BURR - BROWN®

PLL1700

MULTI-CLOCK GENERATOR

FEATURES

- **27MHZ MASTER CLOCK INPUT**
- **GENERATED AUDIO SYSTEM CLOCK:**
  SCKO1: 33.8688MHz (Fixed)
  SCKO2: 256f_S
  SCKO3: 384f_S
  SCKO4: 768f_S
- **ZERO PPM ERROR OUTPUT CLOCKS**
- **LOW CLOCK JITTER: 150ps at SCKO3**
- **MULTIPLE SAMPLING FREQUENCIES:**
  f_S = 32kHz, 44.1kHz, 48kHz, 64kHz, 88.2kHz, 96kHz
- **+3.3V CMOS LOGIC INTERFACE**
- **DUAL POWER SUPPLIES: +5V and +3.3V**
- **SMALL PACKAGE: 20-Lead SSOP**

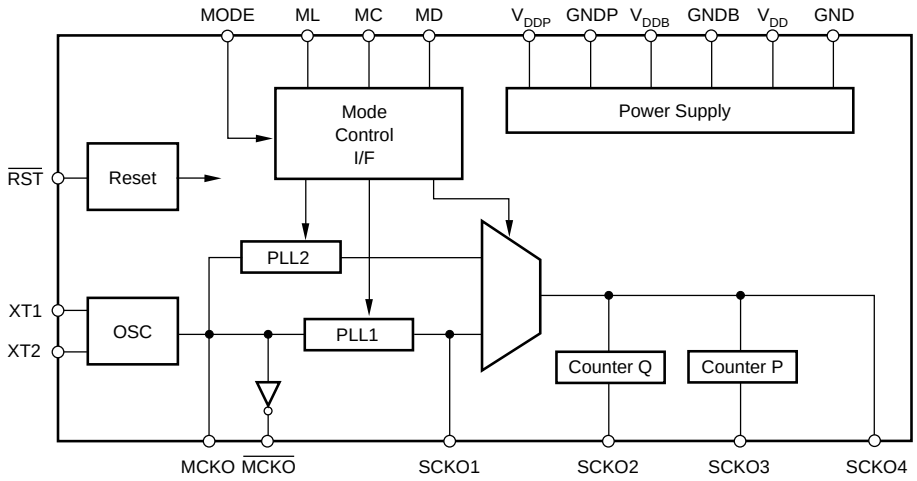
DESCRIPTION

The PLL1700 is a low cost, multi-clock generator Phase Lock Loop (PLL).

The PLL1700 can generate four systems clocks from a 27MHz reference input frequency.

The device gives customers both cost and space savings by eliminating external components and enables customers to achive the very low jitter performance needed for high performance audio digital-to-analog converters (DAC) and/or analog-to-digital converters (ADC).

The PLL1700 is ideal for MPEG-2 applications which use a 27MHz master clock such as DVD players, DVD add-on cards for multimedia PCs, digital HDTV systems, and set-top boxes.



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PDS-1455A
Printed in U.S.A. August, 1998

SPECIFICATIONS

All specifications at T_A = +25°C, V_{DD} = V_{DDP} = +5V, V_{DDB} = +3.3V, f_M = 27MHz crystal oscillation and f_S = 48kHz, unless otherwise noted.

PARAMETER	CONDITIONS	PLL1700E MIN	PLL1700E TYP	PLL1700E MAX	UNITS
DIGITAL INPUT/OUTPUT					
Input Logic Level:			TTL-Compatible		
V_{IH}		2.0			VDC
V_{IL}				0.8	VDC
Input Logic Current:					
I_{IH}(1)	V_{IN} = V_{DD}			200	µA
I_{IL}(1)	V_{IN} = 0V			–1	µA
I_{IH}(2)	V_{IN} = V_{DD}			4	mA
I_{IL}(2)	V_{IN} = 0V			–800	µA
Output Logic Level:			CMOS		
V_{OH}(3)	I_{OH} = 4mA	V_{DDB} – 0.4V			VDC
V_{OL}(3)	I_{OL} = 4mA			0.4	VDC
Sampling Frequency (f_S)	Standard f_S	32	44.1	48	kHz
	Double f_S	64	88.2	96	kHz
MASTER CLOCK (MCKO, $\overline{\text{MCKO}}$)	f_M = 27MHz, C_L = 20pF				
Master Clock Frequency		26.73	27	27.27	MHz
Clock Jitter(4)			300		ps
Clock Duty Cycle MCKO		40	50	60	%
For Crystal Oscillation $\overline{\text{MCKO}}$		40	50	60	%
Clock Duty Cycle MCKO			40		%
For External Clock $\overline{\text{MCKO}}$			60		%
PHASE LOCK LOOP (PLL)	f_M = 27MHz, C_L = 20pF				
Generated System Clock Frequency					
SCKO1	Fixed		33.8688		MHz
SCKO2	256f_S	8.192		24.576	MHz
SCKO3	384f_S	12.288		36.864	MHz
SCKO4	768f_S	24.576		36.864	MHz
Generated Clock Rise Time(3)	20% to 80% V_{DDB}		5		ns
Generated Clock Fall Time(3)	80% to 20% V_{DDB}		5		ns
Generated Clock Duty Cycle	SCKO1, SCKO3, SCKO4	40	50	60	%
	SCKO2 (standard)	40	50	60	%
	SCKO2 (double)(5)	25	33	40	%
Generated Clock Jitter(4)	SCKO1, SCKO2 (standard), SCKO4		300		ps
	SCKO3		150		ps
	SCKO2 (double)		450		ps
Settling Time	To Programmed Frequency			20	ms
Power-Up Time	To Programmed Frequency		15	30	ms
POWER SUPPLY REQUIREMENTS					
Voltage Range	V_{DD}, V_{DDP}	+4.5	+5	+5.5	VDC
	V_{DDB}	+2.7	+3.3	+3.6	VDC
Supply Current(6):					
I_{DD} + I_{DDP}	V_{DD} = V_{DDP} = 5V, f_S = 48kHz		11	16	mA
I_{DDB}	V_{DDB} = +3.3V, f_S = 48kHz		6	9	mA
Power Dissipation	f_S = 48kHz		75	110	mW
TEMPERATURE RANGE					
Operation		–25		+85	°C
Storage		–55		+125	°C

NOTES: (1) ML, MC, MD, MODE, $\overline{\text{RST}}$ (Schmitt-trigger input with internal pull-down resistor). (2) XT1, when an external 27MHz clock is used, the buffer ICs, such as 74HC04, are recommended to interface to XT1. (3) MCKO, $\overline{\text{MCKO}}$, SCKO4, SCKO3, SCKO2, and SCKO1. (4) Jitter performance is specified as standard deviation of jitter under 27MHz crystal oscillation. (5) When SCKO2 is set to double rate clock output, its duty cycle is 33%. (6) f_M = 27MHz crystal oscillation, no load on MCKO, $\overline{\text{MCKO}}$, SCKO4, SCKO3, SCKO2, and SCKO1.

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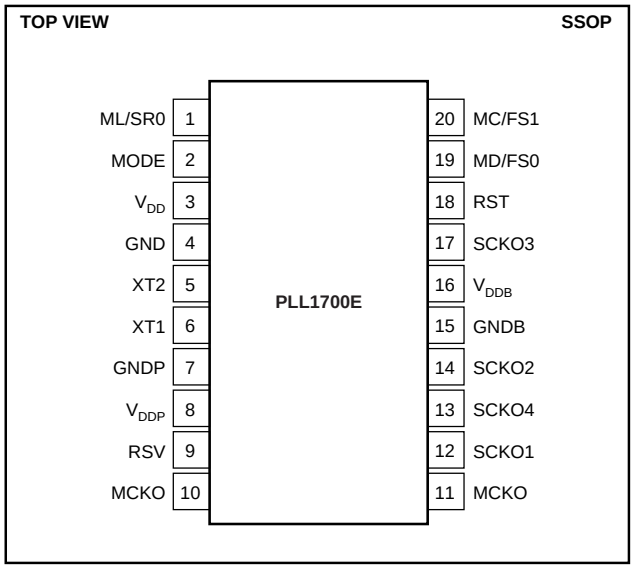
PIN CONFIGURATION



PACKAGE INFORMATION

PRODUCT	PACKAGE	TEMPERATURE RANGE	PACKAGE DRAWING NUMBER(1)
PLL1700E	20-Lead SSOP	–25°C to +85°C	334-1

NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage ($+V_{DD}$, $+V_{DDP}$, $+V_{DDB}$)	+6.5V
Supply Voltage Differences ($+V_{DD}$, $+V_{DDP}$)	±0.1V
GND Voltage Differences: GND, GNDP, GNDB	±0.1V
Digital Input Voltage	–0.3V to (V_{DD} + 0.3V)
Digital Output Voltage	–0.3V to (V_{DDB} + 0.3V)
Input Current (any pins except supply pins)	±10mA
Power Dissipation	300mW
Operating Temperature Range	–25°C to +85°C
Storage Temperature	–55°C to +125°C
Lead Temperature (soldering, 5s)	+260°C
Package Temperature (IR reflow, 10s)	+235°C

PIN ASSIGNMENTS

PIN	NAME	I/O	FUNCTION
1	ML/SR0	IN	Latch Enable for Software Mode/Sampling Rate Selection for Hardware Mode. When MODE pin is LOW, ML is selected.(1)
2	MODE	IN	Mode Control Select. When this pin is HIGH, device is operated in hardware mode using SR0 (pin 1), FS0 (pin 19), and FS1 (pin 20). When this pin is LOW, device is operated in software mode by three-wire interface using ML (pin 1), MD (pin 19) and MC (pin 20).(1)
3	V_{DD}	—	Digital Power Supply, +5V.
4	GND	—	Digital Ground.
5	XT2	—	27MHz Crystal. When an external 27MHz clock is applied to XT1 (pin 6), this pin must be connected to GND.
6	XT1	IN	27MHz Oscillator Input/External 27MHz Input.
7	GNDP	—	Ground for PLL.
8	V_{DDP}	—	Power Supply for PLL, +5V.
9	RSV	—	Reserved. Must be left open.
10	MCKO	OUT	27MHz Output.
11	MCKO	OUT	Inverted 27MHz Output.
12	SCKO1	OUT	Fixed 33.8688MHz Clock Output.
13	SCKO4	OUT	$768f_S$ Clock Output.
14	SCKO2	OUT	$256f_S$ Clock Output.
15	GNDB	—	Digital Ground for V_{DDB}.
16	V_{DDB}	—	Digital Power Supply for Clock Output Buffers, +3.3V.
17	SCKO3	OUT	$384f_S$ Output. This output has been optimized for the lowest jitter and should be connected to the audio DAC(s).
18	RST	IN	Reset. When this pin is LOW, device is held in reset.(1)
19	MD/FS0	IN	Serial Data Input for Software Mode/Sampling Frequency Selection for Hardware Mode. When MODE pin is LOW, MD is selected.(1)
20	MC/FS1	IN	Shift Clock Input for Software Mode/Sampling Frequency Selection for Hardware Mode. When MODE pin is LOW, MC is selected.(1)

NOTE: (1) Schmitt-trigger input with internal pull-down resistors.

ELECTROSTATIC DISCHARGE SENSITIVITY

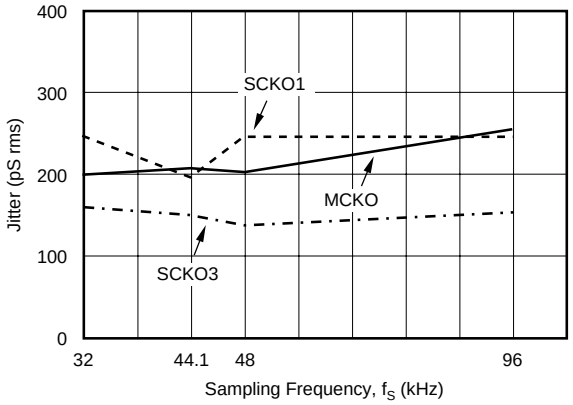
This integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

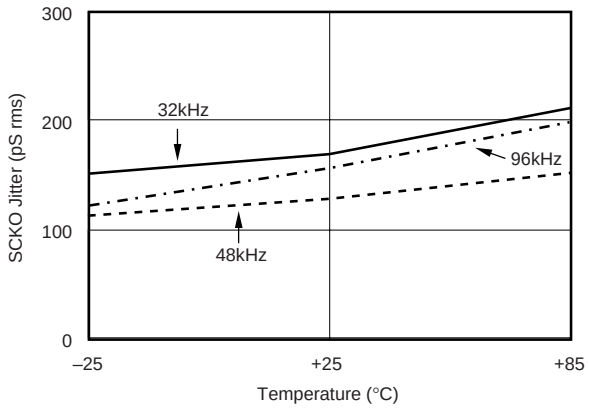
TYPICAL PERFORMANCE CURVES

At T_A = +25°C, V_{DD} = V_{DDP} = +5V, V_{DDB} = +3.3V, C_L = 20pF, unless otherwise noted.

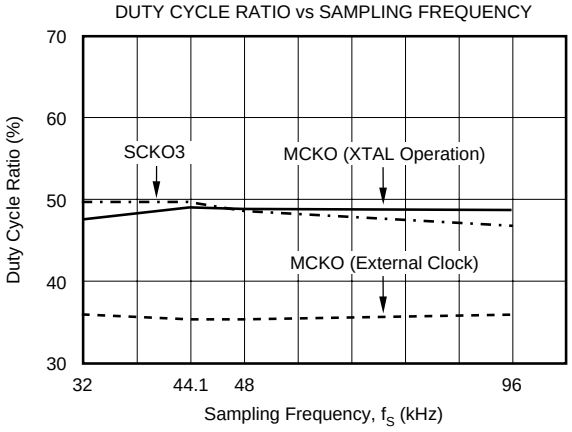
JITTER vs SAMPLING FREQUENCY



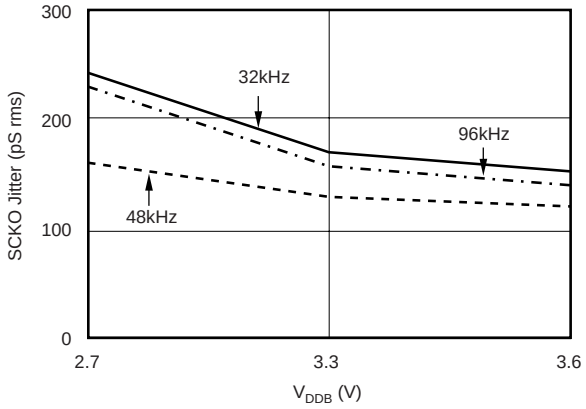
SCKO3 JITTER vs TEMPERATURE



DUTY CYCLE RATIO vs SAMPLING FREQUENCY



SCKO3 JITTER vs V_{DDB}



THEORY OF OPERATION

MASTER CLOCK AND SYSTEM CLOCK OUTPUT

The PLL1700 consists of a dual PLL clock and master clock generator which generates four system clocks and two buffered 27MHz clocks from a 27MHz master clock. Figure 1 shows the block diagram of the PLL1700. The PLL is designed to accept a 27MHz master clock or crystal oscillator. The master clock can be either a crystal oscillator placed between XT1 (pin 6) and XT2 (pin 5), or an external input to XT1. If an external master clock is used, XT2 should be connected to ground. Figure 2 illustrates possible system clock connection options, and Figure 3 illustrates the 27MHz master clock timing requirements.

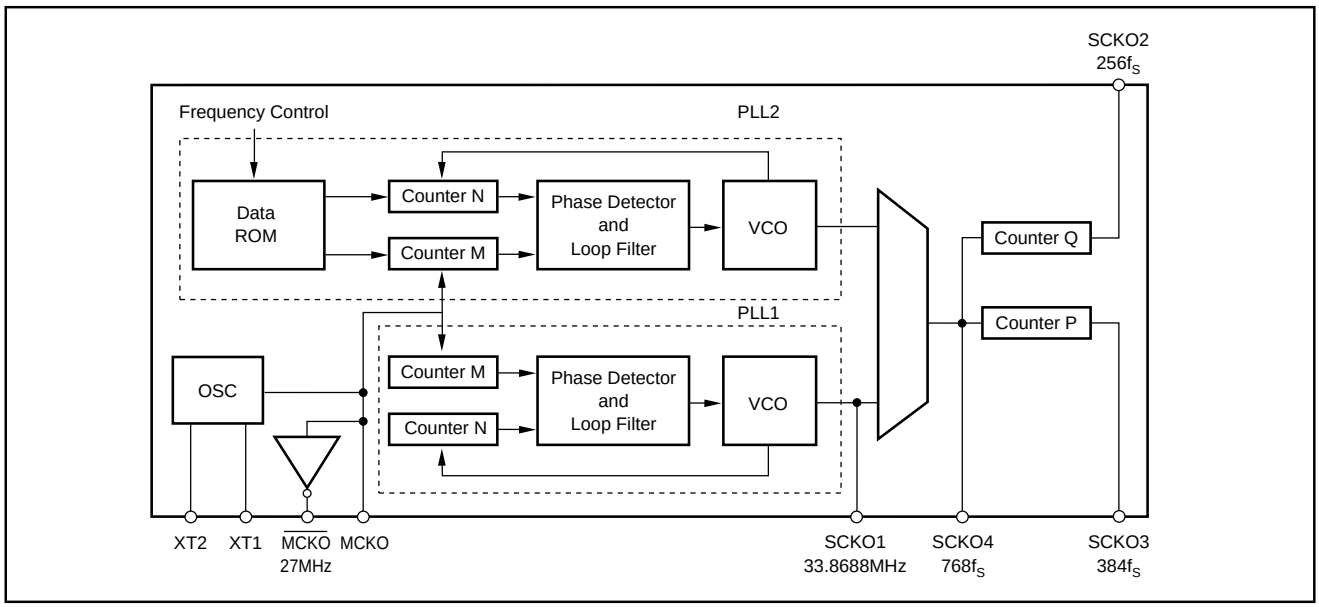


FIGURE 1. Block Diagram of PLL1700.

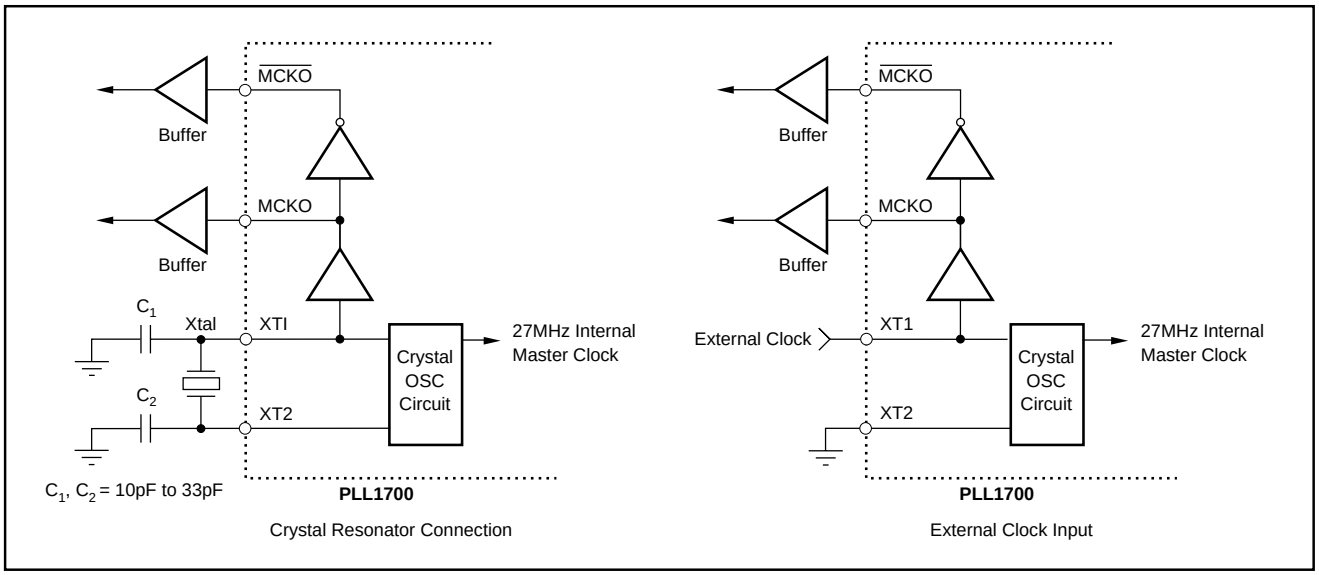
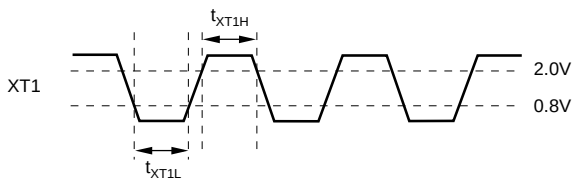


FIGURE 2. Master Clock Generator Connection Diagram.



DESCRIPTION	SYMBOL	MIN	TYP	MAX	UNITS
System Clock Pulse Width HIGH	t_{XT1H}	15			ns
System Clock Pulse Width LOW	t_{XT1L}	15			ns

FIGURE 3. External Master Clock Timing Requirement.

The PLL1700 provides a very low jitter, high accuracy clock. SCKO1 is a fixed frequency clock which is 33.8688MHz (768 x 44.1kHz) for a CD-DA DSP. The output frequency of the remaining clocks is determined by the sampling frequency (f_S) by software or hardware control. SCKO2 and SCKO3 output $256f_S$ and $384f_S$ systems clocks, respectively. SCKO4 output is $768f_S$ if the sampling frequency is 32kHz, 44.1kHz, 48kHz, or the output is $384f_S$ if the sampling frequency is 64kHz, 88.2kHz, or 96kHz. Table I shows each sampling frequency. The system clock output frequencies are generated by a 27MHz master clock and programmed sampling frequencies are shown in Table II.

SAMPLING RATE	SAMPLING FREQUENCY (kHz)		
Standard Sampling Frequencies	32	44.1	48
Double of Standard Sampling Frequencies	64	88.2	96

TABLE I. Sampling Frequencies.

SAMPLING FREQUENCY (kHz)	SAMPLING RATE	SKCO2 (MHz)	SCKO3 (MHz)	SCKO4 (MHz)
32	Standard	8.192	12.288	24.576
44.1	Standard	11.2896	16.9344	33.8688
48	Standard	12.288	18.4320	36.8640
64	Double	16.384	24.576	24.576
88.2	Double	22.5792	33.8688	33.8688
96	Double	24.576	36.8640	36.8640

TABLE II. Sampling Frequencies and Master Clock Output Frequencies.

Response time from power-on (or applying the clock to XT1) to SCKO settling time is typically 15ms. Delay time from sampling frequency change to SCKO settling time is 20ms maximum. Figure 4 illustrates SCKO transient timing. External buffers are recommended on all output clocks in order to avoid degrading the jitter performance of the PLL1700.

RESET

The PLL1700 has an internal power-on reset circuit, as well as an external forced reset (RST, pin 18). Both resets have the same effect on the PLL1700's functions. The mode register's default settings for software mode are initialized by reset. Throughout the reset period, all clock outputs are enabled with the default settings. Initialization for the internal power-on reset is done automatically during 1024 master clocks at $V_{DD} \geq 2.2V$ (1.8V to 2.6V). When using the internal power-on reset, RST should be HIGH. Power-on reset timing is shown in Figure 5. RST (pin 18) accepts an external forced reset by RST = L. Initialization (reset) is done when RST = L and 1024 master clocks after RST = H. External reset timing is shown in Figures 6 and 7.

FUNCTION CONTROL

The built-in function of the PLL1700 can be controlled in the software mode (serial mode), which uses a three-wire interface by ML (pin 1), MC (pin 20), and MD (pin 19), when MODE (pin 2) = L. They can also be controlled in the hardware mode (parallel mode) which uses SR0 (pin 1), FS1 (pin 20) and FS0 (pin 19), when MODE (pin 2) = H. The selectable functions are shown in Table III.

FUNCTION	HARDWARE MODE (MODE = H)	SOFTWARE MODE (MODE = L)
Sampling Frequency Select (32kHz, 44.1kHz, 48kHz)	Yes	Yes
Sampling Rate Select (Standard/Double)	Yes	Yes
Each Clock Output Enable/Disable	No	Yes

TABLE III. Selectable Functions.

HARDWARE MODE (MODE = H)

In the hardware mode, the following functions can be selected:

Sampling Group Select

The sampling frequency group can be selected by FS1 (pin 20) and FS0 (pin 19).

FS1 (Pin 20)	FS0 (Pin 19)	SAMPLING GROUP
L	L	48kHz
L	H	44.1kHz
H	L	32kHz
H	H	Reserved

Sampling Rate Select

The sampling rate can be selected by SR0 (pin 1)

SR0 (Pin 1)	SAMPLING RATE SELECT
L	Standard
H	Double

SOFTWARE MODE (MODE = L)

The PLL1700's special function in software mode is shown in Table IV. These functions are controlled using ML, MC, and MD serial control signal.

FUNCTION	DEFAULT
Sampling Frequency Select (32kHz, 44.1kHz, 48kHz)	48kHz Group
Sampling Rate Select (Standard/Double)	Standard
Each Clock Output Enable/Disable	Enable

TABLE IV. Selectable Functions.

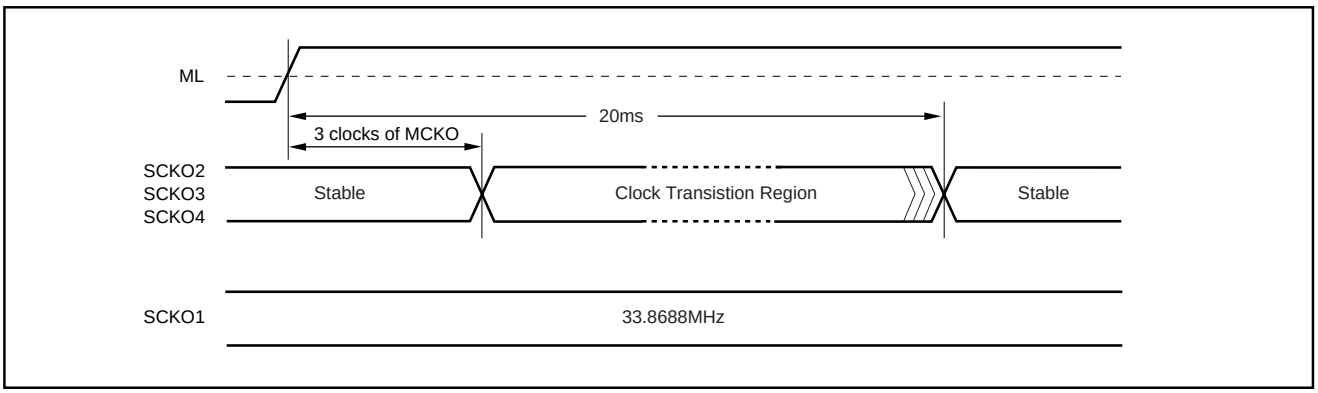


FIGURE 4. System Clock Transient Timing Chart.

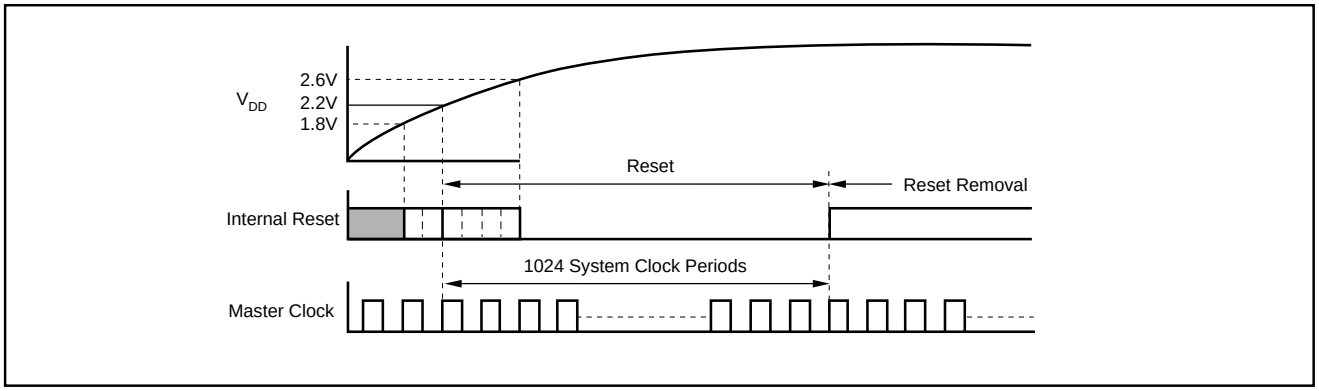


FIGURE 5. Power-On Reset Timing.

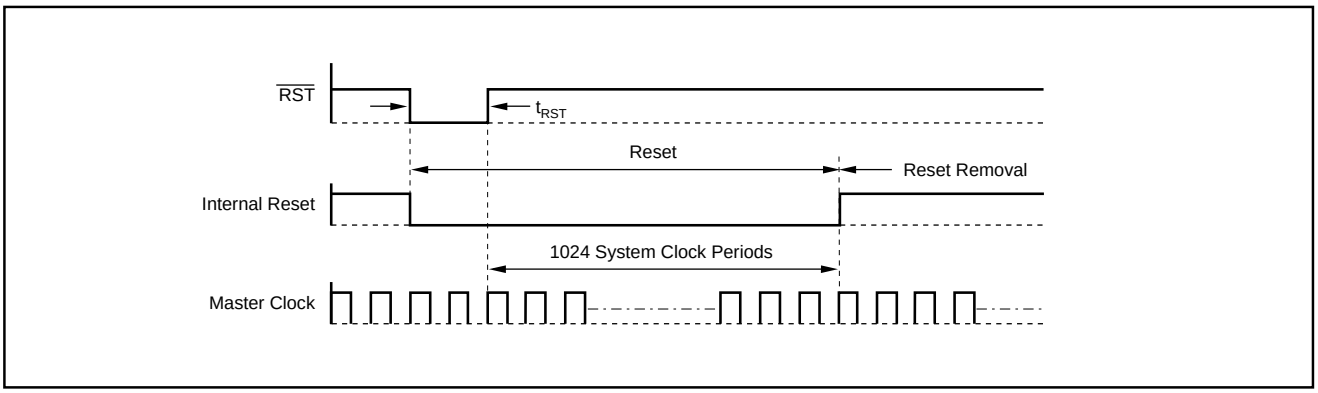


FIGURE 6. External Reset Timing.

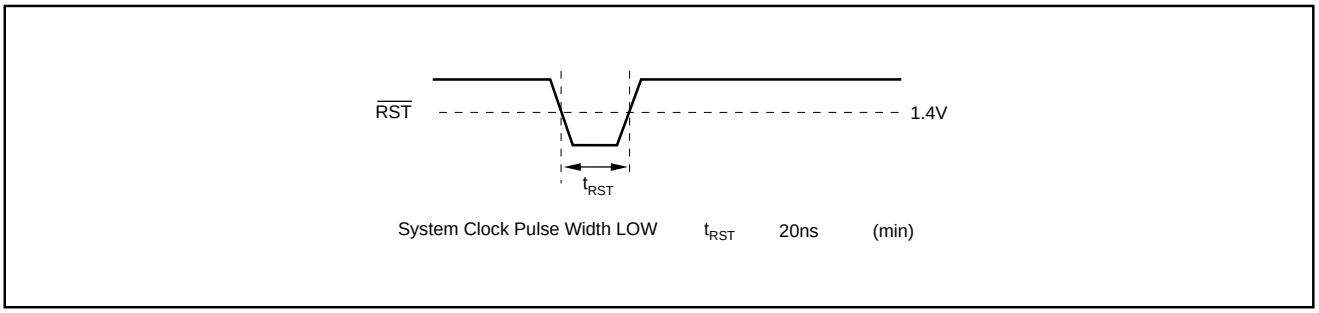


FIGURE 7. Reset Pulse Timing Requirement.

PROGRAM REGISTER BIT-MAPPING

The built-in functions of the PLL1700 are controlled through a 16-bit program register. This register is loaded using MD. After the 16 data bits are clocked in using the rising edge of MC, ML is used to latch the data into the register. Table V shows the bit-mapping of the registers. The software mode control format and control data input timing is shown in Figures 8 and 9, respectively.

Mode Register

D15	D14	D13	D12	D11	D0	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
0	1	1	1	0	0	CE6	CE5	CE4	CE3	CE2	CE1	SR1	SR0	FS1	FS0

REGISTER	BIT NAME	DESCRIPTION
MODE	CE6	$\overline{\text{MCKO}}$ Output Enable/Disable
	CE5	MCKO Output Enable/Disable
	CE4	SCKO4 Output Enable/Disable
	CE3	SCKO3 OUtput Enable/Disable
	CE2	SCKO2 Output Enable/Disable
	CE1	SCKO1 Output Enable/Disable
	SR [1:0]	Sampling Rate Select
	FS [1:0]	Sampling Frequency Select

TABLE V. Register Mapping.

Mode Register

FS [1:0]: Sampling Frequency Group Select

FS1	FS0	SAMPLING FREQUENCY	DEFAULT
0	0	48kHz	O
0	1	44.1kHz	
1	0	32kHz	
1	1	Reserved	

SR [1:0]: Sample Rate Select

SR1	SR0	SAMPLING RATE	DEFAULT
0	0	Standard	O
0	1	Double	
1	0	Reserved	
1	1	Reserved	

CE [1:6]: Clock Output Control

CE1 - CE6	CLOCK OUTPUT CONTROL	DEFAULT
0	Clock Output Disable	
1	Clock Output Enable	O

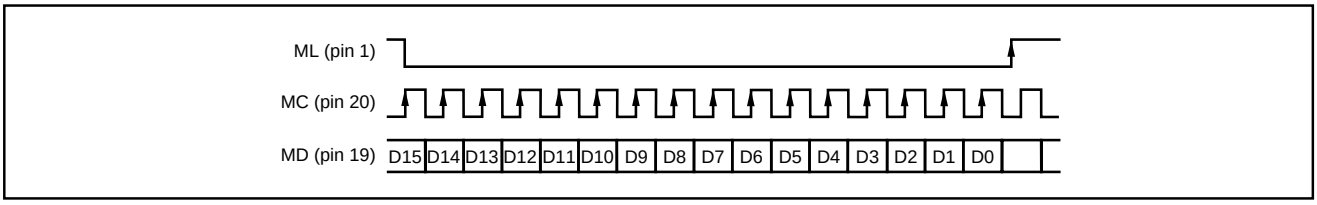
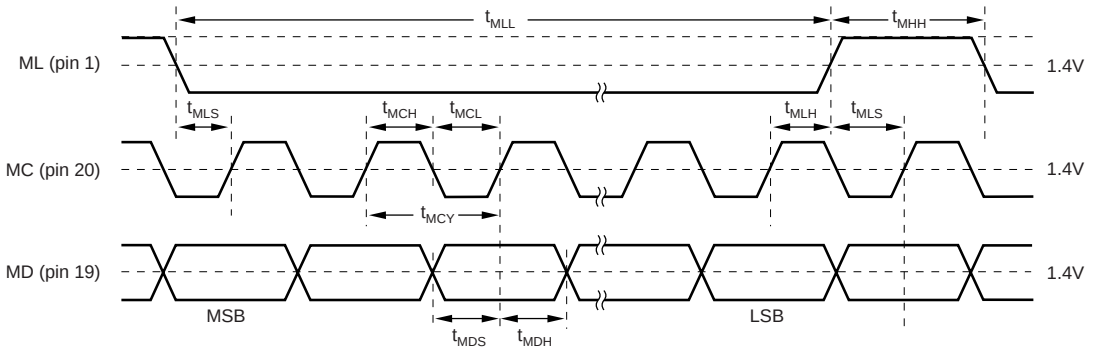


FIGURE 8. Software Mode Control Format.



DESCRIPTION	SYMBOL	MIN	TYP	MAX	UNITS
MC Pulse Cycle Time	t_{MCY}	100			ns
MC Pulse Width LOW	t_{MCL}	40			ns
MC Pulse Width HIGH	t_{MCH}	40			ns
MD Hold Time	t_{MDH}	40			ns
MD Set-Up Time	t_{MDS}	40			ns
ML Low Level Time	t_{MLL}	16			MC Clocks(1)
ML High Level Time	t_{MHH}	200			ns
ML Hold Time(2)	t_{MLH}	40			ns
ML Set-Up Time(3)	t_{MLS}	40			ns

NOTES: (1) MC clocks: MC clock period. (2) MC rising edge for LSB to ML rising edge. (3) ML rising edge to the next MC rising edge. If the MC Clock is stopped after the LSB, any ML rising time is accepted.

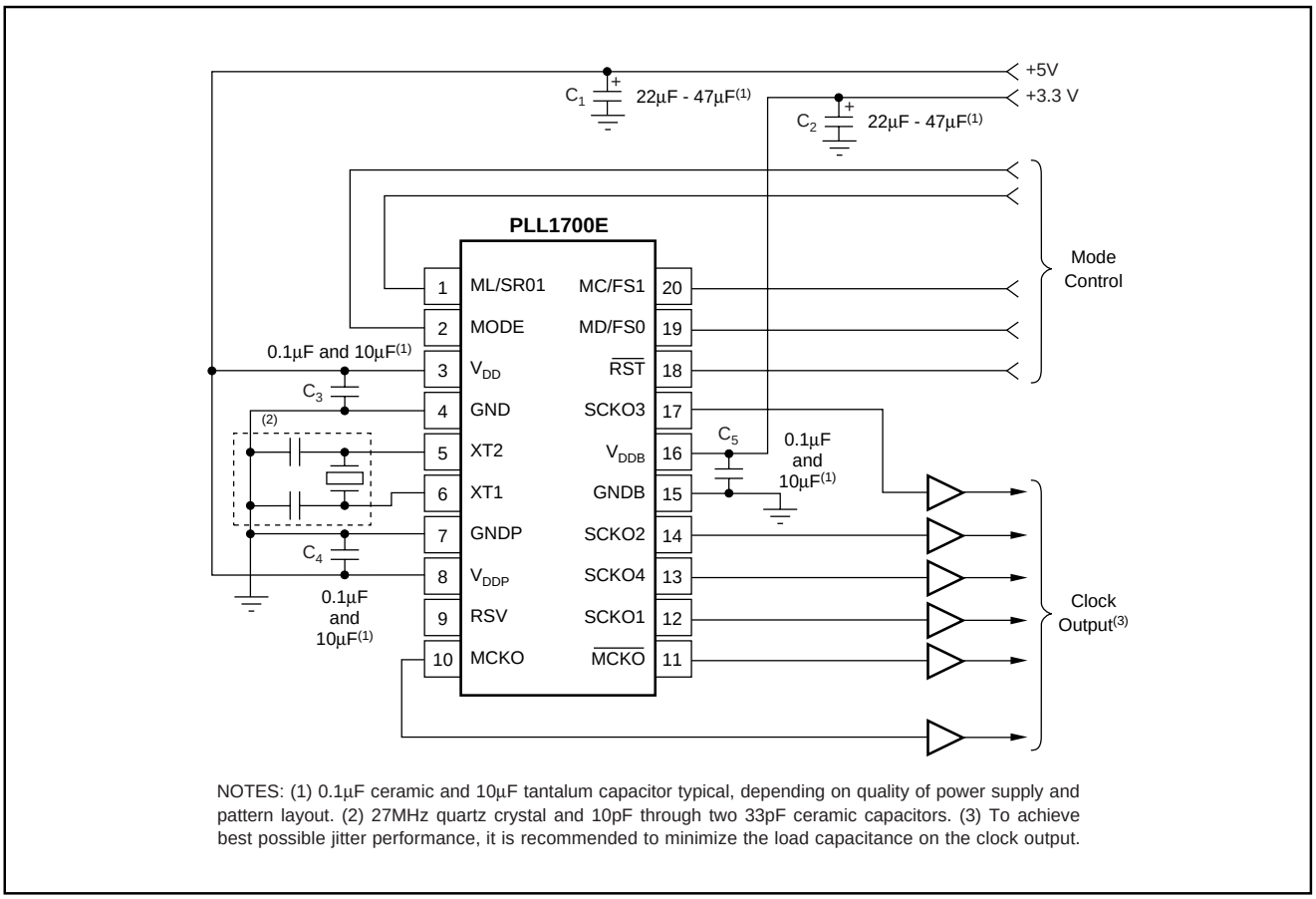
FIGURE 9. Control Data Input Timing.

CONNECTION DIAGRAM

Figure 10 shows the typical connection circuit for the PLL1700. There are three grounds for digital, analog and PLL power supply. However, the use of one common ground connection is recommended to avoid latch-up problems. Power supplies should be bypassed as close as possible to the device.

MPEG-2 APPLICATIONS

Typical applications for the PLL1700 are MPEG-2 based systems such as DVD players, DVD add-on cards for multimedia PCs, digital HDTV systems, and step-top boxes. The PLL1700 provides audio system clocks for a CD-DA DSP, DVD DSP, Karaoke DSP, and DAC(s) from a 27MHz video clock.



NOTES: (1) 0.1µF ceramic and 10µF tantalum capacitor typical, depending on quality of power supply and pattern layout. (2) 27MHz quartz crystal and 10pF through two 33pF ceramic capacitors. (3) To achieve best possible jitter performance, it is recommended to minimize the load capacitance on the clock output.

FIGURE 10. Typical Connection Diagram.

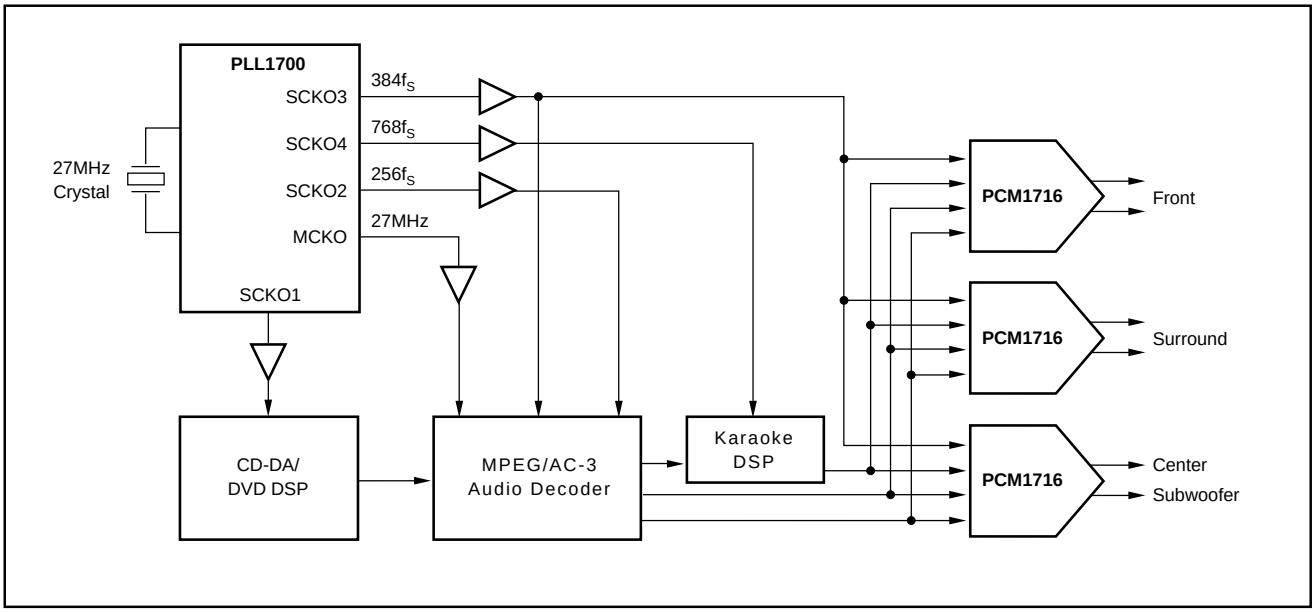


FIGURE 11. PLL1700 System Application Block Diagram.