

# TPS002

## 50 GHz Prescaler

### Features

- ◆ Divide by 2 (TPS002-2) and Divide by 4 (TPS002-4) Prescaler
- ◆ Up to 50 GHz Operation
- ◆ Differential or Single Ended Input
- ◆ 50Ω Single Ended Impedance
- ◆ Differential Output
- ◆ Single Power Supply: +3.3V
- ◆ 4mm x 4mm QFN package
- ◆ Power Dissipation from 285 to 450 mW
- ◆ Adjustable Output Amplitude from 0mVpp to 650mVpp Differential
- ◆ Minimum Input Power -20dBm

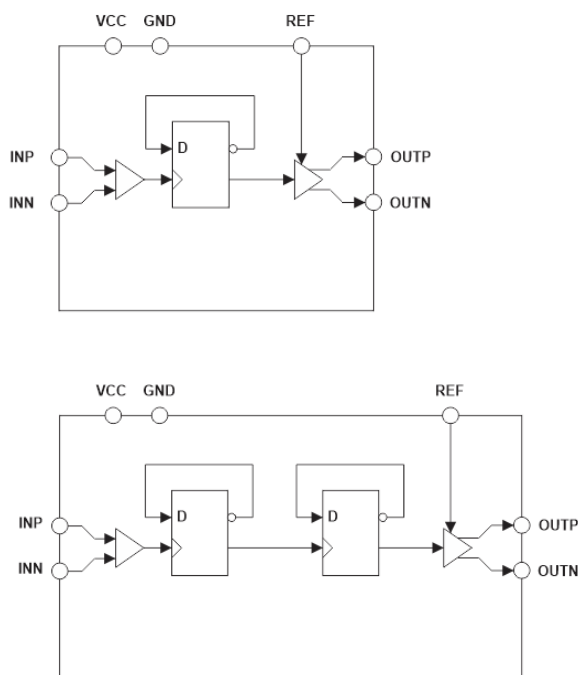



Figure 1 - Functional Block Diagram (TPS002-2 on Top, TPS002-4 on the Bottom).

### Product Description

The differential-to-differential prescaler is a fixed divider block with a wide operating range. There are two versions of the prescaler. TPS002-2 has

one divide by two prescaler; TPS002-4 has one divide by four prescaler. Both versions can operate up to 50 GHz.

### Ordering information

PART NUMBER	DESCRIPTION	<p><b>CAUTION</b> DEVICE SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD)</p> 
TPS002-2-QN	50 GHz Divide by 2 Prescaler	
TPS002-4-QN	50 GHz Divide by 4 Prescaler	
EVTPS002-X	Evaluation Board	

## ***Absolute Maximum Ratings***

### **Supply Voltages**

VCC to GND ..... 3.5V

### **Input Voltages**

INP, INN to VCC (when DC coupled) ..... +/- 1V

### **Temperature**

Case Temperature ..... +125°C

Junction Temperature ..... +150°C

Lead, Soldering (10 Seconds) ..... +220°C

Storage ..... -40 to 125°C

## DC Electrical Specification

Test Conditions (see notes for specific conditions): Room Temperature; VCC = 3.3V; Input: 10GHz, 0.5Vpp Differential; Differential Outputs Terminated Into 50  $\Omega$  to 0V; Inputs and Outputs AC coupled.

	PARAMETER	SYMBOL	CONDITIONS, NOTE	MIN	TYP	MAX	UNITS
<b>1.0</b>	<b>INPUT (INP, INN)</b>						
1.1	Input Impedance	R <sub>IN</sub>	Each Lead to VCC		50		$\Omega$
<b>2.0</b>	<b>OUTPUT (OUTP, OUTN)</b>						
2.1	Output Impedance	R <sub>OUT</sub>	Each Lead to VCC		50		$\Omega$
<b>3.0</b>	<b>POWER SUPPLY REQUIREMENTS</b>						
3.1	Positive Supply Current	ICC	TPS002-2		90		mA
3.2	Positive Supply Current	ICC	TPS002-4		142		mA
3.3	Power Dissipation	P	TPS002-2		297		mW
3.4	Power Dissipation	P	TPS002-4		468		mW

## AC Electrical Specification

Test Conditions (see notes for specific conditions): TPS002-2; Room Temperature; VCC = 3.3V; Input: 10GHz, 0.5Vpp Differential; Differential Outputs Terminated Into 50  $\Omega$  to 0V; Inputs and Outputs AC coupled.

	PARAMETER	SYMBOL	CONDITIONS, NOTE	MIN	TYP	MAX	UNITS
<b>4.0</b>	<b>DYNAMIC PERFORMANCE</b>						
4.1	Output Amplitude	BW	Differential (REF=3.3V)		650		mV
4.2	Phase Noise	BW	IN=5GHz at 10Khz offset		-125		dBc/Hz
4.2	Phase Noise	BW	IN=5GHz at 100Khz offset		-125		dBc/Hz
4.2	Phase Noise	BW	IN=5GHz at 1Mhz offset		-140		dBc/Hz
<b>5.0</b>	<b>TIMING</b>						
5.1	Output Rise Time	BW	20% to 80%		7		ps
5.2	Output Falling Time	BW	80% to 20%		8		ps
5.3	Propagation Delay	BW	50% in to 50% out				ps

## Operating Conditions

	PARAMETER	SYMBOL	CONDITIONS, NOTE	MIN	TYP	MAX	UNITS
<b>6.0</b>	<b>INPUT (INP, INN)</b>						
6.1	Input Amplitude	$V_{IN}$	Differential	50		1000	mVpp
<b>7.0</b>	<b>ANALOG OUTPUT (OUTP, OUTN)</b>						
7.1	Ext. Termination Resistor <sup>1</sup>	$R_{TERM}$	Required From Outputs To GND		50		$\Omega$
<b>8.0</b>	<b>AMPLITUDE CONTROL (REF)</b>						
8.1	Amplitude Control Voltage	$V_{REF}$		0		3.3	V
<b>9.0</b>	<b>POWER SUPPLY REQUIREMENTS</b>						
9.1	Positive Supply Voltage	VCC		3.1	3.3	3.5	V
<b>10.0</b>	<b>OPERATING TEMPERATURE</b>						
10.1	Case Temperature <sup>2</sup>	Tc		-40		85	$^{\circ}C$

Note: 1 - If the output is DC connected the termination resistor should be connected to VCC.

2 - The part is designed to maintain high performance operation within a case temperature range of  $-40 \sim 85^{\circ}C$  and we recommend not to exceed the Absolute Maximum Temperature shown on page 2. For the best performance, operation within the specified temperature range with proper heat dissipation is recommended. The metal pad where the part is soldered should be connected to the ground plane with thermal vias for better heat dissipation. A heatsink can be attached to the bottom of the PCB, on a metal pad connected to the metal pad where the part is soldered.

### TPS002-X Pin Description and Pin Out (20 I/O QFN Package)

P/I/O	PIN	NUM.	NAME	FUNCTION
P	1,3,5,8,11,13,15, bottom pad	8	GND	Ground
P	7,17,19	3	VCC	Positive Power Supply
I	2	1	INP	Input
I	4	1	INN	
O	14	1	OUTP	Output
O	12	1	OUTN	
I	16	1	REF	Output Amplitude Control (Tie to VCC for Max Amplitude)
-	6,9,10,18,20	5	NC	Reserved

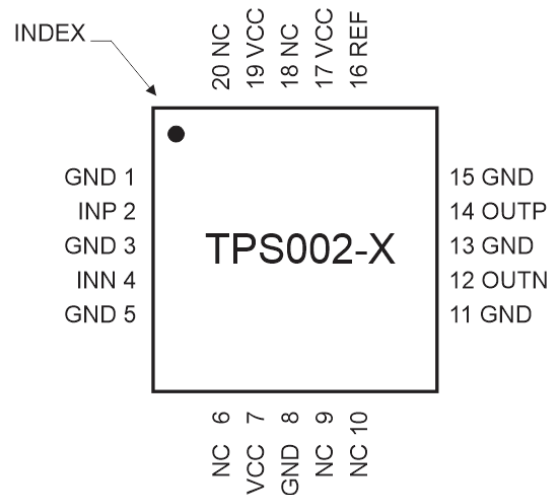


Figure 2 – TPS002-X pinout (top view) 20 I/O QFN package.

### Typical Operating Circuit

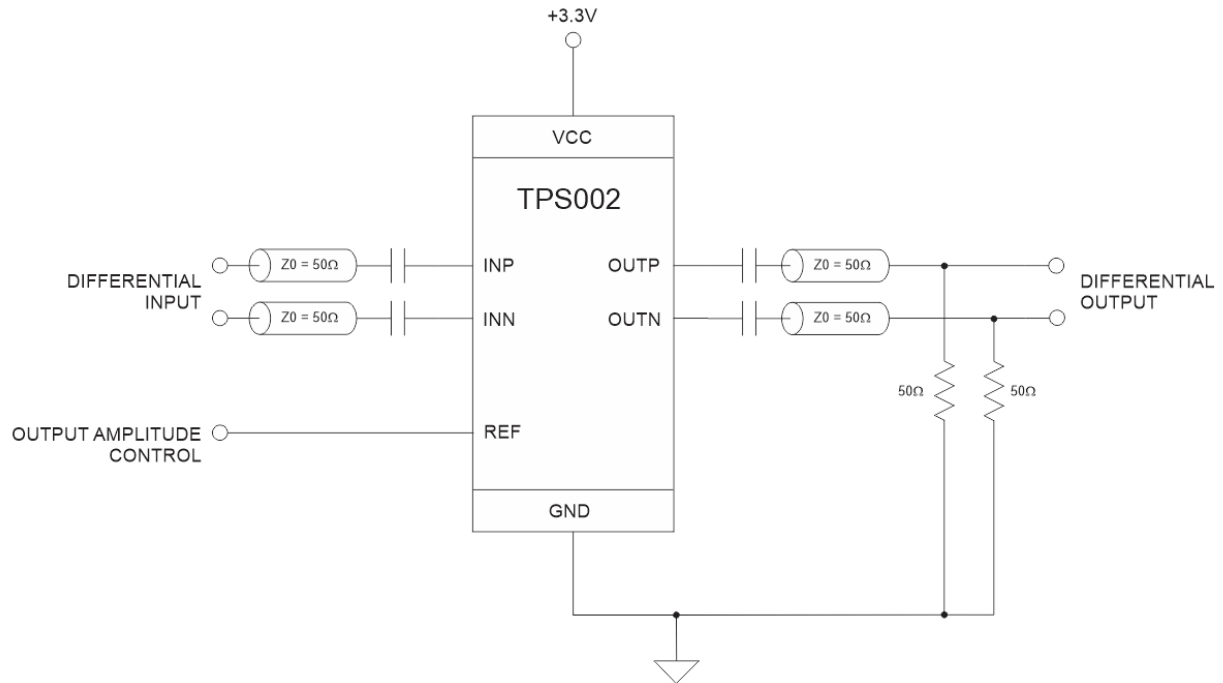
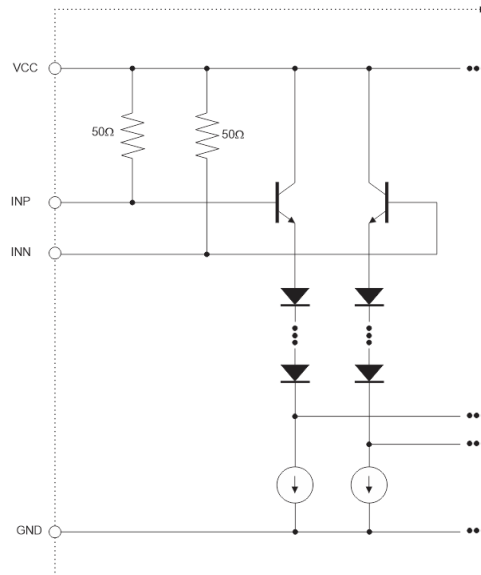
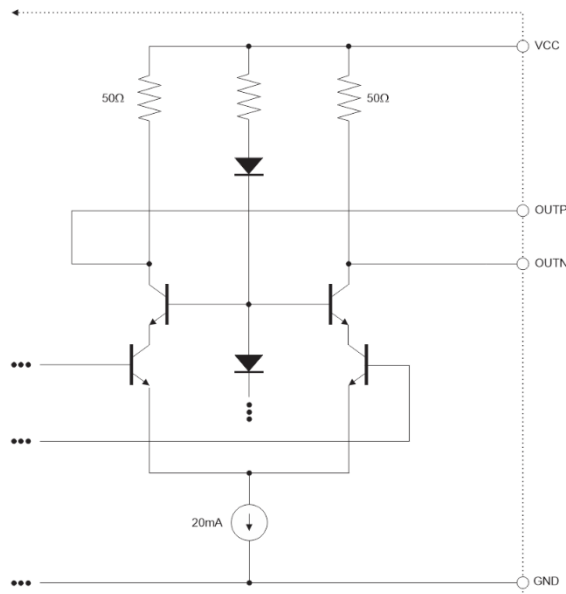


Figure 3 - Typical operating circuit.

## Equivalent Circuit



**Figure 4 - Input circuit.**



**Figure 5 - Output circuit.**



## Typical Performance

Test Conditions: Room Temperature; VCC = 3.3V; REF = 3.3V; Input 0.5Vpp Differential; Differential Outputs Terminated Into 50  $\Omega$  to GND; Inputs and Outputs AC Coupled.

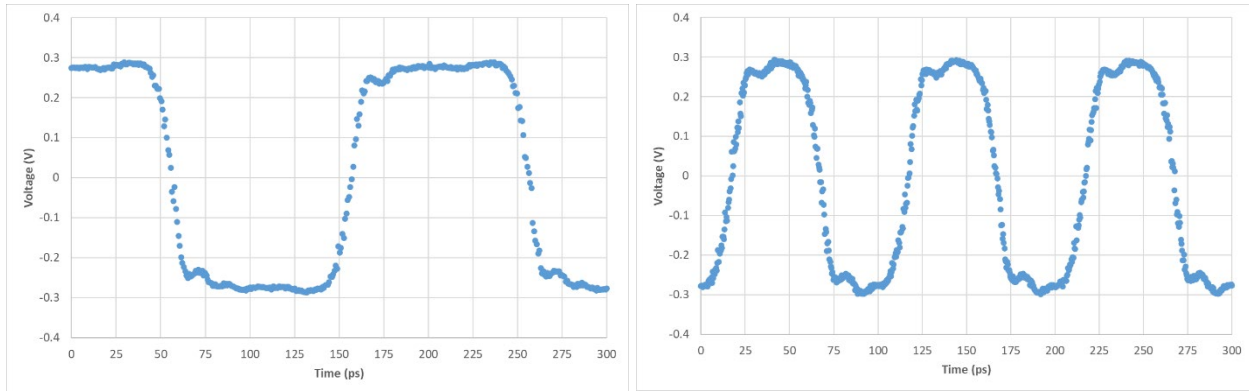


Figure 6 – TPS002-2 differential output with 10GHz and 20GHz input.

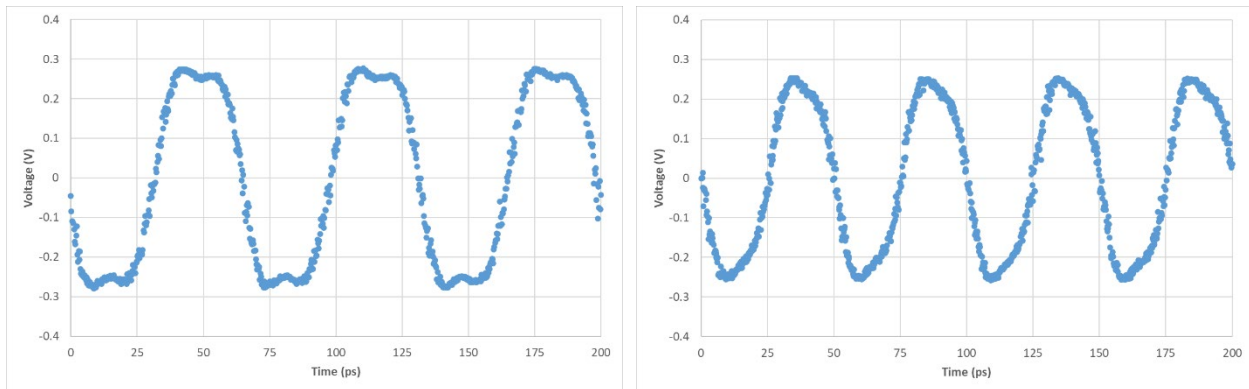


Figure 7 – TPS002-2 differential output with 30GHz and 40GHz input.

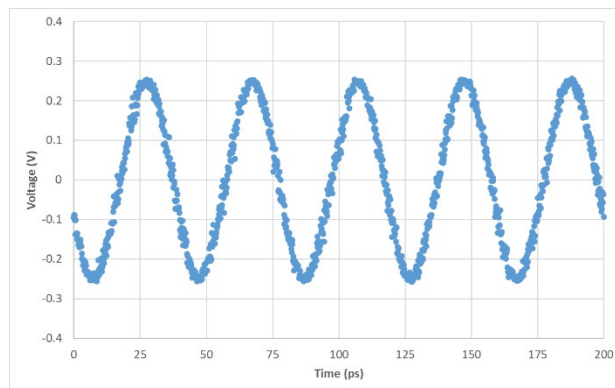
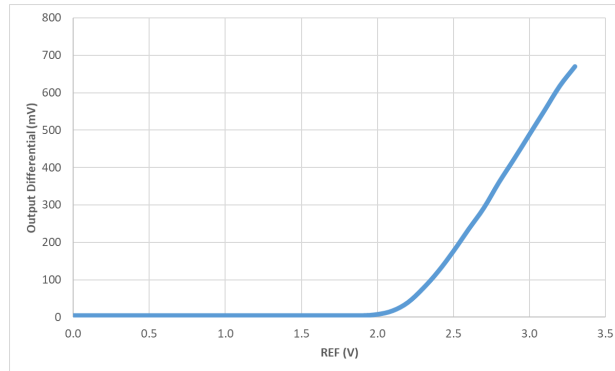


Figure 8 – TPS002-2 differential output with 50GHz input.



**Figure 9 – TPS002-X differential output vs REF voltage.**

## Package Information -QN

The package is an organic laminate 20 IO QFN.

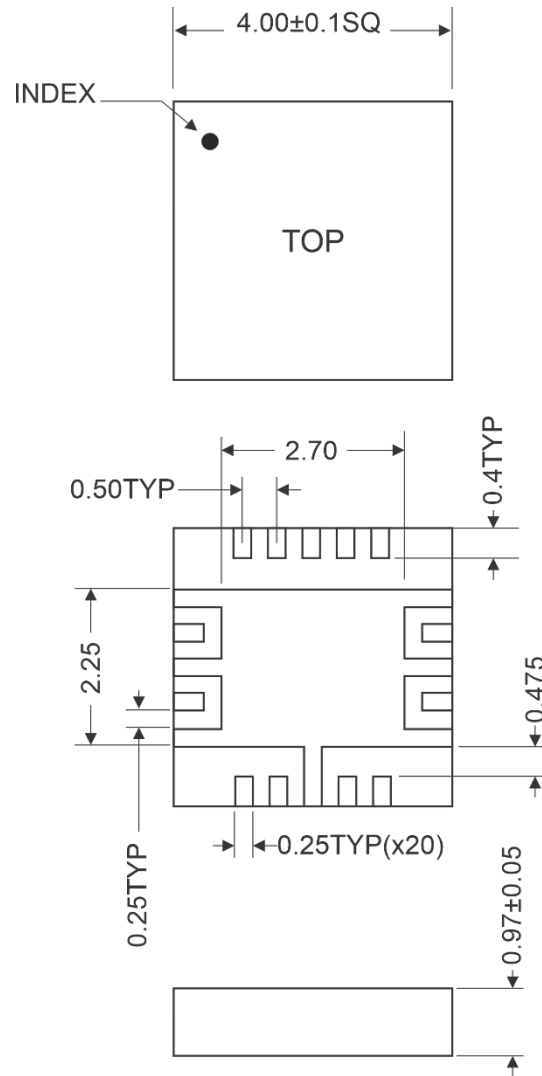


Figure 10 – TPS002-X-QN package outline, dimensions in mm.