

# Keysight 1GG7-4252

## DC - 10 GHz SPDT Packaged Switch



### Data Sheet

#### Features

- Frequency range:  
DC - 10 GHz  
Usable to 13.5 GHz
- Insertion loss:  
0.7 dB @ 10 GHz
- Isolation:  
> 70 dB @ 45 MHz  
> 22 dB @ 10 GHz
- Return loss: 18 dB
- Switching speed:  
< 20 ns (10 - 90% RF)
- Settling time: < 4 msec to  
settle within 0.01 dB
- $P_{-1dB}$ : 29 dBm
- Second harmonic  
intercept point (DC coupled):  
> 80 dBm
- Third harmonic intercept point:  
50 dBm

## Description

The 1GG7-4252 is a packaged GaAs monolithic microwave integrated circuit (MMIC) designed for low insertion loss from DC to 10 GHz. It is intended for use as a general-purpose, single-pole, double-throw (SPDT) switch. One series and one shunt MESFET per throw provide 0.6 dB typical insertion loss and 35 dB typical isolation at 3 GHz. The device is mounted in a 16-lead QFN plastic package. The 1GG7-4252 is fabricated with Keysight Technologies, Inc. GaAs FET MMIC process.

## Absolute maximum ratings<sup>1</sup>

Symbol	Parameters/conditions	Min	Max	Units
$V_{sel}$	Series select voltages 1 & 2	-10.5	+10.5	volts
$P_{in}$	RF input power		27	dBm
$T_{op}$	Operating temperature	-55	+125	°C
$T_{st}$	Storage temperature	-65	+165	°C
$T_{max}^2$	Maximum assembly temperature		+260	°C
ESD	Electrostatic discharge (human body model) RFCOM port, SEL1/2 = ±10 V	-1500	1500	volts

1. Operation in excess of any one of these may result in permanent damage to this device.

$T_A = 25\text{ °C}$  except for  $T_{op}$ ,  $T_{st}$ , and  $T_{max}$ .

2. Refer to JEDEC J-STD-020D for detailed reflow profile



- Package type: 3 x 3 mm MLF-16/QFN-16
- Package dimensions: 3 x 3 mm (118 x 118 mils)
- Package thickness: 0.90 mm (35 mils)
- Pad (lead) pitch: 0.5 mm (20 mils)
- Pad (lead) width: 0.25 mm (10 mils)

## DC specifications/physical properties

( $T_A = 25\text{ }^\circ\text{C}$ )

Symbol	Parameters/conditions	Min	Typ	Max	Units
$I_{\text{SEL}-10\text{V}}$	Select line leakage current @ -10 V			44	$\mu\text{A}$
$I_{\text{SEL}+10\text{V}}$	Select line leakage current @ +10 V			44	$\mu\text{A}$
$V_p$	Pinchoff voltage ( $V_{\text{SEL}2} = V_p$ , $V_{\text{RF}2} = +2\text{V}$ , $I_{\text{RF}2} = 4.8\text{ mA}$ , $V_{\text{SEL}1} = -10\text{V}$ , $V_{\text{RF}1} = \text{open circuit}$ , $\text{VRFCOM} = \text{GND}$ )	-7.0		-3.00	volts
$BV_{\text{gss}2}$	Breakdown voltage (Test FET w/ $V_D = V_S = \text{GND}$ , $I_G = -0.5\text{ mA/mm}$ )			-14.5	volts
$R_{\text{series}}$	On-resistance from RFCOM to RF1/2 SEL1/2 = $\pm 10\text{ V}$		4.7	6.7	ohms
$R_{\text{shunt}}$	On-resistance from RF1/2 to ground SEL1/2 = $\pm 10\text{ V}$		5.5	7.6	ohms
$R_{\text{off}}$	Off-resistance from RF1/2 to ground, SEL1/2 = -10 V	2.5			kohm

## RF specifications

( $T_A = 25\text{ }^\circ\text{C}$ ,  $Z_0 = 50\ \Omega$ ,  $V_{\text{sel-high}} = +10\text{ V}$ ,  $V_{\text{sel-low}} = -10\text{ V}$ )

Symbol	Parameters/conditions	Min	Typ	Max	Units	
BW	Guaranteed operating bandwidth	DC		13.5 <sup>1</sup>	GHz	
IL	Insertion loss, selected ports	DC - 10 GHz	0.3	0.7	1.0 <sup>1</sup>	dB
		10 - 13.5 GHz		1.5	3 <sup>1</sup>	
$IL_{\text{tempco}}$	Insertion loss temperature coefficient		$-1.4 \times 10^{-3}$		dB/ $^\circ\text{C}$	
ISO	Isolation, RFCOM to unselected RF1/2	10 GHz		22	dB	
		13.5 GHz		18		
RL	Return loss (selected ports)	DC - 10 GHz		18	dB	
		10 - 13.5 GHz		10		
$P_{-1\text{dB}}$	Input power where IL increases by 1 dB		29		dBm	
$t_s$	Switching speed, 10% - 90% RF envelope (highly dependent on select line driver circuit)		20		ns	
$t_{\text{settle}}$	Settling time, within 0.01 dB of final value		4		msec	
SHI	2nd harm. intercept, @RFCOM input		80		dBm	
THI	3rd harm. intercept, @RFCOM input		50		dBm	

1. Not tested, guaranteed by design.

## Applications

The 1GG7-4252 can be used in instrumentation, communications, radar, ECM, EW, and many other systems requiring SPDT switching. It can be used for pulse modulation, port isolation, transfer switching, high-speed switching, replacement of mechanical switches, and so on.

## Operation

The 1GG7-4252 package introduces noticeable parasitic elements, which results in 11 dB typical return loss when all ports are at 50 ohms. For narrow-band applications, it is possible to cancel those parasitics with PC-board matching elements to achieve a 20 dB return loss.

## Assembly Techniques

This package is compatible with wave-solder or reflow printed circuit board soldering processes.

GaAs MMICs in either chip or SMT packages are ESD sensitive. ESD preventive measures must be employed in all aspects of storage, handling, and assembly.

MMIC ESD precautions, handling considerations, die attach and bonding methods are critical factors in successful GaAs MMIC performance and reliability.

*Keysight Technologies GaAs MMIC ESD, Die Attach and Bonding Guidelines - Application Note*, literature number 5991-3484EN provides basic information on these subjects.

Moisture sensitivity classification: Class 1, per JESD22- A112-A.

## Additional References

*Keysight Technologies FET Switch Speed and Settling Time - Application Note*, literature number 5991-3516EN

## Recommended Operating Conditions

Select line		RF path	
SEL1	SEL2	RFCOM to RF2	RFCOM to RF1
+10 V	-10 V	Isolated	Low loss
-10 V	+10 V	Low loss	Isolated

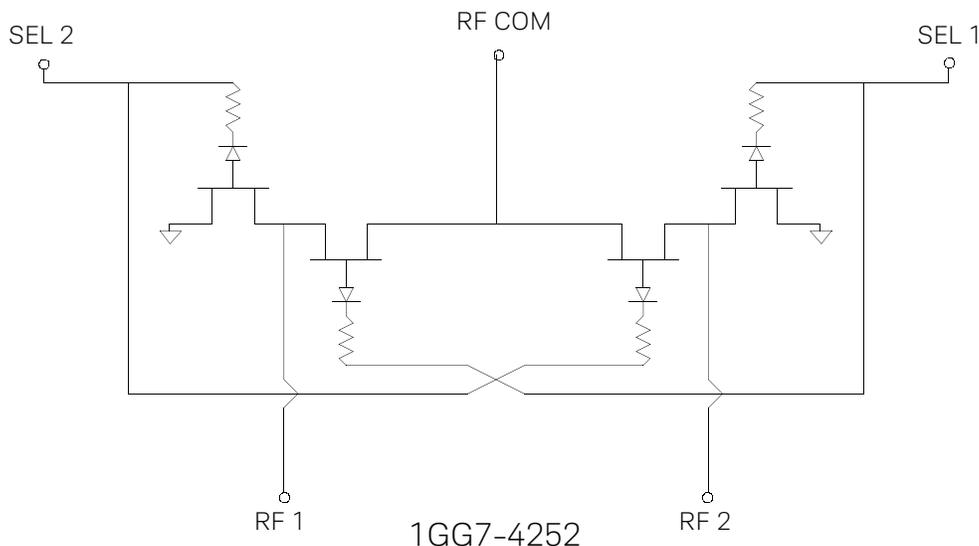


Figure 1. 1GG7-4252 schematic diagram

The 1GG7-4252 die is fabricated using a GaAs-based FET semiconductor material structure which is compatible with newer RoHS assembly temperatures and allows the device to be attached to a hybrid microcircuit housing or to thermally conductive embedded heatsinks which exist in QFN SMT Packages.

## Moisture Compatibility

Injection mold components like the 1GG7-4252 in QFN are moisture-sensitive. The product is tested to the Moisture and Reflow Sensitivity Level 5A as per IPC/Jedec J-STD-020 and must be mounted within 24 hours of opening the shipping container. Store and handle parts for reflow and for rework per IPC/Jedec JSTD- 033B. An example of the moisture sensitivity label is shown in Figure 2.

	<b>CAUTION</b>	<b>3</b>
	This bag contains <b>MOISTURE-SENSITIVE DEVICES</b>	
<p>1. Calculated shelf life in sealed bag: 12 months at &lt;math&gt;&lt;40^{\circ}\text{C}&lt;/math&gt; and &lt;math&gt;&lt;90\%&lt;/math&gt; relative humidity (RH).  <small>If Blank, see adjacent bar code label</small></p>		
<p>2. Peak package body temperature: <u>260</u> °C  <small>If Blank, see adjacent bar code label</small></p>		
<p>3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must  a) Mounted within: <u>168</u> hours of factory  <small>If Blank, see adjacent bar code label</small>  conditions &lt;math&gt;&lt;30^{\circ}\text{C}&lt;/math&gt;/60%.  b) Stored at &lt;math&gt;&lt;10\%&lt;/math&gt; RH.</p>		
<p>4. Devices require bake, before mounting, if:  a) Humidity Indicator Card is &gt;10% when read at &lt;math&gt;23 \pm 5^{\circ}\text{C}&lt;/math&gt;  b) 3a or 3b not met.</p>		
<p>5. If baking is required, devices may be baked for 48 hours at &lt;math&gt;125 \pm 5^{\circ}\text{C}&lt;/math&gt;.  Note: If device containers cannot be subjected to high temperature or shorter bake times are desired, reference IPC/JEDEC J-STD-033 for bake procedure.</p>		
<p>Bag Seal Date: <u>7-7-10</u> <u>DD</u>  <small>If Blank, see adjacent bar code label</small></p>		
<p><small>Note: Level and body temperature defined by IPC/JEDEC J-STD-020</small></p>		

Figure 2. 1GG7-4252 moisture sensitivity label

## Tape and Reel

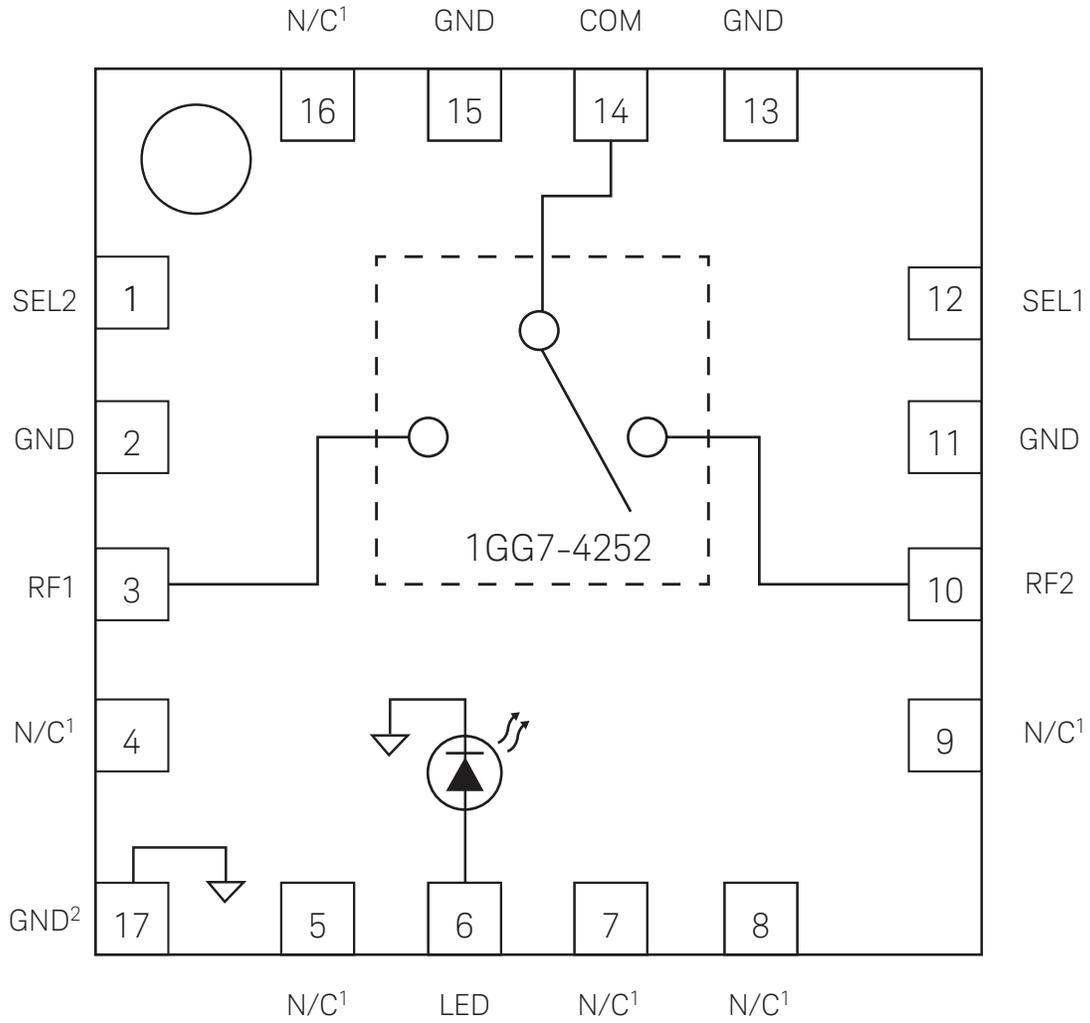
The 1GG7-4252 is available in tape and reel format to facilitate automatic pick and place manufacturing. See Figure 7.

## RoHS Compliance

This device is RoHS Compliant. This means the component meets the requirements of the European Parliament and the Council of the European Union *Restriction of Hazardous Substances Directive 2011/65/EU*, commonly known as *RoHS*. The six regulated substances are lead, mercury, cadmium, chromium VI (hexavalent), polybrominated biphenyls (PBB) and polybrominated biphenyl ethers (PBDE). RoHS compliance implies that any residual concentration of these substances is below the RoHS Directive's maximum concentration values (MVC); being less than 1000 ppm by weight for all substances except for cadmium which is less than 100 ppm by weight.

Made in USA of US and Foreign parts	7/20/10
PART#: 1GG7-4252	
WAFER#: KY400032	
DEVICE : 1GG7-4252	
LOT: AG3006849	
QTY: 100	VENDOR: AZ
ELECTROSTATIC SENSITIVE DEVICES	

Figure 3. Tape and reel label



1. N/C pins can be left open, but it is recommended to connect these to RF/DC ground.
2. Pin 17 is the center heat slug this must be connected to RF/DC ground. Use "filled" vias to prevent solder voids.

Figure 4. 1GG7-4252 simplified schematic and pin-out diagram

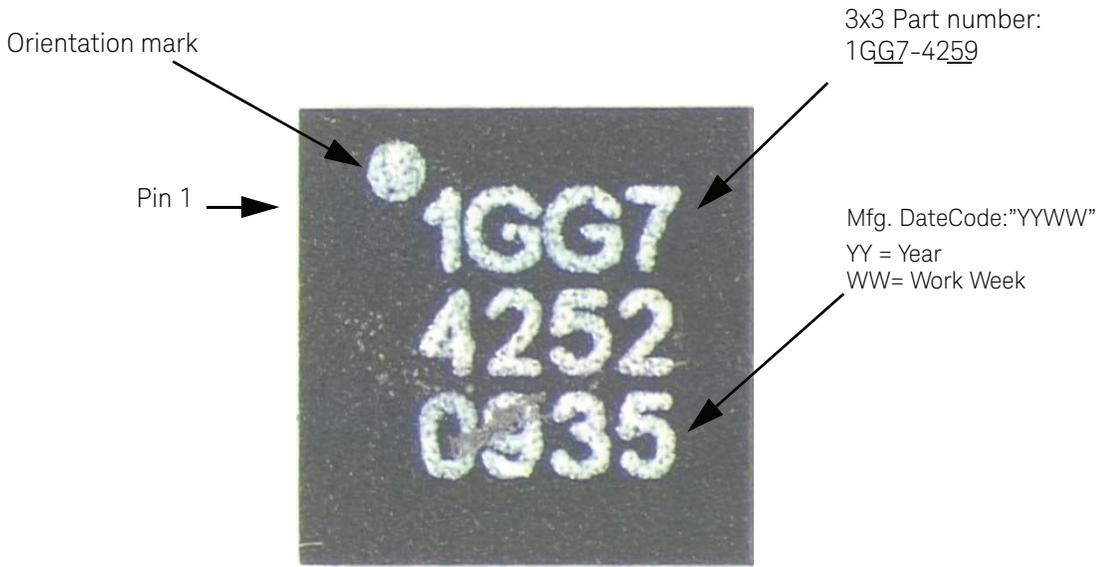


Figure 5. 1GG7-4252 package photo

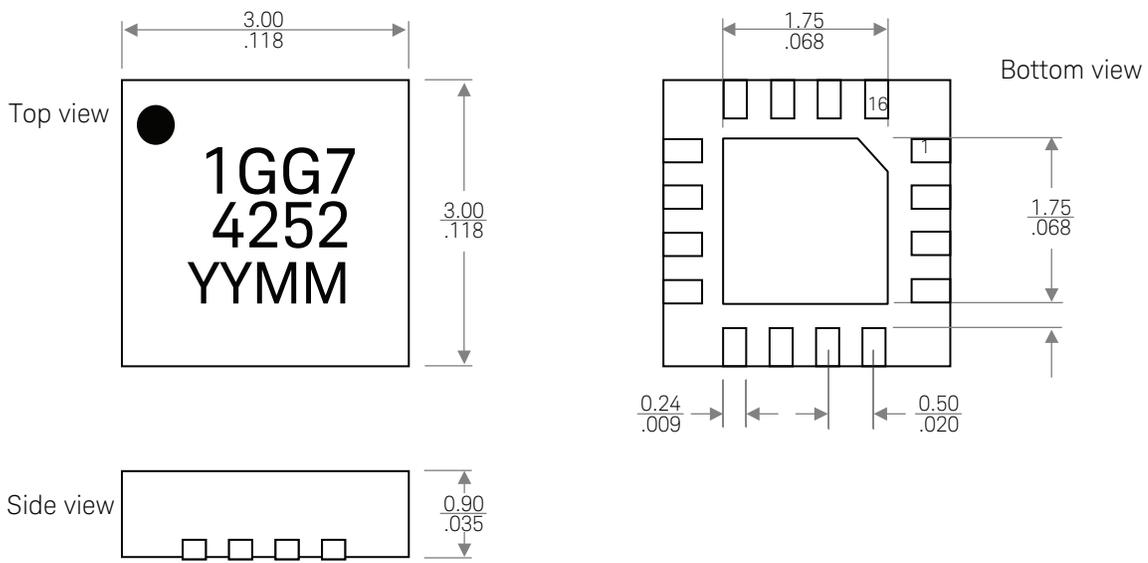


Figure 6. 1GG7-4252 dimensioned drawing

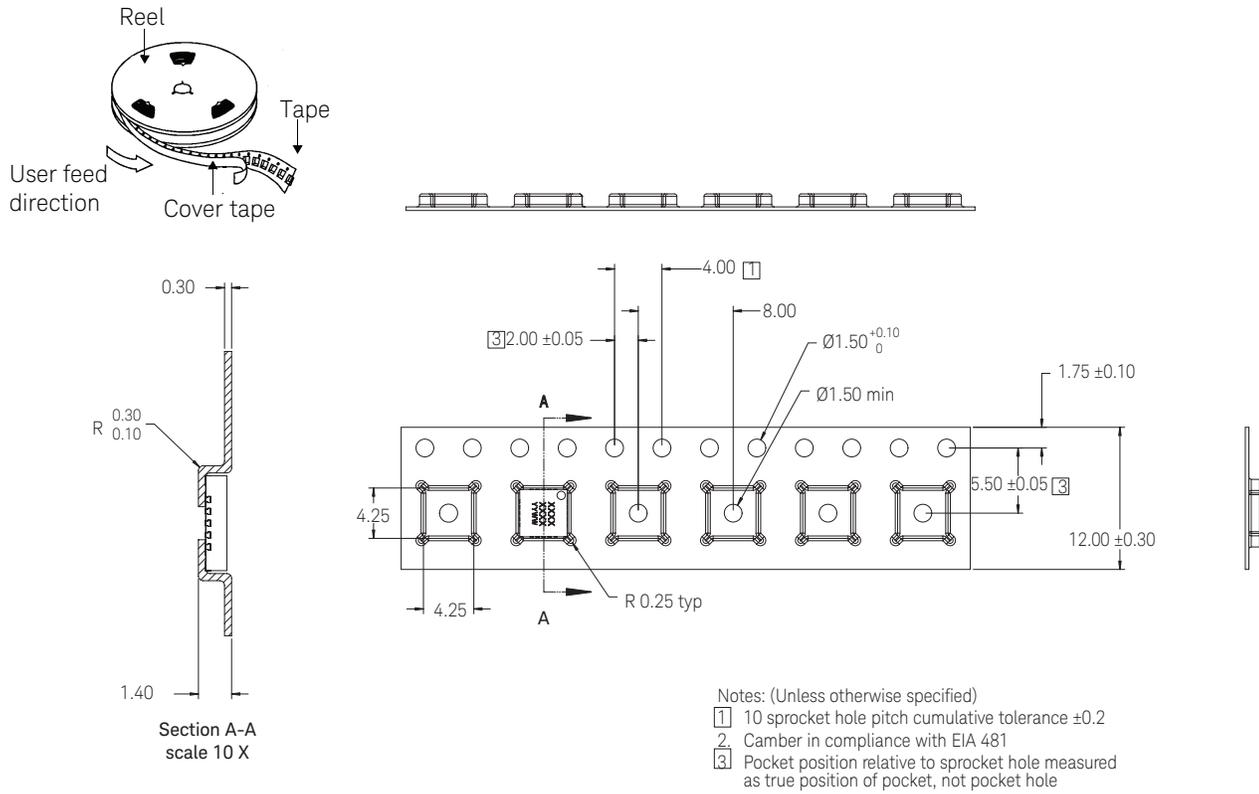


Figure 7. 1GG7-4252 tape and reel configuration

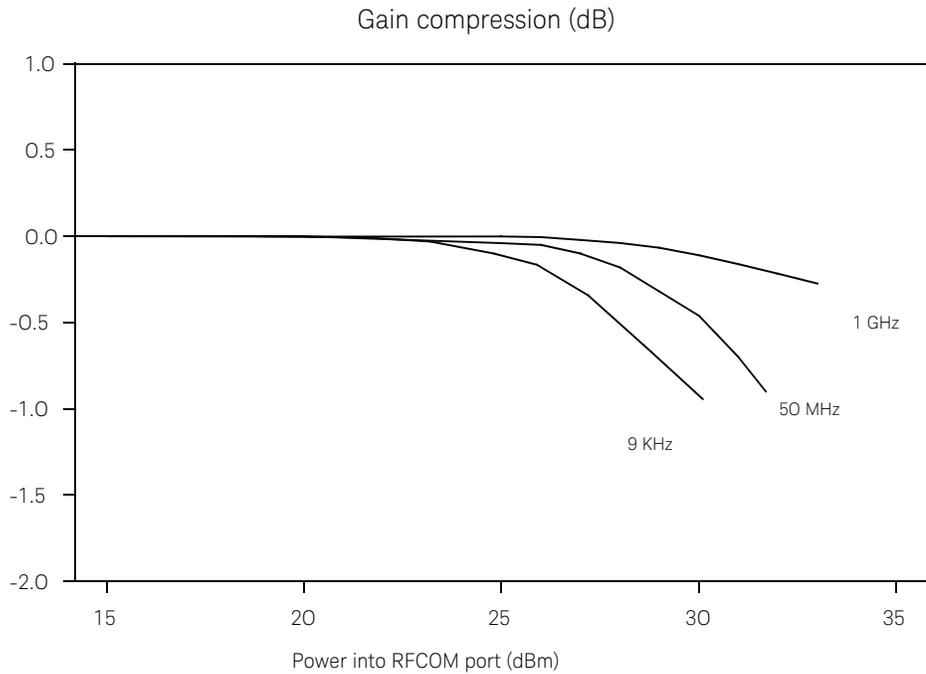


Figure 8. Typical gain compression

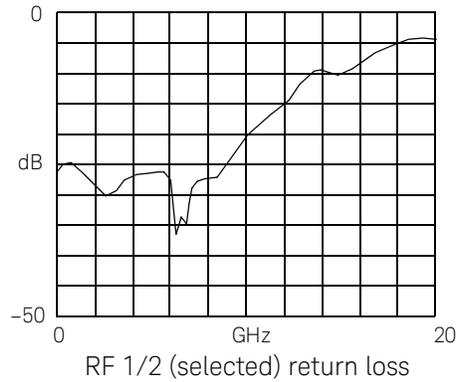
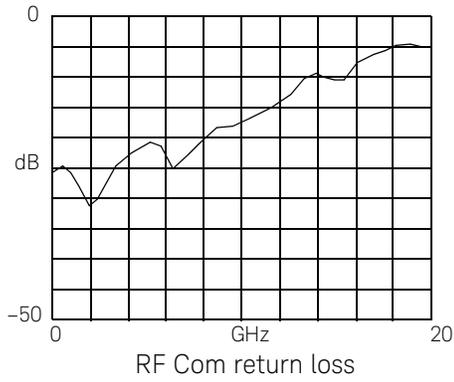
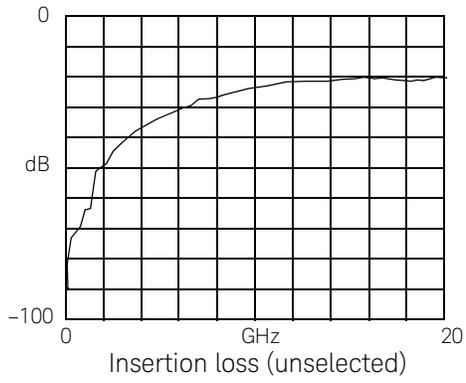
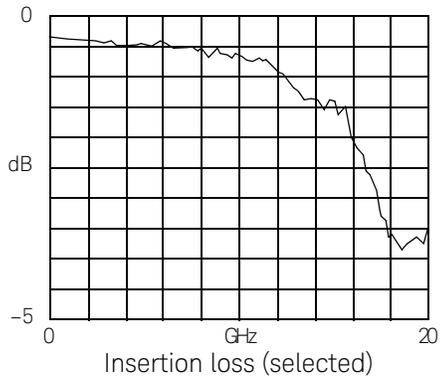


Figure 9. Typical small signal performance

(Measured in Modular Breadboard Package, insertion loss and isolation normalized to 50 ohm thru-line, includes effects of bond wire inductances on all RF ports).  
 Data taken with a IC device mounted in modular breadboard package, see 1GG7-4108 data sheet for detail.

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The product described in this data sheet is *RoHS Compliant* and RoHS Process Compatible with a maximum temperature of 260 °C and a maximum of 3 temperature cycles.

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