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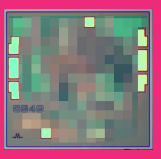
APM-6849CH

GaAs Broadband Low Phase Noise Amplifier

DEVICE OVERVIEW

General Description

The APM-6849 is a single stage broadband, low phase noise LO driver amplifier designed to provide saturated +21 dBm output power. This amplifier uses GaAs HBT technology for low phase noise, and provides industry leading -170 dBc/Hz at 10 kHz offset from carrier frequency. The amplifier is also highly efficient with 21% peak PAE at 5 GHz input frequency and low DC current draw. It is optimized to provide enough power to drive the LO port of an S-diode mixer (2 – 20 GHz) and an H/L-diode mixer (2 - 32 GHz). This amplifier is operational with a variety of bias conditions for both low and high-power applications.



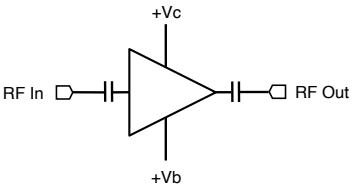
Features

- -170 dBc/Hz phase noise at 10kHz offset frequency
- +21 dBm output power
- 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 and satellite communications
- 5G transceivers
- Driver amplifier L,H,S – diode mixers
- Suitable as a T3 drive

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Connectors	Green Status	Product Lifecycle	Export Classification
APM-6849PA	GaAs Broadband Low Phase Noise Amplifier	PA	Standard	REACH RoHS	Released	EAR99
APM-6849CH	GaAs Broadband Low Phase Noise Amplifier	CH	-	REACH RoHS	Released	EAR99

Table Of Contents

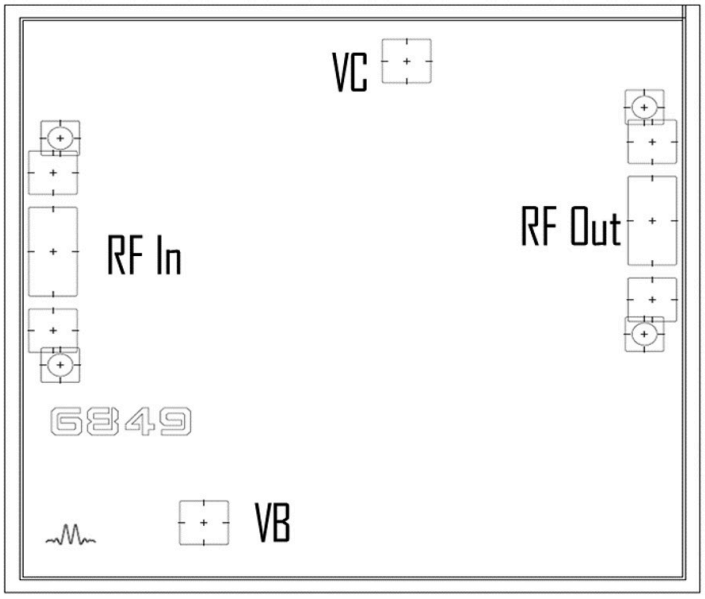
Revision History

Revision Code	Revision Date	Comment
-	2019-11-01	Datasheet Initial Release
A	2020-01-01	Added Time Domain Plots
B	2020-07-01	Updated Max Operating Temperature
C	2020-07-01	Updated Thermal Resistance Specification
D	2020-10-01	Updated Thermal Specs, Updated Min Specs
E	2022-12-01	Added Input/Output Power Plots in Sect 3.6

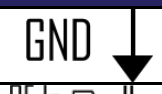
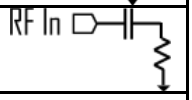
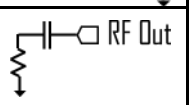
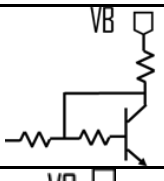
Port Configuration and Functions

Port Diagram

A port diagram of the APM-6849CH is shown below.



Port Functions

Port	Function	Description	Equivalent Circuit for Package
GND	Ground	IC backside must be connected to a DC/RF ground with high thermal and electrical conductivity.	
RF In	RF Input	This is the amplifier die RF Input port. It is internally DC blocked and RF matched to 50 Ω. RF input pad is GSG with 175 µm pitch.	
RF Out	RF Output	This is the amplifier die RF Output port. It is internally DC blocked and RF matched to 50 Ω. The RF output pad is GSG with 175 µm pitch. Must have less than 7:1 VSWR when operating with voltage greater than +5V on port VC.	
VB	Base Supply Port	Port VB is the current mirror DC voltage supply port that controls the collector current supplied to the amplifier. VB port voltage is proportional to VC port collector current. VB effectively functions as a gain control pin. See Typical Performance Plots for performance at different bias conditions.	
VC	Collector Supply Port	Pad VC is the amplifier IC's DC voltage supply pad. See section 3.6 for performance at different bias conditions.	

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)	7	V
Current Mirror Positive Bias Current (Ib)	4	mA
Current Mirror Positive Bias Voltage (VB)	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 (Ic)	90	mA
RF Input Power	16	dBm
Thermal Resistance, θJC	78	°C/W

Package Information

Parameter	Details	Rating
Dimensions	-	1.38 x 1.3 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 Current (Ic)	8	21	32	mA
Positive DC Voltage (VC)	3	5	6	V
Positive DC Current Mirror Current (Ib)	0.9	2	2.6	mA
Ambient Temperature	-40	25	85	°C
Positive DC Current Mirror Voltage (VB)	3	5	6	V

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 voltage greater 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.

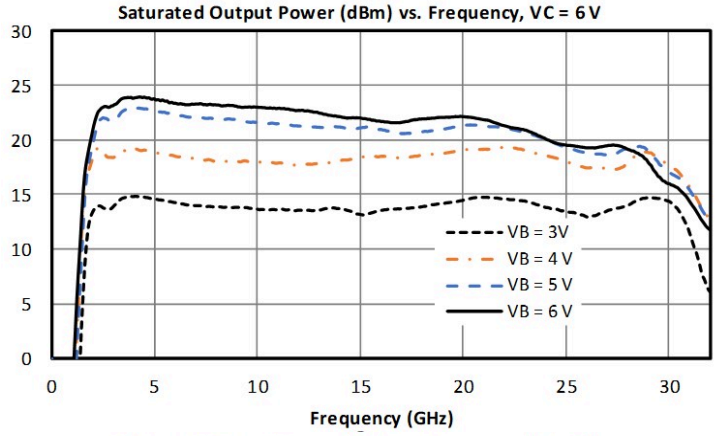
Parameter	Test Conditions	Minimum Frequency (GHz)	Maximum Frequency (GHz)	Min	Typ	Max	Unit
Collector Current, Ic [1]	5V/4V	-	-	-	13	-	mA
Collector Current, Ic [2]	5V/5V	-	-	-	21	-	mA
Collector Current, Ic [3]	5V/6V	-	-	-	32	-	mA
Current Mirror Current, Ib	5V/4V	-	-	-	1.5	-	mA
Current Mirror Current, Ib	5V/5V	-	-	-	2	-	mA
Current Mirror Current, Ib	5V/6V	-	-	-	2.6	-	mA
Input IP3	5V/5V bias, 15 dBm Input Power	2	29	-	10	-	dBm
Input Power for Saturation	5V/5V bias	2	29	-	10	-	dBm
Input Return Loss	5V/5V bias, -25 dBm Input Power	20	29	-	8	-	dB
Input Return Loss	5V/5V bias, -25 dBm Input Power	2	20	-	15	-	dB
Noise Figure	5V/5V bias, -25 dBm Input Power	2	26.5	-	5	-	dB
Output IP3	5V/5V bias, 15 dBm Input Power	2	29	-	21	-	dBm
Output P1dB	5V/5V bias	20	29	-	15	-	dBm
Output P1dB	5V/5V bias	2	20	-	20	-	dBm
Output Power [4]	5V/5V Bias, Input Driver (See footnote)	20	29	-	19	-	dBm
Output Power [5]	5V/5V Bias, Input Driver (See footnote)	2	20	19	21	-	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	-	11	-	dB
Phase Noise @ 10 kHz Offset	5V/5V bias, +9 dBm Input power	2	29	-	-170	-	dBc/Hz
Reverse Isolation	5V/5V bias, -25 dBm Input Power	2	29	-	41	-	dB
Small Signal Gain	5V/5V bias, -25 dBm Input Power	2	20	9	11	-	dB
Small Signal Gain	5V/5V bias, -25 dBm Input Power	20	29	-	10	-	dB

[1][2][3] Bias conditions for Ic and Ib tested with no RF input power. See section 3.6 for DC current vs. RF power. Bias conditions presented as VC/VB.
[4][5] Saturated Output Power tested with two APM-6849PA connected in series; +6 dBm RF input power, corresponding to ~+16 dBm into DUT.

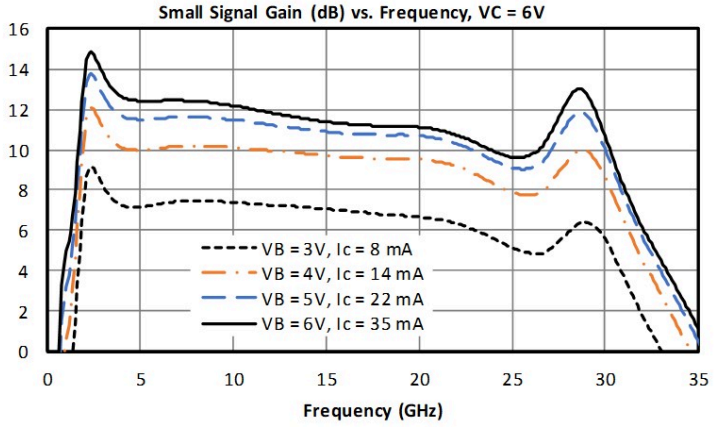
Typical Performance Plots

Probe tested on chip.

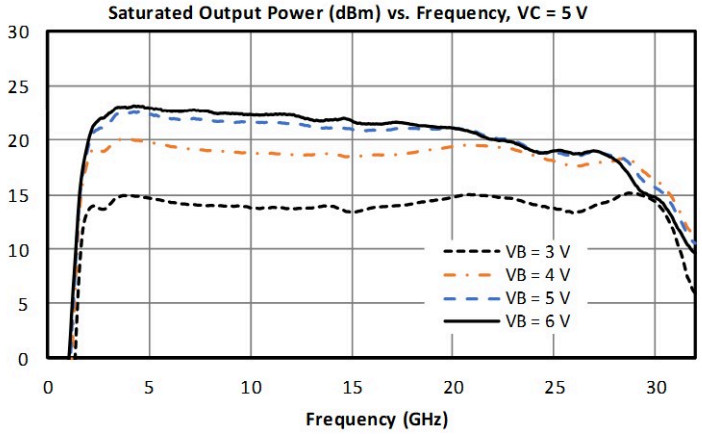
Saturated Output Power (dBm) vs. Frequency, VC = 6 V



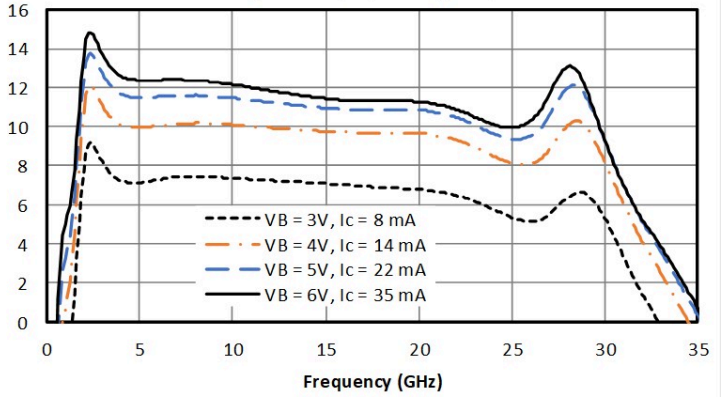
Small Signal Gain (dB) vs. Frequency, VC = 6V



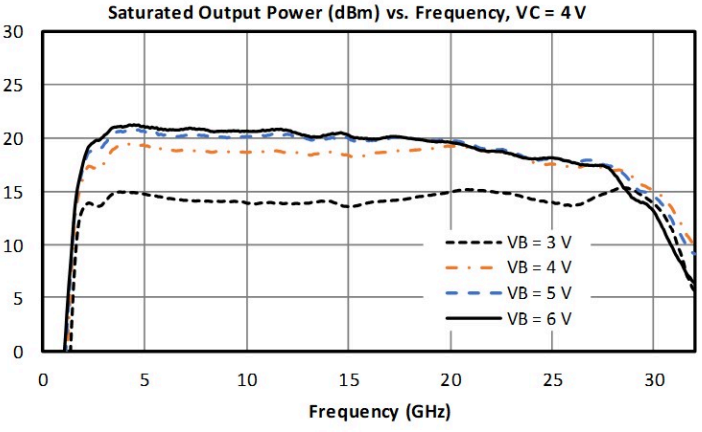
Saturated Output Power (dBm) vs. Frequency, VC = 5 V



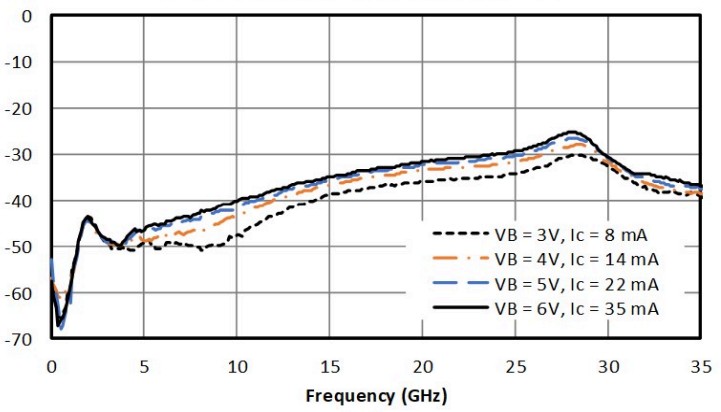
Small Signal Gain (dB) vs. Frequency, VC = 5V



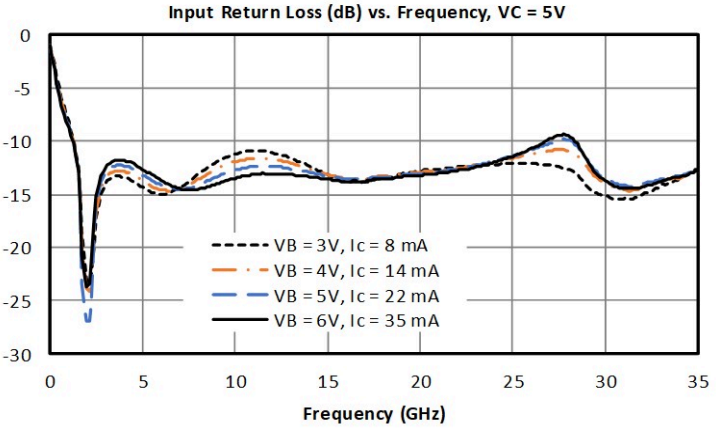
Saturated Output Power (dBm) vs. Frequency, VC = 4 V



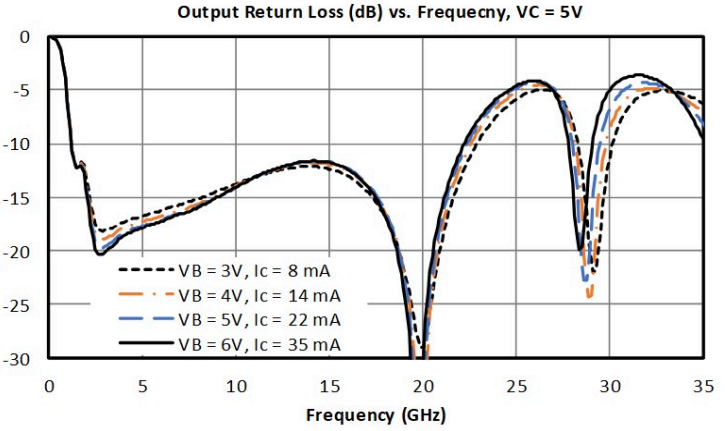
Reverse Isolation (dB) vs. Frequency, VC = 5V



Input Return Loss (dB) vs. Frequency, VC = 5V

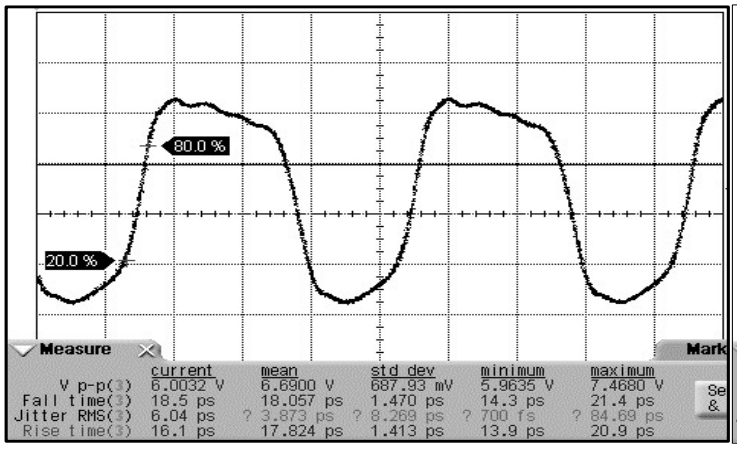


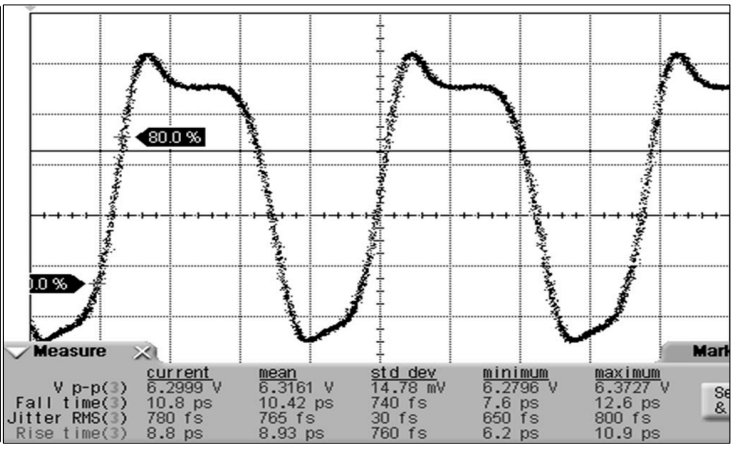
Output Return Loss (dB) vs. Frequecny, VC = 5V



Time Domain Plots

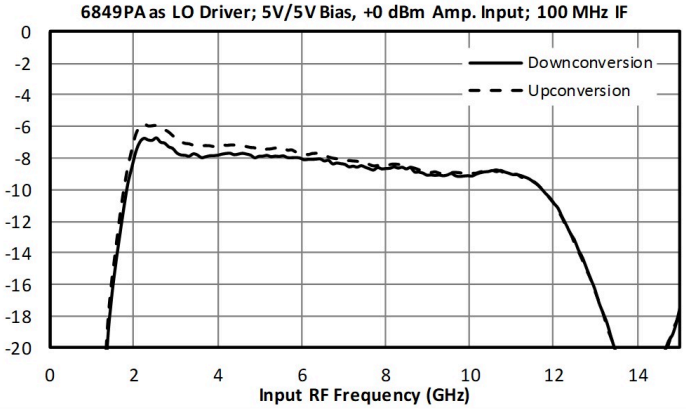
Fast rise time is desirable for linear Marki T3 mixer operation.



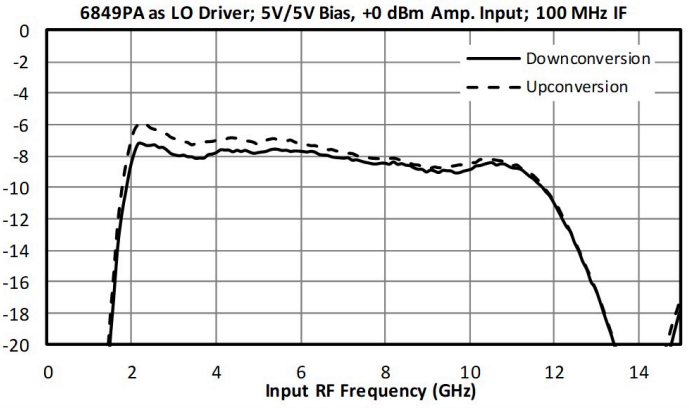


Typical Performance Plots of Marki Mixers Driven With APM-6849PA

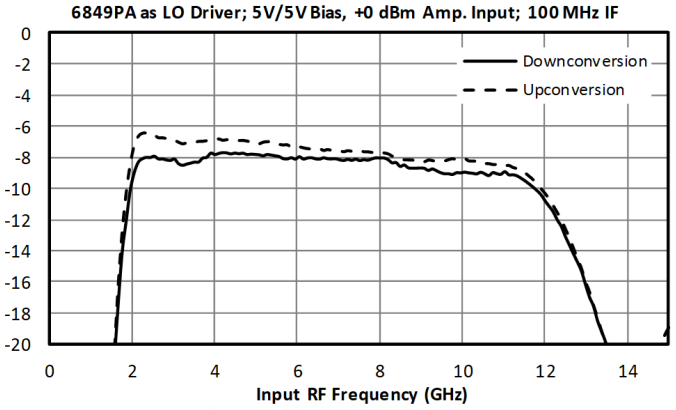
Conv. Loss (dB) of Marki MM1-0212L (Config. A) using two APM-6849PA as LO Driver; 5V/5V Bias, +0 dBm Amp. Input; 100 MHz IF



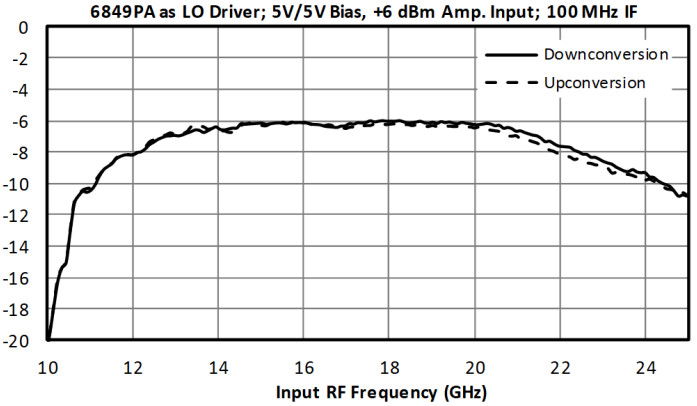
Conv. Loss (dB) of Marki MM1-0212H (Config. A); two series APM-6849PA as LO Driver; 5V/5V Bias, +0 dBm Amp. Input; 100 MHz IF



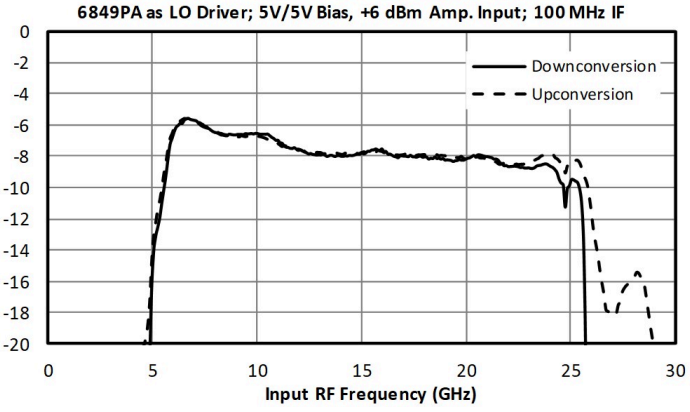
Conv. Loss (dB) of Marki MM1-0212S (Config. A); two series APM-6849PA as LO Driver; 5V/5V Bias, +0 dBm Amp. Input; 100 MHz IF



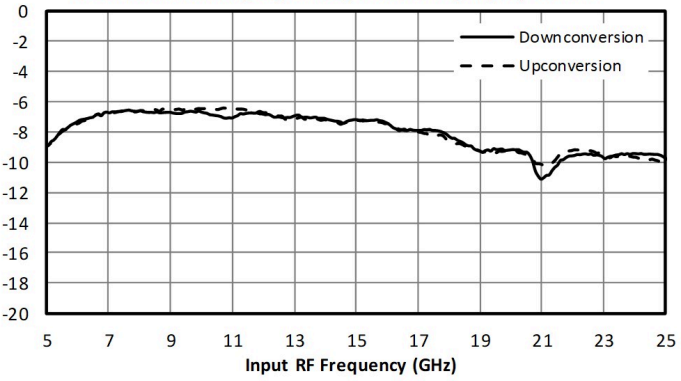
Conv. Loss (dB) of Marki MM1-1240S (Config. A); two series APM-6849PA as LO Driver; 5V/5V Bias, +6 dBm Amp. Input; 100 MHz IF



Conv. Loss (dB) of Marki MM1-0626S (Config. A); two series APM-6849PA as LO Driver; 5V/5V Bias, +6 dBm Amp. Input; 100 MHz IF



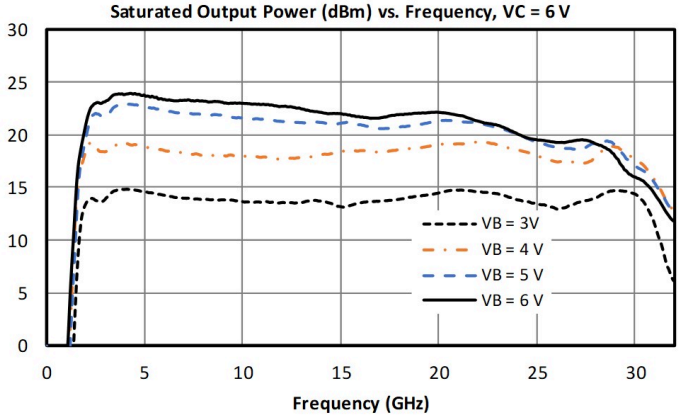
Conv. Loss (dB) of Marki MM1-0530L (Config. A) using two APM-6849PA as LO Driver; 5V/5V Bias, +0 dBm Amp. Input; 1 GHz IF



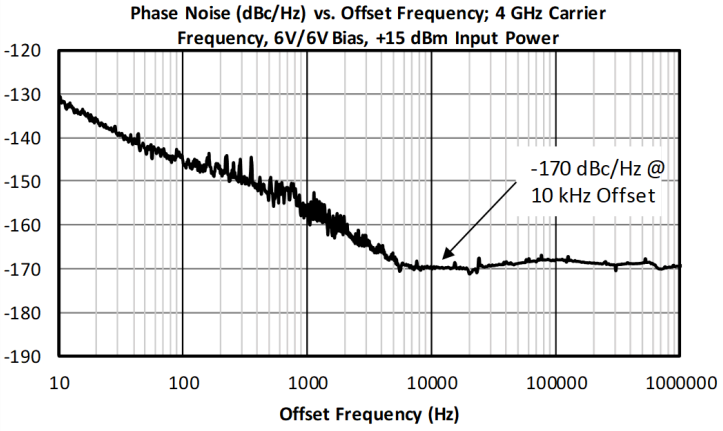
APM-6849PA - Typical Performance Plots

Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.

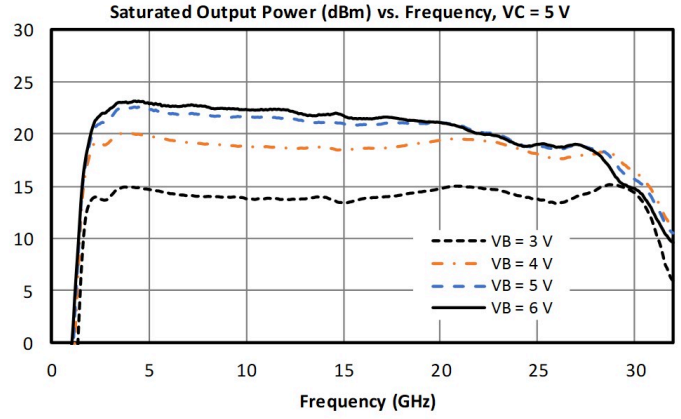
Saturated Output Power (dBm) vs. Frequency, VC = 6 V



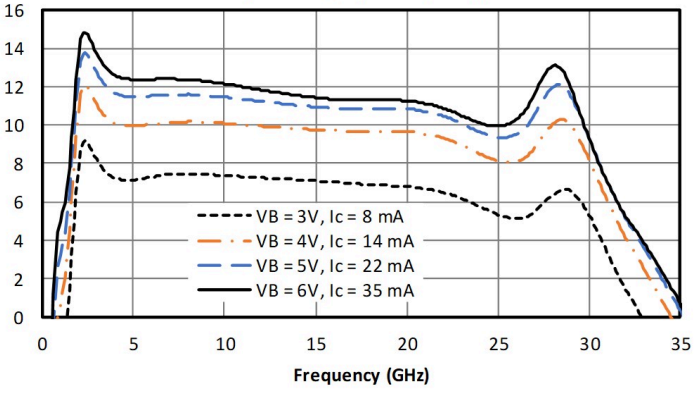
Phase Noise (dBc/Hz) vs. Offset Frequency; 4 GHz Carrier Frequency, 6V/6V Bias, +15 dBm Input Power



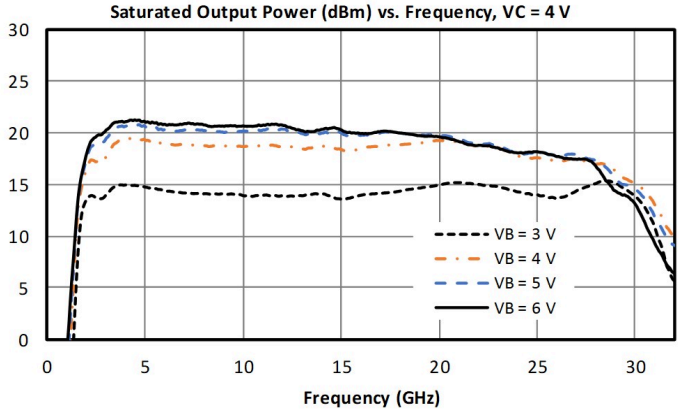
Saturated Output Power (dBm) vs. Frequency, VC = 5 V



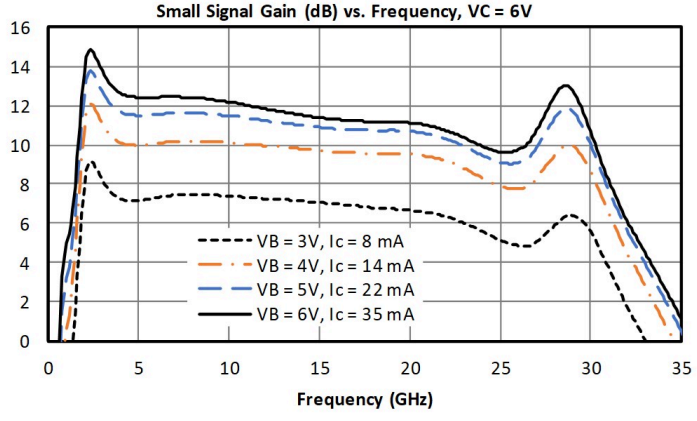
Small Signal Gain (dB) vs. Frequency, VC = 5V



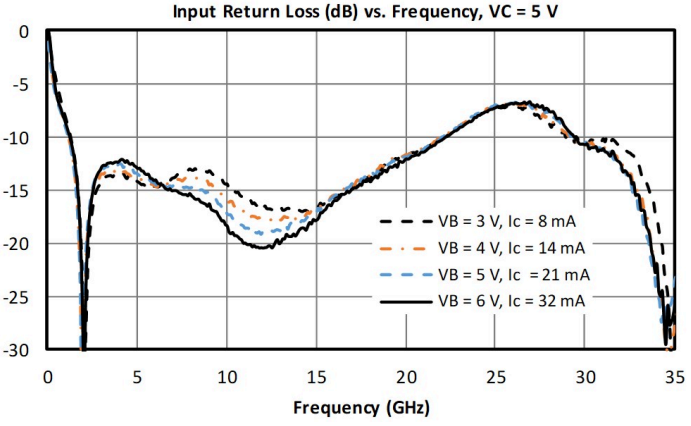
Saturated Output Power (dBm) vs. Frequency, VC = 4 V



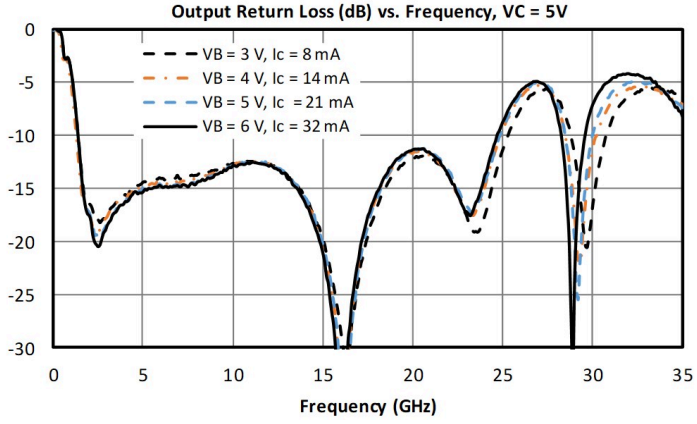
Small Signal Gain (dB) vs. Frequency, VC = 6V



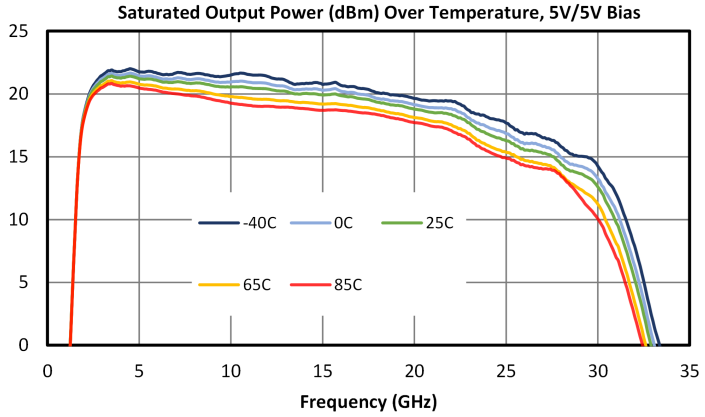
Input Return Loss (dB) vs. Frequency, VC = 5 V



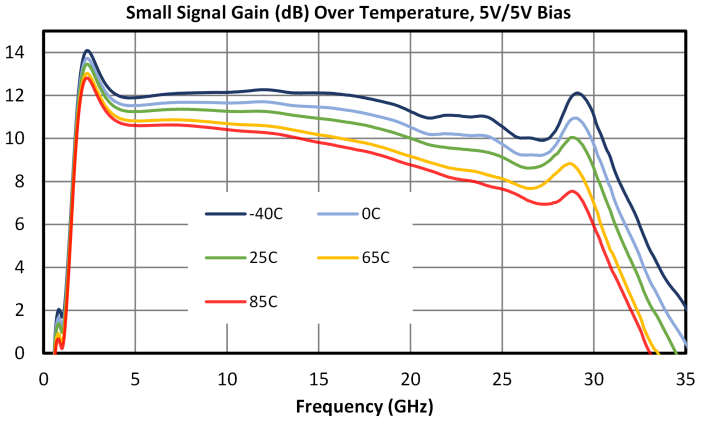
Output Return Loss (dB) vs. Frequency, VC = 5V



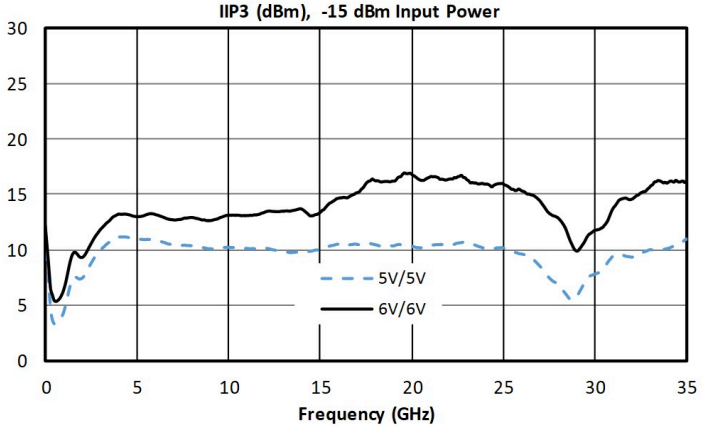
Saturated Output Power (dBm) Over Temperature, 5V/5V Bias



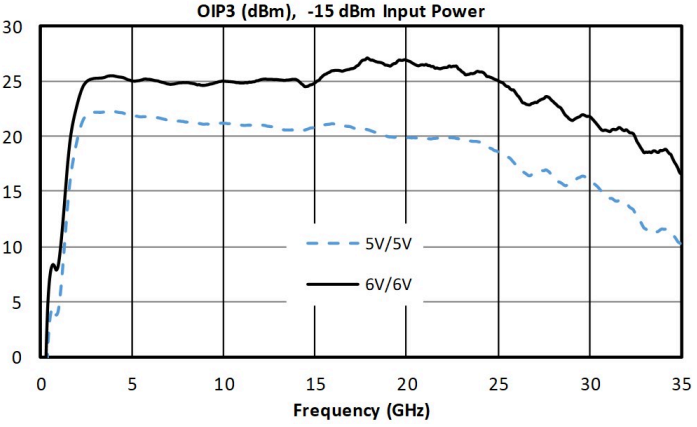
Small Signal Gain (dB) Over Temperature, 5V/5V Bias



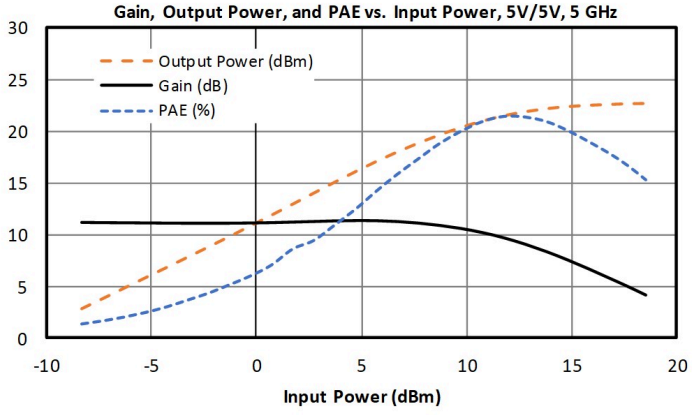
IIP3 (dBm), -15 dBm Input Power



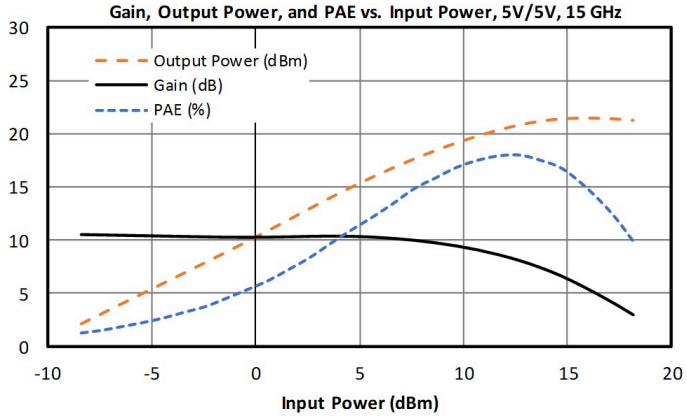
OIP3 (dBm), -15 dBm Input Power



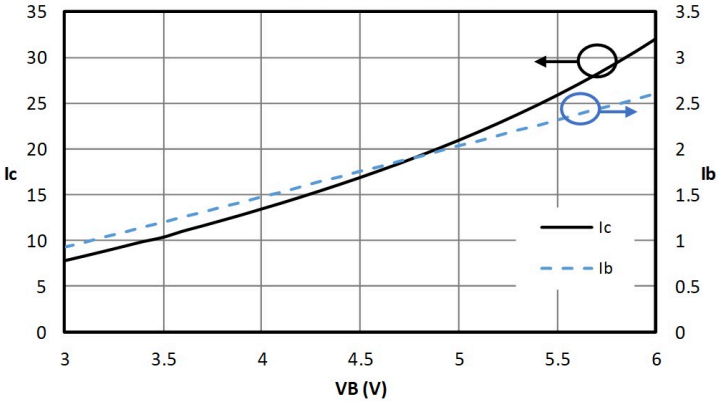
Gain, Output Power, and PAE vs. Input Power, 5V/5V, 5 GHz



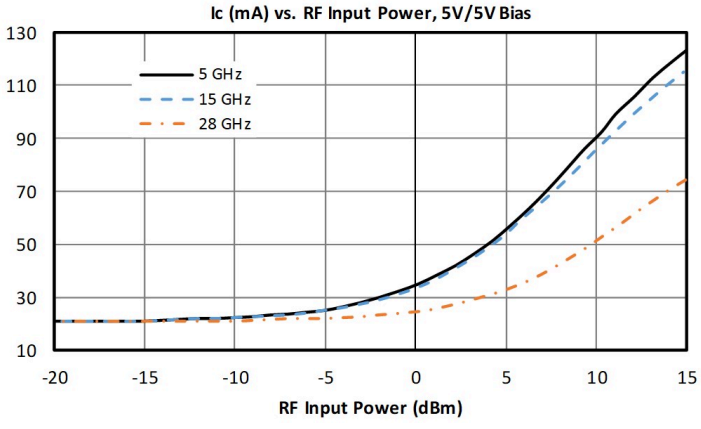
Gain, Output Power, and PAE vs. Input Power, 5V/5V, 15 GHz



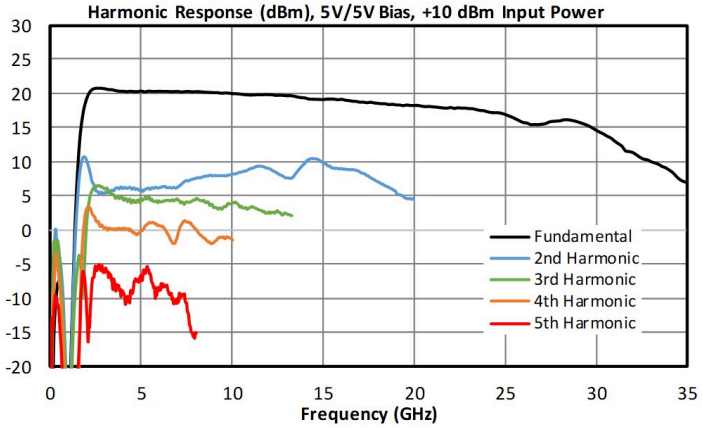
Ic, Ib (mA) vs. VB (VC = 5 V)



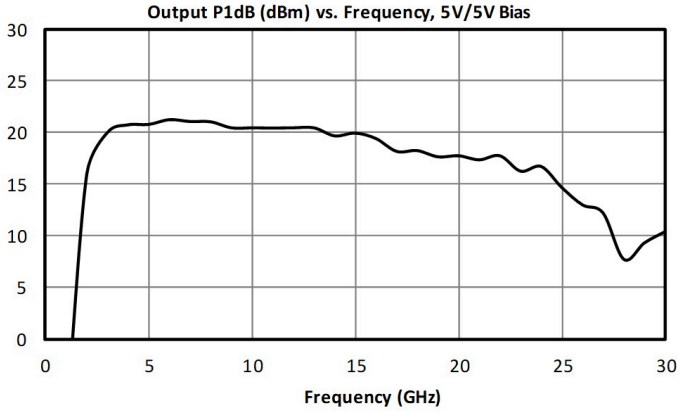
Ic (mA) vs. RF Input Power, 5V/5V Bias



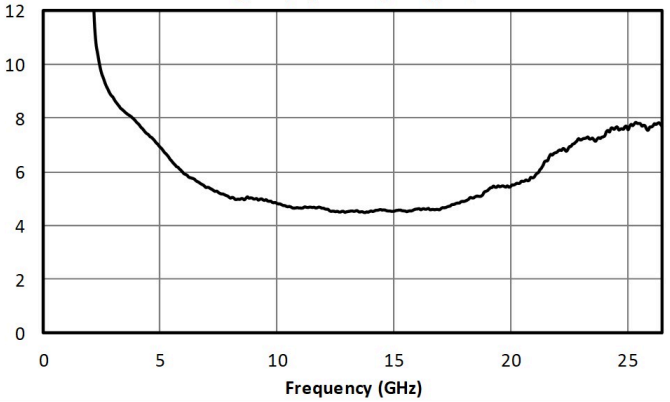
Harmonic Response (dBm), 5V/5V Bias, +10 dBm Input Power



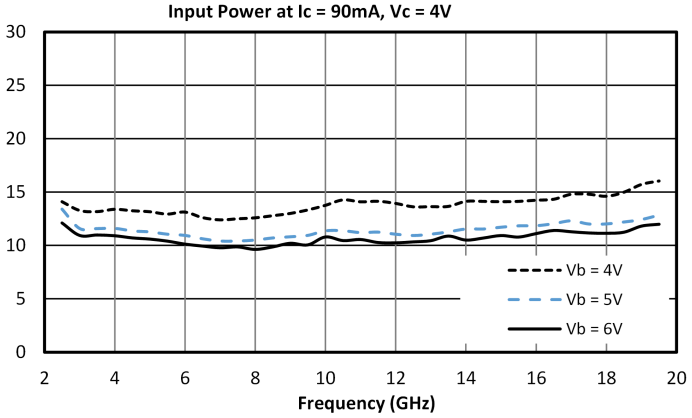
Output P1dB (dBm) vs. Frequency, 5V/5V Bias



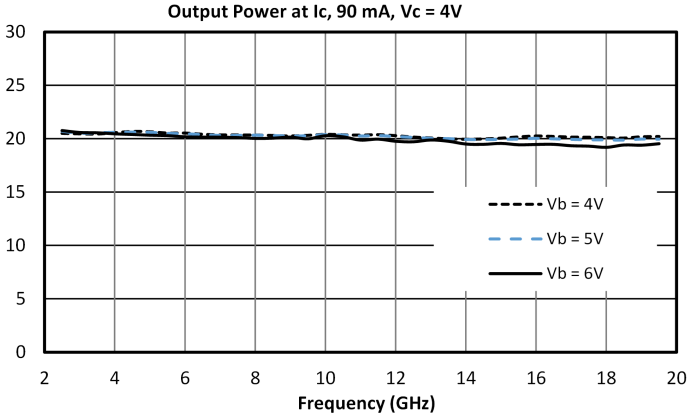
Noise Figure (dB) vs. Frequency, 5V/5V Bias



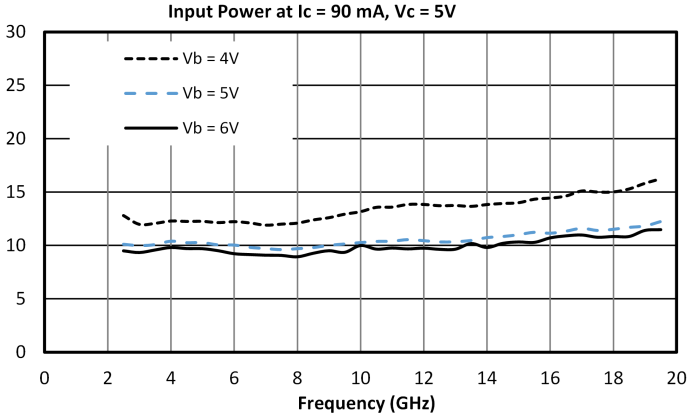
Input Power at Ic = 90mA, Vc = 4V



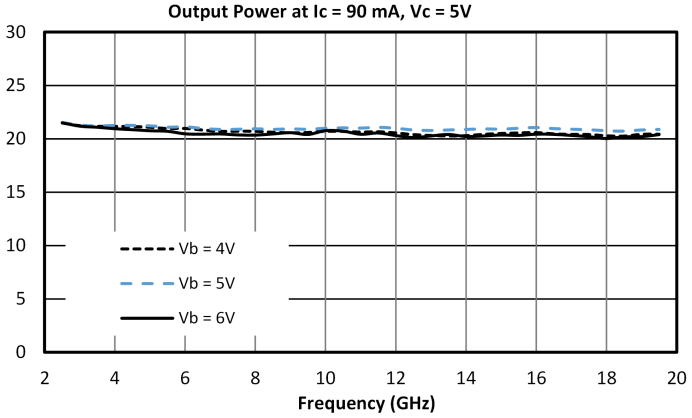
Output Power at Ic, 90 mA, Vc = 4V



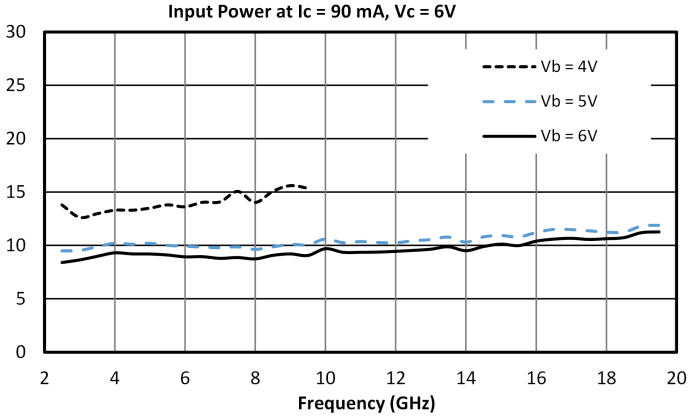
Input Power at Ic = 90 mA, Vc = 5V

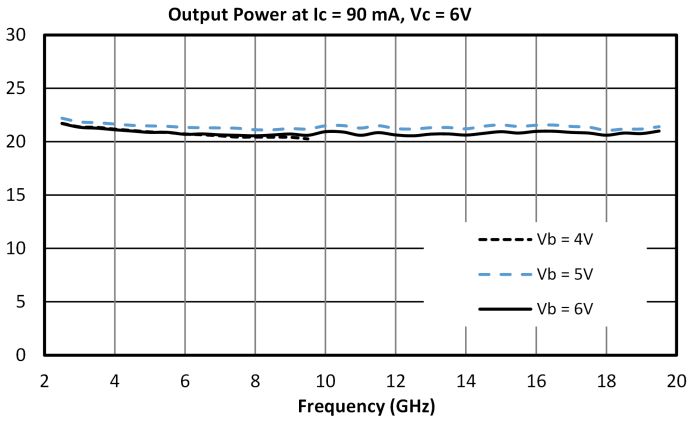


Output Power at Ic = 90 mA, Vc = 5V



Input Power at Ic = 90 mA, Vc = 6V

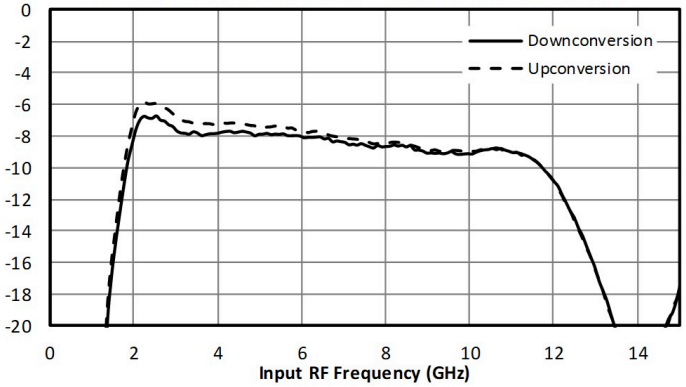




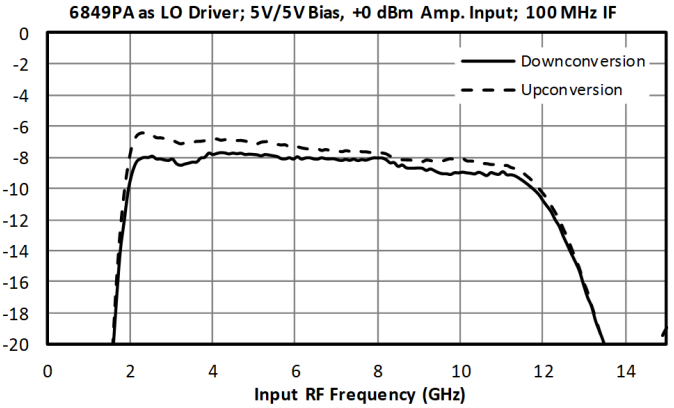
APM-6849PA - Typical Performance Plots of Marki Mixers Driven with APM-6849PA

Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.

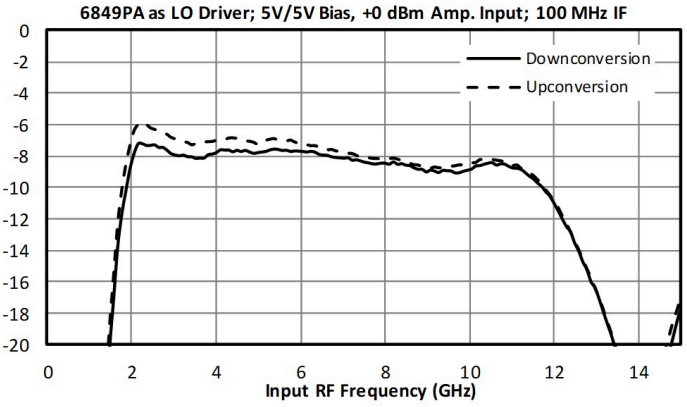
Conv. Loss (dB) of Marki MM1-0212L (Config. A) using two APM-6849PA as LO Driver; 5V/5V Bias, +0 dBm Amp. Input; 100 MHz IF



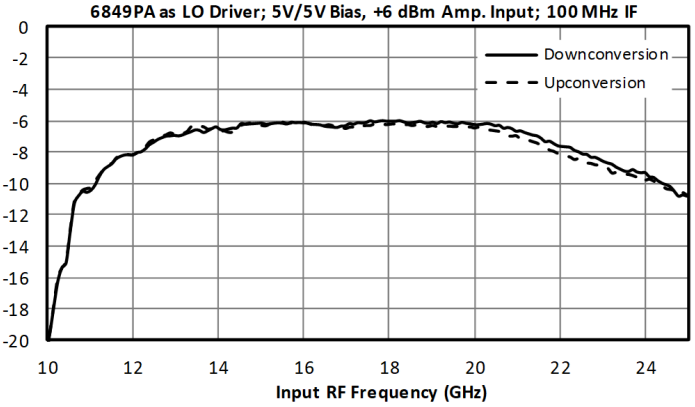
Conv. Loss (dB) of Marki MM1-0212S (Config. A); two series APM-6849PA as LO Driver; 5V/5V Bias, +0 dBm Amp. Input; 100 MHz IF



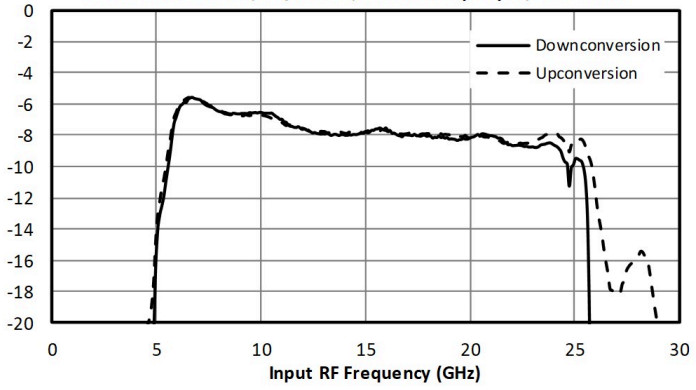
Conv. Loss (dB) of Marki MM1-0212H (Config. A); two series APM-6849PA as LO Driver; 5V/5V Bias, +0 dBm Amp. Input; 100 MHz IF



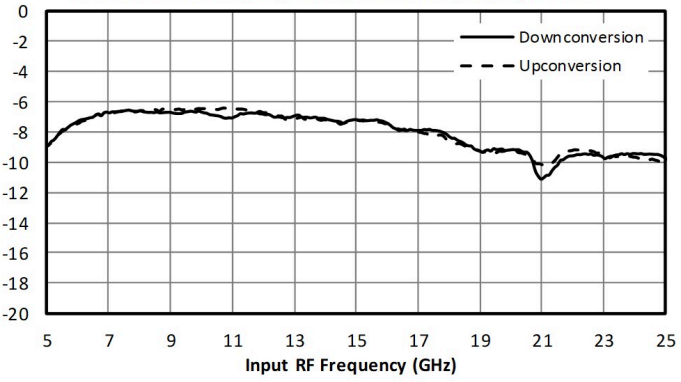
Conv. Loss (dB) of Marki MM1-1240S (Config. A); two series APM-6849PA as LO Driver; 5V/5V Bias, +6 dBm Amp. Input; 100 MHz IF



Conv. Loss (dB) of Marki MM1-0626S (Config. A); two series APM-6849PA as LO Driver; 5V/5V Bias, +6 dBm Amp. Input; 100 MHz IF



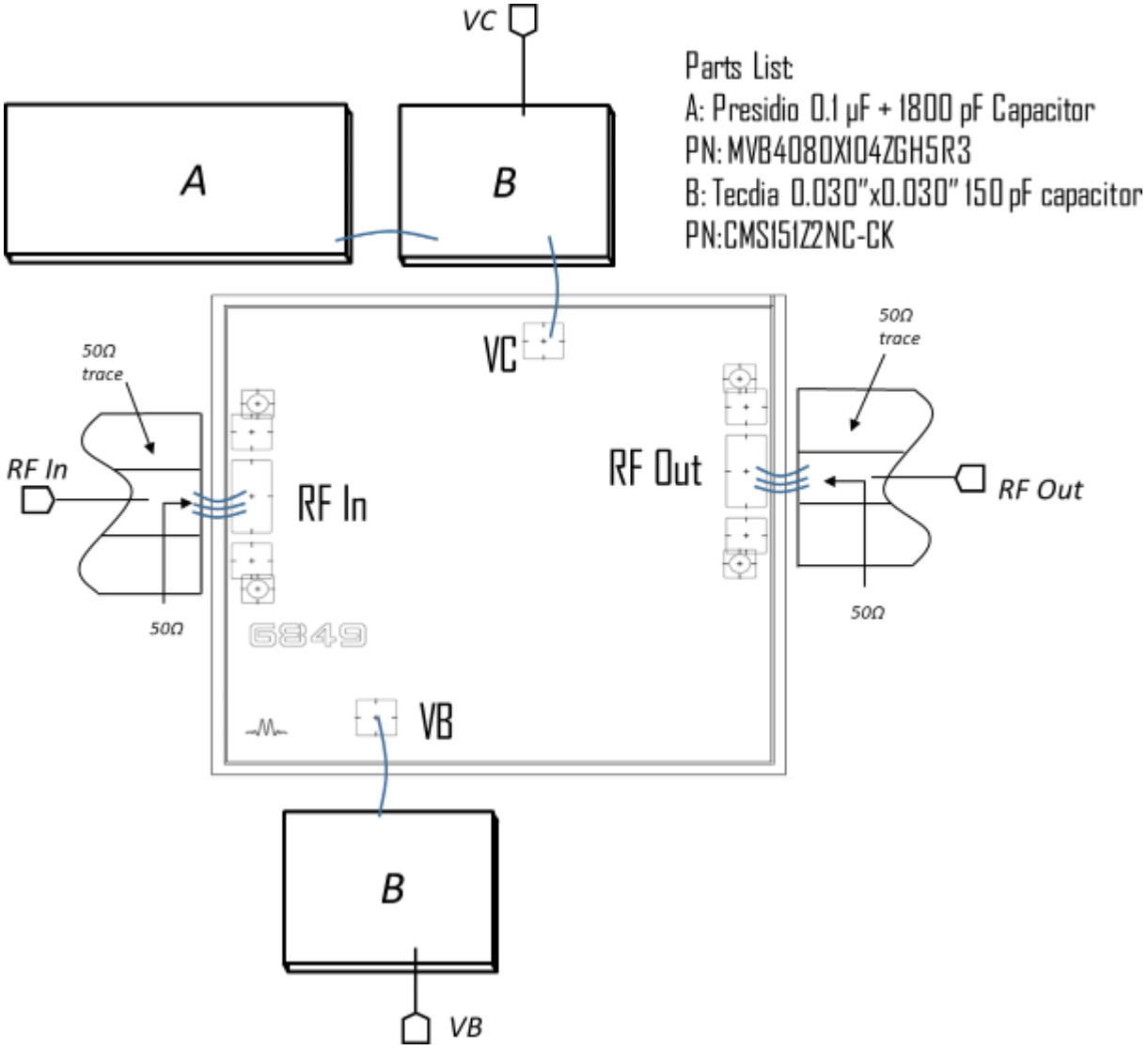
Conv. Loss (dB) of Marki MM1-0530L (Config. A) using two APM-6849PA as LO Driver; 5V/5V Bias, +0 dBm Amp. Input; 1 GHz IF



Application Information

Below is the recommended application circuit for the APM-6849CH.

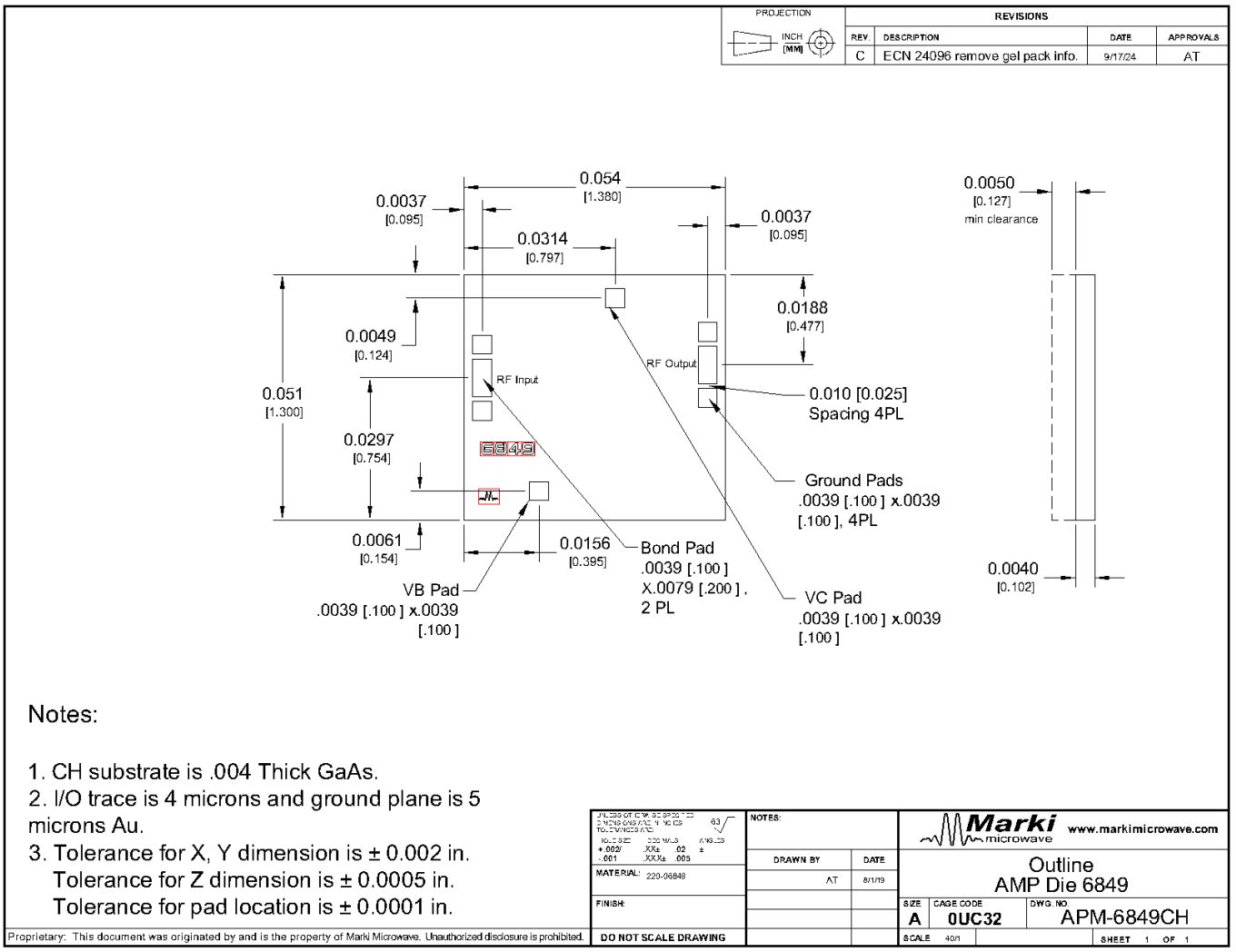
Application Circuit



Mechanical Data

Outline Drawing

Download : Outline 2D Drawing



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