

## Clock Generator for Intel PCI Express Mobile Chipset

### Features

- 14.318 MHz Crystal Input
- Selectable of 100, 133, 166, 200, 266, 333, and 400 MHz CPU Output Frequencies
- SMBus: Power Management Control
- Spread Spectrum support (-0.5% down spread)
- Packaging (Pb-free & Green available):  
— 56-Pin TSSOP

### Output Features

- Two Pairs of Differential CPU Clocks
- One selectable of CPU/SRC Clock
- Seven Pairs of SRC Clocks
- Six PCI Clocks
- One 48 MHz USB clock
- One REF clock
- One 96 MHz Differential clock

### Description

PI6C410M is a high-speed, low-noise clock generator designed to work with the Intel Mobile PCI Express Chipset. This Spread Spectrum PLL based clock generator reduces EMI emission and supports a wide range of frequencies.

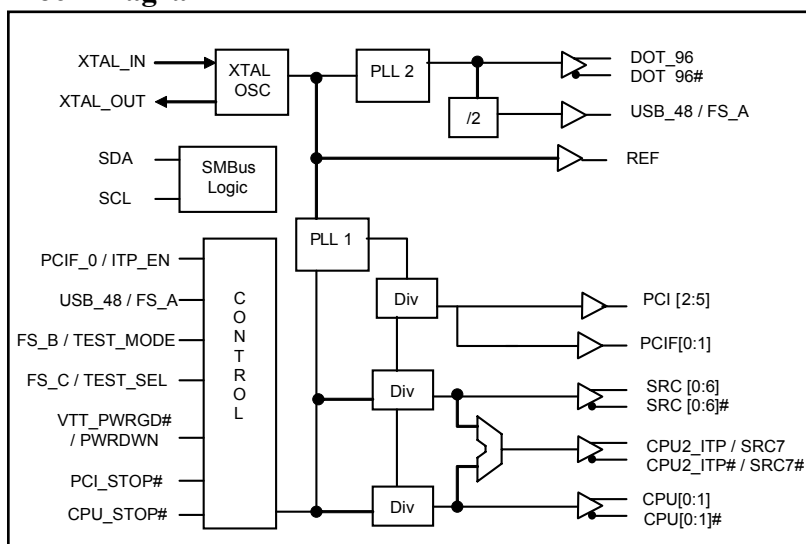
### Jitter Performance

- < 85ps Cycle-to-Cycle CPU 0/1 clock jitter
- < 125ps Cycle-to-Cycle CPU 2 clock jitter
- < 350ps Cycle-to-Cycle 48 MHz clock jitter
- < 500ps Cycle-to-Cycle PCI clock jitter
- < 125ps Cycle-to-Cycle SRC clock jitter
- < 1000ps Cycle-to-Cycle REF clock jitter

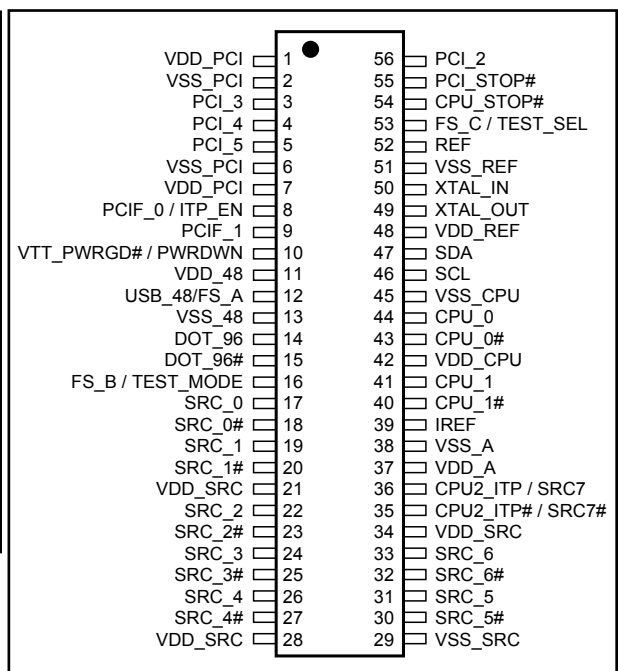
### Skew Performance

- < 100ps Output-to-output CPU 0/1 clock skew
- < 150ps Output-to-output CPU 2 clock skew
- < 500ps Output-to-output PCI clock skew
- < 250ps Output-to-output SRC clock skew

### Block Diagram



### Pin Configuration



**Pin Description**

Pin Name	Type	Pin Number	Descriptions
REF	Output	52	3.3V 14.31818 MHz output
XTAL_IN	Input	50	14.31818 MHz crystal input
XTAL_OUT	Output	49	14.31818 MHz crystal output
CPU[0:1] & CPU[0:1]#	Output	40, 41, 43, 44	Differential CPU outputs
SRC[0:6] & SRC[0:6]#	Output	17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 30, 31, 32, 33	Differential Serial Reference Clock outputs
CPU2_ITP / SRC_7 & CPU2_ITP# / SRC_7#	Output	35, 36	Selectable Differential CPU or SRC clock output ITP_EN = 0 @ Vtt_Pwrgd# assertion = SRC ITP_EN = 1 @ Vtt_Pwrgd# assertion = CPU
PCIF_0 / ITP_EN	Input / Output	8	33 MHz clock output / CPU2 select when HIGH
PCIF_1	Output	9	33 MHz clocks outputs (free running)
PCI[2:5]	Output	3, 4, 5, 56	33 MHz clocks outputs
USB_48 / FS_A	Input / Output	12	48 MHz clock output / 3.3V LVTTTL inputs for CPU frequency selection
DOT_96 & DOT_96#	Output	14, 15	96 MHz differential clock output
PCI_STOP#	Input	55	3.3V LVTTTL active low input for PCI Stop operation. (150k-ohm internal pull-up resistor)
CPU_STOP#	Input	54	3.3V LVTTTL active low input for CPU Stop operation. (150k-ohm internal pull-up resistor)
FS_B / TEST_MODE	Input	16	3.3V LVTTTL inputs for CPU frequency selection / Test Mode select: 0 = Hi-Z, 1 = Ref/N
FS_C / TEST_SEL	Input	53	3.3V LVTTTL inputs for CPU frequency selection / Test Mode select if pulled to 3.3V when Vtt_Pwrgd# is asserted LOW
IREF	Input	39	External resistor connection for internal current reference
VTT_PWRGD# / PWRDWN	Input	10	3.3V LVTTTL Level sensitive strobe used to determine to latch the FS_A, FS_B/TEST_MODE, FS_C/TEST_SEL and PCIF0/ITP_EN inputs (active low) / 3.3V LVTTTL active high input for Power Down operation.
SDA	I/O	47	SMBus compatible SDATA
SCL	Input	46	SMBus compatible SCLOCK
VDD_PCI	Power	1, 7	3.3V Power Supply for Outputs
VDD_48	Power	11	3.3V Power Supply for Outputs
VDD_SRC	Power	21, 28, 34	3.3V Power Supply for Outputs
VDD_CPU	Power	42	3.3V Power Supply for Outputs
VDD_REF	Power	48	3.3V Power Supply for Outputs
VSS_PCI	Ground	2, 6	Ground for Outputs
VSS_48	Ground	13	Ground for Outputs
VSS_SRC	Ground	29	Ground for Outputs
VSS_CPU	Ground	45	Ground for Outputs
VSS_REF	Ground	51	Ground for Outputs
VDD_A	Power	37	3.3V Power Supply for PLL
VSS_A	Ground	38	Ground for PLL

## Functionality

### Frequency Selection<sup>(1)</sup>

FS_C	FS_B	FS_A	CPU	SRC	PCIF / PCI	REF	DOT_96	USB_48
1	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	1	166 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	0	333 MHz	100 MHz	33 MHz	14.318 MHz	96 MHz	48 MHz
1	1	0	400 MHz	100 MHz	33 MHz	14.318 MHz	96 MHz	48 MHz
1	1	1	Reserved	100 MHz	33 MHz	14.318 MHz	96 MHz	48 MHz

#### Note:

1. Refer to DC Electrical Characteristics for FS\_A, FS\_B and FS\_C (Vih\_FS, Vil\_FS) threshold levels.

### Test Mode Selection<sup>(2)</sup>

TEST_MODE	CPU	SRC	PCIF / PCI	REF	DOT_96	USB_48
1	REF/N	REF/N	REF/N	REF	REF/N	REF/N
0	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z

#### Note:

2. Test mode will occur where the SMBus Bit 6 of Byte 6 = 1, or FS\_C/TEST\_SEL is set to logic high level.

### PWRDWN Functionality

PWRDWN	CPU	CPU#	SRC	SRC#	PCIF / PCI	REF	DOT_96	DOT_96#	USB_48
0	Normal	Normal	Normal	Normal	33 MHz	14.318 MHz	Normal	Normal	48 MHz
1	Iref × 2 or Float	Float	Iref × 2 or Float	Float	Low	Low	Iref × 2 or Float	Float	Low

### PCI\_STOP# Functionality

PCI_STOP#	CPU	CPU#	SRC	SRC#	PCIF / PCI	REF	DOT_96	DOT_96#	USB_48
1	Normal	Normal	Normal	Normal	33 MHz	14.318 MHz	Normal	Normal	48 MHz
0	Normal	Normal	Iref × 6 or Float	Low	Low	14.318 MHz	Normal	Normal	48 MHz

### CPU\_STOP# Functionality

CPU_STOP#	CPU	CPU#	SRC	SRC#	PCIF / PCI	REF	DOT_96	DOT_96#	USB_48
1	Normal	Normal	Normal	Normal	33 MHz	14.318 MHz	Normal	Normal	48 MHz
0	Iref × 6 or Float	Low	Normal	Normal	33 MHz	14.318 MHz	Normal	Normal	48 MHz

### Serial Data Interface (SMBus)

PI6C410M is a slave only SMBus device that supports indexed block read and indexed block write protocol using a single 7-bit address and read/write bit as shown below.

#### Address Assignment

A6	A5	A4	A3	A2	A1	A0	R/W
1	1	0	1	0	0	1	I/O

#### Data Protocol<sup>(1)</sup>

1 bit	7 bits	1	1	8 bits	1	8 bits	1	8 bits	1		8 bits	1	1 bit
Start bit	Slave Addr	R/W	Ack	Register offset	Ack	Byte Count = N	Ack	Data Byte 0	Ack		Data Byte N - 1	Ack	Stop bit

**Note:**

1 Register offset for indicating the starting register for indexed block write and indexed block read. Byte Count in write mode cannot be 0.

#### Data Byte 0: Control Register

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Pin	Source Pin
0	SRC_0 Output Enable 1 = Enabled, 0 = Disabled (Hi-Z)	RW	1 = Enabled	SRC_0	17, 18	NA
1	SRC_1 Output Enable 1 = Enabled, 0 = Disabled (Hi-Z)	RW	1 = Enabled	SRC_1	19, 20	NA
2	SRC_2 Output Enable 1 = Enabled, 0 = Disabled (Hi-Z)	RW	1 = Enabled	SRC_2	22, 23	NA
3	SRC_3 Output Enable 1 = Enabled, 0 = Disabled (Hi-Z)	RW	1 = Enabled	SRC_3	24, 25	NA
4	SRC_4 Output Enable 1 = Enabled, 0 = Disabled (Hi-Z)	RW	1 = Enabled	SRC_4	26, 27	NA
5	SRC_5 Output Enable 1 = Enabled, 0 = Disabled (Hi-Z)	RW	1 = Enabled	SRC_5	30, 31	NA
6	SRC_6 Output Enable 1 = Enabled, 0 = Disabled (Hi-Z)	RW	1 = Enabled	SRC_6	32, 33	NA
7	CPU_2 / SRC_7 Output Enable 1 = Enabled, 0 = Disabled (Hi-Z)	RW	1 = Enabled	CPU_2 / SRC_7	35, 36	NA

**Data Byte 1: Control Register**

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Pin	Source Pin
0	Spread Spectrum 1 = Enable, 0 = Disable	RW	0 = Spread off	CPU[0:2], SRC[0:7], PCI[2:5], PCIF[0:1]	3, 4, 5, 8, 9, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 30, 31, 32, 33, 35, 36, 40, 41, 43, 44, 56	NA
1	CPU_0 output enable 1 = Enabled, 0 = Disabled (Hi-Z)	RW	1 = Enabled	CPU_0, CPU_0#	43, 44	NA
2	CPU_1 output enable 1 = Enabled, 0 = Disabled (Hi-Z)	RW	1 = Enabled	CPU_1, CPU_1#	40, 41	NA
3	Reserved	RW				
4	REF Output Enable 1 = Enabled, 0 = Disabled	RW	1 = Enabled	REF	52	NA
5	USB_48 Output Enable 1 = Enabled, 0 = Disabled	RW	1 = Enabled	USB_48	12	NA
6	DOT_96 Output Enable 1 = Enabled, 0 = Disabled (Hi-Z)	RW	1 = Enabled	DOT_96 & DOT96#	14, 15	NA
7	PCIF_0 Output Enable 1 = Enabled, 0 = Disabled	RW	1 = Enabled	PCIF_O	8	NA

**Data Byte 2: Control Register**

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Pin	Source Pin
0	PCIF_1 Output Enable 1 = Enabled, 0 = Disabled	RW	1 = Enabled	PCIF_1	9	NA
1	Reserved	RW				NA
2	Reserved	RW				
3	Reserved	RW				
4	PCI_2 Output Enable 1 = Enabled, 0 = Disabled	RW	1 = Enabled	PCI_2	56	NA
5	PCI_3 Output Enable 1 = Enabled, 0 = Disabled	RW	1 = Enabled	PCI_3	3	NA
6	PCI_4 Output Enable 1 = Enabled, 0 = Disabled	RW	1 = Enabled	PCI_4	4	NA
7	PCI_5 Output Enable 1 = Enabled, 0 = Disabled	RW	1 = Enabled	PCI_5	5	NA

**Data Byte 3: Control Register**

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Pin	Source Pin
0	SRC_0 Output Control 0 = Free Running, 1 = Stopped with PCI_STOP#	RW	0 = Free running, not affected by PCI_STOP#	SRC_0	17, 18	NA
1	SRC_1 Output Control 0 = Free Running, 1 = Stopped with PCI_STOP#	RW	0 = Free running, not affected by PCI_STOP#	SRC_1	19, 20	NA
2	SRC_2 Output Control 0 = Free Running, 1 = Stopped with PCI_STOP#	RW	0 = Free running, not affected by PCI_STOP#	SRC_2	22, 23	NA
3	SRC_3 Output Control 0 = Free Running, 1 = Stopped with PCI_STOP#	RW	0 = Free running, not affected by PCI_STOP#	SRC_3	24, 25	NA
4	SRC_4 Output Control 0 = Free Running, 1 = Stopped with PCI_STOP#	RW	0 = Free running, not affected by PCI_STOP#	SRC_4	26, 27	NA
5	SRC_5 Output Control 0 = Free Running, 1 = Stopped with PCI_STOP#	RW	0 = Free running, not affected by PCI_STOP#	SRC_5	30, 31	NA
6	SRC_6 Output Control 0 = Free Running, 1 = Stopped with PCI_STOP#	RW	0 = Free running, not affected by PCI_STOP#	SRC_6	32, 33	NA
7	SRC_7 Output Control 0 = Free Running, 1 = Stopped with PCI_STOP#	RW	0 = Free running, not affected by PCI_STOP#	SRC_7	35, 36	NA

**Data Byte 4: Control Register**

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Pin	Source Pin
0	CPU_0 Output Control 0 = Free Running, 1 = Stopped with CPU_STOP#	RW	1 = Stopped with CPU_STOP# assertion	CPU_0	43, 44	NA
1	CPU_1 Output Control 0 = Free Running, 1 = Stopped with CPU_STOP#	RW	1 = Stopped with CPU_STOP# assertion	CPU_1	40, 41	NA
2	CPU_2 Output Control 0 = Free Running, 1 = Stopped with CPU_STOP#	RW	1 = Stopped with CPU_STOP# assertion	CPU_2	35, 36	NA
3	PCIF_0 Output Control 0 = Free Running, 1 = Stopped with PCI_STOP#	RW	0 = Free running, not affected by PCI_STOP#	PCIF_0	8	NA
4	PCIF_1 Output Control 0 = Free Running, 1 = Stopped with PCI_STOP#	RW	0 = Free running, not affected by PCI_STOP#	PCIF_1	9	NA
5	Reserved	RW				
6	DOT_Pwrdown drive mode 1 = Hi-Z, 0 = Driven in Pwrdown	RW	0 = Driven in power down	DOT_96 & DOT_96#	14, 15	NA
7	Reserved	RW				

**Data Byte 5: Control Register**

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Pin	Source Pin
0	CPU_0 Pwrdown drive mode 1 = Hi-Z, 0 = Driven in Pwrdown	RW	0 = Driven in power down	CPU_0 & CPU_0#	43, 44	NA
1	CPU_1 Pwrdown drive mode 1 = Hi-Z, 0 = Driven in Pwrdown	RW	0 = Driven in power down	CPU_1 & CPU_1#	40, 41	NA
2	CPU_2 Pwrdown drive mode 1 = Hi-Z, 0 = Driven in Pwrdown	RW	0 = Driven in power down	CPU_2 & CPU_2#	35, 36	NA
3	SRC_Pwrdown drive mode 1 = Hi-Z, 0 = Driven in Pwrdown	RW	0 = Driven in power down	SRC[0:7] & SRC[0:7]#	17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 30, 31, 32, 35, 36	NA
4	CPU_0 Stop drive mode 1 = Hi-Z, 0 = Driven in CPU Stop	RW	0 = Driven in CPU_STOP	CPU_0 & CPU_0#	43, 44	NA
5	CPU_1 Stop drive mode 1 = Hi-Z, 0 = Driven in CPU Stop	RW	0 = Driven in CPU_STOP	CPU_1 & CPU_1#	40, 41	NA
6	CPU_2 Stop drive mode 1 = Hi-Z, 0 = Driven in CPU Stop	RW	0 = Driven in CPU_STOP	CPU_2 & CPU_2#	35, 36	NA
7	SRC_Stop drive mode 1 = Hi-Z, 0 = Driven in PCI Stop	RW	0 = Driven in PCI_STOP	SRC[0:7] & SRC[0:7]#	17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 30, 31, 32, 33, 35, 36	NA

**Data Byte 6: Control Register**

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Pin	Source Pin
0	FS_A Reflects the value of the FS_A pin sampled on power up 0 = FS_A was low during Vtt_Pwrgd# assertion	R	Externally Selected	CPU[0:2]	35, 36, 40, 41, 43, 44	NA
1	FS_B Reflects the value of the FS_B pin sampled on power up 0 = FS_B was low during Vtt_Pwrgd# assertion	R	Externally Selected	CPU[0:2]	35, 36, 40, 41, 43, 44	NA
2	FS_C Reflects the value of the FS_C pin sampled on power up 0 = FS_C was low during Vtt_Pwrgd# assertion	R	Externally Selected	CPU[0:2]	35, 36, 40, 41, 43, 44	NA
3	PCI_Stop control 1 = Disabled, 0 = Enabled, Stopped SRC and PCI clocks	RW	1 = Disabled	All PCI & SRC clocks except PCIF and SRC clocks set to free-running	3, 4, 5, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 30, 31, 32, 33, 35, 36, 56	NA
4	REF Output Drive Strength 0 = 1x, 1 = 2x	RW	1 = 2X	REF	52	NA
5	Reserved	RW				
6	Test Clock Mode Entry Control 0 = Disabled, 1 = REF/N or Hi-Z	RW	0 = Disabled			
7	Test Clock Mode 0 = Hi-Z, 1 = REF/N	RW	0 = Hi-Z	CPU[0:2], SRC[0:7], PCI[2:5], PCIF[0:1], REF, USB_48, DOT_96	3, 4, 5, 8, 9, 12, 14, 15, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 30, 31, 32, 33, 35, 36, 40, 41, 43, 44, 52, 56	NA

**DataByte 7: Control Register**

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Pin
0	Vendor ID	R	0	NA	NA
1		R	0	NA	NA
2		R	0	NA	NA
3		R	0	NA	NA
4	Revision Code	R	1	NA	NA
5		R	0	NA	NA
6		R	1	NA	NA
7		R	0	NA	NA



### Vtt\_Pwrgd# Timing Diagram

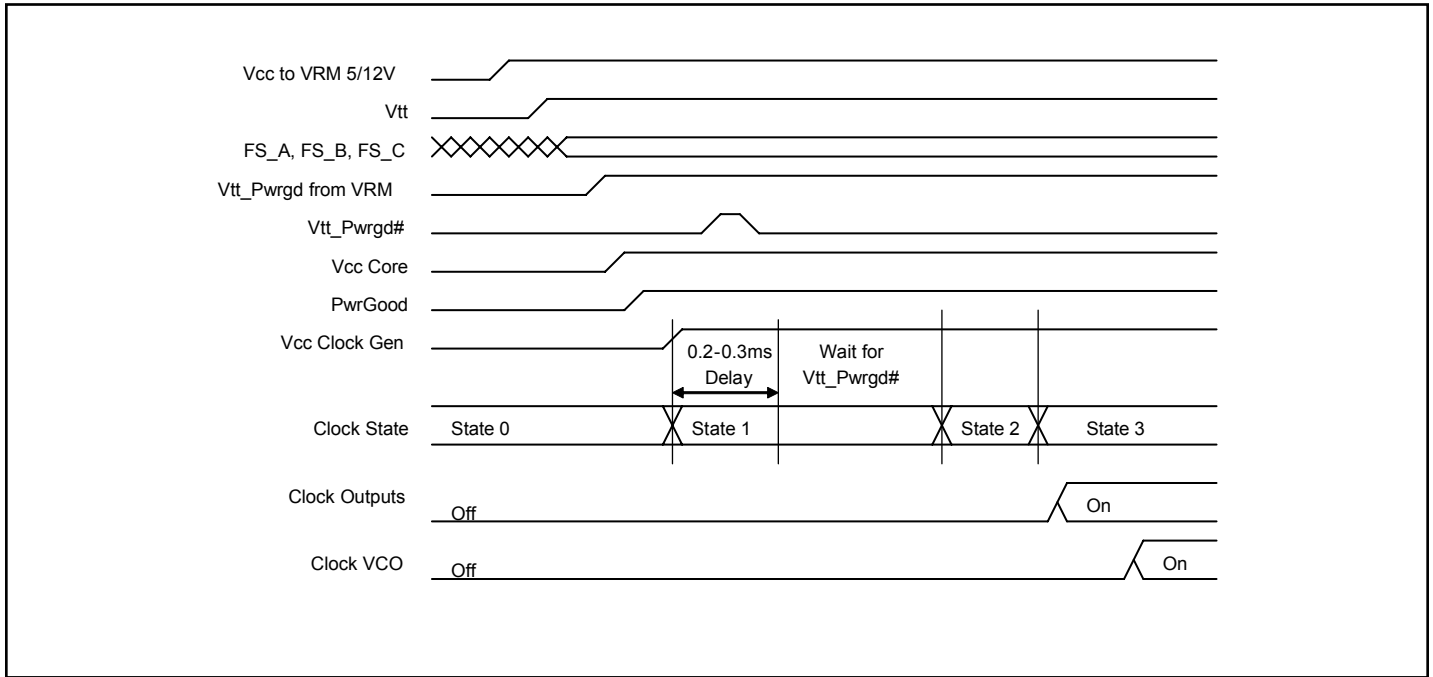


Figure 1. CPU power BEFORE clock power

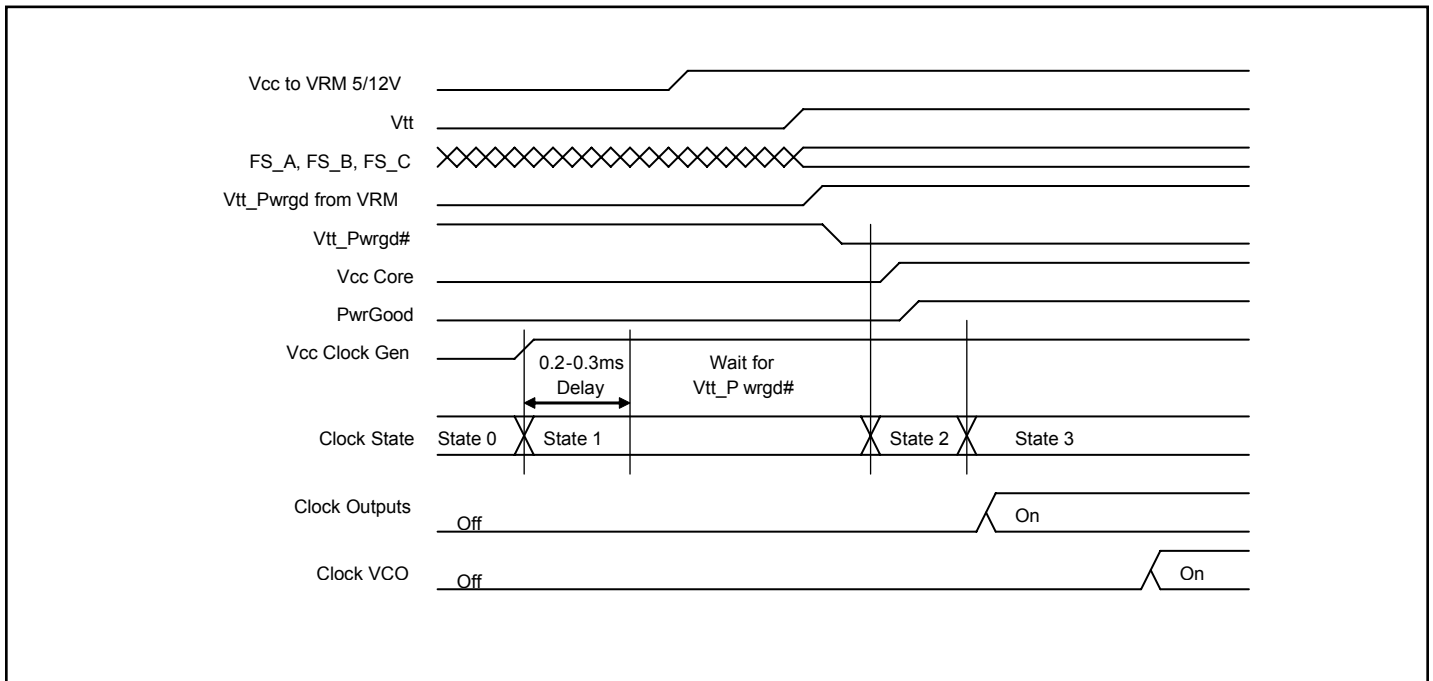


Figure 2. CPU power AFTER clock power

### Clock Power-Up State Machine

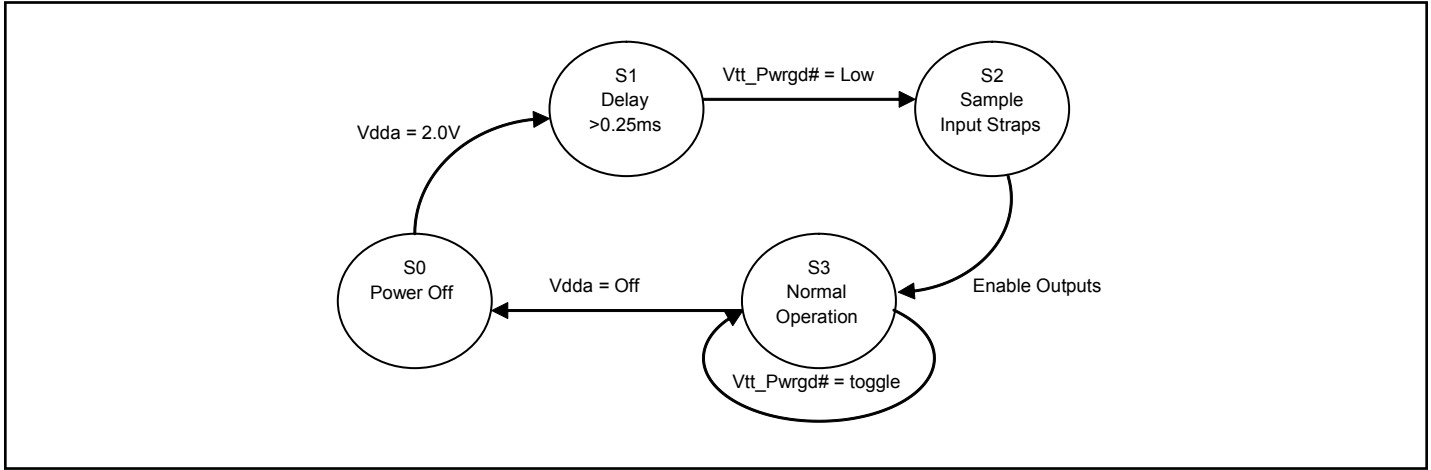


Figure 3. Power-Up State Diagram

### Power Down (PWRDWN assertion)

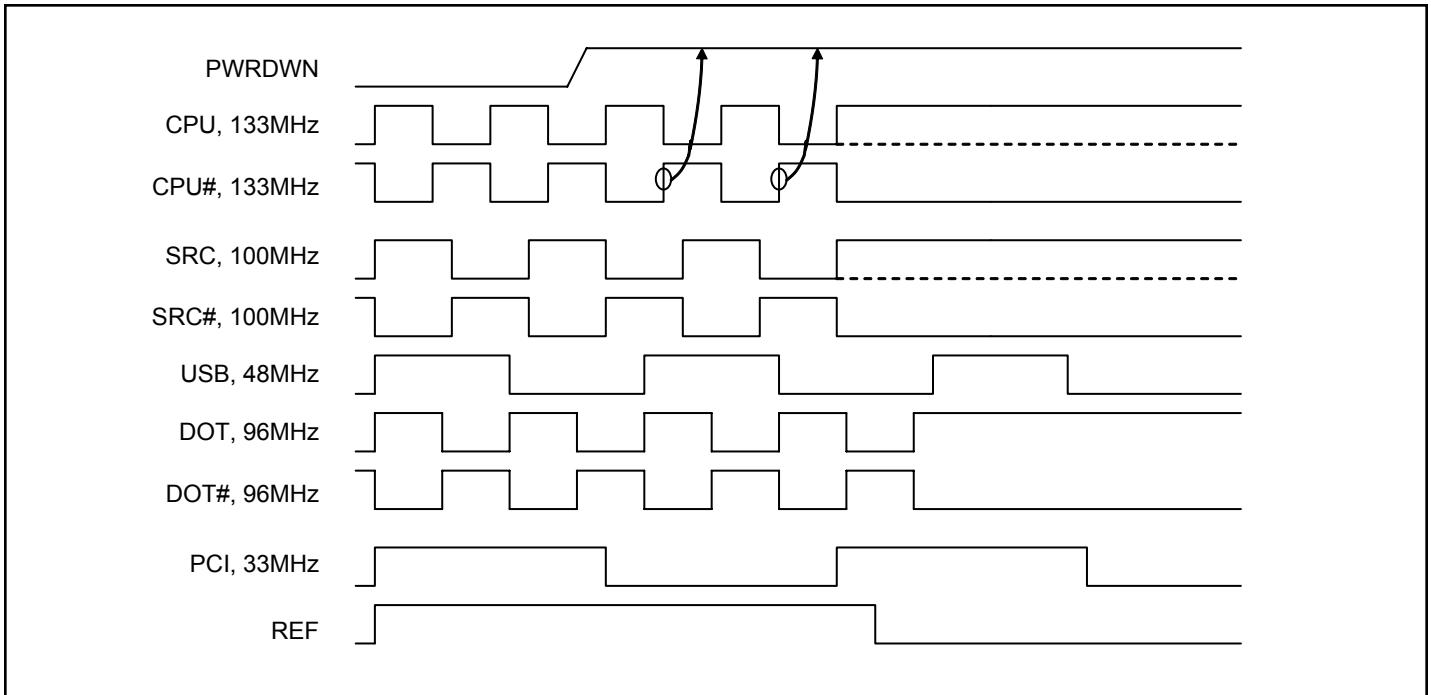


Figure 4. Power down sequence

**Power Down (PWRDWN De-assertion)**

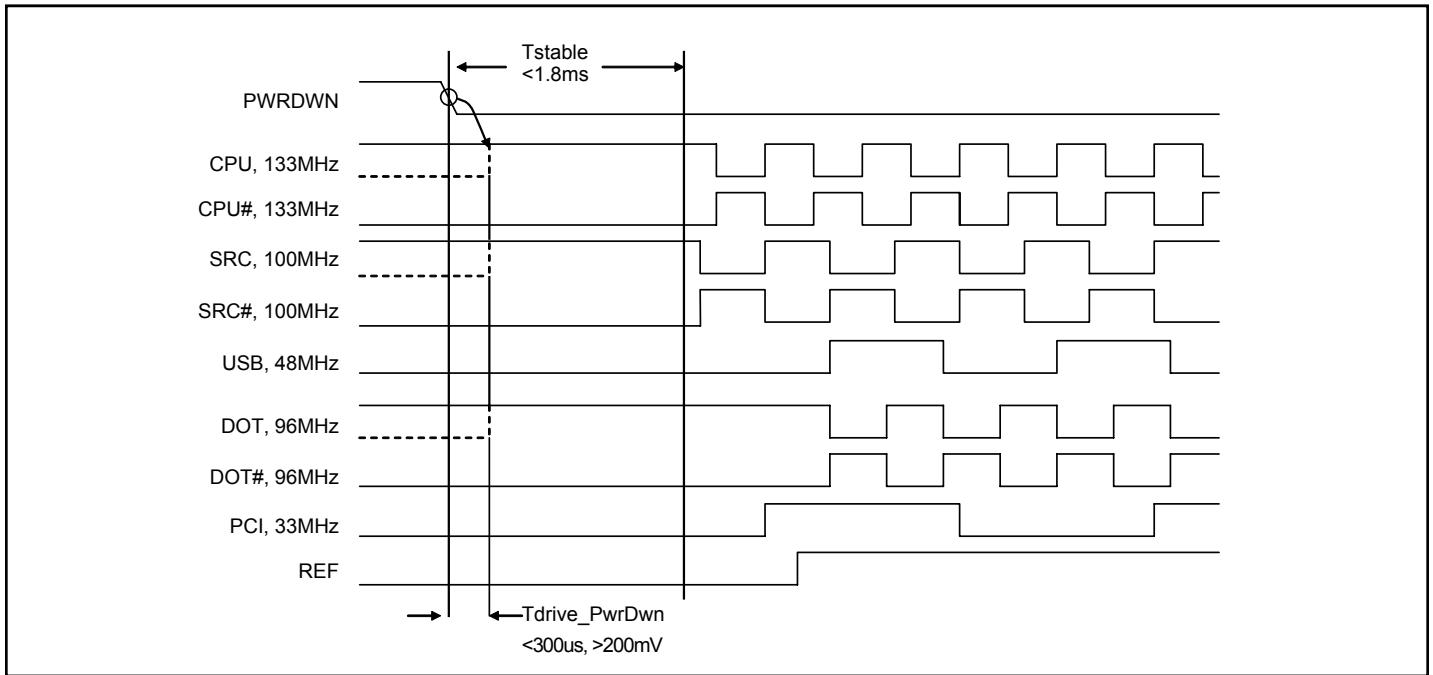


Figure 5. Power down de-assertion

**CPU STOP (CPU\_STOP# assertion)**

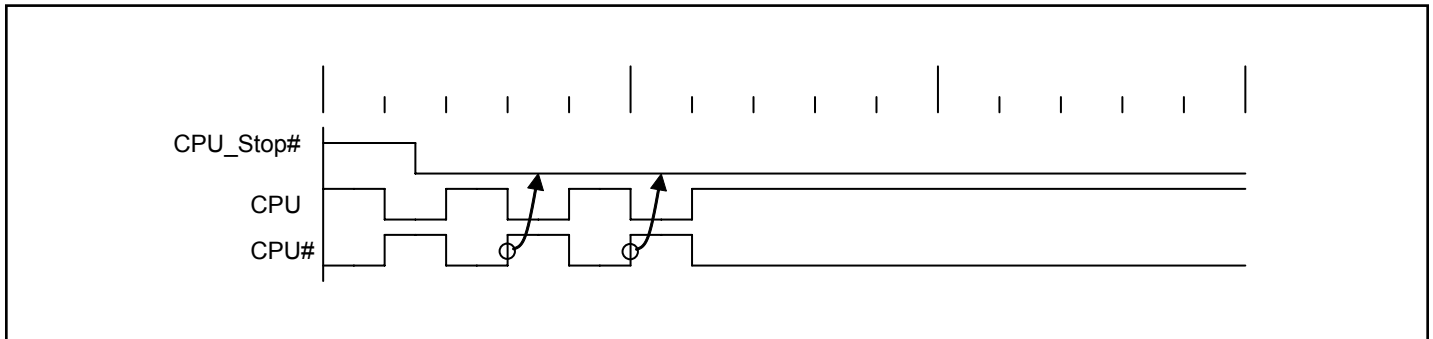


Figure 6. Assertion of CPU\_Stop# Waveforms

### CPU STOP (CPU\_STOP# De-assertion)

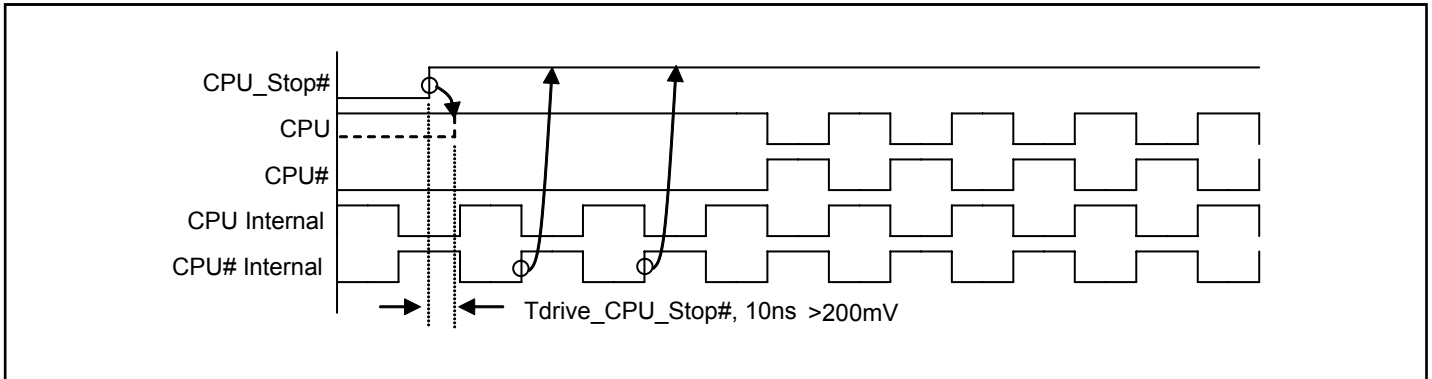


Figure 7. CPU\_STOP# De-assertion Waveform

### PCI STOP (PCI\_STOP# assertion)

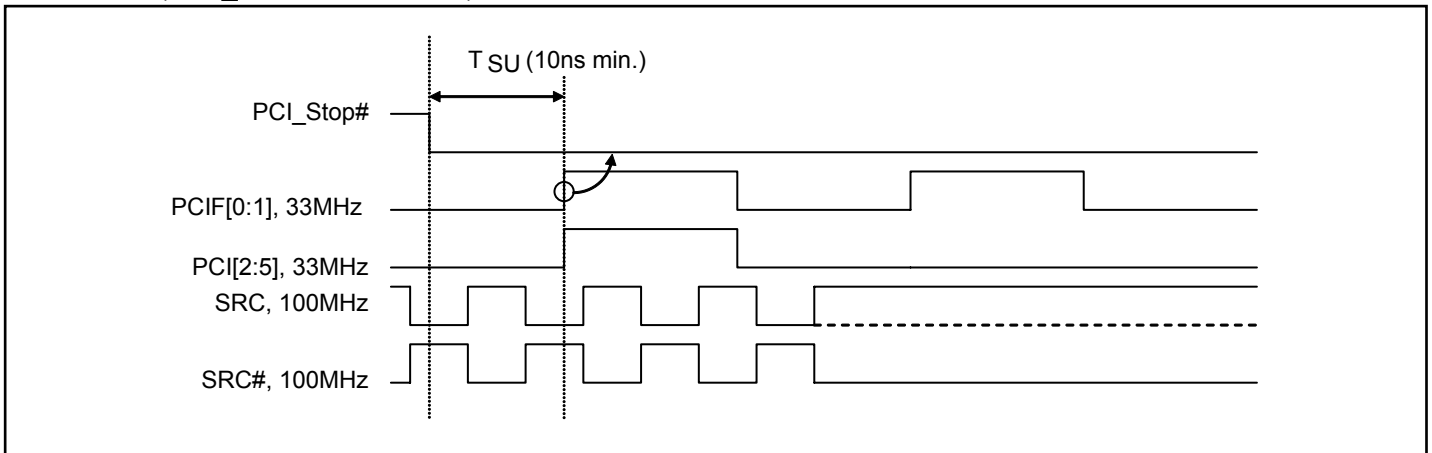


Figure 8. Assertion of PCI\_STOP# Waveform

### PCI STOP (PCI\_STOP# De-assertion)

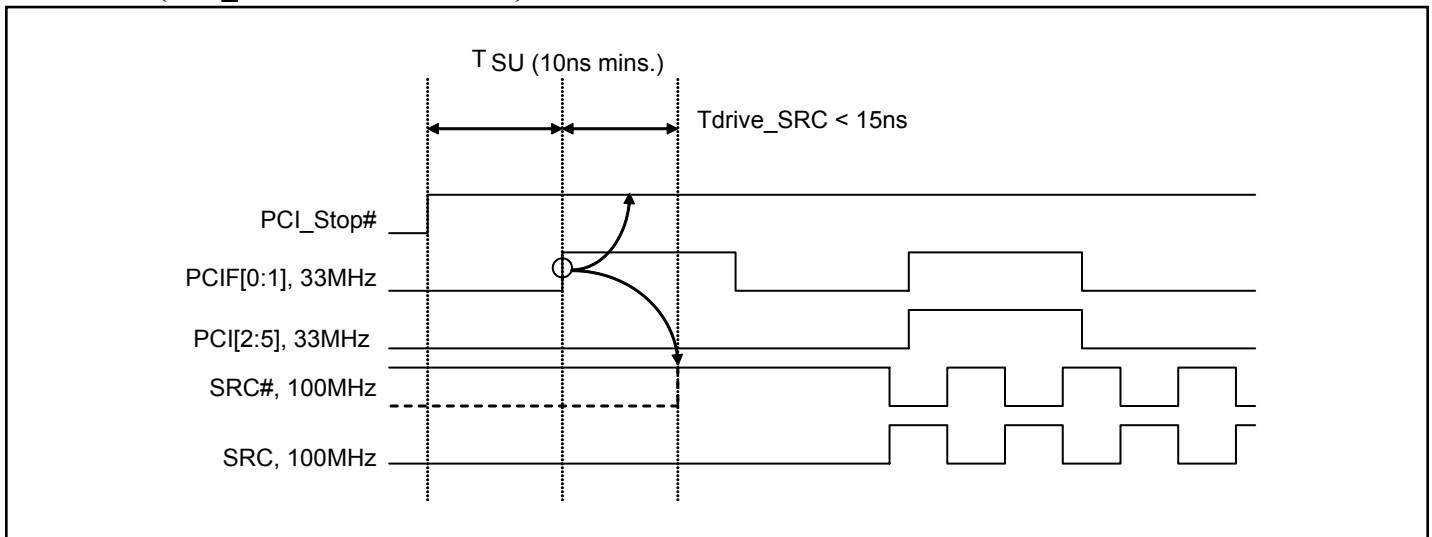


Figure 8. De-assertion of PCI\_STOP# Waveform

## Tristate Specifications

### CPU Tristate clock truth table

Signal	Pwrdsn	CPU_STOP#	CPU_Stop Tristate Bit	Pwrdsn Tristate Bit	Non-stop	Stoppable
	pin	pin			Outputs	Outputs
CPU[0:2]	0	1	X	X	Running	Running
	0	0	0	X	Running	Driven @ Iref x 6
	0	0	1	X	Running	Tristate
	1	X	X	0	Driven @ Iref x 2	Driven @ Iref x 2
	1	X	X	X	1	Tristate

### SRC Tristate clock truth table

Signal	Pwrdsn	PCI_STOP#	PCI_Stop Tristate Bit	Pwrdsn Tristate Bit	Non-stop	Stoppable
	pin	pin			Outputs	Outputs
SRC[0:7]	0	1	X	X	Running	Running
	0	0	0	X	Running	Driven @ Iref x 6
	0	0	1	X	Running	Tristate
	1	X	X	0	Driven @ Iref x 2	Driven @ Iref x 2
	1	X	X	X	1	Tristate

### DOT Tristate clock truth table

Signal	Pwrdsn	Pwrdsn Tristate Bit	Stoppable
	pin		Outputs
DOT96	0	X	Running
	1	0	Driven @ Iref x 2
	1	1	Tristate

### CPU Clock Tristate Timing

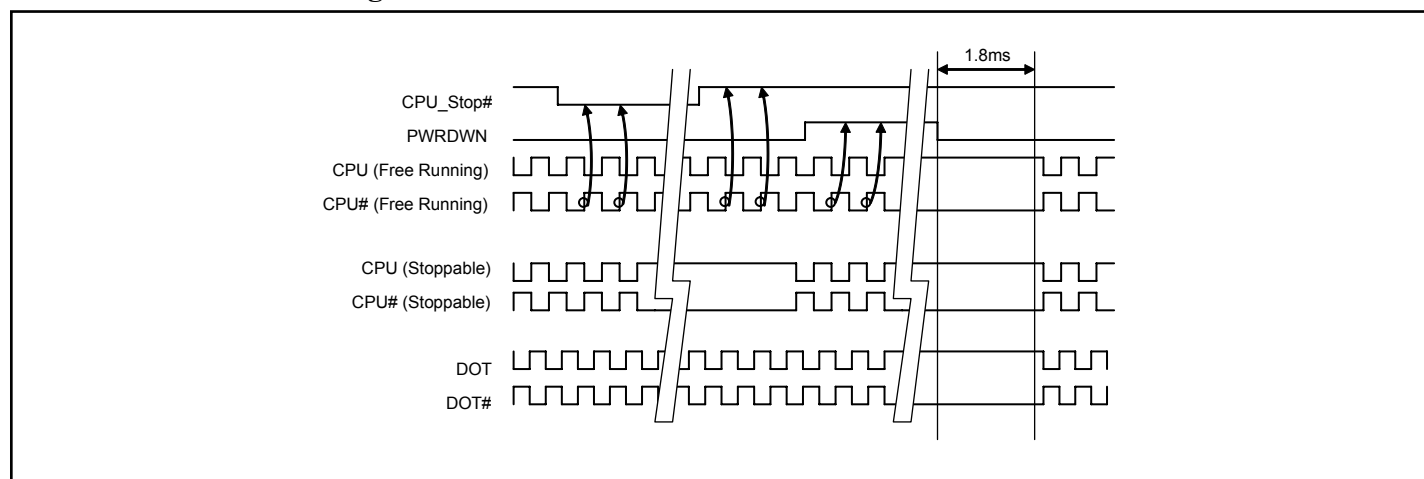


Figure 10. CPU\_STOP = Driven, CPU\_PWRDWN = Driven, DOT\_PWRDWN = Driven

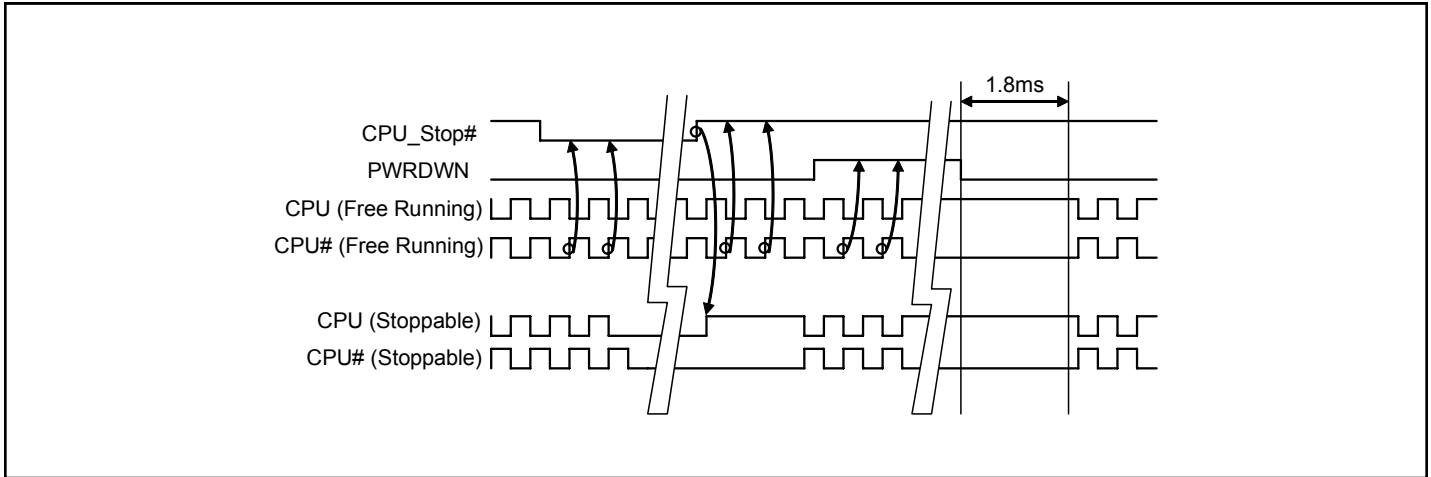


Figure 11. CPU\_Stop = Tristate, CPU\_PWRDWN = Driven

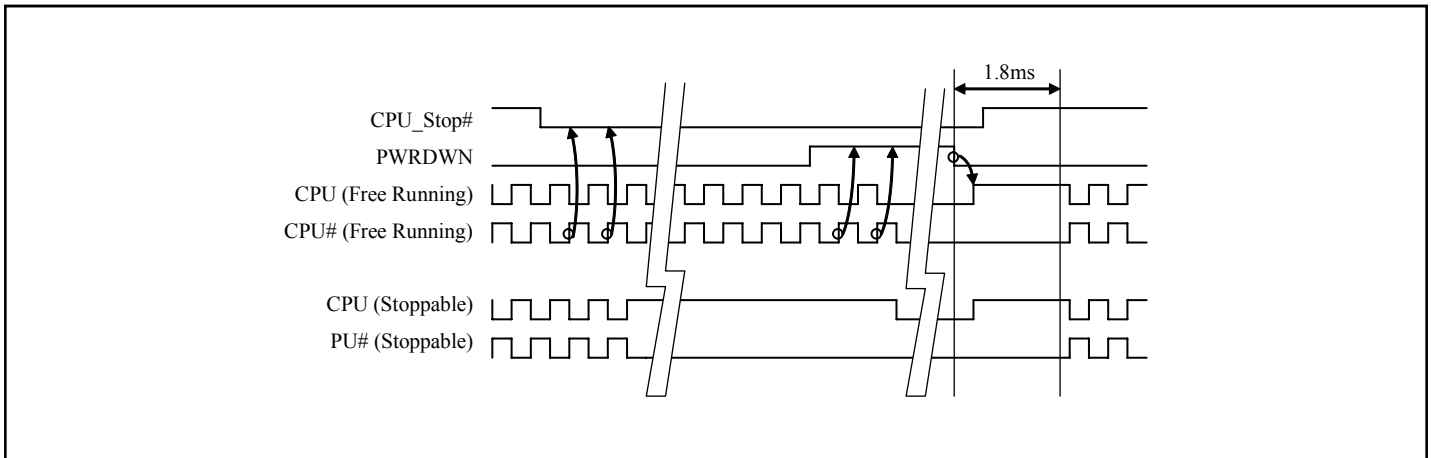


Figure 12. CPU\_Stop = Driven, CPU\_PWRDWN = Tristate

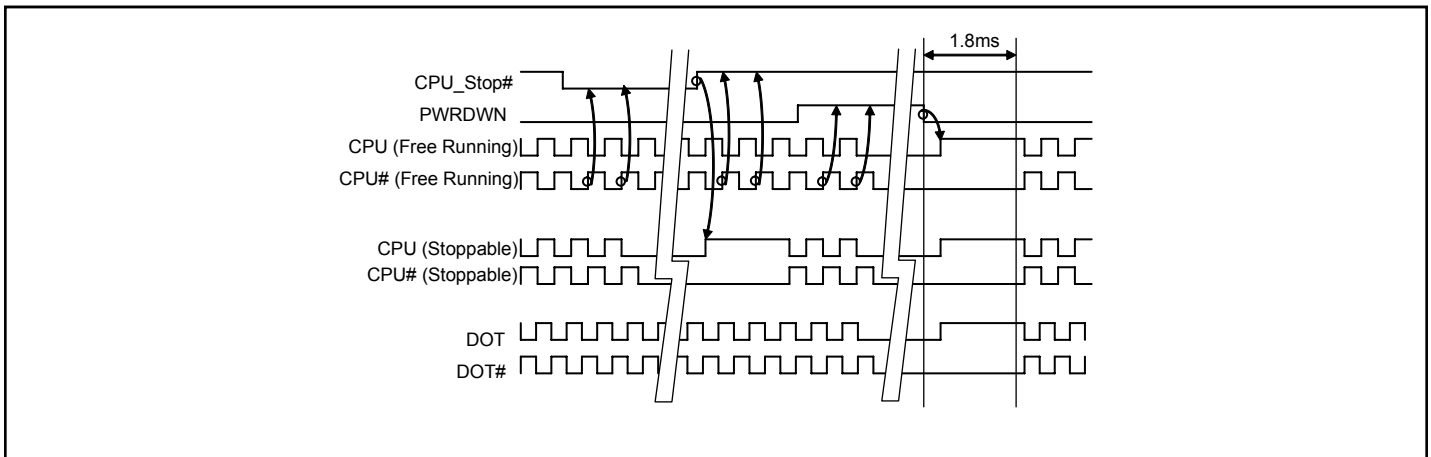


Figure 13. CPU\_STOP = Tristate, CPU\_PWRDWN = Tristate, DOT\_PWRDWN = Tristate

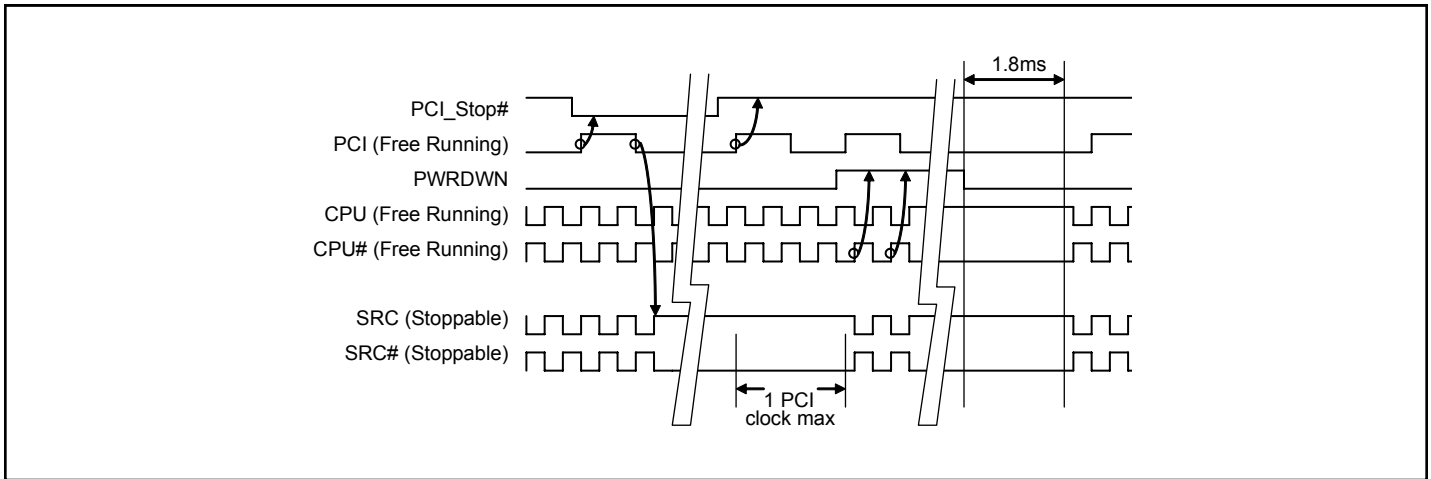


Figure 14. SRC\_Stop = Driven, SRC\_PWRDWN = Driven

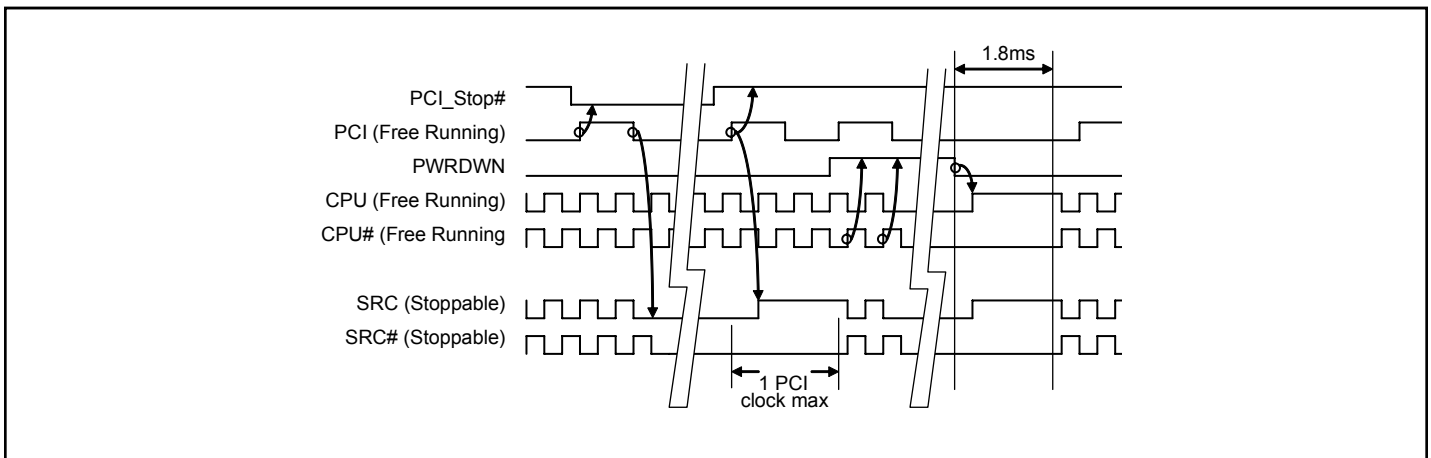


Figure 15. SRC\_Stop = Tristate, SRC\_PWRDWN = Tristate

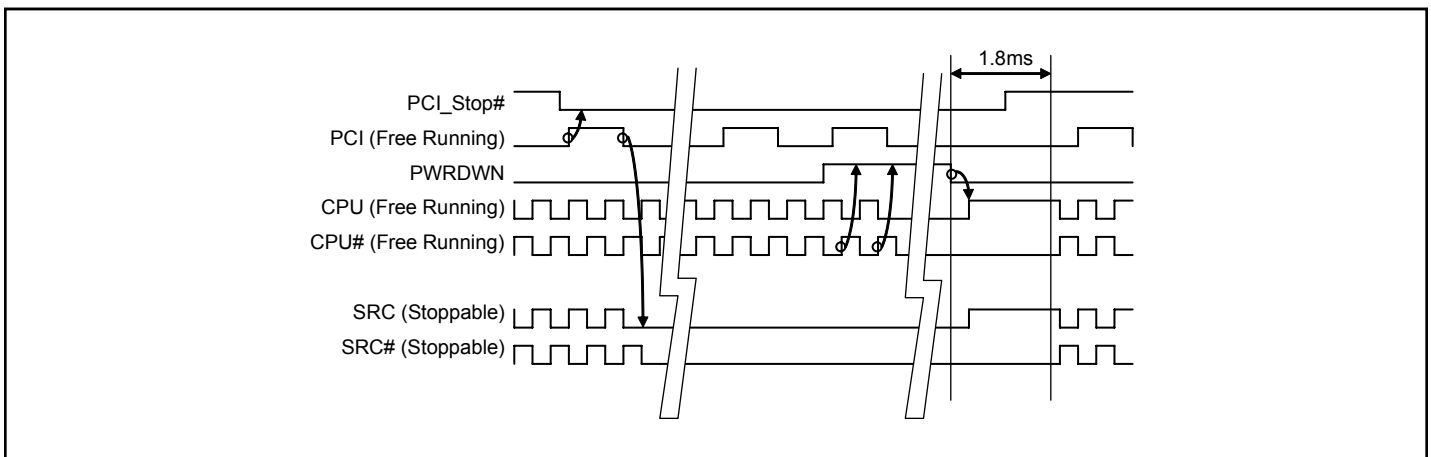


Figure 16. SRC\_STOP = Tristate, SRC\_PWRDWN = Tristate, PCI\_STOP# = Asserted

### Spread Spectrum Specifications

PI6C410M supports Spread Spectrum clocking and can be enabled and disabled via SMBus control. The maximum Spread Spectrum Modulation is  $-0.5\%$  down spread with frequency from 30KHz to 33KHz.

SSC ON	Tperiod		SSC OFF	Tperiod		Unit
	Min	Max		Min	Max	
CPU @ 399.000 MHz	2.4993	2.5133	CPU @ 400.000 MHz	2.4993	2.5008	ns
CPU @ 332.500 MHz	2.9991	3.016	CPU @ 333.333 MHz	2.9991	3.0009	
CPU @ 266.000 MHz	3.7489	3.77	CPU @ 266.666 MHz	3.7489	3.7511	
CPU @ 199.500 MHz	4.9985	5.0266	CPU @ 200.000 MHz	4.9985	5.0015	
CPU @ 166.250 MHz	5.9982	6.032	CPU @ 166.666 MHz	5.9982	6.0018	
CPU @ 133.000 MHz	7.4978	7.54	CPU @ 133.333 MHz	7.4978	7.5023	
CPU @ 99.750 MHz	9.997	10.0533	CPU @ 100.000 MHz	9.997	10.003	
SRC @ 99.750 MHz	9.997	10.0533	SRC @ 100.000 MHz	9.997	10.003	
PCIF / PCI @ 33.250 MHz	29.991	30.1598	PCIF / PCI @ 33.333 MHz	29.991	30.009	

### Current-mode output buffer characteristics of CPU, SRC, and DOT

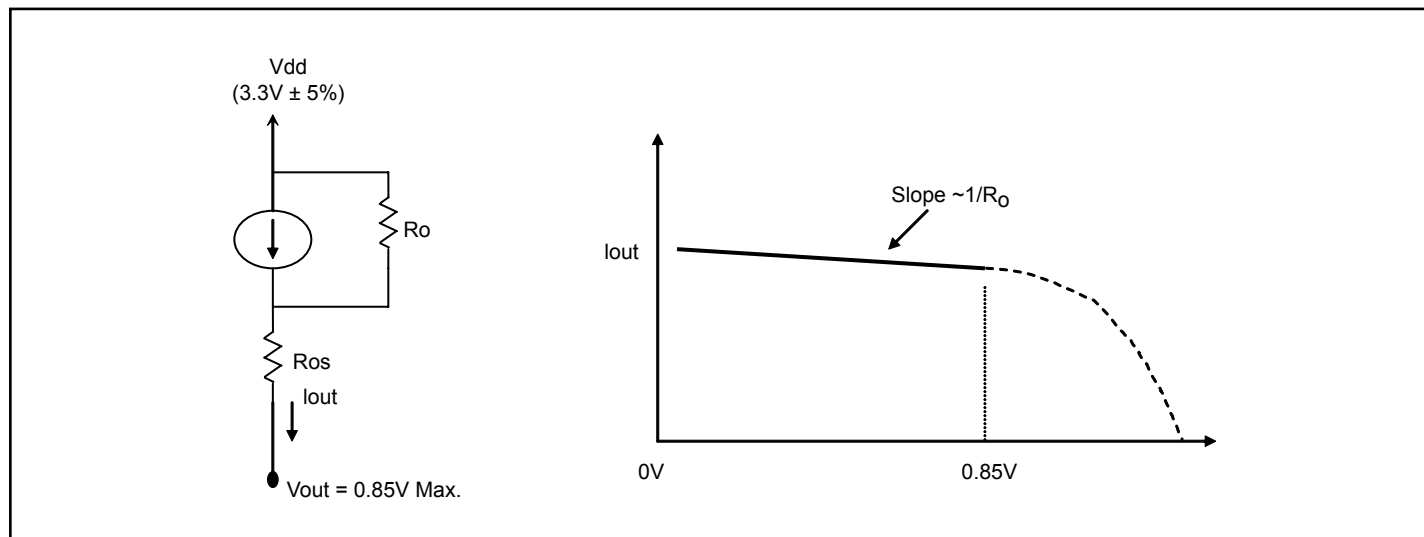


Figure 17. Simplified diagram of a current-mode output buffer

### Host Clock Buffer Characteristics

	Min	Max
$R_o$	3000 $\Omega$	N/A
$R_{os}$	unspecified	unspecified
$V_{out}$	N/A	850mV



**Cueernt Accuracy**

	Conditions	Configuration	Load	Min.	Max.
I <sub>OUT</sub>	V <sub>DD</sub> = 3.30 ±5%	R <sub>ref</sub> = 475Ω I <sub>ref</sub> = 2.32mA	Nominal test load for given configuration	-12% x I <sub>NOMINAL</sub>	+12% x I <sub>NOMINAL</sub>

**Host Clock Output Current**

Board Target Trace/Term Z	Reference R, I <sub>ref</sub> = V <sub>DD</sub> /(3xRr)	Output Current	V <sub>oh</sub> @ Z
100Ω (100Ω differential ≈ 8% coupling ratio)	R <sub>ref</sub> = 475 Ω I <sub>ref</sub> = 2.32mA	I <sub>oh</sub> = 6 x I <sub>ref</sub>	0.7V @ 50

**Crystal Recommendations<sup>(1)</sup>**

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

**Note:**

- External trim capacitors (C<sub>e</sub>) are required. C<sub>e</sub> = 2\*CL – (C<sub>s</sub> + C<sub>i</sub>). Typical C<sub>e</sub> = 33pF when Crystal-load = 20pF, C<sub>trace</sub> (C<sub>s</sub>) = 2.8pF and C<sub>XTAL</sub> = 4.5pF.

**Absolute Maximum Ratings<sup>(1)</sup>** (Over operating free-air temperature range)

Symbol	Parameters	Min.	Max.	Units
V <sub>DD_A</sub>	3.3V Core Supply Voltage	-0.5	4.6	V
V <sub>DD</sub>	3.3V I/O Supply Voltage	-0.5	4.6	
V <sub>IH</sub>	Input High Voltage		4.6	
V <sub>IL</sub>	Input Low Voltage	-0.5		
T <sub>s</sub>	Storage Temperature	-65	150	°C
V <sub>ESD</sub>	ESD Protection	2000		V

**Note:**

- Stress beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device.

**DC Electrical Characteristics** ( $V_{DD} = 3.3 \pm 5\%$ ,  $V_{DD\_A} = 3.3 \pm 5\%$ )

Symbol	Parameters	Condition	Min.	Max.	Units	
VDD_A	3.3V Core Supply Voltage		3.135	3.465	V	
VDD	3.3V I/O Supply Voltage		3.135	3.465		
V <sub>IH</sub>	3.3V Input High Voltage	V <sub>DD</sub>	2.0	V <sub>DD</sub> + 0.3		
V <sub>IL</sub>	3.3V Input Low Voltage		V <sub>SS</sub> - 0.3	0.8		
I <sub>IK</sub>	Input Leakage Current	0 < V <sub>IN</sub> < V <sub>DD</sub>	-5	+5	μA	
V <sub>IH_FS</sub>	3.3V Input High Voltage		0.7	V <sub>DD</sub> + 0.3	V	
V <sub>IL_FS</sub>	3.3V Input Low Voltage		V <sub>SS</sub> - 0.3	0.35		
V <sub>OH</sub>	3.3V Output High Voltage	I <sub>OH</sub> = -1mA	2.4			
V <sub>OL</sub>	3.3V Output Low Voltage	I <sub>OL</sub> = 1mA		0.4		
I <sub>OH</sub>	Output High Current	CPU, SRC, DOT: I <sub>OH</sub> = 6 x I <sub>ref</sub> , I <sub>ref</sub> = 2.32mA	12.2	15.6	mA	
			USB	V <sub>OH</sub> = 1.0V		-29
			V <sub>OH</sub> = 3.135V			-23
		REF, PCI	V <sub>OH</sub> = 1.0V	-33		
		V <sub>OH</sub> = 3.135V		-33		
I <sub>OL</sub>	Output Low Current	USB	V <sub>OL</sub> = 1.95V	29		
			V <sub>OL</sub> = 0.4V		27	
		REF, PCI	V <sub>OL</sub> = 1.95V	30		
			V <sub>OL</sub> = 0.4V		38	
C <sub>in</sub>	Input Pin Capacitance		3	5	pF	
C <sub>xtal</sub>	Xtal Pin Capacitance		3	6		
C <sub>out</sub>	Output Pin Capacitance			6		
L <sub>pin</sub>	Pin Inductance			7	nH	
I <sub>DD</sub>	Power Supply Current	V <sub>DD</sub> = 3.465V, F <sub>CPU</sub> = 400 MHz		500	mA	
I <sub>SS</sub>	Power Down Current	Driven outputs		100		
I <sub>SS</sub>	Power Down Current	Tristate outputs		12		
T <sub>a</sub>	Ambient Temperature		0	70	°C	

**AC Electrical Characteristics** ( $V_{DD} = 3.3 \pm 5\%$ ,  $V_{DD\_A} = 3.3 \pm 5\%$ )

Symbol	Outputs	Parameters	Min.	Max.	Units	Notes
$T_{rise} / T_{fall}$	CPU, SRC, DOT	Rise and fall Time (measured between 0.175V to 0.525V)	175	700	ps	1,2
$T_{rise} / T_{fall}$	PCI/PCIF, REF	Rise and fall Time (measured between 0.8V to 2.0V)	0.5	2.0	ns	4
$T_{rise} / T_{fall}$	USB	Rise and fall Time (measured between 0.8V to 2.0V)	1.0	2.0		5
$\Delta T_{rise} / \Delta T_{fall}$	CPU, SRC, DOT	Rise and fall Time Variation		125	ps	1, 2
$T_{skew}$	CPU0, CPU1	CPU – CPU Skew		100	ps	1,3,6
$T_{skew}$	CPU2	CPU – CPU Skew		200		
$T_{skew}$	SRC	SRC – SRC Skew		250		
$T_{skew}$	PCI/PCIF, REF	PCI – PCI Skew / REF - REF Skew (measured at 1.5V)		500		4
$T_{jitter}$	CPU0, CPU1	Cycle – Cycle Jitter		85		1, 3
$T_{jitter}$	CPU2	Cycle – Cycle Jitter		125		
$T_{jitter}$	SRC	Cycle – Cycle Jitter		125		
$T_{jitter}$	DOT	Cycle – Cycle Jitter		250		
$T_{jitter}$	PCI/PCIF	Cycle – Cycle Jitter (measured at 1.5V)		500		
$T_{jitter}$	USB	Cycle – Cycle Jitter (measured at 1.5V)		350		
$T_{jitter}$	REF	Cycle – Cycle Jitter (measured at 1.5V)		1000	4	
$V_{HIGH}$	CPU, SRC, DOT	Voltage HIGH including overshoot	660	1150	mV	1, 2
$V_{LOW}$	CPU, SRC, DOT	Voltage LOW including undershoot	-300			
$V_{cross}$	CPU, SRC, DOT	Absolute crossing poing voltages	250	550		
$\Delta V_{cross}$	CPU, SRC, DOT	Total variation of $V_{cross}$ over all edges		140		
$T_{DC}$	CPU, SRC, DOT	Duty-Cycle	45	55	%	1,3,6
$T_{DC}$	REF, USB, PCI/PCIF	Duty-Cycle (measured at 1.5V)	45	55	%	4, 5
$T_{stable}$		All clock stabilization from power-up		<1.8	ms	Fig 2
$T_{drive}$		Differential output enable after PwrDwn de-assertion		300	$\mu$ s	
Pwrdown						
$T_{rise} / T_{fall}$		Power down rise and fall time		5.0	ns	
Pwrdown						

**Notes:**

1. Test configuration is  $R_s = 33.2\Omega$ ,  $R_p = 49.9\Omega$ , and  $C_L = 2pF$ .
2. Single-Ended measurement.
3. Differential measurement.
4. PCI, PCIF, and REF  $C_L(\min) = 10pF$ ,  $C_L(\max) = 30pF$ .
5. USB  $C_L(\min) = 10pF$ ,  $C_L(\max) = 20pF$ .
6. CPU measured at 133 MHz.

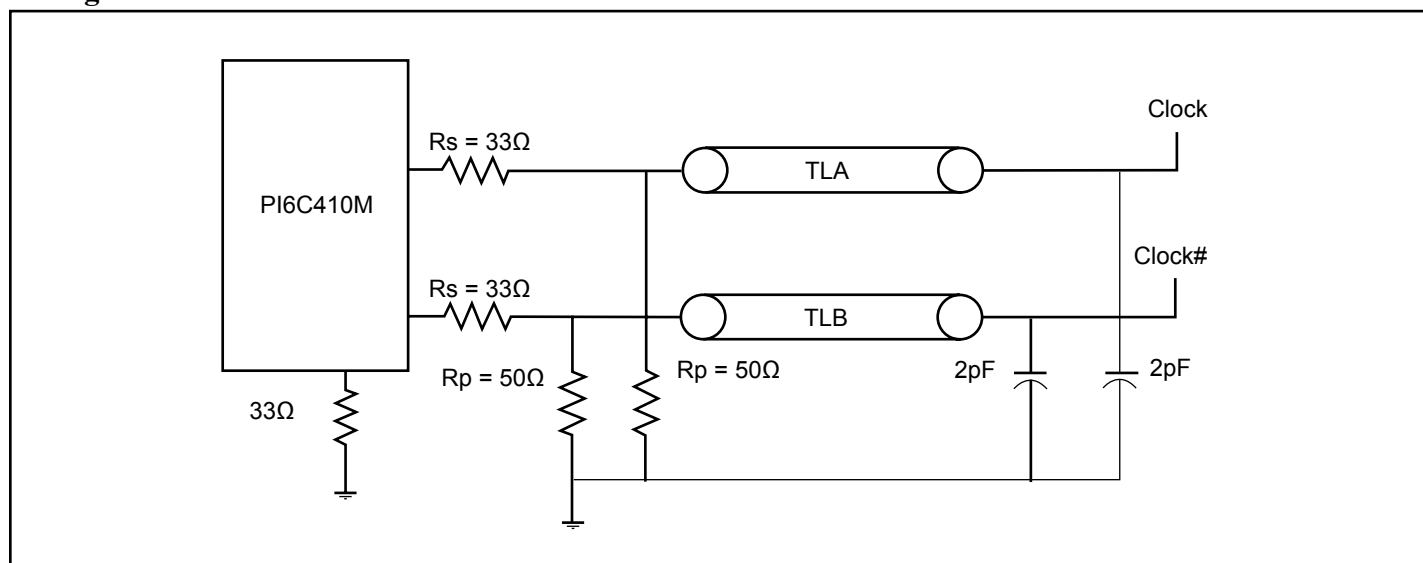
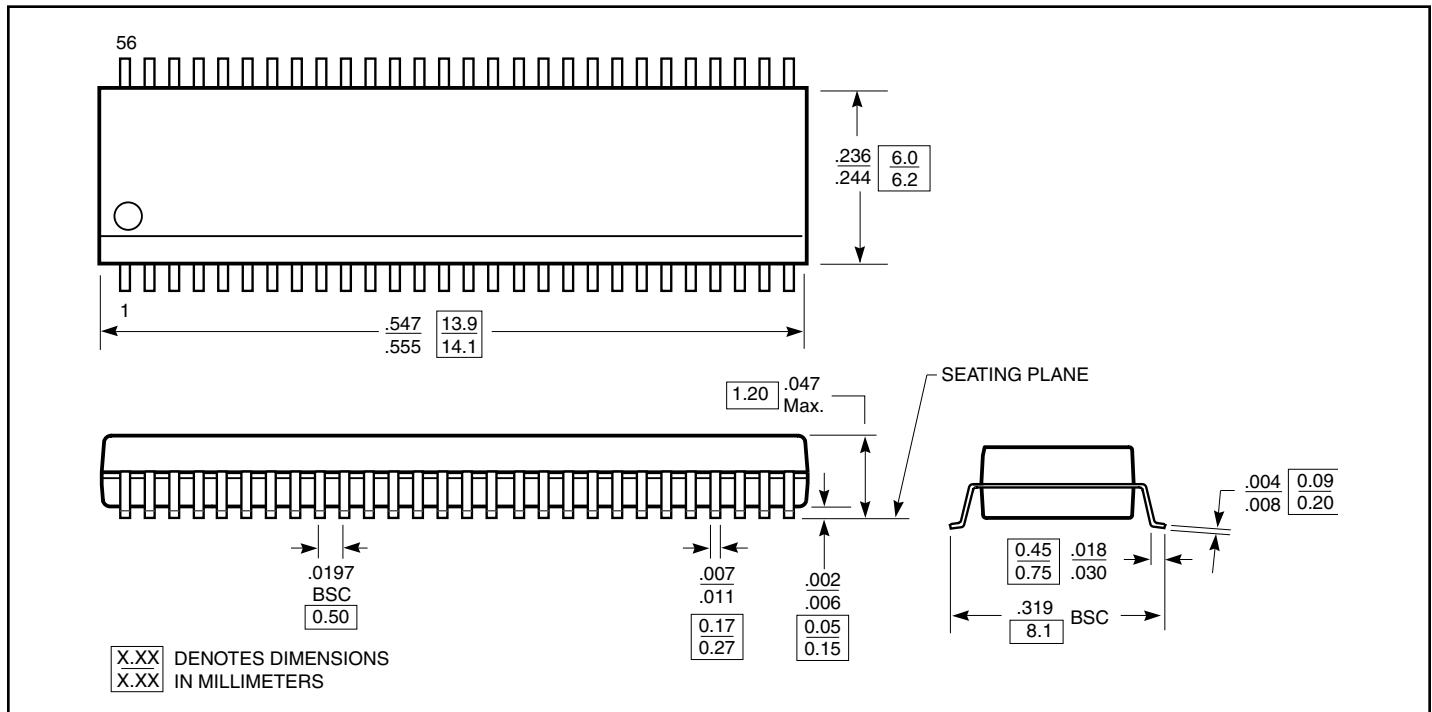
**Configuration Test Load Board Termination**


Figure 18. Configuration test load board termination

**Note:**

1. Maximum 10" trace length for CPU @ 200 MHz, 16" trace for SRC @ 100 MHz.

**Packaging Mechanical: 56-Pin, 240mil wide, 0.5mm pitch TSSOP (A)**



**Ordering Information<sup>(1,2,3)</sup>**

Ordering Code	Package Code	Package Description
PI6C410MA	A	56-Pin, 240mil wide, 0.5mm pitch TSSOP
PI6C410MAE	A	Pb-free & Green 56-Pin, 240mil wide, 0.5mm pitch TSSOP
PI6C410MAAE	A	Pb-free & Green 56-Pin, 240mil wide, 0.5mm pitch TSSOP
PI6C410MAAEX	A	Pb-free & Green 56-Pin, 240mil wide, 0.5mm pitch TSSOP, Tape and Reel

**Notes:**

1. Thermal characteristics can be found on the company web site at [www.pericom.com/packaging/](http://www.pericom.com/packaging/)
2. E = Pb-free and Green
3. X Suffix = Tape/Reel