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## CTSLV394

# LVPECL Divide by 1, Divide by 2 Clock Generator w/ Tri-State Compatible Outputs

MLP8

## FEATURES

- Selectable Divide Ratio
- Selectable Enable Priority and Threshold (CMOS or PECL)
- Tristate Compatible Outputs
- Input Buffer Powers Down when Disabled
- High BW [1.5GHz ( $\div 1$ ), 3.0GHz ( $\div 2$ )]
- 3V to 5.5V Power Supply
- -145dBc/Hz ( $\div 1$ ) Typ Noise Floor
- -151dBc/Hz ( $\div 2$ ) Typ Noise Floor
- RoHS Compliant Pb Free Packages

## DESCRIPTION

The CTSLV394 is a  $\div 1$  or  $\div 2$  clock generation part specifically designed to accommodate Colpitts or Pierce based oscillators. The tri-state compatible outputs allow for on-the-fly switching of multiple oscillators on a common bus. Other features are incorporated to reduce board components. A voltage reference and input biasing allows for easy oscillator interface.

The CTSLV394 provides a  $\div 2$  mode of operation for more frequency options and is selectable with a single connection. A selectable enable is also provided which doubles as a reset when the CTSLV394 is in  $\div 2$  mode. With a single connection, the enable can be selected to operate as active high or active low.

## ENGINEERING NOTES

The CTSLV394 is a specialized  $\div 1$  or  $\div 2$  clock generation part including an enable/reset function. The divide ratio is selected with the DIV-SEL pin/pad. When DIV-SEL is open (NC), the CTSLV394 functions as a standard receiver. If DIV-SEL is connected to  $V_{EE}$ , it functions as a  $\div 2$  divider.

Enable (EN) functionality is selected with the EN-SEL pin/pad which has three valid states: open (NC),  $V_{EE}$ , or connected to  $V_{EE}$  via a  $20k\Omega \pm 20\%$  resistor. Leaving EN-SEL open or connecting it to  $V_{EE}$  allows the EN pin/pad to function as an active high CMOS/TTL enable. When EN-SEL is open, an internal  $75k\Omega$  pull-up resistor is selected which enables the outputs whenever EN is left open. When EN-SEL is connected to  $V_{EE}$ , an internal  $75k\Omega$  pull-down resistor is selected which disables the outputs whenever EN is left open.

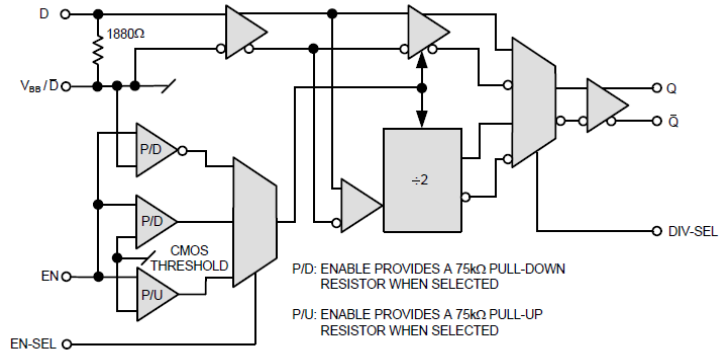
Connecting the EN-SEL to  $V_{EE}$  with a  $20k\Omega$  resistor will allow the EN pin/pad to function as an active low PECL/ECL enable with an internal  $75k\Omega$  pull-down resistor. In this mode, outputs are enabled when EN is left open (NC). The default logic condition can be overridden by connecting the EN to  $V_{CC}$  with an external resistor of  $\leq 20k\Omega$ . If the enable signal is CMOS (rail-to-rail) and the logic sense is active low (EN-SEL connected to  $V_{EE}$  with a  $20k\Omega$  resistor), the EN pin/pad voltage swing must be reduced using two external resistors. Contact the factory for details.

When the CTSLV394 is disabled, the Q and  $\bar{Q}$  outputs are forced LOW and the input buffer is powered down to minimize feed through. This feature allows tri-state compatible parallel output connections. Multiple CTSLV394 chip outputs can be wired together. Since both outputs are forced LOW in the disable mode, an enabled CTSLV394 can drive the output lines without interference from the unselected units. In addition, the CTSLV394 can be used in parallel connection with PECL/ECL parts whose outputs are high impedance when disabled.

The EN pin/pad also functions as a reset when the  $\div 2$  mode is selected. In the  $\div 2$  mode, the counter resets when the outputs are disabled.

The CTSLV394 provides a  $V_{BB}$  with an  $1880\Omega$  internal bias resistor from D to  $V_{BB}$ . This feature allows AC coupling with minimal external components. The  $V_{BB}$  pin supports 1.5mA sink/source current and should be bypassed to ground or  $V_{CC}$  with a  $0.01 \mu F$  capacitor.

## BLOCK DIAGRAM



## ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings are those values beyond which device life may be impaired.

Symbol	Characteristic	Condition	Rating	Unit
$V_{CC}$	PECL Power Supply	$V_{EE} = 0V$	0 to + 6.0	V
$V_{I\_PECL}$	PECL Input Voltage	$V_{EE} = 0V$	0 to + 6.0	V
$V_{EE}$	ECL Power Supply	$V_{CC} = 0V$	-6.0 to 0	V
$V_{I\_ECL}$	ECL Input Supply	$V_{CC} = 0V$	-6.0 to 0	V
$I_{HGOUT}$	Output Current	Continuous	50	mA
		Surge	100	
$T_A$	Operating Temperature Range	-	-40 to +85	°C
$T_{STG}$	Storage Temperature Range	-	-65 to +150	°C
$ESD_{HBM}$	Human Body Model Electro Static Discharge	-	2500	V
$ESD_{MM}$	Machine Model Electro Static Discharge	-	200	V
$ESD_{CDM}$	Charged Device Model Electro Static Discharge	-	2000	V

### 100K ECL DC Characteristics ( $V_{EE} = -3.0V$ to $-5.5V$ , $V_{CC} = GND$ )

Symbol	Characteristic	-40°C		0°C		25°C		85°C		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	
$V_{OH}$	Output HIGH Voltage <sup>1</sup>	-1085	-880	-1025	-880	-1025	-880	-1025	-880	mV
$V_{OL}$	Output LOW Voltage <sup>1</sup>	-1900	-1555	-1900	-1620	-1900	-1620	-1900	-1620	mV
$V_{IH}$	Input HIGH Voltage D,EN (ECL) <sup>2</sup>	-1165	-740	-1165	-740	-1165	-740	-1165	-740	mV
	Input HIGH Voltage EN (CMOS) <sup>3</sup>	$V_{EE} + 2000$	$V_{CC}$	$V_{EE} + 2000$	$V_{CC}$	$V_{EE} + 2000$	$V_{CC}$	$V_{EE} + 2000$	$V_{CC}$	mV
$V_{IL}$	Input LOW Voltage D,EN (ECL) <sup>2</sup>	-1900	-1475	-1900	-1475	-1900	-1475	-1900	-1475	mV
	Input LOW Voltage EN (CMOS) <sup>3</sup>	$V_{EE}$	$V_{EE} + 800$	$V_{EE}$	$V_{EE} + 800$	$V_{EE}$	$V_{EE} + 800$	$V_{EE}$	$V_{EE} + 800$	mV
$V_{BB}$	Reference Voltage	-1390	-1250	-1390	-1250	-1390	-1250	-1390	-1250	mV
$I_{IH}$	Input HIGH Current EN		150		150		150		150	µA
$I_{IL}$	Input LOW Current EN (ECL) <sup>2</sup>	0.5		0.5		0.5		0.5		µA
	Input LOW Current EN (CMOS) <sup>3</sup>	-150		-150		-150		-150		
$I_{EE}$	Power Supply Current <sup>1</sup>		34		34		34		37	mA

<sup>1</sup> Specified with each output terminated through 50Ω resistors to  $V_{CC} - 2V$ .

<sup>2</sup> EN-SEL connected to  $V_{EE}$  through a 20kΩ resistor.

<sup>3</sup> EN-SEL connected to  $V_{EE}$  or left open (NC).

**100K LVPECL DC Characteristics ( $V_{EE} = \text{GND}$ ,  $V_{CC} = +3.3\text{V}$ )**

Symbol	Characteristic	-40°C		0°C		25°C		85°C		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	
$V_{OH}$	Output HIGH Voltage <sup>1,2</sup>	2215	2420	2275	2420	2275	2420	2275	2420	mV
$V_{OL}$	Output LOW Voltage <sup>1,2</sup>	1400	1745	1400	1680	1400	1680	1400	1680	mV
$V_{IH}$	Input HIGH Voltage D,EN (ECL) <sup>3</sup>	2135	2560	2135	2560	2135	2560	2135	2560	mV
	Input HIGH Voltage EN (CMOS) <sup>4</sup>	2000	$V_{CC}$	2000	$V_{CC}$	2000	$V_{CC}$	2000	$V_{CC}$	mV
$V_{IL}$	Input LOW Voltage D,EN (ECL) <sup>3</sup>	1400	1825	1400	1825	1400	1825	1400	1825	mV
	Input LOW Voltage EN (CMOS) <sup>4</sup>	GND	800	GND	800	GND	800	GND	800	mV
$V_{BB}$	Reference Voltage <sup>1</sup>	1910	2050	1910	2050	1910	2050	1910	2050	mV
$I_{IH}$	Input HIGH Current EN		150		150		150		150	μA
$I_{IL}$	Input LOW Current EN (ECL) <sup>3</sup>	0.5		0.5		0.5		0.5		μA
	Input LOW Current EN (CMOS) <sup>4</sup>	-150		-150		-150		-150		
$I_{EE}$	Power Supply Current <sup>2</sup>		34		34		34		37	mA

- <sup>1</sup> For supply voltages other than 3.3V, use the ECL table values and ADD supply voltage value.
- <sup>2</sup> Specified with each output terminated through 50Ω resistors to  $V_{CC} - 2\text{V}$ .
- <sup>3</sup> EN-SEL connected to  $V_{EE}$  through a 20kΩ resistor.
- <sup>4</sup> EN-SEL connected to  $V_{EE}$  or left open (NC).

**100K PECL DC Characteristics ( $V_{EE} = \text{GND}$ ,  $V_{CC} = +5.0\text{V}$ )**

Symbol	Characteristic	-40°C		0°C		25°C		85°C		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	
$V_{OH}$	Output HIGH Voltage <sup>1,2</sup>	3915	4120	3975	4120	3975	4120	3975	4120	mV
$V_{OL}$	Output LOW Voltage <sup>1,2</sup>	3100	3445	3100	3380	3100	3380	3100	3380	mV
$V_{IH}$	Input HIGH Voltage D,EN (ECL) <sup>3</sup>	3835	4260	3835	4260	3835	4260	3835	4260	mV
	Input HIGH Voltage EN (CMOS) <sup>4</sup>	2000	$V_{CC}$	2000	$V_{CC}$	2000	$V_{CC}$	2000	$V_{CC}$	mV
$V_{IL}$	Input LOW Voltage D,EN (ECL) <sup>3</sup>	3100	3525	3100	3525	3100	3525	3100	3525	mV
	Input LOW Voltage EN (CMOS) <sup>4</sup>	GND	800	GND	800	GND	800	GND	800	mV
$V_{BB}$	Reference Voltage <sup>1</sup>	3610	3750	3610	3750	3610	3750	3610	3750	mV
$I_{IH}$	Input HIGH Current EN		150		150		150		150	μA
$I_{IL}$	Input LOW Current EN (ECL) <sup>3</sup>	0.5		0.5		0.5		0.5		μA
	Input LOW Current EN (CMOS) <sup>4</sup>	-150		-150		-150		-150		
$I_{EE}$	Power Supply Current <sup>2</sup>		34		34		34		37	mA

- <sup>1</sup> For supply voltages other than 3.3V, use the ECL table values and ADD supply voltage value.
- <sup>2</sup> Specified with each output terminated through 50Ω resistors to  $V_{CC} - 2\text{V}$ .
- <sup>3</sup> EN-SEL connected to  $V_{EE}$  through a 20kΩ resistor.
- <sup>4</sup> EN-SEL connected to  $V_{EE}$  or left open (NC).

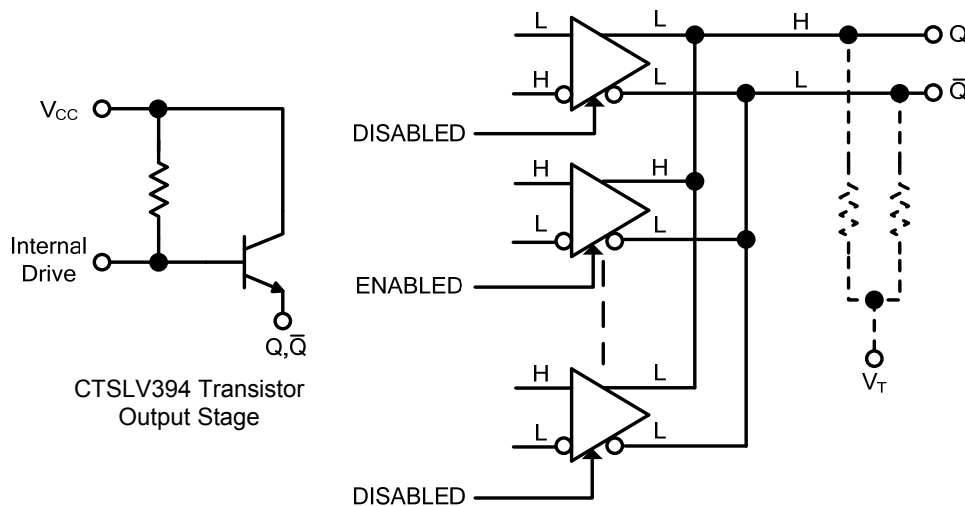
**AC Characteristics ( $V_{EE} = -3.0V$  to  $-5.5V$ ;  $V_{CC}=GND$  or  $V_{EE}=GND$ ;  $V_{CC} = +3.0V$  to  $+5.5V$ )**

Symbol	Characteristic	-40°C			0°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$t_{PLH}/t_{PHL}$	D to $Q/\bar{Q}$ <sup>1</sup>			450			450			450			450	ps
	EN to $Q_{HG}/Q_{bHG}$ <sup>1,2</sup>			3000			3000			3000			3000	ps
$t_{SKEW}$	Duty Cycle Skew <sup>3</sup>		5	20		5	20		5	20		5	20	ps
$V_{PP}$ (AC)	Input Swing <sup>4</sup>	150		1000	150		1000	150		1000	150		1000	mV
$t_R/t_F$	Output Rise/Fall <sup>1</sup> (20% - 80%)	100		240	100		240	100		240	100		240	ps

- 1 Specified with each output terminated through 50Ω resistors to  $V_{CC} - 2V$ .
- 2 Specified from 50% EN input edge to  $V_{OH}$  min to  $V_{OL}$  max of the  $Q/\bar{Q}$  outputs.
- 3 Duty cycle skew is the difference between a  $t_{PLH}$  and  $t_{PHL}$  propagation delay through a device.
- 4  $V_{PP}$  is the peak-to-peak differential input swing for which AC parameters are guaranteed.

**Tri-state Compatible Operation**

The outputs of the CTSLV394 are emitter followers as shown in the left side of Figure 1. When a part is disabled, both outputs are set in the LOW state. This allows a HIGH output from an enabled part to override a disabled output and pull the combined line HIGH as seen in the right hand side of Figure 1. When the enabled part output is LOW, the combined line remains LOW. If all connected CTS94 parts are disabled, both output lines will be in the LOW state. As another feature, while disabled, the input buffer is powered down to minimize feed through.


**Figure 1: Typical Tri-state Operation**

Divide Truth Table

DIV-SEL	÷Ratio
NC	÷1
$V_{EE}^1$	÷2

<sup>1</sup> DIV-SEL connection must be  $\leq 1W$ .

Enable Truth Table

EN-SEL	EN	Q	$\bar{Q}$
NC	CMOS Low or $V_{EE}$	Low	Low
	CMOS High, $V_{CC}$ or NC	Data	Data
$V_{EE}$	CMOS Low, $V_{EE}$ or NC	Low	Low
	CMOS High or $V_{CC}$	Data	Data
20k $\Omega$ to $V_{EE}$	PECL Low, $V_{EE}$ or NC	Low	Low
	PECL High or $V_{CC}$	Data	Data

Figure 2 illustrates the timing sequences for the CTSLV394 in the ÷1 mode which is determined by leaving the DIV-SEL open (NC). It also illustrates the enable in the active High mode being controlled by a CMOS signal. This mode is determined by leaving the EN-SEL open (NC).

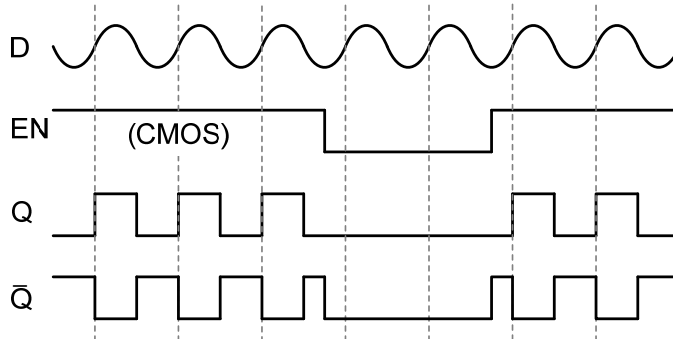


Figure 2

Figure 3 illustrates the timing sequences for the CTSLV394 in the ÷2 mode which is determined by connecting the DIV-SEL to  $V_{EE}$ . It also illustrates the enable in the active Low mode being controlled by a PECL signal. This mode is determined by connecting the EN-SEL to  $V_{EE}$  via 20k $\Omega$  resistor.

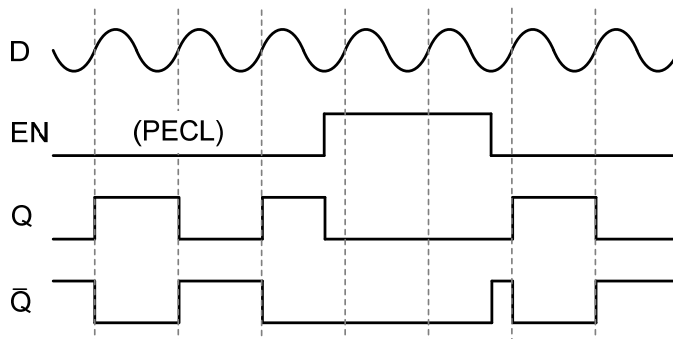
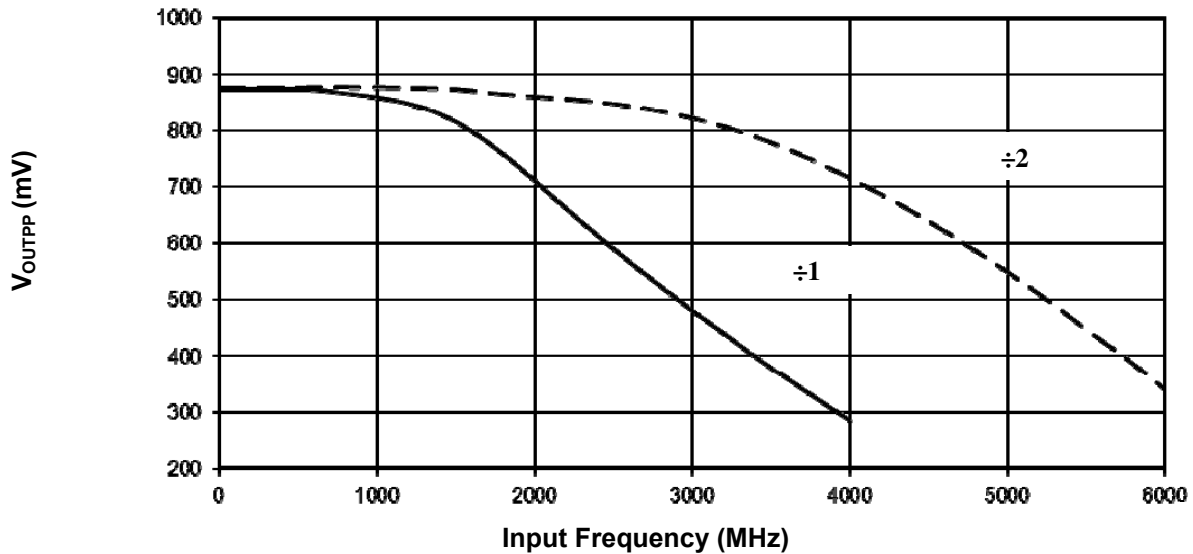


Figure 3

**CTSLV394**

**LVPECL Divide by 1, Divide by 2 Clock Generator w/ Tri-State Compatible Outputs**

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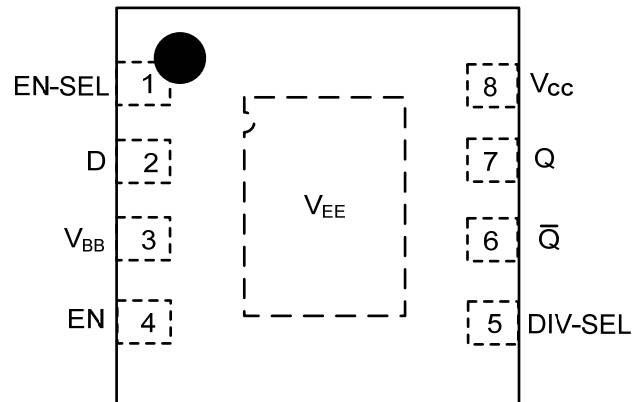


**Typical Large Signal Output Swing**  
Measured with 750mV D input, Q/Q each terminated to V<sub>CC</sub>-2V via 50Ω resistors.

**Pin Description and Configuration**

**Pin Assignments**

Pin	Name	Type	Function
1	EN-SEL	Input	Enable Polarity Select
2	D	Input	Data Input
3	V <sub>BB</sub>	Input	Reference Voltage
4	EN	Input	Output Enable
5	DIV-SEL	Input	Divide Select
6	Q̄	Output	Inverted PECL Output
7	Q	Output	PECL Output
8	V <sub>CC</sub>	Power	Positive Supply
9	V <sub>EE</sub>	Power	Negative Supply



**PART ORDERING INFORMATION**

Part Number	Package	Marking
CTSLV394NG	MLP8	J4G / YWW