

## QUADRATURE CLOCK CONVERTER

April 2009

### FEATURES:

- x1 and x4 mode selection
- Up to 16MHz output clock frequency
- Programmable output clock pulse width
- On-chip filtering of inputs for optical or magnetic encoder applications.
- TTL and CMOS compatible I/Os
- +3V to +12V operation ( $V_{DD} - V_{SS}$ )
- **LS7083N, LS7084N** (DIP);
- **LS7083N-S, LS7084N-S** (SOIC) - See Figure 1

### Applications:

- Interface incremental encoders to Up / Down Counters (See Figure 6A and Figure 6B)
- Interface rotary encoders to Digital Potentiometers (See Figure 7)

### DESCRIPTION:

The **LS7083N** and **LS7084N** are CMOS quadrature clock converters. Quadrature clocks derived from optical or magnetic encoders, when applied to the A and B inputs of the **LS7083N** or **LS7084N**, are converted to strings of Up Clocks and Down Clocks (**LS7083N**) or to a Clock and an Up/Down direction control (**LS7084N**). These outputs can be interfaced directly with standard Up/Down counters for direction and position sensing of the encoder.

### INPUT/OUTPUT DESCRIPTION:

#### RBIAS (Pin 1)

Input for external component connection. A resistor connected between this input and  $V_{SS}$  adjusts the output clock pulse width (Tow). For proper operation, the output clock pulse width must be less than or equal to the A, B pulse separation ( $TOW \leq T_{PS}$ ).

#### $V_{DD}$ (Pin 2)

Supply Voltage positive terminal.

#### $V_{SS}$ (Pin 3)

Supply Voltage negative terminal.

#### A (Pin 4)

Quadrature Clock Input A. This input has a filter circuit to validate input logic level and eliminate encoder dither.

#### B (Pin 5)

Quadrature Clock Input B. This input has a filter circuit identical to input A.

#### Mode (Pin 6)

Mode is a 3-state input to select resolutions x1, x2 or x4. The selected resolution multiplies the input quadrature clock rate by 1, 2 and 4, respectively, in producing the outputs  $\overline{UPCK}$  /  $\overline{DNCK}$  and CLK (see Figure 2).

The Mode input logic levels selects resolutions as follows:

**Logic 0 = x1    Float = x2    Logic 1 = x4**

### PIN ASSIGNMENT - TOP VIEW

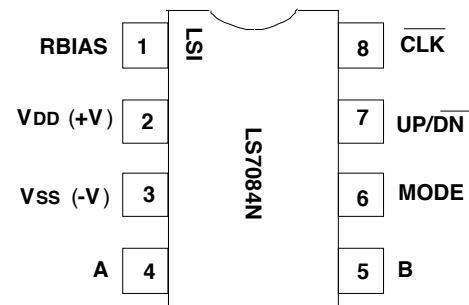
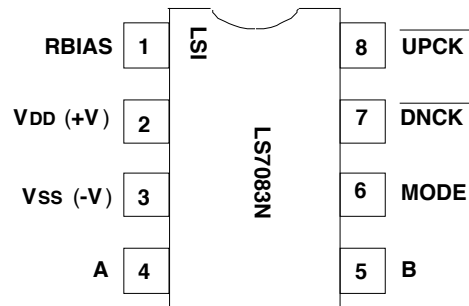


FIGURE 1

#### LS7083N - $\overline{DNCK}$ (Pin 7)

In **LS7083N**, this is the DOWN Clock Output. This output consists of low-going pulses generated when A input lags the B input.

#### LS7084N - $\overline{UP/DN}$ (Pin 7)

In **LS7084N**, this is the count direction indication output. When A input leads the B input, the  $\overline{UP/DN}$  output goes high indicating that the count direction is UP. When A input lags the B input,  $\overline{UP/DN}$  output goes low, indicating that the count direction is DOWN.

#### LS7083N - $\overline{UPCK}$ (Pin 8)

In **LS7083N**, this is the UP Clock output. This output consists of low-going pulses generated when A input leads the B input.

#### LS7084N - CLK (Pin 8)

In **LS7084N**, this is the combined UP Clock and DOWN Clock output. The count direction at any instant is indicated by the  $\overline{UP/DN}$  output (Pin 7).

**NOTE:** For the **LS7084N**, the timing of  $\overline{CLK}$  and  $\overline{UP/DN}$  requires that the counter interfacing with **LS7084N** counts on the rising edge of the CLK pulses.

**ABSOLUTE MAXIMUM RATINGS:**

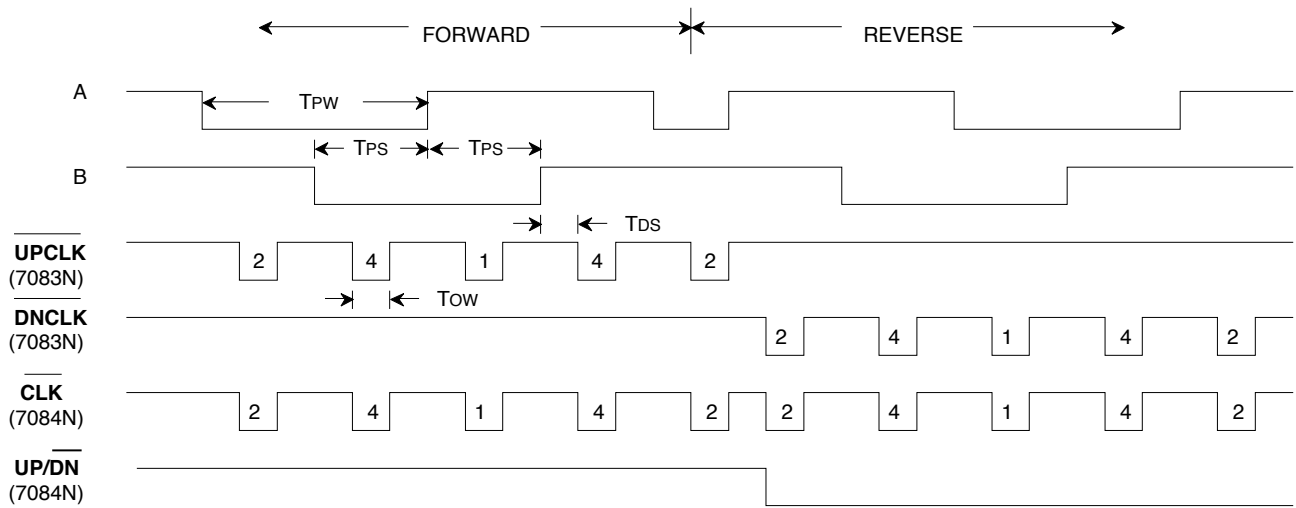
PARAMETER	SYMBOL	VALUE	UNITS
DC Supply Voltage	V <sub>DD</sub> - V <sub>SS</sub>	16.0	V
Voltage at any input	V <sub>IN</sub>	V <sub>SS</sub> - 0.3 to V <sub>DD</sub> + 0.3	V
Operating temperature	T <sub>A</sub>	0 to +70	°C
Storage temperature	T <sub>STG</sub>	-55 to +150	°C

**DC ELECTRICAL CHARACTERISTICS:**(All voltages referenced to V<sub>SS</sub>, T<sub>A</sub> = 0°C to 70°C.)

PARAMETER	SYMBOL	MIN	MAX	UNITS	CONDITION
Supply voltage	V <sub>DD</sub>	3.0	12.0	V	-
Supply current	I <sub>DD</sub>	-	10.0	μA	V <sub>DD</sub> = 12V, All input frequencies = 0Hz RBIAS = 2M
<b>MODE</b> Logic Low	V <sub>IL</sub>	-	0.5V <sub>DD</sub>	V	-
<b>A, B</b> Logic Low	V <sub>IL</sub>	-	0.7	V	V <sub>DD</sub> = 3V
		-	1.0	V	V <sub>DD</sub> = 5V
		-	2.8	V	V <sub>DD</sub> = 12V
<b>MODE</b> Logic High	V <sub>IH</sub>	V <sub>DD</sub> - 0.5	-	V	-
<b>A, B</b> Logic High	V <sub>IH</sub>	2.0	-	V	V <sub>DD</sub> = 3V
		3.0	-	V	V <sub>DD</sub> = 5V
		6.6	-	V	V <sub>DD</sub> = 12V
<b>ALL OUTPUTS:</b>					
Sink Current	I <sub>OL</sub>	1.3	-	mA	V <sub>DD</sub> = 3V
V <sub>OL</sub> = 0.4V		1.9	-	mA	V <sub>DD</sub> = 5V
		2.9	-	mA	V <sub>DD</sub> = 12V
Source Current	I <sub>OH</sub>	0.83	-	mA	V <sub>DD</sub> = 3V
V <sub>OH</sub> = V <sub>DD</sub> - 0.5V		1.1	-	mA	V <sub>DD</sub> = 5V
		1.6	-	mA	V <sub>DD</sub> = 12V

**TRANSIENT CHARACTERISTICS:**(T<sub>A</sub> = 0°C to 70°C)

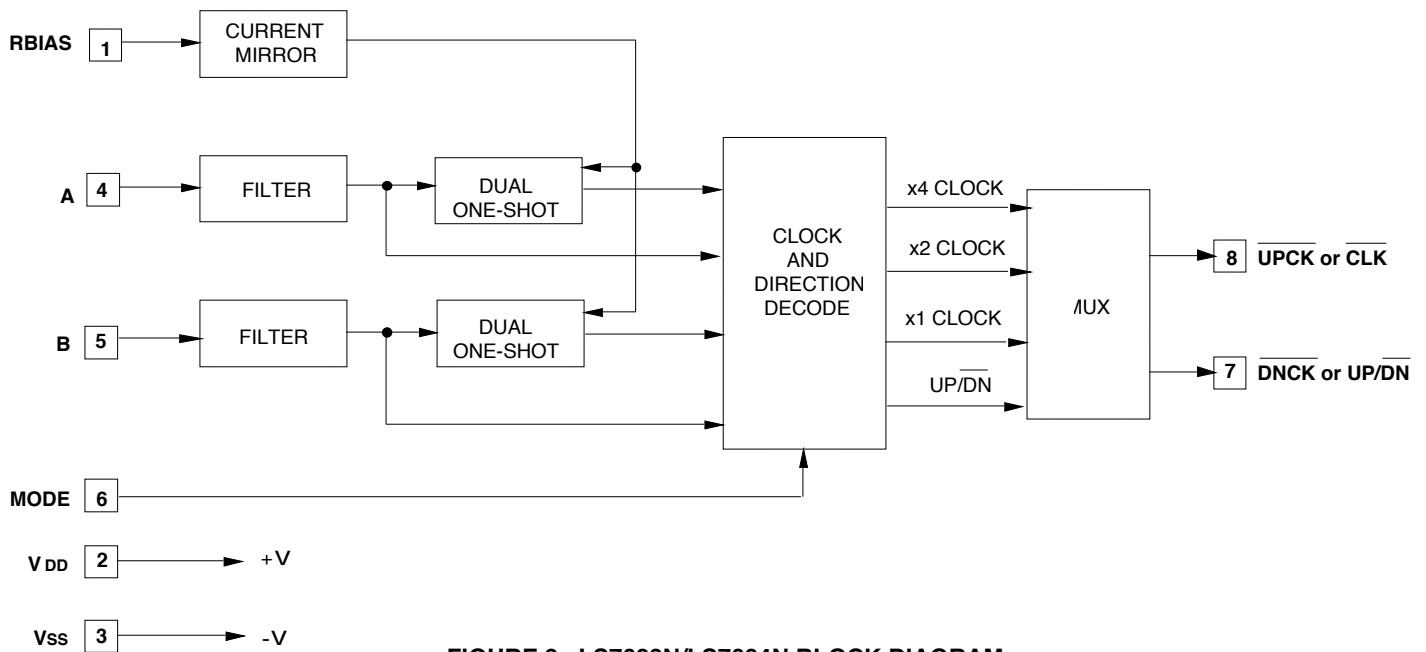
PARAMETER	SYMBOL	MIN	MAX	UNITS	CONDITION
<b>A, B</b> inputs: Validation Delay	T <sub>VD</sub>	-	250	ns	V <sub>DD</sub> = 3V
		-	170	ns	V <sub>DD</sub> = 5V
		-	71	ns	V <sub>DD</sub> = 12V
<b>A, B</b> inputs: Pulse Width	T <sub>PW</sub>	T <sub>VD</sub> + T <sub>OW</sub>	Infinite	ns	-
<b>A to B</b> or <b>B to A</b> Phase Delay	T <sub>PS</sub>	T <sub>OW</sub>	Infinite	ns	-
<b>A, B</b> frequency	f <sub>A, B</sub>	-	$\frac{1}{2T_{PW}}$	Hz	-
Input to Output Delay	T <sub>DS</sub>	-	280	ns	V <sub>DD</sub> = 3V
		-	220	ns	V <sub>DD</sub> = 5V
		-	120	ns	V <sub>DD</sub> = 12V Includes input validation delay
Output Clock Pulse Width	T <sub>OW</sub>	50	-	ns	See Fig. 4 & 5



**NOTE:** Output clocks labeled 1, 2 and 4 have the following interpretations.

1. Generated in x1, x2 and x4 modes.
2. Generated in x2 and x4 modes only.
3. Generated in x4 mode only.

**FIGURE 2. LS7083N / LS7084N INPUT / OUTPUT TIMING**



**FIGURE 3. LS7083N/LS7084N BLOCK DIAGRAM**

The information included herein is believed to be accurate and reliable. However, LSI Computer Systems, Inc. assumes no responsibilities for inaccuracies, nor for any infringements of patent rights of others which may result from its use.

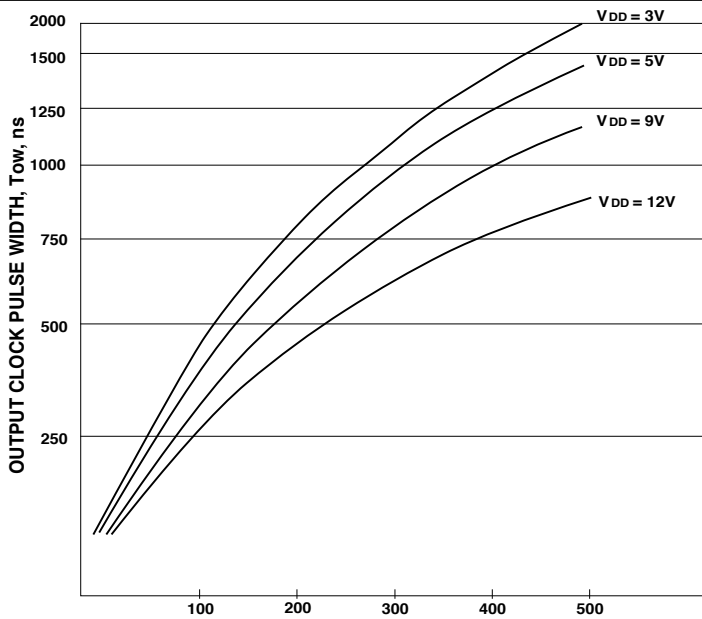


Figure 4. Tow vs RBIAS, kΩ

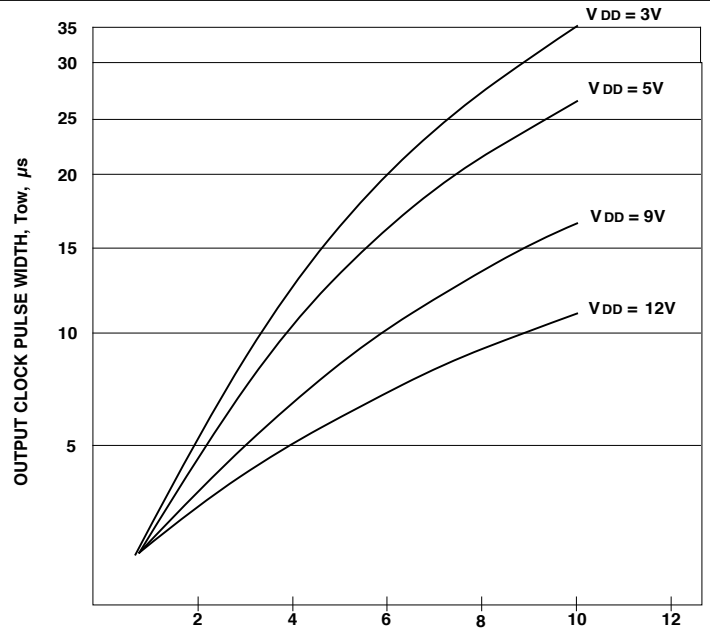


Figure 5. Tow vs RBIAS, MΩ

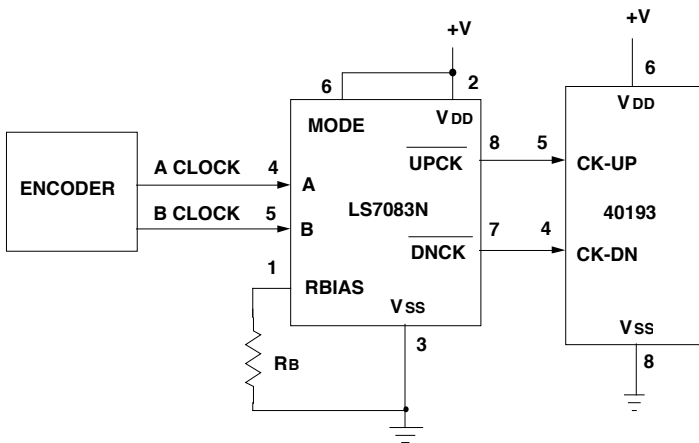


FIGURE 6A. TYPICAL APPLICATION FOR LS7083N in x4 MODE

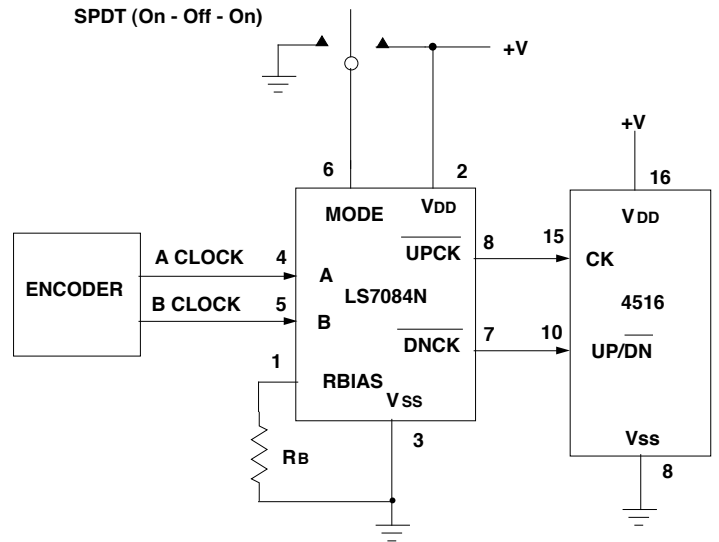
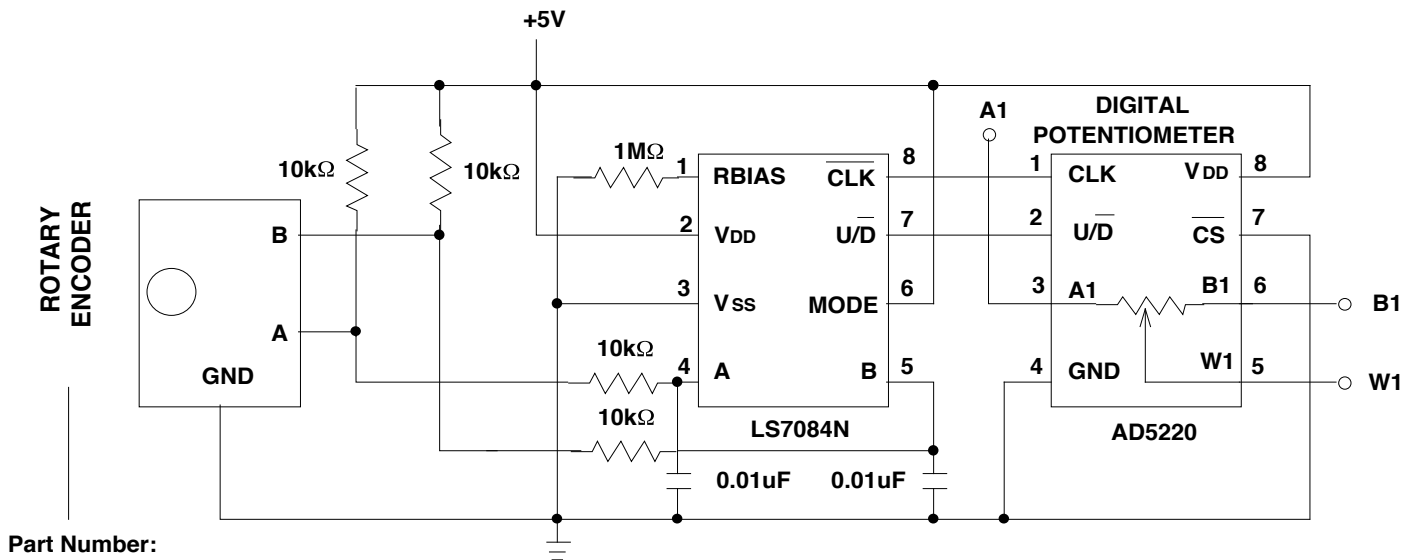


FIGURE 6B\*. TYPICAL APPLICATION FOR LS7084N in x2 MODE

\*See NOTE at bottom right of Page 1



Part Number:  
RE11CT-V1Y12-EF2CS

FIGURE 7. Rotary Encoder Control of Digital Potentiometer