
Bit 3	-	1	Reserved
Bit 2	-	X	Inverted Power-up latched SEL24_48MHz value (Read only)
Bit 1	48	1	REF1 (Active/Inactive)
Bit 0	2	1	REF0 (Active/Inactive)

7. BYTE 6: Revision ID and Vendor ID Register (1=Enable, 0=Disable)

Bit	Pin#	Default	Description
Bit 7	-	0	Revision ID Bit 3*
Bit 6	-	0	Revision ID Bit 2*
Bit 5	-	0	Revision ID Bit 1*
Bit 4	-	0	Revision ID Bit 0*
Bit 3	-	0	Vendor ID Bit 3*
Bit 2	-	0	Vendor ID Bit 2*
Bit 1	-	1	Vendor ID Bit 1*
Bit 0	-	1	Vendor ID Bit 0*

Note: *: Default value at power-up

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8. BYTE 7: Linear Programming (M) Register (1=Enable, 0=Disable)

Bit	Pin#	Default	Description
Bit 7	-	0	Linear programming sign bit (0 is "+", 1 is "-")
Bit 6	-	0	Linear programming magnitude bit 6 (MSB)
Bit 5	-	0	Linear programming magnitude bit 5
Bit 4	-	0	Linear programming magnitude bit 4
Bit 3	-	0	Linear programming magnitude bit 3
Bit 2	-	0	Linear programming magnitude bit 2
Bit 1	-	0	Linear programming magnitude bit 1
Bit 0	-	0	Linear programming magnitude bit 0 (LSB)

9. BYTE 8: Device ID Register (1=Enable, 0=Disable)

Bit	Pin#	Default	Description
Bit 7	-	0	Reserved
Bit 6	-	0	Device ID Bit 6*
Bit 5	-	0	Device ID Bit 5*
Bit 4	-	0	Device ID Bit 4*
Bit 3	-	0	Device ID Bit 3*
Bit 2	-	0	Device ID Bit 2*
Bit 1	-	1	Device ID Bit 1*
Bit 0	-	0	Device ID Bit 0*

Note: *: Default value at power-up

PROGRAMMING OF CPU FREQUENCY

To simplify traditional loop counter setting, the PLL205-01 device incorporates SMART-BYTE™ technology with a single byte programming via I2C to better optimize clock jitter and spread spectrum performance. Detail of PLL205-01's dual mode frequency programming method is described below:

1. ROM-table Frequency Programming:

The pre-defined 32 frequencies found in Frequency table can be accessed either through 5 external jumpers or by setting internal I2C register in BYTE0.

2. Micro-step Linear Frequency Programming:

CPU Frequency can be programmed via I2C in fine and linear positive or negative stepping around selected CPU frequency in Frequency table. The highest step is either +127 or -127. Other bus frequencies will be changed proportionally with the rate that CPU frequency change. The formula is as follow:

$$F_{CPU} = F_{CPU.ROM-Table} \pm \alpha (=0.22) * M$$

- Where:
1. M is magnitude factor defined in I2C Byte 7.bit(0:6)
 2. ± (sign bit) of M is defined in I2C Byte7.bit 7
 3. α is a constant
α = 0.22

FREQUENCY PROGRAMMING EXAMPLE:

1. Procedures to program target CPU frequency to 139.0 Mhz:

- A. Locate the closest CPU frequency from Frequency-ROM table: 136.5
- B. α = 0.22
- C. Solve M (Linear Magnitude factor) in integer:

$$M = (F_{CPU} - F_{CPU-ROMTABLE}) / \alpha$$

$$= (139 - 136.5) / 0.22$$

$$= 11$$

- D. Program I2C register:

7	6	5	4	3	2	1	0
0	1	1	0	1	1	0	0

Setting of I2C.BYTE0

FS3	FS2	FS1	FS0	CTR	FS4		
7	6	5	4	3	2	1	0
0	0	0	0	1	0	1	1

Setting of M = +11 in I2C.BYTE7

Sign	M6	M5	M4	M3	M2	M1	M0
------	----	----	----	----	----	----	----

$$F_{CPU} = 136.5 + (0.22) * 11 = 138.92 \text{ (\% of frequency increased = 1.8 \%)}$$

$$F_{PCI} = 34.1 * (1+1.8\%) = 34.7$$

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ELECTRICAL SPECIFICATIONS

1. Absolute Maximum Ratings

PARAMETERS	SYMBOL	MIN.	MAX.	UNITS
Supply Voltage	V_{DD}	$V_{SS}-0.5$	7	V
Input Voltage, dc	V_I	$V_{SS}-0.5$	$V_{DD}+0.5$	V
Output Voltage, dc	V_O	$V_{SS}-0.5$	$V_{DD}+0.5$	V
Storage Temperature	T_S	-65	150	°C
Ambient Operating Temperature	T_A	0	70	°C
Junction Temperature	T_J		115	°C
ESD Voltage			2	KV

Exposure of the device under conditions beyond the limits specified by Maximum Ratings for extended periods may cause permanent damage to the device and affect product reliability. These conditions represent a stress rating only, and functional operations of the device at these or any other conditions above the operational limits noted in this specification is not implied.

2. AC/DC Electrical Specifications

PARAMETERS	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Input High Voltage	V_{IH}		2.0		$V_{DD}+0.3$	V
Input Low Voltage	V_{IL}		$V_{SS}-0.3$		0.8	V
Input High Current	I_{IH}	$V_{IN} = V_{DD}$			5	uA
Input Low Current	I_{IL1}	Logic inputs without internal pull-up on SCLK, $V_{IN} = 0V$	-5			uA
Input Low Current	I_{IL2}	Logic inputs with internal pull-up resistors, $V_{IN} = 0V$	-200			uA
Power Down	PD				600	uA
Pull-up resistor	R_{pu}	Pin 2,7,8,10,25,26,48		120		Kohm
Operating Supply Current	I_{DD}	$C_L=0$ pF @ 66MHz			180	mA
		$C_L=0$ pF @ 100MHz				
		$C_L=0$ pF @ 133MHz				
Input frequency	F_I	$V_{DD} = 3.3V$	12	14.318	16	Mhz
Input Capacitance	C_{IN}	Logic Inputs			5	PF
	C_{INX}	XIN & XOUT pins	27		45	PF

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2. Output Buffer Electrical Specifications

Unless otherwise stated, all power supplies = 3.3V±5%, and ambient temperature range T_A= 0°C to 70°C

PARAMETERS	SYMBOL	OUTPUTS	CONDITIONS	MIN.	TYP.	MAX.	UNITS	
Output Rise time	T _{OR}	CPU (Open Drain)	Measured @ 0.3V ~ 1.2V, C _L =20pf, 3.3V±5%			0.9	ns	
		REF(0:1)	Measured @ 0.4V ~ 2.4V, C _L =20pf, 3.3V±5%			4		
		PCI(0:5)	Measured @ 0.4V ~ 2.4V, C _L =30pf, 3.3V±5%			2		
		24_48MHz, 48MHz	Measured @ 0.4V ~ 2.4V, C _L =20pf, 3.3V±5%			4		
Output Fall time	T _{OF}	CPU (Open Drain)	Measured @ 1.2V ~ 0.3V, C _L =20pf, 3.3V±5%			0.9	ns	
		REF(0:1)	Measured @ 2.4V ~ 0.4V, C _L =20pf, 3.3V±5%			4		
		PCI(0:5)	Measured @ 2.4V ~ 0.4V, C _L =30pf, 3.3V±5%			2		
		24_48MHz, 48MHz	Measured @ 2.4V ~ 0.4V, C _L =20pf, 3.3V±5%			4		
Duty Cycle	D _T	REF(0:1),CPU, PCI(0:5)	V _T = 50%	45		55	%	
		24_48MHz, 48MHz	V _T = 1.5V					
Clock Skew	T _{SKREW}	CPU to CPU	V _T = 50%			200	ps	
		PCI to PCI				200		
		CPU to PCI				0	3	ns
		CPU to AGP				-500	500	
Output Impedance	Z ₀	CPU	V _O = V _X	V _{DD} =3.3V±5%		50	Ohm	
		PCI(0:5)				30		
		REF(0:1)				40		
		REF1				40		
		24_48MHz, 48MHz				40		

Motherboard Clock Generator for AMD - K7

2. Output Buffer Electrical Specifications, continued

Unless otherwise stated, all power supplies = 3.3V±5%, and ambient temperature range T_A= 0°C to 70°C

PARAMETERS	SYMBOL	OUTPUTS	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Output High Current	I _{OH}	CPU	V _{OH} = 2.0V				mA
		REF(0:1)				-22	
		PCI(0:5)				-16	
		24_48MHz				-22	
		48MHz				-22	
Output Low Current	I _{OL}	CPU	V _{OL} = 0.4V	20			mA
		REF(0:1)	V _{OL} = 0.8V	16			
		PCI(0:5)		19			
		24_48MHz		16			
		48MHz		16			
Jitter, One Sigma	J _{sigma}	REF,48MHz,24MHz	V _T = 1.5V			0.5	ns
Jitter, Absolute	J _{Abs}	CPU	V _T = 50%	-250		250	ps
		REF,48MHz,24MHz	V _T = 1.5V	-1		1	ns
Jitter (cycle to cycle)	J _{cyc-cyc}	CPU	V _T = V _X			250	ps
		PCI	Measured @ 1.5V			250	
AC Differential Voltage	V _{DIF}	CPU (Open Drain)		0.4		V _{pullup} +0.6	V
DC Differential Voltage	V _{DIF}			0.2		V _{pullup} +0.6	V
Differential Crossover Voltage	V _X				550		1100

Note: V_{PULLUP} = 1.5V (external); V_{DIF} specifies the minimum input differential voltages (V_{TR}-V_{CP}) required for switching, where V_{TR} is the "true" input level and V_{CP} is the "complement" input level.

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