

Features

- **CMX901 and CMX902 Evaluation**

- **EV9011 available in three variants:**

EV9011-160 - Operation 150MHz to 170MHz

EV9011-435 - Operation 400MHz to 470MHz

EV9011-915 - Operation 900MHz to 930MHz

- **EV9021 available in two variants:**

EV9021-160 - Operation 150MHz to 170MHz

EV9021-435 - Operation 400MHz to 470MHz



1 Brief Description

The CMX901 and CMX902 are wideband RF power amplifiers with high efficiency and high gain and may be used as a power amplifier or driver amplifier. The CMX901 can be used for a wide range of frequencies from 130MHz to 950MHz and the CMX902 covers 130MHz to 700MHz. The power delivered from the device depends on the power supply.

CMX901 can provide RF power as high as 2.5W with 4.0V supply. It is strongly recommended that the supply voltage DOES NOT exceed 6V and the output power DOES NOT exceed 36dBm (4W).

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It is recommended that you check for the latest product datasheet version from the Datasheets page of the CML website: [www.cmlmicro.com].

1.1 History

Version	Changes	Date
1	Original document	October 2017

This is Provisional Information; changes and additions may be made to this specification. Parameters marked TBD or left blank will be included in later issues. Items that are highlighted or greyed out should be ignored. These will be clarified in later issues of this document.

2 Block Diagram

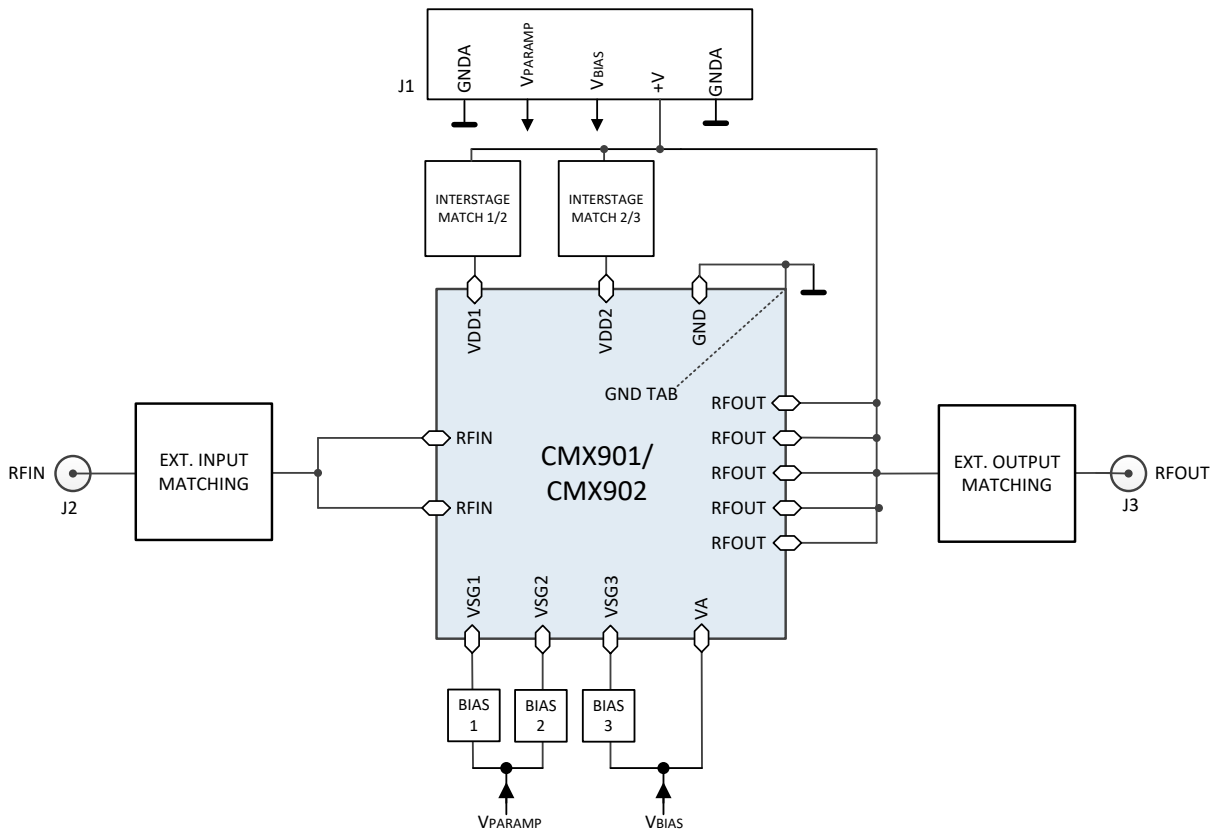


Figure 1 Block Diagram

3 Preliminary Information

The EV9011 is an evaluation kit for the CMX901 and the EV9021 is an evaluation kit for the CMX902. The EV9011 is available in three variants and the EV9021 in two variants:

EV9011-160 and EV9021-160 - Operation 150MHz to 170MHz
EV9011-435 and EV9021-435 - Operation 400MHz to 470MHz
EV9011-915 - Operation 900MHz to 930MHz

3.1 Laboratory Equipment

The following laboratory equipment is needed to use this evaluation kit:

- Dual / Triple Power Supply
- Spectrum Analyser (e.g. 100MHz to 3GHz)
- RF Power Attenuator
- RF Signal Generator (e.g. 100MHz to 1GHz)
- RF Power Meter

For more detailed design or investigation work the customer may require other RF test equipment.

3.1.1 Power Supply

All power supply and control voltage connections to the EV9011/EV9021 are not regulated on the PCB so care should be taken that applied voltages are within the specified values.

The maximum input voltage to the PCB for all circuits, except the PA, is 3.3V.

The supply (+V) to the PA is connected directly to the CMX901/CMX902: a voltage of 4.0V, at the PA, is recommended.

The +3.3V supply should be rated at 100mA and the PA supply (+V) rated at 2A.

NOTE: Care should be exercised with the supplies, as they are not protected for reverse polarity. For optimum RF performance, the PA supply is connected directly to the CMX901/CMX902, good quality power cables are recommended to avoid excessive voltage drop between the power supply and the EV9011/EV9021.

3.2 Handling Precautions

Like most evaluation kits, this product is designed for use in office and laboratory environments. The following practices will help ensure its proper operation.

3.2.1 Static Protection



This product uses CMOS circuits that can be damaged by electrostatic discharge. Partially-damaged circuits can function erroneously, leading to misleading results. Observe ESD precautions at all times when handling this product.

3.2.2 Contents - Unpacking

Please ensure that you have received all of the items on the separate information sheet (EK9011/EK9021) and notify CML within seven working days if the delivery is incomplete.

3.3 Approvals

This product is not approved to any EMC or other regulatory standard. Users are advised to observe local statutory requirements, which may apply to this product and the radio frequency signals that may emanate from it.

4 Quick Start

This section provides instructions for users who wish to experiment immediately with the evaluation kit. A more detailed description of the kit and its use appears later in this document. Before using the EV9011/EV9021 the user should read the CMX901 and CMX902 Datasheets.

4.1 Setting-Up

In this first main step external connections are made to the EV9011/EV9021 and then power is applied. Perform the following steps in sequence:

1. Connect the power amplifier output (J3) to a suitable 50Ω load. **Failure to do this may damage the PA stage and any test equipment being used to monitor the output.**
2. Connect test leads as shown below in Figure 2.
3. Connect signal generator to the input (J2) and ensure that RF is off.
4. Power should be applied to the main supply +V (J1 pin 4, 4.0V nominal).
5. Power should be applied to V_{BIAS} (J1 pin 3, 3.3V nominal).
6. V_{PARAMP} (J1 pin 2) should remain at 0V.

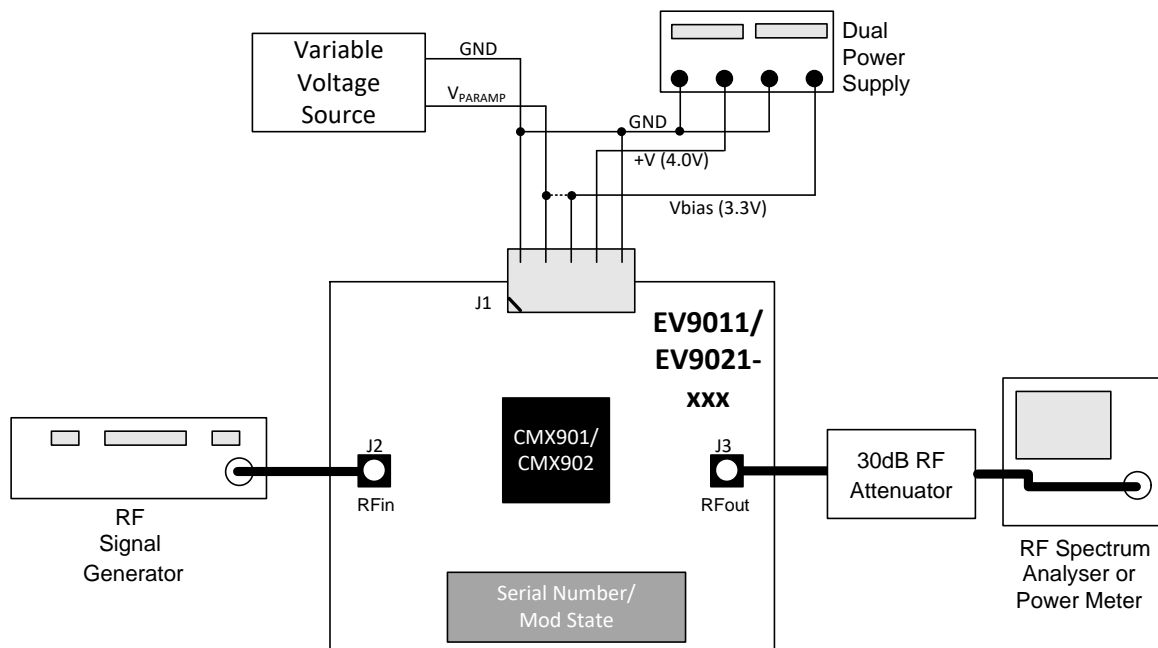


Figure 2 Typical Evaluation Connections for EV9011/EV9021

4.2 Operation

Following the configuration procedure in section 4.1 commence operation as follows:

1. Program the signal generator to the nominal operating frequency for the EV9011/EV9021 version under test
2. Program the spectrum analyser to the nominal operating frequency for the EV9011/EV9021 version under test (typical settings: 1MHz span, other settings auto, apply offset for the power attenuator, set reference level to +35dBm)
3. Turn the signal generator on, set signal level to the input level specified in the CMX901/CMX902 datasheet for the nominal operating frequency
4. Increase V_{PARAMP} to 3.3V
5. Observe the output spectrum on the spectrum analyser

The output power should now be close to P_{max} specified for the relevant frequency band in section 8.1.3.

5 Signal Lists

CONNECTOR PINOUT				
Connector Ref.	Connector Pin No.	Signal Name	Signal Type	Description
J1	1	GND A	PWR	Analogue ground
J1	2	V _{PARAMP}	I/P	Output power control
J1	3	V _{BIAS}	PWR	Final stage bias (3.3V) and VA
J1	4	+V	PWR	Power supply
J1	5	GND A	PWR	Analogue ground
J2	1	RFIN	I/P	RF signal input
J3	1	RFOUT	O/P	RF signal output

Table 1 Signal List

TEST POINTS		
Test Point Ref.	Default Measurement	Description
TP1	3.3V	V _{PARAMP} Output power control voltage

Table 2 Test Points

Notes:

I/P	=	Input
O/P	=	Output
PWR	=	Power Supply Connection
TP	=	Test Point

6 Circuit Schematics and Board Layouts

For clarity, circuit schematics are available as separate high-resolution files. These can be obtained via the CML website. The layout of the pcb is shown in Figure 3 and Figure 4. Note that no components are placed on the underside of the pcb. Complete design files for the PCB are available from the CML website.

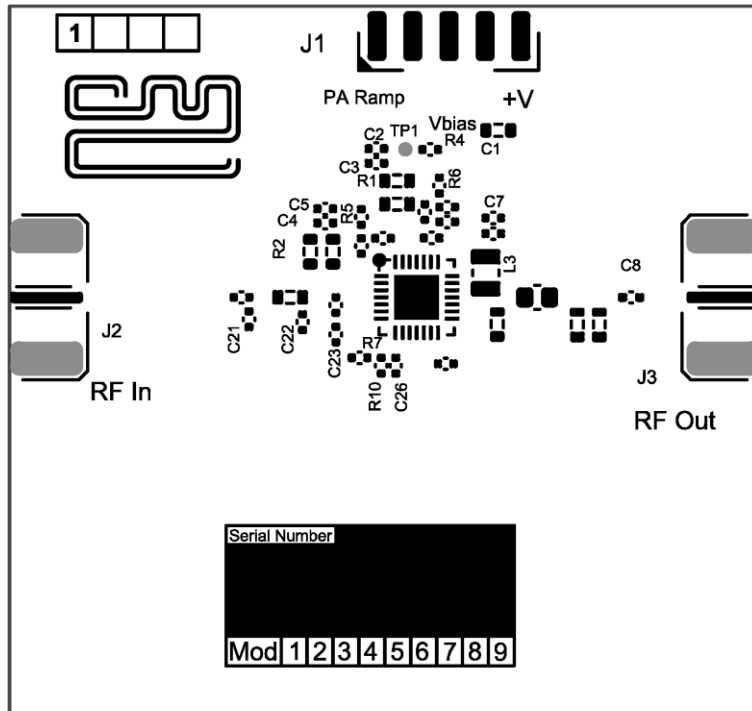


Figure 3 PCB Layout: Overlay

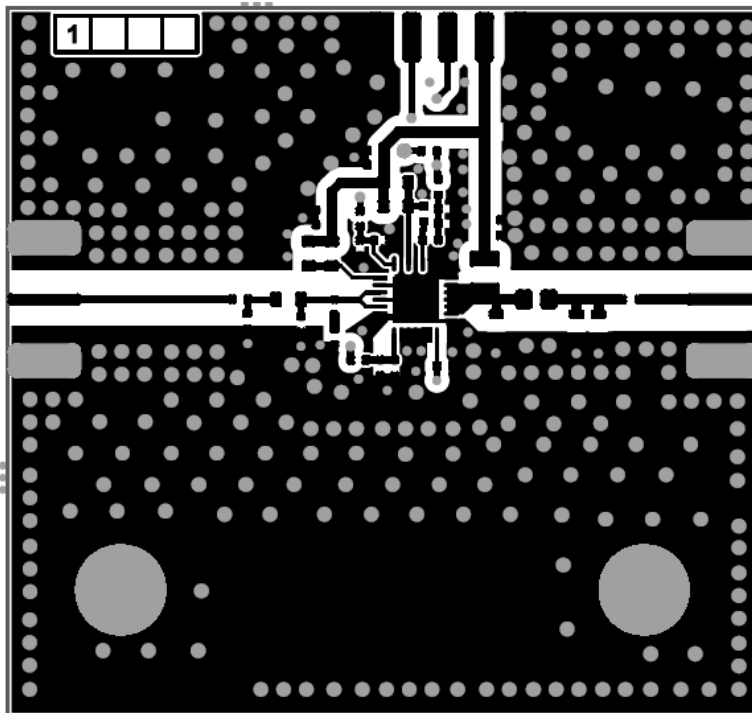


Figure 4 PCB Layout: Top Copper

7 Detailed Description

7.1 Circuit Description

7.1.1 Input Circuit

The RF input is applied via connector J2. C9 provides dc blocking and C21, C22 and L4 provide a flexible pi-match that can be configured depending on the operating frequency. R3 and C23 are placed close to the device input and are important to ensure the stability of the CMX901/CMX902.

7.1.2 Inter-stage Matching

L2 provides inter-stage tuning between the first and second stage of the PA. The match can be “de-Qed” using R2 if required.

L1 and R1 provide similar inter-stage matching between the second and third (final) stages. C20 can provide additional low frequency coupling if required.

7.1.3 Output Circuit

The output circuit comprises L3 and the pi-match of C10, L5 and C11+C12. The circuit transforms the low device output impedance of a few Ohms to the interface impedance of 50Ω. The PA power supply (signal +V) must be applied through L3 which therefore needs to be capable of handling up to 2A and have low dc resistance.

7.1.4 Bias Circuits

The three amplifier stages have separate bias voltages Vgs1, Vgs2 and Vgs3. Control of Vgs1 and Vgs2 can be used to adjust the output power of the device and provide a defined envelope on / off characteristic.

7.2 Vias for the Central Metal Pad

There are 25 thru vias (0.2mm hole size) in the central metal pad of the CMX901/CMX902, this is important to provide a good grounding and thermal dissipation.

7.3 Routings of Input and Output

In order to minimise power loss the PCB traces for the input and output ports are 50Ω microstrip.

7.4 Placement of External Components

All decoupling capacitors and choke inductors in each stage are close to the pins to minimise strays. It is particularly important that the 51Ω resistor in series with Vgs3 (pin 24) is placed close to the pin to avoid self-excitation.

7.5 Heatsink

In all RF power devices some of the consumed power is not converted to RF power and will be converted to thermal energy (heat). To keep the device within specified operating conditions, a good heatsink is necessary.

Note: without a good heatsink, output power may decrease rapidly after power on.

The heatsink should be well contacted to the top of the chip or the ground vias conducting the central metal pad. On the EV9011/EV9021 the large exposed copper ground plane on the rear of the PCB and on internal layers acts as a satisfactory heatsink. Mounting holes are provided if the user wishes to fit an external heatsink.

7.6 Application Information

Results of the CMX901 performance measured on the EV9011 can be found in the CMX901 Datasheet for operation at 150 - 170MHz, 400 – 470MHz and 900 - 930MHz (section 3.2). Results of the CMX902 performance measured on the EV9021 can be found in the CMX902 Datasheet for operation at 150 – 170MHz and 400 -470MHz (section 3.2).

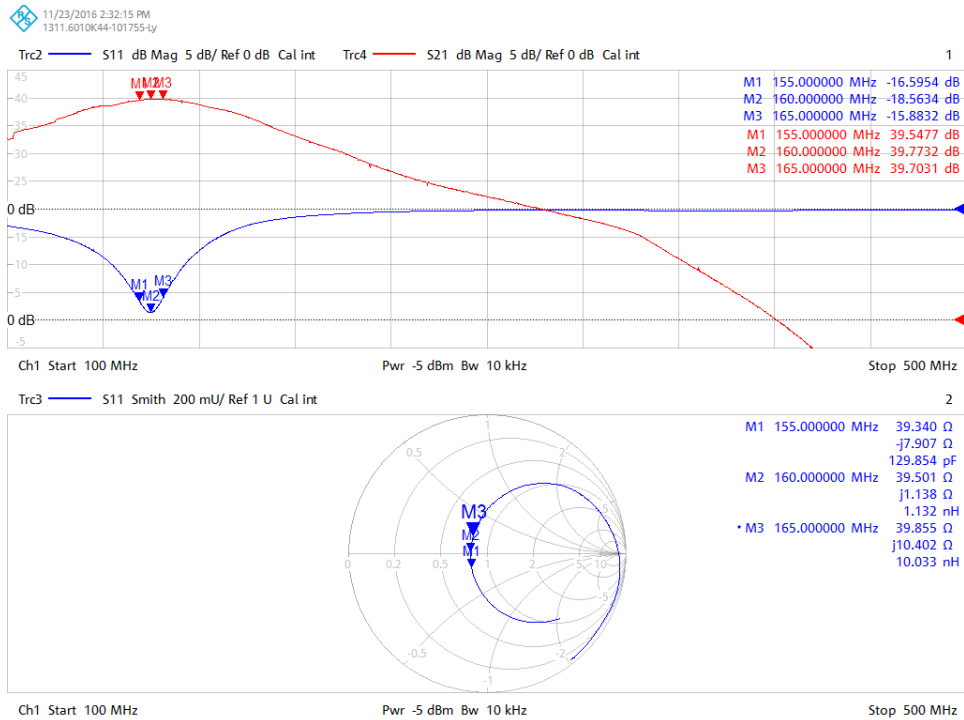


Figure 5 Typical Swept Response of EV9011-160

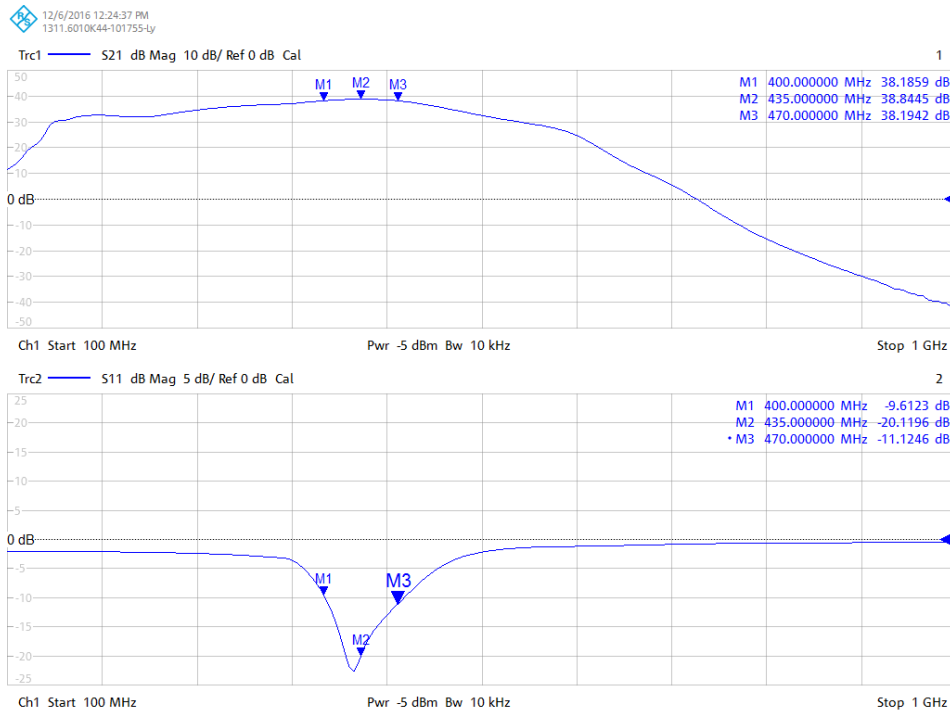


Figure 6 Typical Swept Response of EV9011-435MHz

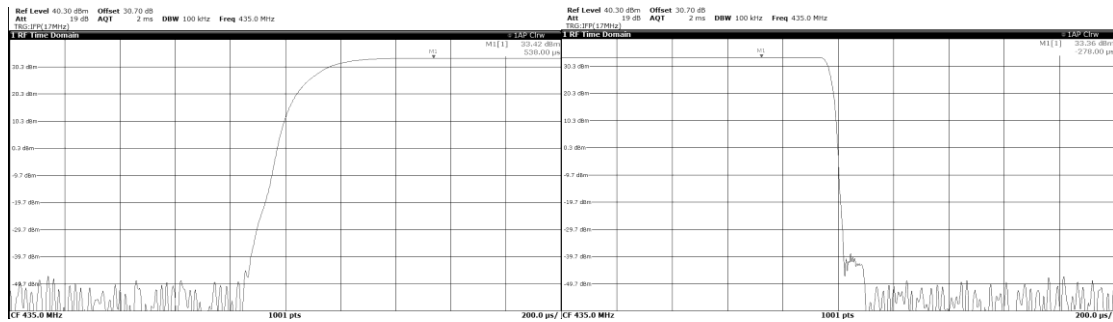


Figure 7 Ramp Up and Down EV9011-435MHz, -40°C

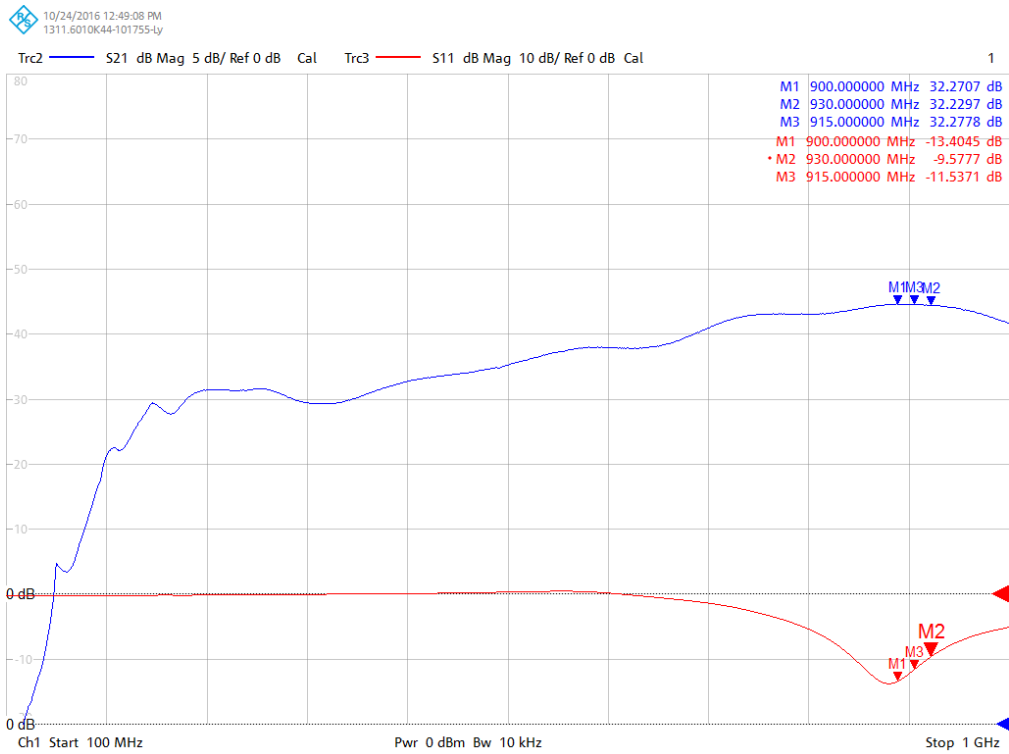


Figure 8 Typical Swept Response of EV9011-915MHz

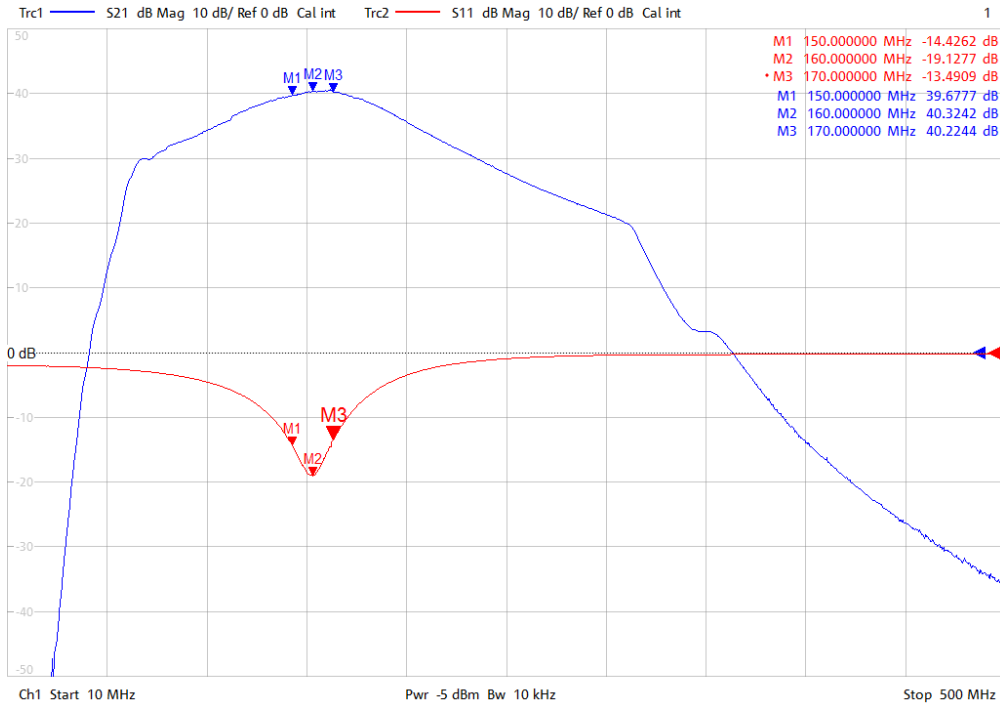


Figure 9 Typical swept response of the EV9021-160

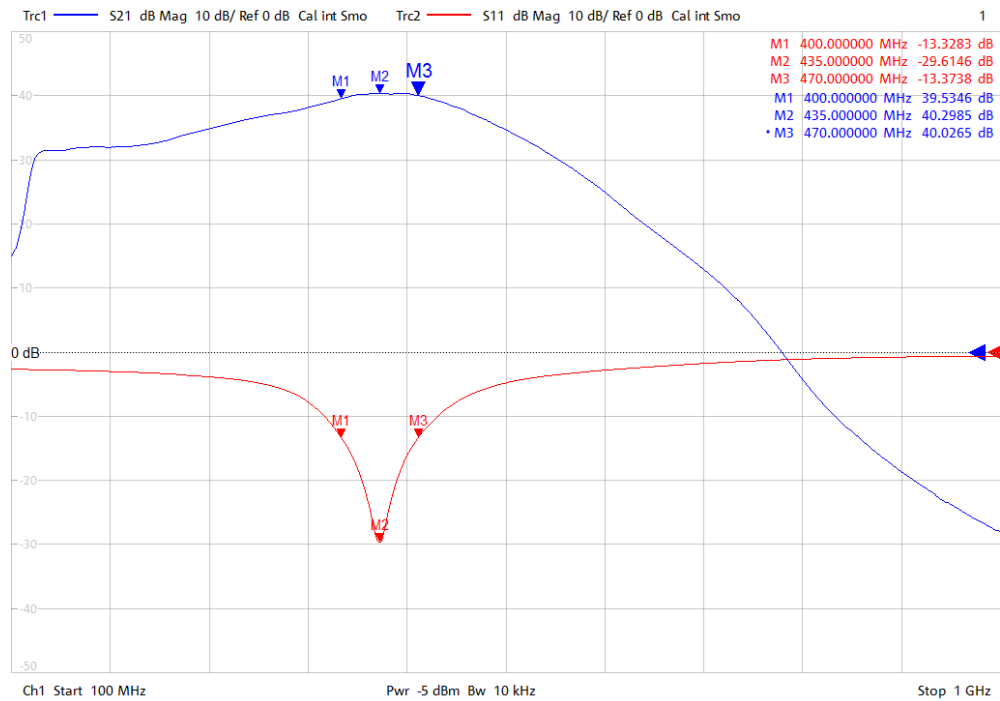


Figure 10 Typical swept response of the EV9021-435

8 Performance Specification

8.1 Electrical Performance

8.1.1 Absolute Maximum Ratings

Exceeding these maximum ratings can result in damage to the Evaluation Kit.

	Min.	Max.	Units
+V Supply ($V_{IN} - V_{GND}$)	-0.3	6.0	V
Voltage on any connector pin to V_{SS}	-0.3	$V_{DD} + 0.3$	V
Current into or out of V_{IN} and V_{SS} pins	0	+1.5	A

8.1.2 Operating Limits

	Notes	Min.	Max.	Units
+V Supply ($V_{IN} - V_{GND}$)		2.7	5.0	V
Ambient Operating Temperature		+15	+35	°C
Extreme Operating Temperature		-40	+85	°C

8.1.3 Operating Characteristics


Details in this section represent design target values and are not currently guaranteed. For the following conditions unless otherwise specified:

+V = 4.0V, V_{BIAS} and $V_{PARAMP} = 3.3V$, $T_{AMB} = +25^{\circ}C$.

	Notes	Min.	Typ.	Max.	Units
DC Parameters					
Supply current (no RF input)	1		16	30	mA
Supply current at PmaxNNN	1				
EV9011-160			1.0	1.2	A
EV9011-435			0.85	1.2	A
EV9011-915			0.9	1.2	A
EV9021-160			1.1	1.25	A
EV9021-435			1.1	1.2	A
AC Parameters					
Tx I/P impedance (nominal)			50		Ω
Tx O/P impedance (nominal)			50		Ω
Signal Output Level (Pmax)					
EV9011-160	1	33	34		dBm
EV9011-435	1	31	32.5		dBm
EV9011-915	1	30	31.5		dBm
EV9021-160	1	33	34.5		dBm
EV9021-435	1	32	33.5		dBm

Notes: 1. Operating conditions as specified to achieve PmaxNNN in the device datasheet.

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