

13 Gbps, FAST RISE TIME XOR / XNOR GATE w/ PROGRAMMABLE OUTPUT VOLTAGE

Typical Applications

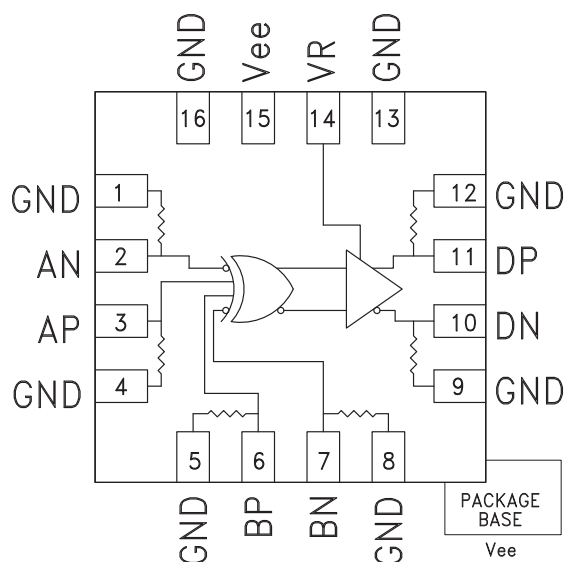
The HMC721LP3E is ideal for:

- RF ATE Applications
- Broadband Test & Measurement
- Serial Data Transmission up to 13 Gbps
- Digital Logic Systems up to 13 GHz

Features

Inputs Terminated Internally in 50 Ohms
Differential & Single-Ended Operation
Fast Rise and Fall Times: 19 / 18 ps
Low Power Consumption: 230 mW typ.
Programmable Differential
Output Voltage Swing: 600 - 1200 mV
Propagation Delay: 95 ps
Single Supply: -3.3V
16 Lead 3x3 mm SMT Package: 9 mm²

Functional Diagram



General Description

The HMC721LP3E is a XOR/XNOR gate function designed to support data transmission rates of up to 13 Gbps, and clock frequencies as high as 13 GHz. The HMC721LP3E also features an output level control pin, VR, which allows for loss compensation or for signal level optimization.

All input signals to the HMC721LP3E are terminated with 50 Ohms to ground on-chip, and may be either AC or DC coupled. The differential outputs of the HMC721LP3E may be either AC or DC coupled. Outputs can be connected directly to a 50 Ohm to ground terminated system, while DC blocking capacitors may be used if the terminating system is 50 Ohms to a non-ground DC voltage. The HMC721LP3E operates from a single -3.3V DC supply, and is available in a RoHS compliant 3x3 mm SMT package.

Electrical Specifications, $T_A = +25^\circ\text{C}$, $V_{ee} = -3.3\text{V}$

Parameter	Conditions	Min.	Typ.	Max	Units
Power Supply Voltage		-3.6	-3.3	-3.0	V
Power Supply Current			70		mA
Maximum Data Rate			13		Gbps
Maximum Clock Rate			13		GHz
Input High Voltage		-0.5		0.5	V
Input Low Voltage		-1.0		0.0	V
Input Return Loss	Frequency <13 GHz		10		dB
Output Amplitude	Single-Ended, peak-to-peak		550		mVp-p
	Differential, peak-to-peak		1100		mVp-p
Output High Voltage			-10		mV
Output Low Voltage			-570		mV
Output Rise / Fall Time	Differential, 20% - 80%		19 / 18		ps

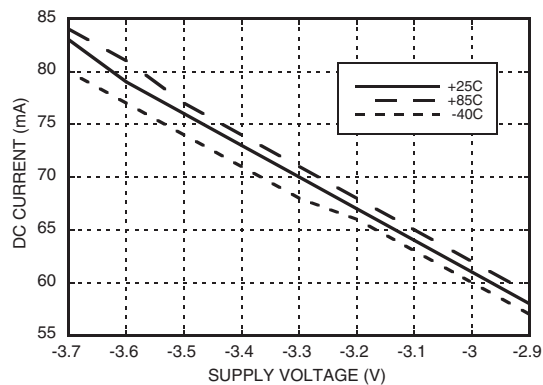
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Electrical Specifications, (continued)

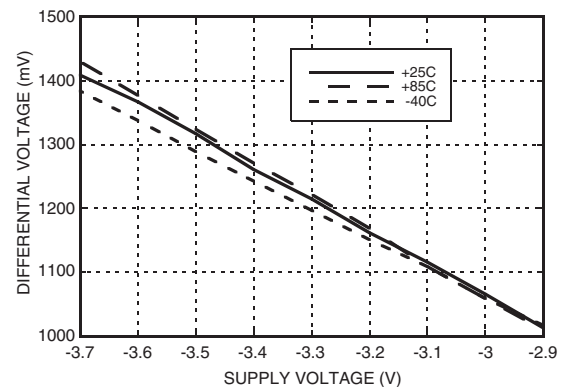
Parameter	Conditions	Min.	Typ.	Max	Units
Output Return Loss	Frequency <13 GHz		10		dB
Small Signal Gain			27		dB
Random Jitter Jr	rms			0.2	ps rms
Deterministic Jitter, Jd	peak-to-peak, 2 ¹⁵ -1 PRBS input [1]		2		ps, pp
Propagation Delay, td			95		ps

[1] Deterministic jitter calculated by simultaneously measuring the jitter of a 300 mV, 13 GHz, 2¹⁵-1 PRBS input, and a single-ended output

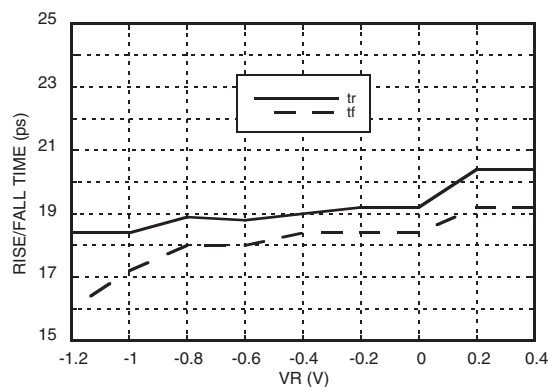
DC Current vs. Supply Voltage [1] [2]



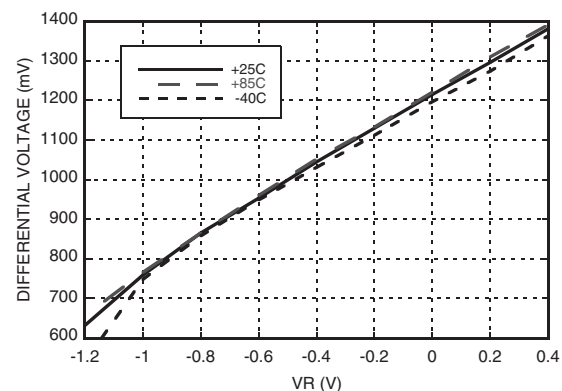
Output Differential vs. Supply Voltage [1] [3]



Rise / Fall Time vs. VR [2]



Output Differential vs. VR [3]



[1] VR = 0.0V

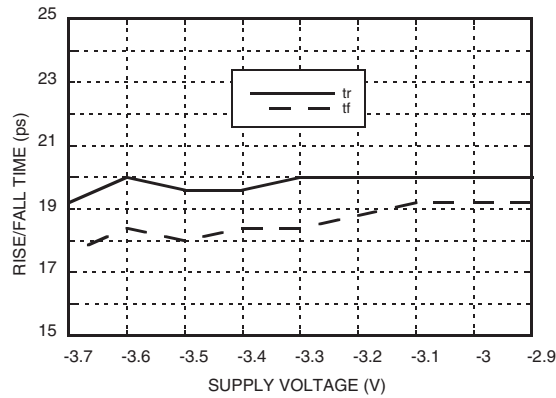
[2] Frequency = 13 GHz

[3] Frequency = 10 GHz

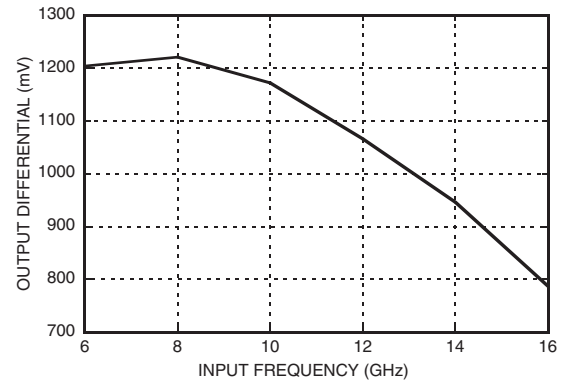


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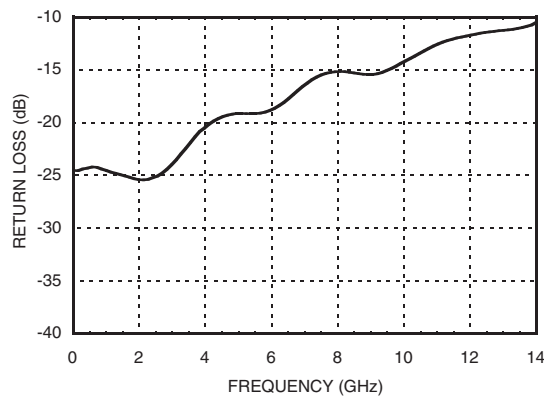
Rise / Fall Time vs. Supply Voltage



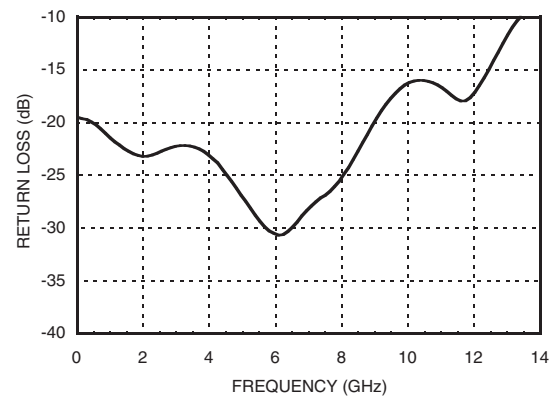
Output Differential vs. Frequency [1]



Input Return Loss vs. Frequency



Output Return Loss vs. Frequency

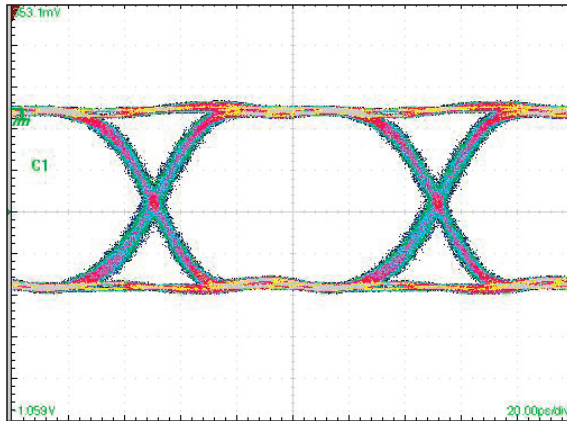


[1] VR = 0.0V

[2] Frequency = 13 GHz

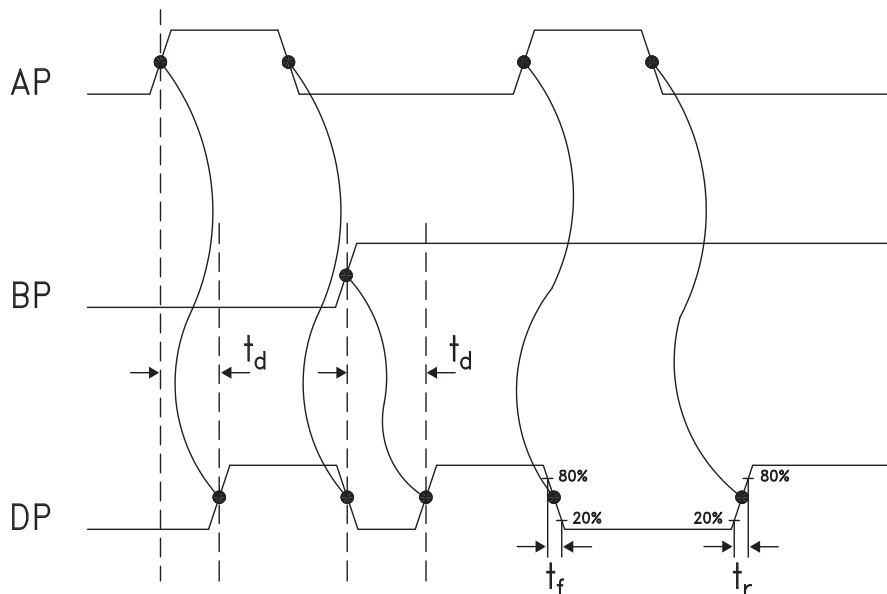
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Eye Diagram



[1] Test Conditions:
Waveform generated with an Agilent N4903A J-Bert. Rate = 10 Gbps.
Eye diagram data presented on a Tektronix CSA 8000

Timing Diagram



Truth Table

Input		Outputs
A	B	D
L	L	L
L	H	H
H	L	H
H	H	L
Notes: A = AP - AN B = BP - BN D = DP - DN		H - Positive voltage level L - Negative voltage level



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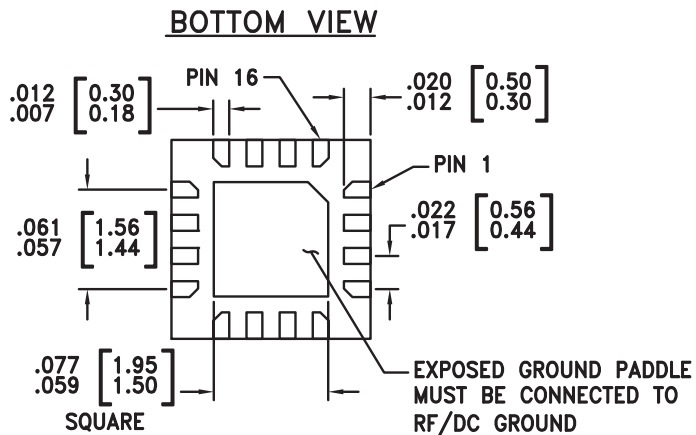
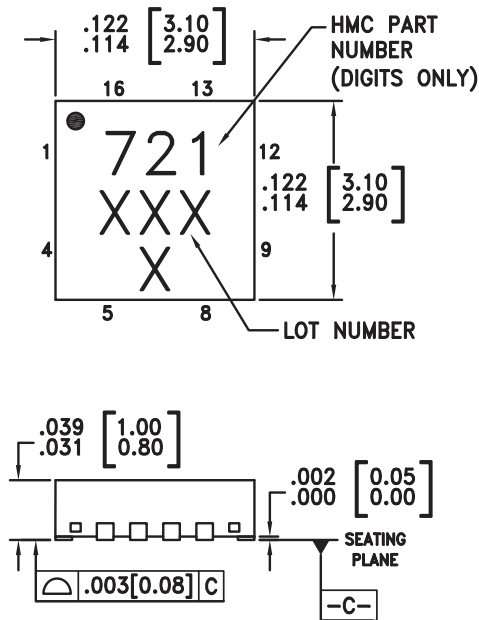
Absolute Maximum Ratings

Power Supply Voltage (Vee)	-3.75V to +0.5V
Input Signals	-2V to +0.5V
Output Signals	-1.5V to +1V
Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to +85°C



**ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS**

Outline Drawing



NOTES:

1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
3. LEAD SPACING TOLERANCE IS NON-CUMULATIVE
4. PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM.
PAD BURR HEIGHT SHALL BE 0.05mm MAXIMUM.
5. PACKAGE WARP SHALL NOT EXCEED 0.05mm.
6. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
7. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.

Package Information

Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking ^[3]
HMC721LP3E	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL1 ^[2]	721 XXXX

[1] Max peak reflow temperature of 235 °C

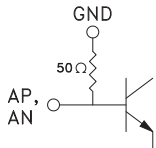
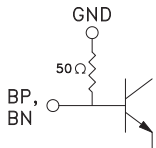
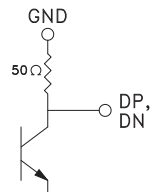
[2] Max peak reflow temperature of 260 °C

[3] 4-Digit lot number XXXX



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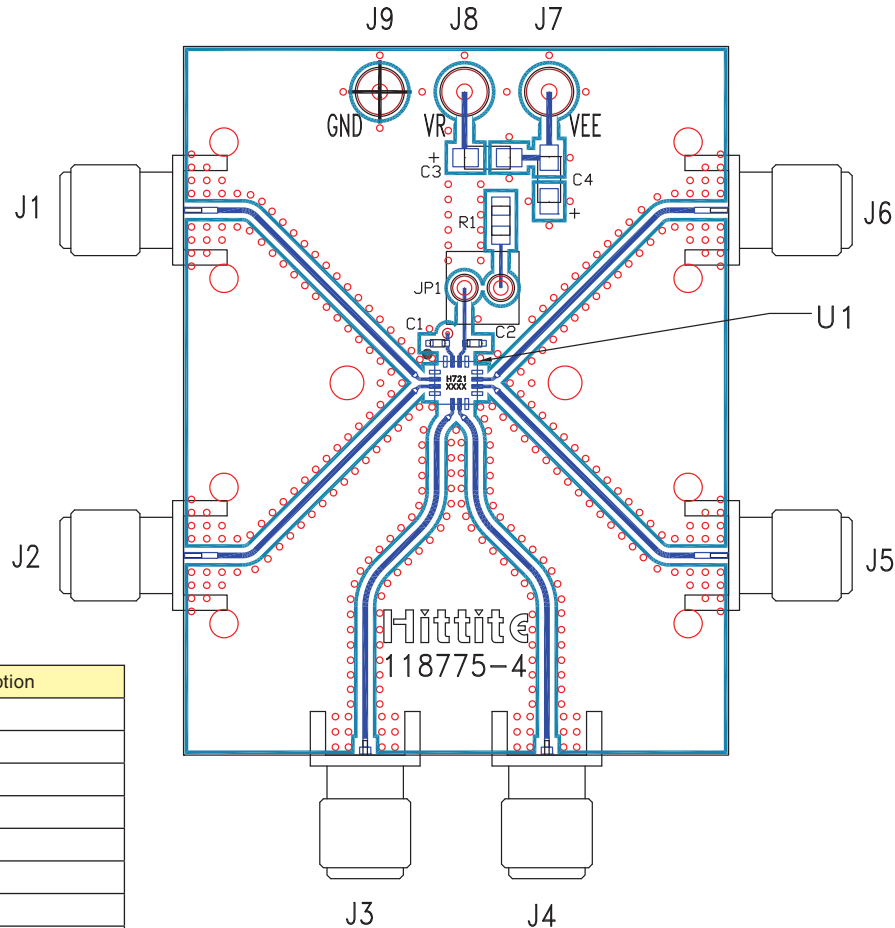
Pin Descriptions

Pin Number	Function	Description	Interface Schematic
1, 4, 5, 8, 9, 12	GND	Signal Grounds	
2, 3	AN, AP	Clock / Data Input A	
6, 7	BP, BN	Clock / Data Input B	
10, 11	DN, DP	Clock / Data Output	
13, 16	GND	Supply Ground	
14	VR	Output level control. Output level may be adjusted by either applying a voltage to VR per "Output Differential vs. VR" plot, or by tying VR to GND with a resistor per the following equation: $V_o(R) = 1.2 / (2.1 + R)$, R in k Ω	
15, Package Base	Vee	Negative Supply	



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Evaluation PCB



Item	Description
J1	AN
J2	AP
J3	BP
J4	BN
J5	DN
J6	DP
J7	Vee
J8	VR
J9	GND

List of Materials for Evaluation PCB 118777 [1]

Item	Description
J1 - J6	PCB Mount SMA RF Connectors
J7 - J9	DC Pin
C1, C2	100 pF Capacitor, 0402 Pkg.
C3, C4	4.7 µF Capacitor, Tantalum
R1	10 Ohm Resistor, 0603 Pkg.
U1	HMC721LP3E High Speed Logic, XOR / XNOR
PCB [2]	118775 Evaluation Board

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350 or Arlon 25FR

The circuit board used in the application should use RF circuit design techniques. Signal lines should have 50 Ohm impedance while the package ground leads should be connected directly to the ground plane similar to that shown. The exposed package base should be connected to Vee. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation circuit board shown is available from Hittite upon request.



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Application Circuit

