Raytheon

RMPA61800

Dual Channel 6-18 GHz 2 Watt Power Amplifier MMIC

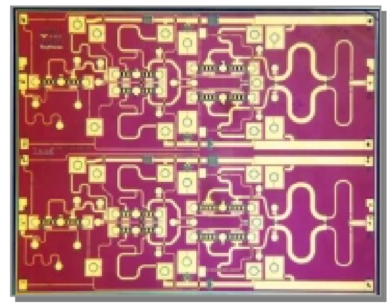
PRELIMINARY INFORMATION

Description

The Raytheon RMPA61800 is a fully monolithic dual channel power amplifier operating over the 6.0 to 18.0 GHz frequency band. The amplifier uses a .25 micron Pseudomorphic High Electron Mobility Transistor (PHEMT) process to maximize efficiency and output power. The chip configuration incorporates two stages of reactively combined amplifiers at the output preceded by an input amplifier stage. Two identical amplifier channels are provided to achieve a typical total combined (using an off-chip combiner) output power of 33 dBm at 3 dB gain compression. A single channel provides typically, 18 dB small signal gain and 31 dBm output power at 1 dB gain compression.

Features

- Two Identical Channels
- 21.0 dB Typical Small Signal Gain, Single Channel
- 2.0:1 Typical Input SWR, 2.5:1 Typical Output SWR, Single Channel
- 31 dBm Output Power at 1 dB Gain Compression, Single Channel
- 32 dBm Output Power at 3 dB Gain Compression, Single Channel
- 34 dBm Output Power at 1 dB Gain Compression, Dual Channel
- 22% Typical Power Added Efficiency at 1 dB Gain Compression
- Chip size: 6.55 mm x 5.15 mm x 0.1 mm



Absolute Maximum Ratings

(Single Channel)

Parameter	Symbol	Value	Unit
Positive Drain DC Voltage	Vd	8.5	V
Negative DC Voltage	Vg	-2	V
Simultaneous (Vd-Vg)	Vdg	+10.5	V
RF CW Input Power (50 Ω source)	Pin	27	dBm
Drain Current	Id	1.2	A
Storage Temperature	Tstg	-55 to +125	°C
Operating Base Plate Temp	Tc	-40 to +85	°C
Thermal Resistance (Channel to Backside)	Rjc	12	°C/W

Performance Characteristics

(at 25°C)
50 Ω system,
Vd=+8V, Quiescent Current (Idq=600 mA)

Parameter	Min	Typ	Max	Unit
Frequency Range	6.0		18.0	GHz
Small Signal Gain	15	21		dB
P1dB Compression	28	31		dBm
P3dB Compression	30	32		dBm
PAE at 1 dB Gain Comp.	12	22		%

Parameter	Min	Typ	Max	Unit
Input Return Loss		9.5		dB
Output Return Loss		7.4		dB
Gate Voltage (Vg)[1]		-0.4		V
Gain vs. Temp. 0~85°C		-0.025		dB/°C

Note: Quiescent Bias VD = +8V, ID = 600mA/channel, T_C = +25°C.

Characteristic performance data and specifications are subject to change without notice.

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Application Information

CAUTION: THIS IS AN ESD SENSITIVE DEVICE

Chip carrier material should be selected to have GaAs compatible thermal coefficient of expansion and high thermal conductivity such as copper molybdenum or copper tungsten. The chip carrier should be machined, finished flat, plated with gold over nickel and should be capable of withstanding 325°C for 15 minutes.

Die attachment for power devices should utilize Gold/Tin (80/20) eutectic alloy solder and should avoid hydrogen environment for PHEMT devices. Note that the backside of the chip is gold plated and is used as RF and DC Ground.

These GaAs devices should be handled with care and stored in dry nitrogen environment to prevent contamination of bonding surfaces. These are ESD sensitive devices and should be handled with appropriate precaution including the use of wrist-grounding straps. All die attach and wire/ribbon bond equipment must be well grounded to prevent static discharges through the device.

Recommended wire bonding uses 3 mils wide and 0.5 mil thick gold ribbon with lengths as short as practical allowing for appropriate stress relief. The RF input and output bonds should be typically 0.012" long corresponding to a typical 2 mil gap between the chip and the substrate material.

Figure 1
Functional Block Diagram

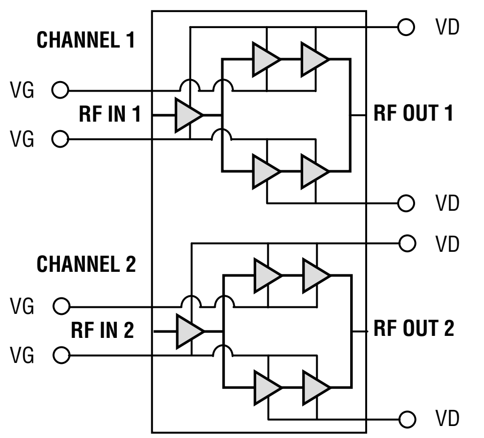
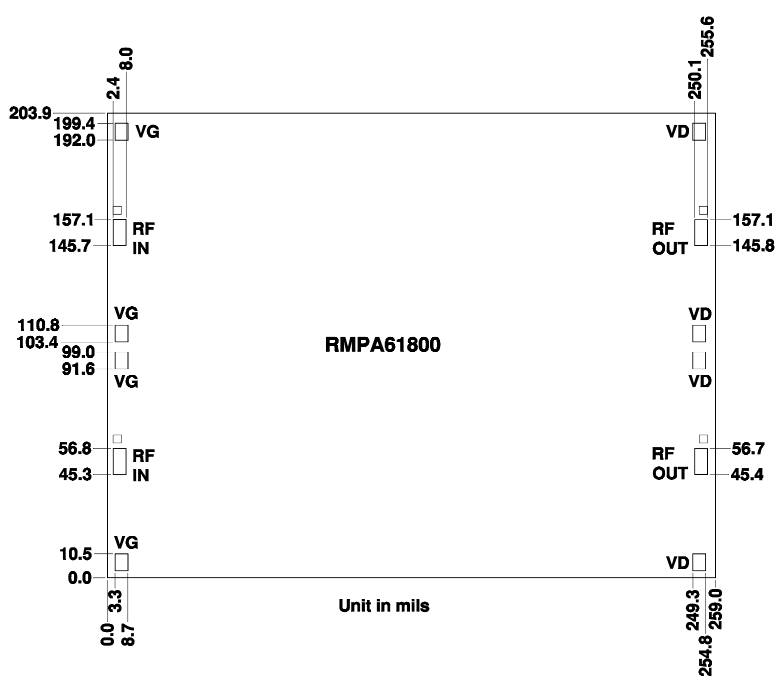


Figure 2
Chip Layout and Bond Pad Locations

(Chip size=6.55mm x 2.67mm x 100µm. Back of Chip is DC Ground)



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Application Note

Scope:

This application note briefly describes the procedure for evaluating the Raytheon RMPA61800, high efficiency 0.25 µm PHEMT Dual Channel Amplifier. The chip configuration incorporates two stages of reactively combined amplifiers at the output preceded by an input amplifier stage.

Carrier Assembly:

The attached drawing shows a recommended off chip bias scheme for the RMPA61800. The MMIC is mounted on a Cu shim or ridge, which in turn blazed to Cu-Mo-Cu, or Cu-W, or Mo carrier with alumina 50-ohm microstrip lines for in/out RF connections and off-chip DC bias components. The drawing shows the placement of components and bond wire connections. The following should be noted:

(1) 1 mil gold bond wires are used on the carrier assembly.

(2) Use 3-1 mil gold wires about 25 mils in length for optimum RF performance.

(3) Vg: Gate Voltage (negative) input terminal for amplifier stages. For best results, the gate supply should have a source resistance less than 100 ohms.

(4) Vd: Drain Voltage (positive) input terminal for amplifier stages.

(5) Vg and Vd on both sides of the MMIC must be biased to insure proper operation.

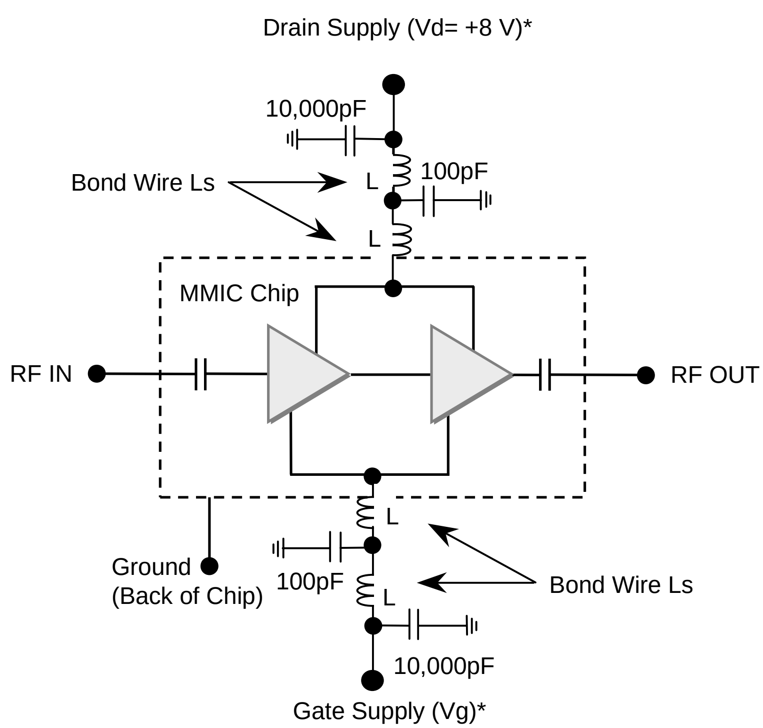
(6) Bias decoupling capacitors of 0.01 uF (multilayer) and 100 pF (single layer) are used on the carrier.

(7) Close placement of external components is essential to stability.

(8) The test fixture may require a pair of 25 µF capacitor on the drain and gate(optional) bias terminals to prevent oscillations caused by the test fixture connections.

(9) For Laboratory testing, use good power supplies. Set current limits on supplies to RF drive-up current level. Keep supply wire/leads as short as possible and if required use additional bypass capacitors at the fixture terminals.

Figure 3
Recommended Application Schematic Circuit Diagram (single channel represented) Bias application is identical for each channel.



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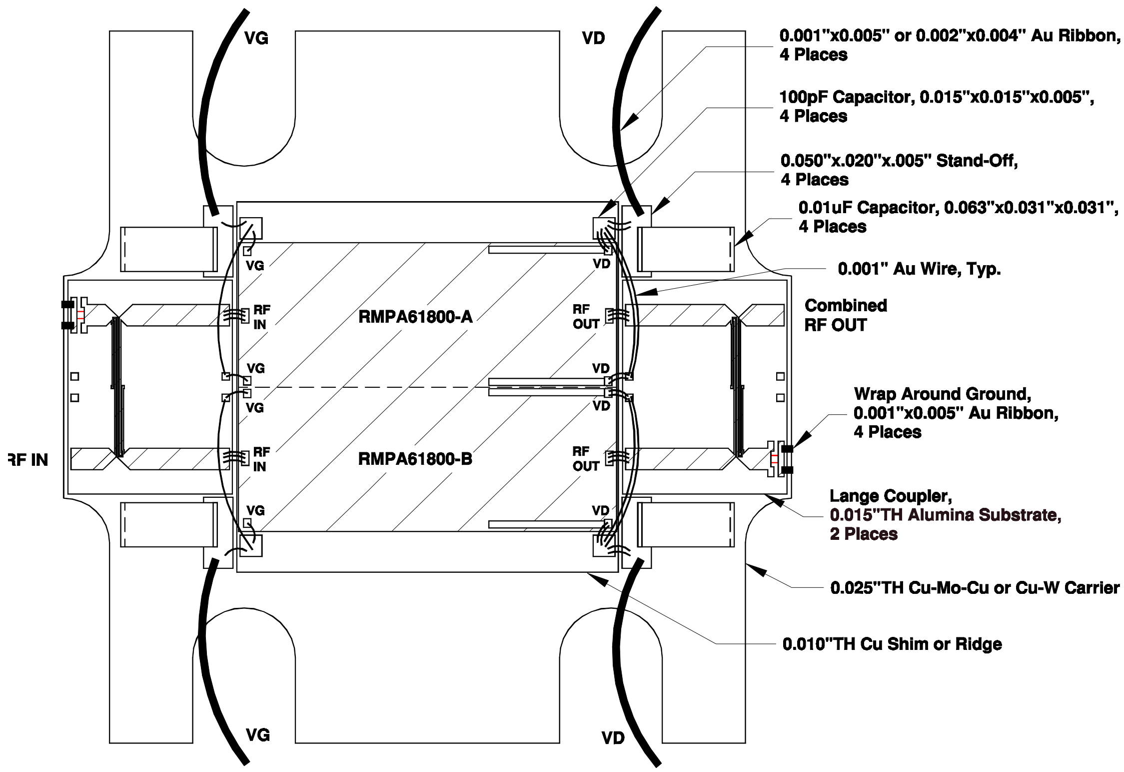
Application Note

Example of Assembled Combiner Module



Recommended Procedure

for biasing and operation

CAUTION: LOSS OF GATE VOLTAGE (Vg) WHILE DRAIN VOLTAGE (Vd) IS PRESENT MAY DAMAGE THE AMPLIFIER. THIS AMPLIFIER IS AN ESD SENSITIVE DEVICE.

The following procedure must be followed to properly test the amplifier:

Step 1: Slowly apply Gate Voltage (typical Vpinch-off= -1.5V) to terminal Vg.

Step 2: Slowly apply Drain Voltage at Vd (<+5 volts) and monitor drain current Ids. Adjust negative voltage Vg to set the drain current (Ids) to approximately 600 mA per channel. Adjust the drain voltage Vg to nominal +8 volts (adjust Gate Voltage Vg, if needed, to maintain the drain current at Ids.

Step 3: After the bias condition is established, RF input signal may now be applied at the appropriate frequency band.

Step 4: Follow Turn-off sequence:

(i) RF input power=off,
(ii) Vd=off,
(iii) Vg=off.

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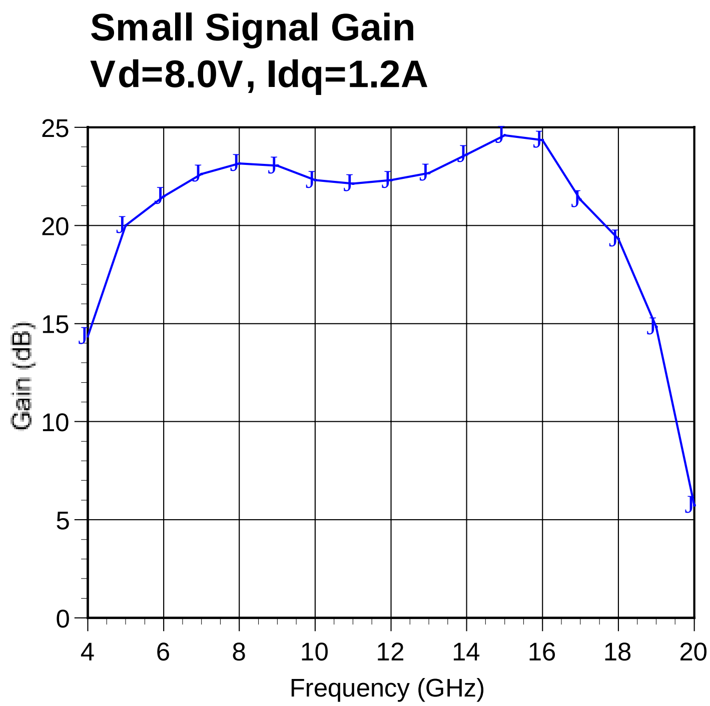
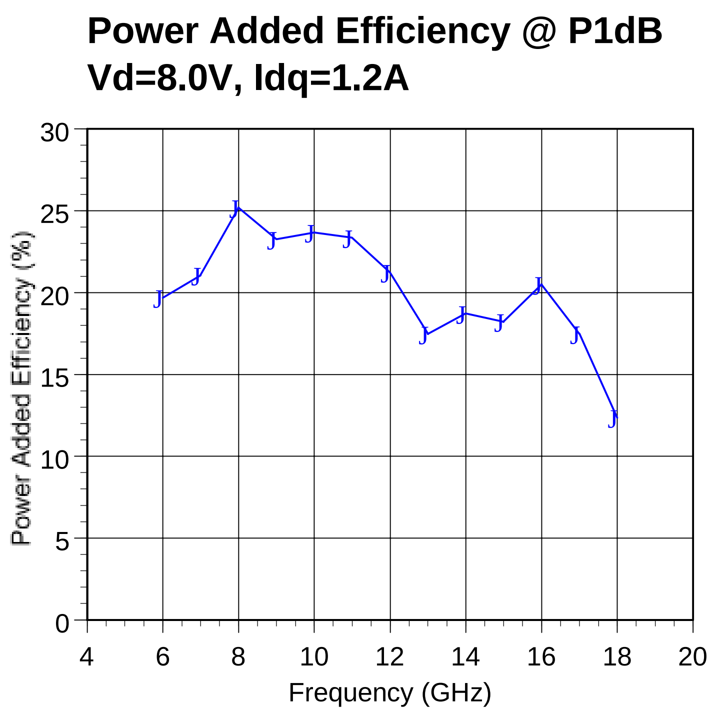
Typical Two Channels Combined Characteristics





The above data is derived from fixtured measurements which includes 3 parallel, 1 mil diameter, 15 mil long, gold bond wires connected to the RF input and output.

The Id @ 1 dB compression increases to approximately 2 A. The dc supply should be able to support the required current to achieve the above performance.

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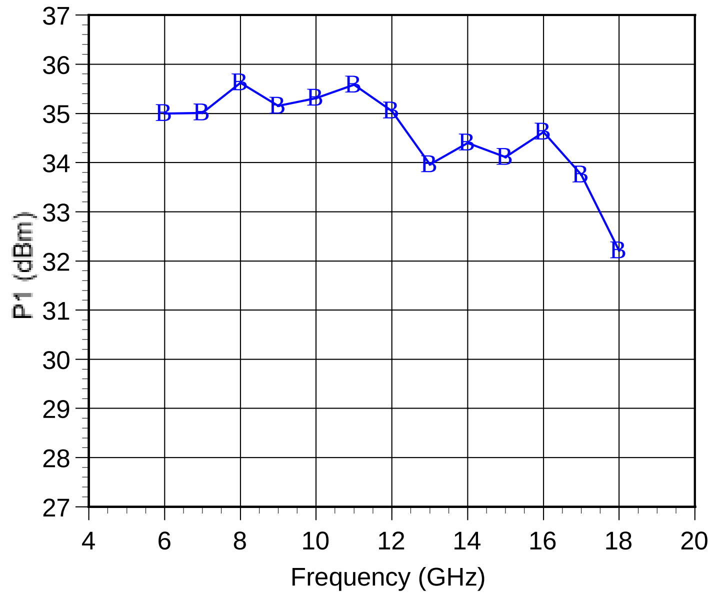
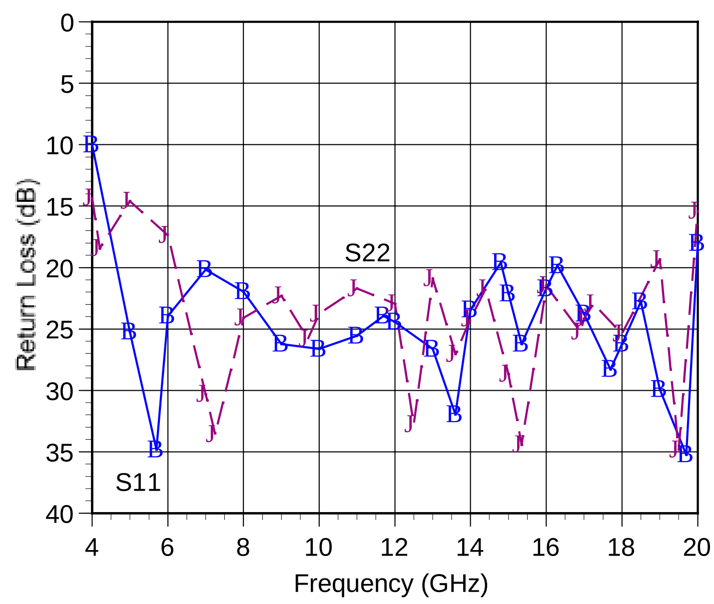
Typical Characteristics, Two Channels Combined

Output Power @ 1dB Compression Vd=8.0V, Idq=1.2A



Input and output Return Loss Vd=8.0V, Idq=1.2A



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Test Procedure

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