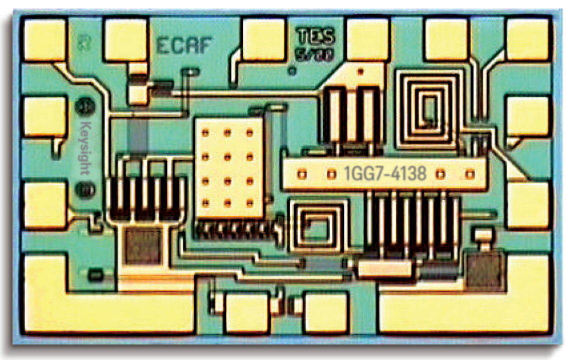
Keysight 1GG7-4138
DC to 4 GHz Preamplifier

Data Sheet



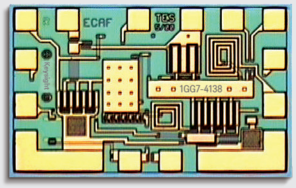
Features

- Frequency range: DC to 4 GHz
- Flat response: ±0.75 dB 5 MHz to 4 GHz
- High gain: 12 dB
- High isolation: –37 dB
- Return loss: Input –15 dB Output –15 dB
- High power output: 19.5 dBm saturated
- Harmonics: –40 dBc @ P_{out} = 10 dBm
- Noise figure: 7.5 dB
- Unconditionally stable

Unlocking Measurement Insights

Description

The 1GG7-4138 is a monolithic, wideband preamplifier designed and fabricated using the Keysight Technologies, Inc. GaAs MESFET process. It features low distortion and delivers (typically) 19.5 dBm saturated output power into 50 Ω to at least 4.0 GHz.



- Chip size: 1120 x 700 µm (44.1 x 27.6 mils)
- Chip size tolerance: ±10 µm (±0.4 mils)
- Chip thickness: 127 ±15 µm (5.0 ±0.6 mils)
- Pad dimensions: 85 x 90 µm (3.35 x 3.54 mils)

Absolute maximum ratings[1]

Symbol	Parameters/conditions	Min.	Max.	Units
V_{DD}	Drain supply	4.5	9.25	Volts
V_{SS}	Source supply	–6	–4.5	Volts
P_{in}	CW input power		25	dBm
T_{bs}	Operating backside temperature[2]	–55	136	°C
T_{stg}	Storage temperature	–65	165	°C
T_{max}	Maximum assembly temperature (for 60 seconds maximum)		300	°C

1. Operation in excess of any one of these conditions may result in permanent damage to this device. T_{case} = 25 °C except for T_{bs}, T_{stg}, and T_{max}.
2. Max. continuous operating temperature to achieve 1x10^6 hours MTTF, while operating with V_{DD} = +8.5 V and V_{SS} = –5 V. Derate MTTF by a factor of 2 for every 5 °C above this temperature.

DC specifications[1]

Symbol	Parameters/conditions	Min.	Typ.	Max.	Units
I_{DD}	Positive supply current V_{DD} = +8.5 volts, V_{SS} = –5.5 volts	125	155	185	mA
I_{SS}	Negative supply current V_{DD} = +8.5 volts, V_{SS} = –5.5 volts		17	20	mA
P_{DC}	DC power dissipation V_{DD} = +8.5 volts, V_{SS} = –5.5 volts		1.4		Watts

1. Data obtained from on-wafer measurements @ T_{chuck} = 25 °C. All voltages specified at device pads.

RF specifications

(V_{DD} = +8.5 V, V_{SS} = –5.5 V, Z_{in} = Z_{out} = 50 Ω)[1]

Symbol	Parameters/conditions	Min.	Typ.	Max.	Units
BW	Guaranteed operating bandwidth[2]	5		4000	MHz
S_{21}	Small-signal gain	10	12	14	dB
ΔS_{21}	Small-signal gain flatness		±0.75		dB
RL_{IN}	Input return loss		–15		dB
RL_{OUT}	Output return loss		–15		dB
S_{12}	Reverse isolation		–37		dB
P_{-1dB}	Output power (@ –1 dB gain compression)		17.5		dBm
P_{SAT}	Saturated output power (@ –3 dB gain compression)	18	19.5		dBm
H_2, H_3	Harmonics (P_{out} with fundamental @ 10 dBm)		–40	–35	dBc
NF	Noise Figure ($f_0 \geq$ 300 MHz)		7.5		dB

1. Data obtained from measurements on individual devices mounted in Keysight 83040 series modular microcircuit packages @ T_{case} = 25 °C.
2. Performance may be extended to lower frequencies with an additional off-chip capacitor, Upper $f_{-3\,dB}$ ≈6.0 GHz; lower $f_{-3\,dB}$ ≈800 KHz without optional L.F.E. capacitor.

Applications

The 1GG7-4138 is designed for use as a broadband power preamplifier or stand-alone amplifier in communication systems and RF instrumentation. It is ideally suited for DC to 4 GHz applications where medium output power, flat gain, low distortion, and clean pulse response are required.

Biasing

This device should be biased such that V_{SS} = –5.5 V and V_{DD} = +8.5 V. These voltages are applied directly to the pads labeled V_{DD} and V_{SS}. The V_{DD} bypass and V_{SS} bypass pads should be connected to bypass capacitors near the chip as shown in Figure 3. Note: the device should NEVER be biased through the V_{DD} Bypass pad.

The input and output of the 1GG7-4138 are DC coupled. The input pad will float at ≈ –V and the output pad will float at ≈ +0.5 V. To prevent the disturbance of internal bias nodes, DC blocking capacitors or level shift stages must be used on the input and output.

When assembled as shown in Figure 3, the 1GG7-4138 will function from 5 MHz to 4 GHz; however, the low frequency performance of this device may be extended to DC. The low frequency corner of the device can be modified by adding capacitance in series between the two low-frequency extension pads. For example, a 10 nF monoblock capacitor added between these pads results in the low frequency corner below 1 kHz. For performance down to DC, the low-frequency extension pads may be shorted together with a bond wire; with this configuration however, the voltage on the V_{SS} pad *must* be adjusted during initial turn on such that the DC voltage on the output pad is approximately 4.5 volts. Some RF performance parameters will be affected. With the capacitive extension technique, no adjustments are required.

In addition, these frequency extension techniques are not sensitive to bond wire inductances due to on-chip isolation resistors.

There are no power supply sequencing requirements for the 1GG7-4138.

Assembly Techniques

Solder die attach using a AuSn solder preform is the recommended assembly method. Gold thermosonic wedge bonding with 0.7 or 1.0 mil wire is recommended for all bonds. Tool force should be 22 grams ±1 gram, stage temperature is 150 ±2 °C, and ultrasonic power of 64 ±1 dB and 76 ± 8 msec, respectively. The top and bottom metallization is gold.

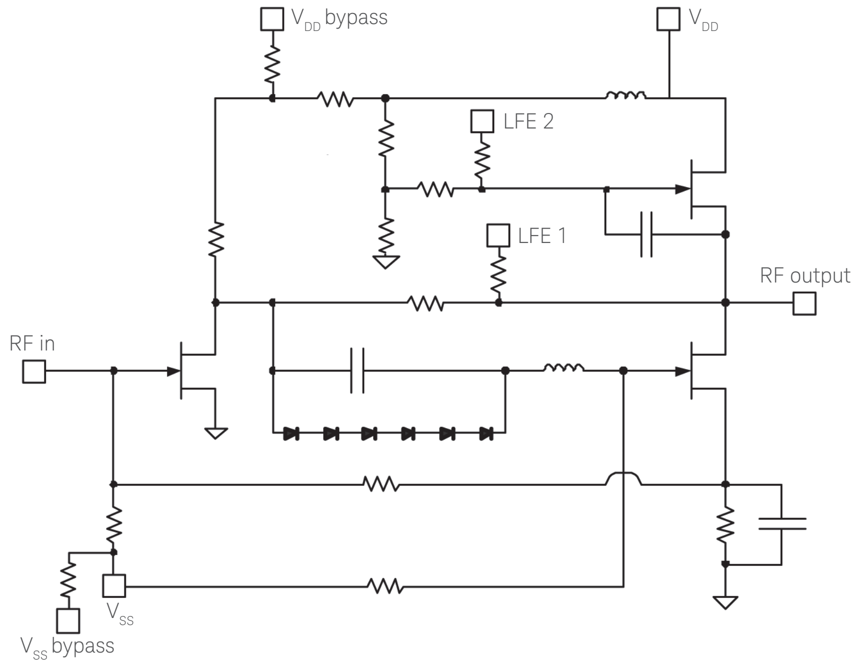
GaAs MMICs are ESD sensitive. ESD preventive measures must be employed in all aspects of storage, handling, and assembly.

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

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

RoHS Compliance

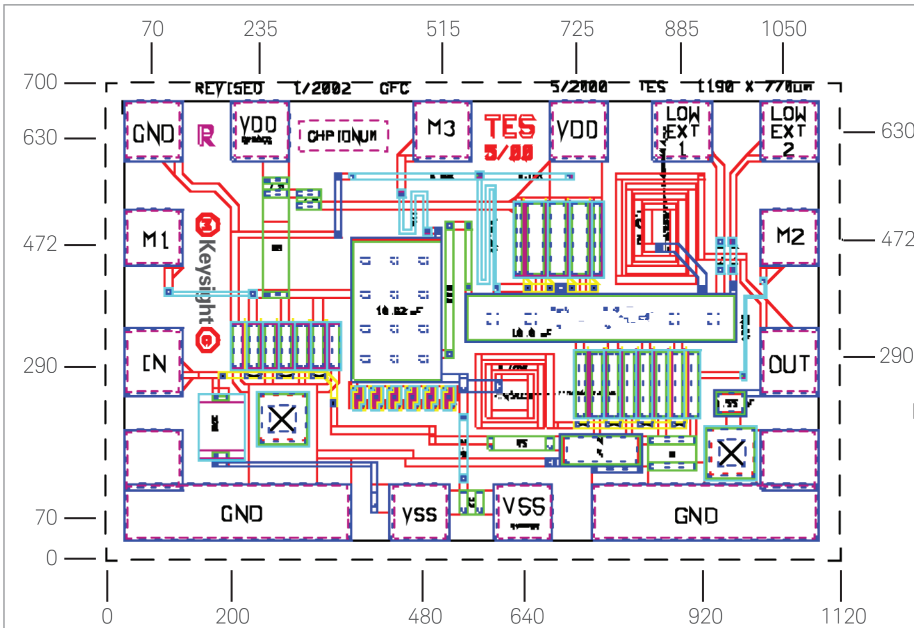
This device is RoHS Compliant. This means the component meets the requirements of the European Parliament and the Council of the European Union Restriction of Hazardous Substances Directive 2011/65/EU, commonly known as RoHS. The six regulated substances are lead, mercury, cadmium, chromium VI (hexavalent), 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.



Notes

- FET gate periphery in microns.
- Resistors in ohms.
- RF Input designed to have 0.5 nH bond wire.
- RF Output designed to have 0.5 nH bond wire.

Figure 1. 1GG7-4138 simplified schematic



Notes

- All dimensions in microns.
- Large GND Pad: 350 x 85 µm.
- All other pads: ≥ 85 x 90 µm.

Figure 2. 1GG7-4138 bond pad locations

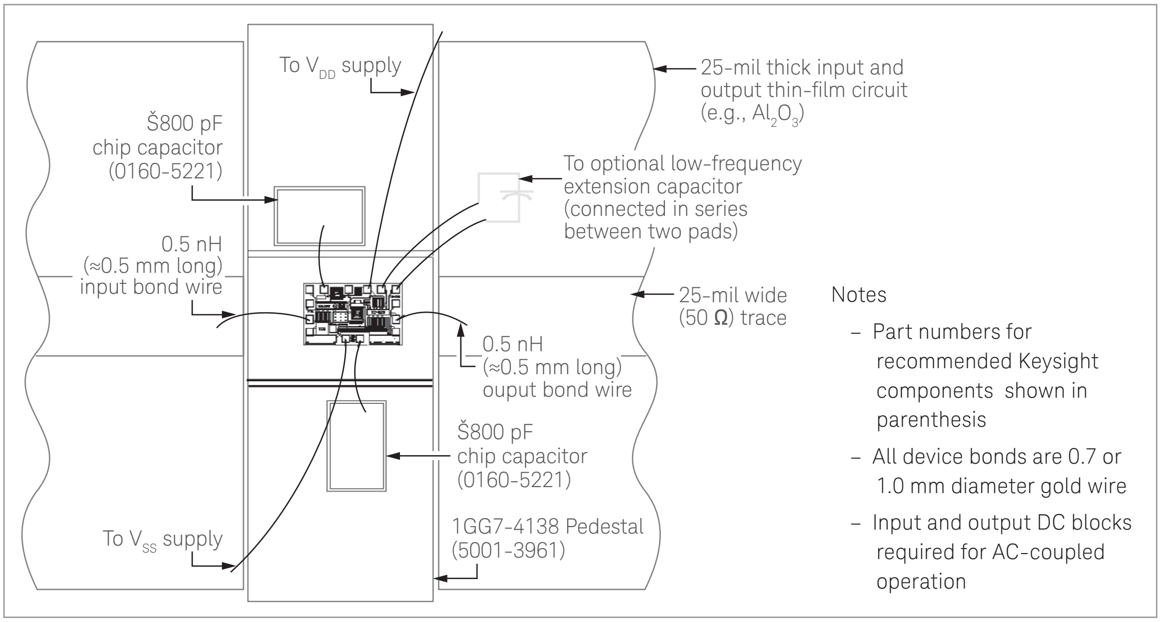


Figure 3. 1GG7-4138 assembly diagram (for 5 MHz to 4 GHz operation)

Typical S–parameters

(V_{DD} = +8.5 V @ 155 mA, V_{SS} = –5 V @ –13 mA, Z_{in} = Z_{out} = 50 Ω)

GHz	S_{11}	dB	Angle	S_{21}	dB	Angle	S_{12}	dB	Angle	S_{22}	dB	Angle
0.05	0.10	–20.37	173.78	3.22	10.16	5.11	0.02	–34.79	13.42	0.10	–19.91	131.37
0.10	0.08	–21.62	170.58	3.70	11.36	2.17	0.02	–32.08	18.58	0.07	–22.97	57.60
0.20	0.08	–22.37	174.25	3.85	11.70	–2.88	0.03	–30.48	13.67	0.05	–25.76	3.47
0.50	0.09	–21.39	179.08	4.05	12.14	–15.02	0.03	–31.34	–14.97	0.03	–31.83	21.93
0.70	0.08	–21.56	173.54	4.05	12.16	–22.98	0.03	–31.39	–14.33	0.08	–21.80	–38.39
1.00	0.08	–22.06	168.71	4.06	12.18	–33.87	0.03	–31.64	–12.16	0.09	–20.93	–64.83
1.50	0.06	–24.12	155.42	4.10	12.25	–51.59	0.03	–30.00	–16.08	0.14	–17.08	–105.16
2.00	0.04	–29.10	161.51	4.07	12.20	–69.57	0.03	–29.43	–31.91	0.15	–16.54	–117.10
2.50	0.02	–32.16	110.60	4.10	12.26	–85.83	0.04	–28.87	–30.96	0.17	–15.33	–135.72
3.00	0.03	–30.55	–3.36	4.24	12.54	–103.35	0.04	–28.74	–51.86	0.13	–17.67	–139.72
3.50	0.08	–22.43	–16.45	4.25	12.57	–122.33	0.04	–28.73	–60.71	0.08	–21.65	–145.82
4.00	0.15	–16.62	–39.59	4.20	12.47	–141.85	0.04	–28.24	–78.17	0.05	–26.07	–63.51
4.50	0.21	–13.40	–48.61	4.26	12.59	–160.47	0.04	–28.82	–91.22	0.12	–18.29	–44.41
5.00	0.28	–11.05	–61.00	4.37	12.82	179.86	0.03	–29.95	–105.24	0.20	–13.81	–55.68
5.50	0.38	–8.46	–70.11	4.37	12.80	153.44	0.03	–30.20	–109.67	0.25	–11.98	–43.53
6.00	0.45	–6.89	–83.28	4.15	12.37	134.00	0.03	–30.33	–128.02	0.41	–7.77	–56.18
6.50	0.53	–5.52	–94.86	3.99	12.03	106.90	0.03	–31.16	–142.98	0.52	–5.61	–63.58
7.00	0.60	–4.49	–106.68	3.50	10.88	78.86	0.02	–32.41	–157.01	0.64	–3.91	–73.38
7.50	0.62	–4.12	–116.85	2.51	8.00	53.77	0.02	–33.42	–169.97	0.75	–2.55	–83.17
8.00	0.68	–3.37	–126.57	2.15	6.64	41.63	0.02	–35.73	176.12	0.81	–1.86	–94.17

Supplemental Data[1]

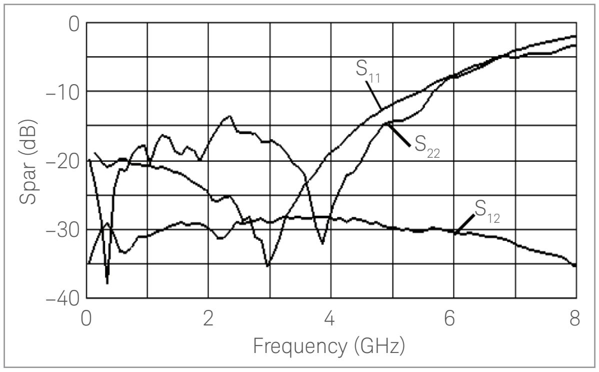


Figure 4. 1GG7-4138 typical S-parameters

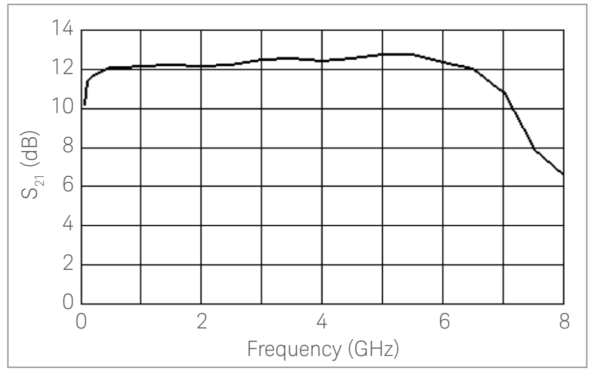


Figure 5. 1GG7-4138 typical small signal gain

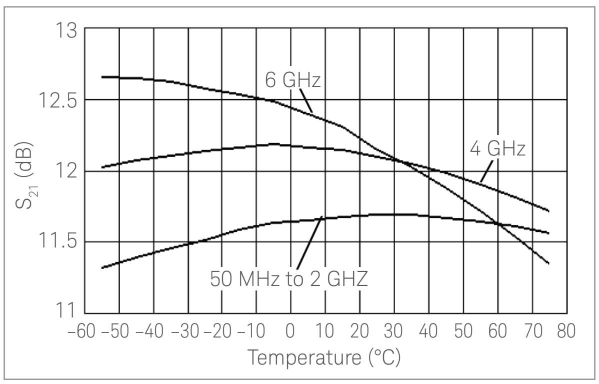


Figure 6. 1GG7-4138 S_{21} vs temperature[2]

1. Data obtained from measurements on an individual device mounted in an Keysight 83040 Series Modular Package @ T_{case} = 25° C.
2. On wafer measurements, T_{chuck} = 25° C

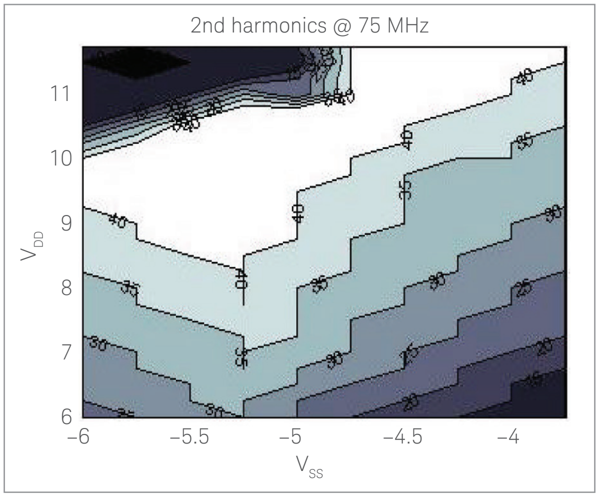


Figure 7. 1GG7-4138 2nd harmonics vs. bias voltages, V_{SS} and V_{DD} @ 75 MHz

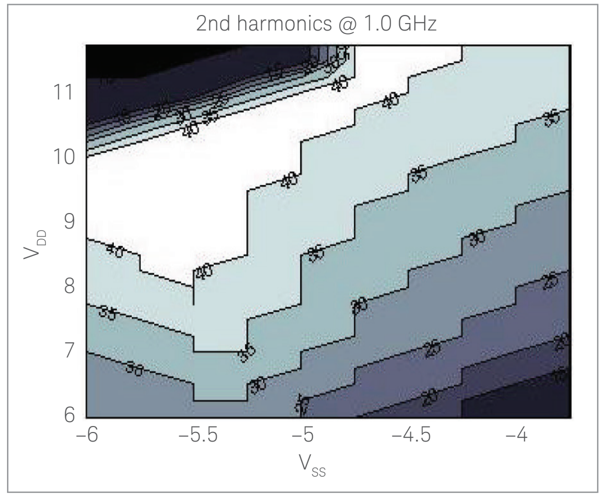


Figure 8. 1GG7-4138 2nd harmonics vs. bias voltages, V_{SS} and V_{DD} @ 1.0 GHz

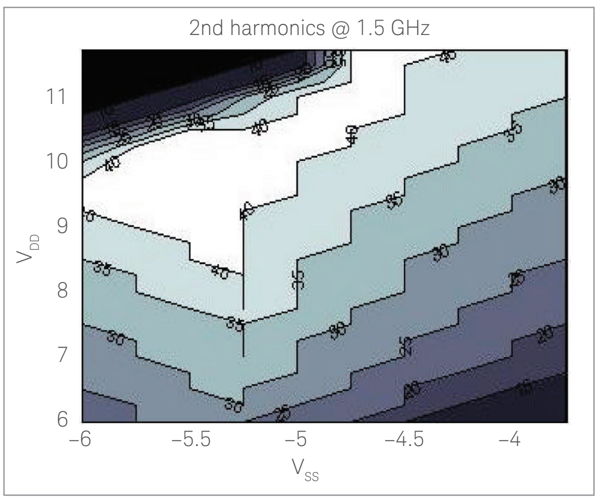


Figure 9. 1GG7-4138 2nd harmonics vs. bias voltages, V_{SS} and V_{DD} @ 1.5 GHz

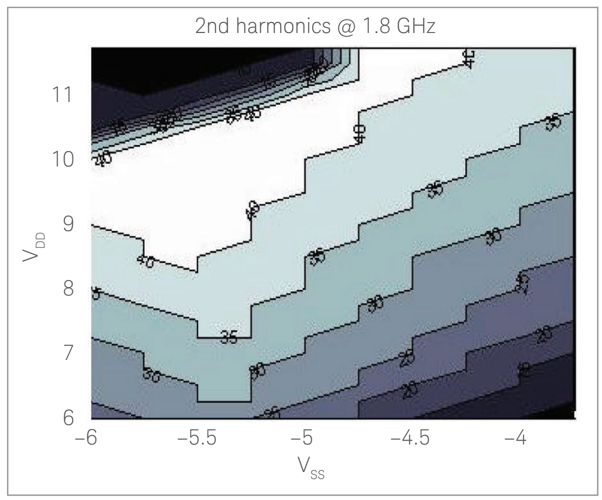


Figure 10. 1GG7-4138 2nd harmonics vs. bias voltages, V_{SS} and V_{DD} @ 1.8 GHz

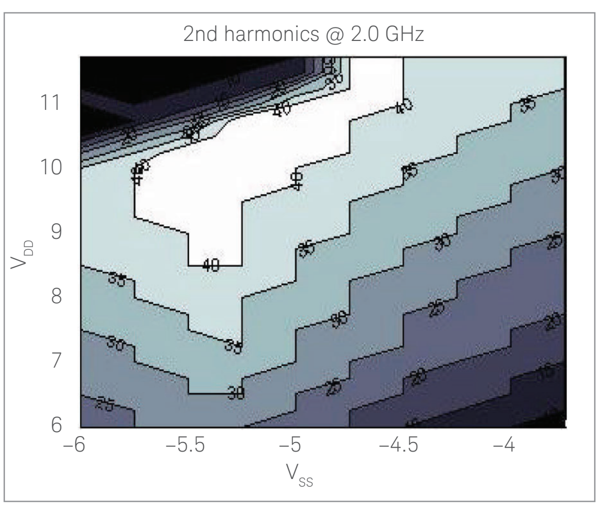


Figure 11. 1GG7-4138 2nd harmonics vs. bias voltages, V_{SS} and V_{DD} @ 2.0 GHz

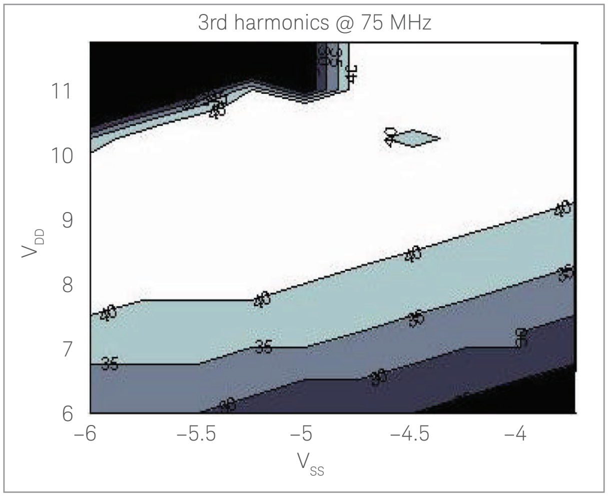


Figure 12. 1GG7-4138 3rd harmonics vs. bias voltages, V_{SS} and V_{DD} @ 75 MHz

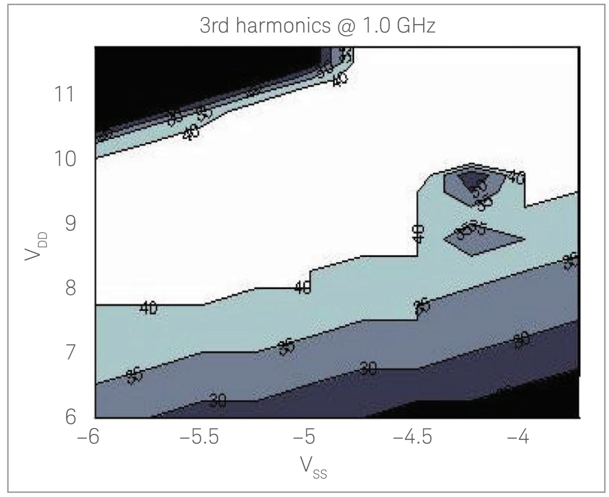


Figure 13. 1GG7-4138 3rd harmonics vs. bias voltages, V_{SS} and V_{DD} @ 1.0 GHz

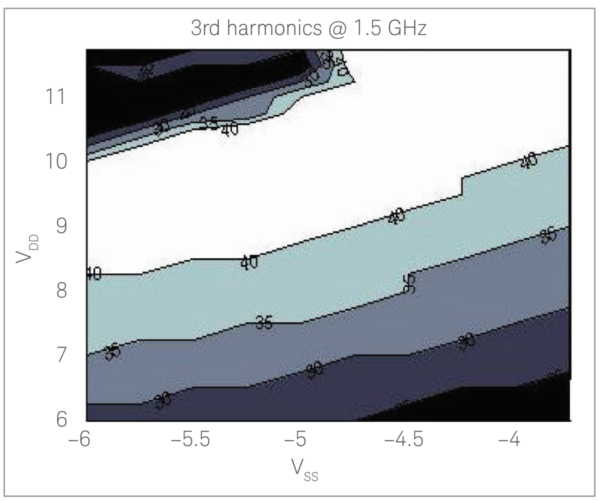


Figure 14. 1GG7-4138 3rd harmonics vs. bias voltages, V_{SS} and V_{DD} @ 1.5. GHz

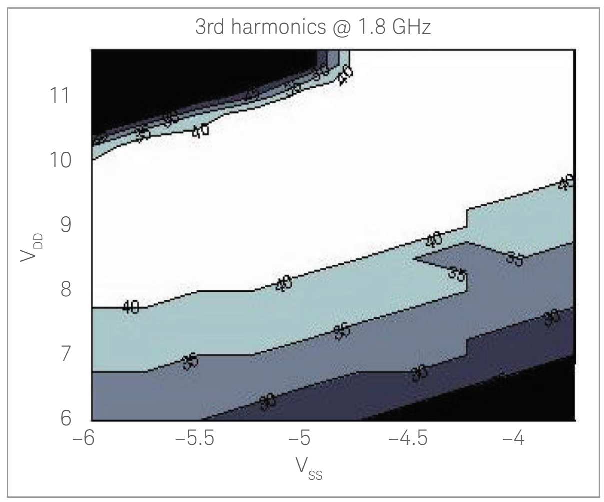


Figure 15. 1GG7-4138 3rd harmonics vs. bias voltages, V_{SS} and V_{DD} @ 1.8 GHz

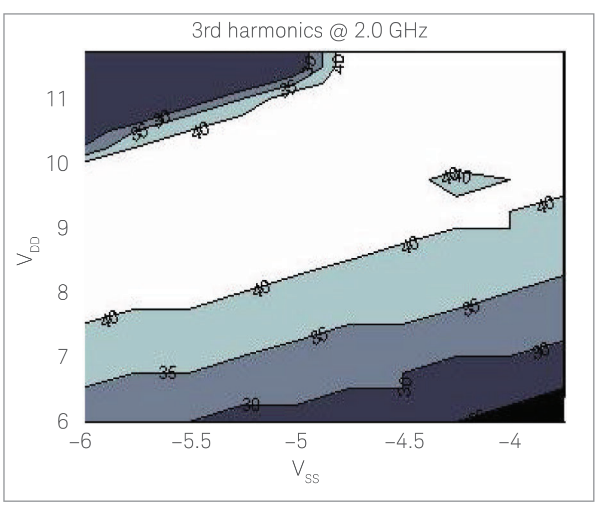


Figure 16. 1GG7-4138 3rd harmonics vs. bias voltages, V_{SS} and V_{DD} @ 2.0. GHz

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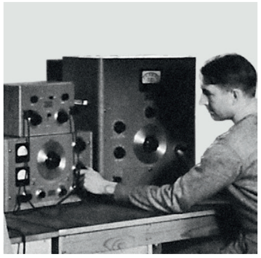
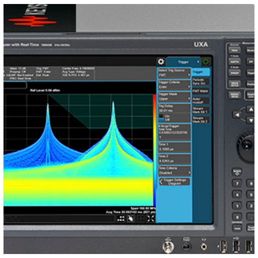


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The product described in this data sheet is RoHS Compliant. See RoHS Compliance section for more details.

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