Spread Spectrum FTG for VIA K7 Chipset

Features

- **Single-chip system frequency synthesizer for VIA K7 chipset**
- **Pin compatible with W210, W230 and W230-03**
- **Programmable clock output frequency with less than 1 MHz increment**
- **Integrated fail-safe Watchdog Timer for system recovery**
- **Automatically switch to HW selected or SW programmed clock frequency when Watchdog Timer time-out**
- **Capable of generate system RESET after a Watchdog Timer time-out occurs or a change in output frequency via SMBus interface**
- **Support SMBus byte read/write and block read/ write operations to simplify system BIOS development**
- **Vendor ID and Revision ID support**
- **Programmable drive strength for CPU, SDRAM and PCI output clocks**
- **Programmable output skew between CPU, PCI and SDRAM**
- **Maximized EMI Suppression using Cypress's Spread Spectrum technology**
- **Available in 48-pin SSOP**

Key Specifications

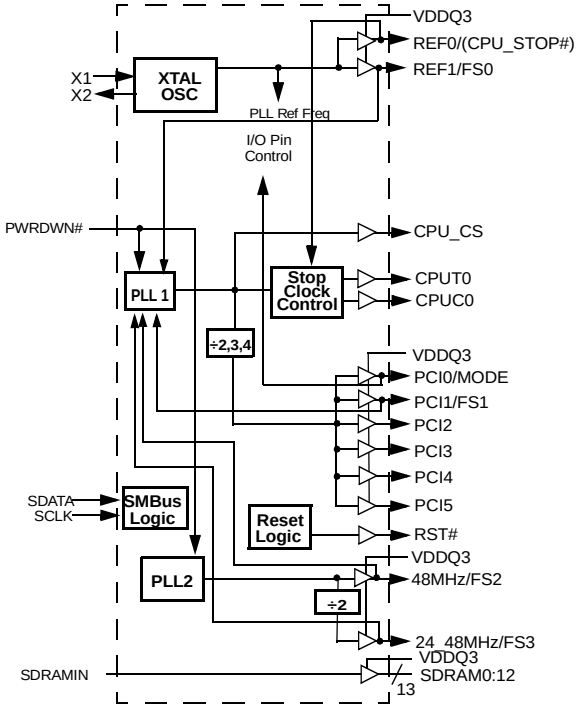
CPU to CPU Output Skew:.....175 ps
PCI to PCI Output Skew:.....500 ps
V_{DD}:.....3.3V ±5%
SDRAMIN to SDRAM0:12 Delay:.....3.7 ns typ.

Table 1. Mode Input Table

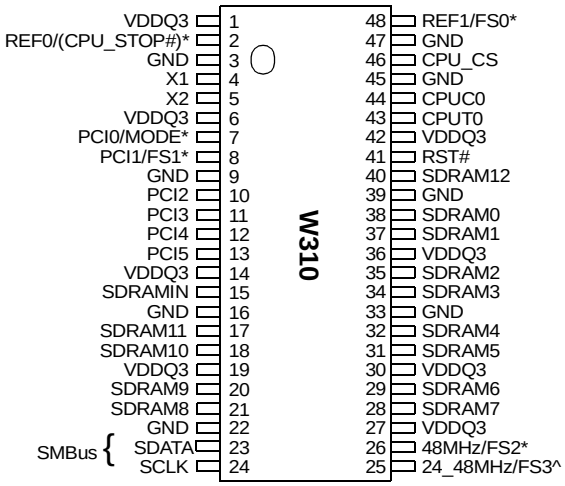
Mode	Pin 2
0	CPU_STOP#
1	REF0

Input Address					
FS 3	FS 2	FS 1	FS 0	CPU_CS CPUT0 (MHz)	PCI 0:5 (MHz)
1	1	1	1	100.0	33.3
1	1	1	0	100.0	33.3
1	1	0	1	100.0	33.3
1	1	0	0	95.0	31.7
1	0	1	1	133.3	33.3
1	0	1	0	133.3	33.3
1	0	0	1	133.3	33.3
1	0	0	0	102.0	34.0
0	1	1	1	104.0	34.6
0	1	1	0	106.0	35.3
0	1	0	1	107.0	35.6
0	1	0	0	108.0	36.0
0	0	1	1	109.0	36.3
0	0	1	0	110.0	36.6
0	0	0	1	111.0	37.0
0	0	0	0	112.0	37.3

Block Diagram



Pin Configuration[1]



Note:

1. Internal pull-up resistors should not be relied upon for setting I/O pins HIGH. Pin function with parentheses determined by MODE pin resistor strapping. Unlike other I/O pins, input FS3 has an internal pull-down resistor.

Pin Definitions

Pin Name	Pin No.	Pin Type	Pin Description
CPUT0, CPUC0,	43, 44	O (open-drain)	***CPU Clock Output 0:*** CPUT0 and CPUC0 are the differential CPU clock outputs for the K7 processor.
CPU_CS	46	O	***CPU Clock Output for Chipset:*** CPU_CS is the push-pull clock output for the chipset. It has the same phase relationship as CPUT0.
PCI2:5	10, 11, 12, 13	O	***PCI Clock Outputs 2 through 5:*** 3.3V 33-MHz PCI clock outputs. Frequency is set by FS0:3 inputs or through serial data interface, see *Table 2* and *Table 5* for details.
PCI1/FS1	8	I/O	***Fixed PCI Clock Output/Frequency Select 1:*** 3.3V 33-MHz PCI clock outputs. As an output, frequency is set by FS0:3 inputs or through serial data interface. This pin also serves as a power-on strap option to determine device operating frequency as described in *Table 2* and *Table 5*.
PCI0/MODE	7	I/O	***Fixed PCI Clock Output/Mode:*** 3.3V 33-MHz PCI clock outputs. As an output, frequency is set by the FS0:3 inputs or through serial data interface, see *Table 2* and *Table 5*. This pin also serves as a power-on strap option to determine the function of pin 2, see *Table 1* for details.
RST#	41	O (open-drain)	***Reset# Output:*** Open drain system reset output.
48MHz/FS2	26	I/O	***48-MHz Output/Frequency Select 2:*** 3.3V 48-MHz non-spread spectrum output. This pin also serves as a power on strap option to determine device operating frequency as described in *Table 2* and *Table 5*.
24_48MHz/ FS3	25	I/O	***24_48MHz Output/Frequency Select 3:*** 3.3V 24 or 48MHz non-spread spectrum output. This pin also serves as a power-on strap option to determine device operating frequency as described in *Table 2* and *Table 5*.
REF1/FS0	48	I/O	***Reference Clock Output 1/Frequency Select 2:*** 3.3V 14.318-MHz output clock. This pin also serves as a power-on strap option to determine device operating frequency as described in *Table 2* and *Table 5*.
REF0/ CPU_STOP#	2	I/O	***Reference Clock Output 0 or CPU_STOP# Input Pin:*** Function is determined by the MODE pin. When CPU_STOP# input is asserted LOW, it will drive CPU_CS to logic 0. When this pin is configured as an output, this pin becomes a 3.3V 14.318-MHz output clock.
SDRAMIN	15	I	***SDRAM Buffer Input Pin:*** Reference input for SDRAM buffer.
SDRAM0:12	38, 37, 35, 34, 32, 31, 29, 28, 21, 20, 18, 17, 40	O	***SDRAM Outputs:*** These thirteen dedicated outputs provide copies of the signal provided at the SDRAMIN input.
SCLK	24	I	Clock pin for SMBus circuitry.
SDATA	23	I/O	Data pin for SMBus circuitry.
X1	4	I	***Crystal Connection or External Reference Frequency Input:*** This pin has dual functions. It can be used as an external 14.318-MHz crystal connection or as an external reference frequency input.
X2	5	I	***Crystal Connection:*** An input connection for an external 14.318-MHz crystal. If using an external reference, this pin must be left unconnected.
VDDQ3	1, 6, 14, 19, 27, 30, 36, 42	P	***Power Connection:*** Power supply for core logic, PLL circuitry, SDRAM outputs, PCI outputs, reference outputs, 48-MHz output, and 24_48-MHz output. Connect to 3.3V supply
GND	3, 9, 16, 22, 33, 39, 45, 47	G	***Ground Connections:*** Connect all ground pins to the common system ground plane.

Overview

The W310 was developed as a single-chip device to meet the clocking needs of VIA K7 core logic chip sets. In addition to the typical outputs provided by a standard FTG, the W310 adds a thirteenth output buffer, supporting SDRAM DIMM modules in conjunction with the chipset.

Functional Description

I/O Pin Operation

Pins 7, 8, 25, 26, and 48 are dual-purpose I/O pins. Upon power-up these pins act as logic inputs, allowing the determination of assigned device functions. A short time after power-up, the logic state of each pin is latched and the pins become clock outputs. This feature reduces device pin count by combining clock outputs with input select pins.

An external 10-kΩ "strapping" resistor is connected between the I/O pin and ground or V_{DD}. Connection to ground sets a latch to "0," connection to V_{DD} sets a latch to "1." *Figure 1* and *Figure 2* show two suggested methods for strapping resistor connections.

Upon W310 power-up, the first 2 ms of operation are used for input logic selection. During this period, the five I/O pins (7, 8, 25, 26, 48) are three-stated, allowing the output strapping resistor on the I/O pins to pull the pins and their associated capacitive clock load to either a logic HIGH or LOW state. At the end of the 2-ms period, the established logic "0" or "1" condition of the I/O pin is latched. Next the output buffer is enabled converting the I/O pins into operating clock outputs. The 2-ms timer starts when V_{DD} reaches 2.0V. The input bits can only be reset by turning V_{DD} off and then back on again.

It should be noted that the strapping resistors have no significant effect on clock output signal integrity. The drive impedance of clock outputs is <40Ω (nominal), which is minimally affected by the 10-KΩ strap to ground or V_{DD}. As with the series termination resistor, the output strapping resistor should be placed as close to the I/O pin as possible in order to keep the interconnecting trace short. The trace from the resistor to ground or V_{DD} should be kept less than two inches in length to prevent system noise coupling during input logic sampling.

When the clock outputs are enabled following the 2-ms input period, the specified output frequency is delivered on the pin, assuming that V_{DD} has stabilized. If V_{DD} has not yet reached full value, output frequency initially may be below target but will increase to target once V_{DD} voltage has stabilized. In either case, a short output clock cycle may be produced from the CPU clock outputs when the outputs are enabled.

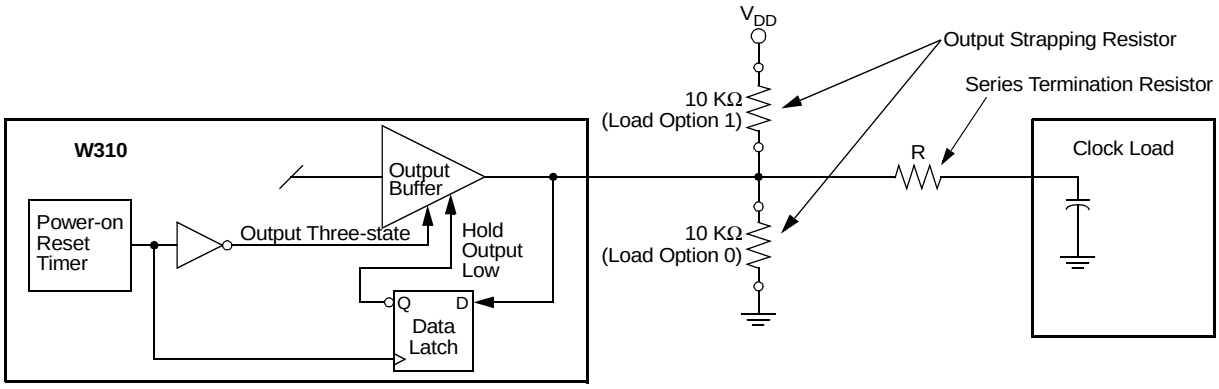


Figure 1. Input Logic Selection Through Resistor Load Option

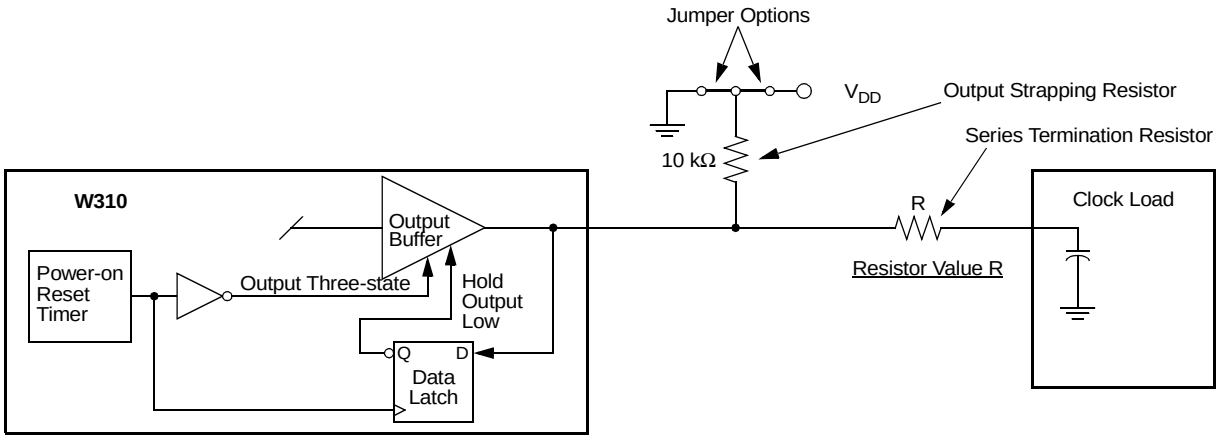


Figure 2. Input Logic Selection Through Jumper Option

Spread Spectrum Frequency Timing Generator

The device generates a clock that is frequency modulated in order to increase the bandwidth that it occupies. By increasing the bandwidth of the fundamental and its harmonics, the amplitudes of the radiated electromagnetic emissions are reduced. This effect is depicted in *Figure 3*.

As shown in *Figure 3*, a harmonic of a modulated clock has a much lower amplitude than that of an unmodulated signal. The reduction in amplitude is dependent on the harmonic number and the frequency deviation or spread. The equation for the reduction is:

$$dB = 6.5 + 9*\log_{10}(P) + 9*\log_{10}(F)$$

Where *P* is the percentage of deviation and *F* is the frequency in MHz where the reduction is measured.

The output clock is modulated with a waveform depicted in *Figure 4*. This waveform, as discussed in "Spread Spectrum Clock Generation for the Reduction of Radiated Emissions" by Bush, Fessler, and Hardin, produces the maximum reduction in the amplitude of radiated electromagnetic emissions. *Figure 4* details the Cypress spreading pattern.

Spread Spectrum clocking is activated or deactivated through the serial data.

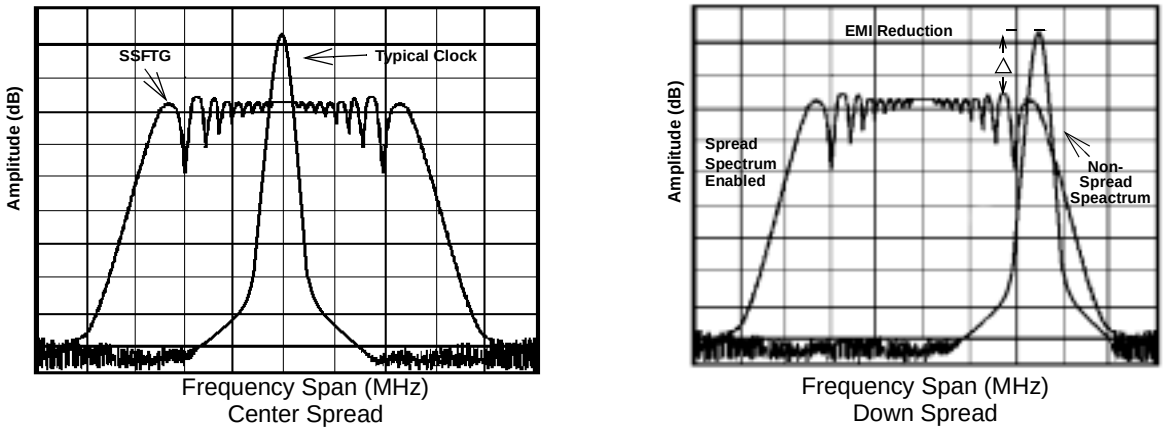


Figure 3. Clock Harmonic with and without SSCG Modulation Frequency Domain Representation

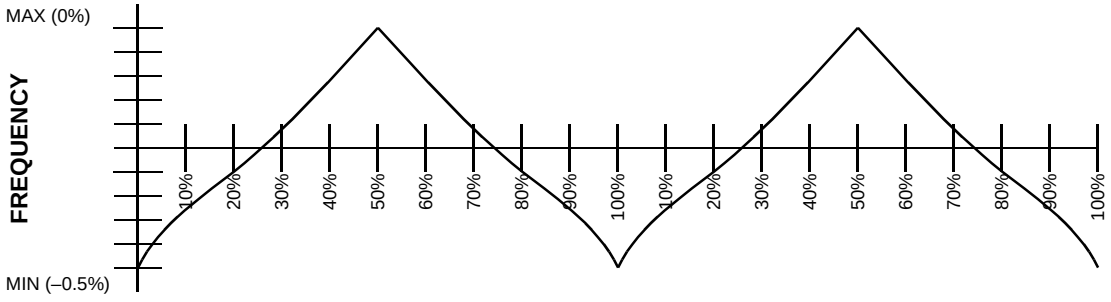


Figure 4. Typical Modulation Profile

Serial Data Interface

The W310 features a two-pin, serial data interface that can be used to configure internal register settings that control particular device functions.

Data Protocol

The clock driver serial protocol supports byte/word write, byte/word read, block write and block read operations from the controller. For block write/read operation, the bytes must be accessed in sequential order from lowest to highest byte with the ability to stop after any complete byte has been transferred. For byte/word write and byte read operations, system controller can access individual indexed byte. The offset of the indexed byte is encoded in the command code.

The definition for the command code is defined as follows:

Bit	Descriptions
7	0 = Block read or block write operation 1 = Byte/Word read or Byte/Word write operation
6:0	Byte offset for byte/word read or write operation. For block read or write operations, these bits need to be set at ‘0000000’.

Table 2. Block Read and Block Write Protocol

Block Write Protocol		Block Read Protocol	
Bit	**Description**	**Bit**	**Description**
1	Start	1	Start
2:8	Slave address - 7 bits	2:8	Slave address - 7 bits
9	Write	9	Write
10	Acknowledge from slave	10	Acknowledge from slave
11:18	Command Code - 8 bits ‘00000000’ stands for block operation	11:18	Command Code - 8 bits ‘00000000’ stands for block operation
19	Acknowledge from slave	19	Acknowledge from slave
20:27	Byte Count - 8 bits	20	Repeat start
28	Acknowledge from slave	21:27	Slave address - 7 bits
29:36	Data byte 0 - 8 bits	28	Read
37	Acknowledge from slave	29	Acknowledge from slave
38:45	Data byte 1 - 8 bits	30:37	Byte count from slave - 8 bits
46	Acknowledge from slave	38	Acknowledge
...	Data Byte N/Slave Acknowledge	39:46	Data byte from slave - 8 bits
...	Data Byte N - 8 bits	47	Acknowledge
...	Acknowledge from slave	48:55	Data byte from slave - 8 bits
...	Stop	56	Acknowledge
		...	Data bytes from slave/Acknowledge
		...	Data byte N from slave - 8 bits
		...	Not Acknowledge
		...	Stop

Table 3. Word Read and Word Write Protocol

Word Write Protocol		Word Read Protocol	
Bit	**Description**	**Bit**	**Description**
1	Start	1	Start
2:8	Slave address - 7 bits	2:8	Slave address - 7 bits
9	Write	9	Write
10	Acknowledge from slave	10	Acknowledge from slave
11:18	Command Code - 8 bits '1xxxxxxx' stands for byte or word operation bit[6:0] of the command code represents the off-set of the byte to be accessed	11:18	Command Code - 8 bits '1xxxxxxx' stands for byte or word operation bit[6:0] of the command code represents the off-set of the byte to be accessed
19	Acknowledge from slave	19	Acknowledge from slave
20:27	Data byte low- 8 bits	20	Repeat start
28	Acknowledge from slave	21:27	Slave address - 7 bits
29:36	Data byte high - 8 bits	28	Read
37	Acknowledge from slave	29	Acknowledge from slave
38	Stop	30:37	Data byte low from slave - 8 bits
		38	Acknowledge
		39:46	Data byte high from slave - 8 bits
		47	NOT acknowledge
		48	Stop

Table 4. Byte Read and Byte Write Protocol

Byte Write Protocol		Byte Read Protocol	
Bit	**Description**	**Bit**	**Description**
1	Start	1	Start
2:8	Slave address - 7 bits	2:8	Slave address - 7 bits
9	Write	9	Write
10	Acknowledge from slave	10	Acknowledge from slave
11:18	Command Code - 8 bits '1xxxxxxx' stands for byte operation bit[6:0] of the command code represents the off-set of the byte to be accessed	11:18	Command Code - 8 bits '1xxxxxxx' stands for byte operation bit[6:0] of the command code represents the off-set of the byte to be accessed
19	Acknowledge from slave	19	Acknowledge from slave
20:27	Data byte - 8 bits	20	Repeat start
28	Acknowledge from slave	21:27	Slave address - 7 bits
29	Stop	28	Read
		29	Acknowledge from slave
		30:37	Data byte from slave - 8 bits
		38	Not Acknowledge
		39	Stop

W310 Serial Configuration Map

1. The serial bits will be read 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

2. All unused register bits (reserved and N/A) should be written to a “0” level.

3. All register bits labeled “Write with 1" must be written to one during initialization.

Bit	Pin#	Name	Default	Description
Bit 7	--	Spread Select1	0	See definition in Bit[0]
Bit 6	--	SEL2	0	See *Table 5*
Bit 5	--	SEL1	0	See *Table 5*
Bit 4	--	SEL0	0	See *Table 5*
Bit 3	--	FS_Override	0	0 = Select operating frequency by FS[3:0] input pins 1 = Select operating frequency by SEL[4:0] settings
Bit 2	--	SEL4	0	See *Table 5*
Bit 1	--	SEL3	0	See *Table 5*
Bit 0	--	Spread Select0	0	‘00’ = OFF ‘01’ = – 0.5% ‘10’ = ±0.5% ‘11’ = ±0.25%

Bit	Pin#	Name	Default	Description
Bit 7	25	Latched FS3 input	X	Latched FS[3:0] inputs. These bits are read only.
Bit 6	26	Latched FS2 input	X	
Bit 5	8	Latched FS1 input	X	
Bit 4	48	Latched FS0 input	X	
Bit 3	40	SDRAM12	1	(Active/Inactive)
Bit 2	44	CPUC0	1	(Active/Inactive)
Bit 1	43	CPUT0	1	(Active/Inactive)
Bit 0	46	CPU_CS	1	(Active/Inactive)

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

Bit	Pin#	Name	Default	Description
Bit 0	8	PCI1	1	(Active/Inactive)

Bit	Pin#	Name	Default	Description
Bit 7	--	Reserved	0	Reserved
Bit 6	--	SEL_48MHz	0	0 = 24 MHz 1 = 48 MHz
Bit 5	26	48MHz	1	(Active/Inactive)
Bit 4	25	24_48MHz	1	(Active/Inactive)
Bit 3	--	Reserved	0	Reserved
Bit 2	21, 20, 18, 17	SDRAM8:11	1	(Active/Inactive)
Bit 1	32, 31, 29, 28	SDRAM4:7	1	(Active/Inactive)
Bit 0	38, 37, 35, 34	SDRAM0:3	1	(Active/Inactive)

Bit	Pin#	Name	Default	Description
Bit 7	-	Reserved	0	Reserved
Bit 6	-	Reserved	0	Reserved
Bit 5	-	Reserved	0	Reserved
Bit 4	-	Reserved	0	Reserved
Bit 3	-	Reserved	0	Reserved
Bit 2	-	Reserved	0	Reserved
Bit 1	-	Reserved	0	Reserved
Bit 0	-	Reserved	0	Reserved

Bit	Pin#	Name	Default	Description
Bit 7	-	Reserved	0	Reserved
Bit 6	-	Reserved	0	Reserved
Bit 5	-	Reserved	0	Reserved
Bit 4	-	Reserved	0	Reserved
Bit 3	-	Reserved	0	Reserved
Bit 2	-	Reserved	0	Reserved
Bit 1	48	REF1	1	(Active/Inactive)
Bit 0	2	REF0	1	(Active/Inactive)

Bit	Name	Default	Pin Description
Bit 7	PCI_Skew1	0	PCI skew control 00 = Normal 01 = –500 ps 10 = Reserved 11 = +500 ps
Bit 6	PCI_Skew0	0	
Bit 5	WD_TIMER4	1	These bits store the time-out value of the Watchdog Timer. The scale of the timer is determine by the pre-scaler. The timer can support a value of 150 ms to 4.8 sec when the pre-scalar is set to 150 ms. If the pre-scaler is set to 2.5 sec, it can support a value from 2.5 sec to 80 sec. When the Watchdog Timer reaches “0.” it will set the WD_TO_STATUS bit and generate Reset if RST_EN_WD is enabled.
Bit 4	WD_TIMER3	1	
Bit 3	WD_TIMER2	1	
Bit 2	WD_TIMER1	1	
Bit 1	WD_TIMER0	1	
Bit 0	WD_PRE_SCALER	0	0 = 150 ms 1 = 2.5 sec

Bit	Pin#	Name	Default	Pin Description
Bit 7	--	Reserved	0	Reserved
Bit 6	25	24_48Mhz_DRV	1	0 = Norm, 1 = High Drive
Bit 5	26	48MHz_DRV	1	0 = Norm, 1 = High Drive
Bit 4	--	Reserved	0	Reserved
Bit 3	--	Reserved	0	Reserved
Bit 2	--	Reserved	0	Reserved
Bit 1	--	Reserved	0	Reserved
Bit 0	--	Reserved	0	Reserved

Bit	Name	Default	Pin Description
Bit 7	Revision_ID3	0	Revision ID bit[3]
Bit 6	Revision_ID2	0	Revision ID bit[2]
Bit 5	Revision_ID1	0	Revision ID bit[1]
Bit 4	Revision_ID0	0	Revision ID bit[0]
Bit 3	Vendor_ID3	1	Bit[3] of Cypress Semiconductor’s Vendor ID. This bit is read only.
Bit 2	Vendor_ID2	0	Bit[2] of Cypress Semiconductor’s Vendor ID. This bit is read only.
Bit 1	Vendor _ID1	0	Bit[1] of Cypress Semiconductor’s Vendor ID. This bit is read only.
Bit 0	Vendor _ID0	0	Bit[0] of Cypress Semiconductor’s Vendor ID. This bit is read only.

Bit	Name	Default	Pin Description
Bit 7	SDRAM_DRV	0	SDRAM clock output drive strength 0 = Normal 1 = High Drive
Bit 6	PCI_DRV	0	PCI clock output drive strength 0 = Normal 1 = High Drive
Bit 5	Reserved	0	Reserved
Bit 4	RST_EN_WD	0	This bit will enable the generation of a Reset pulse when a watchdog timer time-out occurs. 0 = Disabled 1 = Enabled
Bit 3	RST_EN_FC	0	This bit will enable the generation of a Reset pulse after a frequency change occurs. 0 = Disabled 1 = Enabled
Bit 2	WD_TO_STATUS	0	Watchdog Timer Time-out Status bit 0 = No time-out occurs (READ); Ignore (WRITE) 1 = Time-out occurred (READ); Clear WD_TO_STATUS (WRITE)
Bit 1	WD_EN	0	0 = Stop and reload Watchdog Timer. Unlock W310 from recovery frequency mode. 1 = Enable Watchdog Timer. It will start counting down after a frequency change occurs. **Note:** W310 will generate system reset, reload a recovery frequency, and lock itself into a recovery frequency mode after a watchdog timer time-out occurs. Under recovery frequency mode, W310 will not respond to any attempt to change output frequency via the SMBus control bytes. System software can unlock W310 from its recovery frequency mode by clearing the WD_EN bit.
Bit 0	CPU_CS_DRV	0	CPU_CS clock output drive strength 0 = Normal 1 = High Drive

Bit	Name	Default	Description
Bit 7	CPUCS_Skew2	0	000 = Normal 001 = –150 ps 010 = –300 ps 011 = –450 ps 100 = +150 ps 101 = +300 ps 110 = +450 ps 111 = +600 ps
Bit 6	CPUCS_Skew1	0	
Bit 5	CPUCS_Skew0	0	

Bit	Name	Default	Description
Bit 4	SDRAM_Delay2	0	SDRAM skew control 000 = Normal 001 = –300 ps 010 = –600 ps 011 = –900 ps 100 = +150 ps 101 = +300 ps 110 = +600 ps 111 = +900 ps
Bit 3	SDRAM_Delay1	0	
Bit 2	SDRAM_Delay0	0	
Bit 1	CPUT0_Skew1	0	CPUT0 and CPUC0 skew control 00 = Normal 01 = –150 ps 10 = +150 ps 11 = +300 ps
Bit 0	CPUT0_Skew0	0	

Bit	Name	Default	Pin Description
Bit 7	ROCV_FREQ_N7	0	If ROCV_FREQ_SEL is set, W310 will use the values programmed in ROCV_FREQ_N[7:0] and ROCV_FREQ_M[6:0] to determine the recovery CPU output frequency when a Watchdog Timer time-out occurs. The setting of FS_Override bit determines the frequency ratio for CPU and PCI. When it is cleared, W310 will use the same frequency ratio stated in the Latched FS[3:0] register. When it is set, W310 will use the frequency ratio stated in the SEL[4:0] register. W310 supports programmable CPU frequency ranging from 50 MHz to 248 MHz. W310 will change the output frequency whenever there is an update to either ROCV_FREQ_N[7:0] and ROCV_FREQ_M[6:0]. Therefore, it is recommended to use Word or Block write to update both registers within the same SMBus bus operation.
Bit 6	ROCV_FREQ_N6	0	
Bit 5	ROCV_FREQ_N5	0	
Bit 4	ROCV_FREQ_N4	0	
Bit 3	ROCV_FREQ_N3	0	
Bit 2	ROCV_FREQ_N2	0	
Bit 1	ROCV_FREQ_N1	0	
Bit 0	ROCV_FREQ_N0	0	

Bit	Name	Default	Pin Description
Bit 7	ROCV_FREQ_SEL	0	ROCV_FREQ_SEL determines the source of the recover frequency when a Watchdog Timer time-out occurs. The clock generator will automatically switch to the recovery CPU frequency based on the selection on ROCV_FREQ_SEL. 0 = From latched FS[3:0] 1 = From the settings of ROCV_FREQ_N[7:0] & ROCV_FREQ_M[6:0]
Bit 6	ROCV_FREQ_M6	0	If ROCV_FREQ_SEL is set, W310 will use the values programmed in ROCV_FREQ_N[7:0] and ROCV_FREQ_M[6:0] to determine the recovery CPU output frequency when a Watchdog Timer time-out occurs The setting of FS_Override bit determines the frequency ratio for CPU, SDRAM and PCI. When it is cleared, W310 will use the same frequency ratio stated in the Latched FS[4:0] register. When it is set, W310 will use the frequency ratio stated in the SEL[4:0] register. W310 supports programmable CPU frequency ranging from 50 MHz to 248 MHz. W310 will change the output frequency whenever there is an update to either ROCV_FREQ_N[7:0] and ROCV_FREQ_M[6:0]. Therefore, it is recommended to use Word or Block write to update both registers within the same SMBus bus operation.
Bit 5	ROCV_FREQ_M5	0	
Bit 4	ROCV_FREQ_M4	0	
Bit 3	ROCV_FREQ_M3	0	
Bit 2	ROCV_FREQ_M2	0	
Bit 1	ROCV_FREQ_M1	0	
Bit 0	ROCV_FREQ_M0	0	

Bit	Name	Default	Pin Description
Bit 7	CPU_FSEL_N7	0	If Prog_Freq_EN is set, W310 will use the values programmed in CPU_FSEL_N[7:0] and CPU_FSEL_M[6:0] to determine the CPU output frequency. The new frequency will start to load whenever CPU_FSELM[6:0] is updated. The setting of FS_Override bit determines the frequency ratio for CPU, SDRAM and PCI. When it is cleared, W310 will use the same frequency ratio stated in the Latched FS[3:0] register. When it is set, W310 will use the frequency ratio stated in the SEL[4:0] register. W310 supports programmable CPU frequency ranging from 50 MHz to 248 MHz.
Bit 6	CPU_FSEL_N6	0	
Bit 5	CPU_FSEL_N5	0	
Bit 4	CPU_FSEL_N4	0	
Bit 3	CPU_FSEL_N3	0	
Bit 2	CPU_FSEL_N2	0	
Bit 1	CPU_FSEL_N1	0	
Bit 0	CPU_FSEL_N0	0	

Bit	Name	Default	Description
Bit 7	Pro_Freq_EN	0	Programmable output frequencies enabled 0 = Disabled 1 = Enabled
Bit 6	CPU_FSEL_M6	0	If Prog_Freq_EN is set, W310 will use the values programmed in CPU_FSEL_N[7:0] and CPU_FSEL_M[6:0] to determine the CPU output frequency. The new frequency will start to load whenever CPU_FSELM[6:0] is updated. The setting of FS_Override bit determines the frequency ratio for CPU, SDRAM and PCI. When it is cleared, W310 will use the same frequency ratio stated in the Latched FS[3:0] register. When it is set, W310 will use the frequency ratio stated in the SEL[4:0] register. W310 supports programmable CPU frequency ranging from 50 MHz to 248 MHz.
Bit 5	CPU_FSEL_M5	0	
Bit 4	CPU_FSEL_M4	0	
Bit 3	CPU_FSEL_M3	0	
Bit 2	CPU_FSEL_M2	0	
Bit 1	CPU_FSEL_M1	0	
Bit 0	CPU_FSEL_M0	0	

Bit	Pin#	Name	Default	Description
Bit 7	-	Reserved	0	Reserved
Bit 6	-	Reserved	0	Reserved
Bit 5	-	Reserved	0	Reserved
Bit 4	-	Reserved	0	Reserved
Bit 3	-	Reserved	0	Reserved
Bit 2	-	Vendor test Mode	0	Reserved. Write with ‘0’
Bit 1	-	Vendor test mode	1	Test mode. Write with ‘1’
Bit 0	-	Vendor test mode	1	Test mode. Write with ‘1’

Byte 16: Reserved Register

Bit	Pin#	Name	Default	Description
Bit 7	-	Reserved	0	Reserved
Bit 6	-	Reserved	0	Reserved
Bit 5	-	Reserved	0	Reserved
Bit 4	-	Reserved	0	Reserved
Bit 3	-	Reserved	0	Reserved
Bit 2	-	Reserved	0	Reserved
Bit 1	-	Reserved	0	Reserved

Byte 17: Reserved Register

Bit	Pin#	Name	Default	Description
Bit 7	-	Reserved	0	Reserved
Bit 6	-	Reserved	0	Reserved
Bit 5	-	Reserved	0	Reserved
Bit 4	-	Reserved	0	Reserved
Bit 3	-	Reserved	0	Reserved
Bit 2	-	Reserved	0	Reserved
Bit 1	-	Reserved	0	Reserved

Table 5. Additional Frequency Selections through Serial Data Interface Data Bytes

Input Conditions					Output Frequency		
Data Byte 0, Bit 3 = 1							
Bit 2 SEL_4	Bit 1 SEL_3	Bit 6 SEL_2	Bit 5 SEL_1	Bit 4 SEL_0	CPU	PCI	PLL Gear Constant (G)
1	1	1	1	1	100.0	33.3	48.000741
1	1	1	1	0	100.0	33.3	48.000741
1	1	1	0	1	100.0	33.3	48.000741
1	1	1	0	0	95.0	31.7	48.000741
1	1	0	1	1	133.3	33.3	48.000741
1	1	0	1	0	133.3	33.3	48.000741
1	1	0	0	1	133.3	33.3	48.000741
1	1	0	0	0	102.0	34.0	48.000741
1	0	1	1	1	104.0	34.6	48.000741
1	0	1	1	0	106.0	35.3	48.000741
1	0	1	0	1	107.0	35.6	48.000741
1	0	1	0	0	108.0	36.0	48.000741
1	0	0	1	1	109.0	36.3	48.000741
1	0	0	1	0	110.0	36.6	48.000741
1	0	0	0	1	111.0	37.0	48.000741
1	0	0	0	0	112.0	37.3	48.000741
0	1	1	1	1	113.0	37.6	48.000741
0	1	1	1	0	114.0	38.0	48.000741
0	1	1	0	1	115.0	38.3	48.000741
0	1	1	0	0	116.0	38.6	48.000741
0	1	0	1	1	118.0	39.3	48.000741
0	1	0	1	0	120.0	40.0	48.000741
0	1	0	0	1	124.0	31.0	48.000741
0	1	0	0	0	127.0	31.7	48.000741
0	0	1	1	1	130.0	32.5	48.000741
0	0	1	1	0	136.0	34.0	48.000741
0	0	1	0	1	140.0	35.0	48.000741
0	0	1	0	0	145.0	36.2	48.000741
0	0	0	1	1	150.0	37.5	48.000741
0	0	0	1	0	155.0	38.7	48.000741
0	0	0	0	1	160.0	40.0	48.000741
0	0	0	0	0	166.6	33.3	48.000741

Programmable Output Frequency, Watchdog Timer and Recovery Output Frequency Functional Description

The Programmable Output Frequency feature allows users to generate any CPU output frequency from the range of 50 MHz to 248 MHz. Cypress offers the most dynamic and the simplest programming interface for system developers to utilize this feature in their platforms.

The Watchdog Timer and Recovery Output Frequency features allow users to implement a recovery mechanism when the system hangs or getting unstable. System BIOS or other control software can enable the Watchdog Timer before they attempt to make a frequency change. If the system hangs and a Watchdog Timer time-out occurs, a system reset will be generated and a recovery frequency will be activated. All the related registers are summarized in *Table 6*.

Table 6. Register Summary

Name	Description
Pro_Freq_EN	Programmable output frequencies enabled 0 = Disabled (default) 1 = Enabled When it is disabled, the operating output frequency will be determined by either the latched value of FS[3:0] inputs or the programmed value of SEL[4:0]. If FS_Override bit is clear, latched FS[3:0] inputs will be used. If FS_Override bit is set, programmed value of SEL[4:0] will be used. When it is enabled, the CPU output frequency will be determined by the programmed value of CPUFSEL_N, CPUFSEL_M and the PLL Gear Constant. The program value of FS_Override, SEL[4:0] or the latched value of FS[3:0] will determine the PLL Gear Constant and the frequency ratio between CPU and other frequency outputs.
FS_Override	When Pro_Freq_EN is cleared or disabled, 0 = Select operating frequency by FS input pins (default) 1 = Select operating frequency by SEL bits in SMBus control bytes When Pro_Freq_EN is set or enabled, 0 = Frequency output ratio between CPU and other frequency groups and the PLL Gear Constant are based on the latched value of FS input pins (default) 1 = Frequency output ratio between CPU and other frequency groups and the PLL Gear Constant are based on the programmed value of SEL bits in SMBus control bytes
CPU_FSEL_N, CPU_FSEL_M	When Prog_Freq_EN is set or enabled, the values programmed in CPU_FSEL_N[7:0] and CPU_FSEL_M[6:0] determines the CPU output frequency. The new frequency will start to load whenever there is an update to either CPU_FSEL_N[7:0] or CPU_FSEL_M[6:0]. Therefore, it is recommended to use Word or Block write to update both registers within the same SMBus bus operation. The setting of FS_Override bit determines the frequency ratio for CPU and PCI. When FS_Override is cleared or disabled, the frequency ratio follows the latched value of the FS input pins. When FS_Override is set or enabled, the frequency ratio follows the programmed value of SEL bits in SMBus control bytes.
ROCV_FREQ_SEL	ROCV_FREQ_SEL determines the source of the recover frequency when a Watchdog Timer time-out occurs. The clock generator will automatically switch to the recovery CPU frequency based on the selection on ROCV_FREQ_SEL. 0 = From latched FS[3:0] 1 = From the settings of ROCV_FREQ_N[7:0] & ROCV_FREQ_M[6:0]
ROCV_FREQ_N[7:0], ROCV_FREQ_M[6:0]	When ROCV_FREQ_SEL is set, the values programmed in ROCV_FREQ_N[7:0] and ROCV_FREQ_M[6:0] will be used to determine the recovery CPU output frequency when a Watchdog Timer time-out occurs The setting of FS_Override bit determines the frequency ratio for CPU and SDRAM. When it is cleared, the same frequency ratio stated in the Latched FS[3:0] register will be used. When it is set, the frequency ratio stated in the SEL[4:0] register will be used. The new frequency will start to load whenever there is an update to either ROCV_FREQ_N[7:0] and ROCV_FREQ_M[6:0]. Therefore, it is recommended to use Word or Block write to update both registers within the same SMBus bus operation.

Table 6. Register Summary (continued)

Name	Description
WD_EN	0 = Stop and re-load Watchdog Timer. Unlock W310 from recovery frequency mode. 1 = Enable Watchdog Timer. It will start counting down after a frequency change occurs. **Note:** W310 will generate system reset, re-load a recovery frequency, and lock itself into a recovery frequency mode after a watchdog timer time-out occurs. Under recovery frequency mode, W310 will not respond to any attempt to change output frequency via the SMBus control bytes. System software can unlock W310 from its recovery frequency mode by clearing the WD_EN bit.
WD_TO_STATUS	Watchdog Timer Time-out Status bit 0 = No time-out occurs (READ); Ignore (WRITE) 1 = time-out occurred (READ); Clear WD_TO_STATUS (WRITE)
WD_TIMER[4:0]	These bits store the time-out value of the Watchdog Timer. The scale of the timer is determine by the prescaler. The timer can support a value of 150 ms to 4.8 sec. when the prescaler is set to 150 ms. If the prescaler is set to 2.5 sec, it can support a value from 2.5 sec to 80 sec. When the Watchdog Timer reaches “0,” it will set the WD_TO_STATUS bit.
WD_PRE_SCALER	0 = 150 ms 1 = 2.5 sec
RST_EN_WD	This bit will enable the generation of a Reset pulse when a watchdog timer time-out occurs. 0 = Disabled 1 = Enabled
RST_EN_FC	This bit will enable the generation of a Reset pulse after a frequency change occurs. 0 = Disabled 1 = Enabled

How to Program CPU Output Frequency?

When the programmable output frequency feature is enabled (Pro_Freq_EN bit is set), the CPU output frequency is determined by the following equation:

Fcpu = G * (N+3)/(M+3)

“N” and “M” are the values programmed in Programmable Frequency Select N-Value Register and M-Value Register, respectively.

“G” stands for the PLL Gear Constant, which is determined by the programmed value of FS[4:0] or SEL[4:0]. The value is listed in *Table 3*.

The ratio of (N+3) and (M+3) need to be greater than “1” [(N+3)/(M+3) > 1].

The following table lists set of N and M values for different frequency output ranges.This example use a fixed value for the M-Value Register and select the CPU output frequency by changing the value of the N-Value Register.

Table 7. Examples of N and M Value for Different CPU Frequency Range

Frequency Ranges	Gear Constants	Fixed Value for M-Value Register	Range of N-Value Register for Different CPU Frequency
50 MHz – 129 MHz	48.00741	93	97 – 255
130 MHz – 248 MHz	48.00741	45	127 – 245

Absolute Maximum Ratings

Stresses greater than those listed in this table may cause permanent damage to the device. These represent a stress rating only. Operation of the device at these or any other conditions above those specified in the operating sections of this specification is not implied. Maximum conditions for extended periods may affect reliability.

Parameter	Description	Rating	Unit
V_{DD}, V_{IN}	Voltage on any pin with respect to GND	–0.5 to +7.0	V
T_{STG}	Storage Temperature	–65 to +150	°C
T_B	Ambient Temperature under Bias	–55 to +125	°C
T_A	Operating Temperature	0 to +70	°C
ESD_{PROT}	Input ESD Protection	2 (min.)	kV

DC Electrical Characteristics: T_A = 0°C to +70°C, V_{DDQ3} = 3.3V ± 5%

Parameter	Description		Test Condition	Min.	Typ.	Max.	Unit
Supply Current							
I_{DD}	3.3V Supply Current		CPUT0,CPUC0, CPU_S =100 MHz Outputs Loaded[2]		260		mA
I_{DD}	2.5V Supply Current		CPUT0,CPUC0, CPU_CS =100 MHz Outputs Loaded[2]		25		mA
Logic Inputs							
V_{IL}	Input Low Voltage			GND – 0.3		0.8	V
V_{IH}	Input High Voltage			2.0		V_{DD} + 0.3	V
I_{IL}	Input Low Current[3]					–25	µA
I_{IH}	Input High Current[3]					10	µA
Clock Outputs							
V_{OL}	Output Low Voltage		I_{OL} = 1 mA			50	mV
V_{OH}	Output High Voltage		I_{OH} = –1 mA	3.1			V
V_{OL}	Output Low Voltage	CPU_CS, CPUT0, CPUC0	Termination to V pull-up (external)	0		0.3	V
V_{OH}	Output High Voltage	CPU_CS, CPUT0, CPUC0	Termination to V pull-up (external)	1.0		1.2	V
I_{OL}	Output Low Current	PCI0:5	V_{OL} = 1.5V	70	110	135	mA
		REF0:1	V_{OL} = 1.5V	50	70	100	mA
		48 MHz	V_{OL} = 1.5V	50	70	100	mA
		24 MHz	V_{OL} = 1.5V	50	70	100	mA
		SDRAM0:12	V_{OL} = 1.5V	70	110	135	mA
I_{OH}	Output High Current	PCI0:5	V_{OH} = 1.5V	70	110	135	mA
		REF0:1	V_{OH} = 1.5V	50	70	100	mA
		48 MHz	V_{OH} = 1.5V	50	70	100	mA
		24 MHz	V_{OH} = 1.5V	50	70	100	mA
		SDRAM0:12	V_{OH} = 1.5V	70	110	135	mA

Notes:

2. All clock outputs loaded with 6" 60Ω transmission lines with 20-pF capacitors.
3. W310 logic inputs (except FS3) have internal pull-up devices (pull-ups not full CMOS level). Logic input FS3 has an internal pull-down device.

DC Electrical Characteristics: T_A = 0°C to +70°C, V_{DDQ3} = 3.3V ± 5% (continued)

Parameter	Description	Test Condition	Min.	Typ.	Max.	Unit
Crystal Oscillator						
V_{TH}	X1 Input Threshold Voltage[4]	V_{DDQ3} = 3.3V		1.65		V
C_{LOAD}	Load Capacitance, Imposed on External Crystal[5]			18		pF
$C_{IN,X1}$	X1 Input Capacitance[6]	Pin X2 unconnected		TBD		pF
Pin Capacitance/Inductance						
C_{IN}	Input Pin Capacitance	Except X1 and X2			5	pF
C_{OUT}	Output Pin Capacitance				6	pF
L_{IN}	Input Pin Inductance				7	nH

AC Electrical Characteristics

T_A = 0°C to +70°C, V_{DDQ3} = 3.3V±5%, f_{XTL} = 14.31818 MHz

AC clock parameters are tested and guaranteed over stated operating conditions using the stated lump capacitive load at the clock output; Spread Spectrum is disabled.

CPU Clock Outputs (CPUT0, CPUC0, CPU_CS)[7]

Parameter	Description	Test Condition/Comments	CPU = 100 MHz			CPU = 133 MHz			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
t_R	Output Rise Edge Rate	CPU_CS	1.0		4.0	1.0		4.0	V/ns
t_F	Output Fall Edge Rate	CPU_CS	1.0		4.0	1.0		4.0	V/ns
t_D	Duty Cycle	Measured at 50% point	45		55	45		55	%
t_{JC}	Jitter, Cycle to Cycle				250			250	ps
f_{ST}	Frequency Stabilization from Power-up (cold start)	Assumes full supply voltage reached within 1 ms from power-up. Short cycles exist prior to frequency stabilization.		3			3		ms
Z_o	AC Output Impedance	$V_O = V_X$		50			50		Ω

Notes:

4. X1 input threshold voltage (typical) is $V_{DD}/2$.
5. The W310 contains an internal crystal load capacitor between pin X1 and ground and another between pin X2 and ground. Total load placed on crystal is 18 pF; this includes typical stray capacitance of short PCB traces to crystal.
6. X1 input capacitance is applicable when driving X1 with an external clock source (X2 is left unconnected).
7. Refer to *Figure 5* for K7 operation clock driver test circuit.

PCI Clock Outputs, PCI0:5 (Lump Capacitance Test Load = 30 pF

Parameter	Description	Test Condition/Comments	Min.	Typ.	Max.	Unit
t_P	Period	Measured on rising edge at 1.5V	30			ns
t_H	High Time	Duration of clock cycle above 2.4V	12			ns
t_L	Low Time	Duration of clock cycle below 0.4V	12			ns
t_R	Output Rise Edge Rate	Measured from 0.4V to 2.4V	1		4	V/ns
t_F	Output Fall Edge Rate	Measured from 2.4V to 0.4V	1		4	V/ns
t_D	Duty Cycle	Measured on rising and falling edge at 1.5V	45		55	%
t_{JC}	Jitter, Cycle-to-Cycle	Measured on rising edge at 1.5V. Maximum difference of cycle time between two adjacent cycles.			250	ps
t_{SK}	Output Skew	Measured on rising edge at 1.5V			500	ps
t_O	CPU to PCI Clock Skew	Covers all CPU/PCI outputs. Measured on rising edge at 1.5V. CPU leads PCI output.	1.5		4	ns
f_{ST}	Frequency Stabilization from Power-up (cold start)	Assumes full supply voltage reached within 1 ms from power-up. Short cycles exist prior to frequency stabilization.			3	ms
Z_o	AC Output Impedance	Average value during switching transition. Used for determining series termination value.		30		Ω

REF0:1 Clock Outputs (Lump Capacitance Test Load = 20 pF)

Parameter	Description	Test Condition/Comments	Min.	Typ.	Max.	Unit
f	Frequency, Actual	Frequency generated by crystal oscillator		14.318		MHz
t_R	Output Rise Edge Rate	Measured from 0.4V to 2.4V	0.5		2	V/ns
t_F	Output Fall Edge Rate	Measured from 2.4V to 0.4V	0.5		2	V/ns
t_D	Duty Cycle	Measured on rising and falling edge at 1.5V	45		55	%
f_{ST}	Frequency Stabilization from Power-up (cold start)	Assumes full supply voltage reached within 1 ms from power-up. Short cycles exist prior to frequency stabilization.			3	ms
Z_o	AC Output Impedance	Average value during switching transition. Used for determining series termination value.		40		Ω

48-MHz Clock Output (Lump Capacitance Test Load = 20 pF)

Parameter	Description	Test Condition/Comments	Min.	Typ.	Max.	Unit
f	Frequency, Actual	Determined by PLL divider ratio (see m/n below)		48.008		MHz
f_D	Deviation from 48 MHz	(48.008 – 48)/48		+167		ppm
m/n	PLL Ratio	(14.31818 MHz x 57/17 = 48.008 MHz)		57/17		
t_R	Output Rise Edge Rate	Measured from 0.4V to 2.4V	0.5		2	V/ns
t_F	Output Fall Edge Rate	Measured from 2.4V to 0.4V	0.5		2	V/ns
t_D	Duty Cycle	Measured on rising and falling edge at 1.5V	45		55	%
f_{ST}	Frequency Stabilization from Power-up (cold start)	Assumes full supply voltage reached within 1 ms from power-up. Short cycles exist prior to frequency stabilization.			3	ms
Z_o	AC Output Impedance	Average value during switching transition. Used for determining series termination value.		40		Ω

24-MHz Clock Output (Lump Capacitance Test Load = 20 pF)

Parameter	Description	Test Condition/Comments	Min.	Typ.	Max.	Unit
f	Frequency, Actual	Determined by PLL divider ratio (see m/n below)		24.004		MHz
f_D	Deviation from 24 MHz	(24.004 – 24)/24		+167		ppm
m/n	PLL Ratio	(14.31818 MHz x 57/34 = 24.004 MHz)		57/34		
t_R	Output Rise Edge Rate	Measured from 0.4V to 2.4V	0.5		2	V/ns
t_F	Output Fall Edge Rate	Measured from 2.4V to 0.4V	0.5		2	V/ns
t_D	Duty Cycle	Measured on rising and falling edge at 1.5V	45		55	%
f_{ST}	Frequency Stabilization from Power-up (cold start)	Assumes full supply voltage reached within 1 ms from power-up. Short cycles exist prior to frequency stabilization.			3	ms
Z_o	AC Output Impedance	Average value during switching transition. Used for determining series termination value.		40		Ω

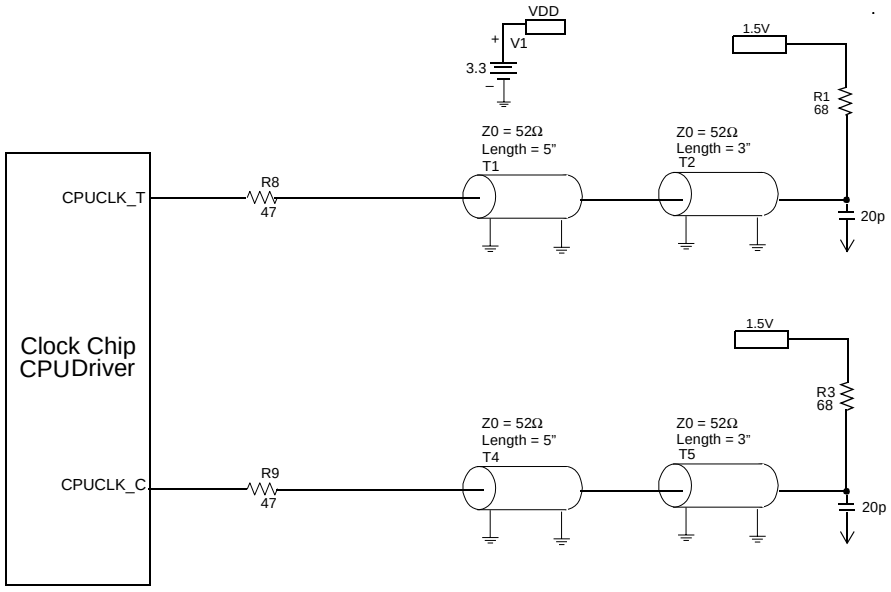
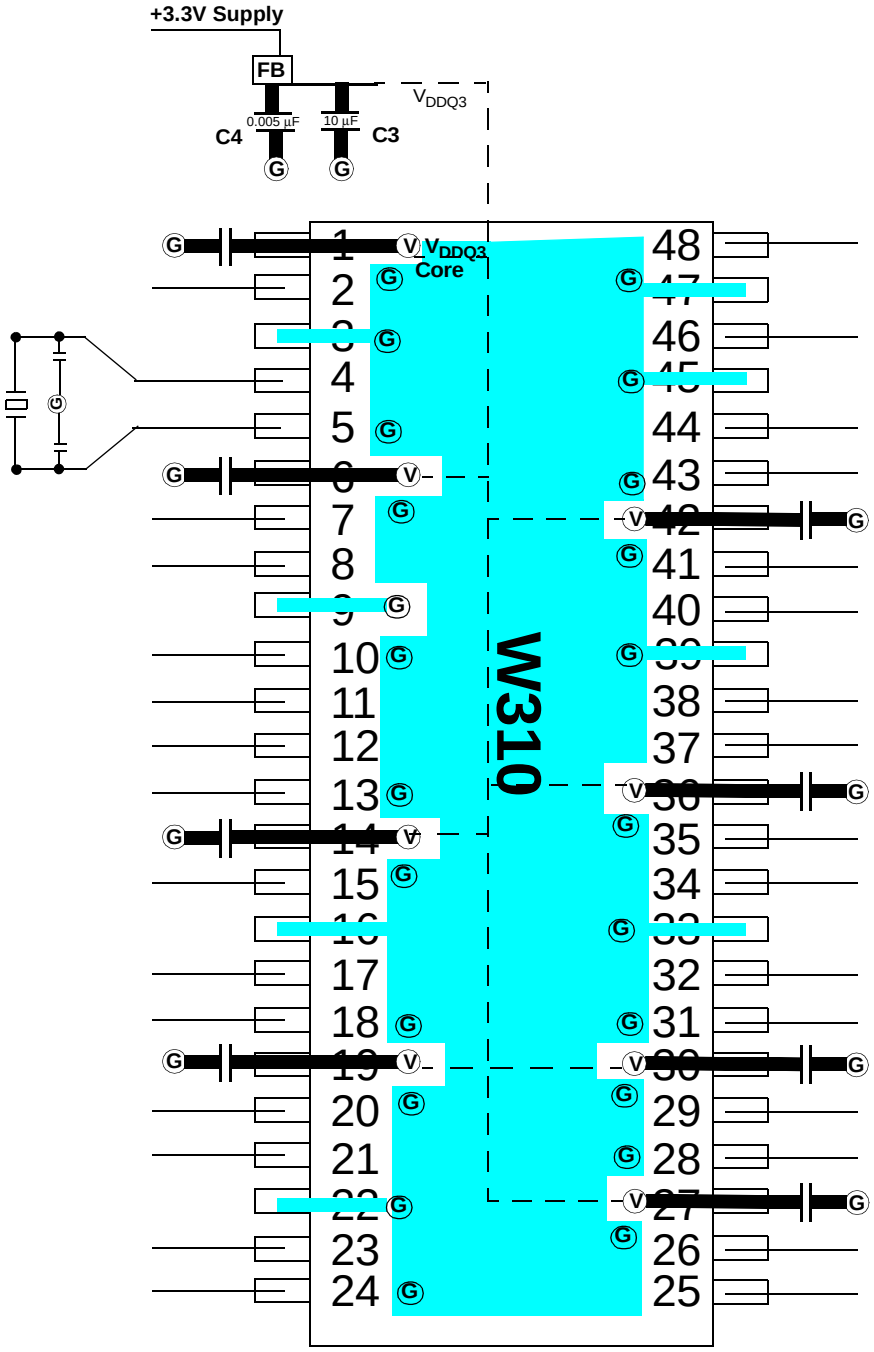


Figure 5. K7 Open Drain Clock Driver Test Circuit

Ordering Information

Ordering Code	Package Name	Package Type
W310	H	48-pin SSOP (300 mils)

Layout Diagram



FB = Dale ILB1206 - 300 (300Ω @ 100 MHz) or TDK ACB2012L-120

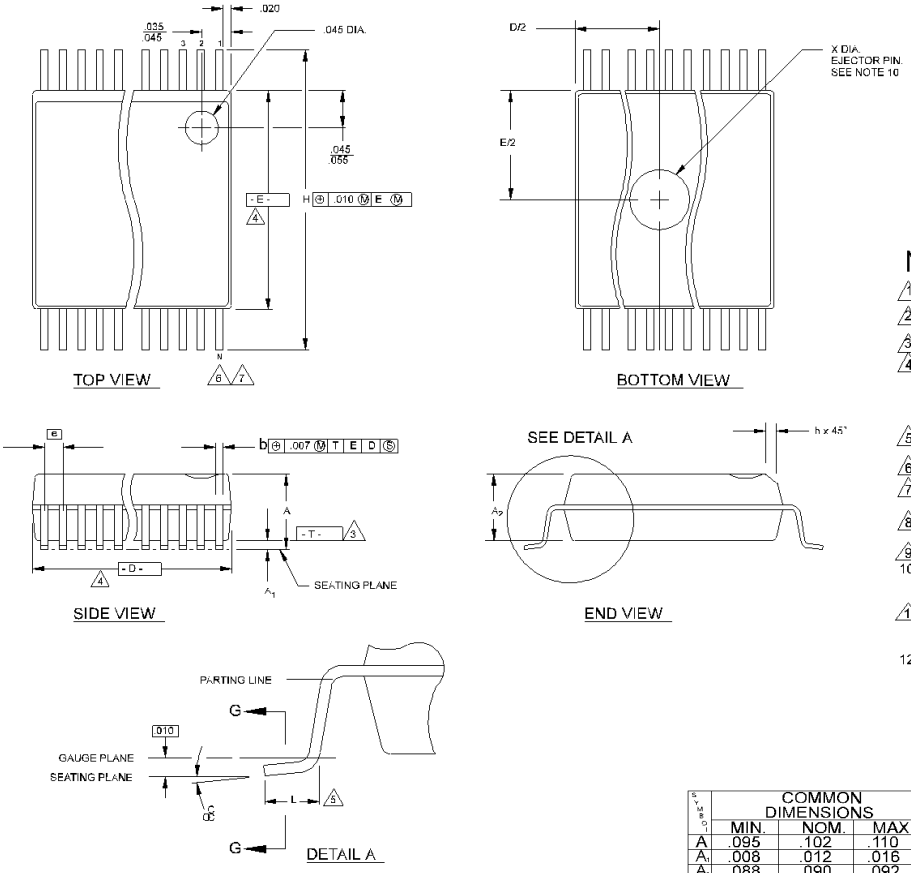
Ceramic Caps C3 = 10–22 µF C4 = 0.005 µF C6 = 0.01 µF

G = VIA to GND plane layer V =VIA to respective supply plane layer

Note: Each supply plane or strip should have a ferrite bead and capacitors

Package Diagram

48-Pin Small Shrink Outline Package (SSOP, 300 mils)



NOTES:

1. MAXIMUM DIE THICKNESS ALLOWABLE IS .025.
2. DIMENSIONING & TOLERANCING PER ANSI Y14.5M - 1982.
3. "T" IS A REFERENCE DATUM.
4. "D" & "E" ARE REFERENCE DATUMS AND DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS, BUT DOES INCLUDE MOLD MISMATCH AND ARE MEASURED AT THE MOLD PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006 INCHES PER SIDE.
5. "L" IS THE LENGTH OF TERMINAL FOR SOLDERING TO A SUBSTRATE.
6. "N" IS THE NUMBER OF TERMINAL POSITIONS.
7. TERMINAL POSITIONS ARE SHOWN FOR REFERENCE ONLY.
8. FORMED LEADS SHALL BE PLANAR WITH RESPECT TO ONE ANOTHER WITHIN .003 INCHES AT SEATING PLANE.
9. CONTROLLING DIMENSION: INCHES.
10. COUNTRY OF ORIGIN LOCATION AND EJECTOR PIN ON PACKAGE BOTTOM IS OPTIONAL AND DEPENDS ON ASSEMBLY LOCATION.
11. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 INCHES AND .010 INCHES FROM THE LEAD TIPS.
12. THIS PART IS COMPLIANT WITH JEDEC SPECIFICATION MO-118, VARIATIONS AA, AB, EXCEPT CHAMFER DIMENSION h. JEDEC SPECIFICATION FOR h IS .015"/.025".

SYMBOL	COMMON DIMENSIONS			h	NOTE VARIATIONS	4 D			6 N
	MIN.	NOM.	MAX.			MIN.	NOM.	MAX.	
A	.095	.102	.110		AA	.620	.625	.630	48
A_1	.008	.012	.016		AB	.720	.725	.730	56
A_2	.088	.090	.092						
b	.008	.010	.0135						
b_1	.008	.010	.012						
c	.005	-	.010						
c_1	.005	.006	.0085						
D	SEE VARIATIONS			4					
E	.292	.296	.299						
e	.025 BSC								
H	.400	.406	.410						
h	.010	.013	.016						
L	.024	.032	.040						
N	SEE VARIATIONS			6					
X	.085	.093	.100	10					
α	0°	5°	8°						

THIS TABLE IN INCHES

Summary of nominal dimensions in inches:

Body Width: 0.296
Lead Pitch: 0.025
Body Length: 0.625
Body Height: 0.102

SYMBOL	COMMON DIMENSIONS			h	NOTE VARIATIONS	4 D			6 N
	MIN.	NOM.	MAX.			MIN.	NOM.	MAX.	
A	2.41	2.59	2.79		AA	15.75	15.88	16.00	48
A_1	0.20	0.31	0.41		AB	18.29	18.42	18.54	56
A_2	2.24	2.29	2.34						
b	0.203	0.254	0.343						
b_1	0.203	0.254	0.305						
c	0.127	-	0.254						
c_1	0.127	0.152	0.216						
D	SEE VARIATIONS			4					
E	7.42	7.52	7.59						
e	0.635 BSC								
H	10.16	10.31	10.41						
h	0.25	0.33	0.41						
L	0.61	0.81	1.02						
N	SEE VARIATIONS			6					
X	2.16	2.36	2.54	10					
α	0°	5°	8°						

THIS TABLE IN MILLIMETERS

Document Title: W310 Spread Spectrum FTG for VIA K7 Chipset Document Number: 38-07258				
REV.	**ECN NO.**	**Issue Date**	**Orig. of Change**	**Description of Change**
**	110523	01/07/02	SZV	Change from Spec number: 38-01086 to 38-07258