

# 12.5 dB Gain pHEMT Low Noise Amplifier, DIE

## 12 - 26 GHz



ENGLA00259A

Rev. V1

### Features

- Operation Across 12 - 26 GHz
- Small Signal Gain: 12.5-dB
- Noise Figure: 3-dB
- I/O Return Loss: 11.5 dB or better
- OIP3: 17 to 20 dBm
- Die Size:
  - 2.12 x 1.73 x 0.1 mm
  - 3.67 sq. mm
  - 0.083 x 0.068 x 0.004 inch
- RoHS\* Compliant

### Applications

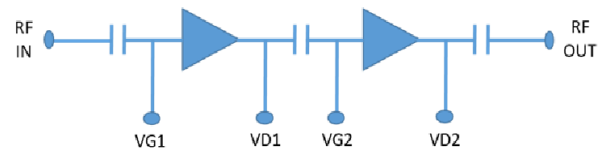
- Ku- & K-Band radar / driver amplifier functions; SATCOM
- Radio receivers / transmitters when biased for linearity
- Test & Measurement Systems

### Description

The ENGLA00259A is a wideband GaAs pHEMT two-stage 12.5 dB gain low noise distributed amplifier, operating across 12 to 26 GHz. The design is 50  $\Omega$  matched. The LNA has a typical noise figure of <3 dB across 14 to 26 GHz, at room temperature. Output third-order intercept point (OIP3) is typically above 17 dBm. The amplifier has gold backside metallization and is designed for gold-tin eutectic or high thermal conductivity silver epoxy attachment.

### Functional Block Diagram

MMIC RF ports are DC-blocked. RF ports designed for 50 ohms.



### Ordering Information

Part Number	Package
ENGLA00259A	Die

\* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

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## Electrical Specifications:

Freq. = 12 - 26 GHz,  $T_A = +25^\circ\text{C}$ ,  $V_D = 3.0\text{ V}$ ;  $I_{DS} = 27\text{ mA}$  ( $I_q$ ),  $V_G \sim +0.56\text{ V}$

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Small Signal Gain	—	dB	10	12.5	—
Noise Figure	—	dB	—	3	4
Input Return Loss	—	dB	12	15	—
Output Return Loss	—	dB	10	12	—
Output IP3	—	dBm	16	20	—
Supply Current	—	mA	—	27	35
Thermal Resistance	includes 25- $\mu\text{m}$ thick AuSn solder mount	$^\circ\text{C/W}$	—	550	—

## Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Drain Voltage	—	3	5	V
Gate Voltage	—	0.56	0.80	V
Drain Current	—	27	35	mA

## Absolute Maximum Ratings<sup>1,2</sup>

Parameter	Absolute Maximum
Drain Voltage	6 V
Gate Voltage	1 V
RF Input Power	20 dBm
Operating Temperature	-55 $^\circ\text{C}$ to +100 $^\circ\text{C}$
Storage Temperature	-65 $^\circ\text{C}$ to +150 $^\circ\text{C}$

1. Exceeding any one or combination of these limits may cause permanent damage to this device.
2. MACOM does not recommend sustained operation near these survivability limits.

## Handling Procedures

Please observe the following precautions to avoid damage:

## Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

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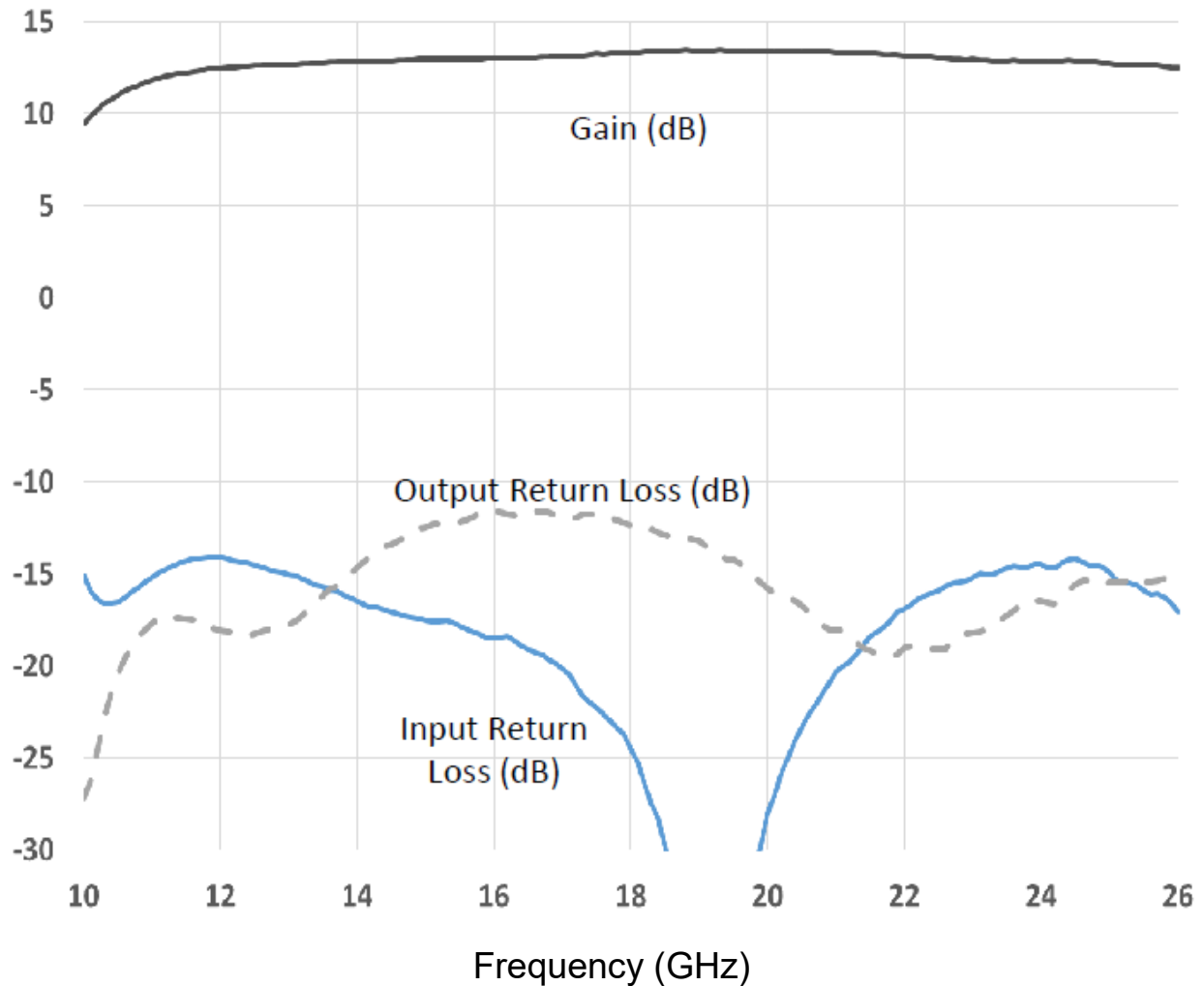


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## Measured RF Data: With Wirebonds and External Microstrip Flares

Gain and In / Out Return Loss:  $T = 25\text{ }^{\circ}\text{C}$ ,  $V_D = 3.0\text{ V}$ ,  $I_Q = 27\text{ mA}$ ,  $V_G = 0.56\text{ V}$



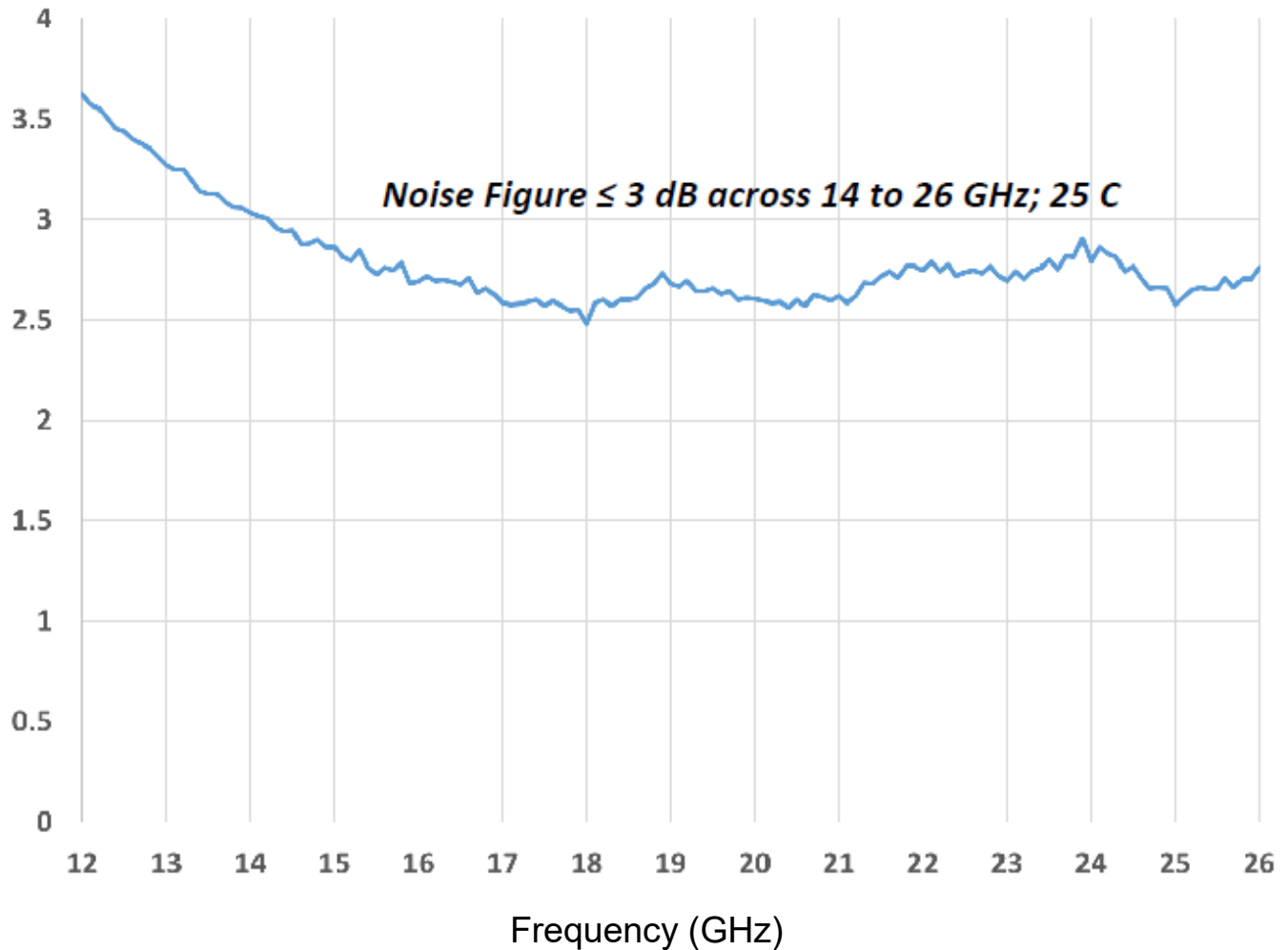
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## Measured RF Data: With Wirebonds and External Microstrip Flares

Noise Figure:  $T = 25\text{ }^{\circ}\text{C}$ ,  $V_D = 3.0\text{ V}$ ,  $I_Q = 27\text{ mA}$ ,  $V_G = 0.56\text{ V}$



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### Measured RF Data: With Wirebonds and External Microstrip Flares

**S-Parameters:  $T = 25\text{ }^{\circ}\text{C}$ ,  $V_D = 3.0\text{ V}$ ,  $I_Q = 27\text{ mA}$ ,  $V_G = 0.56\text{ V}$**

Frequency (GHz)	S11	S11	S21	S21	S12	S12	S22	S22
	mag	angle	mag	angle	mag	angle	mag	angle
	(dB)	(deg)	(dB)	(deg)	(dB)	(deg)	(dB)	(deg)
10	-15.08	61.58	9.46	-119.39	-31.56	31.37	-27.17	6.62
10.5	-16.57	86.25	11.02	-150.37	-30.20	5.62	-20.49	-75.25
11	-15.23	94.80	11.82	-178.86	-29.61	-18.55	-17.70	-99.15
11.5	-14.31	92.12	12.24	154.87	-29.34	-39.87	-17.47	-112.42
12	-14.09	86.31	12.46	130.48	-29.29	-58.93	-18.08	-115.85
12.5	-14.50	81.23	12.60	107.86	-29.09	-77.15	-18.27	-113.09
13	-15.03	77.73	12.71	86.12	-28.83	-96.22	-17.74	-109.64
13.5	-15.70	74.31	12.77	65.50	-28.90	-113.49	-16.19	-108.15
14	-16.50	72.01	12.80	45.56	-28.91	-128.92	-14.64	-112.88
14.5	-17.04	71.38	12.88	26.03	-28.77	-144.73	-13.40	-121.43
15	-17.55	70.06	12.95	6.75	-28.79	-159.74	-12.47	-133.35
15.5	-17.83	67.26	12.97	-12.28	-28.63	-173.40	-12.16	-146.44
16	-18.50	65.69	13.05	-30.66	-28.74	171.84	-11.56	-159.78
16.5	-19.11	59.64	13.02	-48.95	-28.41	160.42	-11.68	-174.03
17	-20.13	52.51	13.09	-66.71	-28.03	147.31	-11.95	172.39
17.5	-22.29	50.17	13.23	-84.38	-27.82	132.46	-11.78	159.25
18	-24.51	41.41	13.33	-102.70	-27.69	121.63	-12.37	143.81
18.5	-29.84	42.25	13.43	-120.80	-27.26	108.62	-12.90	131.25
19	-35.54	72.42	13.46	-139.21	-27.02	93.38	-13.22	115.73
19.5	-36.33	155.98	13.46	-157.81	-26.86	80.65	-14.23	100.10
20	-28.00	-175.77	13.42	-175.56	-27.00	68.21	-15.75	89.24
20.5	-23.41	179.58	13.38	166.41	-26.89	56.47	-16.73	79.80
21	-20.32	171.16	13.34	148.65	-26.83	45.11	-18.02	73.55
21.5	-18.42	163.85	13.23	130.86	-26.69	31.22	-19.21	74.19
22	-16.90	154.82	13.17	112.84	-26.83	21.97	-19.01	73.33
22.5	-15.90	146.63	13.02	95.35	-26.61	10.86	-19.08	74.45
23	-15.20	139.14	12.96	78.20	-26.53	-2.04	-18.18	75.94
23.5	-14.72	132.03	12.84	60.93	-26.48	-12.97	-17.26	70.51
24	-14.44	124.20	12.81	43.71	-26.42	-24.98	-16.48	63.57
24.5	-14.20	116.83	12.84	25.50	-26.38	-38.42	-15.59	57.12
25	-14.91	105.12	12.71	7.28	-26.72	-48.25	-15.49	47.29
25.5	-15.90	100.81	12.63	-11.01	-26.62	-57.61	-15.46	46.06
26	-17.06	95.95	12.53	-29.43	-26.56	-68.03	-15.05	45.73

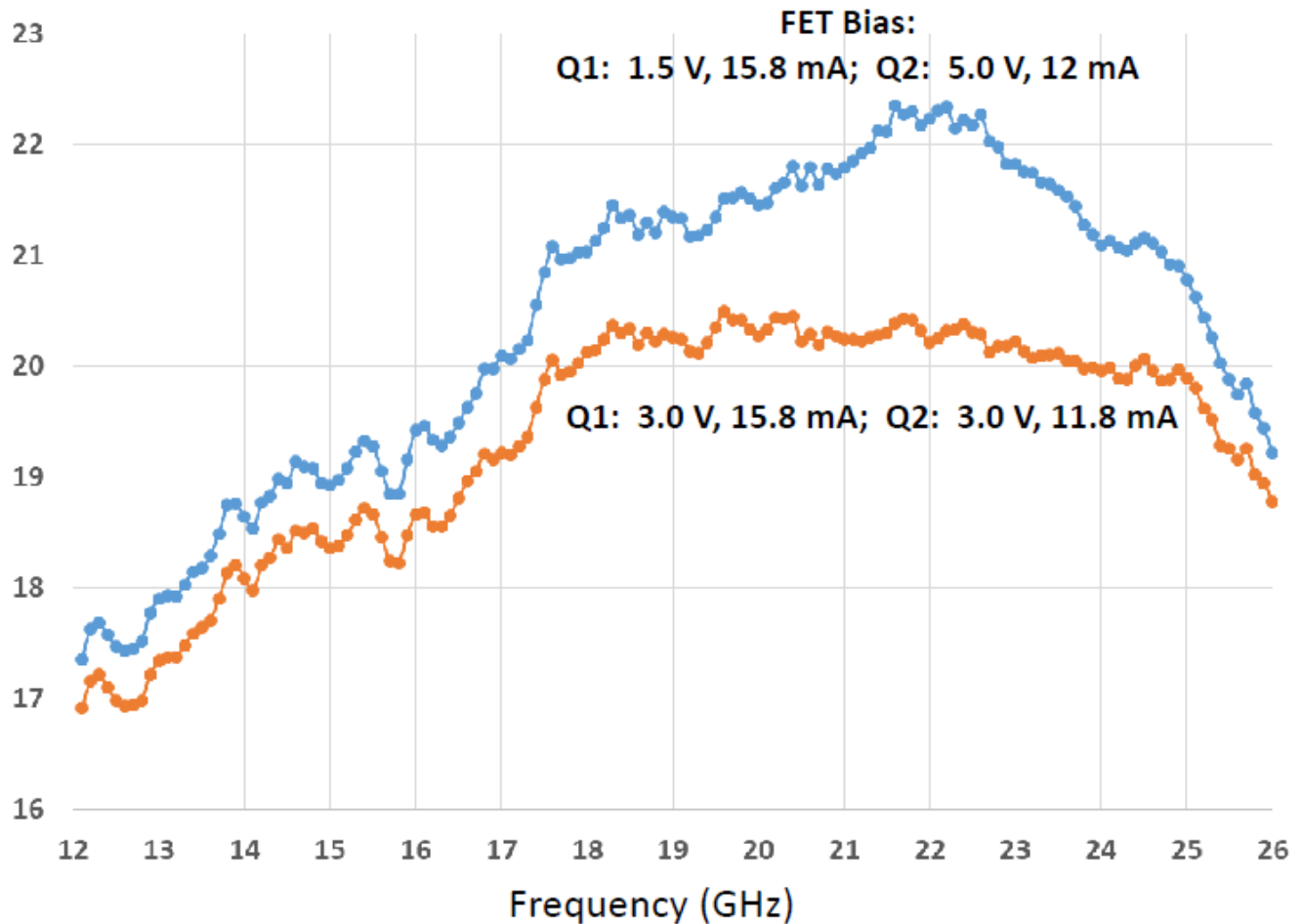
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## Measured RF Data: With Wirebonds and External Microstrip Flares

Output Third-Order Intercept Point:  $T = 25\text{ }^{\circ}\text{C}$ ,  $V_D = 3.0\text{ V}$ ,  $I_Q = 27\text{ mA}$ ,  $V_G = 0.56\text{ V}$



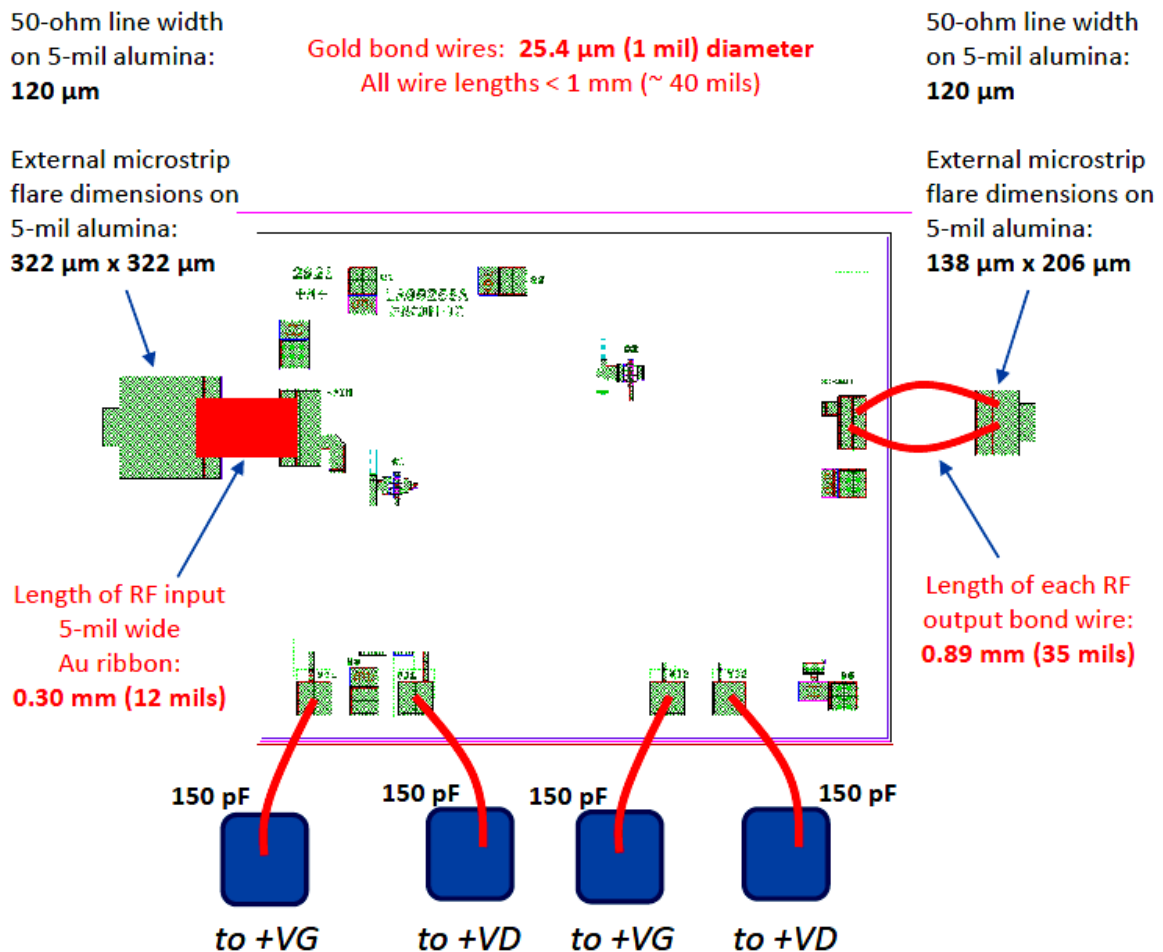
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## MMIC Assembly Drawing: External Microstrip Flares, 150 pF Bypass Capacitors, & Bond Wires



## Assembly Comments

1. If mounting the MMIC using either AuSn solder, or high thermal conductivity silver epoxy, the regions underneath the FET heat sources should be void free. Even small voids underneath the FETs could cause FET channel temperature to significantly increase.
2. RF ports are DC blocked.
3. At Ku- / K-band, RF I/O port impedances are near 50 ohms.

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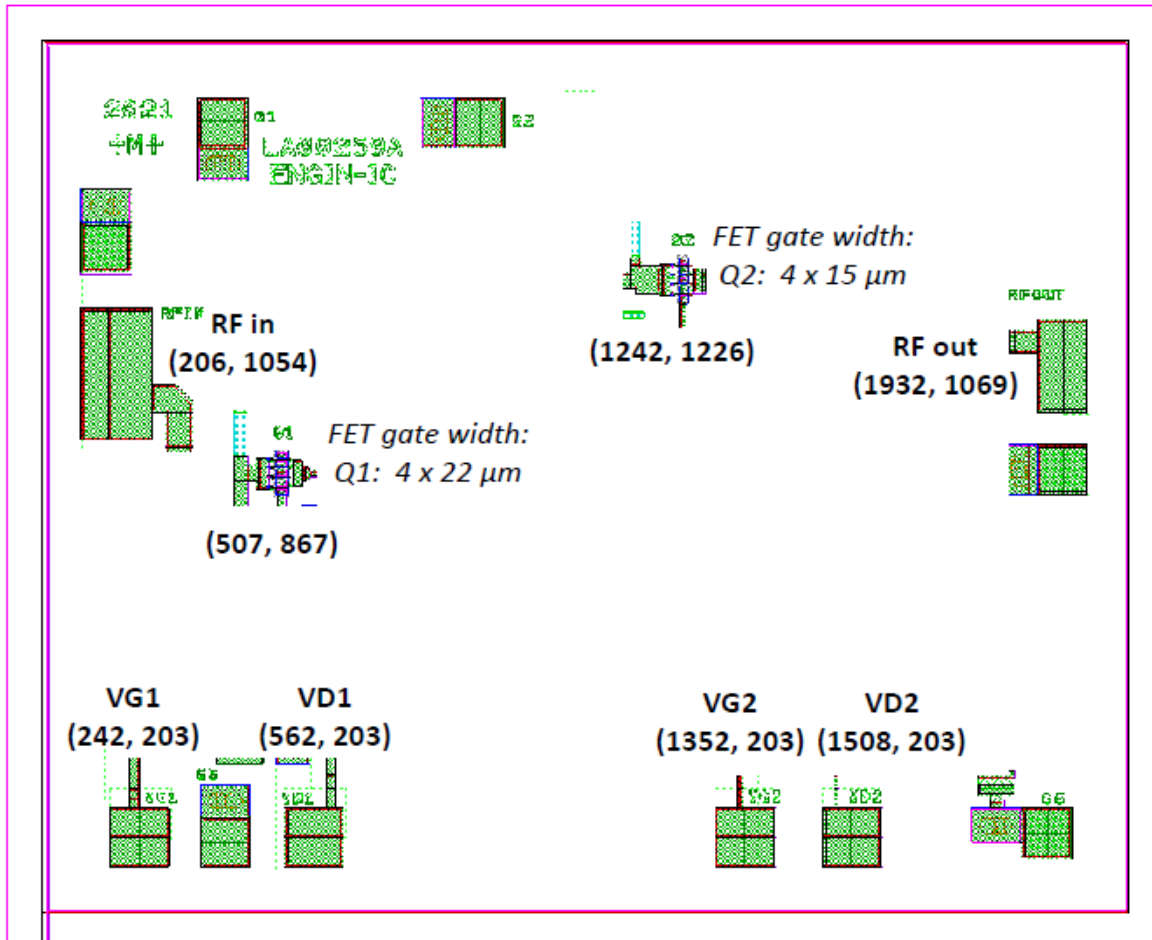


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Outline Drawing – MMIC Dimensions: 2.12 mm x 1.73 mm  
 FET (heat source) and bond pad **center coordinates** shown ( $\mu\text{m}$ )

(2120, 1730)



(0, 0)

**Notes:**

All dimensions are given in micrometers ( $\mu\text{m}$ ) unless specified. Typ. tolerance:  $+ 25 \mu\text{m} / -25 \mu\text{m}$ .  
 GaAs thickness (excluding front side/back side metallization):  $100 \mu\text{m}$ . Typical tolerance  $\pm 10 \mu\text{m}$ .  
 Backside metallization is gold.  
 Bond pad metallization is gold.



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