

# ON Semiconductor

## Is Now

# onsemi™

To learn more about onsemi™, please visit our website at  
[www.onsemi.com](http://www.onsemi.com)

---

**onsemi** and **onsemi** and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi** product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.

# Single stage LNA for GPS Using the MCH4009

---



**ON Semiconductor®**

<http://onsemi.com>

## Application Note

### Overview

This application note explains about ON Semiconductor's MCH4009 which is used as a Low Noise Amplifier (LNA) for GPS (Global Positioning System).

The MCH4009 is a silicon bipolar transistor best suited for high-frequency applications which is assembled in the 4-pin surface mount package.

For information about the performance, please refer to the datasheet of this product.

Since the evaluation board is adjusted to achieve optimal performance in GPS (1575 MHz), the product can provide 14.1dB gain and 1.5dB noise figure.

A standard material FR4 is used for the printed circuit board (PCB).

Please note that the losses of the PCB and the SMA connector are not excluded from the noise figure.

## Single stage LNA for GPS Using the MCH4009

---

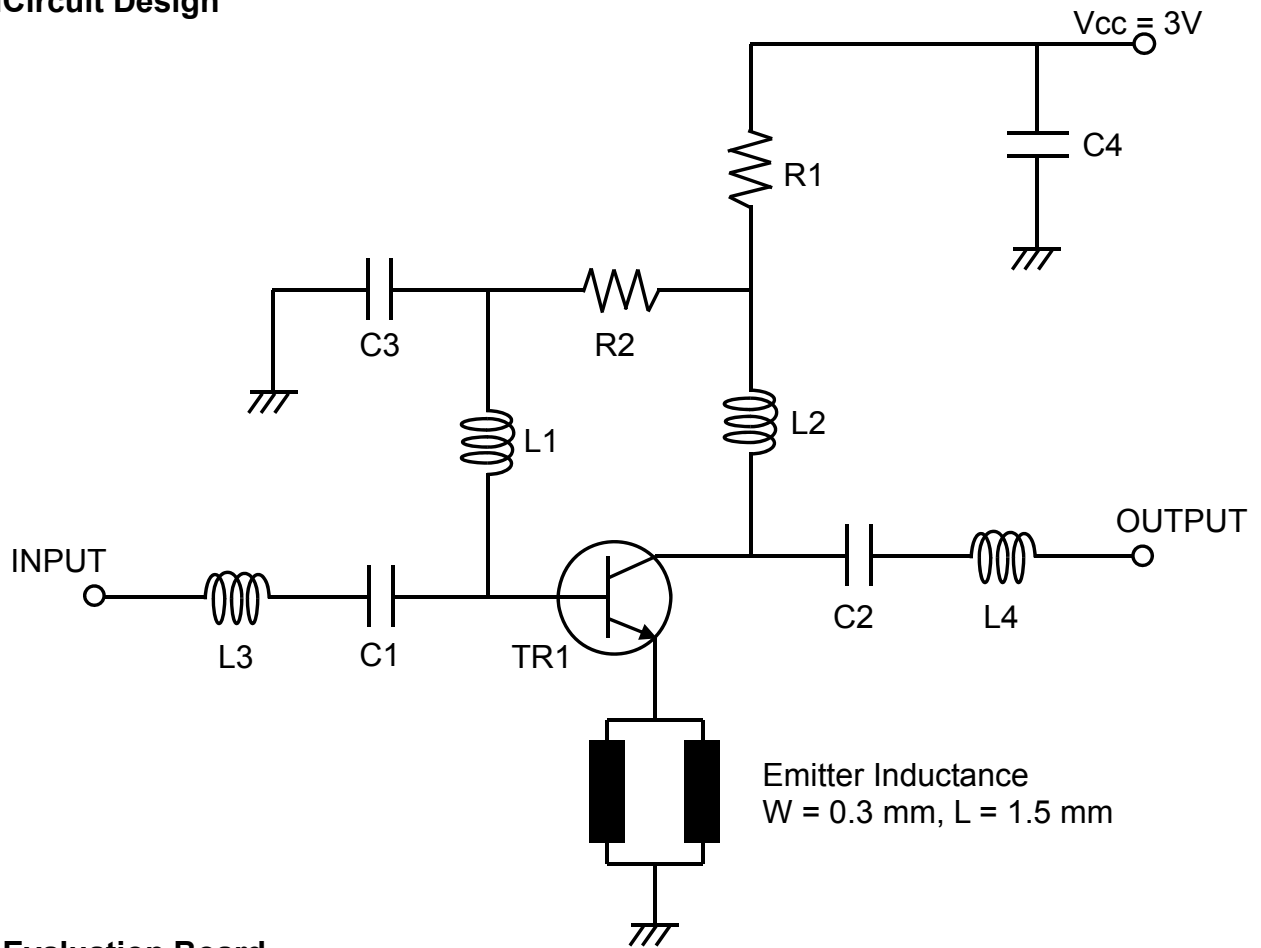
### ■ Summary of Data

Ta = 25 °C, Input Power = -40 dBm

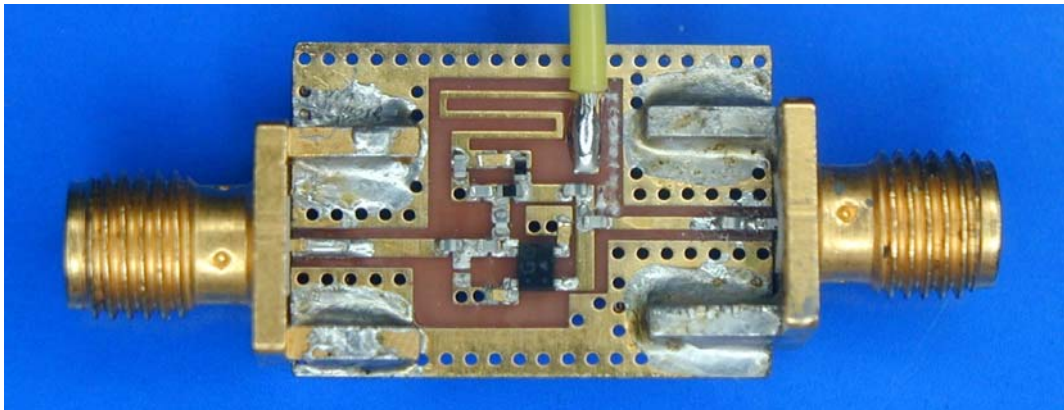
Parameter	Symbol	Condition	Result	Unit
DC Voltage	Vcc		3.0	V
DC Current	Icc		4.9	mA
Power Gain	Gp	f = 1575 MHz	14.1	dB
Noise Figure	NF	f = 1575 MHz	1.5	dB
Input Return Loss	RLin	f = 1575 MHz	10.4	dB
Output Return Loss	RLout	f = 1575 MHz	8.4	dB
Isolation	ISL	f = 1575 MHz	21.1	dB
Gain 1dB Compression Input Power	Pin1dB	f = 1575 MHz	-15	dBm
Input 3rd Order Intercept Point	IIP3	f1 = 1575 MHz f2 = 1576 MHz Pin = -26 dBm	-0.5	dBm

# Single stage LNA for GPS Using the MCH4009

## ■Circuit Design



## ■Evaluation Board



## Single stage LNA for GPS Using the MCH4009

---

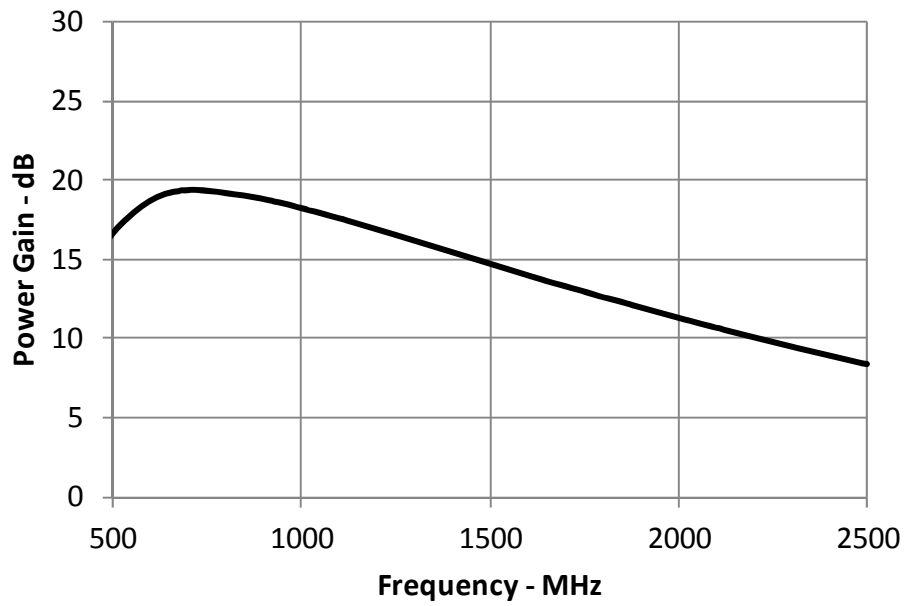
### ■Bill of Materials

Item	Symbol	Value	Manufacturer	Size
Bip-Tr	TR1	MCH4009	ON Semiconductor	SC82
Capacitor	C1	6 pF	Murata GRM155	1005
	C2	100 pF	Murata GRM155	1005
	C3	1000 pF	Murata GRM155	1005
	C4	1000 pF	Murata GRM155	1005
Resistor	R1	150 $\Omega$	Various	1005
	R2	22 k $\Omega$	Various	1005
Inductor	L1	8.2 nH	TDK MLG1005S	1005
	L2	33 nH	TDK MLG1005S	1005
	L3	1 nH	TDK MLG1005S	1005
	L4	2.7 nH	TDK MLG1005S	1005
Material	-	FR4	-	20 x 14 mm

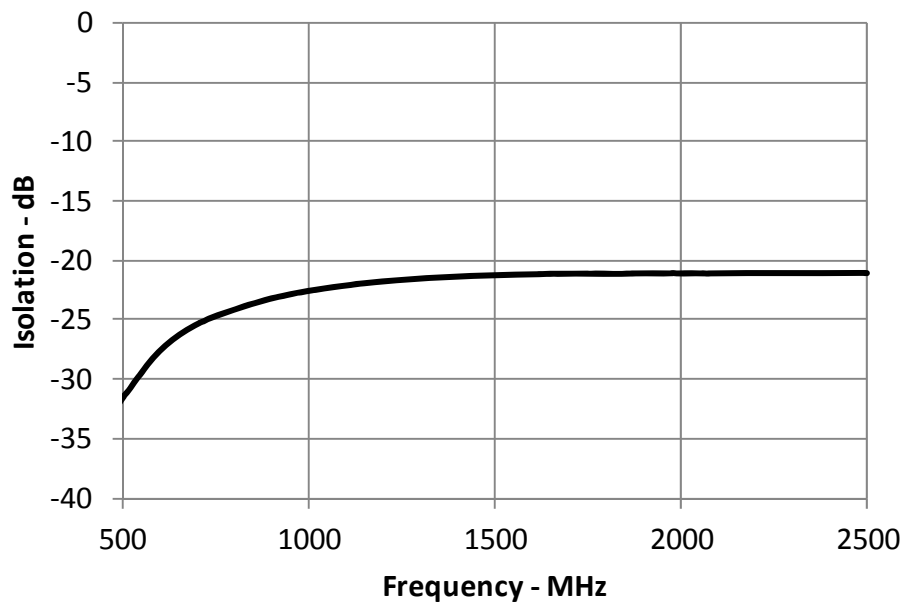
## Single stage LNA for GPS Using the MCH4009

---

### ■ Power Gain



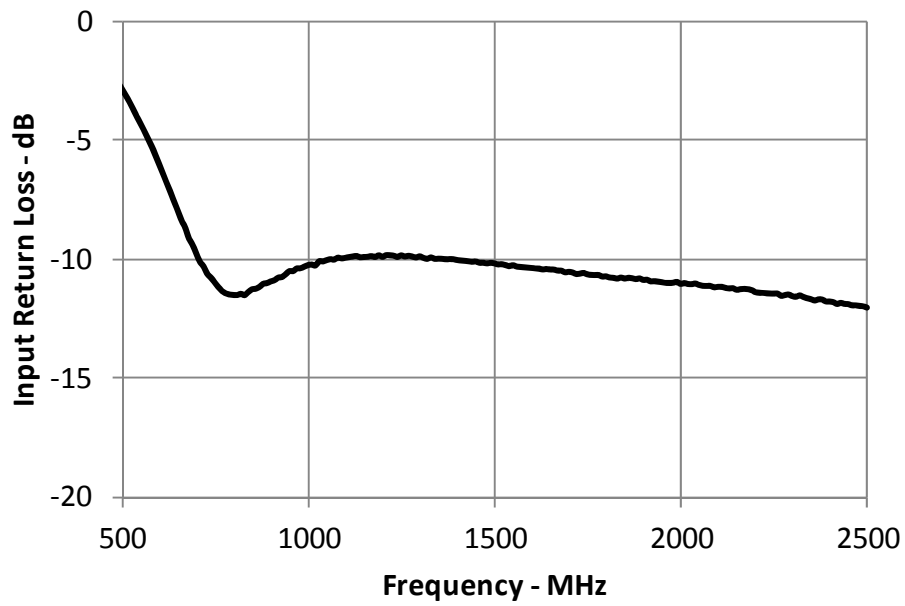
### ■ Isolation



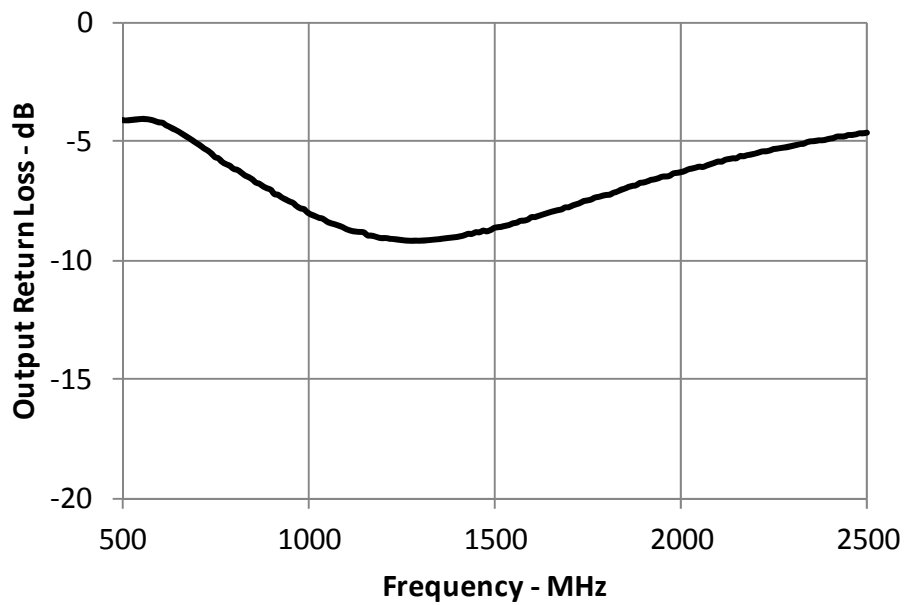
# Single stage LNA for GPS Using the MCH4009

---

## ■ Input Return Loss

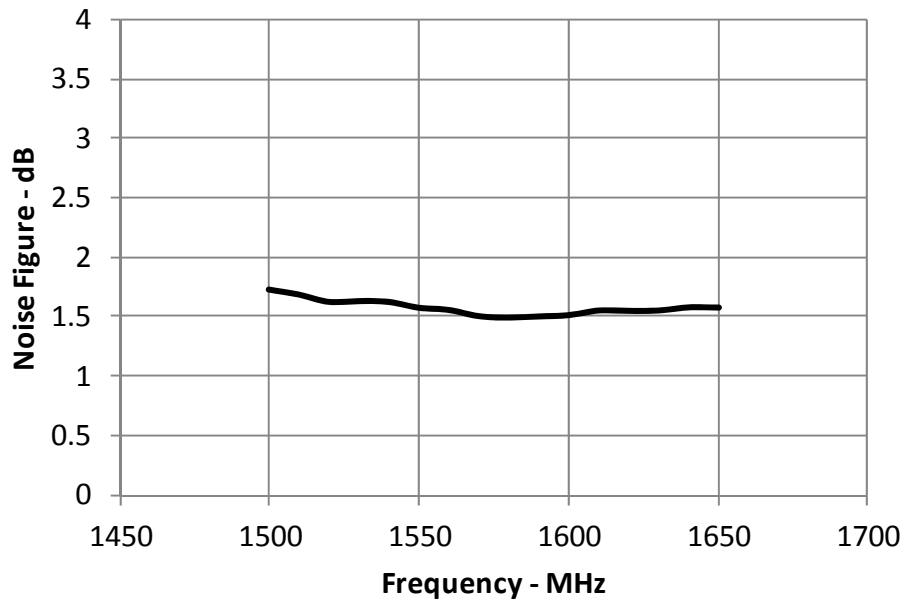


## ■ Output Return Loss

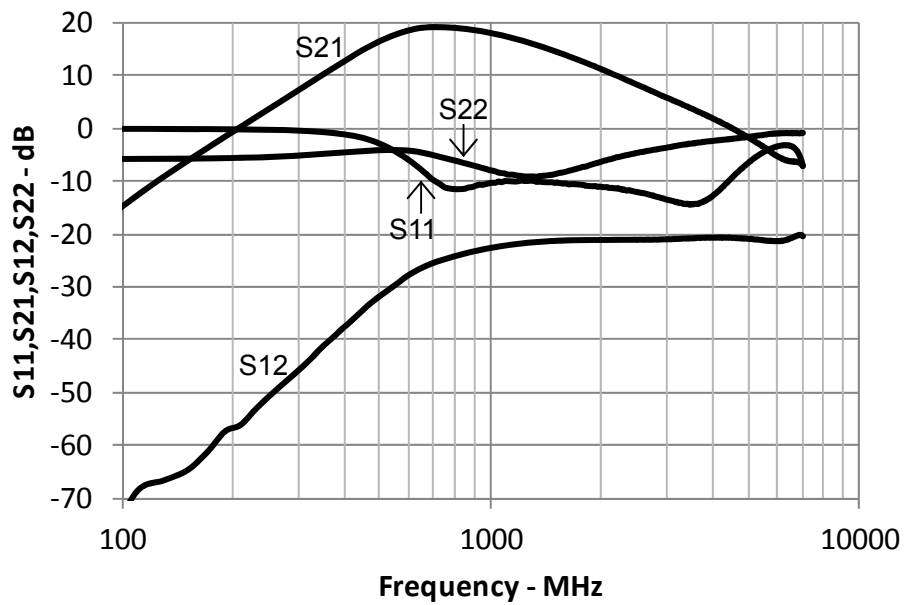


# Single stage LNA for GPS Using the MCH4009

## ■ Noise Figure



## ■ S11, S21, S12, S22 Wide Span

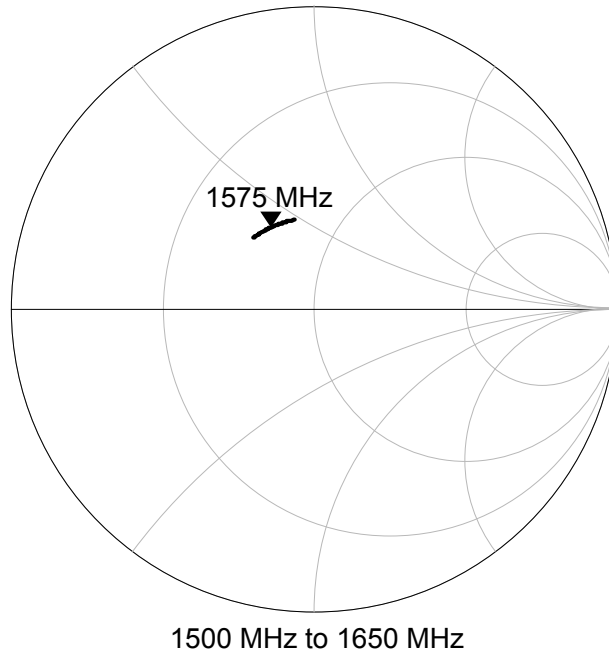




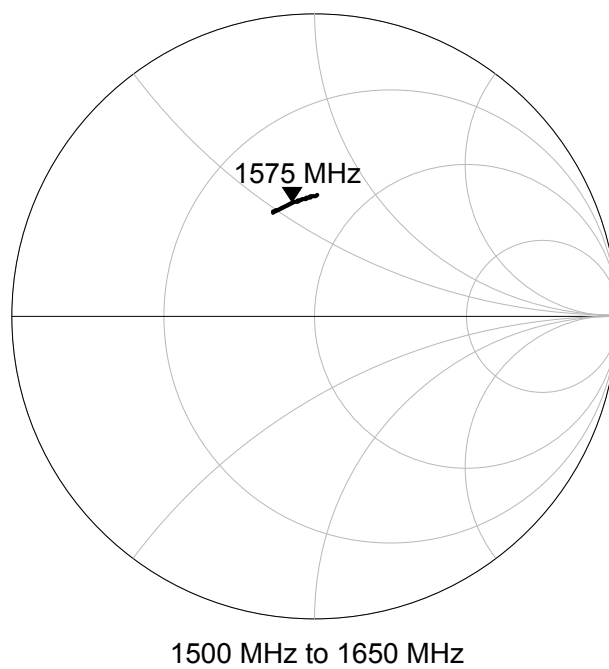
# Single stage LNA for GPS Using the MCH4009

---

## ■ Smith Chart Input Return Loss

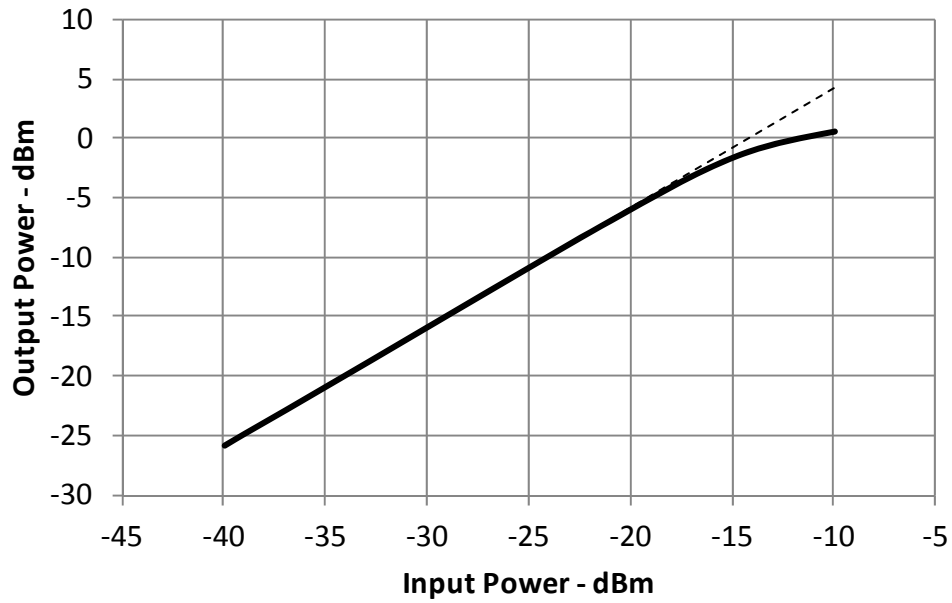


## ■ Smith Chart Output Return Loss



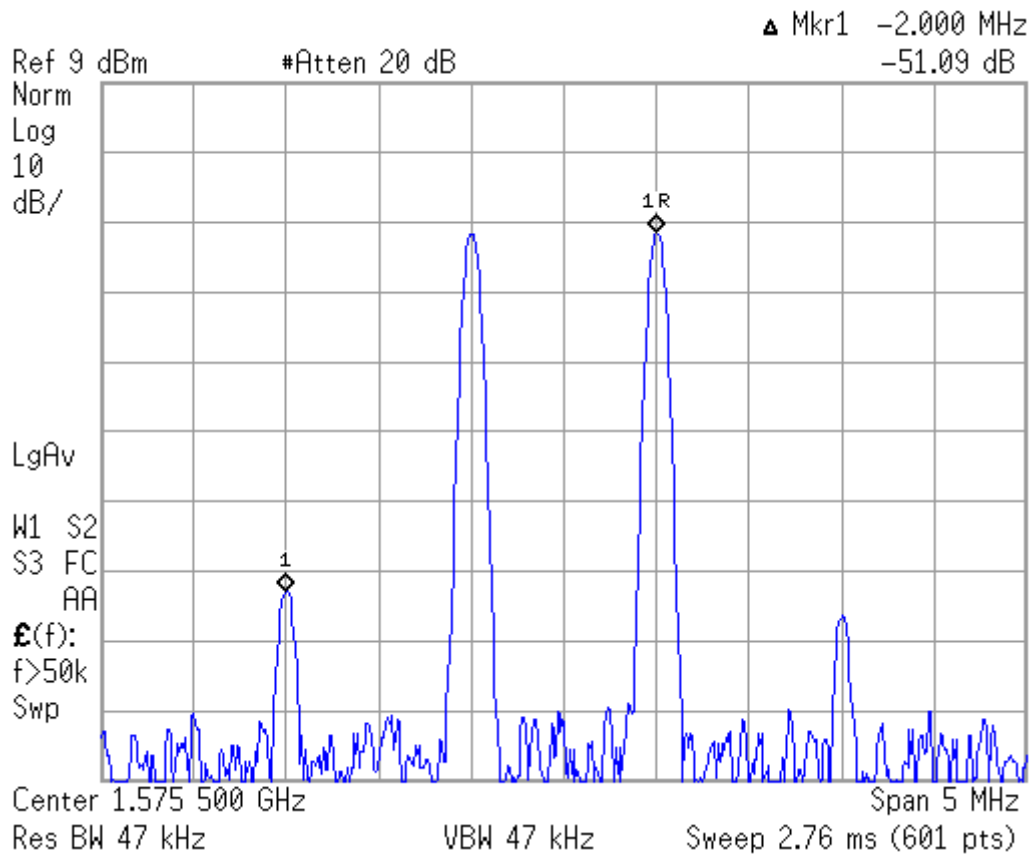
# Single stage LNA for GPS Using the MCH4009

## ■ Gain 1dB Compression Point



## ■ Input 3rd Order Intercept Point

f1 = 1575 MHz, f2 = 1576 MHz, Pin = -26 dBm



## Single stage LNA for GPS Using the MCH4009

---

ON Semiconductor and the ON logo are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.