

Evaluating the **ADPA7006** 18 GHz to 44 GHz, GaAs, pHEMT, >25 dBm (>0.5 W), MMIC Power Amplifier

FEATURES

Fully featured evaluation board for the **ADPA7006**
2-layer Rogers 4350B evaluation board with heat sink
End launch 2.9 mm RF connectors
Through calibration path

EVALUATION KIT CONTENTS

ADPA7006-EVALZ evaluation board

EQUIPMENT NEEDED

RF signal generator
RF spectrum analyzer
RF network analyzer
5 V, 1 A power supply
–1.5 V, 100 mA power supply

GENERAL DESCRIPTION

The ADPA7006-EVALZ evaluation board consists of a 2-layer printed circuit board (PCB) fabricated from a 10 mil thick, Rogers 4350B, copper clad mounted to an aluminum heat sink. The heat sink provides thermal relief to the device as well as mechanical support to the PCB. Mounting holes on the heat sink allow attachment to larger heat sinks for improved thermal management.

The RFIN and RFOUT ports on the ADPA7006-EVALZ are populated by 2.9 mm, female coaxial connectors. The respective RF traces of the ports have a 50 Ω characteristic impedance. The ADPA7006-EVALZ is populated with components suitable for use over the entire –40°C to +85°C operating temperature range of the device. To calibrate evaluation board trace losses, a through calibration path is provided between the J3 and J4 connectors. J3 and J4 must be populated with RF connectors to use the through calibration path. See Table 1 and Figure 3 for the through calibration path performance.

The power, ground, gate control voltages, and detector output voltages are accessed through two 8-pin headers (see Table 1).

RF traces are 50 Ω grounded, coplanar waveguide. Package ground leads and the exposed paddle connect directly to the ground plane. Multiple vias connect the top and bottom ground planes with particular focus on the area directly beneath the ground paddle to provide adequate electrical conduction and thermal conduction to the heat sink.

The power supply decoupling capacitors on the ADPA7006-EVALZ represent the configuration used to characterize and qualify the device. It is possible to reduce the number of capacitors with a scope, but the scope varies from system to system. It is recommended to first remove or combine the largest capacitors that are farthest from the device.

For more information about the **ADPA7006**, refer to the **ADPA7006** data sheet. Consult the data sheet in conjunction with this user guide when using the ADPA7006-EVALZ evaluation board.

TABLE OF CONTENTS

Features	1	Power-Up.....	4
Evaluation Kit Contents.....	1	Power-Down	4
Equipment Needed.....	1	Evaluation Board Schematics and Artwork.....	5
General Description	1	Ordering Information.....	6
Revision History	2	Bill of Materials.....	6
Evaluation Board Photographs.....	3		
Operating the ADPA7006-EVALZ.....	4		

REVISION HISTORY

4/2020—Revision 0: Initial Version

EVALUATION BOARD PHOTOGRAPHS

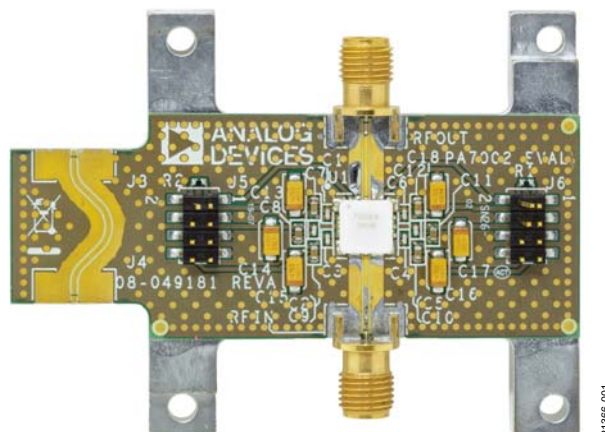


Figure 1. ADPA7006-EVALZ Top Side Photo

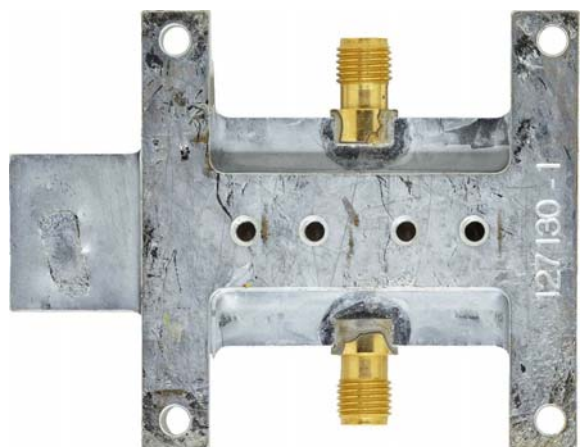


Figure 2. ADPA7006-EVALZ Bottom Side Photo

OPERATING THE ADPA7006-EVALZ

A 5 V, 1 A power supply is required to provide the main bias to the ADPA7006-EVALZ board. The 5 V power supply must be connected in parallel to all of the VDD lines (VDD1, VDD2, VDD3, and VDD4) through the J5 and J6 headers. Additionally, a 0 V to –1.5 V, 100 mA power supply is required to provide the required gate control voltage. Connect the –1.5 V power supply in parallel to the two VGG1 lines through the J5 and J6 headers.

POWER-UP

During power-up, use the following biasing sequence:

1. Connect the ADPA7006 GND pin to the RF ground and dc ground.
2. Initially, set the gate voltages (V_{GG1}) and drain voltages (V_{DD1} , V_{DD2} , V_{DD3} , and V_{DD4}) to 0 V.
3. Set the ADPA7006 V_{GG1} pin voltages to –1.5 V.
4. Set all the drain bias voltages (V_{DDX} pin voltages) to 5 V.
5. Increase the V_{GG1} pin and V_{GG2} pin voltages to achieve a quiescent drain current of 800 mA.
6. Apply the RF signal to the device.

POWER-DOWN

During power-down, use the following biasing sequence:

1. Turn off the RF signal.
2. Decrease the V_{GG1} pin and V_{GG2} pin voltages to –1.5 V to achieve $I_{DQ} = 0$ mA (approximately, where I_{DQ} is the quiescent drain current).
3. Decrease all V_{DDX} pin voltages to 0 V.
4. Decrease the V_{GG1} pin voltage and V_{GG2} pin voltage to 0 V.

Table 1. J5 and J6 Header Connections to the ADPA7006

Connector	Header	ADPA7006 Pin
J5	1	VREF
J5	2	VREF (through a 100 k Ω resistor)
J5	3, 5, 7	GND
J5	4	V_{DD3}
J5	6	V_{DD1}
J5	8	V_{GG1}
J6	1	VDET (through a 100 k Ω resistor)
J6	2	VDET
J6	3	V_{DD4}
J6	4, 6, 8	GND
J6	5	V_{DD2}
J7	7	V_{GG1}

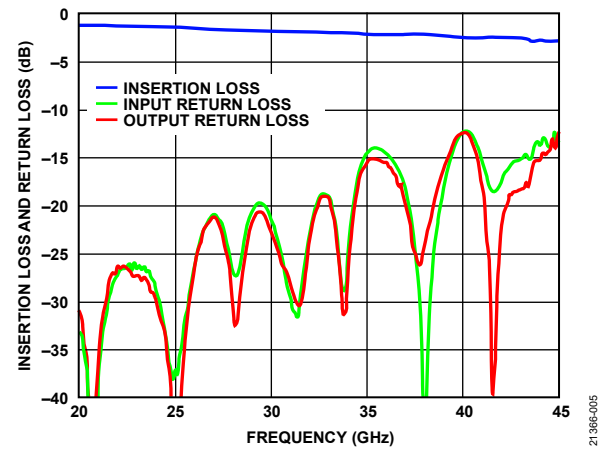


Figure 3. Insertion Loss and Return Loss of Through Calibration Path

Table 2. Insertion Loss and Return Loss of Through Calibration Path

Frequency (GHz)	Insertion Loss (dB)
18	–1.1
20	–1.2
22.5	–1.3
25	–1.4
27.5	–1.6
30	–1.8
32.5	–1.9
35	–2.1
37.5	–2.1
40	–2.6
42.5	–2.5
45	–3

EVALUATION BOARD SCHEMATICS AND ARTWORK

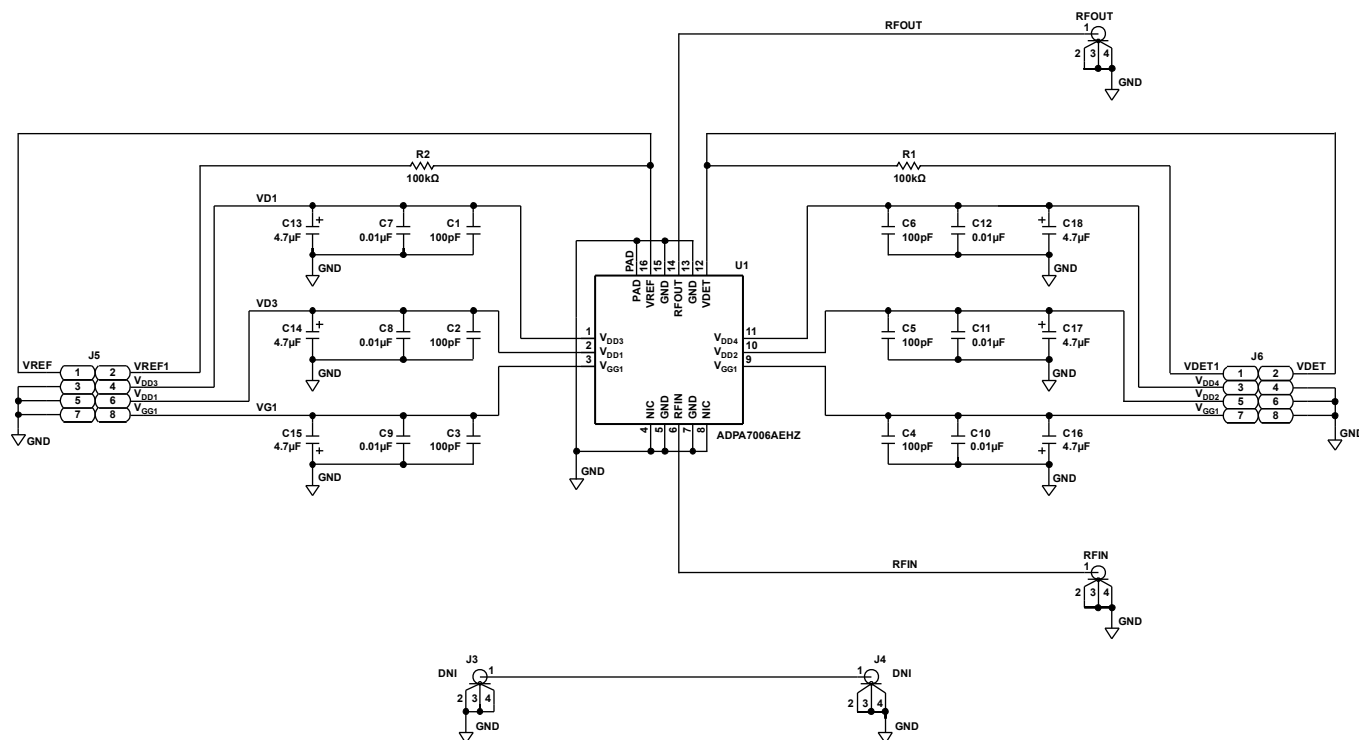


Figure 4. ADPA7006-EVALZ Evaluation Board Schematic

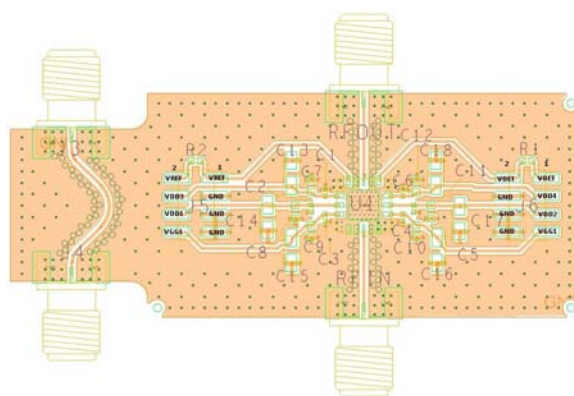


Figure 5. ADPA7006-EVALZ Assembly Drawing (J3 and J4 Not Installed)

ORDERING INFORMATION

BILL OF MATERIALS

Table 3.

Qty	Reference Designator	Description	Manufacturer	Part Number
6	C1 to C6	Ceramic capacitors, 100 pF	Kemet	C0402C101J5GACTU
6	C7 to C12	Multilayer ceramic capacitors, XR7, 0.01 μ F	Kemet	C0603C103K5RECAUTO
6	C13 to C18	Tantalum capacitors, 4.7 μ F	AVX	TAJA475K020RNJ
2	J3 and J4	Connectors, 2.9 mm, jack, PCB mount receptacle, do not install	SRI Connector Gage Co	25-146-1000-92
2	J5 and J6	PCB connector headers, 8-position, vertical, dual-row, 2 mm pitch	Molex	87759-0814
2	R1 and R2	Thick film chip resistors, 100 k Ω	Panasonic	ERJ-2GEJ104X
2	RFIN, RFOUT	Connectors, 2.9 mm, jack, PCB mount receptacle	SRI Connector Gage Co	25-146-1000-92
1	U1	18 GHz to 44 GHz gallium arsenide (GaAs), pseudo morphic high electron mobility transfer (pHEMPT), monolithic microwave integrated circuit (MMIC) power amplifier, 0.5 W	Analog Devices	ADPA7006AEHZ
1	Not applicable	2.51 inch \times 1.9 inch aluminum heat sink	Not applicable	Not applicable

**ESD Caution**

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.