

1Gsps Dual-Stage Differential Track-and-Hold TH721

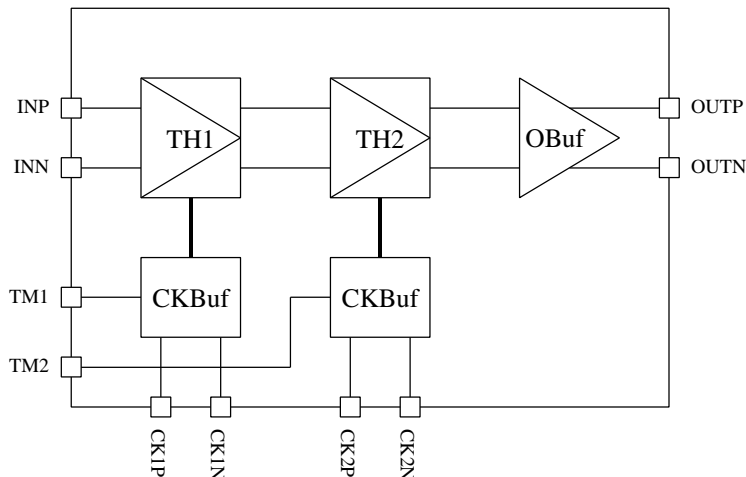
PRODUCT DESCRIPTION

TH721 is a dual-stage differential Track-and-Hold amplifier with independent clock inputs. TH721 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

- 9 GHz small-signal bandwidth
- 8 GHz large-signal bandwidth (1 V_{p-p} differential)
- 100-1000 MHz sampling rate
- -71 dB THD (single-ended 250mV_{p-p} 1GHz input)
- -66 dB THD (single-ended 250mV_{p-p} 2GHz input)
- -64 dB THD (single-ended 250mV_{p-p} 3GHz input)
- < 100 fs aperture jitter
- < 250 ps acquisition time
- < 40 ps rise time (20-80%)
- Differential analog input/output
- Excellent performance with single-ended input
- Adjustable output common mode voltage
- Independent track mode enable on both stages

BLOCK DIAGRAM



ELECTRICAL SPECIFICATIONS

Parameter	Conditions/Note	Min	Typical	Max	Unit
ANALOG INPUT					
Full Scale Range	Differential		1		V _{p-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	V _{to}	1.5		3.5	V
Ext. Termination Resistor	R _{to} , from outputs to V _{to}		50		Ω
Max Swing	Differential		1		V _{p-p}
Common Mode Voltage	Relative to GND	0.5		2.5	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 < 0.1V _{pp}		9		GHz
Bandwidth, large signal	-3dB, signal=1V _{pp}		8		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	1V _{pp} 500MHz input		-75		dB

Notes:

-Above measurements are with differential 1000MHz out-of-phase CK1 & CK2.

-V_{to}=2V

ELECTRICAL SPECIFICATIONS (CONTINUED)

Parameter	Conditions/Note	Min	Typical	Max	Unit
DYNAMIC PERFORMANCE (continued)					
SFDR, 60 MHz input	Single-ended 250mVpp input		87		dB
SFDR, 1060 MHz input	Single-ended 250mVpp input		71		dB
SFDR, 2060 MHz input	Single-ended 250mVpp input		66		dB
SFDR, 3060 MHz input	Single-ended 250mVpp input		64		dB
SFDR, 4060 MHz input	Single-ended 250mVpp input		59		dB
SFDR, 5060 MHz input	Single-ended 250mVpp input		51		dB
SFDR, 6060 MHz input	Single-ended 250mVpp input		48		dB
SFDR, 7060 MHz input	Single-ended 250mVpp input		48		dB
SFDR, 60 MHz input	Single-ended 500mVpp input		77		dB
SFDR, 1060 MHz input	Single-ended 500mVpp input		62		dB
SFDR, 2060 MHz input	Single-ended 500mVpp input		57		dB
SFDR, 3060 MHz input	Single-ended 500mVpp input		55		dB
SFDR, 4060 MHz input	Single-ended 500mVpp input		49		dB
SFDR, 5060 MHz input	Single-ended 500mVpp input		42		dB
SFDR, 6060 MHz input	Single-ended 500mVpp input		41		dB
SFDR, 7060 MHz input	Single-ended 500mVpp input		42		dB
SFDR, 60 MHz input	Single-ended 1Vpp input		68		dB
SFDR, 1060 MHz input	Single-ended 1Vpp input		51		dB
SFDR, 2060 MHz input	Single-ended 1Vpp input		46		dB
SFDR, 3060 MHz input	Single-ended 1Vpp input		45		dB
SFDR, 4060 MHz input	Single-ended 1Vpp input		38		dB
SFDR, 5060 MHz input	Single-ended 1Vpp input		35		dB
SFDR, 6060 MHz input	Single-ended 1Vpp input		33		dB
SFDR, 7060 MHz input	Single-ended 1Vpp input		33		dB

Notes:

-Above measurements are with single-ended 1000MHz out-of-phase CK1 & CK2.

-Vto=2V

ELECTRICAL SPECIFICATIONS (CONTINUED)

Parameter	Conditions/Note	Min	Typical	Max	Unit
DYNAMIC PERFORMANCE (continued)					
THD, 60 MHz input	Single-ended 250mVpp input		-85		dB
THD, 1060 MHz input	Single-ended 250mVpp input		-66		dB
THD, 2060 MHz input	Single-ended 250mVpp input		-63		dB
THD, 3060 MHz input	Single-ended 250mVpp input		-63		dB
THD, 4060 MHz input	Single-ended 250mVpp input		-53		dB
THD, 5060 MHz input	Single-ended 250mVpp input		-48		dB
THD, 6060 MHz input	Single-ended 250mVpp input		-47		dB
THD, 7060 MHz input	Single-ended 250mVpp input		-50		dB
THD, 60 MHz input	Single-ended 500mVpp input		-77		dB
THD, 1060 MHz input	Single-ended 500mVpp input		-60		dB
THD, 2060 MHz input	Single-ended 500mVpp input		-56		dB
THD, 3060 MHz input	Single-ended 500mVpp input		-56		dB
THD, 4060 MHz input	Single-ended 500mVpp input		-46		dB
THD, 5060 MHz input	Single-ended 500mVpp input		-42		dB
THD, 6060 MHz input	Single-ended 500mVpp input		-41		dB
THD, 7060 MHz input	Single-ended 500mVpp input		-44		dB
THD, 60 MHz input	Single-ended 1Vpp input		-69		dB
THD, 1060 MHz input	Single-ended 1Vpp input		-51		dB
THD, 2060 MHz input	Single-ended 1Vpp input		-47		dB
THD, 3060 MHz input	Single-ended 1Vpp input		-46		dB
THD, 4060 MHz input	Single-ended 1Vpp input		-37		dB
THD, 5060 MHz input	Single-ended 1Vpp input		-34		dB
THD, 6060 MHz input	Single-ended 1Vpp input		-33		dB
THD, 7060 MHz input	Single-ended 1Vpp input		-37		dB

Notes:

-Above measurements are with single-ended 1000MHz out-of-phase CK1 & CK2.

-Vto=2V

ELECTRICAL SPECIFICATIONS (CONTINUED)

Parameter	Conditions/Note	Min	Typical	Max	Unit
DYNAMIC PERFORMANCE (continued)					
SFDR, 60 MHz input	Differential 250mVpp input		87		dB
SFDR, 1060 MHz input	Differential 250mVpp input		80		dB
SFDR, 2060 MHz input	Differential 250mVpp input		75		dB
SFDR, 3060 MHz input	Differential 250mVpp input		70		dB
SFDR, 4060 MHz input	Differential 250mVpp input		57		dB
SFDR, 5060 MHz input	Differential 250mVpp input		60		dB
SFDR, 6060 MHz input	Differential 250mVpp input		57		dB
SFDR, 7060 MHz input	Differential 250mVpp input		61		dB
SFDR, 60 MHz input	Differential 500mVpp input		80		dB
SFDR, 1060 MHz input	Differential 500mVpp input		76		dB
SFDR, 2060 MHz input	Differential 500mVpp input		71		dB
SFDR, 3060 MHz input	Differential 500mVpp input		68		dB
SFDR, 4060 MHz input	Differential 500mVpp input		51		dB
SFDR, 5060 MHz input	Differential 500mVpp input		59		dB
SFDR, 6060 MHz input	Differential 500mVpp input		53		dB
SFDR, 7060 MHz input	Differential 500mVpp input		55		dB
SFDR, 60 MHz input	Differential 1Vpp input		75		dB
SFDR, 1060 MHz input	Differential 1Vpp input		69		dB
SFDR, 2060 MHz input	Differential 1Vpp input		67		dB
SFDR, 3060 MHz input	Differential 1Vpp input		63		dB
SFDR, 4060 MHz input	Differential 1Vpp input		45		dB
SFDR, 5060 MHz input	Differential 1Vpp input		50		dB
SFDR, 6060 MHz input	Differential 1Vpp input		55		dB
SFDR, 7060 MHz input	Differential 1Vpp input		59		dB

Notes:

-Above measurements are with differential 1000MHz out-of-phase CK1 & CK2.

-Vto=2V

ELECTRICAL SPECIFICATIONS (CONTINUED)

Parameter	Conditions/Note	Min	Typical	Max	Unit
DYNAMIC PERFORMANCE (continued)					
THD, 60 MHz input	Differential 250mVpp input		-85		dB
THD, 1060 MHz input	Differential 250mVpp input		-80		dB
THD, 2060 MHz input	Differential 250mVpp input		-69		dB
THD, 3060 MHz input	Differential 250mVpp input		-61		dB
THD, 4060 MHz input	Differential 250mVpp input		-56		dB
THD, 5060 MHz input	Differential 250mVpp input		-55		dB
THD, 6060 MHz input	Differential 250mVpp input		-51		dB
THD, 7060 MHz input	Differential 250mVpp input		-54		dB
THD, 60 MHz input	Differential 500mVpp input		-76		dB
THD, 1060 MHz input	Differential 500mVpp input		-73		dB
THD, 2060 MHz input	Differential 500mVpp input		-60		dB
THD, 3060 MHz input	Differential 500mVpp input		-53		dB
THD, 4060 MHz input	Differential 500mVpp input		-50		dB
THD, 5060 MHz input	Differential 500mVpp input		-49		dB
THD, 6060 MHz input	Differential 500mVpp input		-51		dB
THD, 7060 MHz input	Differential 500mVpp input		-45		dB
THD, 60 MHz input	Differential 1Vpp input		-71		dB
THD, 1060 MHz input	Differential 1Vpp input		-62		dB
THD, 2060 MHz input	Differential 1Vpp input		-48		dB
THD, 3060 MHz input	Differential 1Vpp input		-43		dB
THD, 4060 MHz input	Differential 1Vpp input		-41		dB
THD, 5060 MHz input	Differential 1Vpp input		-36		dB
THD, 6060 MHz input	Differential 1Vpp input		-34		dB
THD, 7060 MHz input	Differential 1Vpp input		-35		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		60		ps
Aperture Jitter	Jitter free 0.5 V _{pp} 1 GHz CK1		100		fs
Settling Time	To 1 mV		300		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 STATE, TH1					
Acquisition Time	To 1 mV, FSR step input		250		ps
Max Acquisition Slew Rate	FSR step input		20		V/ns
Rise Time	20-80%		40		ps
Min Track Time			0.3		ns
Recovery Time			3		ns
TRACK-TO-HOLD AND HOLD STATE, TH2					
Aperture Delay	After CK1 goes negative		60		ps
Settling Time	To 1 mV		300		ps
Differential Pedestal	Relative to Vin		-0.2		%
Differential Droop Rate	Relative to Vin		-0.05		%/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 STATE, TH2					
Min Track Time	After TH1 in Hold Mode		0.5		ns
Recovery Time			4		ns

Notes:

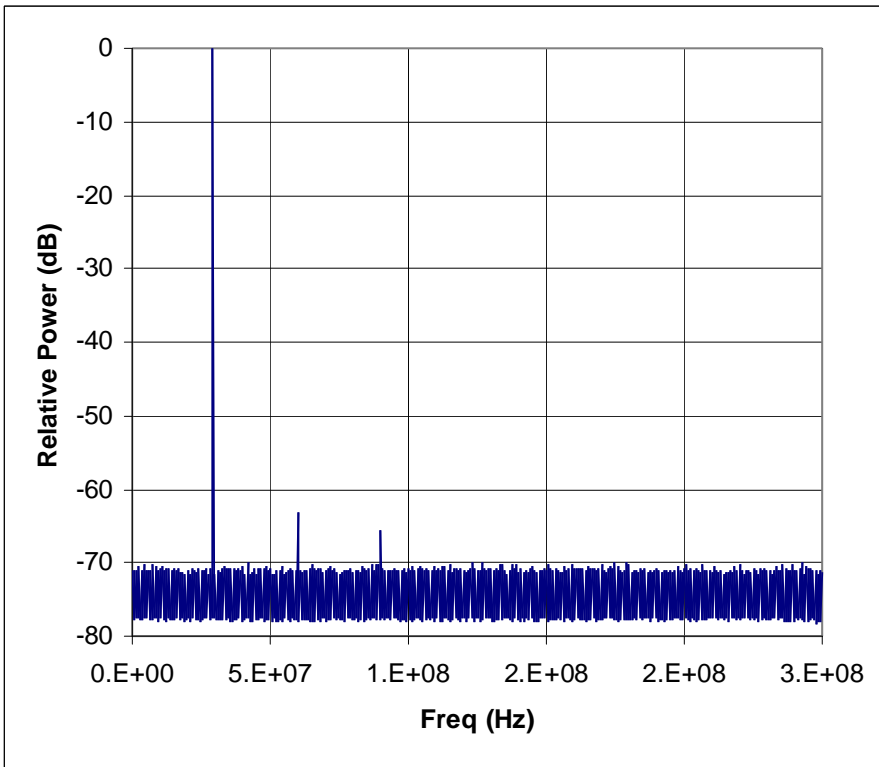
-Above measurements are with differential 1000MHz out-of-phase CK1 & CK2 clocks.

-V_{to}=2V

ELECTRICAL SPECIFICATIONS (CONTINUED)

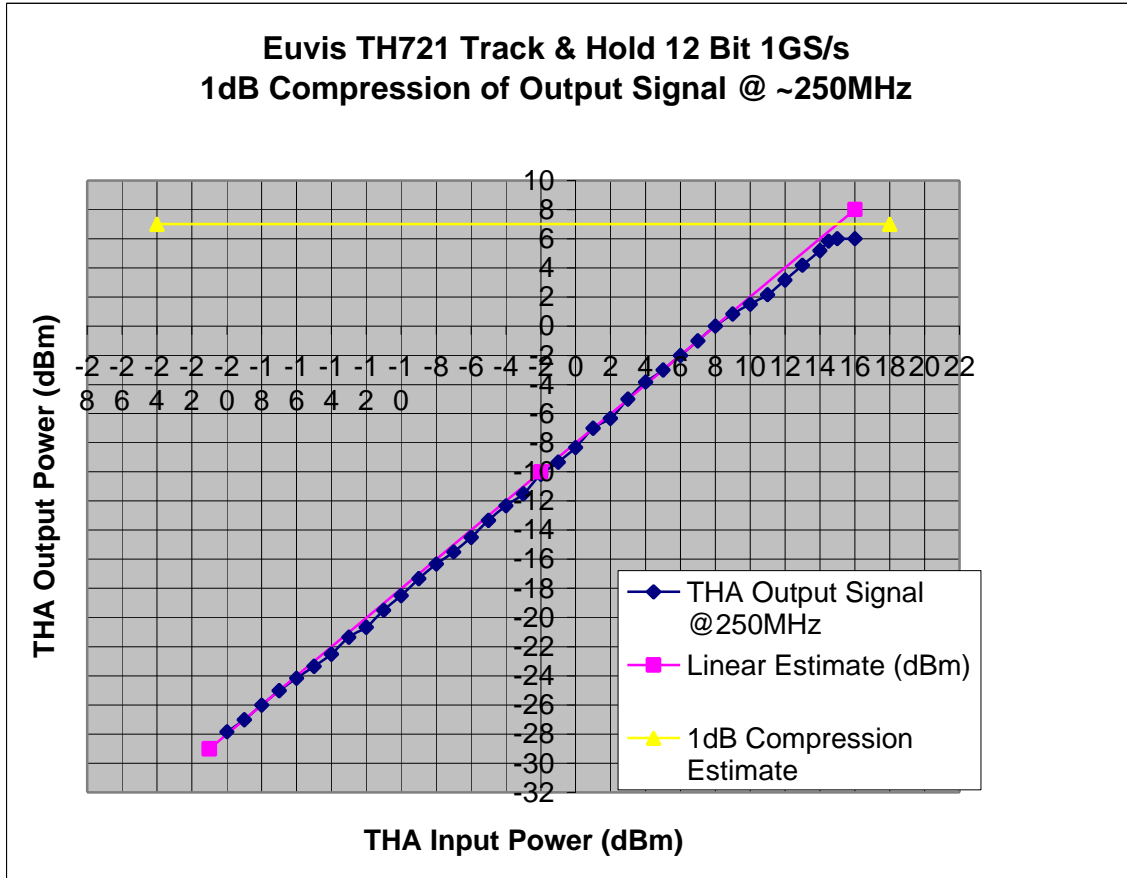
Parameter	Conditions/Note	Min	Typical	Max	Unit
POWER SUPPLY					
Positive Supply Voltage	Vcc	4.75	5	5.25	V
Vcc Current	Icc		110		mA
Negative Supply Voltage	Vee	-5.45	-5.2	-4.95	V
Vee Current	Iee		230		mA
Vto Current	Ivto		40		mA
Power Dissipation			1.9		W
Warm Up Time			10		s

TYPICAL OUTPUT SPECTRUM



Input: 3060 MHz, 250 mVpp Single-ended
Clock: 1000 MHz

LINEARITY MEASUREMENTS

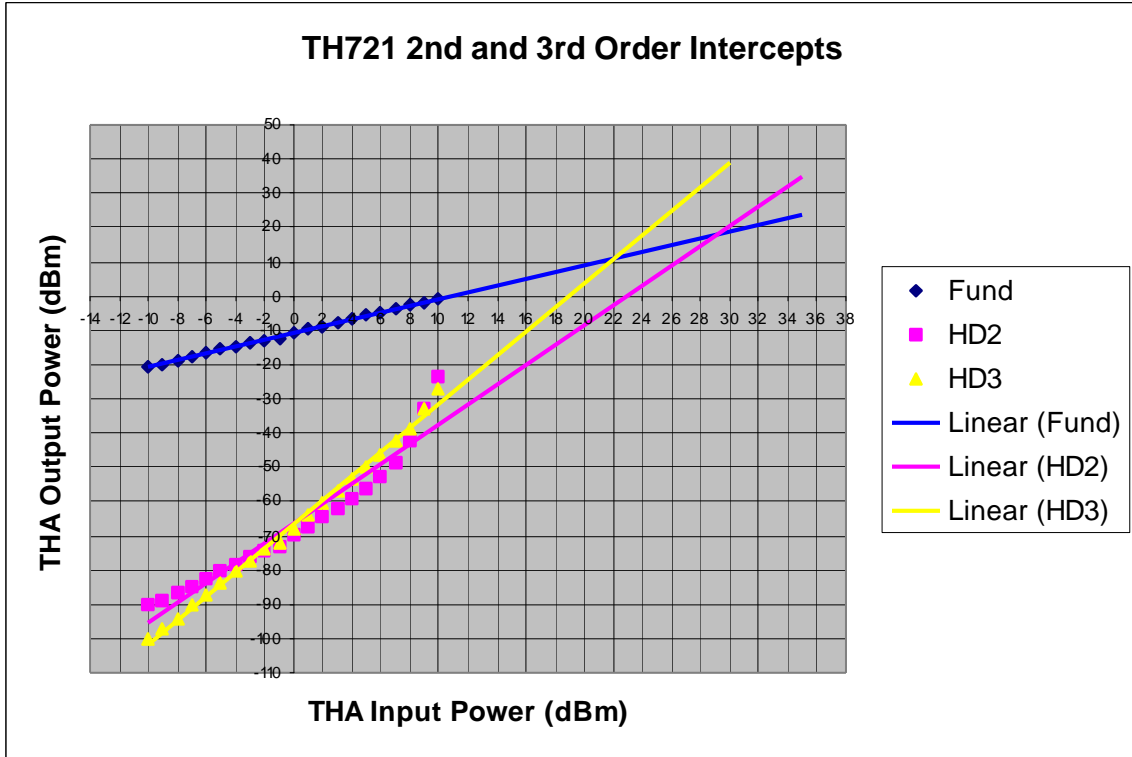


1 dB compression point = 7 dBm output
 conversion gain @ 1 dB compression point = -3 dB

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.

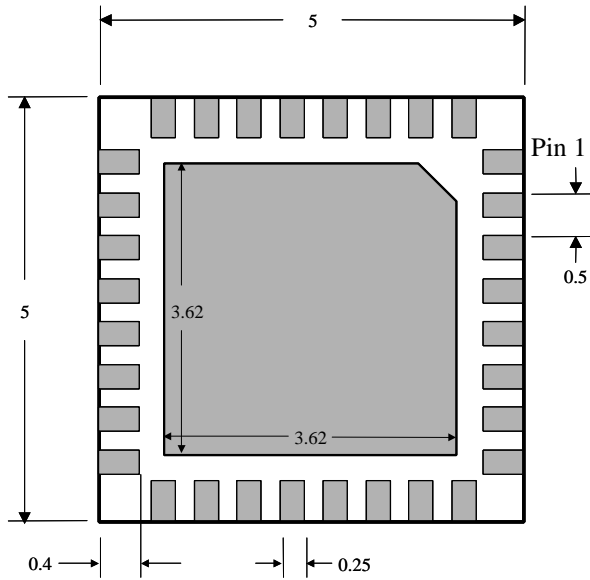
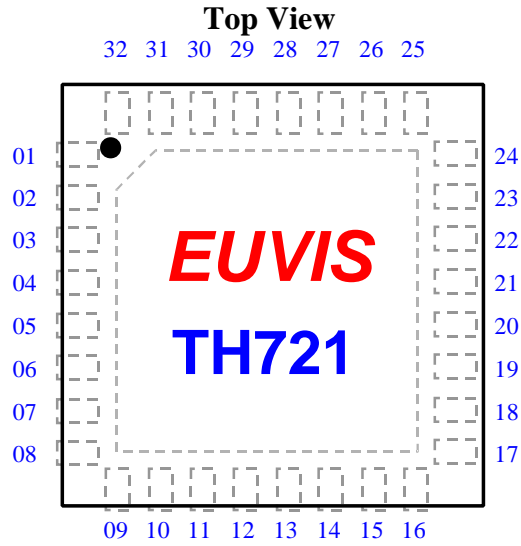
LINEARITY MEASUREMENTS CONTINUED



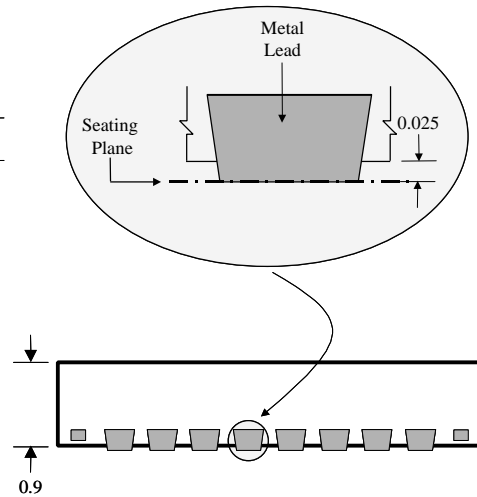
2nd Order intercept located: (29.35 dBm input, 18.3 dBm output)
3rd Order intercept located: (22.1 dBm input, 11.1 dBm output)

PACKAGE OUTLINE DIMENSIONS

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



Bottom View



Side View

PIN DESCRIPTION

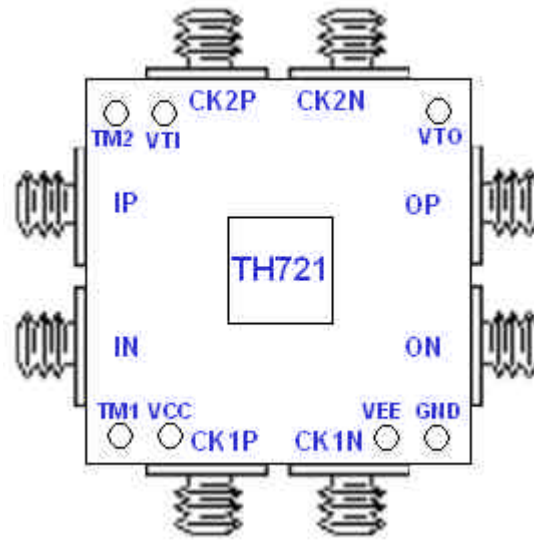
Pin	Name	Function
2, 23	VCC	Positive power supply
7, 18	VEE	Negative power supply
8, 17	VTO	Output termination voltage
28	INP	Positive input
29	INN	Negative input
13	OUTP	Positive output
12	OUTN	Negative output
4	CK1P	Clock 1 positive input
5	CK1N	Clock 1 negative input
21	CK2P	Clock 2 positive input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

ABSOLUTE MAXIMUM RATINGS

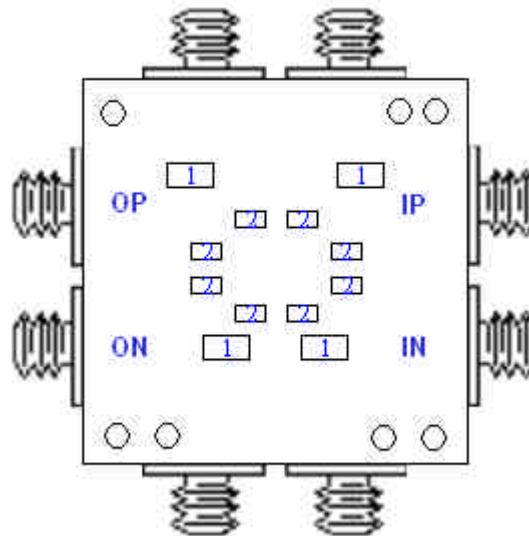
V _{cc}	0V to 6V
V _{ee}	-6V to 0V
V _{to}	0V to 6V
Inputs (INP/N, CK1P/N, CK2P/N)	-1V to 1V
Outputs (OUTP/N)	-2V to V _{cc}
θ_{JA}	TBD
Maximum Junction Temperature	150°C
Operating Temperature Range	0°C to +70°C
Storage Temperature Range	-40°C to +125°C

LEAD TEMPERATURE RANGE (SOLDERING 60 SEC) TBD

EVALUATION PCB LAYOUT



Top View

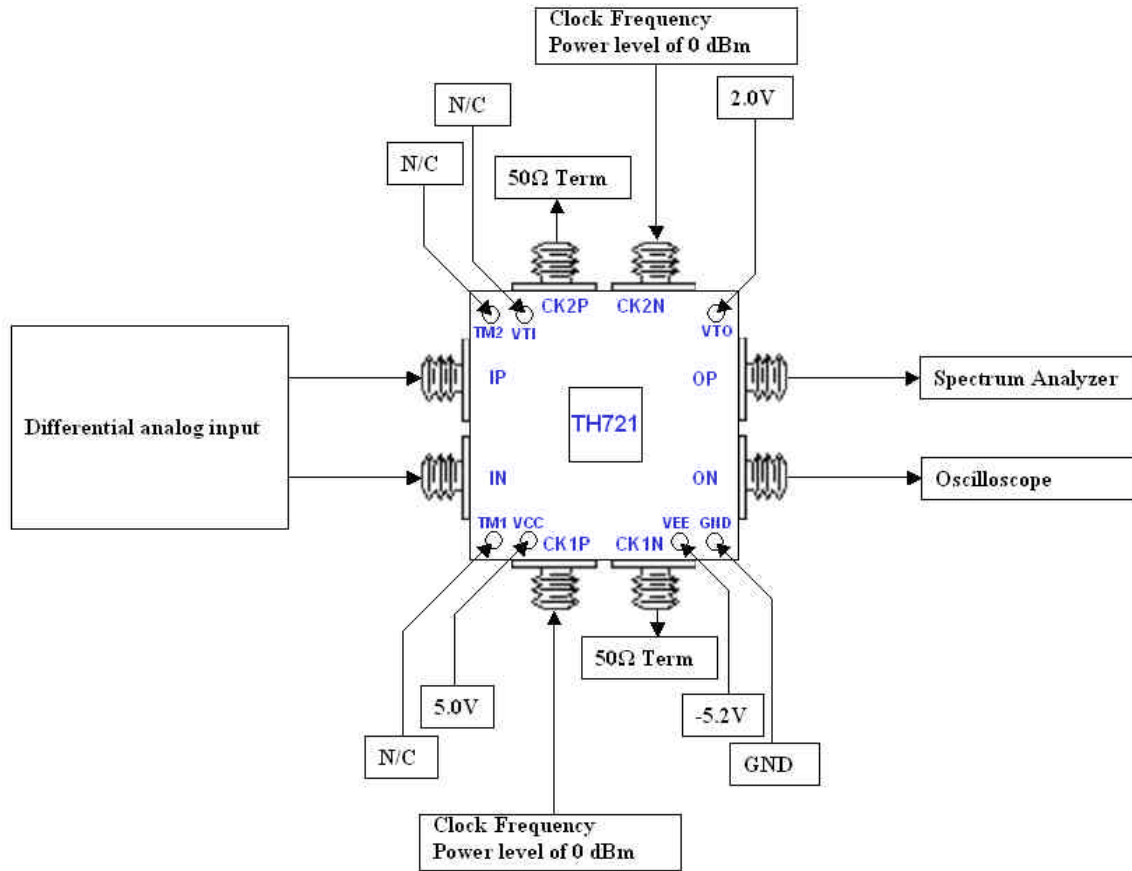


Bottom View

Notes:

- Parts labeled "1" are 0603 10 uF Capacitors.
- Parts labeled "2" are 0402 100nF Capacitors.

TYPICAL CONNECTION DIAGRAM



Description:

The measurements in the TH721 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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