0.1-1Gsps Dual-Stage Differential Track-and-Hold
TH720

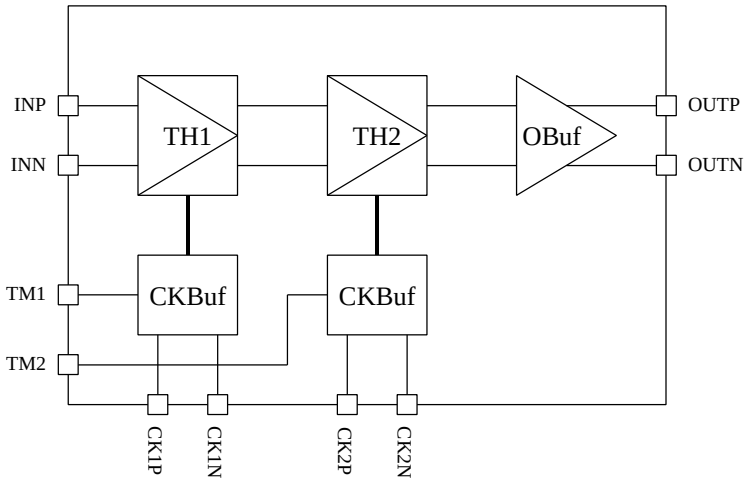
PRODUCT DESCRIPTION

TH720 is a dual-stage differential Track-and-Hold amplifier with independent clock inputs. TH720 is able to sample 1 GHz signal with 12 bits of resolution, making it an ideal solution for high-speed high-resolution data acquisition systems like instrumentation, radio, radar, tester, etc.

KEY FEATURES

- 1.5 GHz large- and small-signal bandwidth
- 100-1000 MHz sampling rate
- -82 dB THD (50MHz 250mVp-p input 100Msps)
- -77 dB THD (500MHz 250mVp-p input 100Msps)
- -74 dB THD (1GHz 250mVp-p input 100Msps)
- < 200 ps rise/fall time (20-80%)
- Adjustable output common mode voltage
- Independent track mode enable on both stages
- Dual +5V and –5.2V power supplies
- Plastic 5x5mm 32-pin QFN package
- 1.5W

BLOCK DIAGRAM



ELECTRICAL SPECIFICATIONS

Parameter	Conditions/Note	Min	Typical	Max	Unit
ANALOG INPUT					
Full Scale Range	Differential		1		Vp-p
Common Mode Voltage		-100	0	100	mV
Input Resistance	Single-ended to GND	45	50	55	Ω
Input Capacitance	Single-ended to GND		100		fF
CLOCK INPUT					
Amplitude	Differential, sinusoidal	250	500	1000	mV
Common Mode Voltage		-200	0	200	mV
Input Resistance		45	50	55	Ω
Input Capacitance			100		fF
DIGITAL INPUT					
TM1/2 High	Track mode	-0.5	0	0.3	V
TM1/2 Low	Hold mode	-5	Open	-2	V
Max Current Draw	Into each lead, TM1/2 high		0.6		mA
ANALOG OUTPUT					
Ext. Termination Voltage	Vto	0		2.5	V
Ext. Termination Resistor	Rto, from outputs to Vto		50		Ω
Max Swing	Differential		1		Vp-p
Common Mode Voltage	Relative to Vto		-1.6		V
Average Current	Into each output lead		TBD		mA
Max Current	Into each output lead		TBD		mA
DC CHARACTERISTIC					
Gain			1		
Offset Voltage		-15		15	mV
DYNAMIC PERFORMANCE					
Bandwidth, small signal	-3dB, signal < 0.1Vpp		1.5		GHz
Bandwidth, large signal	-3dB, signal=1Vpp		1.5		GHz
Gain Variation	100MHz to 800MHz	-0.5		0.5	dB
Integrated Noise	Input referred		TBD		µV
Noise Floor	Input referred		TBD		nV/ns
TH1 Hold Feedthrough	1Vpp 500MHz input		-68		dB

Notes:
-Above measurements are with differential 100MHz out-of-phase CK1 & CK2.
-Vto=2V

ELECTRICAL SPECIFICATIONS (CONTINUED)

Parameter	Conditions/Note	Min	Typical	Max	Unit
DYNAMIC PERFORMANCE (continued)					
SFDR, 48 MHz input	Differential 250mVpp input		81		dB
SFDR, 248 MHz input	Differential 250mVpp input		80		dB
SFDR, 448 MHz input	Differential 250mVpp input		77		dB
SFDR, 1048 MHz input	Differential 250mVpp input		74		dB
SFDR, 2048 MHz input	Differential 250mVpp input		62		dB
THD, 48 MHz input	Differential 250mVpp input		-83		dB
THD, 248 MHz input	Differential 250mVpp input		-82		dB
THD, 448 MHz input	Differential 250mVpp input		-79		dB
THD, 1048 MHz input	Differential 250mVpp input		-78		dB
THD, 2048 MHz input	Differential 250mVpp input		-68		dB
SFDR, 48 MHz input	Differential 500mVpp input		78		dB
SFDR, 248 MHz input	Differential 500mVpp input		76		dB
SFDR, 448 MHz input	Differential 500mVpp input		73		dB
SFDR, 1048 MHz input	Differential 500mVpp input		67		dB
SFDR, 2048 MHz input	Differential 500mVpp input		58		dB
THD, 48 MHz input	Differential 500mVpp input		-76		dB
THD, 248 MHz input	Differential 500mVpp input		-74		dB
THD, 448 MHz input	Differential 500mVpp input		-72		dB
THD, 1048 MHz input	Differential 500mVpp input		-66		dB
THD, 2048 MHz input	Differential 500mVpp input		-55		dB
SFDR, 48 MHz input	Differential 1Vpp input		66		dB
SFDR, 248 MHz input	Differential 1Vpp input		64		dB
SFDR, 448 MHz input	Differential 1Vpp input		66		dB
SFDR, 1048 MHz input	Differential 1Vpp input		61		dB
SFDR, 2048 MHz input	Differential 1Vpp input		50		dB
THD, 48 MHz input	Differential 1Vpp input		-65		dB
THD, 248 MHz input	Differential 1Vpp input		-63		dB
THD, 448 MHz input	Differential 1Vpp input		-64		dB
THD, 1048 MHz input	Differential 1Vpp input		-60		dB
THD, 2048 MHz input	Differential 1Vpp input		-49		dB

Notes:
-Above measurements are with differential 100MHz out-of-phase CK1 & CK2.
-Vto=2V

ELECTRICAL SPECIFICATIONS (CONTINUED)

Parameter	Conditions/Note	Min	Typical	Max	Unit
DYNAMIC PERFORMANCE (continued)					
SFDR, 48 MHz input	Differential 250mVpp input		80		dB
SFDR, 548 MHz input	Differential 250mVpp input		76		dB
SFDR, 1048 MHz input	Differential 250mVpp input		74		dB
SFDR, 2048 MHz input	Differential 250mVpp input		65		dB
THD, 48 MHz input	Differential 250mVpp input		-80		dB
THD, 548 MHz input	Differential 250mVpp input		-73		dB
THD, 1048 MHz input	Differential 250mVpp input		-71		dB
THD, 2048 MHz input	Differential 250mVpp input		-65		dB
SFDR, 48 MHz input	Differential 500mVpp input		79		dB
SFDR, 548 MHz input	Differential 500mVpp input		77		dB
SFDR, 1048 MHz input	Differential 500mVpp input		75		dB
SFDR, 2048 MHz input	Differential 500mVpp input		62		dB
THD, 48 MHz input	Differential 500mVpp input		-80		dB
THD, 548 MHz input	Differential 500mVpp input		-75		dB
THD, 1048 MHz input	Differential 500mVpp input		-73		dB
THD, 2048 MHz input	Differential 500mVpp input		-61		dB
SFDR, 48 MHz input	Differential 1Vpp input		71		dB
SFDR, 548 MHz input	Differential 1Vpp input		68		dB
SFDR, 1048 MHz input	Differential 1Vpp input		68		dB
SFDR, 2048 MHz input	Differential 1Vpp input		57		dB
THD, 48 MHz input	Differential 1Vpp input		-78		dB
THD, 548 MHz input	Differential 1Vpp input		-76		dB
THD, 1048 MHz input	Differential 1Vpp input		-76		dB
THD, 2048 MHz input	Differential 1Vpp input		-57		dB

Notes:
-Above measurements are with differential 500MHz out-of-phase CK1 & CK2.
-Vto=2V

ELECTRICAL SPECIFICATIONS (CONTINUED)

Parameter	Conditions/Note	Min	Typical	Max	Unit
DYNAMIC PERFORMANCE (continued)					
SFDR, 48 MHz input	Differential 250mVpp input		78		dB
SFDR, 1048 MHz input	Differential 250mVpp input		79		dB
SFDR, 2048 MHz input	Differential 250mVpp input		71		dB
THD, 48 MHz input	Differential 250mVpp input		-78		dB
THD, 1048 MHz input	Differential 250mVpp input		-78		dB
THD, 2048 MHz input	Differential 250mVpp input		-71		dB
SFDR, 48 MHz input	Differential 500mVpp input		76		dB
SFDR, 1048 MHz input	Differential 500mVpp input		76		dB
SFDR, 2048 MHz input	Differential 500mVpp input		67		dB
THD, 48 MHz input	Differential 500mVpp input		-76		dB
THD, 1048 MHz input	Differential 500mVpp input		-77		dB
THD, 2048 MHz input	Differential 500mVpp input		-67		dB
SFDR, 48 MHz input	Differential 1Vpp input		64		dB
SFDR, 1048 MHz input	Differential 1Vpp input		62		dB
SFDR, 2048 MHz input	Differential 1Vpp input		61		dB
THD, 48 MHz input	Differential 1Vpp input		-72		dB
THD, 1048 MHz input	Differential 1Vpp input		-62		dB
THD, 2048 MHz input	Differential 1Vpp input		-61		dB

Notes:
-Above measurements are with differential 1000MHz out-of-phase CK1 & CK2.
-Vto=2V

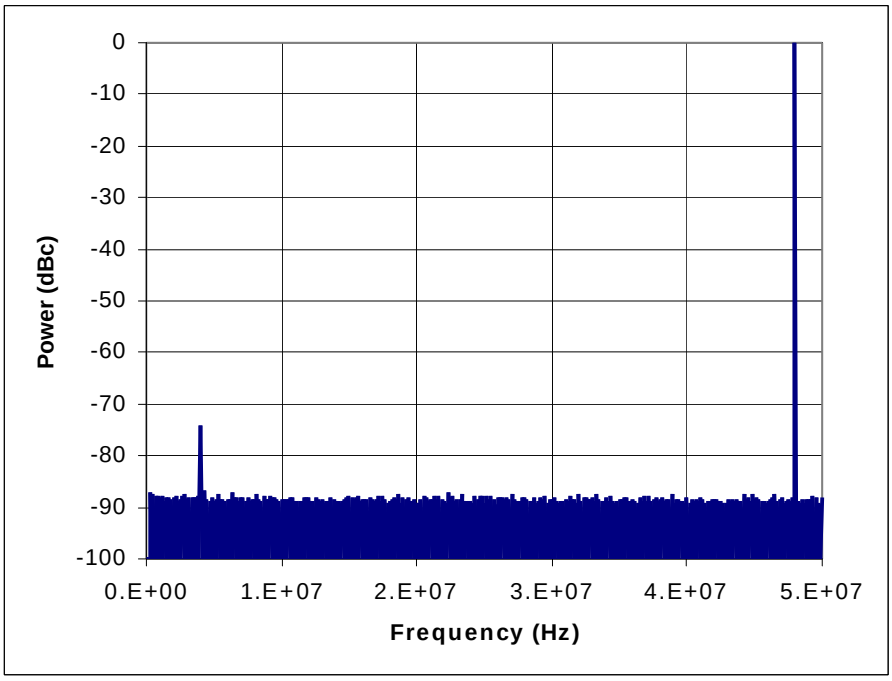
TRACK-TO-HOLD AND HOLD STATE, TH1					
Aperture Delay	After CK1 goes negative		120		ps
Aperture Jitter	Jitter free 0.5 Vpp 1 GHz CK1		110		fs
Settling Time	To 1 mV		320		ps
Differential Pedestal	Relative to Vin		-1		%
Differential Droop Rate	Relative to Vin		-0.5		%/ns
Hold Noise			TBD		μV/√Hz
Min Clock Frequency	50% duty cycle clock		100		MHz
Max Clock Frequency	50% duty cycle clock		1000		MHz
Max Hold Time			10		ns
HOLD-TO-TRACK AND TRACK TATE, TH1					
Acquisition Time	To 1 mV, FSR step input		300		ps
Max Acquisition Slew Rate	FSR step input		2		V/ns
Rise Time	20-80%		200		ps
Min Track Time			0.5		ns
Recovery Time			3		ns
TRACK-TO-HOLD AND HOLD STATE, TH2					
Aperture Delay	After CK1 goes negative		120		ps
Settling Time	To 1 mV		320		ps
Differential Pedestal	Relative to Vin		-0.5		%
Differential Droop Rate	Relative to Vin		-0.2		%/ns
Hold Noise			TBD		μV/√Hz
Min Clock Frequency	50% duty cycle clock		100		MHz
Max Clock Frequency	50% duty cycle clock		1000		MHz
Max Hold Time			20		ns
HOLD-TO-TRACK AND TRACK STATE, TH2					
Min Track Time	After TH1 in Hold Mode		0.5		ns
Recovery Time			4		ns

Notes:
-Above measurements are with differential 100MHz out-of-phase CK1 & CK2 clocks.
-Vto=2V

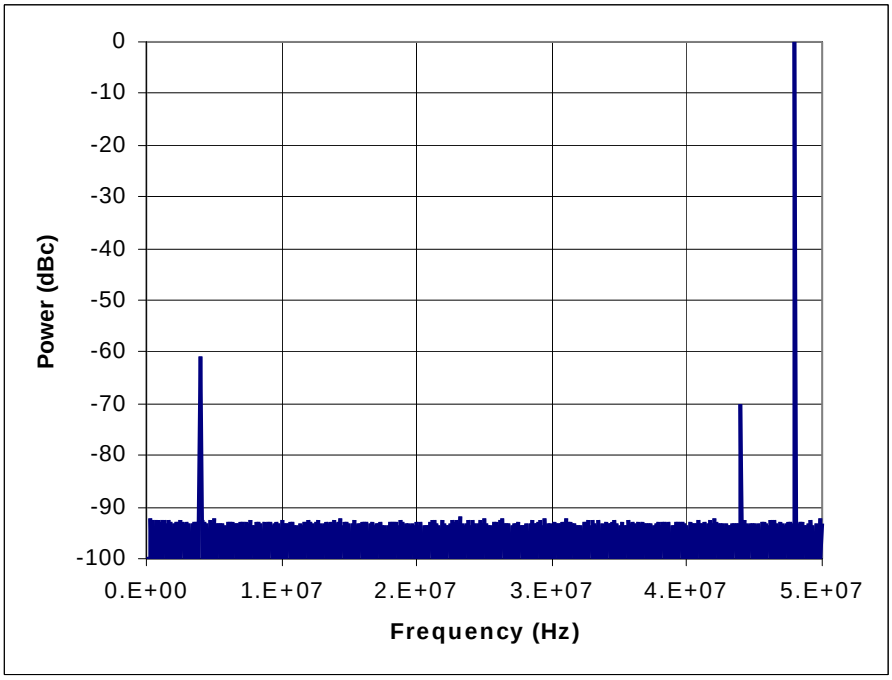
ELECTRICAL SPECIFICATIONS (CONTINUED)

Parameter	Conditions/Note	Min	Typical	Max	Unit
POWER SUPPLY					
Positive Supply Voltage	Vcc	4.75	5	5.25	V
Vcc Current	Icc		60		mA
Negative Supply Voltage	Vee	-5.45	-5.2	-4.95	V
Vee Current	Iee		200		mA
Vto Current	Ivto		65		mA
Power Dissipation			1.5		W
Warm Up Time			10		s

TYPICAL OUTPUT SPECTRUM

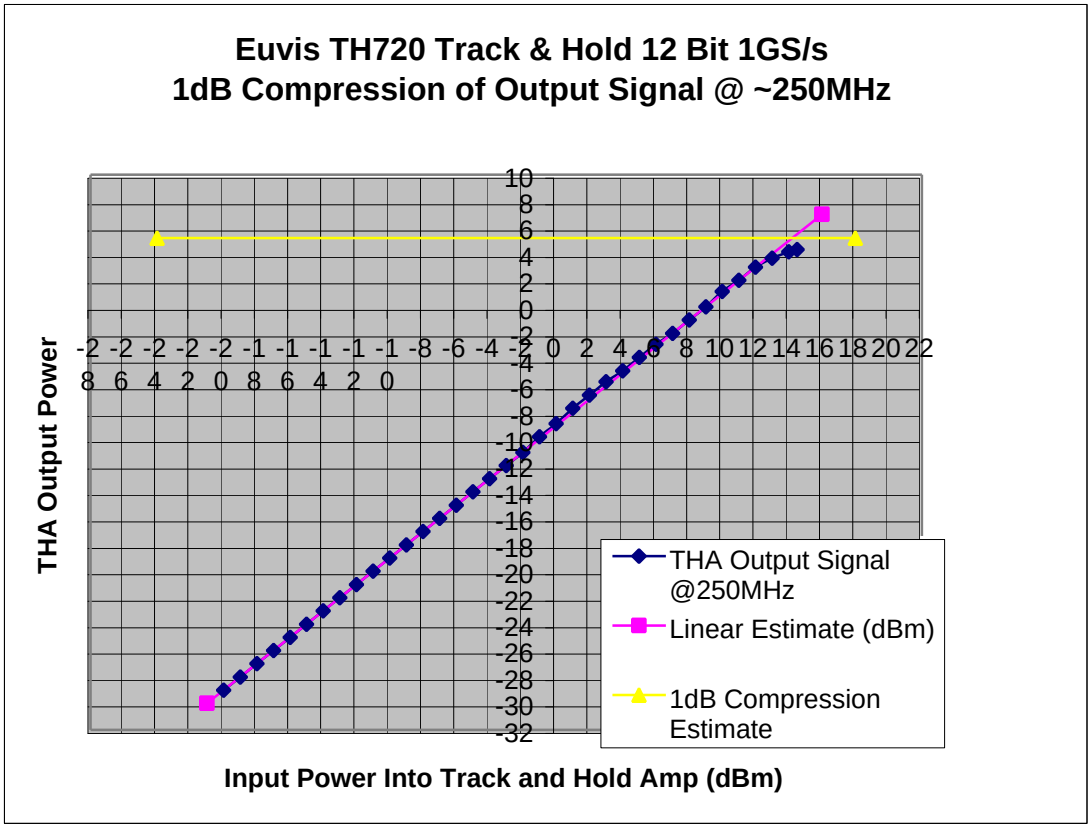


Input: 1048 MHz, 250 mVpp differential
Clock: 100 MHz



Input: 1048 MHz, 1Vpp differential
Clock: 100 MHz

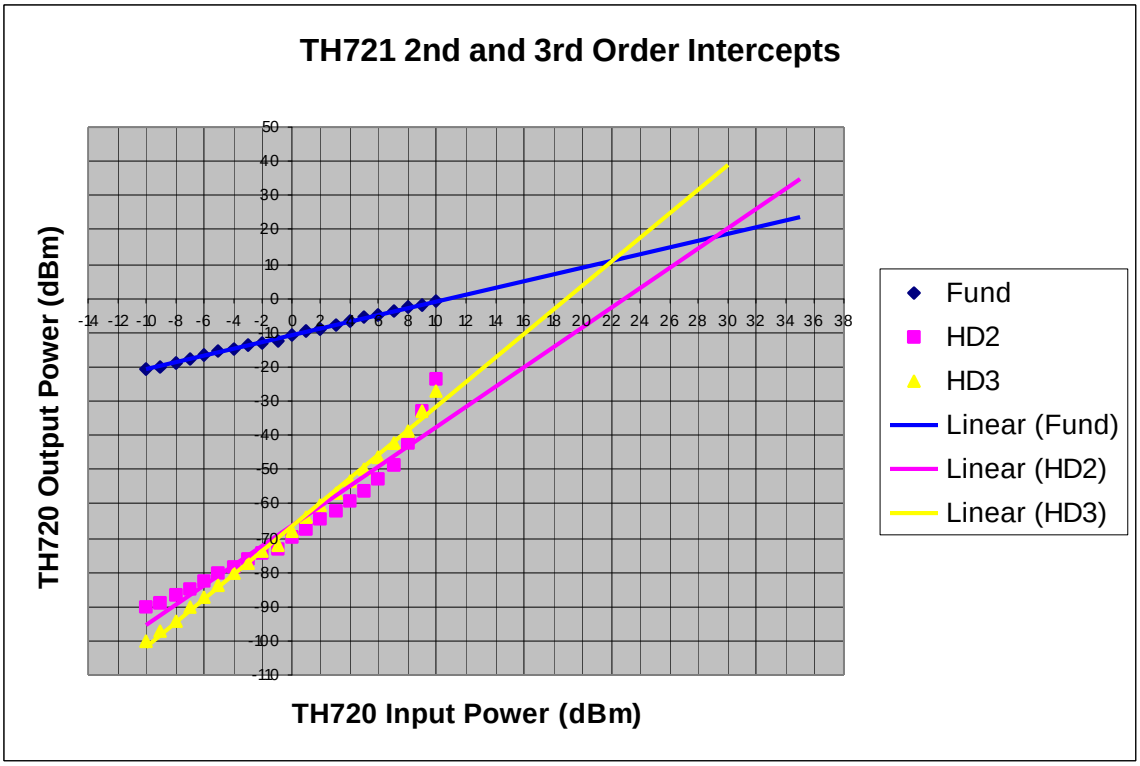
LINEARITY MEASUREMENTS



1 dB compression point = 5.2 dBm output
conversion gain @ 1 dB compression point = -3.83 dB

Notes:
-Input power into track and hold amplifier is single-ended. The single-ended output will be –6 dB lower than the single-ended input. Output power in the chart does not reflect the –6dB correction.

LINEARITY MEASUREMENTS CONTINUED

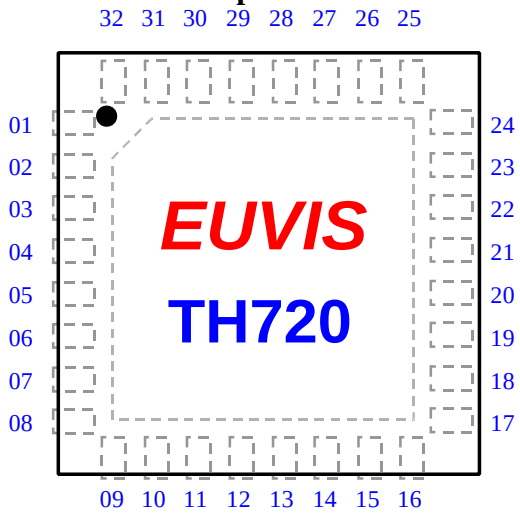


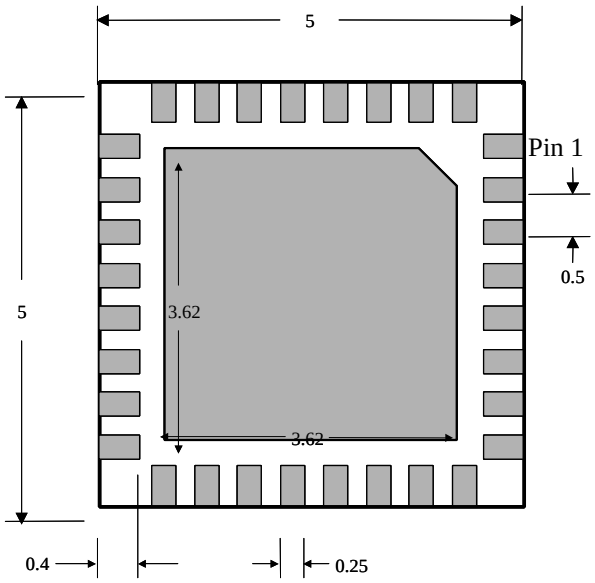
2nd Order intercept located: (33.4 dBm input, 25 dBm output)
3rd Order intercept located: (24.9 dBm input, 16.55 dBm output)

PACKAGE OUTLINE DIMENSIONS

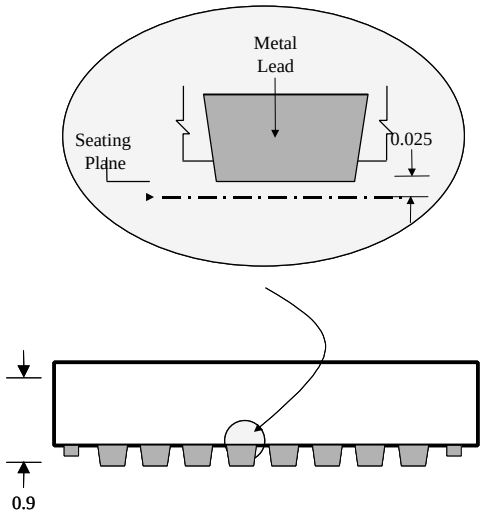
- Unit: mm
- Package Format: 32-pin QFN
- Package Size: 5 mm x 5 mm
- Pin Pitch: 0.5 mm

Top View





Bottom View



Side View

PIN DESCRIPTION

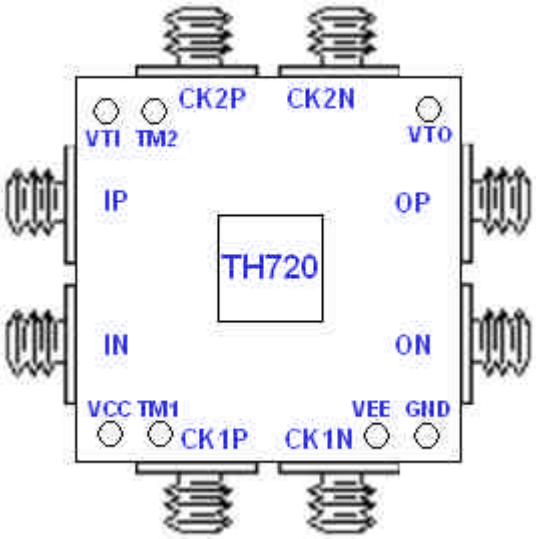
Pin	Name	Function
2, 23	**VCC**	Positive power supply
7, 18	**VEE**	Negative power supply
17, 24	**VTO**	Output termination voltage
4	**INP**	Positive input
5	**INN**	Negative input
21	**OUTP**	Positive output
20	**OUTN**	Negative output
12	**CK1P**	Clock 1 positive input
13	**CK1N**	Clock 1 negative input
29	**CK2P**	Clock 2 positive input
28	**CK2N**	Clock 2 negative input
10	**TM1**	Track mode select for T/H stage 1
31	**TM2**	Track mode select for T/H stage 2
1, 3, 6, 8, 9, 11, 14, 16, 19, 22, 25, 27, 30, 32	**GND**	Ground
15, 26	**NC**	No connection

ABSOLUTE MAXIMUM RATINGS

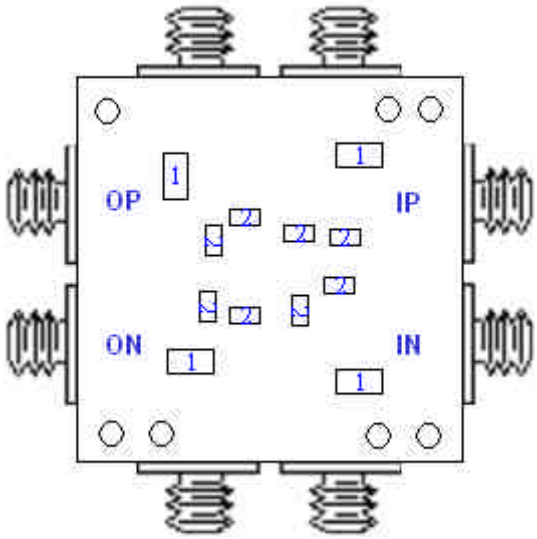
Vcc	0V to 6V
Vee	-6V to 0V
Vto	0V to 6V
Inputs (INP/N, CK1P/N, CK2P/N)	-1V to 1V
Outputs (OUTP/N)	-2V to Vcc
θ_{JA}	TBD
Maximum Junction Temperature	150°C
Operating Temperature Range	0°C to +70°C
Storage Temperature Range	-40°C to +125°C

LEAD TEMPERATURE RANGE (SOLDERING 60 SEC) **TBD**

EVALUATION PCB LAYOUT



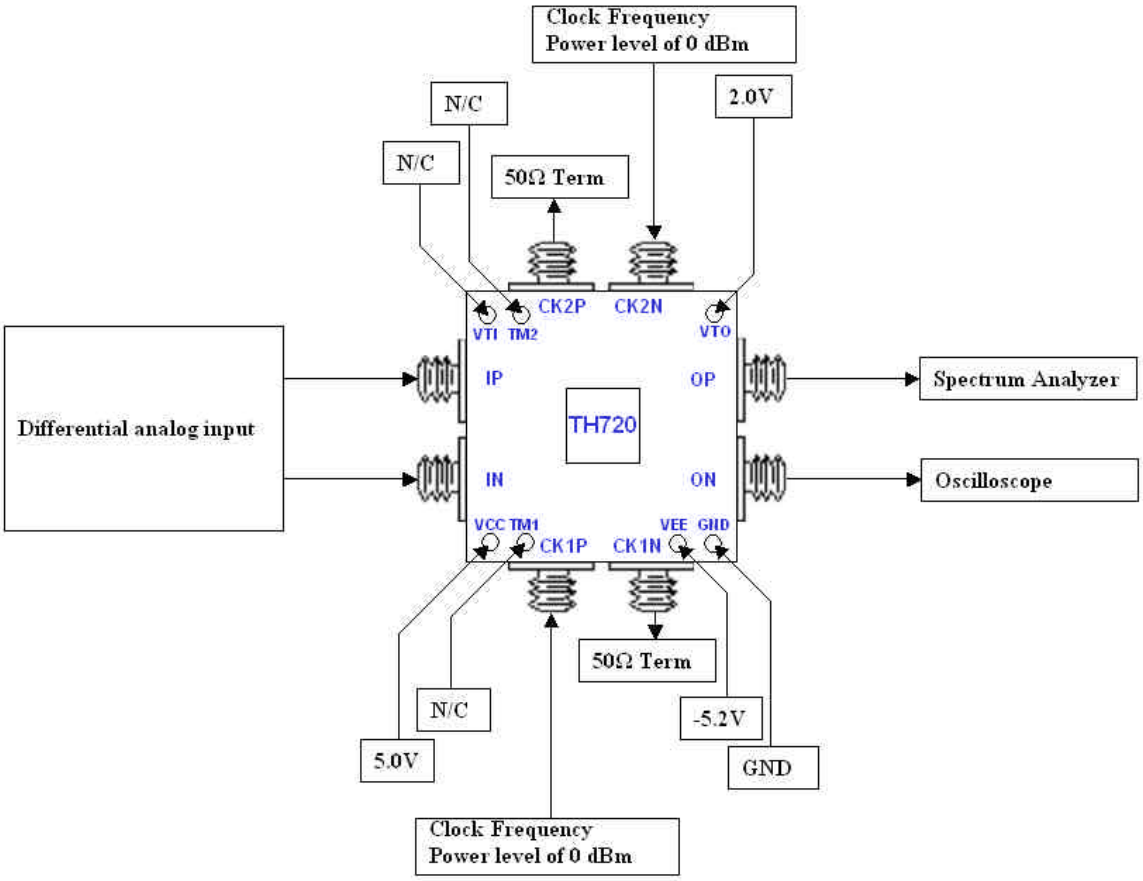
Top View



Bottom View

Notes:
-Parts labeled “1” are 0603 10 uF Capacitors
-Parts labeled “2” are 0402 100 nF Capacitors

TYPICAL CONNECTION DIAGRAM



Description:
The measurements in the TH720 data sheet were taken using the setup above. First, connect the output OP to a spectrum analyzer and output ON to an oscilloscope. Then, connect the differential analog input to IP and IN. Connect the clock frequency to CK1P and CK2N. Terminate the unconnected SMA connectors with a 50Ω termination caps. After the SMA connections are properly made, connect power supply outputs to the corresponding DC pins without turning on the power. When ready to use, supply a DC voltage of +5.0V to VCC, +2.0V to VTO, and –5.2V to VEE.

Notes:
-Using appropriate band-pass filters for the input signal may improve performance.

ORDERING INFORMATION

E-mail: sales@euvis.com
Tel: (805) 583-9888
Fax: (805) 583-9889

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