

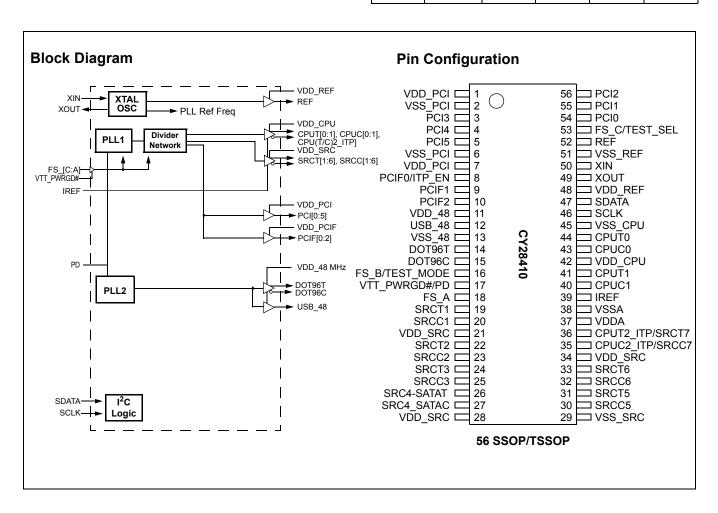
Clock Generator for Intel® Grantsdale Chipset

Features

- Compliant with Intel[®] CK410
- · Supports Intel P4 and Tejas CPU
- Selectable CPU frequencies
- Differential CPU clock pairs
- 100-MHz differential SRC clocks
- · 96-MHz differential dot clock
- 48-MHz USB clocks

- 33-MHz PCI clock
- · Low-voltage frequency select input
- I²C support with readback capabilities
- Ideal Lexmark Spread Spectrum profile for maximum electromagnetic interference (EMI) reduction
- 3.3V power supply
- · 56-pin SSOP and TSSOP packages

CPU	SRC	PCI	REF	DOT96	USB_48
x2 / x3	x6 / x7	x 9	x 1	x 1	x 1





Pin Definitions

Pin No.	Name	Туре	Description
44,43,41,40	CPUT/C	O, DIF	Differential CPU clock outputs.
36,35	CPUT2_ITP/SRCT7, CPUC2_ITP/SRCC7	O, DIF	Selectable Differential CPU or SRC clock output. ITP_EN = 0 @ VTT_PWRGD# assertion = SRC7 ITP_EN = 1 @ VTT_PWRGD# assertion = CPU2
14,15	DOT96T, DOT96C	O, DIF	Fixed 96-MHz clock output.
18	FS_A	I	3.3V tolerant input for CPU frequency selection. Refer to DC Electrical Specifications table for Vil_FS and Vih_FS specifications.
16	FS_B/TEST_MODE	I	3.3V tolerant input for CPU frequency selection. Selects Ref/N or Hi-Z when in test mode 0 = Hi-Z,1 = Ref/N Refer to DC Electrical Specifications table for Vil_FS and Vih_FS specifications.
53	FS_C/TEST_SEL	I	3.3V tolerant input for CPU frequency selection . Selects test mode if pulled to V _{IHFS_C} when VTT_PWRGD# is asserted low. Refer to DC Electrical Specifications table for V _{ILFS_C} , V _{IMFS_C} , V _{IHFS_C} specifications.
39	IREF	I	A Precision resistor is attached to this pin, which is connected to the internal current reference.
54,55,56,3,4,5	PCI	O, SE	33-MHz clocks.
9,10	PCIF	O, SE	33-MHz clocks.
8	PCIF0/ITP_EN	I/O, SE	33-MHz clock/CPU2 select (sampled on the VTT_PWRGD# assertion). 1 = CPU2_ITP, 0 = SRC7
52	REF	O, SE	Reference clock. 3.3V 14.318 MHz clock output.
46	SCLK	I	SMBus-compatible SCLOCK.
47	SDATA	I/O	SMBus-compatible SDATA.
26,27	SRC4_SATAT, SRC4_SATAC	O, DIF	Differential serial reference clock. recommended output for SATA.
19,20,22,23,2 4,25,31,30,33, 32	SRCT/C	O, DIF	Differential serial reference clocks.
12	USB_48	I/O, SE	Fixed 48 MHz clock output.
11	VDD_48	PWR	3.3V power supply for outputs.
42	VDD_CPU	PWR	3.3V power supply for outputs.
1,7	VDD_PCI	PWR	3.3V power supply for outputs.
48	VDD_REF	PWR	3.3V power supply for outputs.
21,28,34	VDD_SRC	PWR	3.3V power supply for outputs.
37	VDDA	PWR	3.3V power supply for PLL.
13	VSS_48	GND	Ground for outputs.
45	VSS_CPU	GND	Ground for outputs.
2,6	VSS_PCI	GND	Ground for outputs.
51	VSS_REF	GND	Ground for outputs.
29	VSS_SRC	GND	Ground for outputs.
38	VSSA	GND	Ground for PLL.
17	VTT_PWRGD#/PD	I, PU	3.3V LVTTL input is a level sensitive strobe used to latch the USB_48/FS_A, FS_B, FS_C/TEST_SEL and PCIF0/ITP_EN inputs. After VTT_PWRGD# (active low) assertion, this pin becomes a realtime input for asserting power-down (active high)
50	XIN	I	14.318-MHz Crystal Input
49	XOUT	O, SE	14.318-MHz Crystal Output



Frequency Select Pins (FS_A, FS_B and FS_C)

Host clock frequency selection is achieved by applying the appropriate logic levels to FS_A, FS_B, FS_C inputs prior to VTT_PWRGD# assertion (as seen by the clock synthesizer). Upon VTT_PWRGD# being sampled low by the clock chip (indicating processor VTT voltage is stable), the clock chip

samples the FS_A, FS_B and FS_C input values. For all logic levels of FS_A, FS_B and FS_C, VTT_PWRGD# employs a one-shot functionality in that once a valid low on VTT_PWRGD# has been sampled, all further VTT_PWRGD#, FS_A, FS_B and FS_C transitions will be ignored, except in test mode.

Table 1. Frequency Select Table FS_A, FS_B and FS_C

FS_C	FS_B	FS_A	CPU	SRC	PCIF/PCI	REF0	DOT96	USB
MID	0	1	100 MHz	100 MHz	33 MHz	14.318 MHz	96 MHz	48 MHz
0	0	1	133 MHz	100 MHz	33 MHz	14.318 MHz	96 MHz	48 MHz
0	1	0	200 MHz	100 MHz	33 MHz	14.318 MHz	96 MHz	48 MHz
0	0	0	266 MHz	100 MHz	33 MHz	14.318 MHz	96 MHz	48 MHz
1	0	х	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z
1	1	0	REF/2	REF/8	REF/24	REF	REF	REF
1	1	1	REF/2	REF/8	REF/24	REF	REF	REF

Serial Data Interface

To enhance the flexibility and function of the clock synthesizer, a two-signal serial interface is provided. Through the Serial Data Interface, various device functions, such as individual clock output buffers, can be individually enabled or disabled. The registers associated with the Serial Data Interface initializes to their default setting upon power-up, and therefore use of this interface is optional. Clock device register changes are normally made upon system initialization, if any are required. The interface cannot be used during system operation for power management functions.

Data Protocol

The clock driver serial protocol accepts byte write, byte 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 (most significant bit first) with the ability to stop after any complete byte has been transferred. For byte write and byte read operations, the system controller can access individually indexed bytes. The offset of the indexed byte is encoded in the command code, as described in *Table 2*.

The block write and block read protocol is outlined in *Table 3* while *Table 4* outlines the corresponding byte write and byte read protocol. The slave receiver address is 11010010 (D2h).

Table 2. Command Code Definition

	Bit	Description
	7	0 = Block read or block write operation, 1 = Byte read or byte write operation
(,	Byte offset for byte read or byte write operation. For block read or block write operations, these bits should be '0000000'

Table 3. Block Read and Block Write Protocol

	Block Write Protocol		Block Read Protocol
Bit	Description	Bit	Description
1	Start	1	Start
8:2	Slave address – 7 bits	8:2	Slave address – 7 bits
9	Write	9	Write
10	Acknowledge from slave	10	Acknowledge from slave
18:11	Command Code – 8 bits	18:11	Command Code – 8 bits
19	Acknowledge from slave	19	Acknowledge from slave
27:20	Byte Count – 8 bits (Skip this step if I ² C_EN bit set)	20	Repeat start
28	Acknowledge from slave	27:21	Slave address – 7 bits
36:29	Data byte 1 – 8 bits	28	Read = 1
37	Acknowledge from slave	29	Acknowledge from slave
45:38	Data byte 2 – 8 bits	37:30	Byte Count from slave – 8 bits
46	Acknowledge from slave	38	Acknowledge



Table 3. Block Read and Block Write Protocol (continued)

	Block Write Protocol	Block Read Protocol		
Bit	Description	Bit	Description	
	Data Byte /Slave Acknowledges	46:39	Data byte 1 from slave – 8 bits	
	Data Byte N –8 bits	47	Acknowledge	
	Acknowledge from slave	55:48	Data byte 2 from slave – 8 bits	
	Stop	56	Acknowledge	
			Data bytes from slave / Acknowledge	
			Data Byte N from slave – 8 bits	
			NOT Acknowledge	
			Stop	

Table 4. Byte Read and Byte Write Protocol

	Byte Write Protocol		Byte Read Protocol
Bit	Description	Bit	Description
1	Start	1	Start
8:2	Slave address – 7 bits	8:2	Slave address – 7 bits
9	Write	9	Write
10	Acknowledge from slave	10	Acknowledge from slave
18:11	Command Code – 8 bits	18:11	Command Code – 8 bits
19	Acknowledge from slave	19	Acknowledge from slave
27:20	Data byte – 8 bits	20	Repeated start
28	Acknowledge from slave	27:21	Slave address – 7 bits
29	Stop	28	Read
		29	Acknowledge from slave
		37:30	Data from slave – 8 bits
		38	NOT Acknowledge
		39	Stop

Control Registers

Byte 0:Control Register 0

Bit	@Pup	Name	Description
7	1	CPUT2_ITP/SRCT7 CPUC2_ITP/SRCC7	CPU[T/C]2_ITP/SRC[T/C]7 Output Enable 0 = Disable (Hi-Z), 1 = Enable
6	1	SRC[T/C]6	SRC[T/C]6 Output Enable 0 = Disable (Hi-Z), 1 = Enable
5	1	SRC[T/C]5	SRC[T/C]5 Output Enable 0 = Disable (Hi-Z), 1 = Enable
4	1	SRC[T/C]4	SRC[T/C]4 Output Enable 0 = Disable (Hi-Z), 1 = Enable
3	1	SRC[T/C]3	SRC[T/C]3 Output Enable 0 = Disable (Hi-Z), 1 = Enable
2	1	SRC[T/C]2	SRC[T/C]2 Output Enable 0 = Disable (Hi-Z), 1 = Enable
1	1	SRC[T/C]1	SRC[T/C]1 Output Enable 0 = Disable (Hi-Z), 1 = Enable
0	1	Reserved	Reserved, Set = 1



Byte 1: Control Register 1

Bit	@Pup	Name	Description
7	1	PCIF0	PCIF0 Output Enable 0 = Disabled, 1 = Enabled
6	1	DOT_96T/C	DOT_96 MHz Output Enable 0 = Disable (Hi-Z), 1 = Enabled
5	1	USB_48	USB_48 MHz Output Enable 0 = Disabled, 1 = Enabled
4	1	REF	REF Output Enable 0 = Disabled, 1 = Enabled
3	0	Reserved	Reserved
2	1	CPU[T/C]1	CPU[T/C]1 Output Enable 0 = Disable (Hi-Z), 1 = Enabled
1	1	CPU[T/C]0	CPU[T/C]0 Output Enable 0 = Disable (Hi-Z), 1 = Enabled
0	0	CPUT/C SRCT/C PCIF PCI	Spread Spectrum Enable 0 = Spread off, 1 = Spread on

Byte 2: Control Register 2

Bit	@Pup	Name	Description
7	1	PCI5	PCI5 Output Enable 0 = Disabled, 1 = Enabled
6	1	PCI4	PCI4 Output Enable 0 = Disabled, 1 = Enabled
5	1	PCI3	PCI3 Output Enable 0 = Disabled, 1 = Enabled
4	1	PCI2	PCI2 Output Enable 0 = Disabled, 1 = Enabled
3	1	PCI1	PCI1 Output Enable 0 = Disabled, 1 = Enabled
2	1	PCI0	PCI0 Output Enable 0 = Disabled, 1 = Enabled
1	1	PCIF2	PCIF2 Output Enable 0 = Disabled, 1 = Enabled
0	1	PCIF1	PCIF1 Output Enable 0 = Disabled, 1 = Enabled

Byte 3: Control Register 3

Bit	@Pup	Name	Description
7	0	SRC7	Allow control of SRC[T/C]7 with assertion of SW PCI_STP# 0 = Free running, 1 = Stopped with SW PCI_STP#
6	0	SRC6	Allow control of SRC[T/C]6 with assertion of SW PCI_STP# 0 = Free running, 1 = Stopped with SW PCI_STP#
5	0	SRC5	Allow control of SRC[T/C]5 with assertion of SW PCI_STP# 0 = Free running, 1 = Stopped with SW PCI_STP#
4	0	SRC4	Allow control of SRC[T/C]4 with assertion of SW PCI_STP# 0 = Free running, 1 = Stopped with SW PCI_STP#
3	0	SRC3	Allow control of SRC[T/C]3 with assertion of SW PCI_STP# 0 = Free running, 1 = Stopped with SW PCI_STP#
2	0	SRC2	Allow control of SRC[T/C]2 with assertion of SW PCI_STP# 0 = Free running, 1 = Stopped with SW PCI_STP#



Byte 3: Control Register 3 (continued)

Bit	@Pup	Name	Description
1	0	SRC1	Allow control of SRC[T/C]1 with assertion of SW PCI_STP# 0 = Free running, 1 = Stopped with SW PCI_STP#
0	0	Reserved	Reserved, Set = 0

Byte 4: Control Register 4

Bit	@Pup	Name	Description
7	0	Reserved	Reserved, Set = 0
6	0	DOT96[T/C]	DOT_PWRDWN Drive Mode 0 = Driven in PWRDWN, 1 = Hi-Z
5	0	PCIF2	Allow control of PCIF2 with assertion of SW PCI_STP# 0 = Free running, 1 = Stopped with SW PCI_STP#
4	0	PCIF1	Allow control of PCIF1 with assertion of SW PCI_STP# 0 = Free running, 1 = Stopped with SW PCI_STP#
3	0	PCIF0	Allow control of PCIF0 with assertion of SW PCI_STP# 0 = Free running, 1 = Stopped with SW PCI_STP#
2	1	Reserved	Reserved, Set = 1
1	1	Reserved	Reserved, Set = 1
0	1	Reserved	Reserved, Set = 1

Byte 5: Control Register 5

Bit	@Pup	Name	Description
7	0	SRC[T/C][7:0]	SRC[T/C] Stop Drive Mode 0 = Driven when SW PCI_STP# asserted,1 = Hi-Z when PCI_STP# asserted
6	0	Reserved	Reserved, Set = 0
5	0	Reserved	Reserved, Set = 0
4	0	Reserved	Reserved, Set = 0
3	0	SRC[T/C][7:0]	SRC[T/C] PWRDWN Drive Mode 0 = Driven when PD asserted,1 = Hi-Z when PD asserted
2	0	CPU[T/C]2	CPU[T/C]2 PWRDWN Drive Mode 0 = Driven when PD asserted,1 = Hi-Z when PD asserted
1	0	CPU[T/C]1	CPU[T/C]1 PWRDWN Drive Mode 0 = Driven when PD asserted,1 = Hi-Z when PD asserted
0	0	CPU[T/C]0	CPU[T/C]0 PWRDWN Drive Mode 0 = Driven when PD asserted,1 = Hi-Z when PD asserted

Byte 6: Control Register 6

Bit	@Pup	Name	Description
7	0		REF/N or Hi-Z Select 1 = REF/N Clock, 0 = Hi-Z
6	0		Test Clock Mode Entry Control 1 = REF/N or Hi-Z mode, 0 = Normal operation
5	0	Reserved	Reserved, Set = 0
4	1	REF	REF Output Drive Strength 0 = Low, 1 = High
3	1	PCIF, SRC, PCI	SW PCI_STP# Function 0=SW PCI_STP assert, 1 = SW PCI_STP deassert When this bit is set to 0, all STOPPABLE PCI, PCIF and SRC outputs will be stopped in a synchronous manner with no short pulses. When this bit is set to 1, all STOPPED PCI, PCIF and SRC outputs will resume in a synchronous manner with no short pulses.



Byte 6: Control Register 6 (continued)

Bit	@Pup	Name	Description
2	Externally selected	CPUT/C	FS_C. Reflects the value of the FS_C pin sampled on power-up 0 = FS_C was low during VTT_PWRGD# assertion
1	Externally selected	CPUT/C	FS_B. Reflects the value of the FS_B pin sampled on power-up 0 = FS_B was low during VTT_PWRGD# assertion
0	Externally selected	CPUT/C	FS_A. Reflects the value of the FS_A pin sampled on power-up 0 = FS_A was low during VTT_PWRGD# assertion

Byte 7: Vendor ID

Bit	@Pup	Name	Description
7	0	Revision Code Bit 3	Revision Code Bit 3
6	0	Revision Code Bit 2	Revision Code Bit 2
5	1	Revision Code Bit 1	Revision Code Bit 1
4	0	Revision Code Bit 0	Revision Code Bit 0
3	1	Vendor ID Bit 3	Vendor ID Bit 3
2	0	Vendor ID Bit 2	Vendor ID Bit 2
1	0	Vendor ID Bit 1	Vendor ID Bit 1
0	0	Vendor ID Bit 0	Vendor ID Bit 0

Crystal Recommendations

The CY28410 requires a Parallel Resonance Crystal. Substituting a series resonance crystal will cause the CY28410 to operate at the wrong frequency and \violate the ppm specification. For most applications there is a 300ppm frequency shift between series and parallel crystals due to incorrect loading.

Crystal Loading

Crystal loading plays a critical role in achieving low ppm performance. To realize low ppm performance, the total capacitance the crystal will see must be considered to calculate the appropriate capacitive loading (CL).

The following diagram shows a typical crystal configuration using the two trim capacitors. An important clarification for the following discussion is that the trim capacitors are in series with the crystal not parallel. It's a common misconception that load capacitors are in parallel with the crystal and should be approximately equal to the load capacitance of the crystal. This is not true.

Table 5. Crystal Recommendations

Frequency (Fund)	Cut	Loading	Load Cap	Drive (max.)	Shunt Cap (max.)	Motional (max.)	Tolerance (max.)	Stability (max.)	Aging (max.)
14.31818 MHz	AT	Parallel	20 pF	0.1 mW	5 pF	0.016 pF	35 ppm	30 ppm	5 ppm



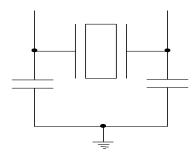


Figure 1. Crystal Capacitive Clarification

Calculating Load Capacitors

In addition to the standard external trim capacitors, trace capacitance and pin capacitance must also be considered to correctly calculate crystal loading. As mentioned previously, the capacitance on each side of the crystal is in series with the crystal. This means the total capacitance on each side of the crystal must be twice the specified crystal load capacitance (CL). While the capacitance on each side of the crystal is in series with the crystal, trim capacitors (Ce1,Ce2) should be calculated to provide equal capacitive loading on both sides.

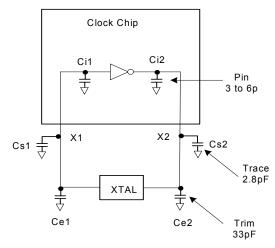


Figure 2. Crystal Loading Example

As mentioned previously, the capacitance on each side of the crystal is in series with the crystal. This mean the total capacitance on each side of the crystal must be twice the specified load capacitance (CL). While the capacitance on each side of the crystal is in series with the crystal, trim capacitors(Ce1,Ce2) should be calculated to provide equal capacitance loading on both sides.

Use the following formulas to calculate the trim capacitor values fro Ce1 and Ce2.

Load Capacitance (each side)

$$Ce = 2 * CL - (Cs + Ci)$$

Total Capacitance (as seen by the crystal)

CLe =
$$\frac{1}{\left(\frac{1}{Ce1 + Cs1 + Ci1} + \frac{1}{Ce2 + Cs2 + Ci2}\right)}$$



CL	Crystal load capacitance
CLeusing standard value trim cap	Actual loading seen by crystal acitors
Ce	External trim capacitors
Cs	Stray capacitance (terraced)
Ci(lead frame, bond wires etc.)	Internal capacitance

PD (Power-down) Clarification

The VTT_PWRGD# /PD pin is a dual function pin. During initial power-up, the pin functions as VTT_PWRGD#. Once VTT_PWRGD# has been sampled low by the clock chip, the pin assumes PD functionality. The PD pin is an asynchronous active high input used to shut off all clocks cleanly prior to shutting off power to the device. This signal is synchronized internal to the device prior to powering down the clock synthesizer. PD is also an asynchronous input for powering up the system. When PD is asserted high, all clocks are driven to a low value and held prior to turning off the VCOs and the crystal oscillator.

PD (Power-down) - Assertion

When PD is sampled high by two consecutive rising edges of CPUC, all single-ended outputs will be held low on their next high to low transition and differential clocks must be held high or Hi-Z (depending on the state of the control register drive

mode bit) on the next diff clock# high to low transition within 4 clock periods. When the SMBus PD drive mode bit corresponding to the differential (CPU, SRC, and DOT) clock output of interest is programmed to '0', the clock output must be held with "Diff clock" pin driven high at 2 x Iref, and "Diff clock#" tristate. If the control register PD drive mode bit corresponding to the output of interest is programmed to "1", then both the "Diff clock" and the "Diff clock#" are Hi-Z. Note the example below shows CPUT = 133 MHz and PD drive mode = '1' for all differential outputs. This diagram and description is applicable to valid CPU frequencies 100,133,166,200,266,333, and 400 MHz. In the event that PD mode is desired as the initial power-on state, PD must be asserted high in less than 10 uS after asserting VTT PWRGD#.

PD Deassertion

The power-up latency is less than 1.8 ms. This is the time from the deassertion of the PD pin or the ramping of the power supply until the time that stable clocks are output from the clock chip. All differential outputs stopped in a three-state condition resulting from power-down must be driven high in less than 300 μs of PD deassertion to a voltage greater than 200 mV. After the clock chip's internal PLL is powered up and locked, all outputs are enabled within a few clock cycles of each other. Below is an example showing the relationship of clocks coming up.

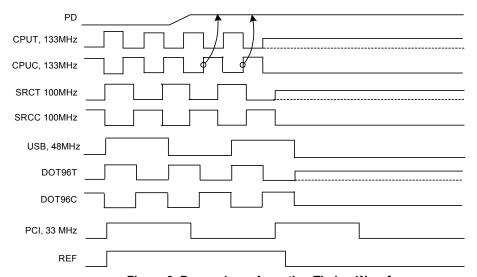


Figure 3. Power-down Assertion Timing Waveform



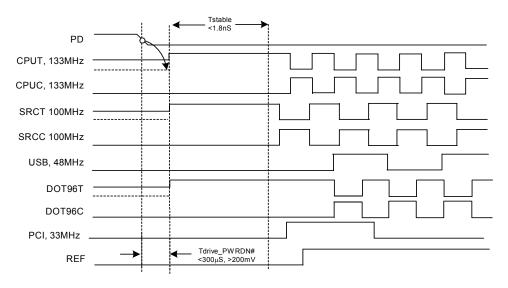


Figure 4. Power-down Deassertion Timing Waveform

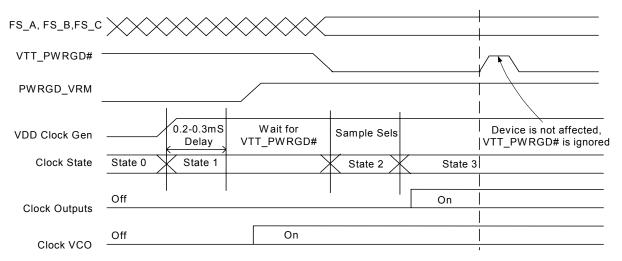


Figure 5. VTT_PWRGD# Timing Diagram

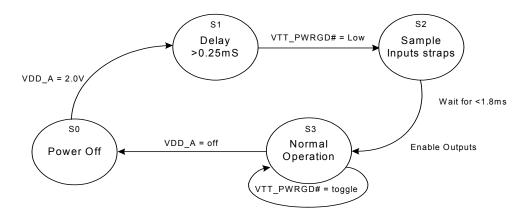


Figure 6. Clock Generator Power-up/Run State Diagram



Absolute Maximum Conditions

Parameter	Description	Condition	Min.	Max.	Unit
V_{DD}	Core Supply Voltage		-0.5	4.6	V
V_{DD_A}	Analog Supply Voltage		-0.5	4.6	V
V _{IN}	Input Voltage	Relative to V _{SS}	-0.5	V _{DD} + 0.5	VDC
T _S	Temperature, Storage	Non-functional	-65	150	°C
T _A	Temperature, Operating Ambient	Functional	0	70	°C
TJ	Temperature, Junction	Functional	_	150	°C
\emptyset_{JC}	Dissipation, Junction to Case	SSOP	;	39.56	°C/W
	(Mil-Spec 883E Method 1012.1)	TSSOP	2	4.6 4.6 V _{DD} + 0.5 150 70 150 9.56 9.56 9.62 5.29 62.26	
\emptyset_{JA}	Dissipation, Junction to Ambient	SSOP	4	4.6 4.6 V _{DD} + 0.5 150 70 150 39.56 20.62 45.29 62.26	°C/W
	JEDEC (JESD 51)	TSSOP	(
ESD _{HBM}	ESD Protection (Human Body Model)	MIL-STD-883, Method 3015	2000	_	V
UL-94	Flammability Rating	At 1/8 in.		V-0	
MSL	Moisture Sensitivity Level			1	

Multiple Supplies: The voltage on any input or I/O pin cannot exceed the power pin during power-up. Power supply sequencing is NOT required.

DC Electrical Specifications

Parameter	Description	Condition	Min.	Max.	Unit
VDD_A VDD_REF, VDD_PCI, VDD_3V66, VDD_48, VDD_CPU	3.3V Operating Voltage	3.3 ± 5%	3.135	3.465	V
V _{ILI2C}	Input Low Voltage	SDATA, SCLK	_	1.0	V
V _{IHI2C}	Input High Voltage	SDATA, SCLK	2.2	_	V
V _{IL_FS}	FS_A/FS_B Input Low Voltage		$V_{SS} - 0.3$	0.35	V
V _{IH_FS}	FS_A/FS_B Input High Voltage		0.7	V _{DD} + 0.5	V
V _{ILFS_C}	FS_C Low Range		0	0.35	V
V _{IMFS_C}	FS_C Mid Range		0.7	1.7	V
V _{IH FS_C}	FS_C High Range		2.1	V_{DD}	V
V _{IL}	Input Low Voltage		$V_{SS} - 0.5$	0.8	V
V _{IH}	Input High Voltage		2.0	V _{DD} + 0.5	V
I _{IL}	Input Low Leakage Current	except internal pull-up resistors, 0 < V _{IN} < V _{DD}	- 5		μА
I _{IH}	Input High Leakage Current	except internal pull-down resistors, $0 < V_{IN} < V_{DD}$		5	μА
V_{OL}	Output Low Voltage	I _{OL} = 1 mA	_	0.4	V
V _{OH}	Output High Voltage	I _{OH} = -1 mA	2.4	-	V
I_{OZ}	High-impedance Output Current		-10	10	μА
C _{IN}	Input Pin Capacitance		2	5	pF
C _{OUT}	Output Pin Capacitance		3	6	pF
L _{IN}	Pin Inductance		_	7	nΗ
V_{XIH}	Xin High Voltage		0.7V _{DD}	V_{DD}	V
V_{XIL}	Xin Low Voltage		0	0.3V _{DD}	V
I _{DD3.3V}	Dynamic Supply Current	At max load and freq per Figure 8	_	550	mA
I _{PD3.3V}	Power-down Supply Current	PD asserted, Outputs driven	_	70	mA
I _{PD3.3V}	Power-down Supply Current	PD asserted, Outputs Hi-Z	_	2	mA



AC Electrical Specifications

Parameter	Description	Condition	Min.	Max.	Unit
Crystal			l.	l .	
T _{DC}	XIN Duty Cycle	The device will operate reliably with input duty cycles up to 30/70 but the REF clock duty cycle will not be within specification	47.5	52.5	%
T _{PERIOD}	XIN Period	When XIN is driven from an external clock source	69.841	71.0	ns
T _R / T _F	XIN Rise and Fall Times	Measured between 0.3V _{DD} and 0.7V _{DD}	-	10.0	ns
T _{CCJ}	XIN Cycle to Cycle Jitter	As an average over 1-μs duration	-	500	ps
L _{ACC}	Long-term Accuracy	Over 150 ms	-	300	ppm
CPU at 0.7V					
T _{DC}	CPUT and CPUC Duty Cycle	Measured at crossing point V _{OX}	43	57	%
T _{PERIOD}	100-MHz CPUT and CPUC Period	Measured at crossing point V _{OX}	9.997001	10.00300	ns
T _{PERIOD}	133-MHz CPUT and CPUC Period	Measured at crossing point V _{OX}	7.497751	7.502251	ns
T _{PERIOD}	200-MHz CPUT and CPUC Period	Measured at crossing point V _{OX}	4.998500	5.001500	ns
T _{PERIOD}	266-MHz CPUT and CPUC Period	Measured at crossing point V _{OX}	3.748875	3.751125	ns
T _{PERIODSS}	100-MHz CPUT and CPUC Period, SSC	Measured at crossing point V _{OX}	9.997001	10.05327	ns
T _{PERIODSS}	133-MHz CPUT and CPUC Period, SSC	Measured at crossing point V _{OX}	7.497751	7.539950	ns
T _{PERIODSS}	200-MHz CPUT and CPUC Period, SSC	Measured at crossing point V _{OX}	4.998500	5.026634	ns
T _{PERIODSS}	266-MHz CPUT and CPUC Period, SSC	Measured at crossing point V _{OX}	3.748875	3.769975	ns
T _{PERIODAbs}	100-MHz CPUT and CPUC Absolute period	Measured at crossing point V _{OX}	9.912001	10.08800	ns
T _{PERIODAbs}	133-MHz CPUT and CPUC Absolute period	Measured at crossing point V _{OX}	7.412751	7.587251	ns
T _{PERIODSSAbs}	100-MHz CPUT and CPUC Absolute period, SSC	Measured at crossing point V _{OX}	9.912001	10.13827	ns
T _{PERIODSSAbs}	133-MHz CPUT and CPUC Absolute period, SSC	Measured at crossing point V _{OX}	7.412751	7.624950	ns
T _{PERIODSSAbs}	200-MHz CPUT and CPUC Absolute period, SSC	Measured at crossing point V _{OX}	4.913500	5.111634	ns
T _{PERIODSSAbs}	266-MHz CPUT and CPUC Absolute period, SSC	Measured at crossing point V _{OX}	3.663875	3.854975	ns
T _{PERIODSSAbs}	400-MHz CPUT and CPUC Absolute period, SSC	Measured at crossing point V _{OX}	2.414250	2.598317	ns
T _{SKEW}	Any CPUT/C to CPUT/C Clock Skew, SSC	Measured at crossing point V _{OX}	-	100	ps
T _{CCJ2}	CPU2_ITP Cycle to Cycle Jitter	Measured at crossing point V _{OX}	-	125	ps
T _{CCJ}	CPUT/C Cycle to Cycle Jitter	Measured at crossing point V _{OX}	-	115	ps
T _{SKEW2}	CPU2_ITP to CPU0 Clock Skew	Measured at crossing point V _{OX}	_	150	ps
T _R / T _F	CPUT and CPUC Rise and Fall Times	Measured from V_{OL} = 0.175 to V_{OH} = 0.525V	175	1100	ps
T _{RFM}	Rise/Fall Matching	Determined as a fraction of 2*(T _R – T _F)/(T _R + T _F)	_	20	%
ΔT_{R}	Rise Time Variation		_	125	ps
ΔT_{F}	Fall Time Variation		_	125	ps
V _{HIGH}	Voltage High	Math averages <i>Figure 8</i>	660	850	mV



AC Electrical Specifications (continued)

Parameter	Description	Condition	Min.	Max.	Unit
V_{LOW}	Voltage Low	Math averages Figure 8	-150	_	mV
V _{OX}	Crossing Point Voltage at 0.7V Swing		250	550	mV
V _{OVS}	Maximum Overshoot Voltage		-	V _{HIGH} + 0.3	٧
V _{UDS}	Minimum Undershoot Voltage		-0.3	_	V
V_{RB}	Ring Back Voltage	See Figure 8. Measure SE	_	0.2	V
SRC			I	I	
T _{DC}	SRCT and SRCC Duty Cycle	Measured at crossing point V _{OX}	45	55	%
T _{PERIOD}	100-MHz SRCT and SRCC Period	Measured at crossing point V _{OX}	9.997001	10.00300	ns
T _{PERIODSS}	100-MHz SRCT and SRCC Period, SSC	Measured at crossing point V _{OX}	9.997001	10.05327	ns
T _{PERIODAbs}	100-MHz SRCT and SRCC Absolute Period	Measured at crossing point V _{OX}	10.12800	9.872001	ns
T _{PERIODSSAbs}	100-MHz SRCT and SRCC Absolute Period, SSC	Measured at crossing point V _{OX}	9.872001	10.17827	ns
T _{SKEW}	SRC Skew	Measured at crossing point V _{OX}	-	250	ps
T _{CCJ}	SRCT/C Cycle to Cycle Jitter	Measured at crossing point V _{OX}	-	125	ps
L _{ACC}	SRCT/C Long Term Accuracy	Measured at crossing point V _{OX}	-	300	ppm
T _R / T _F	SRCT and SRCC Rise and Fall Times	Measured from V_{OL} = 0.175 to V_{OH} = 0.525V	175	1100	ps
T _{RFM}	Rise/Fall Matching	Determined as a fraction of $2*(T_R - T_F)/(T_R + T_F)$	-	20	%
ΔT _R	Rise Time Variation		-	125	ps
ΔT _F	Fall Time Variation		-	125	ps
V _{HIGH}	Voltage High	Math averages Figure 8	660	850	mV
V_{LOW}	Voltage Low	Math averages Figure 8	-150	_	mV
V _{OX}	Crossing Point Voltage at 0.7V Swing		250	550	mV
V _{OVS}	Maximum Overshoot Voltage		_	V _{HIGH} + 0.3	٧
V _{UDS}	Minimum Undershoot Voltage		-0.3	_	V
V_{RB}	Ring Back Voltage	See Figure 8. Measure SE	-	0.2	V
PCI/PCIF					
T _{DC}	PCI Duty Cycle	Measurement at 1.5V	45	55	%
T _{PERIOD}	Spread Disabled PCIF/PCI Period	Measurement at 1.5V	29.99100	30.00900	ns
T _{PERIODSS}	Spread Enabled PCIF/PCI Period, SSC	Measurement at 1.5V	29.9910	30.15980	ns
T _{PERIODAbs}	Spread Disabled PCIF/PCI Period	Measurement at 1.5V	29.49100	30.50900	ns
T _{PERIODSSAbs}	Spread Enabled PCIF/PCI Period, SSC	Measurement at 1.5V	29.49100	30.65980	ns
T _{HIGH}	PCIF and PCI high time	Measurement at 2.4V	11.5	-	ns
T _{LOW}	PCIF and PCI low time	Measurement at 0.4V	11.5	-	ns
T _R / T _F	PCIF and PCI rise and fall times	Measured between 0.8V and 2.0V	0.5	2.0	ns
T _{SKEW}	Any PCI clock to Any PCI clock Skew	Measurement at 1.5V	-	500	ps
T _{CCJ}	PCIF and PCI Cycle to Cycle Jitter	Measurement at 1.5V	-	500	ps
DOT					•
T _{DC}	DOT96T and DOT96C Duty Cycle	Measured at crossing point V _{OX}	45	55	%
T _{PERIOD}	DOT96T and DOT96C Period	Measured at crossing point V _{OX}	10.41354	10.41979	ns



AC Electrical Specifications (continued)

Period	Parameter	Description	Condition	Min.	Max.	Unit
DOT96T/C Long Term Accuracy Measured at crossing point V _{OX} − 100 ppm	T _{PERIODAbs}		Measured at crossing point V _{OX}	10.16354	10.66979	ns
LACC DOT96T/C Long Term Accuracy Measured at crossing point V _{OX} — 100 ppm T _R / T _F DOT96T and DOT96C Rise and Fall Times 0.525V 175 to V _{OH} = 175 1100 ps T _{RM} Rise/Fall Matching Determined as a fraction of 2°(T _R − T _F)/(T _R — 20 % ΔT _R Rise Time Variation — 125 ps ΔT _F Fall Time Variation — 125 ps VH _{IGH} Voltage High Math averages Figure 8 660 850 mV V _{LOW} Voltage Low Math averages Figure 8 — -150 — mV V _{OVS} Crossing Point Voltage at 0.7V Swing 250 550 mV mV vV mV vV	T _{CCJ}	DOT96T/C Cycle to Cycle Jitter	Measured at crossing point V _{OX}	_	250	ps
TR / TF	L _{ACC}	DOT96T/C Long Term Accuracy	Measured at crossing point V _{OX}	_	100	ppm
T _F Rise Time Variation	T _R / T _F			175	1100	ps
Fall Time Variation	T _{RFM}	Rise/Fall Matching		_	20	%
VHIGH Voltage High Math averages Figure 8 660 850 mV VLOW Voltage Low Math averages Figure 8 −150 − mV VOX Crossing Point Voltage at 0.7V Swing 250 550 mV VOVS Maximum Overshoot Voltage − VHIGH + VO √ VDB Minimum Undershoot Voltage −0.3 − V VRB Ring Back Voltage See Figure 8. Measure SE − 0.2 V USB Big Period Measurement at 1.5V 45 55 % TPERIODA Period Measurement at 1.5V 20.83125 20.83125 20.83542 ns TPERIODABs Absolute Period Measurement at 1.5V 20.48125 21.18542 ns TIGH USB ligh time Measurement at 2.4V 8.094 10.036 ns TLOW USB low time Measurement at 0.4V 7.694 9.836 ns T _{CCJ} Cycle to Cycle Jitter Measurement at 1.5V - 350 ps </td <td>ΔT_R</td> <td>Rise Time Variation</td> <td></td> <td>-</td> <td>125</td> <td>ps</td>	ΔT _R	Rise Time Variation		-	125	ps
Voice Voltage Low Math averages Figure 8 −150 − mV Vox Crossing Point Voltage at 0.7V Swing 250 550 mV Voys Maximum Overshoot Voltage − VHIGH † V Voil	ΔT _F	Fall Time Variation		_	125	ps
Voltage Low	V _{HIGH}	Voltage High	Math averages Figure 8	660	850	mV
Vovs Maximum Overshoot Voltage − VHIGH + 0.3 V Vous Minimum Undershoot Voltage −0.3 − V VRB Ring Back Voltage See Figure 8. Measure SE − 0.2 V USB TDC Duty Cycle Measurement at 1.5V 45 55 % TPERIODADS Absolute Period Measurement at 1.5V 20.83125 20.83542 ns THIGH USB high time Measurement at 1.5V 20.48125 21.18542 ns TIGOW USB low time Measurement at 2.4V 8.094 10.036 ns TIGOW USB low time Measurement at 0.4V 7.694 9.836 ns TIGOW USB Long Term Accuracy Measurement at 1.5V − 350 ps -Acc USB Long Term Accuracy - 100 ppm REF Duty Cycle Measurement at 1.5V 45 55 % TpeRIODABS REF Duty Cycle Measurement at 1.5V 69.8203 69.8622 ns	V_{LOW}	Voltage Low	Math averages Figure 8	-150	_	mV
Vovs Maximum Overshoot Voltage − VHIGH + 0.3 V Vons Minimum Undershoot Voltage −0.3 − V VRB Ring Back Voltage See Figure 8. Measure SE − 0.2 V USB TDC Duty Cycle Measurement at 1.5V 45 55 % TPERIOD Period Measurement at 1.5V 20.83125 20.83542 ns TPERIODAbs Absolute Period Measurement at 1.5V 20.48125 21.18542 ns TpERIODAbs Absolute Period Measurement at 2.4V 8.094 10.036 ns TLOW USB low time Measurement at 0.4V 7.694 9.836 ns TCCJ Cycle to Cycle Jitter Measurement at 1.5V 0.475 1.4 ns TCCJ Cycle to Cycle Jitter Measurement at 1.5V − 350 ps TDC REF Period Measurement at 1.5V 45 55 % TPERIODAbs REF Period Measurement at 1.5V 69.8203 </td <td>V_{OX}</td> <td>Crossing Point Voltage at 0.7V Swing</td> <td></td> <td>250</td> <td>550</td> <td>mV</td>	V _{OX}	Crossing Point Voltage at 0.7V Swing		250	550	mV
Virgin Ring Back Voltage See Figure 8. Measure SE - 0.2 Virgin	V _{OVS}	Maximum Overshoot Voltage		_	V _{HIGH} + 0.3	V
VRB Ring Back Voltage See Figure 8. Measure SE — 0.2 V USB TDC Duty Cycle Measurement at 1.5V 45 55 % TPERIOD Period Measurement at 1.5V 20.83125 20.83542 ns TPERIODAbs Absolute Period Measurement at 1.5V 20.48125 21.18542 ns THIGH USB high time Measurement at 2.4V 8.094 10.036 ns TLOW USB low time Measurement at 0.4V 7.694 9.836 ns TR / TF Rise and Fall Times Measured between 0.8V and 2.0V 0.475 1.4 ns TCCJ Cycle to Cycle Jitter Measurement at 1.5V — 350 ps REF DEC REF Duty Cycle Measurement at 1.5V 45 55 % TPERIOD REF Period Measurement at 1.5V 45 55 % TPERIODAbs REF Absolute Period Measurement at 1.5V 68.82033 70.86224 ns T _{CCJ} R	V _{UDS}	Minimum Undershoot Voltage		-0.3	_	V
Duty Cycle Measurement at 1.5V	V_{RB}	Ring Back Voltage	See Figure 8. Measure SE	_	0.2	V
TPERIOD	USB			ı	I	
Territorial description of the period of the	T _{DC}	Duty Cycle	Measurement at 1.5V	45	55	%
THIGH USB high time Measurement at 2.4V 8.094 10.036 ns TLOW USB low time Measurement at 0.4V 7.694 9.836 ns TR / TF Rise and Fall Times Measured between 0.8V and 2.0V 0.475 1.4 ns TCCJ Cycle to Cycle Jitter Measurement at 1.5V — 350 ps LACC USB Long Term Accuracy — 100 ppm REF TDC REF Duty Cycle Measurement at 1.5V 45 55 % TPERIOD REF Period Measurement at 1.5V 69.8203 69.8622 ns TPERIODABS REF Absolute Period Measurement at 1.5V 68.82033 70.86224 ns TCCJ REF Rise and Fall Times Measured between 0.8V and 2.0V 0.35 2.0 V/ns TCCJ REF Cycle to Cycle Jitter Measurement at 1.5V - 1000 ps ENABLE/DISABLE and SET-UP — 1.8 ms TSTABLE Clock Stabilization from Power-up	T _{PERIOD}	Period	Measurement at 1.5V	20.83125	20.83542	ns
Name	T _{PERIODAbs}	Absolute Period	Measurement at 1.5V	20.48125	21.18542	ns
Tocj Cycle to Cycle Jitter Measurement at 1.5V - 350 ps Lacc USB Long Term Accuracy - 100 ppm REF Toc REF Duty Cycle Measurement at 1.5V 45 55 % Tocol REF Period Measurement at 1.5V 69.8203 69.8622 ns Tocol REF Absolute Period Measurement at 1.5V 68.82033 70.86224 ns Tocol REF Rise and Fall Times Measurement at 1.5V 68.82033 70.86224 ns Tocol REF Cycle to Cycle Jitter Measurement at 1.5V 0.35 2.0 V/ns Tocol REF Cycle to Cycle Jitter Measurement at 1.5V - 1000 ps ENABLE/DISABLE and SET-UP Tocol Ref Cycle Stabilization from Power-up - 1.8 ms Tocol Stopclock Set-up Time - 10.0 - ns	T _{HIGH}	USB high time	Measurement at 2.4V	8.094	10.036	ns
TCCJ Cycle to Cycle Jitter Measurement at 1.5V — 350 ps LACC USB Long Term Accuracy — 100 ppm REF TDC REF Duty Cycle Measurement at 1.5V 45 55 % TPERIOD REF Period Measurement at 1.5V 69.8203 69.8622 ns TPERIODAbs REF Absolute Period Measurement at 1.5V 68.82033 70.86224 ns TR / TF REF Rise and Fall Times Measured between 0.8V and 2.0V 0.35 2.0 V/ns TCCJ REF Cycle to Cycle Jitter Measurement at 1.5V — 1000 ps ENABLE/DISABLE and SET-UP TSTABLE Clock Stabilization from Power-up — 1.8 ms TSS Stopclock Set-up Time 10.0 — ns	T _{LOW}	USB low time	Measurement at 0.4V	7.694	9.836	ns
Lacc USB Long Term Accuracy — 100 ppm	T _R / T _F	Rise and Fall Times	Measured between 0.8V and 2.0V	0.475	1.4	ns
Toc REF Duty Cycle Measurement at 1.5V 45 55 %	T _{CCJ}	Cycle to Cycle Jitter	Measurement at 1.5V	_	350	ps
TDC REF Duty Cycle Measurement at 1.5V 45 55 % TPERIOD REF Period Measurement at 1.5V 69.8203 69.8622 ns TPERIODAbs REF Absolute Period Measurement at 1.5V 68.82033 70.86224 ns TR / TF REF Rise and Fall Times Measured between 0.8V and 2.0V 0.35 2.0 V/ns TCCJ REF Cycle to Cycle Jitter Measurement at 1.5V - 1000 ps ENABLE/DISABLE and SET-UP TSTABLE Clock Stabilization from Power-up - 1.8 ms TSS Stopclock Set-up Time 10.0 - ns	L _{ACC}	USB Long Term Accuracy		_	100	ppm
T _{PERIOD} REF Period Measurement at 1.5V 69.8203 69.8622 ns T _{PERIODAbs} REF Absolute Period Measurement at 1.5V 68.82033 70.86224 ns T _R / T _F REF Rise and Fall Times Measured between 0.8V and 2.0V 0.35 2.0 V/ns T _{CCJ} REF Cycle to Cycle Jitter Measurement at 1.5V - 1000 ps ENABLE/DISABLE and SET-UP T _{STABLE} Clock Stabilization from Power-up T _{SS} Stopclock Set-up Time 10.0 - ns	REF				l .	
T _{PERIODAbs} REF Absolute Period Measurement at 1.5V 68.82033 70.86224 ns T _R / T _F REF Rise and Fall Times Measured between 0.8V and 2.0V 0.35 2.0 V/ns T _{CCJ} REF Cycle to Cycle Jitter Measurement at 1.5V - 1000 ps ENABLE/DISABLE and SET-UP T _{STABLE} Clock Stabilization from Power-up - 1.8 ms T _{SS} Stopclock Set-up Time 10.0 - ns	T _{DC}	REF Duty Cycle	Measurement at 1.5V	45	55	%
TPERIODADS REF Absolute Period Measurement at 1.5V 68.82033 70.86224 ns TR / TF REF Rise and Fall Times Measured between 0.8V and 2.0V 0.35 2.0 V/ns TCCJ REF Cycle to Cycle Jitter Measurement at 1.5V - 1000 ps ENABLE/DISABLE and SET-UP TSTABLE Clock Stabilization from Power-up - 1.8 ms TSS Stopclock Set-up Time 10.0 - ns	T _{PERIOD}	REF Period	Measurement at 1.5V	69.8203	69.8622	ns
TR / TF REF Rise and Fall Times Measured between 0.8V and 2.0V 0.35 2.0 V/ns TCCJ REF Cycle to Cycle Jitter Measurement at 1.5V - 1000 ps ENABLE/DISABLE and SET-UP TSTABLE Clock Stabilization from Power-up - 1.8 ms TSS Stopclock Set-up Time 10.0 - ns		REF Absolute Period	Measurement at 1.5V	68.82033	70.86224	ns
T _{CCJ} REF Cycle to Cycle Jitter Measurement at 1.5V - 1000 ps ENABLE/DISABLE and SET-UP T _{STABLE} Clock Stabilization from Power-up - 1.8 ms T _{SS} Stopclock Set-up Time 10.0 - ns		REF Rise and Fall Times	Measured between 0.8V and 2.0V	0.35	2.0	V/ns
ENABLE/DISABLE and SET-UP T _{STABLE} Clock Stabilization from Power-up - 1.8 ms T _{SS} Stopclock Set-up Time 10.0 - ns		REF Cycle to Cycle Jitter	Measurement at 1.5V	_	1000	ps
T _{SS} Stopclock Set-up Time 10.0 – ns			1	1	I	ı
T _{SS} Stopclock Set-up Time 10.0 – ns	T _{STABLE}	Clock Stabilization from Power-up		_	1.8	ms
	T _{SS}	Stopclock Set-up Time		10.0	_	ns
	T _{SH}	Stopclock Hold Time		0	_	ns



Test and Measurement Set-up

For PCI Single-ended Signals and Reference

The following diagram shows the test load configurations for the single-ended PCI, USB, and REF output signals.

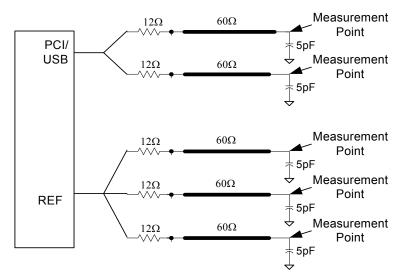


Figure 7. Single-ended Load Configuration

For Differential CPU, SRC and DOT96 Output Signals

The following diagram shows the test load configuration for the differential CPU and SRC outputs.

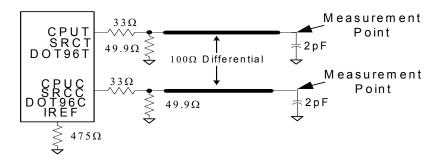


Figure 8. 0.7V Single-ended Load Configuration

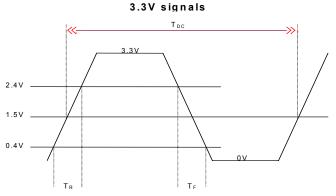


Figure 9. Single-ended Output Signals (for AC Parameters Measurement)



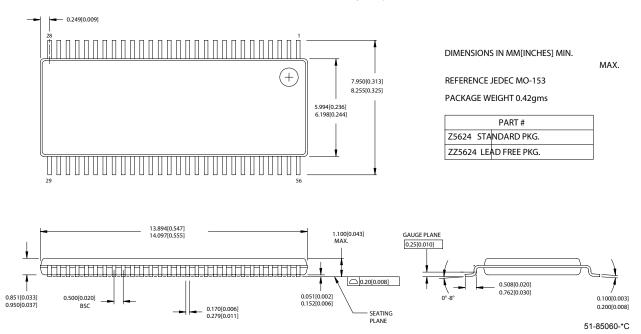
Ordering Information

Part Number	Package Type	Product Flow		
Standard		<u> </u>		
CY28410OC	56-pin SSOP	Commercial, 0° to 70°C		
CY28410OCT	56-pin SSOP – Tape and Reel	Commercial, 0° to 70°C		
CY28410ZC	56-pin TSSOP	Commercial, 0° to 70°C		
CY28410ZCT	56-pin TSSOP – Tape and Reel	Commercial, 0° to 70°C		
Lead-free (Planned)		<u> </u>		
CY28410OXC	56-pin SSOP	Commercial, 0° to 70°C		
CY28410OXCT	56-pin SSOP – Tape and Reel Commercia			
CY28410ZXC	56-pin TSSOP Commercial, 0° to			
CY28410ZXCT	56-pin TSSOP – Tape and Reel	Commercial, 0° to 70°C		



Package Drawing and Dimensions

56-Lead Thin Shrunk Small Outline Package, Type II (6 mm x 12 mm) Z56



Purchase of I^2C components from Cypress or one of its sublicensed Associated Companies conveys a license under the Philips I^2C Patent Rights to use these components in an I^2C system, provided that the system conforms to the I^2C Standard Specification as defined by Philips. Intel and Pentium are registered trademarks of Intel Corporation. All product and company names mentioned in this document are the trademarks of their respective holders.



Document History Page

Document Title: CY28410 Clock Generator for Intel [®] Grantsdale Chipset Document Number: 38-07593					
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change	
**	130204	12/24/03	RGL	New Data Sheet	
*A	207740	See ECN	RGL	Corrected the frequency select table Corrected the V _{IH_FS} and V _{IL_FS} specs in the DC Electrical specs Fixed the Single-ended Load Configuration diagram (<i>Figure 8</i>) Corrected the ECN no. from 38-07595 to 130204 Corrected the Ordering Information entry for the PB free to match the Devmaster	
*B	229399	See ECN	RGL	Change the Long Term Accuracy spec in the 96MHz DOT clock from 300ppm to 100ppm Fixed the Single-ended Load Configuration Fixed the AC table based on new char result Removed all references to 166/333 and 400MHz CPU frequencies	
*C	270664	See ECN	RGL	Corrected a typo in the ordering information	