10 W High Power Amplifier MMIC
17-20.5 GHz

ReliaSat

Product Datasheet

HPA11201721B

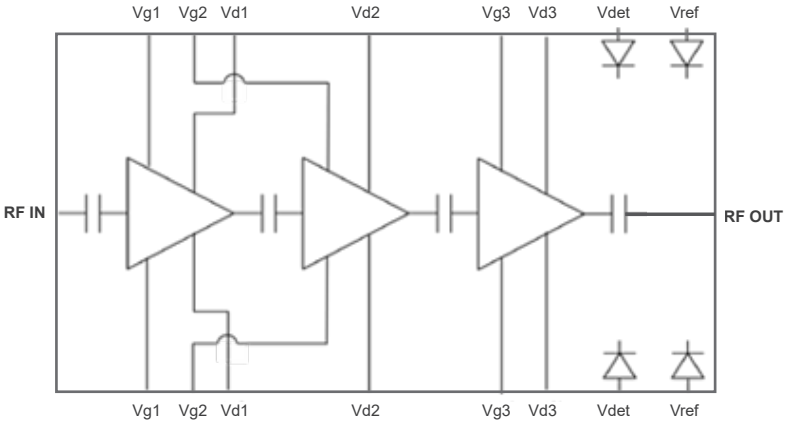
10 W GaN MMIC High Power Amplifier for K-band.

Overview

HPA11201721B is a High Power MMIC Amplifier fabricated on Space Qualified 0.25 um GaN on SiC. This MMIC operates from 17-20.5 GHz and delivers >10 W saturated output power across the band, with power-added efficiency in excess of 25% and large-signal gain of 20 dB.

The RF ports are matched to 50 Ω with integrated DC blocking capacitors. The part incorporates an output power detector to assist with system integration and is well suited for satellite communications and point to point applications.

Functional Diagram



Features

- Frequency range 17-20.5 GHz
- Power >10 W saturated
- Small signal gain 25 dB
- Large signal gain 20 dB
- Integrated power detector
- PAE: >25% at Pin=20 dBm
- Bias: VD=25 V, IDQ=300 mA, VG~-3.6 V
- Chip dimension: 3.6 x 2.9 x 0.1 mm

Applications

- Satellite communications
- Radar
- Mobile communications
- 5G

Available as	
HPA11201721B	17-20.5 GHz bare die GaN HPA
HPA11201721BE	17-20.5 GHz bare die GaN HPA evaluation board
HPA11201721QF	17-20.5 GHz packaged GaN HPA
HPA11201721QFE	17-20.5 GHz packaged GaN HPA evaluation board
SSPA11201721SS	17-20.5 GHz GaN solid state power amplifier

10 W High Power Amplifier MMIC 17-20.5 GHz

ReliaSat

Product Datasheet

Electrical Specification

Freq 17-20.5 GHz, T_a=25 °C V_d=25 V, Idq=300 mA, Zo=50 Ω

Parameter	Test Conditions	Min	Typ	High	Unit
Operational Frequency Range		17.0		20.5	(GHz)
Small Signal Gain	17-19 GHz 19-20.5 GHz		26 22		(dB)
Input Return Loss	17.5-20.5 GHz		10		(dB)
Output Return Loss	17.5-20.5 GHz		10		(dB)
Output Power at Saturation	17.5-19.5 GHz 19.5-20.5 GHz		42 40		(dBm)
Power Added Efficiency	Pin=20 dBm 17.5-19 GHz 19-20 GHz 20.5 GHz		33 25 20		(%)
Output Power Temperature Coefficient	19 GHz, Psat -40 to 85 °C		0.03		(dB/°C)

Absolute Maximum Ratings

Parameter	Rating
Drain Voltage (V_d)	30 V
Gate Voltage Range (V_g)	-8 to 0 V
Drain Current (I_d)	2.5 A
Power Dissipation (PDISS) 85 °C	44 W
Input Power (Pin)	23 dBm
Mounting Temperature (30 seconds)	260 °C
Storage Temperature	-55 to 150 °C
Junction Temperature	200 °C

Exceeding any one or combination of these limits may cause permanent damage to this device. Sustained operation near these survivability limits is not recommended.

Recommended Operating Conditions

Parameter	Rating
Drain Voltage (V_d)	20-30 V
Gate Voltage (V_g)	-3.6 (TYP)
Drain Current, Quiesent (I_{dq})	300 mA
Junction Temperature	<200 °C

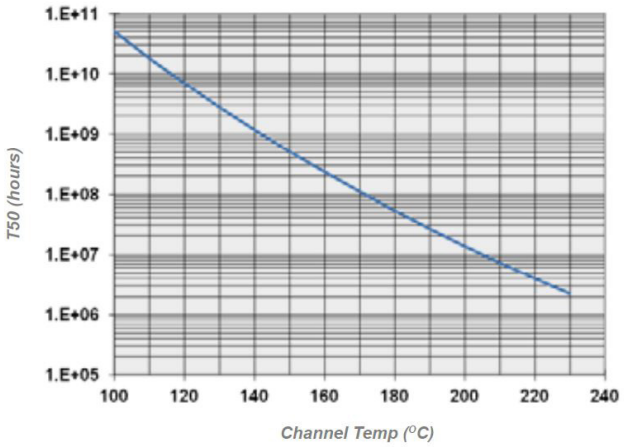
Thermal Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θjc)(1)	Tbase= 85 °C, V_d=25 V, I_d=0-1.5 A	2.5	°C/W

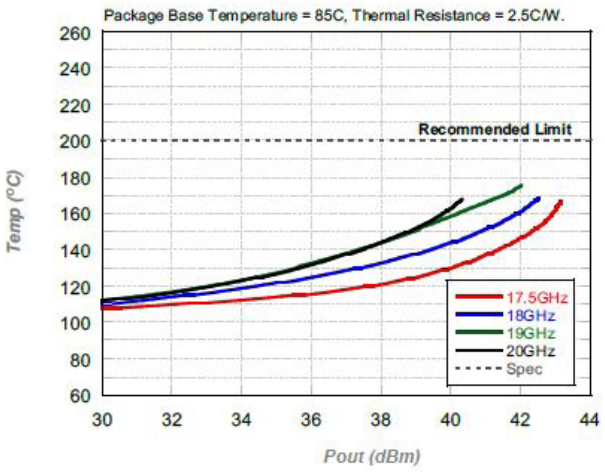
Notes:
Thermal resistance measured using Raman Thermography on device channel referenced to back of package.

Median Time To Failure vs Channel Temperature

0.25 um GaN process

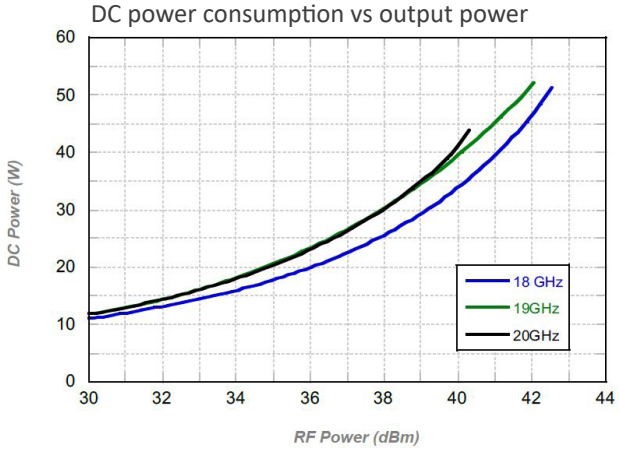


Channel Temperature vs Pout



Power Consumption

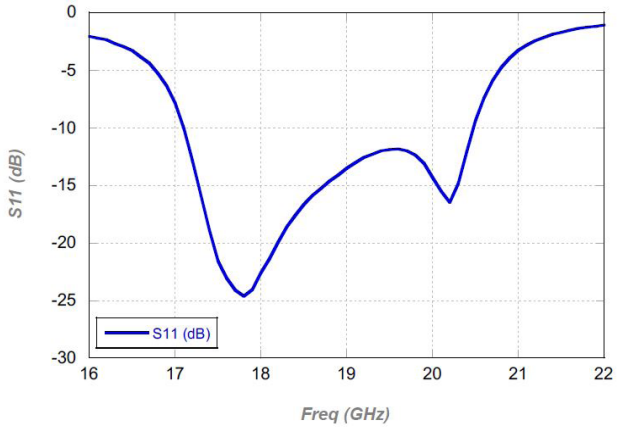
DC power consumption vs output power



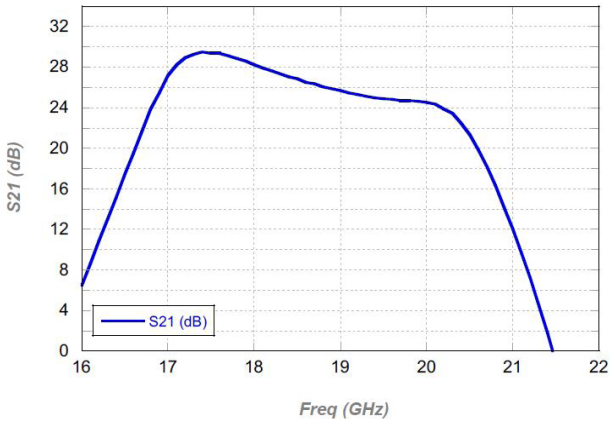
Small Signal Performance Curves

V_D=25 V, I_{DQ}=300 mA, V_G~-3.6 V typical, T_A=25 °C

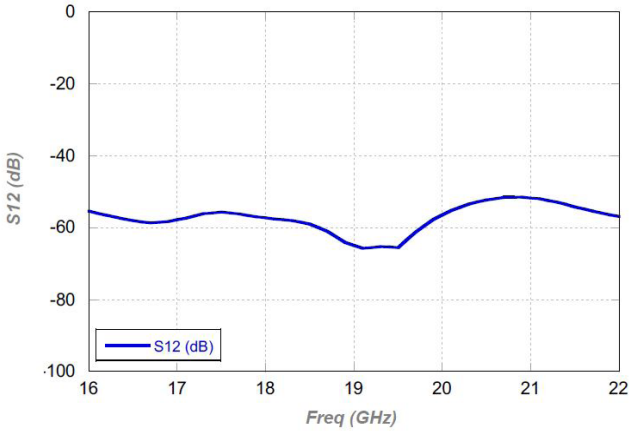
Input Return Loss vs Frequency



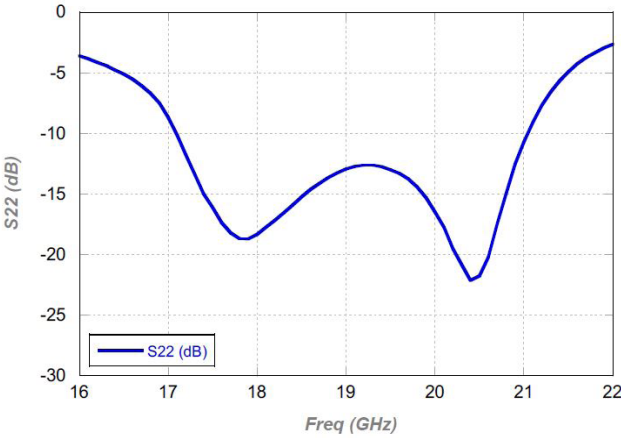
Small Signal Gain vs Frequency



Reverse Gain vs Frequency



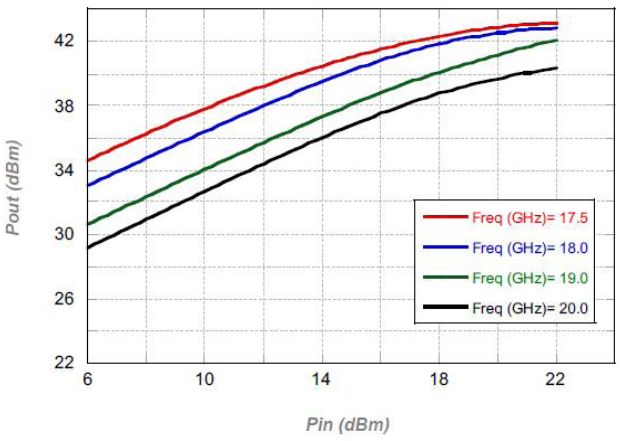
Output Return Loss vs Frequency



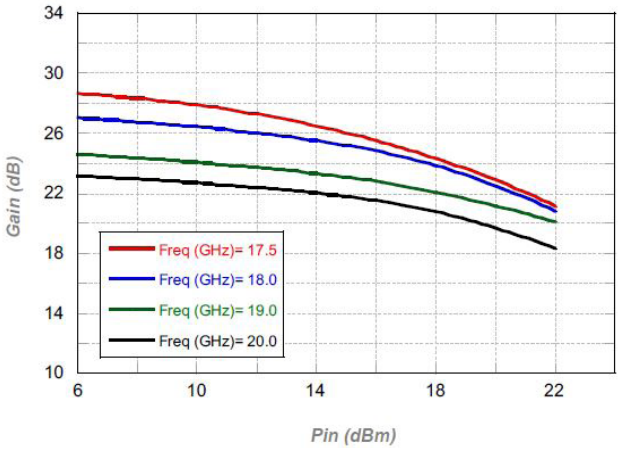
Large Signal Performance Curves

V_D=25 V, I_{DQ}=300 mA, V_G~-3.6 V typical, T_A=25 °C

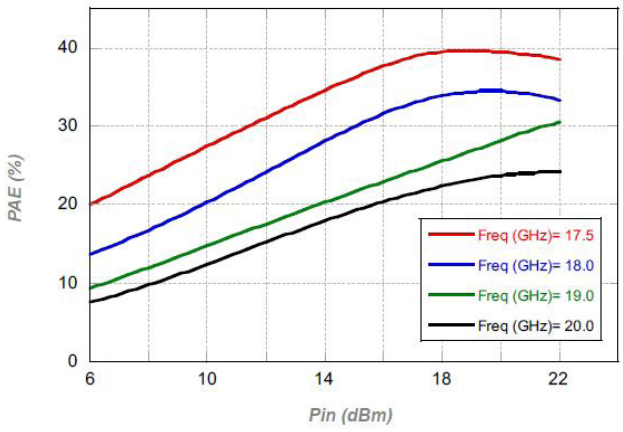
Pout vs Pin vs Frequency



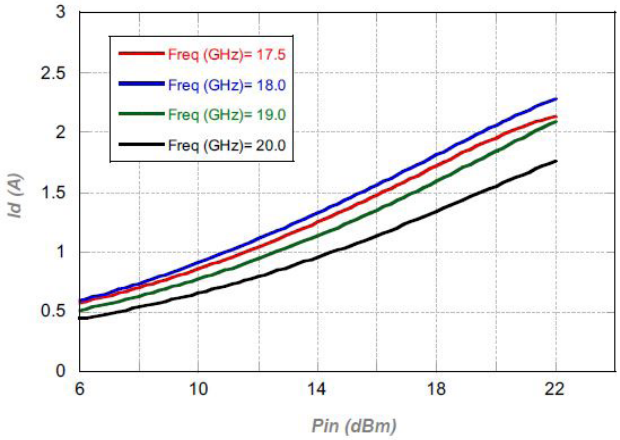
Gain vs Pin vs Frequency



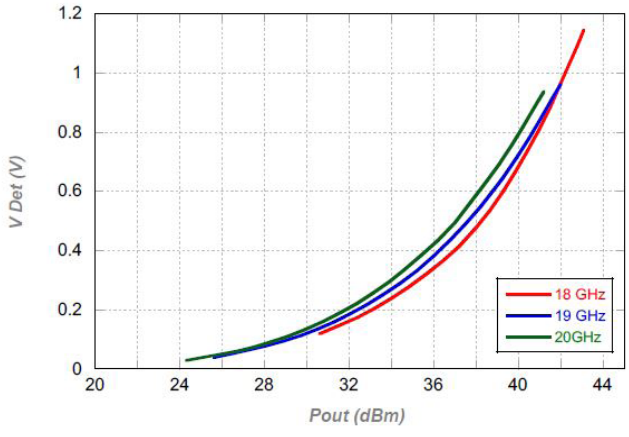
PAE vs Pin vs Frequency



Drain Current vs Pin vs Frequency



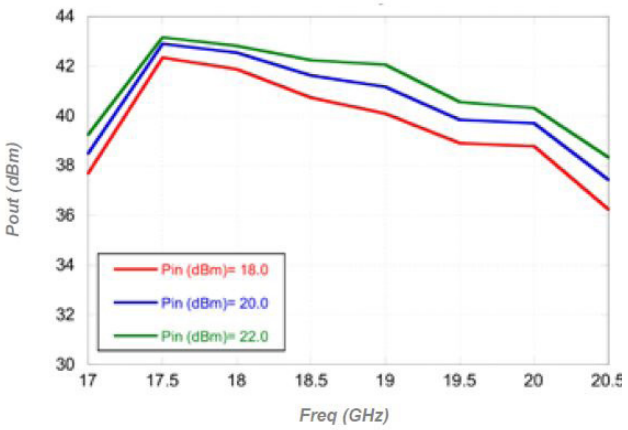
Power Detect Voltage vs Pout



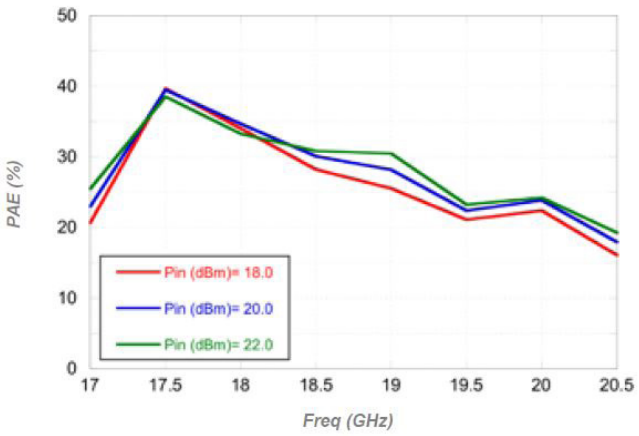
Large Signal Performance Curves

V_D=25 V, I_{DQ}=300 mA, V_G~-3.6 V typical, T_A=25 °C

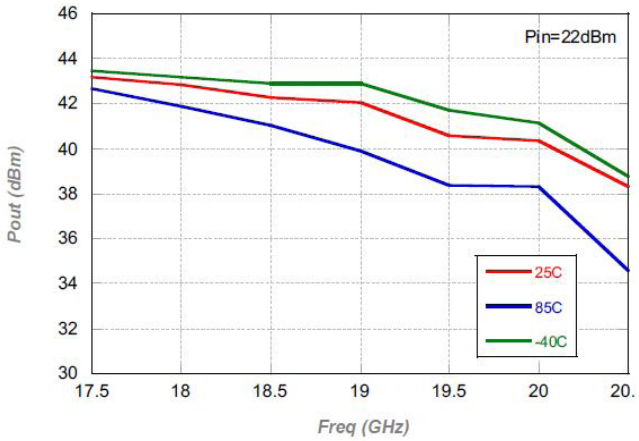
Pout vs Frequency vs Pin



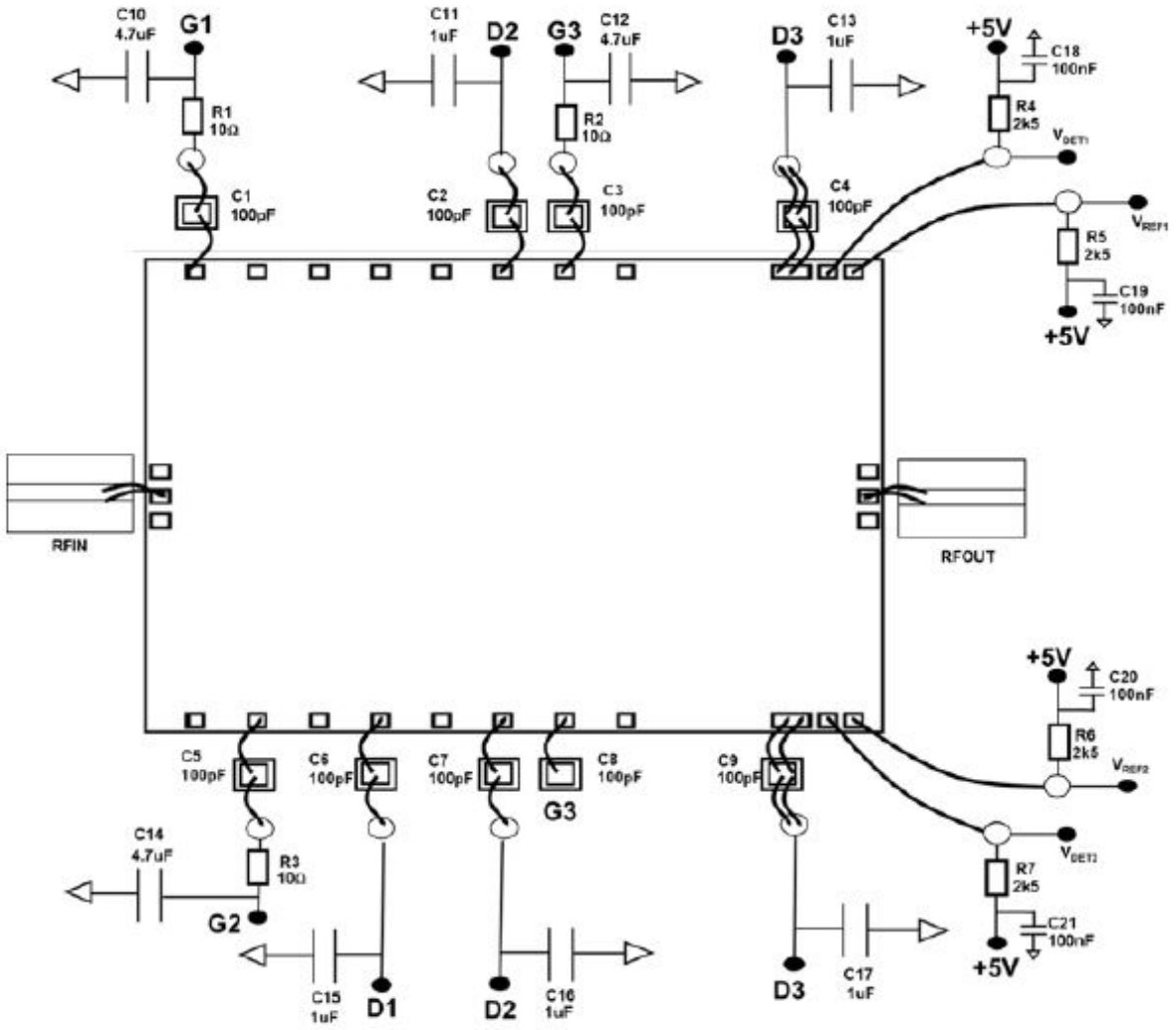
PAE vs Frequency vs Pin



Output Power vs Frequency vs Temperature



Recommended Application Circuit



Bill Of Materials

Part	Vale	Case Size
C1, C2, C3, C4, C5. C6. C7, C8, C9	100 pF	SLC
C10, C12, C14	4.7 uF	1608 (0603)
C11, C13, C15, C16, C17	1 uF	1608 (0603)
C18, C19, C20, C21	100 nF	1608 (0603)
R1, R2, R3	10 Ohm	1005 (0402)
R4, R5, R6, R7	2.5k Ohm	1005 (0402)

Bias

Sequences

Bias Up Sequence	Bias Down Sequence
1. Set ID limit to 2.5 A, IG limit to 50 mA	1. Turn off RF supply
2. Apply -5 V to VG	2. Reduce VG to -5 V
3. Apply +25 V to VD; IDQ is ~0 mA	3. Set VD to 0 V
4. Adjust VG until IDQ = 300 mA (VG~ -3.6 V)	4. Turn off VD supply
5. Turn on RF supply	5. Turn off VG supply

Arrangement

G1, G2, and D1 can be biased from either side, with the non-biased side left open.
G3 can be biased from either side, with the non-biased side bonded to a 100 pF SLC.
D2 and D3 must be biased from both sides.
Drain side capacitors should be 35 V minimum rating.

Detector Operation

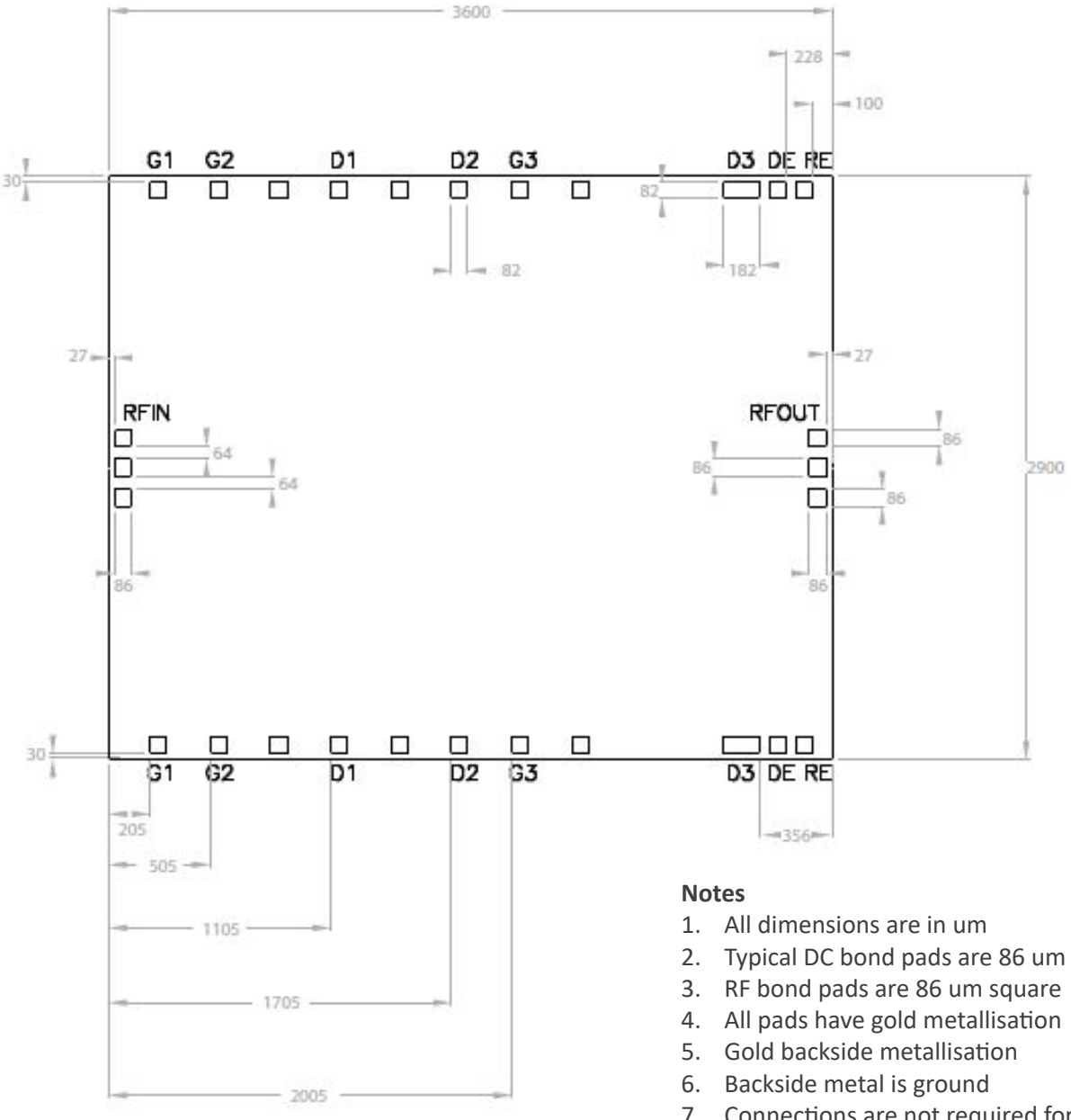
HPA11201721B includes power detectors on both sides of the device to facilitate integration into larger systems. The power detector requires an external 5V supply. For temperature compensation, the VDET and VREF outputs can be connected to a voltage comparator circuit, the output from which can be fed into an ADC or multimeter for the result.

10 W High Power Amplifier MMIC
17-20.5 GHz

ReliaSat

Product Datasheet

Outline drawing



Die Packing Information

All die delivered using gel-packs unless otherwise requested.

Notes

1. All dimensions are in um
2. Typical DC bond pads are 86 um square
3. RF bond pads are 86 um square
4. All pads have gold metallisation
5. Gold backside metallisation
6. Backside metal is ground
7. Connections are not required for unlabelled bon pads
8. Die thickness is 100 um

Pad Descriptions

Name	Description
RFIN	Input RF pad. This pad is AC coupled
RFOUT	Output RF pad. This pad is AC coupled
Dx	Drain bias pad for stage x
Gx	Gate bias pad for stage x
DE	Voltage detector
RE	Voltage reference detector
BOTTOM	The die backside must be connected to RF/DC ground

General Notes On Assembly

Die should be mounted on conductive material such as gold-plated metal to provide a good ground and suitable heat sink, if necessary.

1. Attaching the die using Au/Sn preforms is preferable. The Eutectic melt for Au/Sn occurs at approximately 280 °C so the die (plus mount and preform) is initially heated up to 180 °C and then it is heated for approximately 10 seconds to 280 °C using a nitrogen heat gun.
2. Pure, dry nitrogen should be used as the heat source.
3. If the devices cannot be lifted/ placed by a vacuum device, then ESD die-lifting tweezers are preferable.
4. Supply lines should be decoupled with 100 pF capacitors.
5. Aluminium wire must not be used.

Handling Precautions

Parameter	Rating
ESD - Human Bodel Model (HBM)	TBD

CAUTION!
ESD – Sensitive Device

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.

Contact Information

ReliaSat European Offices

e: sales@reliasat.com

www.reliasat.com