ICS527-03

Clock Slicer User Configurable PECL Output Zero Delay Buffer

Description

The ICS527-03 is the most flexible way to generate an output clock from an input clock with zero skew. The user can easily configure the device to produce nearly any output clock that is multiplied or divided from the input clock. The part supports non-integer multiplications and divisions. Using Phase-Locked Loop (PLL) techniques, the device accepts an input clock up to 200 MHz and produces an output clock up to 160 MHz.

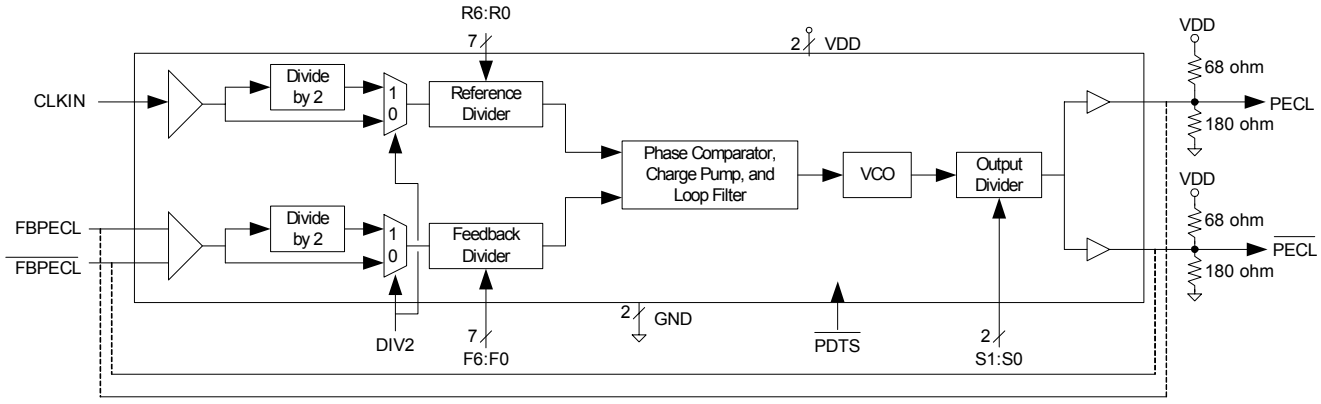
The ICS527-03 aligns rising edges on CLKIN with FBPECL at a ratio determined by the reference and feedback dividers.

For a PECL input and output clock with zero delay, use the ICS527-04.

Features

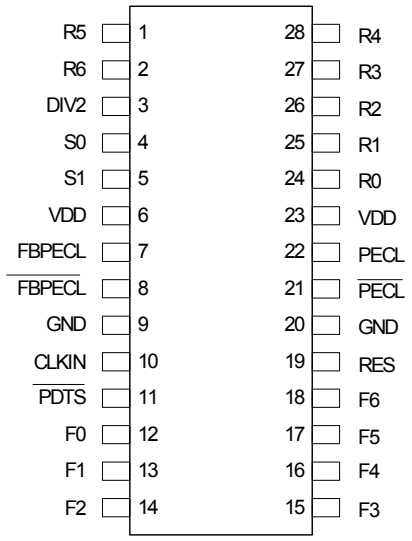
- Packaged as 28 pin SSOP (150 mil body)
- Synchronizes fractional clocks rising edges
- CMOS in to PECL out
- Pin selectable dividers
- Zero input to output skew
- User determines the output frequency - no software needed
- Slices frequency or period
- Input clock frequency of 1.5 MHz to 200 MHz
- Output clock frequencies from 2.5 MHz to 160 MHz
- Very low jitter
- Duty cycle of 45/55
- Operating voltage of 3.3 V
- Advanced, low power CMOS process

Block Diagram



Integrated Circuit Systems, Inc. ● 525 Race Street, San Jose, CA 95126 ● tel (408) 297-1201 ● www.icst.com

Pin Assignment



28 pin 150 mil body SSOP

Output Frequency and Output Divider Table

S1	S0	Output Divider	Output Frequency (MHz)
0	0	2	10 - 80
0	1	4	5 - 40
1	0	8	2.5 - 20
1	1	1	20 -160

Pin Descriptions

Pin Number	Pin Name	Pin Type	Pin Description
1,2, 24-28	R5, R6, R0-R4	Input	Reference divider word input pins determined by user. Forms a binary number from 0 to 127. Internal pull-up.
3	DIV2	Input	Selects CLK2 function to output a SYNC signal or a divide by 2 of CLK1 based on the table above. Internal pull-up.
4, 5	S0, S1	Input	Select pins for output divider determined by user. See table above. Internal pull-up.
6, 23	VDD	Power	Connect to +3.3 V.
7	FPECL	Input	PECL feedback input.
8	$\overline{\text{FPECL}}$	Input	Complementary PECL feedback input.
9, 20	GND	Power	Connect to ground
10	CLKIN	Input	Clock input.
11	$\overline{\text{PDTS}}$	Input	Power Down. Active low. Turns off entire chip when low, both clock outputs are tri-stated. Internal pull-up.
12-18	F0-F6	Input	Feedback divider word input pins determined by user. Forms a binary number from 0 to 127. Internal pull-up
19	RES	BIAS	Resistor connection to VDD for setting level of PECL outputs.
21	$\overline{\text{PECL}}$	Output	Complementary PECL input clock.
22	PECL	Output	PECL input clock.

External Components

Decoupling Capacitors

As with any high performance mixed-signal IC, the ICS527-03 must be isolated from system power supply noise to perform optimally.

Decoupling capacitors of 0.01µF must be connected between each VDD and the PCB ground plane. They must be connected close to the device to minimize lead inductance.

Series Termination Resistor

Clock output traces over one inch should use series termination. To series terminate a 50Ω trace (a commonly used trace impedance), place a 33Ω resistor in series with the clock line, as close to the clock output pin as possible. The nominal impedance of the clock output is 20Ω.

Determining (setting) the ICS527-03 Dividers

The user has full control in setting the desired output clock over the range shown in the table on page 2. The user should connect the divider select input pins directly to ground (or VDD, although this is not required because of internal pull-ups) during Printed Circuit Board layout, so the ICS527-03 automatically produces the correct clock when all components are soldered. It is also possible to connect the inputs to parallel I/O ports in order to switch frequencies.

The output of the ICS527-03 can be determined by the following simple equation:

$$\text{FB Frequency} = \text{Input Frequency} \times \frac{\text{FDW} + 2}{\text{RDW} + 2}$$

Where:

Reference Divider Word (RDW) = 0 to 127
Feedback Divider Word (FDW) = 0 to 127
FB Frequency is the same as either CLK1 or CLK2 depending on feedback connection

Also, the following operating ranges should be observed:

$$300\text{kHz} < \frac{\text{Input Frequency}}{\text{RDW} + 2} < 20\ \text{MHz}$$

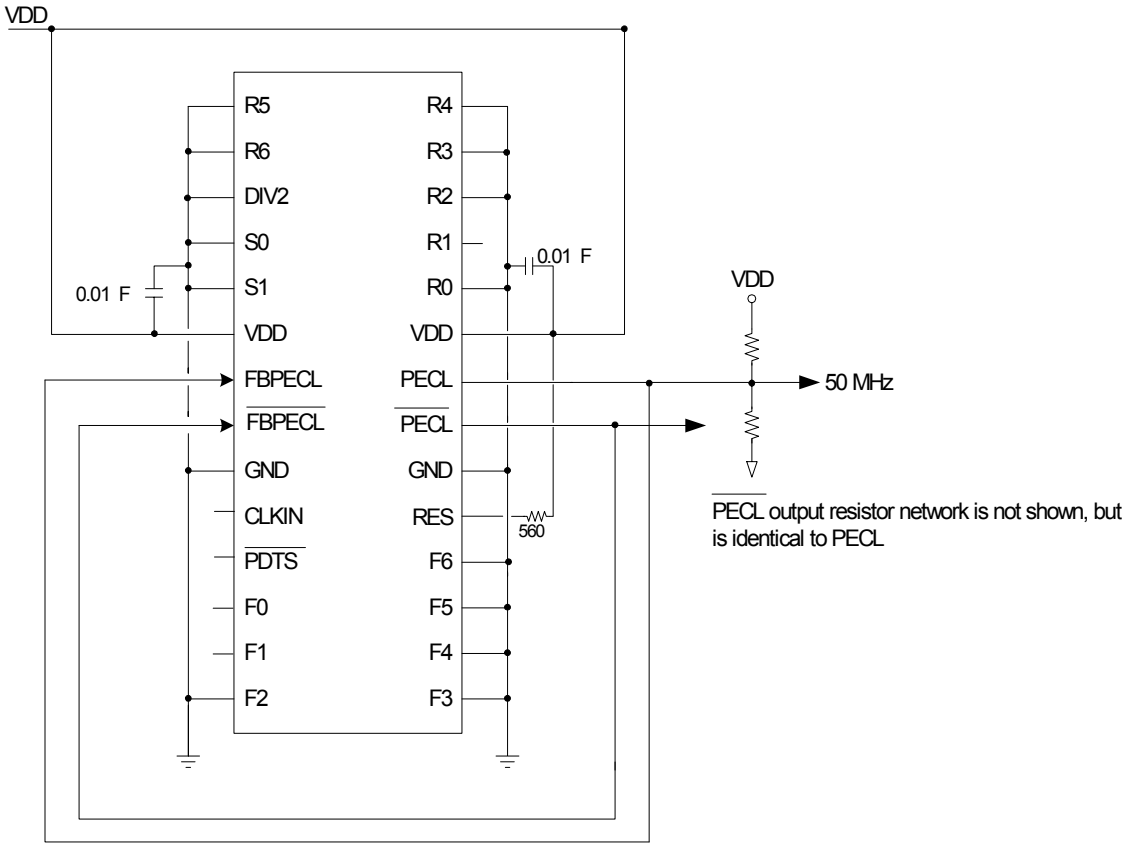
The output divide should be selected depending on the frequency of CLK1. The table on page 2 gives the ranges.

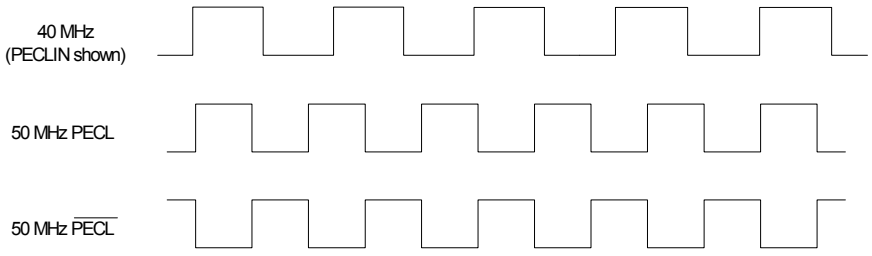
The dividers are expressed as integers. For example, if a 50 MHz output on CLK1 is desired from a 40 MHz input, the reference divider word (RDW) should be 2 and the feedback divider word (FDW) should be 3 which gives the required 5/4 multiplication. If multiple choices of dividers are available, then the lowest numbers should be used. In this example, the output divide (OD) should be selected to be 2. Then R6:R0 is 0000010, F6:F0 is 0000011 and S1:S0 is 00. Also, this example assumes CLK1 is connected to FBIN.

If you need assistance determining the optimum divider settings, please send an e-mail to ics-mk@icst.com with the desired input clock and the desired output frequency.

Typical Example

The following connection diagram shows the implementation of the example from the previous section. This will generate a 50 MHz clock synchronously with a 40 MHz input. The layout diagram below will produce the waveforms shown on the right.





Note: The series termination resistor is located before the feedback

Multiple Output Example

In this example, an output clock of 125 MHz is used. Four copies of 50 MHz are required, de-skewed and aligned to the 125 MHz input clock. The following solution uses the ICS554-01A which has buffers with low pin to pin skew. The layout diagram below will produce the waveforms shown on the bottom.

PCB Layout Recommendations

For optimum device performance and lowest output phase noise, the following guidelines should be observed.

1) Each 0.01µF decoupling capacitor should be mounted on the component side of the board as close to the VDD pin as possible. No via's should be used between decoupling capacitor and VDD pin. The PCB trace to VDD pin should be kept as short as possible, as should the PCB trace to the ground via.

2) PECL termination networks should be located as close to the outputs as possible.

3) An optimum layout is one with all components on the same side of the board, minimizing vias through other signal layers. Other signal traces should be routed away from the ICS527-03. This includes signal traces just underneath the device, or on layers adjacent to the ground plane layer used by the device.

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Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the ICS527-03. These ratings, which are standard values for ICS commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

Item	Rating
Supply Voltage, VDD	7V
All Inputs and Outputs	-0.5V to VDD+0.5V
Ambient Operating Temperature	0 to +70°C
Storage Temperature	-65 to +150°C
Junction Temperature	175°C
Soldering Temperature	260°C

Recommended Operation Conditions

Parameter	Min.	Typ.	Max.	Units
Ambient Operating Temperature, ICS527R-02	0		+70	°C
Ambient Operating Temperature, ICS527R-02I	0		+70	°C
Power Supply Voltage (measured in respect to GND)	+3.15	+3.3	+3.45	V

DC Electrical Characteristics

Unless stated otherwise, VDD = 3.3V ±5%, Ambient Temperature 0 to +70°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	VDD		3.15	3.3	3.45	V
Supply Current	IDD	15 MHz in, 60MHz out, no load		15		mA
Supply Current, Power Down	IDDPD	$\overline{PDTS}$=0		20		µA
Input High Voltage	V_{IH}		2			V
Input Low Voltage	V_{IL}				0.8	V
Input High Voltage, PECLIN and FBIN	V_{IH}		VDD/2+1			V
Input Low Voltage, PECLIN and FBIN	V_{IL}				VDD/2-1	V
Output High Voltage	V_{OH}	I_{OH} = -12 mA	2.4			V
Output Low Voltage	V_{OL}	I_{OL} = 12 mA			0.4	V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Capacitance, except PECLIN and FBIN	C_{IN}			5		pF
Short Circuit Current	I_{OS}			±70		mA
On-chip pull-up resistor	R_{PU}			270		kΩ

AC Electrical Characteristics

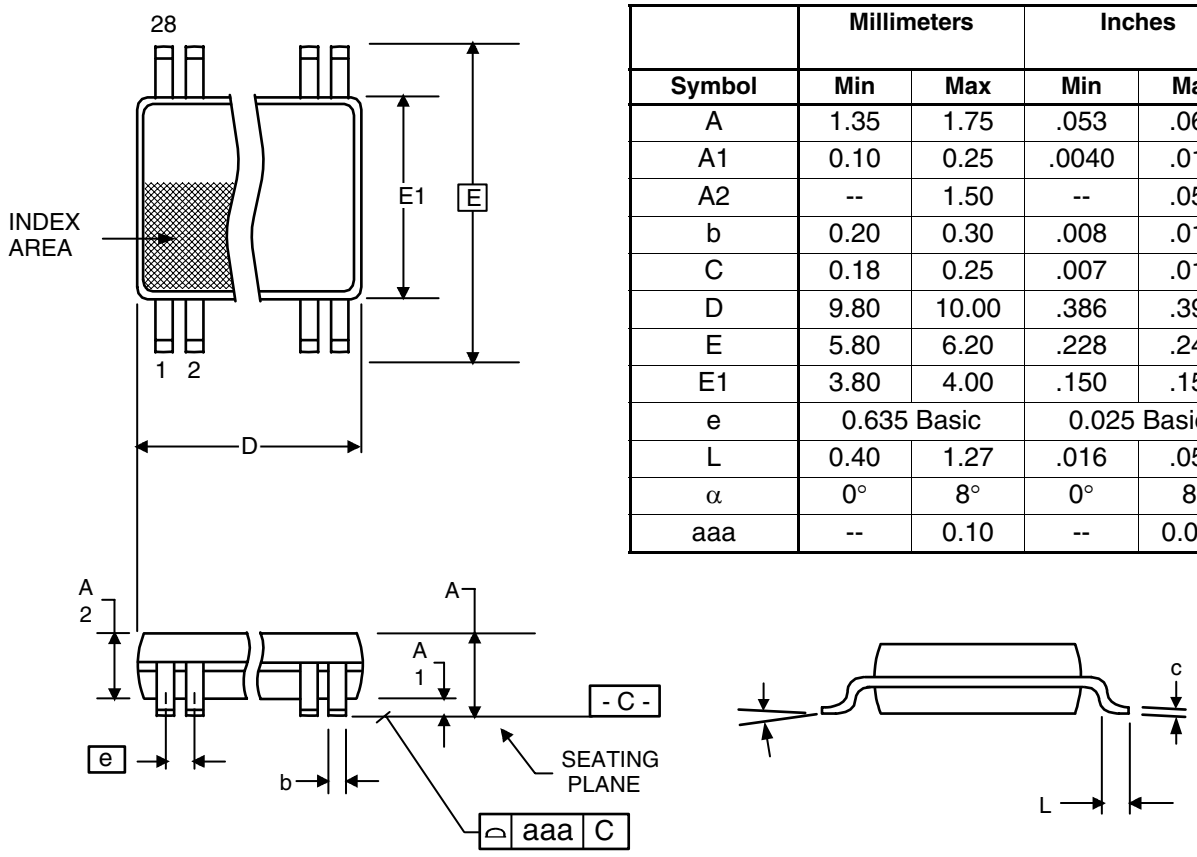
Unless stated otherwise, VDD = 3.3V ±5%, Ambient Temperature 0 to +70°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Frequency	F_{IN}		1.5		200	MHz
Output Frequency, CLK1	F_{OUT}	0 to +70°C	2.5		160	MHz
		-40 to +85°C	4		140	MHz
Output Rise Time	t_{OR}	0.8 to 2.0V, C_L=15pF		1		ns
Output Fall Time	t_{OF}	2.0 to 0.8V, C_L=15pF		1		ns
Output Duty Cycle (% high time)	t_{OD}	Measured at VDD/2, C_L=15pF	45	50	55	%
Power Down Time, $\overline{PDTS}$ low to clocks tri-stated					50	ns
Power Up ime, $\overline{PDTS}$ high to clocks stable					10	ms
Absolute Clock Period Jitter	t_{ja}	Deviation from mean		± 90		ps
One sigma Clock Period Jitter	t_{js}			40		ps
Input to output skew	t_{IO}	PECLIN to CLK1, Note 1	-250		250	ps
Device to device skew	t_{pi}	Common PECLIN, measured at FBIN		0	500	ps

Note 1: Assumes clocks with same rise time, measured from rising edges at VDD/2.

Package Outline and Package Dimensions (28 pin SSOP, 150 mil Body, 0.025 mm Pitch)

Package dimensions are kept current with JEDEC Publication No. 95, MO-153



	Millimeters		Inches	
Symbol	**Min**	**Max**	**Min**	**Max**
A	1.35	1.75	.053	.069
A1	0.10	0.25	.0040	.010
A2	--	1.50	--	.059
b	0.20	0.30	.008	.012
C	0.18	0.25	.007	.010
D	9.80	10.00	.386	.394
E	5.80	6.20	.228	.244
E1	3.80	4.00	.150	.157
e	0.635 Basic		0.025 Basic	
L	0.40	1.27	.016	.050
α	0°	8°	0°	8°
aaa	--	0.10	--	0.004

Ordering Information

Part / Order Number	Marking	Shipping packaging	Package	Temperature
ICS527R-03	ICS527R-03	Tubes	28 pin SSOP	0 to +70°C
ICS527R-03T	ICS527R-03	Tape and Reel	28 pin SSOP	0 to +70°C

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