Sales: 408-778-9952 | General: 408-778-4200 | Fax: 408-778-4300
Sales & Customer Support: sales@markimicrowave.com
Tech Support: support@markimicrowave.com

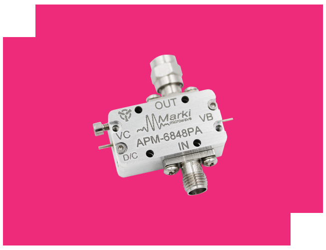
APM-6848PA

2-32 GHz GaAs Broadband Low Phase Noise Amplifier

DEVICE OVERVIEW

General Description

The APM-6848 is an integrated 2-stage broadband, low phase noise LO driver amplifier designed to provide a saturated +20 dBm output power from a 0-4 dBm input power with low DC power consumption. This amplifier uses GaAs HBT technology for low phase noise, and is optimized to provide enough power to drive the LO port of an S-diode mixer from 2 GHz to 20 GHz or of an H or L diode mixer from 2 GHz to 32 GHz. This amplifier can be operated with a variety of bias conditions for both low power and high-power applications.



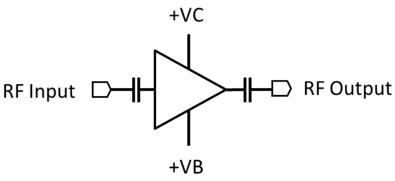
Features

- -165 dBc/Hz phase noise at 10 kHz offset frequency
- +21 dBm output power
- +23 dB gain
- Low DC power consumption
- Positive-only biasing
- No sequencing required
- Unconditionally stable
- Integrated DC blocks – No bias-tees or off-chip blocking required

Applications

- Mobile test and measurement equipment
- Radar
- SATCOM
- 5G transceivers
- Driver amplifier for S, H, and L – diode mixers
- Suitable as a T3 driver

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Connectors	Green Status	Product Lifecycle	Export Classification
APM-6848PA	2-32 GHz GaAs Broadband Low Phase Noise Amplifier	PA	Standard	REACH RoHS	Obsolete	EAR99

Table Of Contents

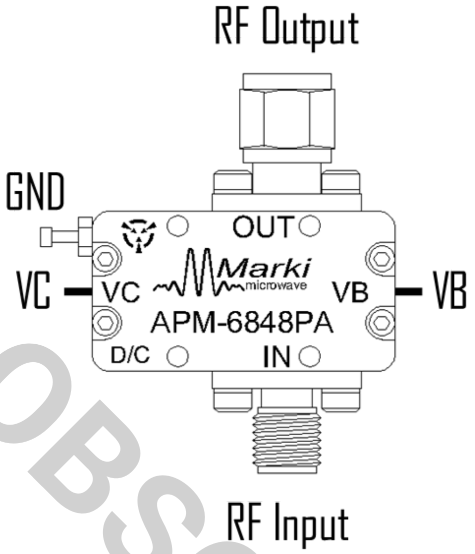
Revision History

Revision Code	Revision Date	Comment
-	2019-10-01	Datasheet Initial Release
A	2020-01-01	Revised Min. Psat/SSG Spec, Added Time Domain Plots
B	2020-07-01	Revised Max Operating Temperature
C	2020-07-01	Updated Thermal Resistance
D	2020-10-01	Updated Thermal Specs, Updated Min Specs
E	2020-12-01	Updated Performance Plots to Adhere to Max Input Power Spec

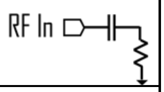
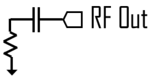
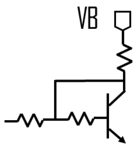
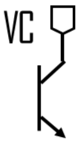
Port Configuration and Functions

Port Diagram

A port diagram of the APM-6848PA is shown below.



Port Functions

Port	Function	Connector Type	Description	Equivalent Circuit for Package
GND	Ground	-	Housing or outside of the coaxial cables must be connected to a DC/RF ground potential with high thermal and electrical conductivity.	
RF In	RF Input	2.92F	This is the RF input port of the amplifier. It is internally DC blocked and RF matched to 50 Ω.	
RF Out	RF Output	2.92M	This is the RF output port of the amplifier. It is internally DC blocked and RF matched to 50 Ω. Must have less than 7:1 VSWR when operating with voltage larger than 5V on port VC.	
VB	Base Supply	-	Port VB is the DC voltage supply port for current mirrors which controls the collector current supplied to the 2 amplifier stages. Larger voltages result in a higher current draw through port VC, effectively functioning as a gain control pin. The VB port in the PA module internally connects to both VB1 and VB2 of the IC described in Port Functions of this datasheet.	
VC	Collector Supply	-	Port VC is the DC voltage supply port for both stages of the 2-stage amplifier. The VC port in the PA module internally connects to both VC1 and VC2 of the IC described in Port Functions of this datasheet.	

Specifications

Absolute Maximum Ratings

The Absolute Maximum Ratings indicate limits beyond which damage may occur to the device. If these limits are exceeded, the device may become inoperable or have a reduced lifetime.

Parameter	Maximum Rating	Unit
Collector Positive Bias Voltage (VC, VC1, VC2)	7	V
Current Mirror Positive Bias Current (Ib, Ib1+Ib2)	8	mA
Current Mirror Positive Bias Voltage (VB, VB1, VB2)	7	V
Maximum Operating Temperature	85	°C
Maximum Storage Temperature	150	°C
Max Junction Temperature for MTTF >1E6 Hours	125	°C
Minimum Operating Temperature	-40	°C
Minimum Storage Temperature	-65	°C
Output Load VSWR	7	-
Positive Bias Current (Ic1)	90	mA
Positive Bias Current (Ic2)	90	mA
RF Input Power	5	dBm
Thermal Resistance, θJC	53	°C/W

Package Information

Parameter	Details	Rating
Weight	Package name: PA	14.7g
Dimensions	-	28.45 x 14.99 mm

Recommended Operating Conditions

The Recommended Operating Conditions indicate the limits, inside which the device should be operated, to guarantee the performance given in Electrical Specifications Operating outside these limits may not necessarily cause damage to the device, but the performance may degrade outside the limits of the electrical specifications. For limits, above which damage may occur, see Absolute Maximum Ratings.

Parameter	Min	Nominal	Max	Unit
Positive DC Voltage (VC2)	3	5	6	V
Positive DC Current (Ic2)	8	21	40	mA
Positive DC Current (Ic1)	8	21	40	mA
Ambient Temperature	-40	25	85	°C
Positive DC Voltage (VC1)	3	5	6	V
Positive DC Current Mirror Voltage (Ib2)	0.9	2	2.6	mA
Positive DC Current Mirror Voltage (VB2)	3	5	6	V
Positive DC Current Mirror Current (Ib1)	0.9	2	2.6	mA
Positive DC Current Mirror Voltage (VB1)	3	5	6	V

Maximum recommended operating current conditions without RF input applied. Please see typical performance plots on page 12 for relationship between RF input power and DC current draw.

Sequencing Requirements

There is no sequencing required to power up or power down the amplifier.
Amplifier must have an output load connected when operating with a VC, VC1, or VC2 voltage larger than +5V.

Electrical Specifications

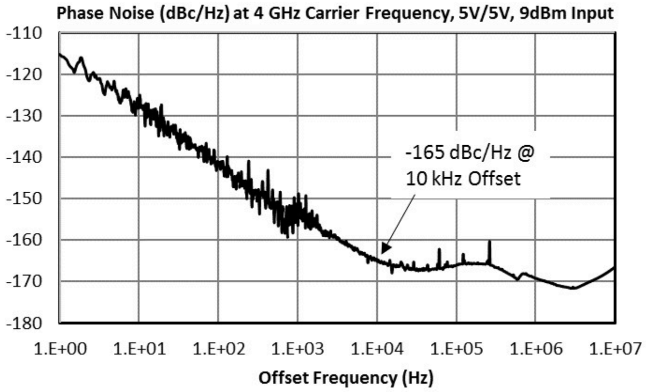
The electrical specifications apply at TA=+25°C in a 50Ω system. Min and Max limits apply only to our connectorized units and are guaranteed at TA=+25°C. Die are 100% DC tested and RF tested on a per lot basis. All Specifications and performance shown with VC1 = VC2 and VB1 = VB2.

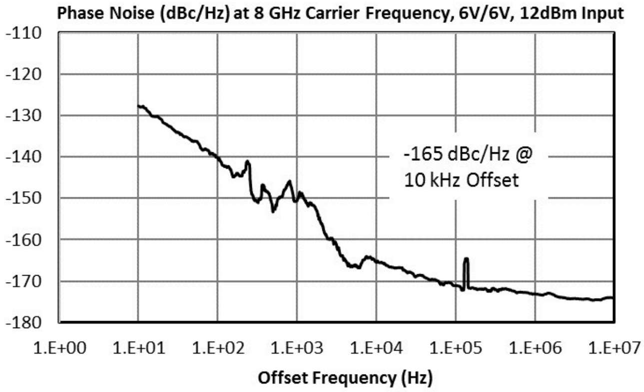
Parameter	Test Conditions	Minimum Frequency (GHz)	Maximum Frequency (GHz)	Min	Typ	Max	Unit
Collector Current, Ic [1]	5V/4V	-	-	-	27	-	mA
Collector Current, Ic [2]	5V/5V	-	-	-	43	-	mA
Collector Current, Ic [3]	5V/6V	-	-	-	67	-	mA
Current Mirror Current, Ib	5V/4V	-	-	-	2.9	-	mA
Current Mirror Current, Ib	5V/5V	-	-	-	4	-	mA
Current Mirror Current, Ib	5V/6V	-	-	-	5.2	-	mA
Input IP3	5V/5V bias, -25 dBm Input Power	2	29	-	0.5	-	dBm
Input Power for Saturation	5V/5V bias	2	29	-	4	-	dBm
Input Return Loss	5V/5V bias, -25 dBm Input Power	20	29	-	9	-	dB
Input Return Loss	5V/5V bias, -25 dBm Input Power	2	20	-	11	-	dB
Noise Figure	5V/5V bias, -25 dBm Input Power	2	26.5	-	6	-	dB
Output IP3	5V/5V bias, -25 dBm Input Power	2	29	-	21	-	dBm
Output P1dB	5V/5V bias	2	20	-	19	-	dBm
Output P1dB	5V/5V bias	20	29	-	13	-	dBm
Output Power	5V/5V bias, +4 dBm Input Power	2	20	19	21	-	dBm
Output Power	5V/5V bias, +4 dBm Input Power	20	29	-	18	-	dBm
Output Return Loss	5V/5V bias, -25 dBm Input Power	2	20	-	15	-	dB
Output Return Loss	5V/5V bias, -25 dBm Input Power	20	29	-	7	-	dB
Phase Noise @ 10 kHz Offset	5V/5V bias, +9 dBm Input power	4	4	-	-165	-	dBc/Hz
Reverse Isolation	5V/5V bias, -25 dBm Input Power	2	29	-	65	-	dB
Small Signal Gain	5V/5V bias, -25 dBm Input Power	20	29	-	21	-	dB
Small Signal Gain	5V/5V bias, -25 dBm Input Power	2	20	19	23	-	dB

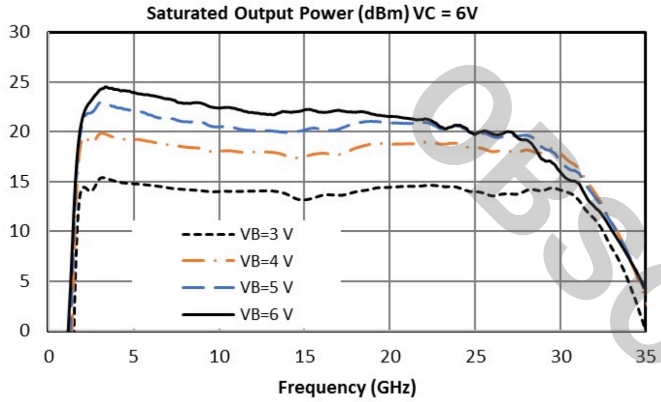
[1][2][3] Bias conditions for Ic and Ib tested with no RF input power. See Typical Performance Plots for DC current vs. RF power. Bias conditions presented as VC/VB.

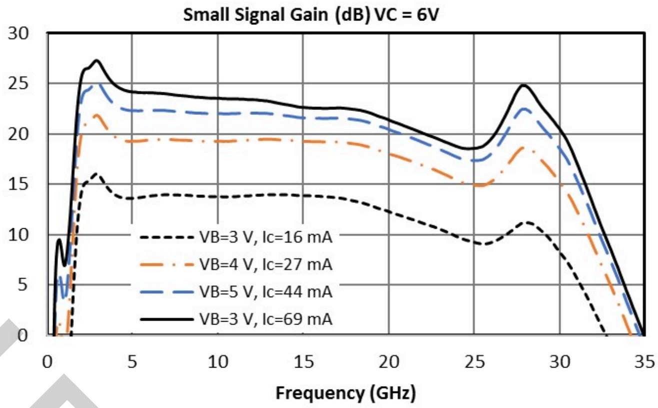
Typical Performance Plots

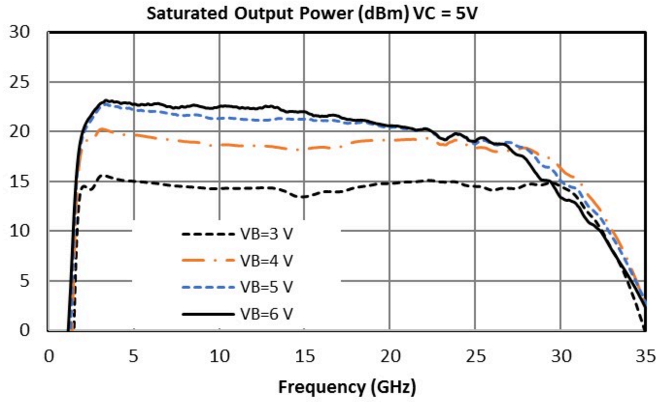
Phase Noise Plots taken above maximum recommended input power for MTTF >1E6 hours. Input powers greater than +5dBm can result in MTTF <1E6 hours.

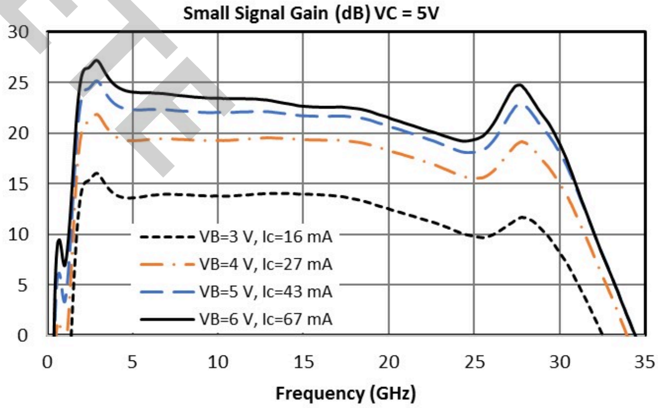




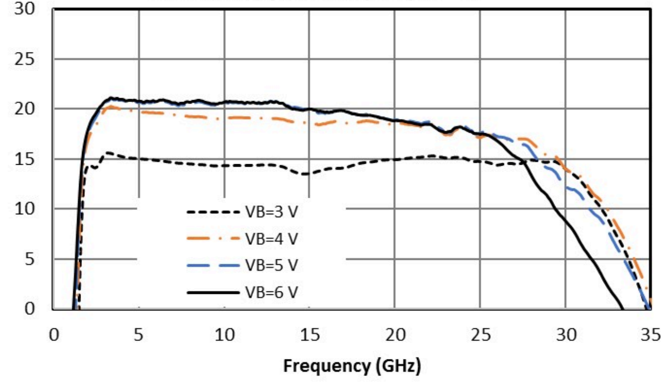




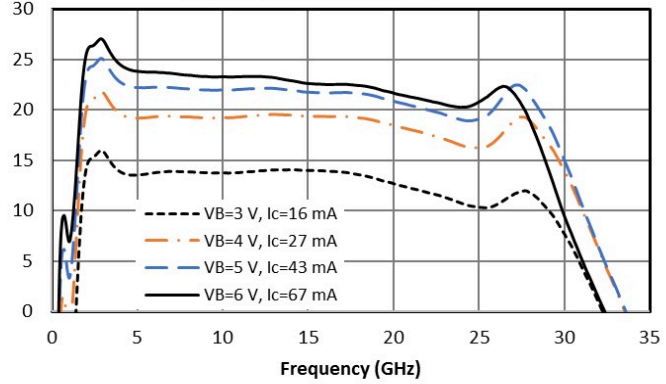




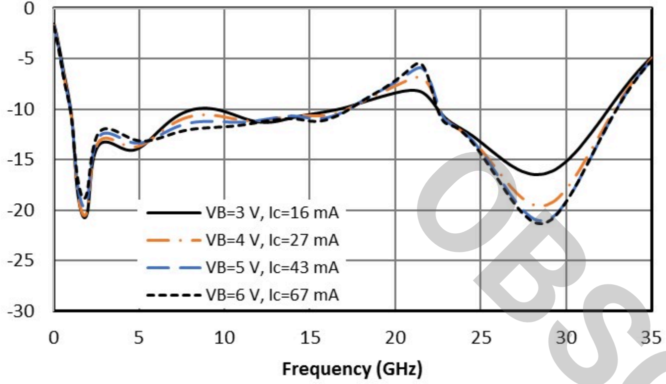
Saturated Output Power (dBm) VC = 4V



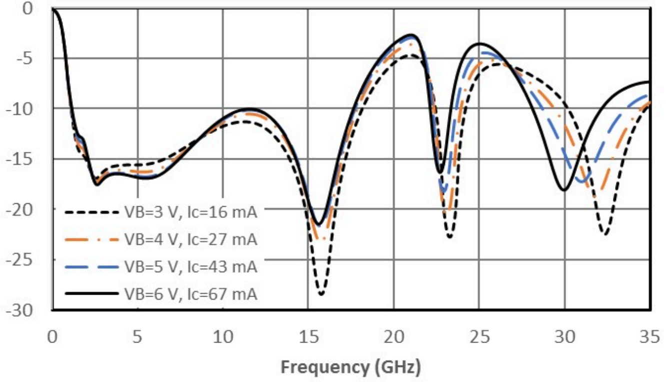
Small Signal Gain (dB) VC = 4V



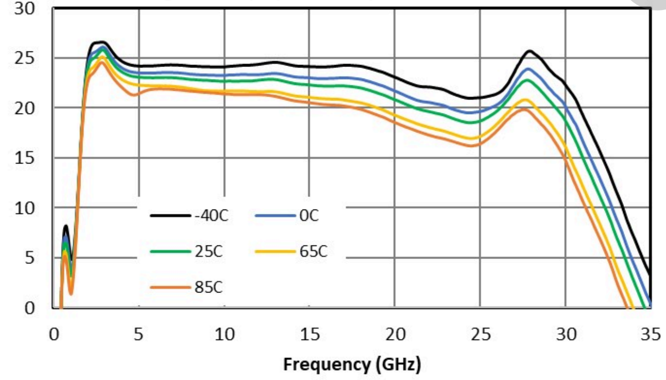
Input Return Loss (dB) VC = 5V



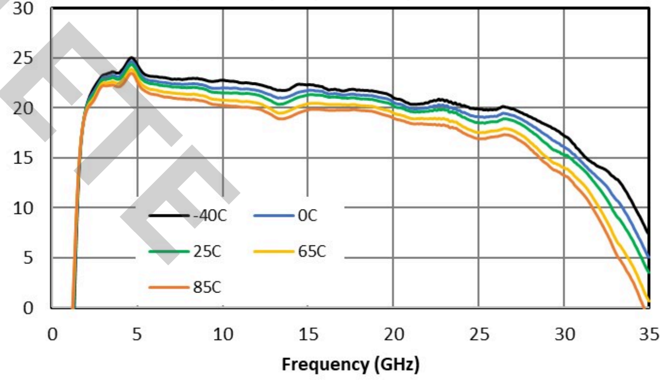
Output Return Loss (dB) VC = 5V



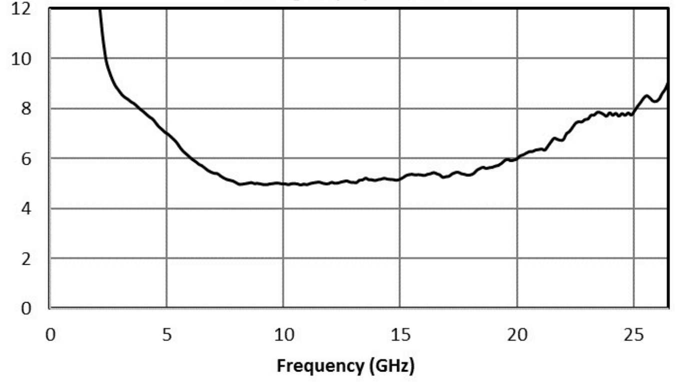
Small Signal Gain (dB) Over Temperature 5V/5V Bias



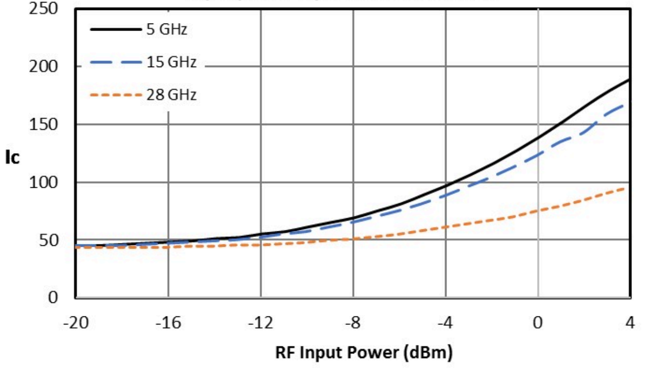
Saturated Output Power (dBm) Over Temperature 5V/5V Bias

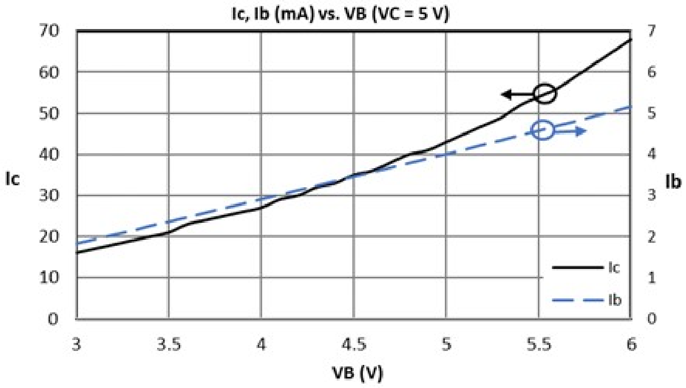


Noise Figure (dB), 5V/5V Bias



Ic (mA) vs. RF Input Power, 5V/5V bias

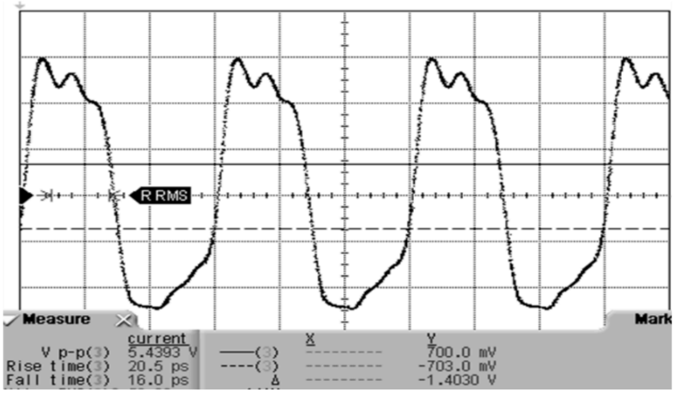



Ic, Ib (mA) vs. VB (VC = 5 V)
Ic
Ib
VB (V)
70
60
50
40
30
20
10
0
7
6
5
4
3
2
1
0
3
3.5
4
4.5
5
5.5
6
Ic
Ib

Time Domain Plots

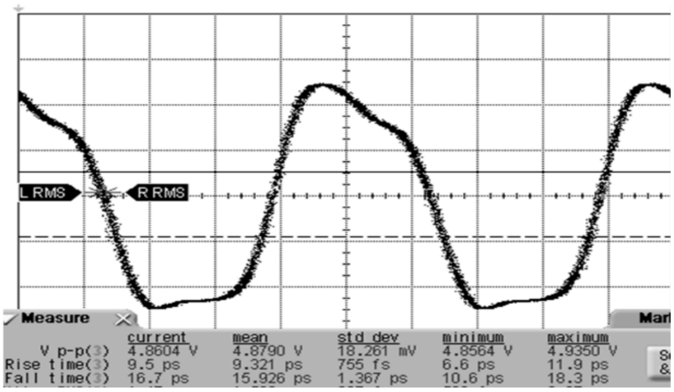
Fast rise time is desirable for linear T3 mixer operation.

5 GHz, +5 dBm In, 5V/5V bias



```
                current       X            Y
    V p-p(3)   5.4393 V   ——(3)  ---------   700.0 mV
Rise time(3)   20.5 ps    ----(3) ---------  -703.0 mV
Fall time(3)   16.0 ps        Δ  ---------  -1.4030 V
```

10 GHz, +5 dBm In, 5V/5V bias



```
                current     mean        std dev     minimum     maximum
    V p-p(3)   4.8604 V   4.8790 V    18.261 mV   4.8564 V    4.9350 V
Rise time(3)   9.5 ps     9.321 ps    755 fs      6.6 ps      11.9 ps
Fall time(3)   16.7 ps    15.926 ps   1.367 ps    10.6 ps     18.3 ps
```

Application Information

Gain and Power Control

The APM-6848 is a 2-stage amplifier integrated on a single IC. In the APM-6848PA module, VB1 & VB2 and VC1 & VC2 are connected internally for user convenience. However, in the APM-6848CH bare die, the user has some freedom to operate the 2 amplifier stages independently for their application-specific needs. Please refer to Port Functions to see the function of each pad on the APM-6848CH, and refer to the gain and Psat plots in typical performance plots to see how bandwidth, saturated output power, and gain profile change for various bias conditions.

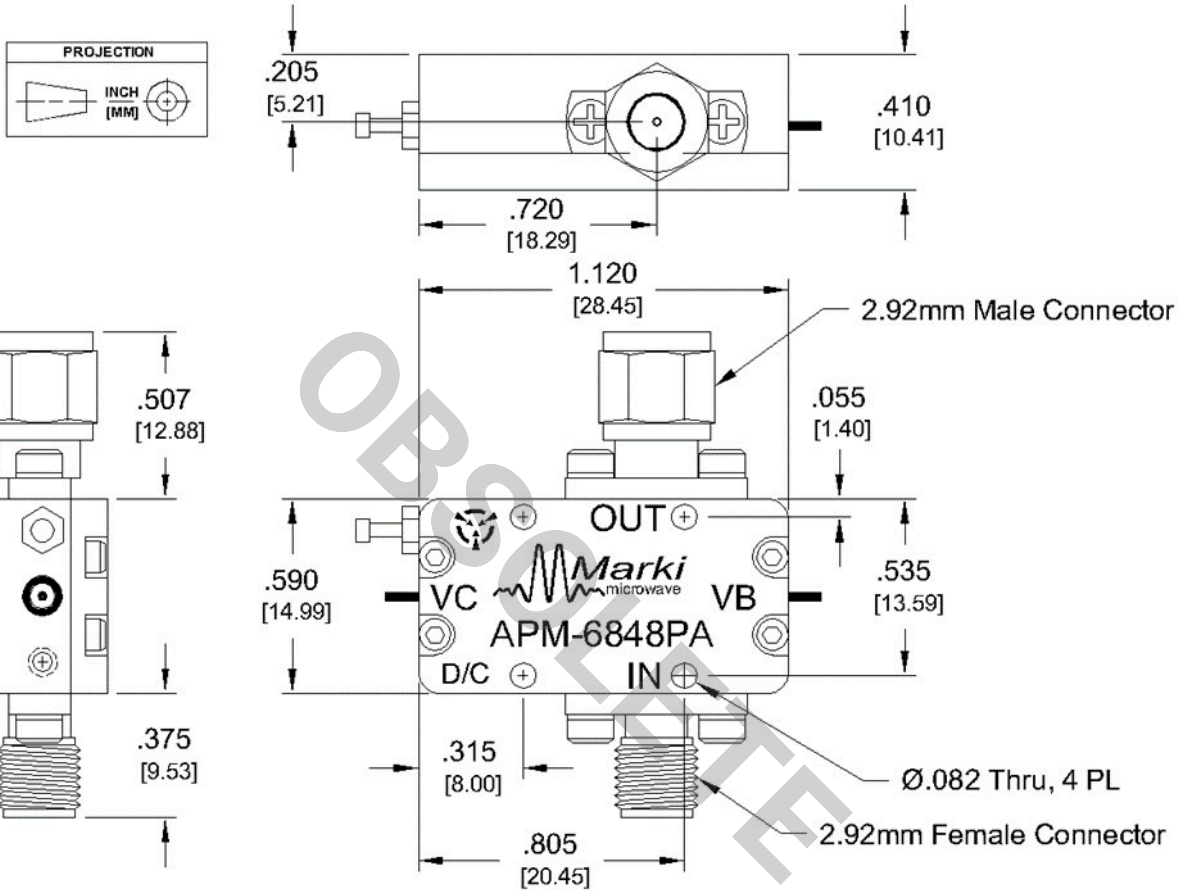
Generally, the gain of the first stage and second stage of the amplifier can be controlled by adjusting VB1 and VB2 respectively. Increasing the voltage applied to a VB pad increases the current drawn into the corresponding amplifier stage, which strongly correlates to the gain of that stage, and some difference to the output power of that stage. Increasing the voltage on a VC pad generally increases the linearity, maximum output power, and DC power consumption of the corresponding amplifier stage.

In the case where a user wants to drive the LO port of a mixer from an initial LO power of +5 dBm at 10 GHz, the user could apply 5V at all 4 DC ports and see an output power of +21.5 dBm and an overall power consumption of about 1 watt (the amplifier stages pull more DC current as the gain compresses in a high input power condition). Alternatively, the user could apply 3.5 V – 4 V to VB1 and VC1, and 6V to VB2 and VC2 and see an output power of 22.5 dBm with very little difference in the overall power consumption. For applications with a strict power budget and performance requirements, optimizing the bias conditions of the amplifier can be a useful tool for the system designer.

Mechanical Data

Outline Drawing

Download : Outline 2D Drawing | Outline 3D Drawing | Outline 3D STP



DISCLAIMER

MARKI MICROWAVE, INC., (“MARKI”) PROVIDES TECHNICAL SPECIFICATIONS AND DATA (INCLUDING DATASHEETS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, AND OTHER INFORMATION AND RESOURCES “AS IS” AND WITH ALL FAULTS. MARKI DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT.

These resources are intended for developers skilled in the art designing with Marki products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards and other requirements. Marki makes no guarantee regarding the suitability of its products for any particular purpose, nor does Marki assume any liability whatsoever arising out of your use or application of any Marki product.

Marki grants you permission to use these resources only for development of an application that uses Marki products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Marki intellectual property or to any third-party intellectual property. Marki reserves the right to make changes to the product(s) or information contained herein without notice.

MARKI MICROWAVE and T3 MIXER are trademarks or registered trademarks of Marki Microwave, Inc. All other trademarks used are the property of their respective owners.