

# DATA SHEET

## **PCK2014A**

CK98 (100/133 MHz) spread spectrum  
system clock generator

Product specification

2001 Apr 02

ICL03 — PC Motherboard ICs; Logic Products Group

# CK98 (100/133 MHz) spread spectrum system clock generator

## PCK2014A

### FEATURES

- ESD classification testing is done to JEDEC Standard JESD22. Protection exceeds 2000 V to HBM per method A114.
- Latch-up testing is done to JEDEC Standard JESD78 which exceeds 100 mA.
- Mixed 2.5 V and 3.3 V operation
- Six CPU clocks at 2.5 V
- Six PCI clocks at 3.3 V, one free-running (synchronous with CPU clocks)
- Two 3.3 V fixed clocks @ 66 MHz
- Three 2.5 V IOAPIC clocks @ 16.67 MHz
- One 3.3 V 48 MHz USB clock
- Two 3.3 V reference clocks @ 14.318 MHz
- Reference 14.31818 MHz Xtal oscillator input
- 133 MHz or 100 MHz operation
- Power management control input pins
- CPU clock jitter  $\leq 150$  ps cycle-cycle
- CPU clock skew  $\leq 175$  ps pin-pin
- 0.0 ns – 1.5 ns CPU - 3V66 delay
- 1.5 ns – 3.5 ns 3V66 - PCI delay
- 1.5 ns – 4.0 ns CPU - IOAPIC delay
- 1.5 ns – 4.0 ns CPU - PCI delay
- Available in 56-pin SSOP package
- $\pm 0.6\%$  Center spread spectrum capability via select pins
- $-0.6\%$  Down spread spectrum capability via select pins

### DESCRIPTION

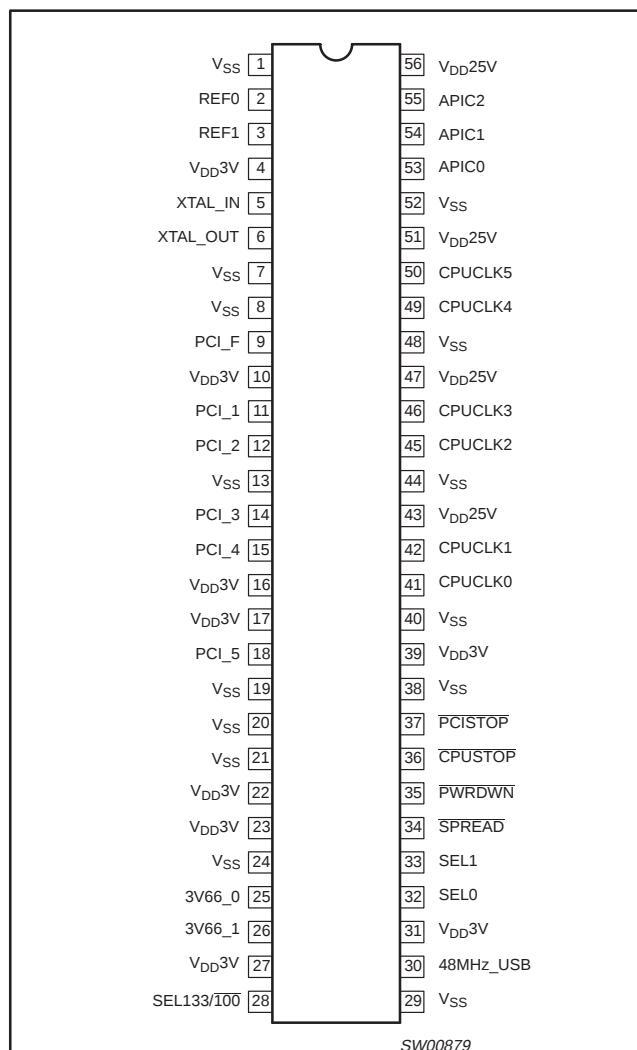
The PCK2014A is a clock generator (frequency synthesizer) chip for a Pentium III and other similar processors.

The PCK2014A has six CPU clock outputs at 2.5 V, two 3V66 clocks running at 66 MHz. There are six PCI clock outputs running at 33 MHz. Additionally, the part has three 2.5 V IOAPIC clock outputs at 16.67 MHz and two 3.3 V reference clock outputs at 14.318 MHz. All clock outputs meet Intel's drive strength, rise/fall time, jitter, accuracy, and skew requirements.

The part possesses dedicated power-down,  $\overline{\text{CPUSTOP}}$ , and  $\overline{\text{PCISTOP}}$  input pins for power management control. These inputs are synchronized on-chip and ensure glitch-free output transitions. When the  $\overline{\text{CPUSTOP}}$  input is asserted, the CPU clock outputs and 3V66 clock outputs are driven LOW. When the  $\overline{\text{PCISTOP}}$  input is asserted, the PCI clock outputs are driven LOW.

Finally, when the  $\overline{\text{PWRDWN}}$  input pin is asserted, the internal reference oscillator and PLLs are shut down, and all outputs are driven LOW.

### PIN CONFIGURATION



### ORDERING INFORMATION

| PACKAGES            | TEMPERATURE RANGE | ORDER CODE | DRAWING NUMBER |
|---------------------|-------------------|------------|----------------|
| 56-pin plastic SSOP | 0 to +70 °C       | PCK2014ADL | SOT371-1       |

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## PIN DESCRIPTION

| PIN NUMBER                                             | SYMBOL             | FUNCTION                                                                                                            |
|--------------------------------------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------|
| 2, 3                                                   | REF [0–1]          | 3.3 V 14.318 MHz clock output                                                                                       |
| 5                                                      | XTAL_IN            | 14.318 MHz crystal input                                                                                            |
| 6                                                      | XTAL_OUT           | 14.318 MHz crystal output                                                                                           |
| 9, 11, 12, 14, 15, 18                                  | PCI_[F, 1–5]       | 3.3 V PCI clock outputs, pin 9 is a free running PCI clock                                                          |
| 25, 26                                                 | 3V66 [0–1]         | 3.3 V fixed 66 MHz clock outputs                                                                                    |
| 28                                                     | SEL133/100         | Select input pin for enabling 133 MHz or 100 MHz CPU outputs.<br>H = 133 MHz, L = 100 MHz                           |
| 30                                                     | 48 MHz USB         | 3.3 V fixed 48 MHz clock output                                                                                     |
| 32, 33                                                 | SEL [0–1]          | Logic select pins. TTL levels.                                                                                      |
| 34                                                     | SPREAD             | 3.3 V LVTTTL input. Enables spread spectrum mode when held LOW.                                                     |
| 35                                                     | PWRDWN             | 3.3 V LVTTTL input. Device enters powerdown mode when held LOW.                                                     |
| 36                                                     | CPUSTOP            | 3.3 V LVTTTL input. Stops all CPU clocks and 3V66 clocks when held LOW.<br>CPUDIV_2 output remains on all the time. |
| 37                                                     | PCISTOP            | 3.3 V LVTTTL input. Stops all PCI clocks except PCICLK_F when held LOW.                                             |
| 41, 42, 45, 46, 49, 50                                 | CPUCLK [0–5]       | 2.5 V CPU output. 133 MHz or 100 MHz depending on state of input pin SEL133/100.                                    |
| 53, 54, 55                                             | APIC [0–2]         | 2.5 V clock outputs running divide synchronous with the CPU clock frequency.<br>Fixed 16.67 MHz limit.              |
| 4, 10, 16, 17,<br>22, 23, 27, 31, 39                   | V <sub>DD3V</sub>  | 3.3 V power supply, pins 22 and 23 are analog V <sub>DD</sub> .                                                     |
| 1, 7, 8, 13, 19, 20, 21, 24,<br>29, 38, 40, 44, 48, 52 | V <sub>SS</sub>    | Ground, pins 20 and 21 are analog V <sub>SS</sub> .                                                                 |
| 43, 47, 51, 56                                         | V <sub>DD25V</sub> | 2.5 V power supply                                                                                                  |

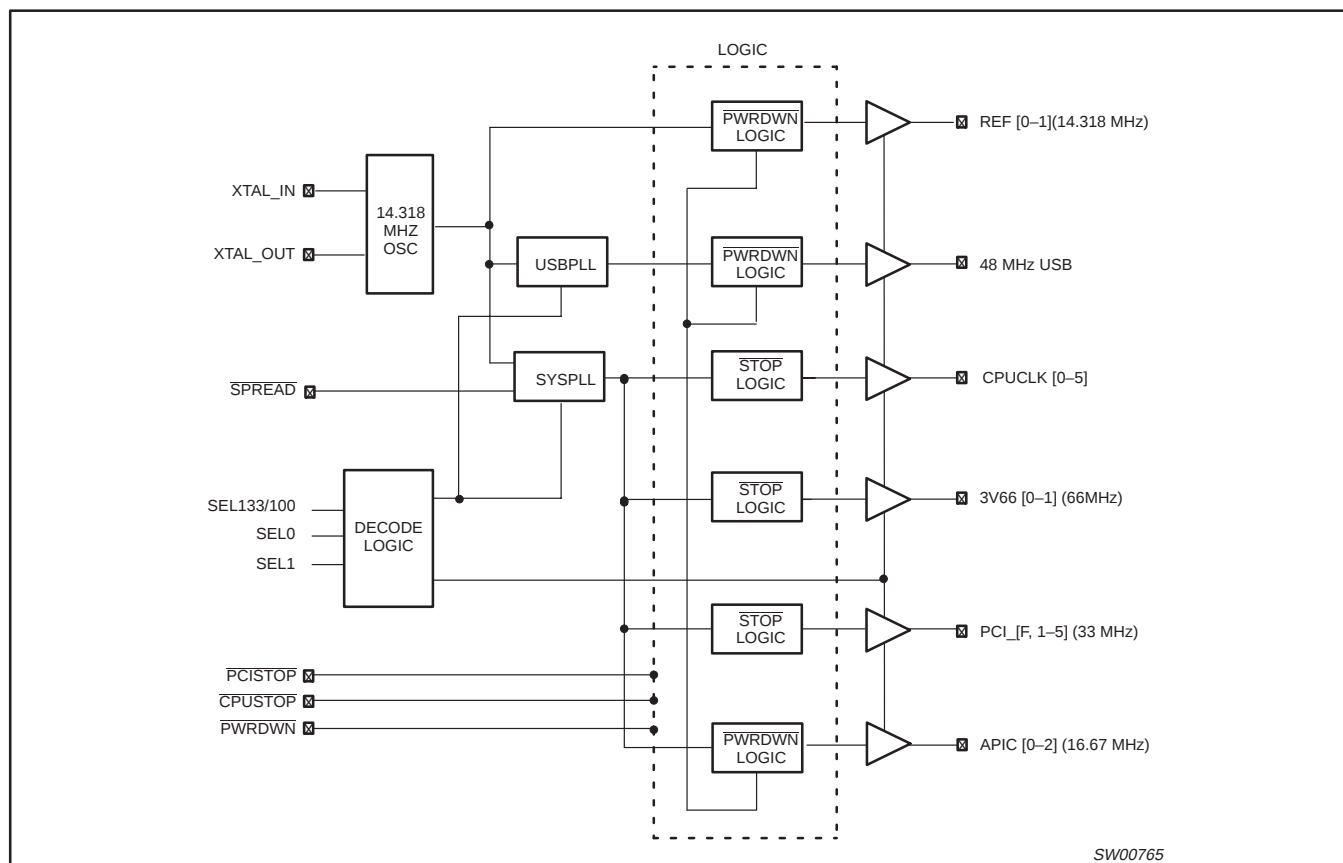
### NOTE:

1. V<sub>DD3V</sub>, V<sub>DD25V</sub> and V<sub>SS</sub> in the above table reflects a likely internal POWER and GROUND partition to reduce the effects of internal noise on the performance of the device. In reality, the platform will be configured with the V<sub>DD25V</sub> pins tied to a 2.5 V supply, all remaining V<sub>DD</sub> pins tied to a common 3.3 V supply and all V<sub>SS</sub> pins being common.
2. Pins 20 and 21 are analog ground and should be tied to a ground plane. Pins 22 and 23 are analog V<sub>DD</sub> should be properly decoupled to a 3.3 V supply. These analog power supply pins should not be tied to the PCI power and ground to avoid noise coupling into the analog power supply pins. The PCK2014 provides separate power supplies for the internal digital circuitry (pin 39, V<sub>CC</sub>) and the internal PLLs of the device (pins 22 and 23, V<sub>CC</sub>). The purpose of this approach is to try and isolate the high switching noise digital outputs from relatively sensitive analog blocks. In controlled environments such as a test board this level is very well controlled. However, in a mixed signal environment, a second level of isolation may be required.

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## BLOCK DIAGRAM



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## FUNCTION TABLE

| SEL 133/100 | SEL1 | SEL0 | CPU     | 3V66   | PCI    | 48 MHz | REF        | IOAPIC    | NOTES   |
|-------------|------|------|---------|--------|--------|--------|------------|-----------|---------|
| 0           | 0    | 0    | HI-Z    | HI-Z   | HI-Z   | HI-Z   | HI-Z       | HI-Z      | 1       |
| 0           | 0    | 1    | 100 MHz | 66 MHz | 33 MHz | 48 MHz | 14.318 MHz | 16.67 MHz | 2       |
| 0           | 1    | 0    | 100 MHz | 66 MHz | 33 MHz | HI-Z   | 14.318 MHz | 16.67 MHz | 3       |
| 0           | 1    | 1    | 100 MHz | 66 MHz | 33 MHz | 48 MHz | 14.318 MHz | 16.67 MHz | 4, 7, 8 |
| 1           | 0    | 0    | TCLK/2  | TCLK/4 | TCLK/8 | TCLK/2 | TCLK       | TCLK/16   | 5, 6    |
| 1           | 0    | 1    | 133 MHz | 66 MHz | 33 MHz | 48 MHz | 14.318 MHz | 16.67 MHz | 2       |
| 1           | 1    | 0    | 133 MHz | 66 MHz | 33 MHz | HI-Z   | 14.318 MHz | 16.67 MHz | 3       |
| 1           | 1    | 1    | 133 MHz | 66 MHz | 33 MHz | 48 MHz | 14.318 MHz | 16.67 MHz | 4, 7, 8 |

### NOTES:

1. Required for board level "bed-of-nails" testing.
2. Philips center spread mode.
3. 48 MHz PLL disabled to reduce component jitter. 48 MHz outputs to be held HI-Z instead of driven to LOW state.
4. "Normal" mode of operation.
5. TCLK is a test clock over driven on the XTALIN input during test mode. TCLK mode is based on 133 MHz CPU select logic.
6. Required for DC output impedance verification.
7. Frequency accuracy of 48 MHz must be +167 PPM to match USB default.
8. Range of reference frequency allowed is MIN = 14.316 MHz, NOMINAL = 14.31818 MHz, MAX = 14.32 MHz

| CLOCK OUTPUT        | TARGET FREQUENCY (MHz) | ACTUAL FREQUENCY (MHz) | PPM |
|---------------------|------------------------|------------------------|-----|
| USBCLK <sup>7</sup> | 48.0                   | 48.008                 | 167 |

## CLOCK ENABLE CONFIGURATION

| CPUSTOP | PWRDWN | PCISTOP | CPUCLK | APIC | 3V66 | PCI | REF / 48 MHz | OSC | VCOs |
|---------|--------|---------|--------|------|------|-----|--------------|-----|------|
| X       | 0      | X       | LOW    | LOW  | LOW  | LOW | LOW          | OFF | OFF  |
| 0       | 1      | 0       | LOW    | ON   | LOW  | LOW | ON           | ON  | ON   |
| 0       | 1      | 1       | LOW    | ON   | LOW  | ON  | ON           | ON  | ON   |
| 1       | 1      | 0       | ON     | ON   | ON   | LOW | ON           | ON  | ON   |
| 1       | 1      | 1       | ON     | ON   | ON   | ON  | ON           | ON  | ON   |

### NOTES:

1. LOW means outputs held static LOW as per latency requirement below
2. ON means active.
3. PWRDWN pulled LOW, impacts all outputs including REF and 48 MHz outputs.
4. All 3V66 clocks as well as CPU clocks should stop cleanly when CPUSTOP is pulled LOW.
5. CPUDIV2, IOAPIC, REF, 48 MHz signals are not controlled by the CPUSTOP functionality and are enabled all in all conditions except when PWRDWN is LOW.

## POWER MANAGEMENT REQUIREMENTS

| SIGNAL  | SIGNAL STATE         | LATENCY                                    |
|---------|----------------------|--------------------------------------------|
|         |                      | NO. OF RISING EDGES OF FREE RUNNING PCICLK |
| CPUSTOP | 0 (DISABLED)         | 1                                          |
|         | 1 (ENABLED)          | 1                                          |
| PCISTOP | 0 (DISABLED)         | 1                                          |
|         | 1 (ENABLED)          | 1                                          |
| PWRDWN  | 1 (NORMAL OPERATION) | 3 ms                                       |
|         | 0 (POWER DOWN)       | 2 MAX                                      |

### NOTES:

1. Clock ON/OFF latency is defined as the number of rising edges of free running PCICLKs between the clock disable goes HIGH/LOW to the first valid clock that comes out of the device.
2. Power up latency is when PWRDWN goes inactive (HIGH) to when the first valid clocks are driven from the device.

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## ABSOLUTE MAXIMUM RATINGS<sup>1, 2</sup>

In accordance with the Absolute Maximum Rating System (IEC 134).

Voltages are referenced to  $V_{SS}$  ( $V_{SS} = 0$  V).

| SYMBOL     | PARAMETER                                                  | CONDITION                                                                            | LIMITS |                | UNIT |
|------------|------------------------------------------------------------|--------------------------------------------------------------------------------------|--------|----------------|------|
|            |                                                            |                                                                                      | MIN    | MAX            |      |
| $V_{DD3}$  | DC 3.3 V core supply voltage                               |                                                                                      | -0.5   | +4.6           | V    |
| $V_{DDQ3}$ | DC 3.3 V I/O supply voltage                                |                                                                                      | -0.5   | +4.6           | V    |
| $V_{DDQ2}$ | DC 2.5 V I/O supply voltage                                |                                                                                      | -0.5   | +3.6           | V    |
| $I_{IK}$   | DC input diode current                                     | $V_I < 0$                                                                            |        | -50            | mA   |
| $V_I$      | DC input voltage                                           | Note 2                                                                               | -0.5   | 5.5            | V    |
| $I_{OK}$   | DC output diode current                                    | $V_O > V_{CC}$ or $V_O < 0$                                                          |        | $\pm 50$       | mA   |
| $V_O$      | DC output voltage                                          | Note 2                                                                               | -0.5   | $V_{CC} + 0.5$ | V    |
| $I_O$      | DC output source or sink current                           | $V_O = 0$ to $V_{CC}$                                                                |        | $\pm 50$       | mA   |
| $T_{stg}$  | Storage temperature range                                  |                                                                                      | -65    | +150           | °C   |
| $P_{TOT}$  | Power dissipation per package plastic medium-shrink (SSOP) | For temperature range: -40 to +125 °C<br>above +55 °C derate linearly with 11.3 mW/K |        | 850            | mW   |

### NOTES:

- Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

## RECOMMENDED OPERATING CONDITIONS

| SYMBOL      | PARAMETER                                       | CONDITIONS                      | LIMITS   |                           | UNIT |
|-------------|-------------------------------------------------|---------------------------------|----------|---------------------------|------|
|             |                                                 |                                 | MIN      | MAX                       |      |
| $V_{DD3V}$  | DC 3.3 V core supply voltage                    |                                 | 3.135    | 3.465                     | V    |
| $V_{DD25V}$ | DC 2.5 V I/O supply voltage                     |                                 | 2.375    | 2.625                     | V    |
| $C_L$       | Capacitive load on:                             |                                 |          |                           |      |
|             | CPUCLK                                          | 1 device load, possible 2 loads | 10       | 20                        | pF   |
|             | PCI                                             | Must meet PCI 2.1 requirements  | 10       | 30                        | pF   |
|             | 3V66                                            | 1 device load, possible 2 loads | 10       | 30                        | pF   |
|             | 48 MHz clock USB                                | 1 device load                   | 10       | 20                        | pF   |
|             | REF                                             | 1 device load                   | 10       | 20                        | pF   |
|             | APIC                                            | 1 device load                   | 10       | 20                        | pF   |
| $V_I$       | DC input voltage range                          |                                 | 0        | $V_{DD3V}$                | V    |
| $V_O$       | DC output voltage range                         |                                 | 0        | $V_{DD25V}$<br>$V_{DD3V}$ | V    |
| $f_{REF}$   | Reference frequency, oscillator nominal value   |                                 | 14.31818 | 14.31818                  | MHz  |
| $T_{amb}$   | Operating ambient temperature range in free air |                                 | 0        | +70                       | °C   |

## POWER MANAGEMENT

| CK133<br>CONDITION                                                             | MAXIMUM 2.5V SUPPLY CONSUMPTION<br>MAXIMUM DISCRETE CAP LOADS,<br>$V_{DD25V} = 2.625$ V<br>ALL STATIC INPUTS = $V_{DD3V}$ OR $V_{SS}$ | MAXIMUM 3.3V SUPPLY CONSUMPTION<br>MAXIMUM DISCRETE CAP LOADS,<br>$V_{DD25V} = 3.465$ V<br>ALL STATIC INPUTS = $V_{DD3V}$ OR $V_{SS}$ |
|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Power-down mode<br>(PWRDWN = 0)                                                | 100 $\mu$ A                                                                                                                           | 200 $\mu$ A                                                                                                                           |
| Full active 100 MHz<br>SEL133/100 = 0<br>SEL1, 0 = 1 1<br>CPUSTOP, PCISTOP = 1 | 80 mA                                                                                                                                 | 80 mA                                                                                                                                 |
| Full active 133 MHz<br>SEL133/100 = 1<br>SEL1, 0 = 1 1<br>CPUSTOP, PCISTOP = 1 | 90 mA                                                                                                                                 | 80 mA                                                                                                                                 |

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## DC CHARACTERISTICS

| SYMBOL            | PARAMETER                                            | TEST CONDITIONS        |                                              |                                | LIMITS                         |     |                       | UNIT |
|-------------------|------------------------------------------------------|------------------------|----------------------------------------------|--------------------------------|--------------------------------|-----|-----------------------|------|
|                   |                                                      |                        |                                              |                                | T <sub>amb</sub> = 0 to +70 °C |     |                       |      |
|                   |                                                      | V <sub>DD</sub><br>(V) | OTHER                                        |                                | MIN                            | TYP | MAX                   |      |
| V <sub>IH</sub>   | HIGH level input voltage                             | 3.135 to 3.465         |                                              | V <sub>DD25V</sub> = 2.5 V ±5% | 2.0                            |     | V <sub>DD</sub> + 0.3 | V    |
| V <sub>IL</sub>   | LOW level input voltage                              | 3.135 to 3.465         |                                              | V <sub>DD3V</sub> = 3.3 V ±5%  | V <sub>SS</sub> – 0.3          |     | 0.8                   | V    |
| V <sub>OH2</sub>  | 2.5 V output HIGH voltage<br>CPUCLK, APIC            | 2.375 to 2.625         | I <sub>OH</sub> = –1 mA                      |                                | 2.3                            |     | –                     | V    |
| V <sub>OL2</sub>  | 2.5 V output LOW voltage<br>CPUCLK, APIC             | 2.375 to 2.625         | I <sub>OL</sub> = 1 mA                       |                                | –                              |     | 0.25                  | V    |
| V <sub>OH3</sub>  | 3.3 V output HIGH voltage<br>REF, 48 MHz USB         | 3.135 to 3.465         | I <sub>OH</sub> = –1 mA                      |                                | 2.0                            |     | –                     | V    |
| V <sub>OL3</sub>  | 3.3 V output LOW voltage<br>REF, 48 MHz USB          | 3.135 to 3.465         | I <sub>OL</sub> = 1 mA                       |                                | –                              |     | 0.4                   | V    |
| V <sub>OH3</sub>  | 3.3 V output HIGH voltage<br>PCI, 3V66               | 3.135 to 3.465         | I <sub>OH</sub> = –1 mA                      |                                | 2.4                            |     | –                     | V    |
| V <sub>OL3</sub>  | 3.3 V output LOW voltage<br>PCI, 3V66                | 3.135 to 3.465         | I <sub>OL</sub> = 1 mA                       |                                | –                              |     | 0.55                  | V    |
| I <sub>OH</sub>   | APIC, CPUCLK<br>output HIGH current                  | 2.375                  | V <sub>OUT</sub> = 1.0 V                     |                                | –27                            |     | –                     | mA   |
|                   |                                                      | 2.625                  | V <sub>OUT</sub> = 2.375 V                   |                                | –                              |     | –27                   |      |
| I <sub>OH</sub>   | 48 MHz USB, REF<br>output HIGH current               | 3.135                  | V <sub>OUT</sub> = 1.0 V                     |                                | –29                            |     | –                     | mA   |
|                   |                                                      | 3.465                  | V <sub>OUT</sub> = 3.135 V                   |                                | –                              |     | –23                   |      |
| I <sub>OH</sub>   | PCI, 3V66<br>output HIGH current                     | 3.135                  | V <sub>OUT</sub> = 1.0 V                     |                                | –33                            |     | –                     | mA   |
|                   |                                                      | 3.465                  | V <sub>OUT</sub> = 3.135 V                   |                                | –                              |     | –33                   |      |
| I <sub>OL</sub>   | APIC, CPUCLK<br>output LOW current                   | 2.375                  | V <sub>OUT</sub> = 1.2 V                     |                                | 27                             |     | –                     | mA   |
|                   |                                                      | 2.625                  | V <sub>OUT</sub> = 0.3 V                     |                                | –                              |     | 30                    |      |
| I <sub>OL</sub>   | 48 MHz USB, REF<br>output LOW current                | 3.135                  | V <sub>OUT</sub> = 1.95 V                    |                                | 29                             |     | –                     | mA   |
|                   |                                                      | 3.465                  | V <sub>OUT</sub> = 0.4 V                     |                                | –                              |     | 27                    |      |
| I <sub>OL</sub>   | PCI, 3V66<br>output LOW current                      | 3.135                  | V <sub>OUT</sub> = 1.95 V                    |                                | 30                             |     | –                     | mA   |
|                   |                                                      | 3.465                  | V <sub>OUT</sub> = 0.4 V                     |                                | –                              |     | 38                    |      |
| ±I <sub>I</sub>   | Input leakage current                                | 3.465                  |                                              |                                | –                              |     | 5                     | µA   |
| ±I <sub>OZ</sub>  | 3-State output OFF-State<br>current                  | 3.465                  | V <sub>OUT</sub> =<br>V <sub>dd</sub> or GND | I <sub>O</sub> = 0             | –                              |     | 10                    | µA   |
| C <sub>in</sub>   | Input pin capacitance                                |                        |                                              |                                |                                |     | 5                     | pF   |
| C <sub>Xtal</sub> | Xtal pin capacitance, as seen<br>by external crystal |                        |                                              |                                |                                | 18  |                       | pF   |
| C <sub>out</sub>  | Output pin capacitance                               |                        |                                              |                                |                                |     | 6                     | pF   |

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## AC CHARACTERISTICS

 $V_{DD3V} = 3.3\text{ V} \pm 5\%$ ;  $V_{DDAPIC} = V_{DD25V} = 2.5\text{ V} \pm 5\%$ ;  $f_{\text{crystal}} = 14.31818\text{ MHz}$ 

### CPU CLOCK OUTPUTS, CPU(0–5) (LUMP CAPACITANCE TEST LOAD = 20 pF)

| SYMBOL                                 | PARAMETER                      | LIMITS<br>T <sub>amb</sub> = 0 to +70 °C |      | LIMITS<br>T <sub>amb</sub> = 0 to +70 °C |      | UNIT | NOTES |
|----------------------------------------|--------------------------------|------------------------------------------|------|------------------------------------------|------|------|-------|
|                                        |                                | 133 MHz MODE                             |      | 100 MHz MODE                             |      |      |       |
|                                        |                                | MIN                                      | MAX  | MIN                                      | MAX  |      |       |
| T <sub>HKP</sub> (avg)                 | Average CPUCLK period          | 7.5                                      | 7.65 | 10.0                                     | 10.3 | ns   | 2, 9  |
| T <sub>HKP</sub> (abs <sub>_om</sub> ) | Absolute minimum CPUCLK period | 7.35                                     | n/a  | 9.85                                     | n/a  | ps   |       |
| T <sub>HKH</sub>                       | CPUCLK HIGH time               | 1.87                                     | n/a  | 3.0                                      | n/a  | ns   | 5, 10 |
| T <sub>HKL</sub>                       | CPUCLK LOW time                | 1.67                                     | n/a  | 2.8                                      | n/a  | ns   | 6, 10 |
| T <sub>HRISE</sub>                     | CPUCLK rise time               | 0.4                                      | 1.6  | 0.4                                      | 1.6  | ns   | 8     |
| T <sub>HFALL</sub>                     | CPUCLK fall time               | 0.4                                      | 1.6  | 0.4                                      | 1.6  | ns   | 8     |
| T <sub>JITTER</sub>                    | CPUCLK cycle-cycle jitter      |                                          | 150  |                                          | 150  | ps   |       |
| DUTY CYCLE                             | Output Duty Cycle              | 45                                       | 55   | 45                                       | 55   | %    | 1     |
| T <sub>HSKW</sub>                      | CPUCLK pin-pin skew            |                                          | 175  |                                          | 175  | ps   | 2     |

### PCI CLOCK OUTPUTS, PCI(0–5) (LUMP CAPACITANCE TEST LOAD = 30 pF)

| SYMBOL              | PARAMETER              | LIMITS<br>T <sub>amb</sub> = 0 to +70 °C |     | LIMITS<br>T <sub>amb</sub> = 0 to +70 °C |     | UNIT | NOTES |
|---------------------|------------------------|------------------------------------------|-----|------------------------------------------|-----|------|-------|
|                     |                        | 133 MHz MODE                             |     | 100 MHz MODE                             |     |      |       |
|                     |                        | MIN                                      | MAX | MIN                                      | MAX |      |       |
| T <sub>HKP</sub>    | PCI period             | 30.0                                     | n/a | 30.0                                     | n/a | ns   | 2, 9  |
| T <sub>HKH</sub>    | PCI HIGH time          | 12.0                                     | n/a | 12.0                                     | n/a | ns   | 5, 10 |
| T <sub>HKL</sub>    | PCI LOW time           | 12.0                                     | n/a | 12.0                                     | n/a | ns   | 6, 10 |
| T <sub>HRISE</sub>  | PCI rise time          | 0.5                                      | 2.0 | 0.5                                      | 2.0 | ns   | 8     |
| T <sub>HFALL</sub>  | PCI fall time          | 0.5                                      | 2.0 | 0.5                                      | 2.0 | ns   | 8     |
| T <sub>JITTER</sub> | PCI cycle-cycle jitter |                                          | 300 |                                          | 300 | ps   |       |
| DUTY CYCLE          | PCI Duty Cycle         | 45                                       | 55  | 45                                       | 55  | %    | 1     |
| T <sub>HSKW</sub>   | PCI pin-pin skew       |                                          | 500 |                                          | 500 | ps   | 2     |

### APIC(0–1) CLOCK OUTPUT (LUMP CAPACITANCE TEST LOAD = 20 pF)

| SYMBOL              | PARAMETER                   | LIMITS<br>T <sub>amb</sub> = 0 to +70 °C |      | LIMITS<br>T <sub>amb</sub> = 0 to +70 °C |      | UNIT | NOTES |
|---------------------|-----------------------------|------------------------------------------|------|------------------------------------------|------|------|-------|
|                     |                             | 133 MHz MODE                             |      | 100 MHz MODE                             |      |      |       |
|                     |                             | MIN                                      | MAX  | MIN                                      | MAX  |      |       |
| T <sub>HKP</sub>    | APIC CLK period             | 60.0                                     | 61.2 | 60.0                                     | 61.2 | ns   | 2, 9  |
| T <sub>HKH</sub>    | APIC CLK HIGH time          | 25.5                                     | n/a  | 25.5                                     | n/a  | ns   | 5, 10 |
| T <sub>HKL</sub>    | APIC CLK LOW time           | 25.3                                     | n/a  | 25.3                                     | n/a  | ns   | 6, 10 |
| T <sub>HRISE</sub>  | APIC CLK rise time          | 0.4                                      | 1.6  | 0.4                                      | 1.6  | ns   | 8     |
| T <sub>HFALL</sub>  | APIC CLK fall time          | 0.4                                      | 1.6  | 0.4                                      | 1.6  | ns   | 8     |
| T <sub>JITTER</sub> | APIC CLK cycle-cycle jitter |                                          | 500  |                                          | 500  | ps   |       |
| DUTY CYCLE          | APIC CLK Duty Cycle         | 45                                       | 55   | 45                                       | 55   | %    | 1     |
| T <sub>HSKW</sub>   | APIC CLK pin-pin skew       |                                          | 250  |                                          | 250  | ps   | 2     |

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## 3V66 CLOCK OUTPUT, 3V66 (0–1) (LUMP CAPACITANCE TEST LOAD = 30 pF)

| SYMBOL              | PARAMETER                   | LIMITS<br>T <sub>amb</sub> = 0 to +70 °C |      | LIMITS<br>T <sub>amb</sub> = 0 to +70 °C |      | UNIT | NOTES   |
|---------------------|-----------------------------|------------------------------------------|------|------------------------------------------|------|------|---------|
|                     |                             | 133 MHz MODE                             |      | 100 MHz MODE                             |      |      |         |
|                     |                             | MIN                                      | MAX  | MIN                                      | MAX  |      |         |
| T <sub>HKP</sub>    | 3V66 CLK period             | 15.0                                     | 15.3 | 15.0                                     | 15.3 | ns   | 2, 9, 4 |
| T <sub>HKH</sub>    | 3V66 CLK HIGH time          | 4.95                                     | n/a  | 4.95                                     | n/a  | ns   | 5, 10   |
| T <sub>HKL</sub>    | 3V66 CLK LOW time           | 4.55                                     | n/a  | 4.55                                     | n/a  | ns   | 6, 10   |
| T <sub>HRISE</sub>  | 3V66 CLK rise time          | 0.5                                      | 2.0  | 0.5                                      | 2.0  | ns   | 8       |
| T <sub>HFALL</sub>  | 3V66 CLK fall time          | 0.5                                      | 2.0  | 0.5                                      | 2.0  | ns   | 8       |
| T <sub>JITTER</sub> | 3V66 CLK cycle-cycle jitter |                                          | 500  |                                          | 500  | ps   |         |
| DUTY CYCLE          | 3V66 CLK Duty Cycle         | 45                                       | 55   | 45                                       | 55   | %    | 1       |
| T <sub>HSKW</sub>   | 3V66 CLK pin-pin skew       |                                          | 250  |                                          | 250  | ps   | 2       |

## 48MHZ CLOCK OUTPUT (LUMP CAPACITANCE TEST LOAD = 20 pF)

| SYMBOL               | PARAMETER                                          | LIMITS 133 MHz<br>$T_{amb} = 0 \text{ to } +70 \text{ }^{\circ}\text{C}$ |       | LIMITS 100 MHz<br>$T_{amb} = 0 \text{ to } +70 \text{ }^{\circ}\text{C}$ |       | UNIT | NOTES |
|----------------------|----------------------------------------------------|--------------------------------------------------------------------------|-------|--------------------------------------------------------------------------|-------|------|-------|
|                      |                                                    | MIN                                                                      | MAX   | MIN                                                                      | MAX   |      |       |
| $T_{HKP}$            | 48 MHz clock period average                        | 20.83                                                                    | 20.83 | 20.83                                                                    | 20.83 | ns   | 2     |
| $T_{HKH}$            | 48 MHz clock HIGH time                             | 7.57                                                                     | n/a   | 7.57                                                                     | n/a   | ns   |       |
| $T_{HKL}$            | 48 MHz clock LOW time                              | 7.17                                                                     | n/a   | 7.17                                                                     | n/a   | ns   |       |
| $T_{HRISE} (t_R)$    | Output rise edge rate                              | 1                                                                        | 4     | 1                                                                        | 4     | ns   |       |
| $T_{HFAIL} (t_F)$    | Output fall edge rate                              | 1                                                                        | 4     | 1                                                                        | 4     | ns   |       |
| DUTY CYCLE ( $t_D$ ) | Duty Cycle                                         | 45                                                                       | 55    | 45                                                                       | 55    | %    |       |
| $T_{JITTER}$         | CLK cycle-cycle jitter                             |                                                                          | 500   |                                                                          | 500   | ps   |       |
| $T_{HSTB} (f_{ST})$  | Frequency stabilization from Power-up (cold start) |                                                                          |       |                                                                          | 3     | ms   |       |

### NOTE:

- See Figure 5 for measure points.
- Average period over 1  $\mu\text{s}$ .

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## AC CHARACTERISTICS (Continued)

| SYMBOL         | PARAMETER                        | TEST CONDITIONS               |                               | LIMITS<br>$T_{amb} = 0 \text{ to } +70 \text{ }^{\circ}\text{C}$ |      |     | UNIT | NOTES |
|----------------|----------------------------------|-------------------------------|-------------------------------|------------------------------------------------------------------|------|-----|------|-------|
|                |                                  | Measurement loads<br>(lumped) | Measure points                | MIN                                                              | TYP  | MAX |      |       |
| $T_{HPOFFSET}$ | CPUCLK to 3V66 CLK,<br>CPU leads | CPU@20 pF,<br>3V66@30 pF      | CPU@1.25 V,<br>3V66@1.5 V     | 0.0                                                              | 0.45 | 1.5 | ns   | 1     |
| $T_{HPOFFSET}$ | 3V66 CLK to PCI,<br>3V66 leads   | 3V66@30 pF,<br>PCI@30 pF      | 3V66@1.5 V,<br>PCI@1.5 V      | 1.5                                                              | 2.0  | 3.5 | ns   | 1     |
| $T_{HPOFFSET}$ | CPUCLK to APIC,<br>CPU leads     | CPU@20 pF,<br>IOAPIC@20 pF    | 3CPU@1.25 V,<br>IOAPIC@1.25 V | 1.5                                                              | 2.4  | 4.0 | ns   | 1     |
| $T_{HPOFFSET}$ | CPUCLK to PCI,<br>CPU leads      | CPU@20 pF<br>PCI@30 pF        | CPU@1.25 V<br>PCI@1.5 V       | 1.5                                                              | 2.7  | 4.0 | ns   |       |

### NOTES:

- Output drivers must have monotonic rise/fall times through the specified  $V_{OL}/V_{OH}$  levels.
- Period, jitter, offset and skew measured on rising edge @ 1.25 V for 2.5 V clocks and @ 1.5 V for 3.3 V clocks.
- The PCI is the CPUCLK divided by four at CPUCLK = 133 MHz. The 3V66 CLK is internal VCO frequency divided by three at CPUCLK = 100 MHz.
- 3V66 CLK is internal VCO frequency divided by two at CPUCLK = 133 MHz. The 3V66 CLK is internal VCO frequency divided by three at CPUCLK = 100 MHz.
- $T_{HKH}$  is measured at 2.0 V for 2.5 V outputs, 2.4 V for 3.3 V outputs as shown in Figure 4.
- $T_{HKL}$  is measured at 0.4 V for all outputs as shown in Figure 4.
- The time is specified from when  $V_{DDQ}$  achieves its nominal operating level (typical condition  $V_{DDQ} = 3.3 \text{ V}$ ) until the frequency output is stable and operating within specification.
- $T_{HRISE}$  and  $T_{H FALL}$  are measured as a transition through the threshold region  $V_{OL} = 0.4 \text{ V}$  and  $V_{OH} = 2.4 \text{ V}$  for 3 V outputs,  $V_{OL} = 0.4 \text{ V}$ , and  $V_{OH} = 2.0 \text{ V}$  for 2.5 V outputs. (1 mA) JEDEC specification.
- The average period over any 1  $\mu\text{s}$  period of time must be greater than the minimum specified period.
- Calculated at minimum edge-rate (1 V/ns) to guarantee 45/55% duty-cycle. Pulse width is required to be wider at faster edge-rate to ensure duty-cycle specification is met.
- Output (see Figure 5 for measure points).

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**SPREAD SPECTRUM FUNCTION TABLE**

| SPREAD#      | SEL133/100# | SEL1   | SEL0   | Function                           |
|--------------|-------------|--------|--------|------------------------------------|
| pin 34       | pin 28      | pin 33 | pin 32 |                                    |
| 0 (active)   | 0 (100 MHz) | 0      | 0      | 3-State to High Impedance          |
| 0 (active)   | 0 (100 MHz) | 0      | 1      | 100 MHz, Center Spread $\pm 0.6\%$ |
| 0 (active)   | 0 (100 MHz) | 1      | 0      | 100 MHz, Down Spread $-0.6\%$      |
| 0 (active)   | 0 (100 MHz) | 1      | 1      | 100 MHz, Down Spread $-0.6\%$      |
| 0 (active)   | 1 (133 MHz) | 0      | 0      | Test Mode                          |
| 0 (active)   | 1 (133 MHz) | 0      | 1      | 133 MHz, Center Spread $\pm 0.6\%$ |
| 0 (active)   | 1 (133 MHz) | 1      | 0      | 133 MHz, Down Spread $-0.6\%$      |
| 0 (active)   | 1 (133 MHz) | 1      | 1      | 133 MHz, Down Spread $-0.6\%$      |
| 1 (inactive) | 0 (100 MHz) | 0      | 0      | 3-State to High Impedance          |
| 1 (inactive) | 0 (100 MHz) | 0      | 1      | 100 MHz, No Center Spread          |
| 1 (inactive) | 0 (100 MHz) | 1      | 0      | 100 MHz, No Down Spread            |
| 1 (inactive) | 0 (100 MHz) | 1      | 1      | 100 MHz, No Down Spread            |
| 1 (inactive) | 1 (133 MHz) | 0      | 0      | Test Mode                          |
| 1 (inactive) | 1 (133 MHz) | 0      | 1      | 133 MHz, No Center Spread          |
| 1 (inactive) | 1 (133 MHz) | 1      | 0      | 133 MHz, No Down Spread            |
| 1 (inactive) | 1 (133 MHz) | 1      | 1      | 133 MHz, No Down Spread            |

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## AC WAVEFORMS

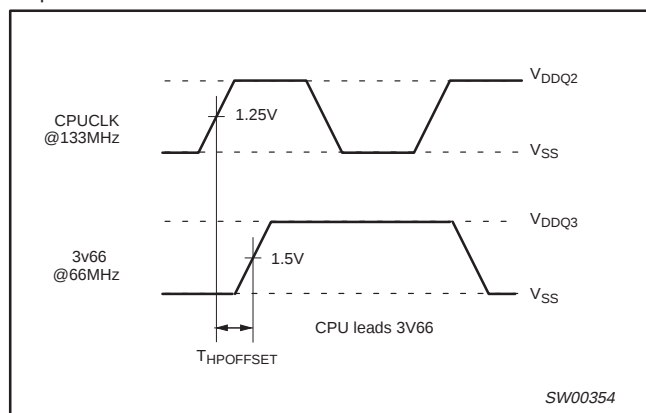
 $V_M = 1.25\text{ V @ }V_{DDQ2}\text{ and }1.5\text{ V @ }V_{DDQ3}$ 
 $V_X = V_{OL} + 0.3\text{ V}$ 
 $V_Y = V_{OH} - 0.3\text{ V}$ 
 $V_{OL}$  and  $V_{OH}$  are the typical output voltage drop that occur with the output load.


Figure 1. CPUCLK to 3V66 offset

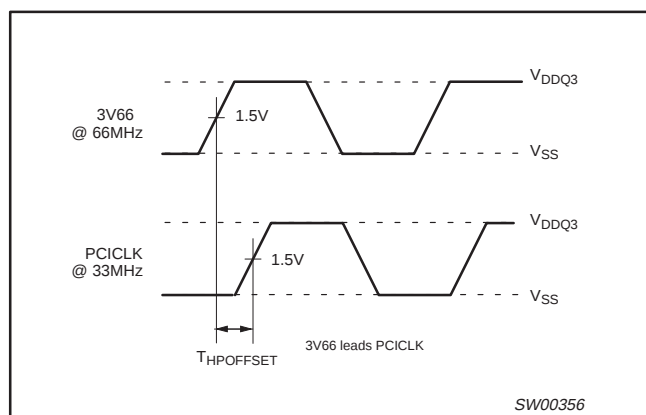


Figure 2. 3V66 to PCI offset

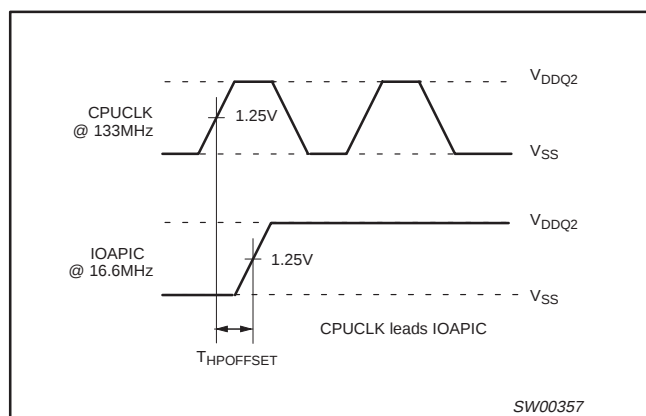


Figure 3. CPU to IOAPIC offset

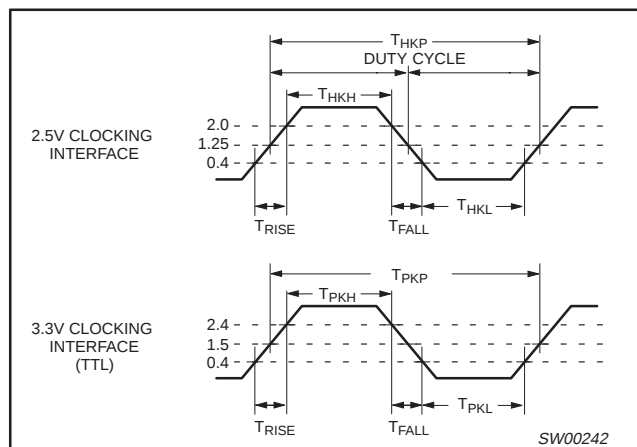


Figure 4. 2.5V/3.3V clock waveforms

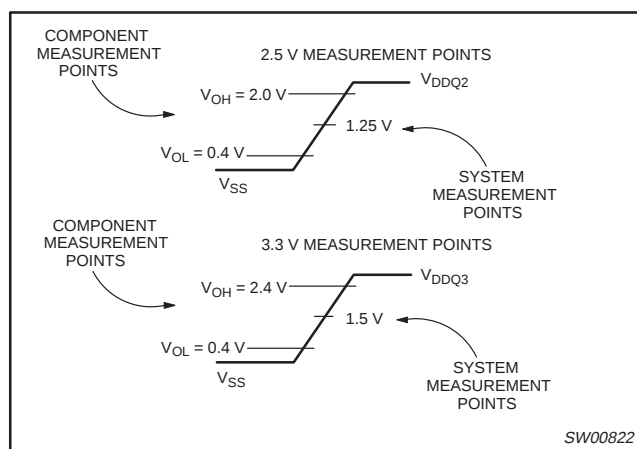


Figure 5. Component versus system measure points

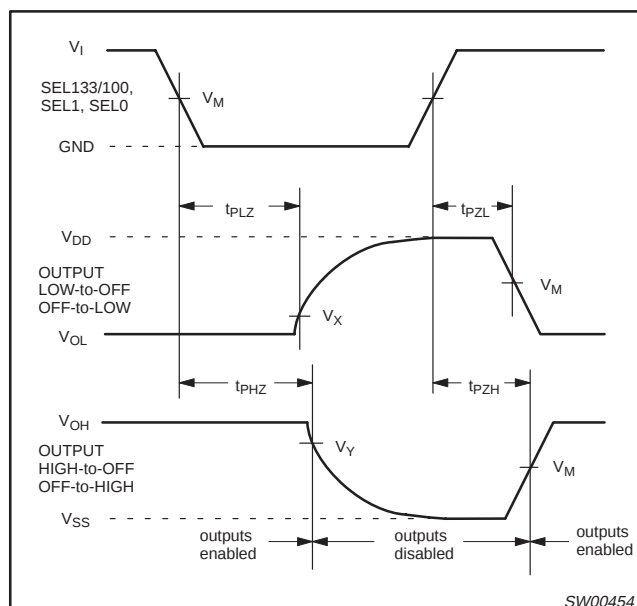


Figure 6. 3-State enable and disable times

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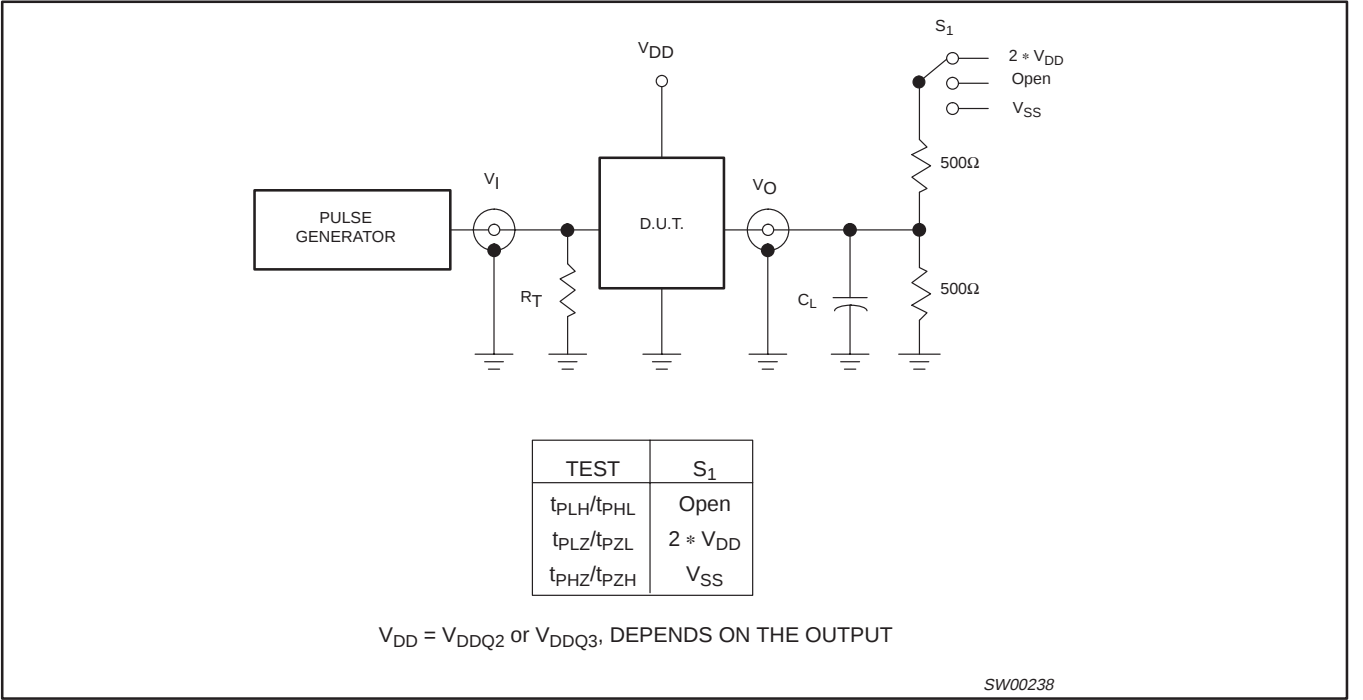


Figure 7. Load circuitry for switching times

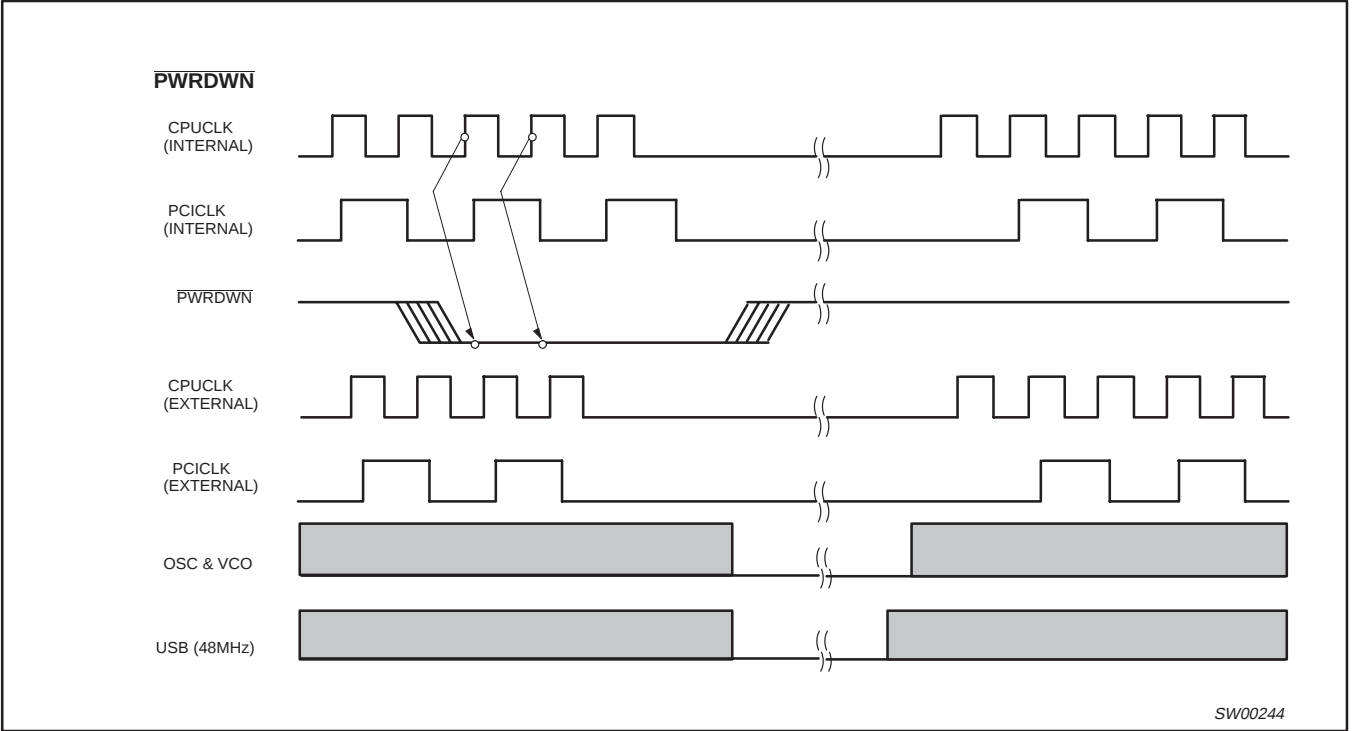


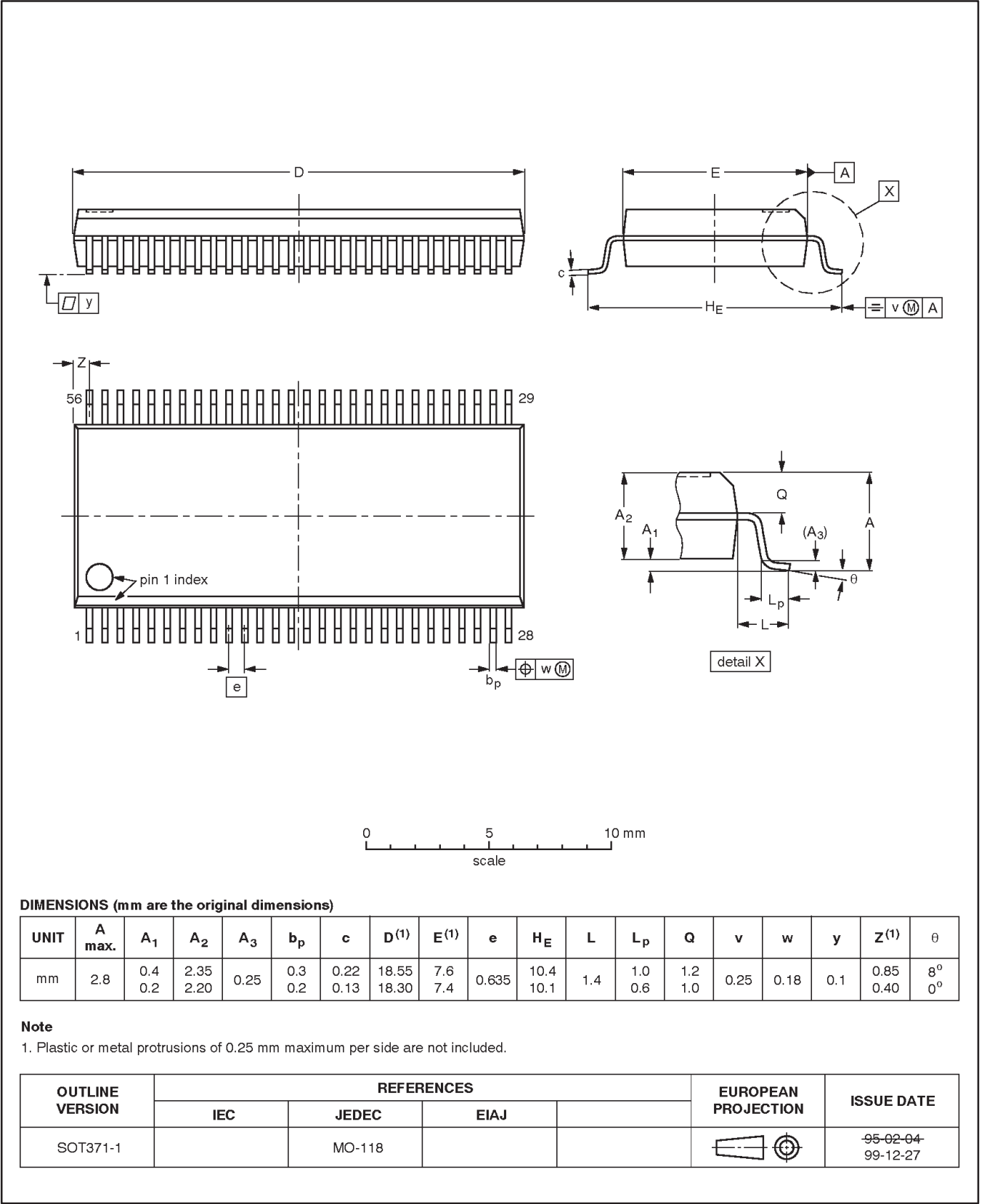
Figure 8. Power Management

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SSOP56: plastic shrink small outline package; 56 leads; body width 7.5 mm

SOT371-1



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**PCK2014A****NOTES**

# CK98 (100/133 MHz) spread spectrum system clock generator

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## Data sheet status

| Data sheet status         | Product status | Definition [1]                                                                                                                                                                                                                                             |
|---------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Objective specification   | Development    | This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.                                                                                                          |
| Preliminary specification | Qualification  | This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |
| Product specification     | Production     | This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.                                                       |

[1] Please consult the most recently issued datasheet before initiating or completing a design.

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