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Tech Support: support@markimicrowave.com

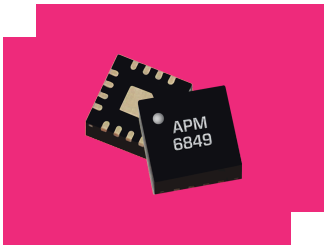
APM-6849SM

2-30 GHz Surface Mount Low Phase Noise Amplifier

DEVICE OVERVIEW

General Description

The APM-6849SM is a single stage broadband, low phase noise pre-amplifier designed to provide 11 dB typical gain packaged in a 3 mm QFN with low current consumption. This amplifier uses GaAs HBT technology for low phase noise, and provides industry leading 170 dBc/Hz at 10 kHz offset from carrier frequency. It offers low power dissipation while providing sufficient gain and power to drive a saturated LO driver amplifier such as the APM-7516SM, APM-7098SM, or APM-7099SM.



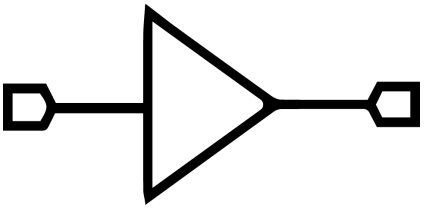
Features

- -170 dBc/Hz phase noise at 10 kHz offset frequency
- 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
- Pre-amplifier for saturated LO driver amplifiers
- Suitable as a T3 mixer LO pre-amplifier
- 5G transceivers
- SATCOM
- Radar

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Packing Size	Green Status	Product Lifecycle	Export Classification
APM-6849SM	2-30 GHz Surface Mount Low Phase Noise Amplifier	QFN	-	REACH RoHS	Released	EAR99
EVAL-APM-6849SM	Evaluation Board, Low Phase Noise 2 – 30 GHz Amplifier	EVAL	-	REACH RoHS	Released	EAR99
APM-6849-TR	Tape and Reel, 2-30 GHz Surface Mount Low Phase Noise Amplifier	QFN	7"	REACH RoHS	Released	EAR99

APM-6849SM

2-30 GHz Surface Mount Low Phase Noise Amplifier

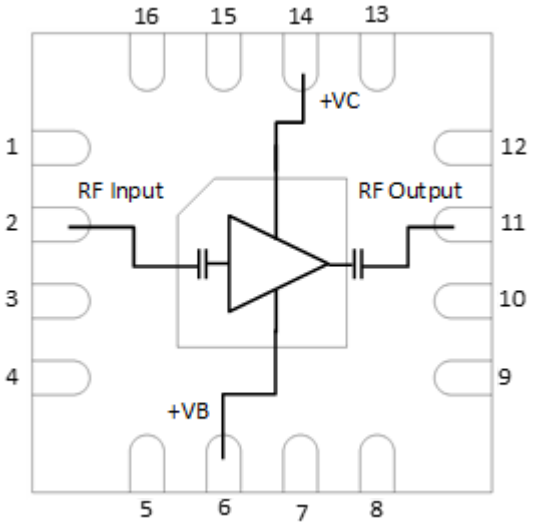
Table Of Contents

Revision History

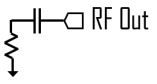
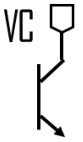
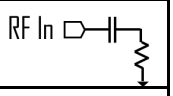
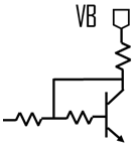
Revision Code	Revision Date	Comment
-	2019-11-01	Datasheet Initial Release
A	2020-05-01	Updated EVAL board outline
B	2020-07-01	Updated Small Signal Gain Min Spec
C	2020-07-01	Updated Max Operating Temperature
D	2020-10-01	Updated Min Specs and Input Power for Saturation
E	2020-11-01	Updated Thermal Specs and Min Specs, added link
F	2022-01-01	Updated device description, input power limit, and plots

Port Configuration and Functions

Port Diagram



Port Functions

Port	Function	Description	Equivalent Circuit for Package
11	RF Output	Pin 11 is the amplifier die RF Output port. It is internally DC blocked and RF matched to 50 Ω. Must have less than 7:1 VSWR when operating with voltage greater than 5V on VC.	
14	Collector Supply Port	Pin 14 is the amplifier IC's DC voltage supply pad. See section 3.6 for performance at different bias conditions.	
2	RF Input	This is the amplifier die RF Input port. It is internally DC blocked and RF matched to 50 Ω.	
6	Base Supply Port	Pin 6 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 section 3.6 for performance at different bias conditions.	
GND	Ground	Pin 11 is the amplifier die RF Output port. It is internally DC blocked and RF matched to 50 Ω. Must have less than 7:1 VSWR when operating with voltage greater than 5V on VC.	

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
θJC	78	°C/W

Package Information

Parameter	Details	Rating
Dimensions	-	3 x 3 mm
Moisture Sensitivity Level	-	MSL 1

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 Mirror Current (Ib)	0.9	2	2.6	mA
Ambient Temperature	-40	25	85	°C
Positive DC Current (Ic)	8	21	32	mA
Positive DC Voltage (VC)	3	5	6	V
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.
Collector current must be strictly limited to 90 mA for reliable operation.

Electrical Specifications

The electrical specifications apply at TA=+25°C in a 50Ω system. QFNs are 100% RF tested.

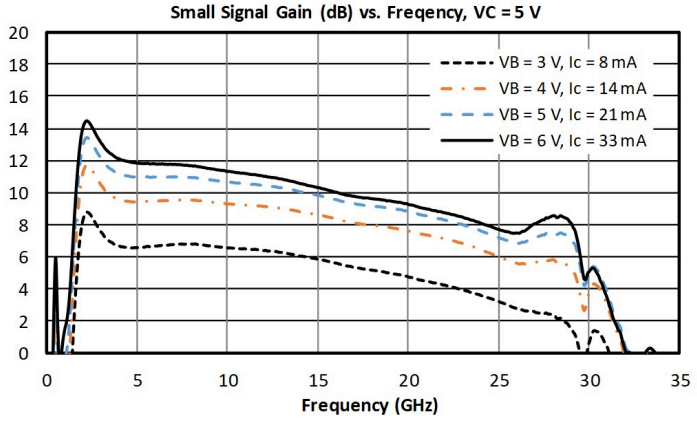
Parameter	Test Conditions	Minimum Frequency (GHz)	Maximum Frequency (GHz)	Min	Typ	Max	Unit
Collector Current, Ic [1]	5V/4V	-	-	-	13	-	mA
Collector Current, Ic [2]	5V/5V	-	-	-	21	-	mA
Collector Current, Ic [3]	5V/6V	-	-	-	32	-	mA
Input IP3	5V/5V bias, -15 dBm Input Power	2	30	-	11	-	dBm
Input Return Loss	5V/5V bias, -25 dBm Input Power	20	30	-	15	-	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	30	-	20	-	dBm
Output P1dB	5V/5V bias	2	20	-	20	-	dBm
Output P1dB	5V/5V bias	20	30	-	14	-	dBm
Output Power	5V/5V bias, Ic=90mA	2	20	-	21	-	dBm
Output Return Loss	5V/5V bias, -25 dBm Input Power	20	30	-	8	-	dB
Output Return Loss	5V/5V bias, -25 dBm Input Power	2	20	-	16	-	dB
Phase Noise @ 10 kHz Offset	5V/5V bias, +9 dBm Input power	2	30	-	-170	-	dBc/Hz
Reverse Isolation	5V/5V bias, -25 dBm Input Power	2	30	-	42	-	dB
Small Signal Gain	5V/5V bias, -25 dBm Input Power	20	30	-	7.5	-	dB
Small Signal Gain	5V/5V bias, -25 dBm Input Power	2	20	8	11	-	dB

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

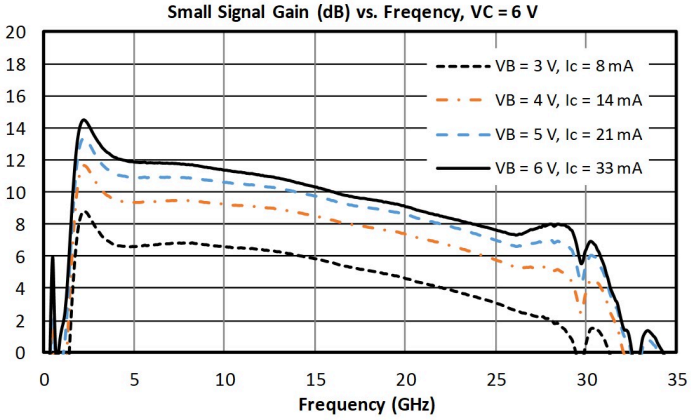
Typical Performance Plots

APM-6849SM measurements taken in EVAL-APM-6849 evaluation board.

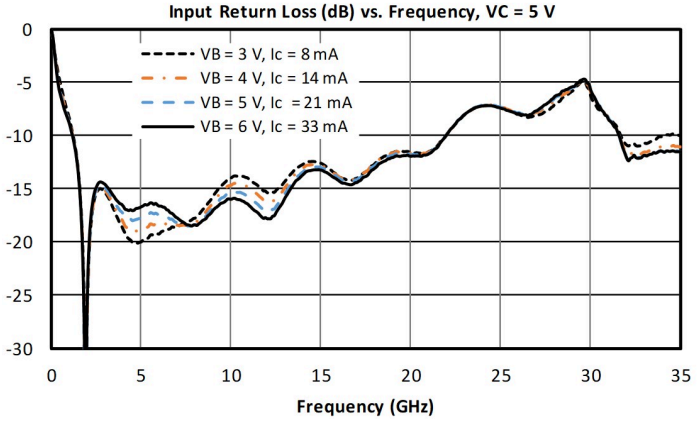
Small Signal Gain (dB) vs. Freqency, VC = 5 V



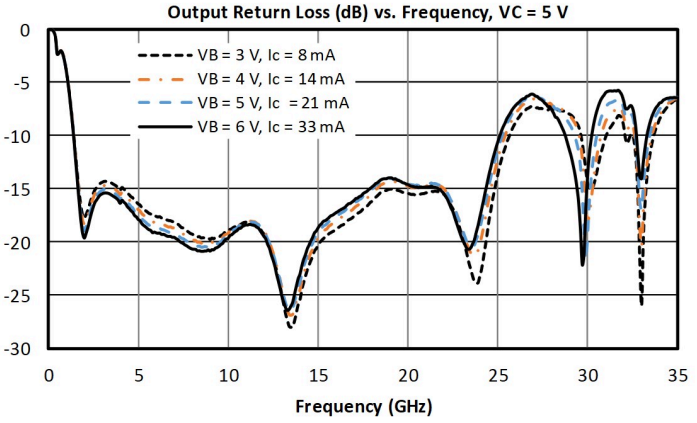
Small Signal Gain (dB) vs. Freqency, VC = 6 V



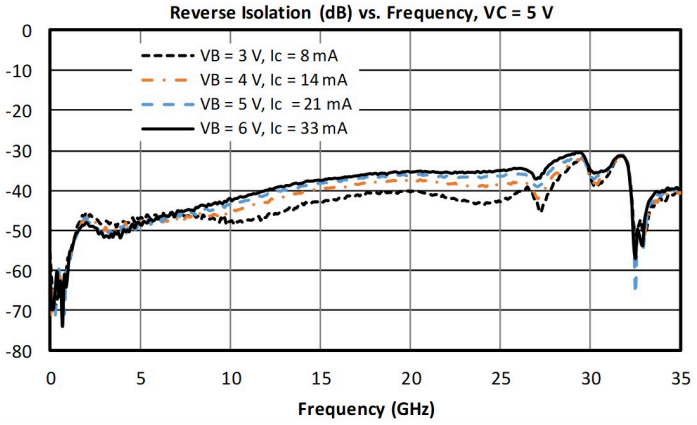
Input Return Loss (dB) vs. Frequency, VC = 5 V



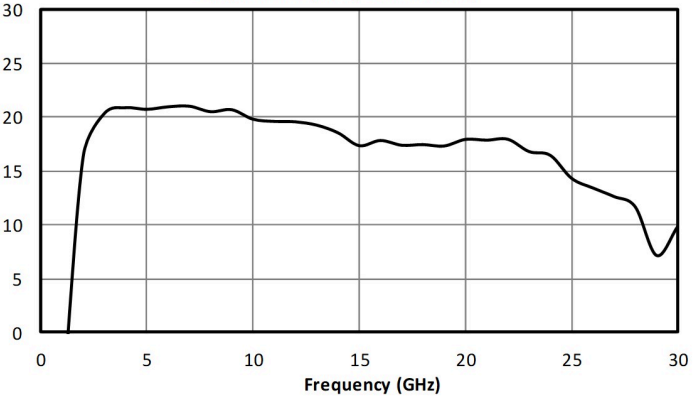
Output Return Loss (dB) vs. Frequency, VC = 5 V



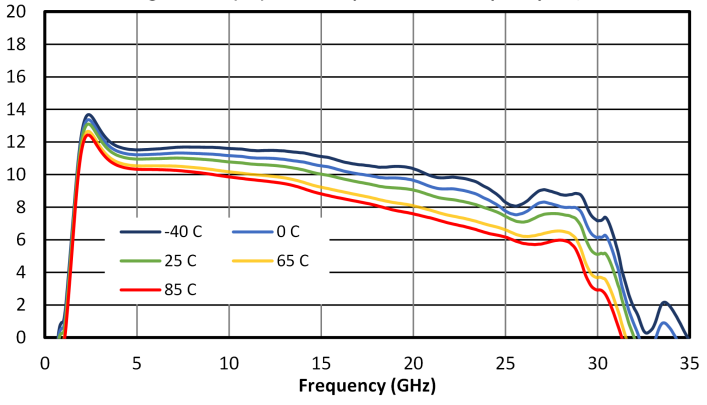
Reverse Isolation (dB) vs. Frequency, VC = 5 V



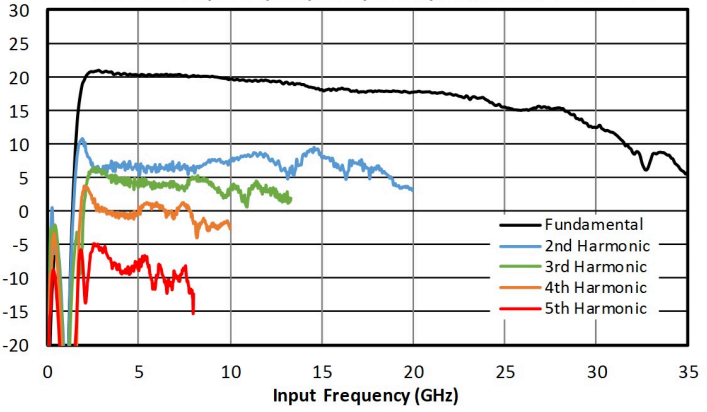
Output P1dB (dBm) vs. Frequency



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



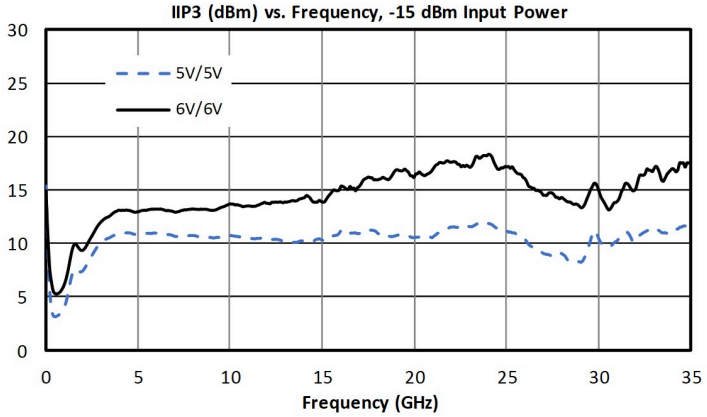
Harmonic Response (dBm) vs. Input Freq., 5V/5V Bias, +10 dBm Pin



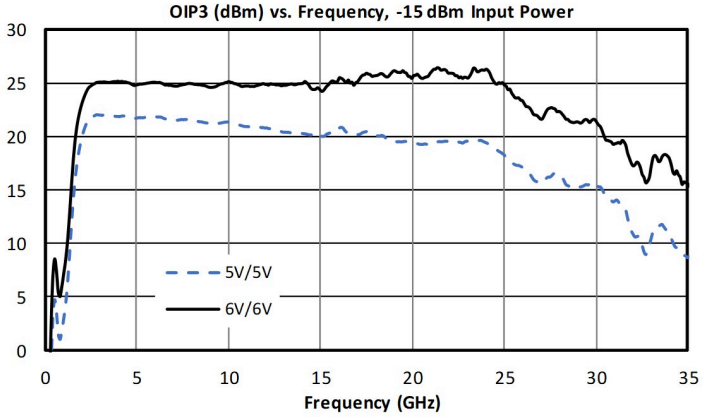
APM-6849SM

2-30 GHz Surface Mount Low Phase Noise Amplifier

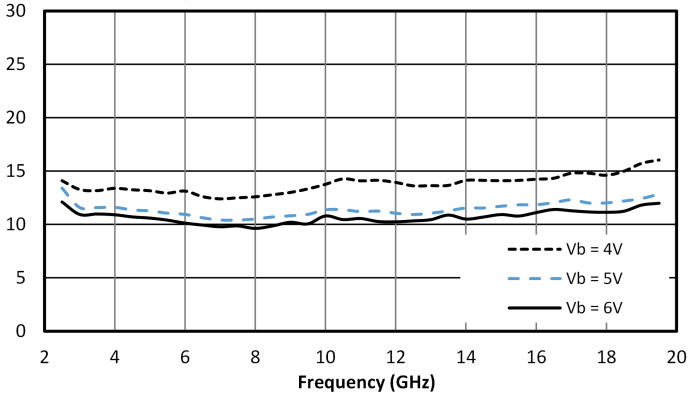
IIP3 (dBm) vs. Frequency, -15 dBm Input Power



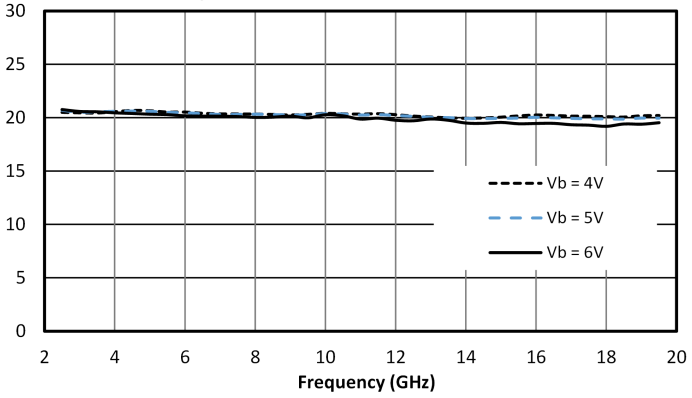
OIP3 (dBm) vs. Frequency, -15 dBm Input Power



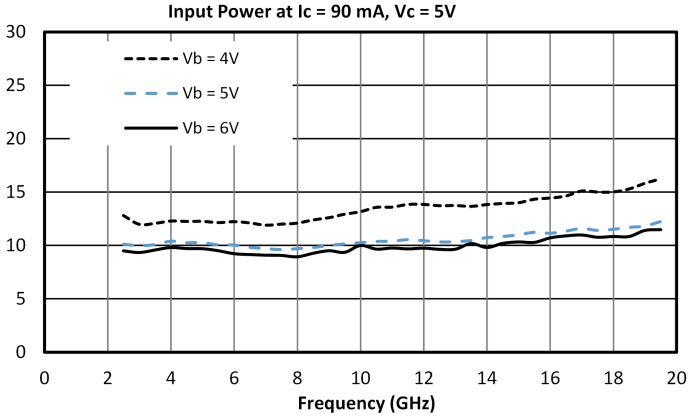
Input Power at Ic = 90mA, Vc = 4V



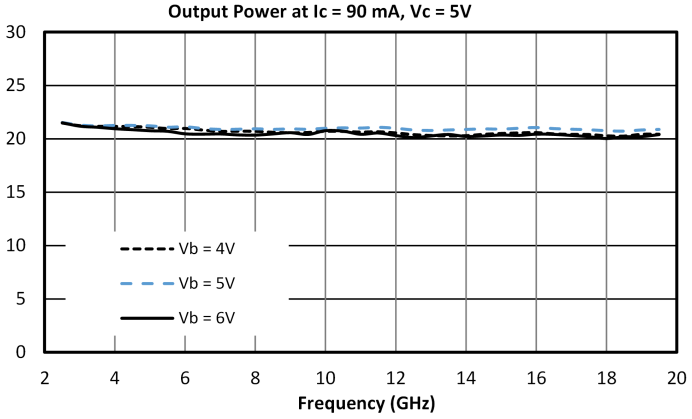
Output Power at Ic, 90 mA, Vc = 4V



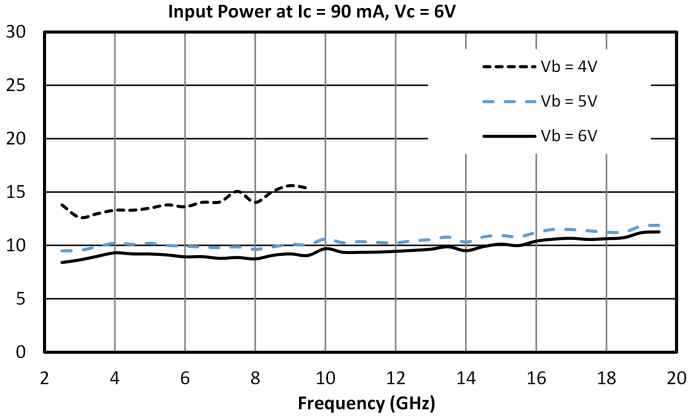
Input Power at Ic = 90 mA, Vc = 5V



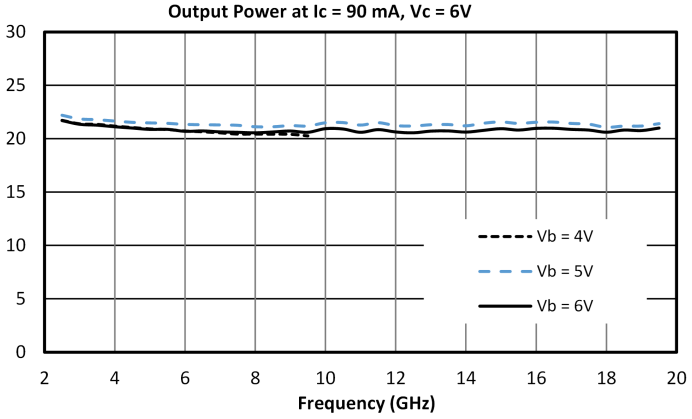
Output Power at Ic = 90 mA, Vc = 5V



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

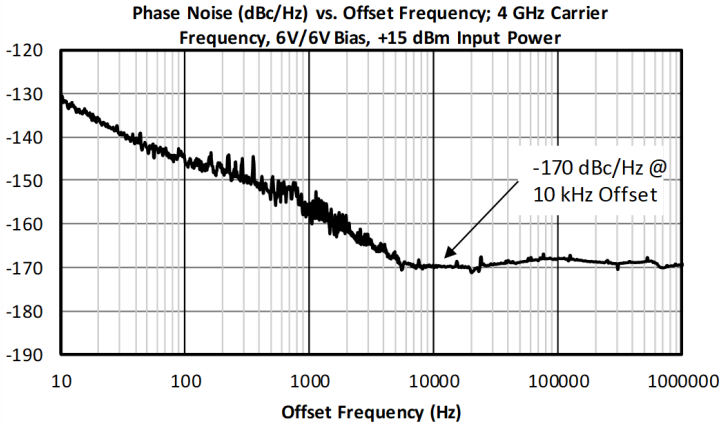


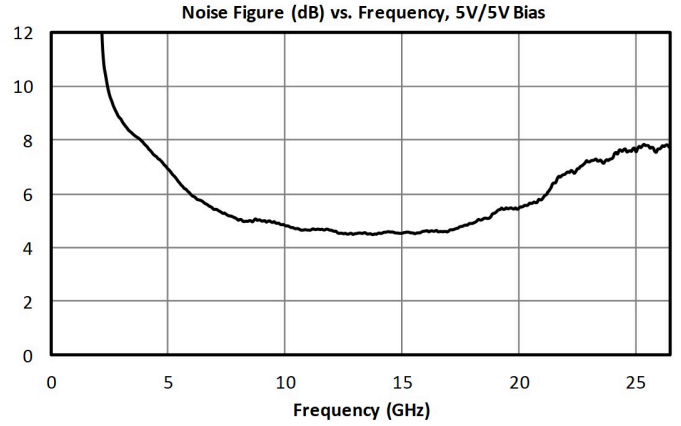
Output Power at Ic = 90 mA, Vc = 6V

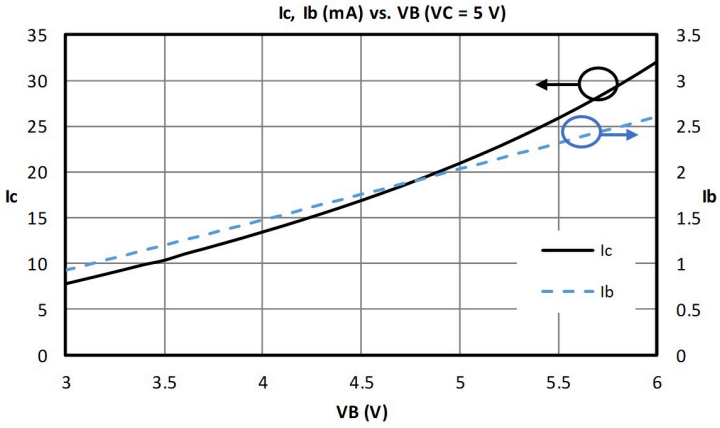


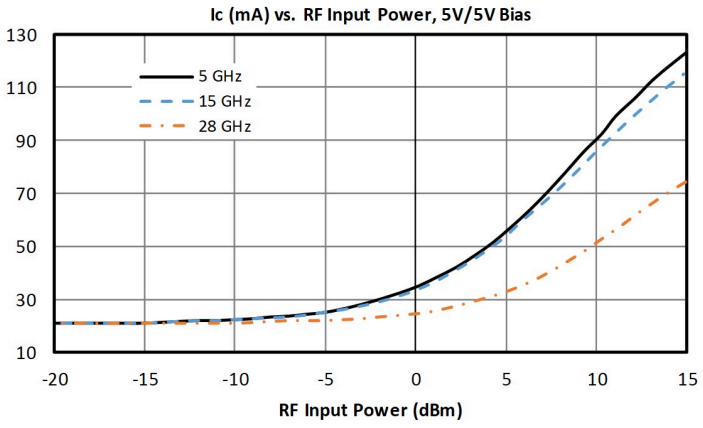
Connectorized Module APM-6849PA Performance Plots

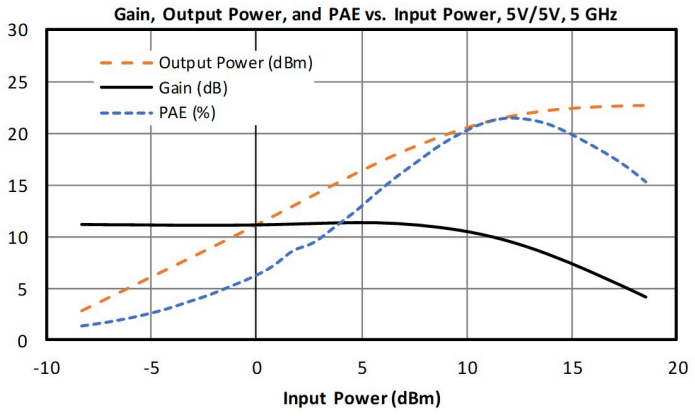
Surface mount module APM-6849SM performance is expected to be similar to connectorized module performance.

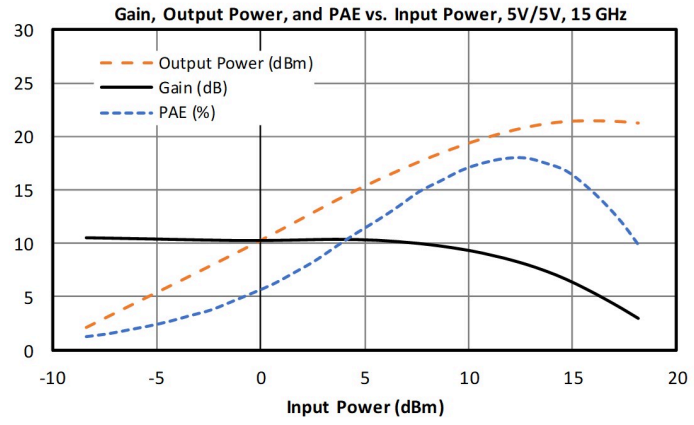






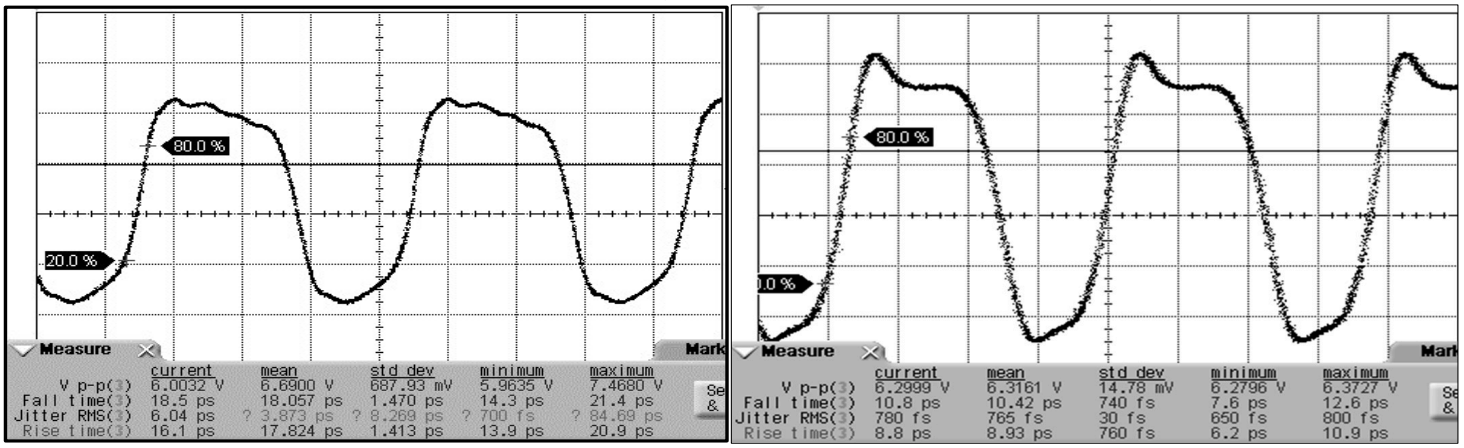




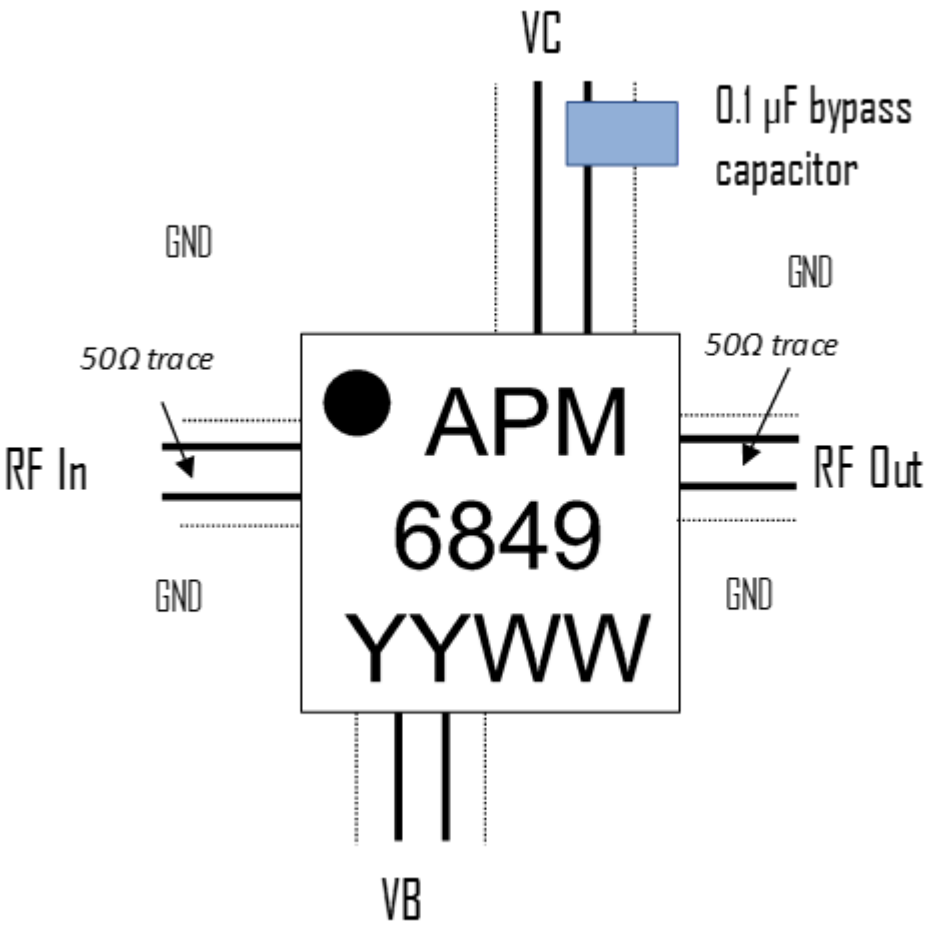


Time Domain Plots

Fast rise time is desirable for linear T3 mixer operation. (5GHz on the left and 10GHz on the right)



Application Circuit



Application Circuit Description

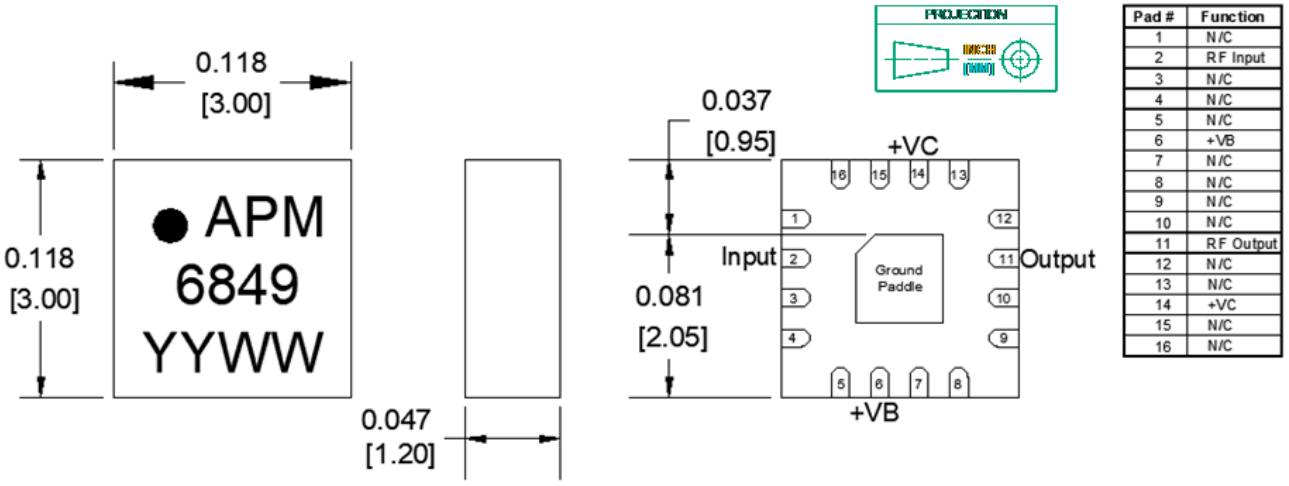
RF input and output should be soldered to 50 Ω traces. This is a single stage amplifier, and feedback oscillations are unlikely to occur. However, a bypass capacitance to ground on the VC supply line is recommended for consistent RF performance.

Note that Collector current must be strictly limited to 90 mA for reliable operation.

Mechanical Data

Outline Drawing

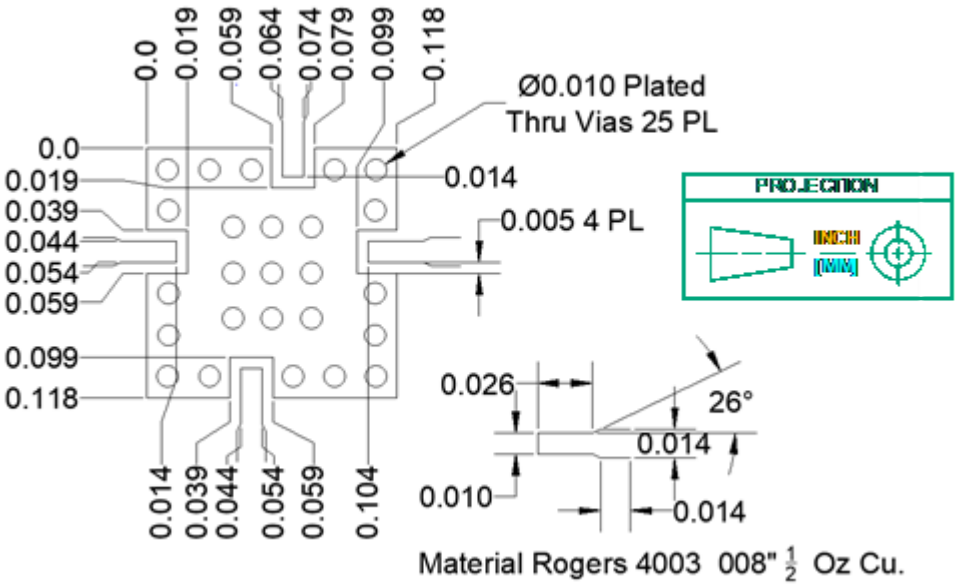
Download : Outline 2D Drawing | Outline 3D Drawing | Outline 3D STP



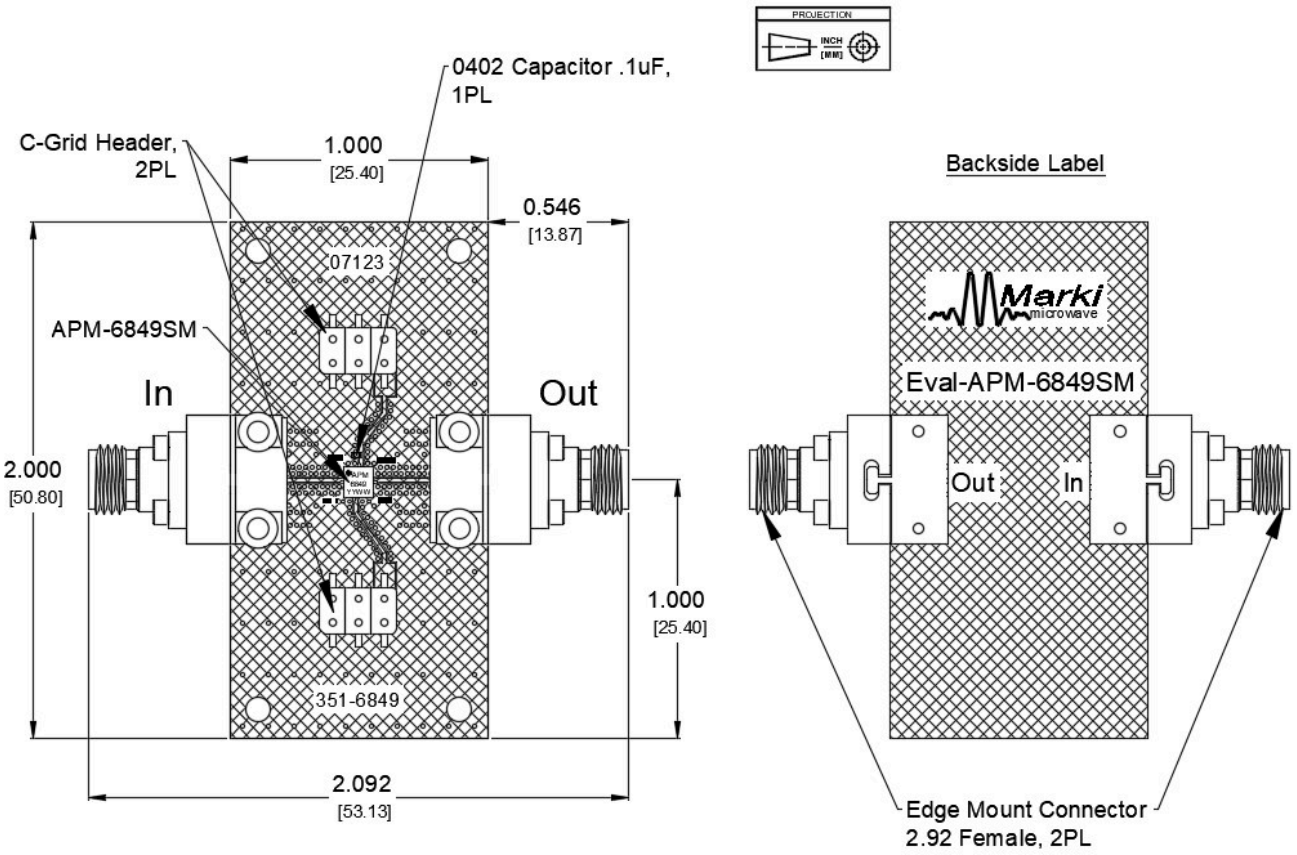
Pad #	Function
1	N/C
2	RF Input
3	N/C
4	N/C
5	N/C
6	+VB
7	N/C
8	N/C
9	N/C
10	N/C
11	RF Output
12	N/C
13	N/C
14	+VC
15	N/C
16	N/C

Footprint Image

Download : Footprint Drawing



Evaluation Board - Outline Drawing



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