User's Guide
SBOU237–December 2019

LMH9226 Evaluation Module

This document outlines the basic steps and functions that are required to ensure the proper operation and quick setup of the LMH9226RRL-EVM. This document also includes a schematic diagram, a bill of materials (BOM), printed-circuit board (PCB) layouts, and test block diagrams. Throughout this document, the abbreviations *EVM, LMH9226 EVM* and the term *evaluation module* are synonymous with the LMH9226RRL-EVM, unless otherwise noted.

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1 Description

The LMH9226 evaluation module (EVM) is used to evaluate the LMH9226 device, which is a single-ended input to differential output RF gain block amplifier available in a 2 × 2-mm^2, 12-pin RRL package. The device is well-suited to support requirements for the next generation 5G m-MIMO Active antenna system while interfacing with the input of transceiver. The EVM is designed to quickly demonstrate the functionality and performance of the LMH9226 device in the 2.2-GHz to 3-GHz receive frequency band with 400 MHz of 1-dB bandwidth.

By default, the board is set up for 50-Ω single-ended input matching and 100-Ω differential output matching for easy interface with 50-Ω test equipment. The EVM is ready to connect to a +3.3-V power supply, signal source, and test instruments through the use of onboard connectors.

1.1 Features

- Operates on single +3.3-V supply
- Designed for single-ended 50-Ω input matching and 100-Ω differential output matching interface
- Simple interface to the inputs and output through onboard SMA connectors
- Power down option available onboard using jumper connector

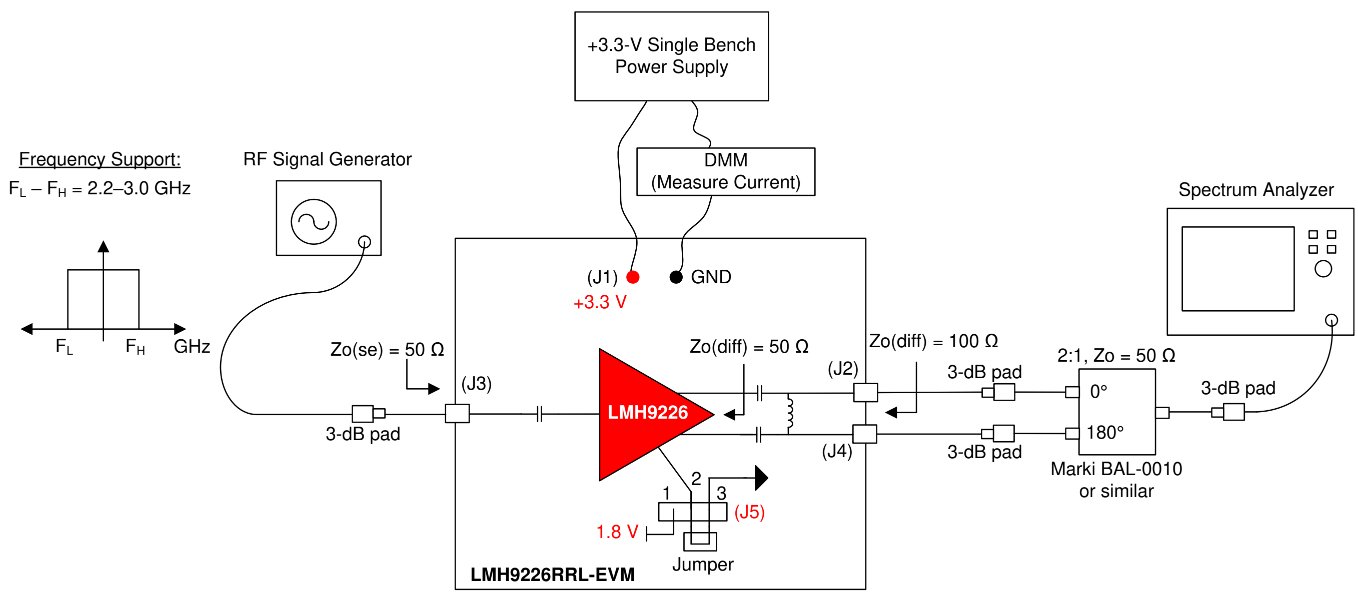


Figure 1. Single Tone Setup for Gain and Output P1dB

1.2 General Usage Information

This section provides general usage information for the LMH9226 EVM. See Figure 1 for a general single tone setup diagram as a reference point to the following instructions. Some components such as supply bypass capacitors, and power down reference voltage generation are omitted in Figure 1 for clarity.

1. Recommended power up sequence:
   a. Before connecting the power-supply cables to the EVM, set the DC output power supply to +3.3 V
   b. Set the current limit of the DC output power supply at 150 mA
   c. Making sure the supply is turned off, connect the power supply cables to the J1 connector of the EVM
   d. Now turn on the DC power supply of VCC = +3.3 V. The supply current (I_Q) drawn from the power supply should be approximately 80 mA.
   e. If the supply current is low, ensure the device is not disabled by shorting the jumper connection for J5 between 2 and 3 header pins
2. Power-down option:

   a. Short terminals 1 and 2 on J5 to put the LMH9226 device in its power down state. The supply current (I_Q) drawn should be < 15 mA.
3. Single tone measurement setup recommendation:
   a. Connect an RF signal generator to input J3 SMA connector
   b. The RF signal generator used must support 2.2-GHz to 3-GHz signal frequency for testing out the LMH9226 EVM
   c. When measuring the EVM for single tone distortion products, TI recommends using an RF band pass filter (not shown in Figure 1) between the signal source and J3 SMA input.
   d. The LMH9226 device input is tuned to 50-Ω matching impedance in the 2.2-GHz to 3-GHz frequency band of operation. To minimize signal reflections due to impedance mismatch, TI recommends using approximately 3- to 6-dB attenuator pad between the source and J3 SMA input.
   e. The EVM outputs are fully differential (or 180° out-of-phase) at J2 and J4 SMA connectors. Although the LMH9226 device output is internally matched to 50-Ω differential impedance, the onboard discrete L and C components transform the differential output impedance to 100-Ω in the 2.2-GHz to 3-GHz frequency band. See Table 1 for the discrete L and C component values used on the LMH9226 EVM.
   f. When connecting to a spectrum analyzer single-ended input, the differential signal out of the EVM should be converted to a single-ended signal using a passive balun as shown in Figure 1.
   g. It is recommended to use balun which operates in the same frequency band as the LMH9226 device to avoid any setup issues. Also, use of an approximate 3- to 6-dB attenuator pad is recommended at the three terminals of the passive balun for 50-Ω matching between the EVM output and spectrum analyzer input.
   h. Lastly, it is recommended to properly characterize and account for the insertion loss of RF coaxial (coax) cables, attenuator pads, and passive baluns to measure accurate gain and power levels for the device.
4. Matching or tuning options:
   a. Solder mask has been removed along the RF signal paths and VCC path allowing an easy method to slide surface mount components along these traces for optimal tuning.
   b. The device differential output is tuned for 100-Ω differential impedance in the 2.2-GHz to 3-GHz frequency band using discrete L and C components. The trace impedance is calculated by the stack-up configuration as given in Section 2.4. See Table 1 for the L and C component values used on the LMH9226 EVM.

2 EVM Overview

This section includes the schematic diagram, a bill of materials (BOM), PCB layer prints, and EVM stack-up information.

2.1 Schematic

Figure 2 shows the LMH9226 EVM schematic.

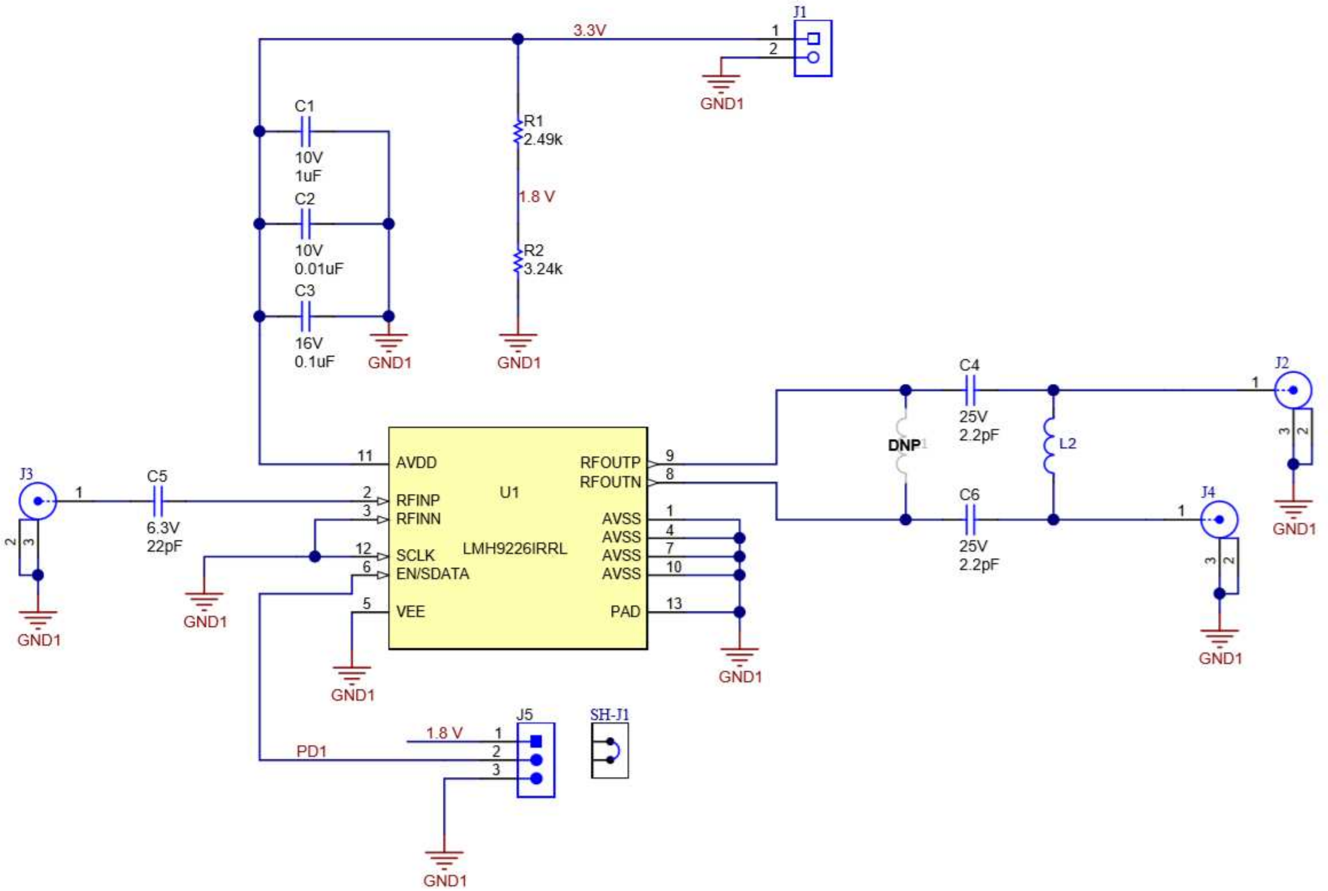


Figure 2. LMH9226 EVM Schematic

2.2 PCB Layers

Figure 3 through Figure 6 illustrate the PCB layers for this EVM.

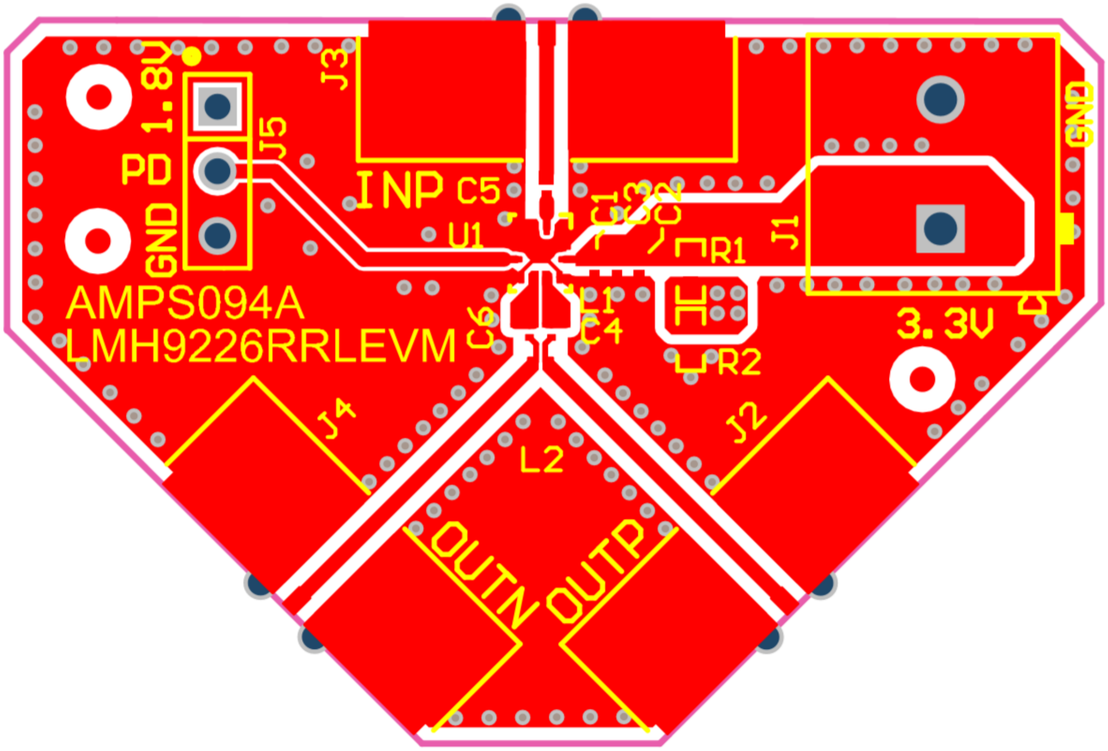


Figure 3. Top Layer

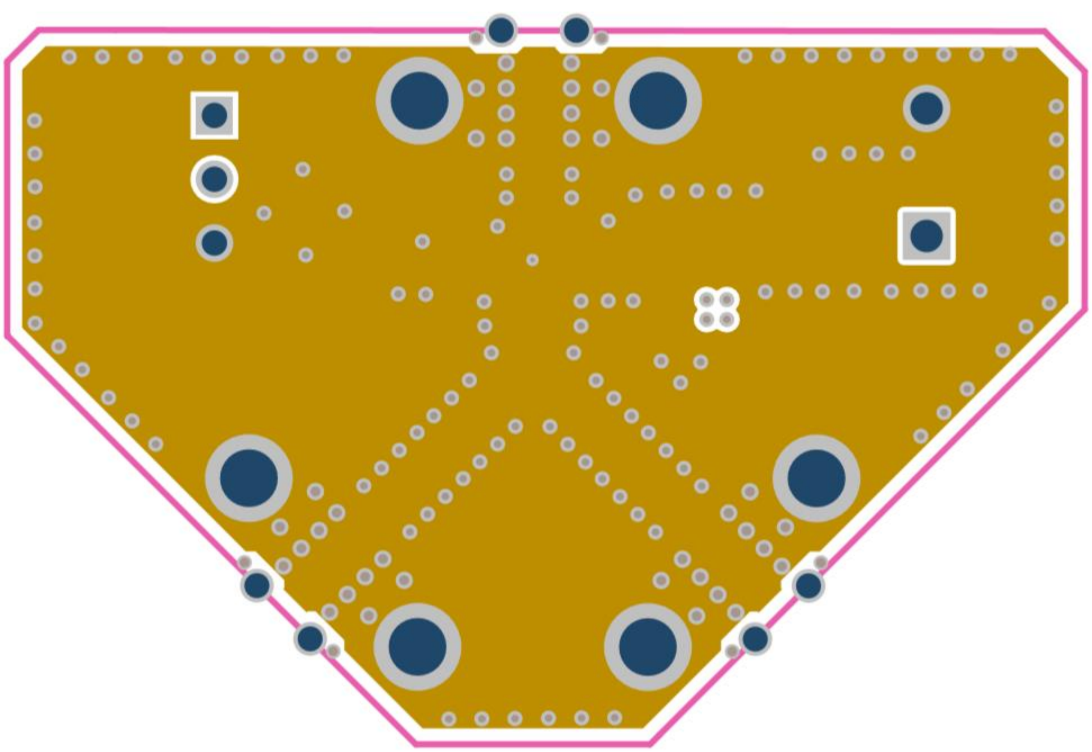


Figure 4. Layer 2

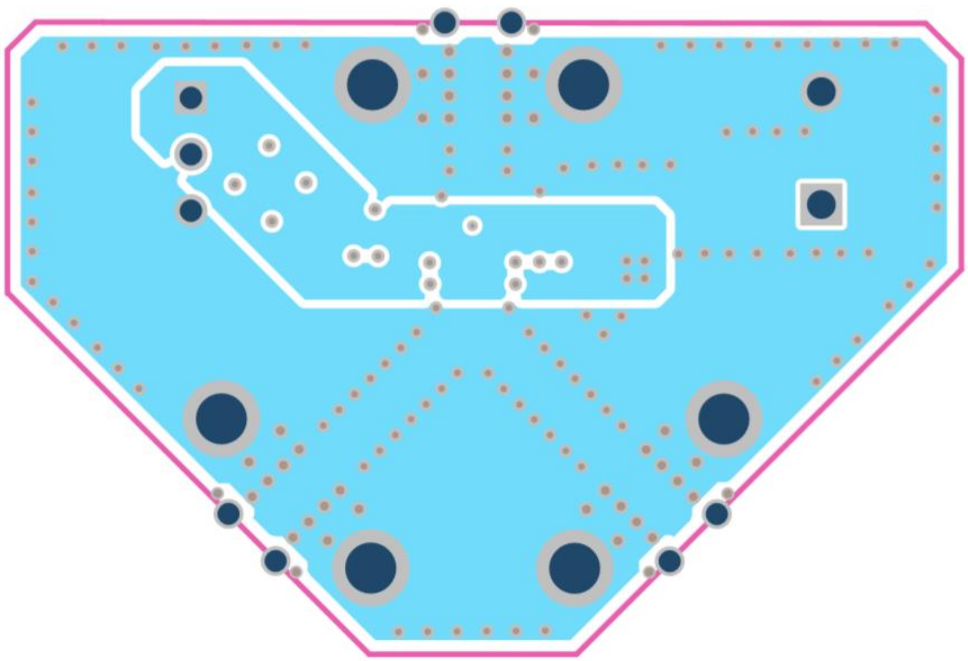


Figure 5. Layer 3

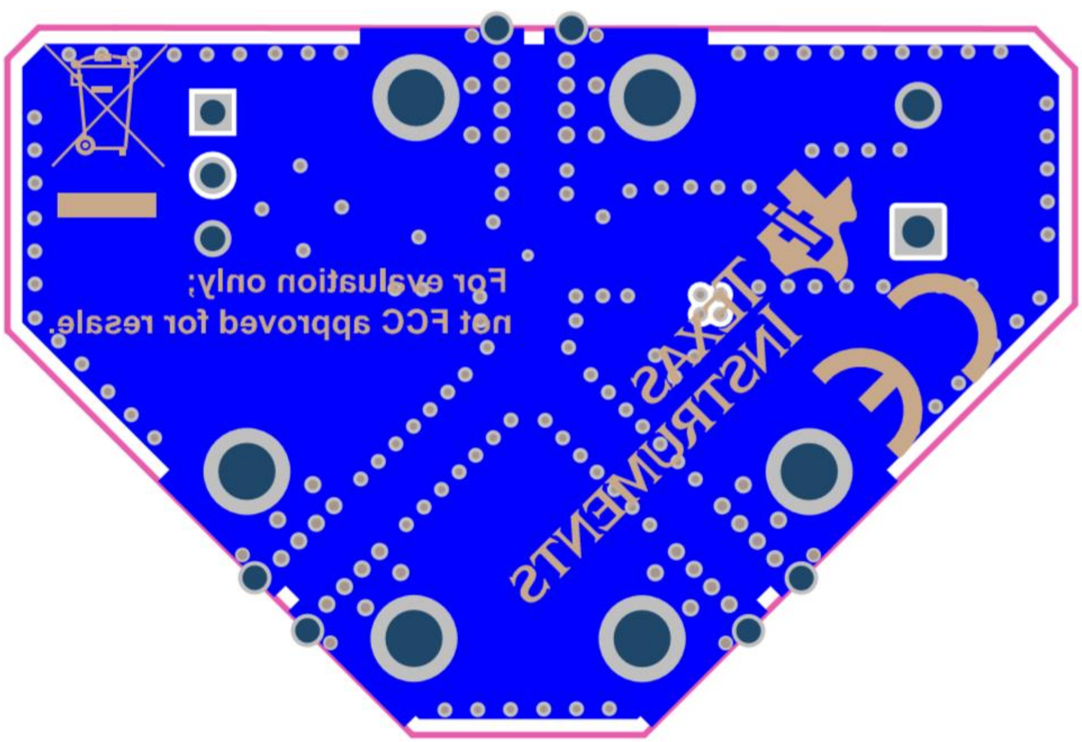


Figure 6. Bottom Layer

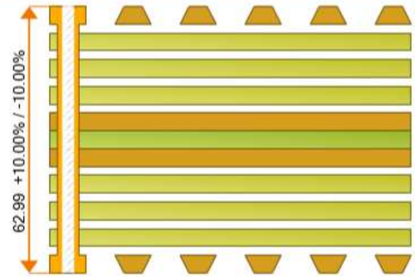
2.3 LMH9226 EVM Bill of Material

Table 1. LMH9226 EVM BOM

Common BOM							
Item #	**Designator**	**Quantity**	**Value**	**Description**	**Footprint**	**Manufacturer**	**Part Number**
1	!PCB1	1		Printed Circuit Board		Any	AMPS094
2	C1	1	1 µF	CAP, CERM, 1 µF, 10 V, ±20%, X5R, 0201	0201	Samsung Electro-Mechanics	CL03A105MP3NSNC
3	C2	1	0.01 µF	CAP, CERM, 0.01 µF, 10 V, ±10%, X7R, 0201	0201	MuRata	GRM033R71A103KA01D
4	C3	1	0.1 µF	CAP, CERM, 0.1 µF, 16 V, ±10%, X5R, 0201	0201_033	MuRata	GRM033C71C104KE14D
5	C5	1	22 pF	CAP, CERM, 22 pF, 6.3 V, ±2%, C0G/NP0, 0201	0201_033	MuRata	GJM0335C0J220GB01D
6	J1	1		Terminal Block, 5.08 mm, 2×1, TH	PhoenixContact_1715721	Phoenix Contact	1715721
7	J2, J3, J4	3		SMA JACK 50 Ω, R/A, SMT	Rosenberger_32K243-40ML5	Rosenberger	32K243-40ML5
8	J5	1		Header, 100 mil, 3x1, Tin, TH	CONN_PEC03SAAN	Sullins Connector Solutions	PEC03SAAN
9	R1	1	2.49 kΩ	RES, 2.49 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	Vishay-Dale	CRCW04022K49FKED
10	R2	1	3.24 kΩ	RES, 3.24 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	Vishay-Dale	CRCW04023K24FKED
11	SH-J1	1	1×2	Shunt, 100 mil, Gold plated, Black	SNT-100-BK-G	Samtec	SNT-100-BK-G
12	FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial10-20	N/A	N/A
13	C4, C6	2	2.2 pF	CAP, Film, 2.2 pF, 25 V, ±4.55%, 0201 SMD	ACCU_0201	AVX	02013J2R2BBSTR
14	L2	1	6.2 nH	FIXED IND 6.2NH 300MA 600 MΩ	FP-LQP03TN6N2H02D_0201-IPC_B	Murata	LQP03TN6N2H02D
15	U1	1		LMH9226IRRL, RRL0012A (WQFN-12)	RRL0012A	Texas Instruments	LMH9226IRRL
16	L1	0	6.2 nH	FIXED IND 6.2NH 300MA 600 MΩ	FP-LQP03TN6N2H02D_0201-IPC_B	Murata	LQP03TN6N2H02D

2.4 Stack up and Material

The LMH9226 EVM is a 56-mil, 4-layer board whose material type is Isola® 370HR. The top layer routes the power, ground, and signals to and from the device. The signal impedance is targeted at 49.9 Ω. The bottom 3 layers are ground layers.



Layer	Stack up	Type	Supplier	Supplier Description	Description	Base Thickness	Impedance ID	Mask Thickness	Processed Thickness	εr
1		Copper			Copper Foil	0.579	1, 2, 3		1.760	
		FR4	isola	370HR	PrePreg 2116	4.331			4.308	4.100
		FR4	isola	370HR	PrePreg 2116	4.331			4.308	4.100
		FR4	isola	370HR	PrePreg 1080	2.559			2.546	3.930
2						1.181			1.181	
		FR4	isola	370HR	Core	27.953			27.953	4.360
3						1.181			1.181	
		FR4	isola	370HR	PrePreg 1080	2.559			2.546	3.930
		FR4	isola	370HR	PrePreg 2116	4.331			4.308	4.100
		FR4	isola	370HR	PrePreg 2116	4.331			4.308	4.100
4		Copper			Copper Foil	0.579	4, 5, 6		1.760	

Figure 7. LMH9226 EVM Stack-up (Units in Mils)

3 Test Setup Diagrams

This section includes general recommendations for S-parameter, noise figure, and two-tone OIP3 setup while measuring the LMH9226 EVM.

3.1 S-Parameter Test Setup

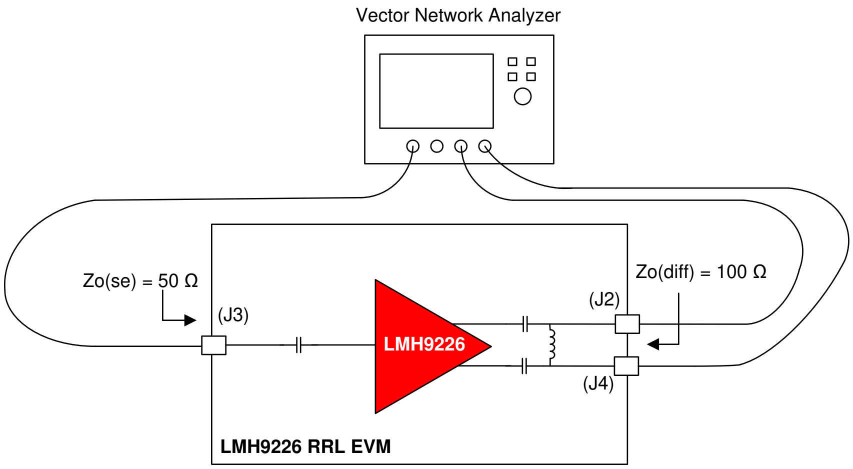


Figure 8. S-Parameter Test Setup

Use the following guidelines for S-parameter measurement:

1. S-parameter measurement is typically done using a Vector Network Analyzer (VNA), as Figure 8 shows. For measuring the LMH9226 EVM, a 4-port VNA is recommended which can generate and receive truly differential signals at the input and output ports.
2. Before connecting the RF coax cables to the LMH9226 EVM, you must calibrate the VNA along with the cables using a calibration kit. This accounts for any cable losses in the S-parameter calculation at the VNA and helps set reference impedance at the cable ends.
3. Make sure the frequency sweep and output power level from the VNA is set within the linear operating range of the LMH9226 devices. The resolution bandwidth (RBW) and dynamic range of the VNA can be adjusted to give optimum sweep time for the measurement.
4. It is important to account for onboard trace losses at the input and output pins of the device. De-embedding of the input and output traces is recommended to improve the S-parameter measurement

that is representative of the device performance. Figure 9 and Figure 10 give typical input and output trace losses measured on the LMH9226 EVM, respectively.

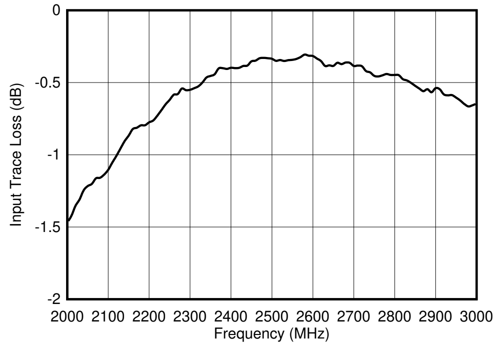


Figure 9. Input PCB Trace Loss vs Frequency

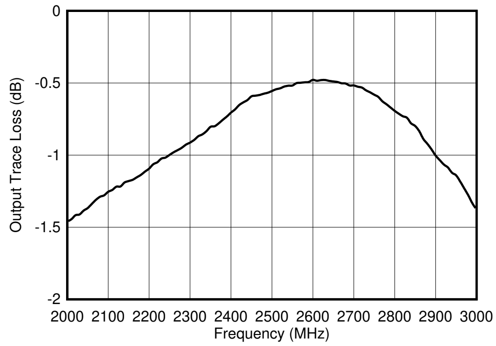


Figure 10. Output PCB Trace Loss vs Frequency

3.2 Noise Figure Test Setup

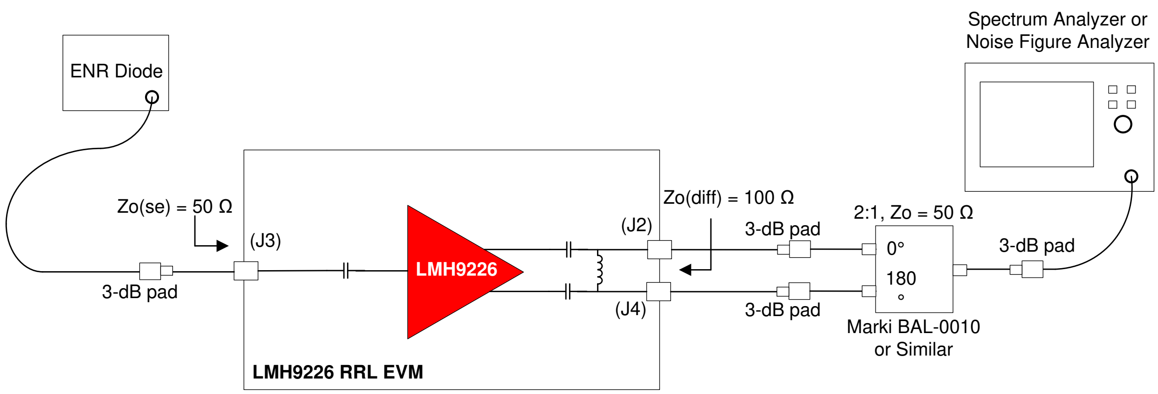


Figure 11. Noise Figure Test Setup

Use the following guidelines for Noise Figure (NF) measurement:

1. The traditional Y-factor method can be used for the NF measurement using a Noise Diode and a spectrum analyzer (or a Noise Figure Analyzer), as Figure 11 shows.
2. While doing the measurement, take into account any RF cable losses to the EVM board. Any external input attenuator added for matching will result in proportional NF degradation and must be calibrated out in the measurement.
3. Also, onboard losses of the input traces at the device input pin must be factored into the NF measurement.

4. If the device output loss is significant, it is important to factor the output loss into the NF measurement.
5. Using the *Friis* equation is helpful when calculating combined NF of the measurement setup, and then back calculating the individual device noise figure.

3.3 Two-Tone OIP3 Test Setup

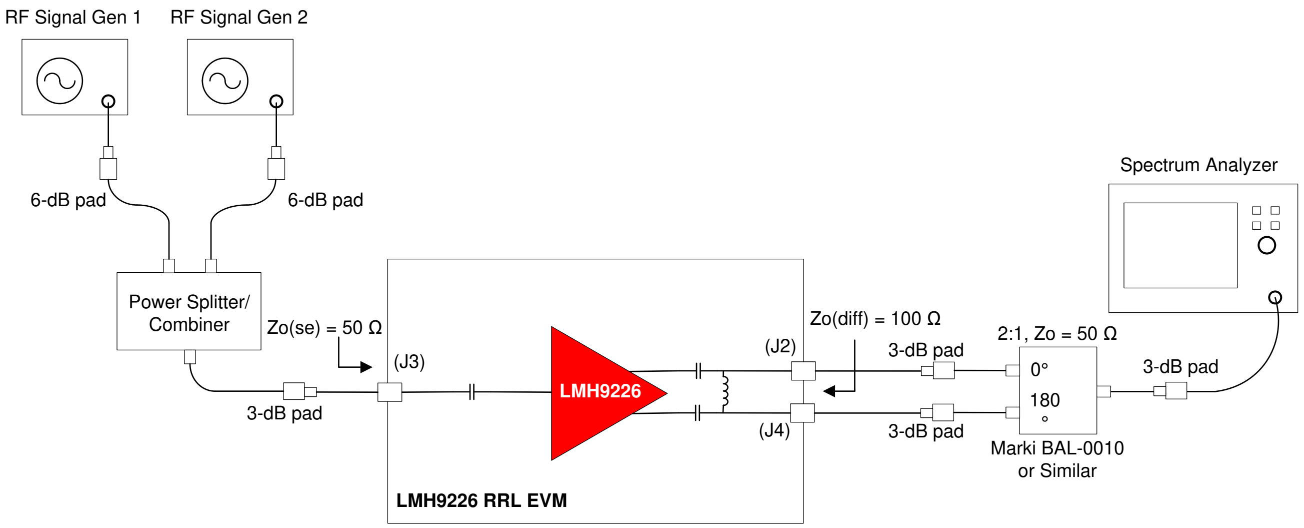


Figure 12. OIP3 Test Setup

Use the following guidelines for two-tone OIP3 measurement:

1. As Figure 12 shows, combine two signal generator outputs using an in-phase power splitter and combiner. A 6-dB attenuator is recommended at the signal generator outputs to prevent the generators from talking to each other and resulting in signal generator IMD3 spurs.
2. Set both the signal generator outputs to a power level and frequency spacing such that it would yield the desired output power (P_{OUT}) at the device.
3. TI recommends that the output power level is within the linear operation range of the LMH9226 device. For example, if the total desired output power at the device is 8 dBm, then set the signal generators such that each of the fundamental output power results in 2 dBm per tone. However, if each output tone is at 8 dBm instead, the amplifier linearity will degrade as a result of higher total composite output power of 14 dBm at the device outputs. As a general rule, it is recommended to keep the total output power level approximately 6 to 8 dB lower than the 1-dB compression point. Also, see the device data sheet for the recommended output power levels supported by the device.
4. For the OIP3 test, the two tones can be spaced ±10 MHz with respect to the desired center frequency
5. TI recommends setting the spectrum analyzer attenuation setting from 20 to 26 dB based on sweet spot of the incoming input power level
6. Keep spectrum analyzer RBW and VBW settings identical for main tone and IM3 products
7. For output IP3 calculation, take into account combined losses at the desired frequency band between the LMH9226 device output to the spectrum analyzer input. The combined power losses include loss due to PCB output trace, RF coax cable, 0/180◦passive balun and any attenuator pad used for external matching purposes. The calculated OIP3 is given in .

Output IP3 = (P_{IN_SA} – IMD3) / 2 + P_{IN_SA} + P_{LOSS}

where,

- P_{IN_SA} = Input power per tone into the spectrum analyzer
- P_{LOSS} = Power loss from the device output to the spectrum analyzer input
- IMD3 = Higher power of the two inter-modulation distortion products recorded at either 2f1 – f2 or 2f2 – f1

8. The thing to note in is the P_{IN_SA} + P_{LOSS} = P_{OUT} which is the amplifier output power per tone.

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   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

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User shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d’usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。 http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered “Radio Frequency Products” in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry’s Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page 電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

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