

### PLL Clock Multiplier

#### Features

- Low cost frequency multiplier
- Zero ppm multiplication error
- Input crystal frequency of 5 - 30 MHz
- Input clock frequency of 4 - 50 MHz
- Output clock frequencies up to 180 MHz
- Period jitter 50ps (100~180MHz)
- Duty cycle of 45/55% up to 160MHz
- Operating voltages of 3.0 to 5.5V
- Tri-state output for board level testing
- Die form, Wafer form

#### Applications

- Used for crystal oscillator

#### Description

The PT7C4502 is a high performance frequency multiplier, which integrates Analog Phase Lock Loop techniques.

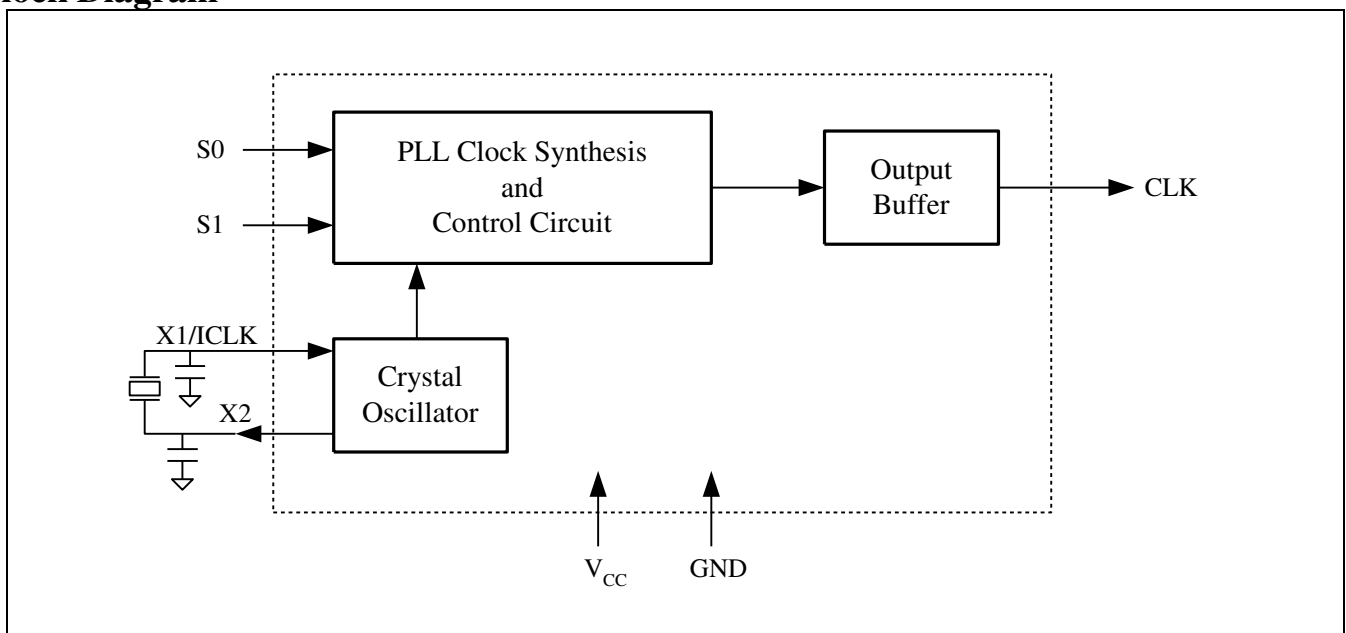
The PT7C4502 is the most cost effective way to generate a high quality, high frequency clock output from a lower frequency crystal or clock input. It is designed to replace crystal oscillators in most electronic systems, clock multiplier and frequency translation.

Using Phase-Locked-Loop (PLL) techniques, the device uses a standard fundamental mode, inexpensive crystal to produce output clocks up to 180 MHz.

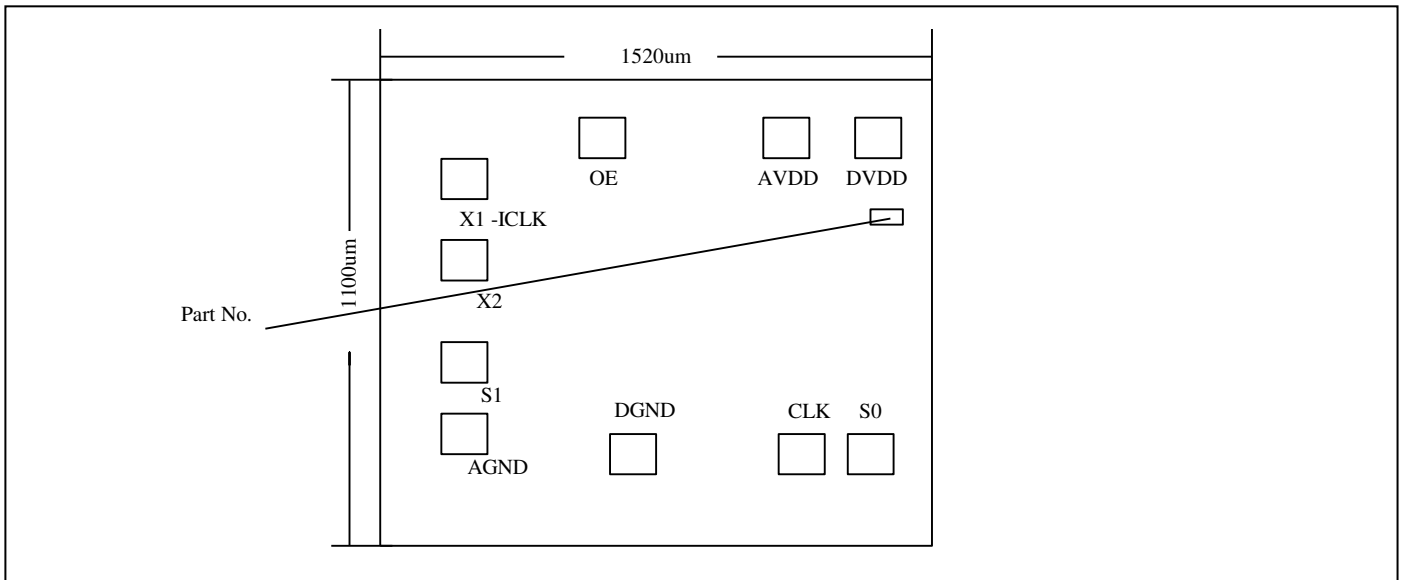
The complex Logic divider is the ability to generate nine different popular multiplication factors, allowing one chip to output many common frequencies.

The device also has an Output Enable pin that tri-states the clock output when the OE pin is taken low. This product is intended for clock generation and frequency translation with low output jitter (variation in the output period)

#### Block Diagram



### Pin/Pad Configuration



### Pin/Pad Description

Pin Name	Pad Name	Type	Description
X1/ICLK	X1-ICLK	I	Crystal connection or clock input.
	X2	O	Crystal connection. Leave unconnected for clock input.
	S0	I	Multiplier select pin 0. Connect to Vcc or float.
	S1	I	Multiplier select pin 1. Connect to GND or float. Internal pull-up.
	OE	I	Output Enable. Tri-states CLK output when low.
	CLK	O	Clock output.
VCC	AVDD	P	Analog Power.
	DVDD	P	Digital power.
GND	AGND	P	Analog Ground
	DGND	P	Digital ground.

Pad Coordinate File					
Pad Name	X Coordinate	Y Coordinate	Pad Name	X Coordinate	Y Coordinate
X1-ICLK	120.90	892.90	CLK	1098.90	118.60
X2	120.90	641.50	S0	1322.10	118.60
S1	117.70	401.10	DVDD	1303.50	973.30
AGND	111.50	225.80	AVDD	1063.10	973.30
DGND	698.40	118.60	OE	470.70	981.70

**Note:** Substrate is connected to GND.  
**Die Size:** 1670µm\*1180µm (Including scribe line size 150µm\*80µm.)  
**Die Thickness:** PT7C4502DE: 350±25µm without coating; PT7C4502-2WF: 220±20µm with coating  
**Pad Size:** 75µm\*75µm

S1	S0	CLK
0	M <sup>Note 2</sup>	×2 <sup>Note 1</sup>
0	1	×3
1 <sup>Note 3</sup>	M <sup>Note 2</sup>	×4 (default)
1 <sup>Note 3</sup>	1	×5

Note 1: CLK output frequency=ICLK×2;  
 2. M=Leave unconnected (self-biases to Vcc/2);  
 3. Internal pull-up on S1, unconnected = 1

## External Components

### Decoupling Capacitor

As with any high-performance mixed-signal IC, the PT7C4502 must be isolated from system power supply noise to perform optimally. A decoupling capacitor of 0.01 $\mu$ F or 0.1 $\mu$ F must be connected between VCC and the GND. It must be connected close to the PT7C4502 to minimize lead inductance. No external power supply filtering is required for the PT7C4502.

### Series Termination Resistor

A 33 $\Omega$  terminating resistor can be used next to the CLK pin for trace lengths over one inch.

### Crystal Load Capacitors

There is no on-chip capacitance build-in chip. A parallel resonant, fundamental mode crystal should be used. The device crystal connections should include

pads for small capacitors from X1 to ground and from X2 to ground. These capacitors are used to adjust the stray capacitance of the board to match the nominally required crystal load capacitance. Because load capacitance can only be increased in this trimming process, it is important to keep stray capacitance to a minimum by using very short PCB traces (and no vias) between the crystal and device. Crystal capacitors, if needed, must be connected from each of the pins X1 and X2 to ground. The value (in pF) of these crystal caps should equal  $C_L * 2$ . In this equation,  $C_L$  = crystal load capacitance in pF. Example: For a crystal with a 15 pF load capacitance, each crystal capacitor would be 30pF.

## Maximum Ratings

Storage Temperature .....	-65°C to +150°C
Supply Voltage to Ground Potential ( $V_{CC}$ ) .....	-0.3V to +7.0V
Inputs (Reference to GND) .....	-0.5V to $V_{CC} + 0.5V$
Clock Output (Reference to GND) .....	-0.5V to $V_{CC} + 0.5V$
Soldering Temperature (Max of 10 seconds) .....	260°C

### Note:

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## Recommended operation conditions

Symbol	Description	Min	Type	Max	Unit
$T_A$	Operation Temperature	-40	-	+85	°C
$V_{DD}$	Supply voltage	3.0	-	5.5	V

### DC Electrical Characteristics

( $V_{CC} = 3.3V \pm 0.3V$ ,  $T_A = -40 \sim 85^\circ C$ , unless otherwise noted)

Sym.	Parameter	Test Condition	Pin	Min.	Typ.	Max.	Unit
V <sub>CC</sub>	Supply Voltage	-	V <sub>CC</sub>	3	3.3	3.6	V
I <sub>CC</sub>	Supply Current	no load, 20MHz crystal, OE = V <sub>CC</sub>	V <sub>CC</sub>	-	12	20	mA
V <sub>IH</sub>	Input Logic High	-	ICLK, OE	2	-	-	V
V <sub>IL</sub>	Input Logic Low	-	ICLK, OE	-	-	0.8	V
V <sub>IH</sub>	Input Logic High	-	S0, S1	V <sub>CC</sub> -0.5	-	-	V
V <sub>IM</sub>	Input mid-level	-	S0, S1	-	V <sub>CC</sub> /2	-	V
V <sub>IL</sub>	Input Logic Low	-	S0, S1	-	-	0.5	V
V <sub>OH</sub>	High-level output voltage	I <sub>OH</sub> = -12mA	CLK	2.4	-	-	V
V <sub>OL</sub>	Low-level output voltage	I <sub>OL</sub> = 12mA	CLK	-	-	0.4	V
I <sub>S</sub>	Short Circuit Current	-	CLK	-	±30	-	mA
I <sub>I</sub>	Input Leakage Current	-	OE	-	-	1	μA
		-	S1	-	-7.5	-20	μA

( $V_{CC} = 5.0V \pm 0.5V$ ,  $T_A = -40 \sim 85^\circ C$ , unless otherwise noted)

Sym.	Parameter	Test Condition	Pin	Min.	Typ.	Max.	Unit
V <sub>CC</sub>	Supply Voltage	-	V <sub>CC</sub>	4.5	5.0	5.5	V
I <sub>CC</sub>	Supply Current	no load, 20MHz crystal, OE = V <sub>CC</sub>	V <sub>CC</sub>	-	20	30	mA
V <sub>IH</sub>	Input Logic High	-	ICLK, OE	0.65V <sub>CC</sub>	-	-	V
V <sub>IL</sub>	Input Logic Low	-	ICLK, OE	-	-	0.8	V
V <sub>IH</sub>	Input Logic High	-	S0, S1	V <sub>CC</sub> -0.4	-	-	V
V <sub>IM</sub>	Input mid-level	-	S0, S1	-	V <sub>CC</sub> /2	-	V
V <sub>IL</sub>	Input Logic Low	-	S0, S1	-	-	0.4	V
V <sub>OH</sub>	High-level output voltage	I <sub>OH</sub> = -12mA	CLK	V <sub>CC</sub> -0.5	-	-	V
V <sub>OL</sub>	Low-level output voltage	I <sub>OL</sub> = 12mA	CLK	-	-	0.4	V
I <sub>S</sub>	Short Circuit Current	-	CLK	-	±70	-	mA
I <sub>I</sub>	Input Leakage Current	-	OE	-	-	1	μA
		-	S1	-	-7.5	-20	μA

### AC Electrical Characteristics

( $V_{CC} = 3.3V \pm 0.3V$ ,  $T_A = -40 \sim 85^\circ C$ , unless otherwise noted)

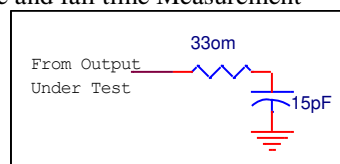
Sym.	Parameter	Test Condition	Pin	Min.	Typ.	Max.	Unit
$f_{IN}$	Input Frequency	Crystal	ICLK	5	-	30	MHz
$f_{OUT}$	Output frequency	$V_{CC}: 3.0$ to $3.6V$	CLK	20	-	180	MHz
$t_r$	Output clock rise time	$0.8$ to $2.0V$ , $15pF$ load	CLK	-	1	-	ns
$t_f$	Output clock fall time	$2.0$ to $0.8V$ , $15pF$ load	CLK	-	1	-	ns
Duty	Output clock duty cycle	At $V_{CC}/2$ , below $160MHz$	CLK	45	50	55	%
		At $V_{CC}/2$ , $160MHz$ to $180MHz$	CLK	40	-	60	%
	PLL bandwidth	-	-	10	-	-	kHz
	Output enable time	OE high to output on	-	-	-	50	ns
	Output disable time	OE low to tri-state	-	-	-	50	ns
	Period Jitter	$100MHz \sim 180MHz$	CLK	-	50	100	ps

( $V_{CC} = 5.0V \pm 0.5V$ ,  $T_A = -40 \sim 85^\circ C$ , unless otherwise noted)

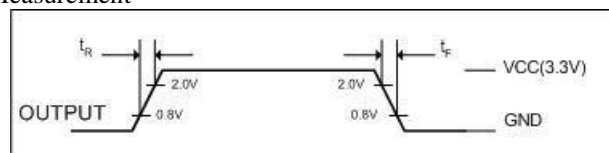
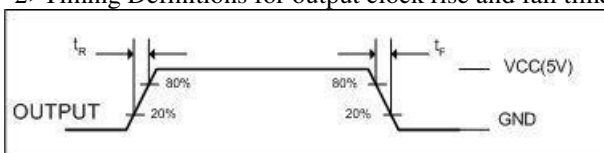
Sym.	Parameter	Test Condition	Pin	Min.	Typ.	Max.	Unit
$f_{IN}$	Input Frequency	Crystal	ICLK	5	-	30	MHz
$f_{OUT}$	Output frequency	$V_{CC}: 4.5$ to $5.5V$	CLK	20	-	180	MHz
$t_r$	Output clock rise time	$20\%V_{CC}$ to $80\%V_{CC}$ , $15pF$ load	CLK	-	1.2	-	ns
$t_f$	Output clock fall time	$20\%V_{CC}$ to $80\%V_{CC}$ , $15pF$ load	CLK	-	1.2	-	ns
Duty	Output clock duty cycle	At $V_{CC}/2$ , below $160MHz$	CLK	45	50	55	%
		At $V_{CC}/2$ , $160MHz$ to $180MHz$	CLK	40	-	60	%
	PLL bandwidth	-	-	10	-	-	kHz
	Output enable time	OE high to output on	-	-	-	50	ns
	Output disable time	OE low to tri-state	-	-	-	50	ns
	Period Jitter	$100MHz \sim 180MHz$	CLK	-	50	100	ps

#### Test circuits

1>Load circuit for output clock duty cycle, rise and fall time Measurement



2>Timing Definitions for output clock rise and fall time Measurement



**Ordering Information**

<b>Part Number</b>	<b>Package Code</b>	<b>Package</b>
PT7C4502DE	DE	350±25µm without coating Die form
PT7C4502-2WF	WF	220±20µm with coating Wafer form

**Note:**

- E = Pb-free and Green
- “-2” shows die thickness is 220±20µm with coating; PT7C4502DE die thickness is 350±25µm with coating.
- Adding X Suffix= Tape/Reel

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