

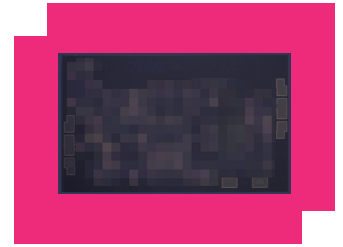
# APM-7099CH

## 0.01GHz – 20 GHz Low Phase Noise Amplifier

### DEVICE OVERVIEW

#### General Description

The APM-7099 is a broadband distributed, low phase noise driver amplifier designed to provide a saturated +25 dBm output power with low DC power consumption. This amplifier uses GaAs HBT technology for low phase noise, and is optimized to drive our NLTL multiplier line. It can also provides sufficient power to drive the LO port of an S-diode mixer from 10 MHz to 15 GHz or of an H or L diode mixer from 10 MHz to 20 GHz. This amplifier can be operated with a variety of bias conditions for both low power and high-power applications.



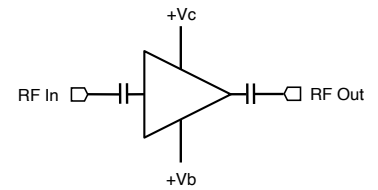
#### Features

- -167 dBc/Hz phase noise at 10 kHz offset frequency
- +25 dBm output power
- Low DC power consumption
- Positive-only biasing
- No sequencing required
- Unconditionally stable

#### Applications

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

#### Functional Block Diagram



#### Part Ordering Options

Part Number	Description	Package	Connectors	Green Status	Product Lifecycle	Export Classification
<a href="#">APM-7099PA</a>	0.01GHz – 20 GHz Low Phase Noise Amplifier	PA	<a href="#">Standard</a>	REACH RoHS	Released	EAR99
APM-7099CH	0.01GHz – 20 GHz Low Phase Noise Amplifier	CH	-	REACH RoHS	Released	EAR99

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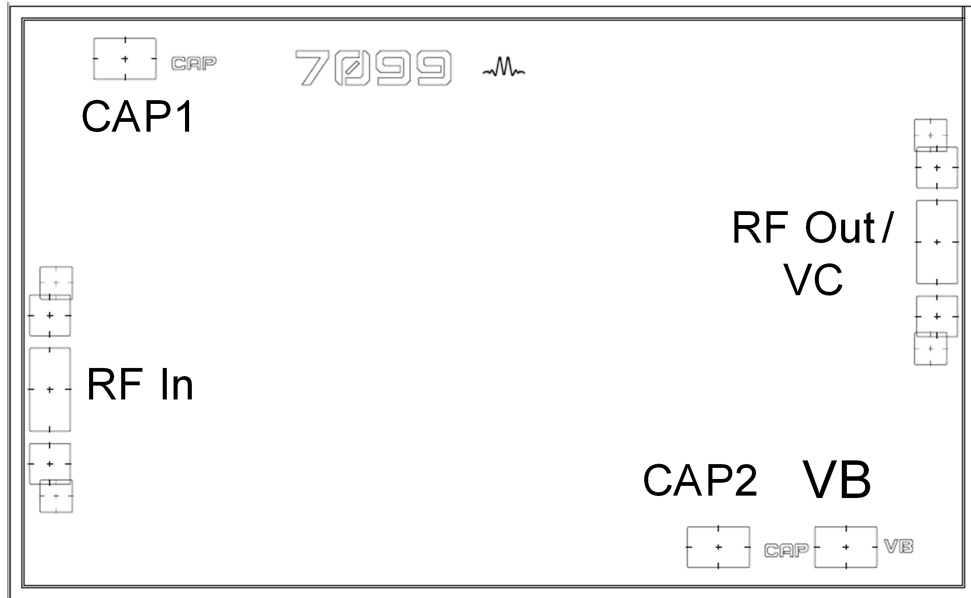
**Revision History**

Revision Code	Revision Date	Comment
-	2020-10-01	Datasheet Initial Release
A	2021-03-01	Updated maximum input power and min specs
B	2021-06-01	Updated Saturated Output Power Min Spec Bandwidth
C	2021-08-01	Updated Thermal Resistance

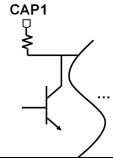
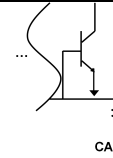
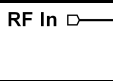
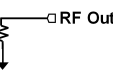

**Port Configuration and Functions**

**Port Diagram**

A port diagram of the APM-7099CH is shown below.



**Port Functions**

Port	Function	Description	Equivalent Circuit for Package
CAP1	Off-Chip Cap Port 1	CAP1 is a pad that allows the user to attach additional off chip bypass capacitance to the VC supply line. A 0.1 $\mu$ F capacitor is recommended	
CAP2	Off-Chip Cap Port 2	CAP2 is a pad that allows the user to attach additional off chip bypass capacitance to provide adequate AC grounding termination. A 0.1 $\mu$ F capacitor is recommended	
GND	Ground	Backside of the IC must be connected to a DC/RF ground with high thermal and electrical conductivity.	<b>GND</b> ↓
RF In	RF Input	This is the RF Input port of the amplifier die. It is RF matched to 50 $\Omega$ , and is DC coupled. RF input pad is GSG with 175 $\mu$ m pitch.	
RF Out/VC	RF Output and Collector Supply Port	This is the amplifier die's RF Output and positive VC supply voltage port. It is RF matched to 50 $\Omega$ and is DC coupled. RF output pad is GSG with 175 $\mu$ m pitch. Must have less than 7:1 VSWR when operating with voltage larger 8V on VC	
VB	Current Mirror Bias Port	Port VB is the DC voltage bias pad for the current mirror that control the collector current supplied to the amplifier. Larger voltages result in a higher current draw through port RF Out/VC, effectively functioning as a gain control pin of the amplifier. See Typical Performance Plots 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)	9	V
Maximum Operating Temperature	85	°C
Maximum Storage Temperature	150	°C
Max Junction Temperature for MTTF > 1E6 Hours	125	°C
Max Power Dissipation for MTTF of 1E6 hours at 85°C Baseplate Temperature	709	mW
Minimum Operating Temperature	-40	°C
Minimum Storage Temperature	-65	°C
Output Load VSWR	7	-
Positive Bias Current (Ic)	225	mA
Positive DC Current Mirror Voltage (Vb)	9	V
RF Input Power (10 MHz – 3GHz)	12	dBm
RF Input Power (3 GHz – 20 GHz)	15	dBm
θJC, Junction to Ambient Thermal Resistance	38	°C/W

### Package Information

Parameter	Details	Rating
Dimensions	-	2.28 x 1.40 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. Ic should be modified by changing bias voltage VB to maintain junction temperature within MTTF target for given operating conditions.

Parameter	Min	Nominal	Max	Unit
Ambient Temperature	-40	25	85	°C
Power Supply DC Voltage (VC)	5	8	9	V
Power Supply DC Current (with RF Input) <sup>1</sup>	-	-	180	mA
Power Supply DC Current (Ic) (No RF Input) <sup>2</sup>	38	72	132	mA

<sup>[1]</sup> Operation above recommended max power supply DC current will result in reduced MTTF.

<sup>[2]</sup> Ic should be modified by changing bias voltage VB to maintain junction temperature within MTTF target for given operating conditions. 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 during operation.

**Electrical Specifications**

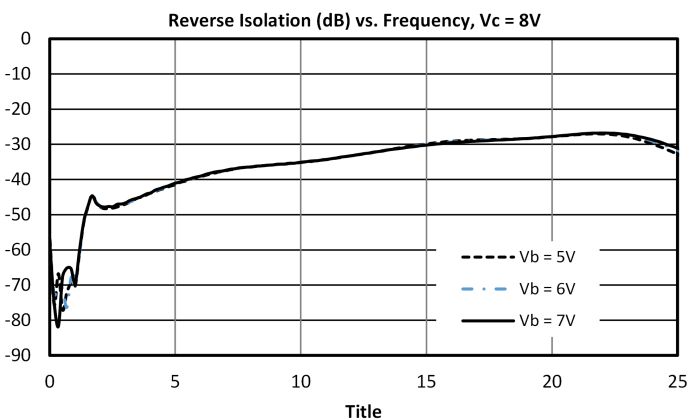
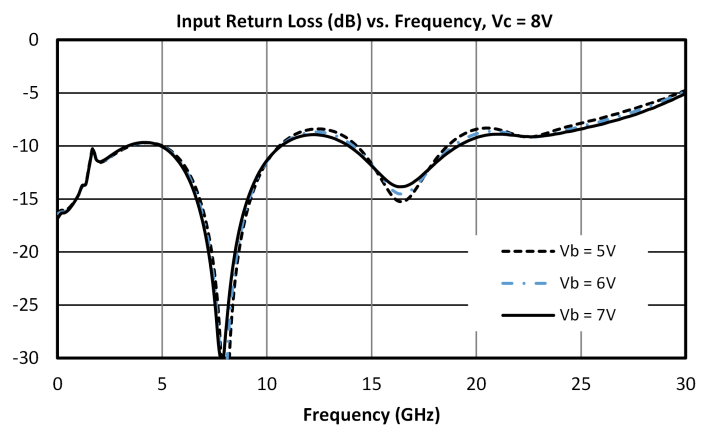
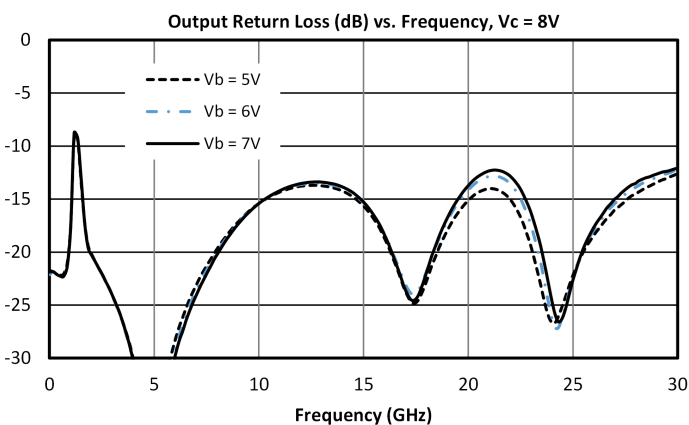
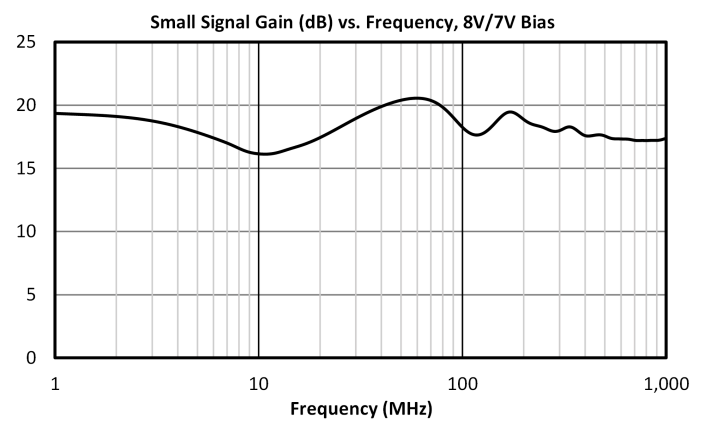
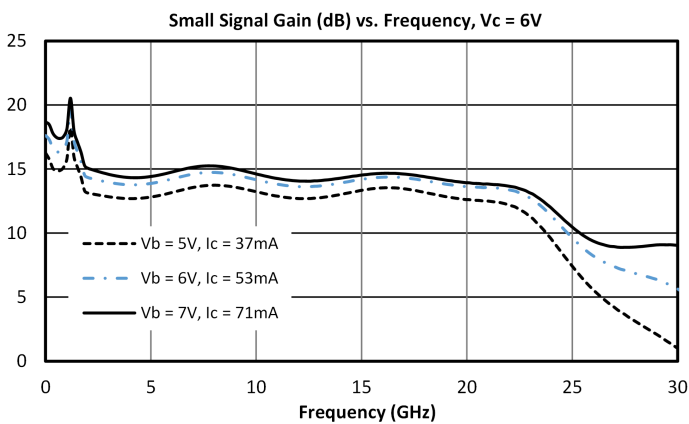
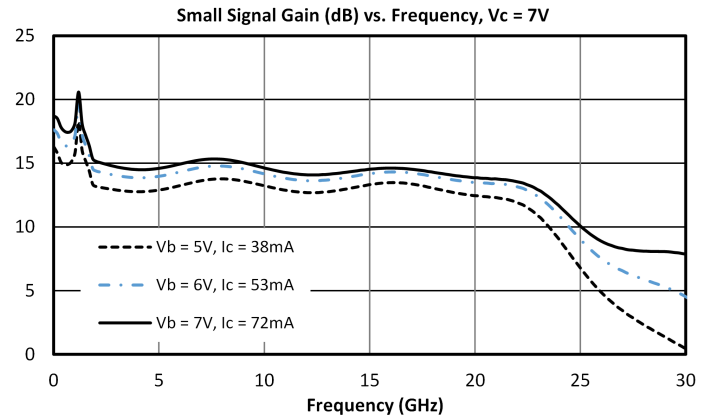
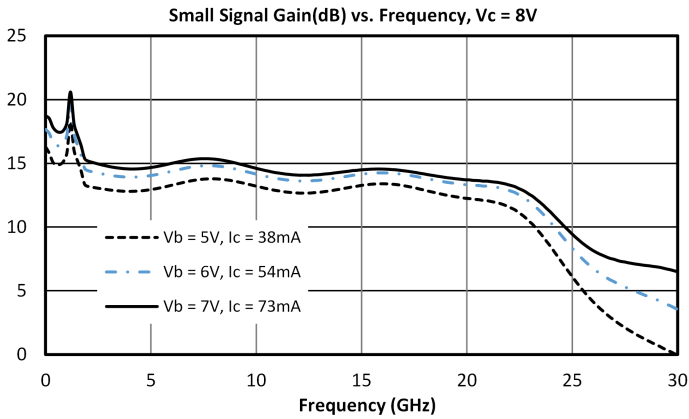
The electrical specifications apply at TA=+25°C in a 50Ω system. Min and Max limits apply only to our connectorized units and are guaranteed at TA=+25°C. Die are 100% DC tested and RF tested on a per lot basis

Parameter	Test Conditions	Minimum Frequency (GHz)	Maximum Frequency (GHz)	Min	Typ	Max	Unit
Collector Current, Ic <sup>1</sup>	8V/6V	-	-	-	53	-	mA
Collector Current, Ic <sup>2</sup>	8V/7V	-	-	-	72	-	mA
Collector Current, Ic <sup>3</sup>	8V/8V	-	-	-	96	-	mA
Current Mirror Current, Ib	8V/6V	-	-	-	3.4	-	mA
Current Mirror Current, Ib	8V/7V	-	-	-	4.2	-	mA
Current Mirror Current, Ib	8V/8V	-	-	-	5	-	mA
Input IP3	8V/7V bias, -15 dBm Input Power	0.01	20	-	12	-	dBm
Input Power for Saturation	8V/7V bias	0.01	20	-	12	-	dBm
Input Return Loss	8V/7V bias, -15 dBm Input Power	0.01	20	-	14	-	dB
Noise Figure	-30 dBm Input Power	0.01	20	-	5	-	dB
Output IP3	8V/7V bias, -15 dBm Input Power	0.01	20	-	24	-	dBm
Output P1dB	8V/7V bias	0.01	20	-	23	-	dBm
Output Power <sup>4</sup>	8V/7V bias	0.01	0.1	-	20	-	dBm
Output Power <sup>5</sup>	8V/7V bias	0.1	15	19	25	-	dBm
Output Power <sup>6</sup>	8V/7V bias	15	20	-	23	-	dBm
Output Return Loss	8V/7V bias, -15 dBm Input Power	0.01	20	-	20	-	dB
Phase Noise @ 10 kHz Offset	+12 dBm Input power	1	1	-	-167	-	dBc/Hz
Reverse Isolation	8V/7V bias, -15 dBm Input Power	0.01	20	-	36	-	dB
Small Signal Gain	8V/7V bias, -15 dBm Input Power	15	20	-	12	-	dB
Small Signal Gain	8V/7V bias, -15 dBm Input Power	0.01	15	10	14	-	dB

<sup>[1][2][3]</sup> 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.

<sup>[4][5][6]</sup> Saturated Output Power specification defined using the APM-7099PA P3dB compression curve shown in Typical Performance Plots.

### Typical Performance Plots

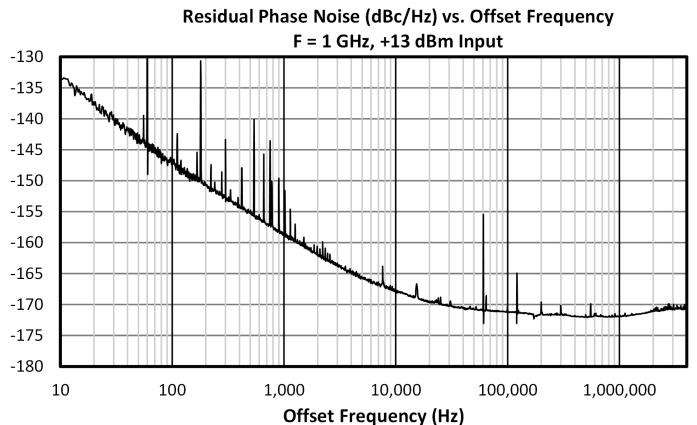
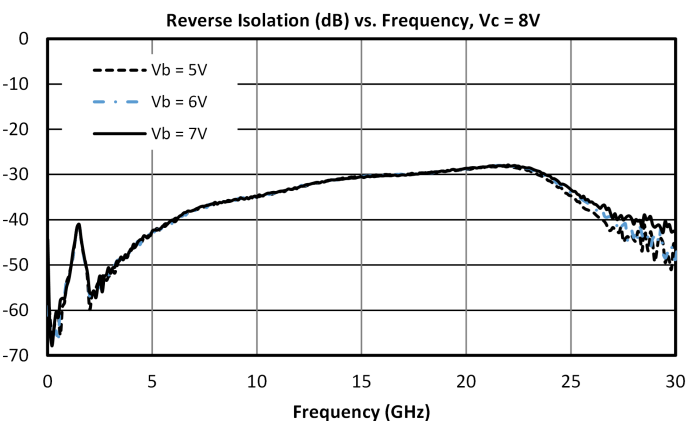
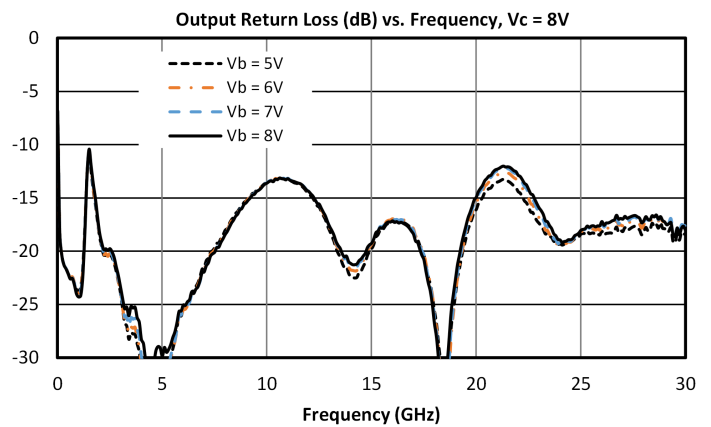
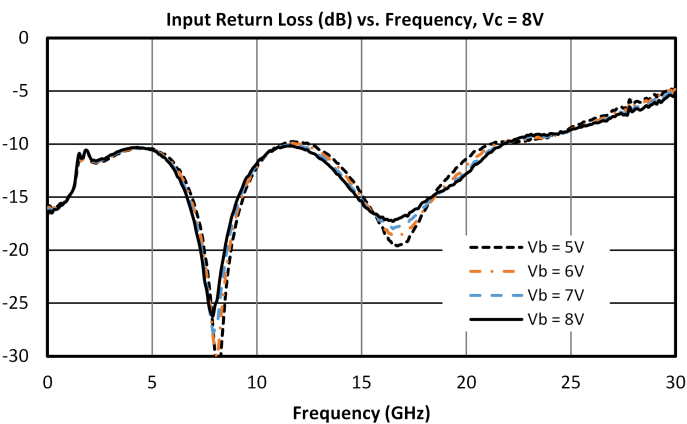
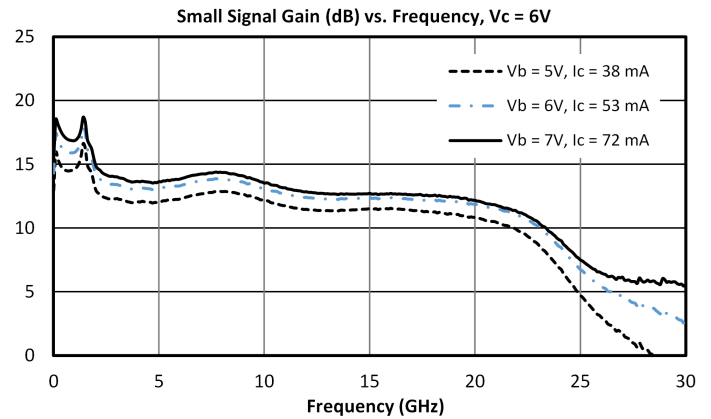
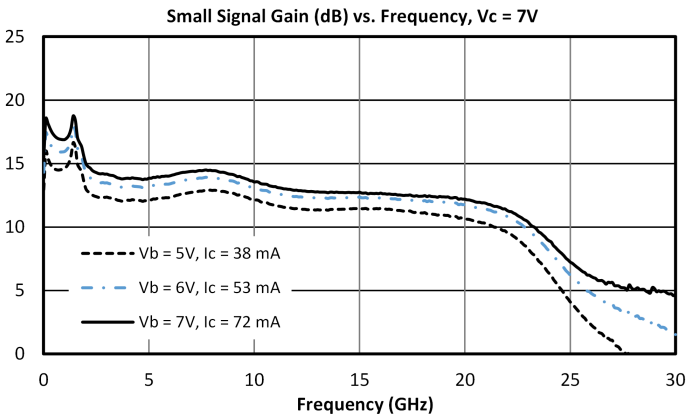
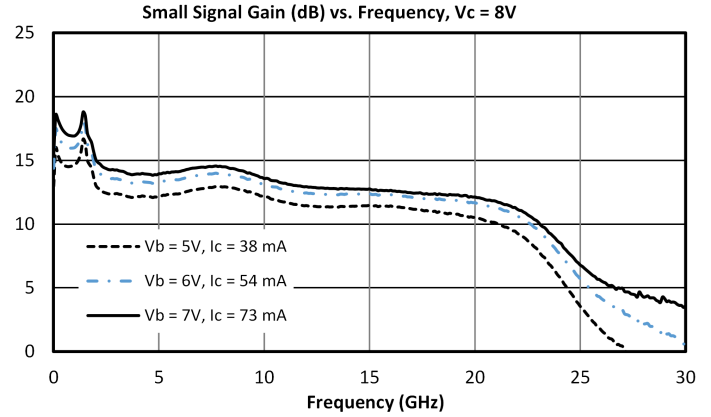
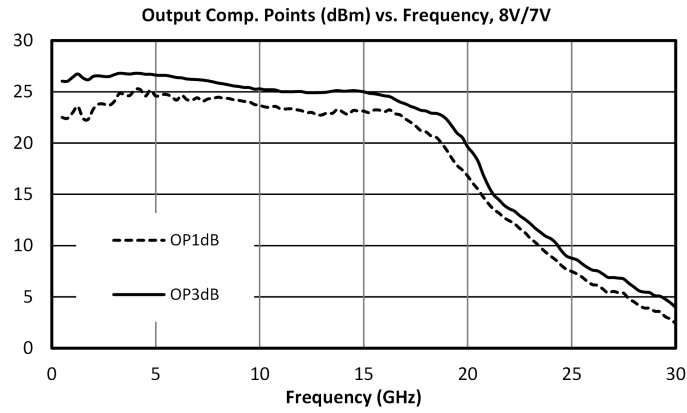


Title

### APM-7099PA - Typical Performance Plots

Operation above Max I<sub>c</sub> Limit = 180mA, will result in reduced MTTF

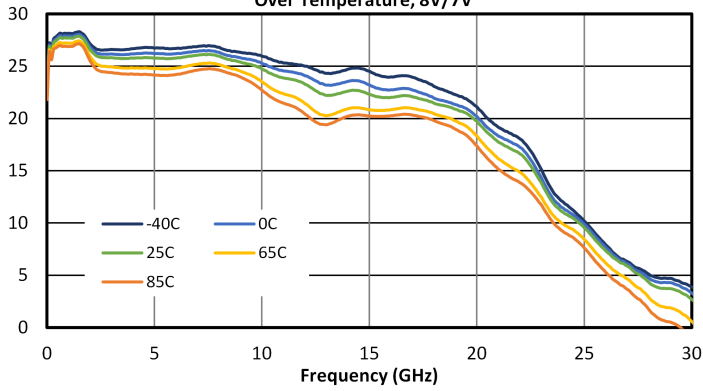
Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.



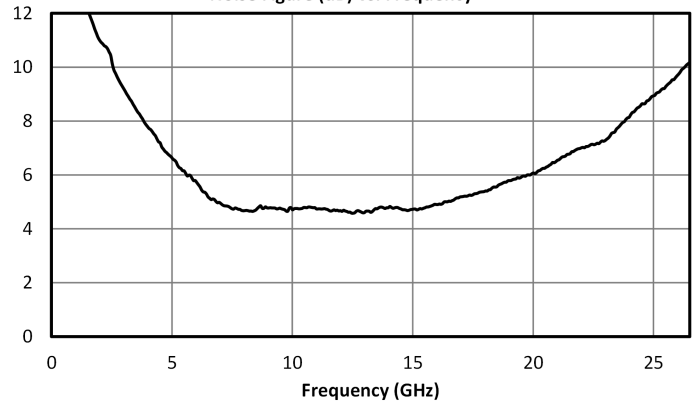
# APM-7099CH

## 0.01GHz – 20 GHz Low Phase Noise Amplifier

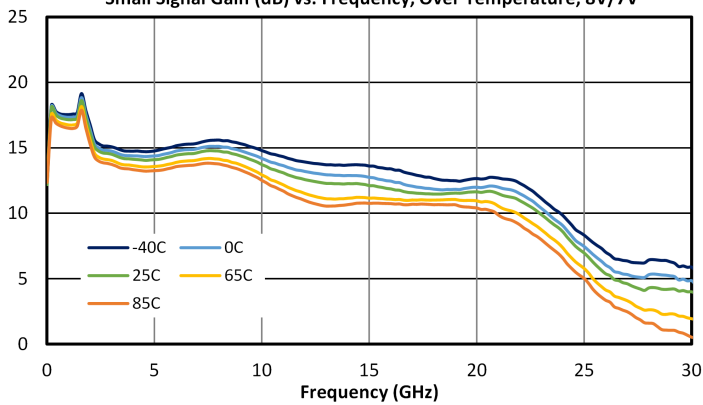
Saturated Output Power (dBm) vs. Frequency, Over Temperature, 8V/7V



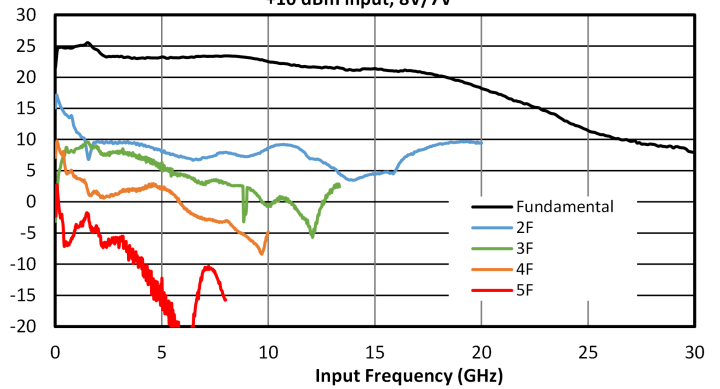
Noise Figure (dB) vs. Frequency



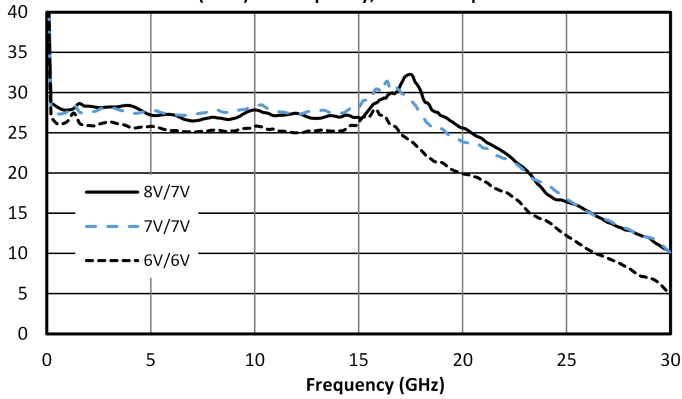
Small Signal Gain (dB) vs. Frequency, Over Temperature, 8V/7V



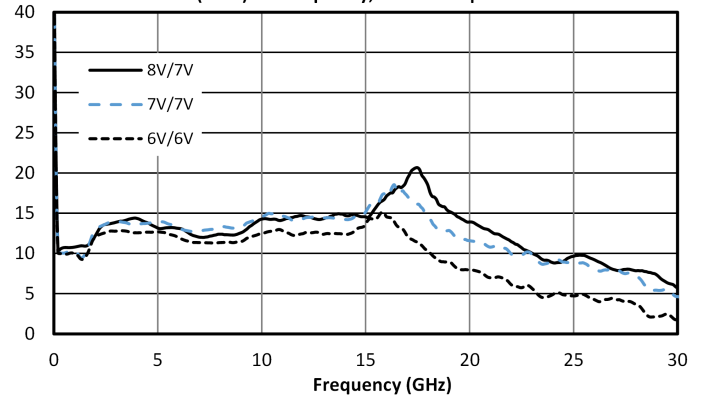
Harmonic Response (dBm) vs. Input Frequency, +10 dBm input, 8V/7V



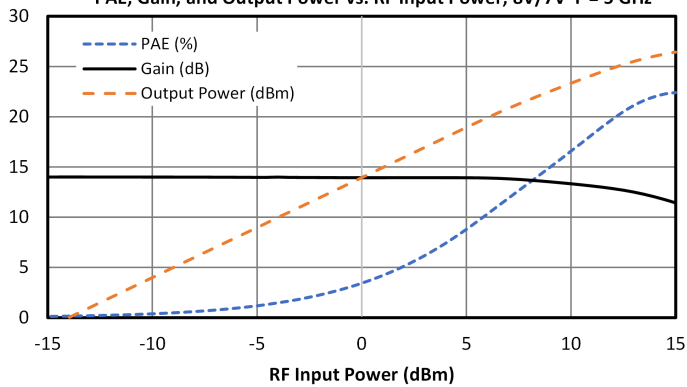
OIP3 (dBm) vs. Frequency, -15 dBm Input



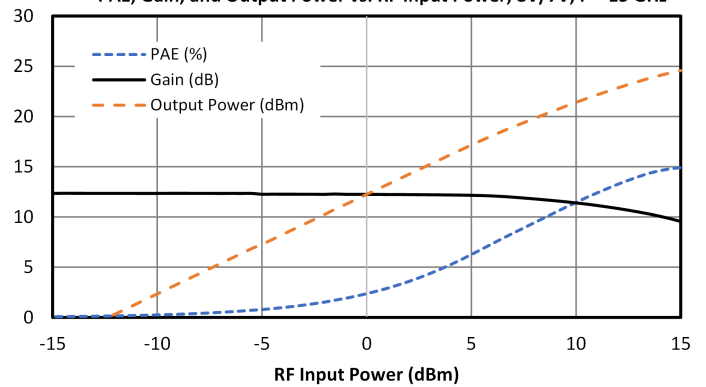
IIP3 (dBm) vs. Frequency, -15 dBm Input



PAE, Gain, and Output Power vs. RF Input Power, 8V/7V, F = 5 GHz

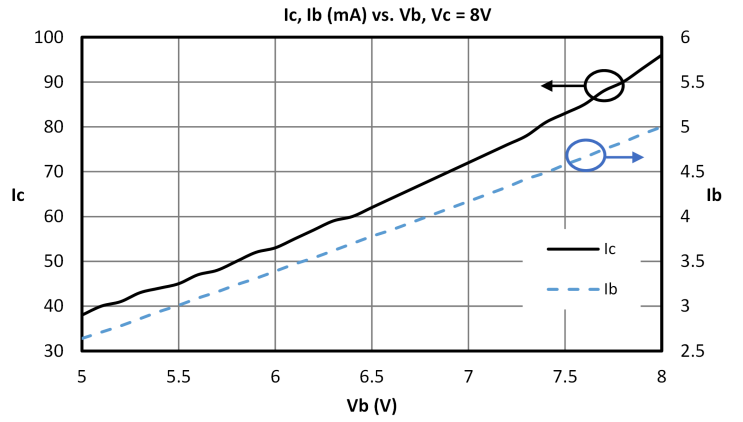
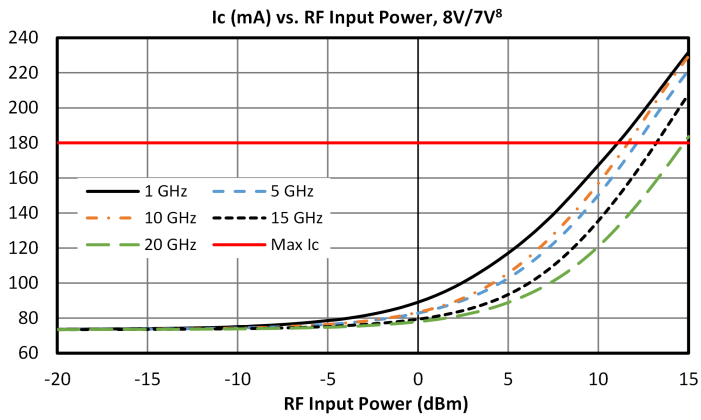


PAE, Gain, and Output Power vs. RF Input Power, 8V/7V, F = 15 GHz



# APM-7099CH

## 0.01GHz – 20 GHz Low Phase Noise Amplifier

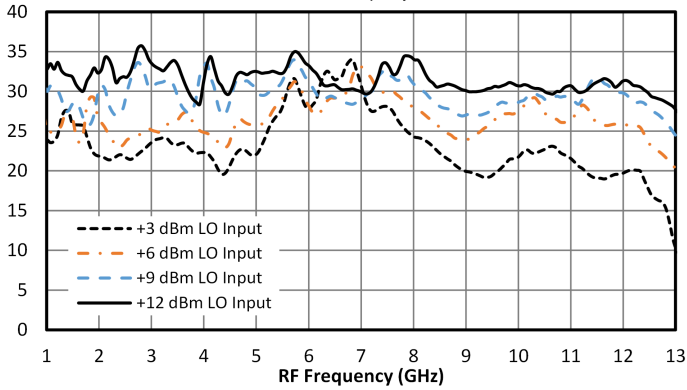


### APM-7099PA - Typical Performance Plots of Marki MT3H-0113H with APM 7099PA LO Driver

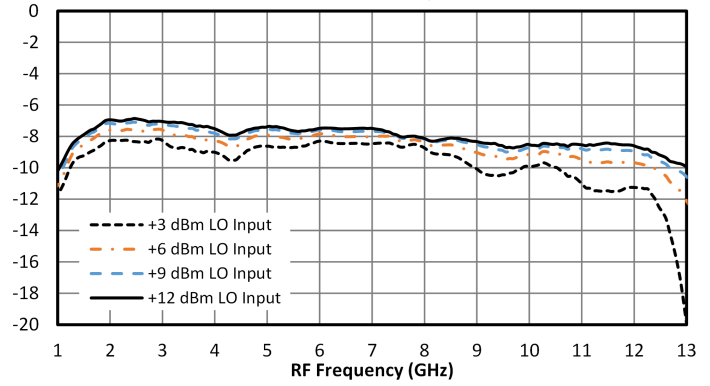
LO Input Powers specified as the input power into the APM-7099PA LO driver

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.

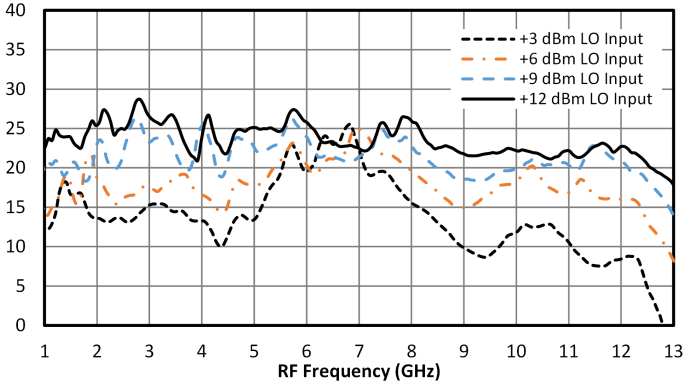
MT3H-0113H Config. A IIP3 (dBm) vs. Frequency, 1 GHz IF, APM-7099PA LO Driver, 8V/7V Bias



MT3H-0113H Config. A Conv. Loss (dB) vs. Frequency, 1 GHz IF, APM-7099PA LO Driver, 8V/7V Bias



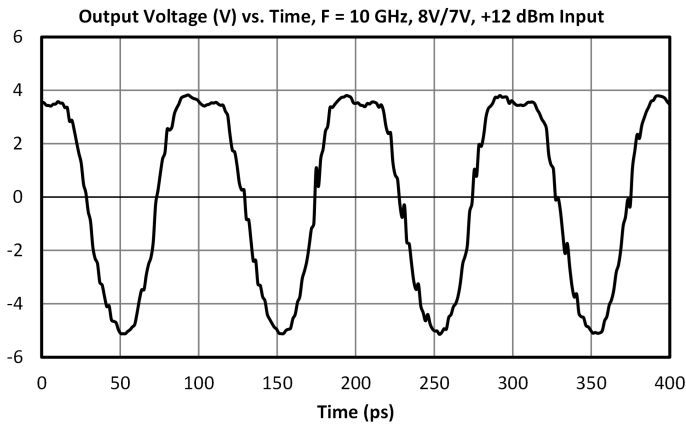
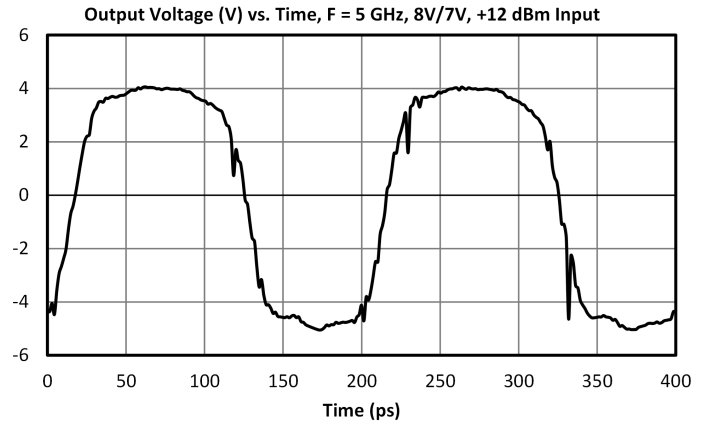
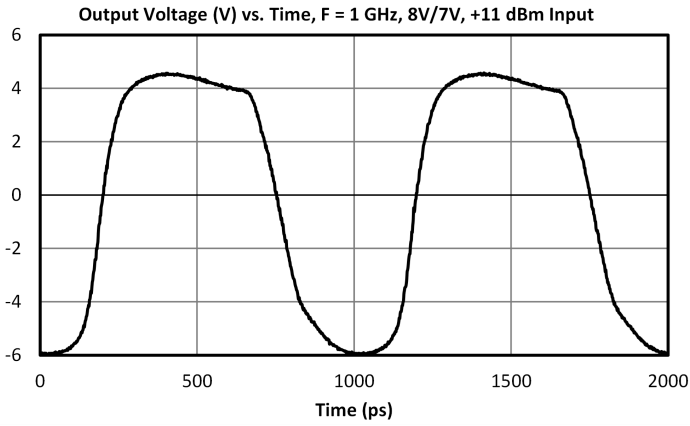
MT3H-0113H Config. A OIP3 (dBm) vs. Frequency, 1 GHz IF, APM-7099PA LO Driver, 8V/7V Bias



**APM-7099PA - Time Domain Plots**

Fast rise time is desirable for linear T3 mixer operation.

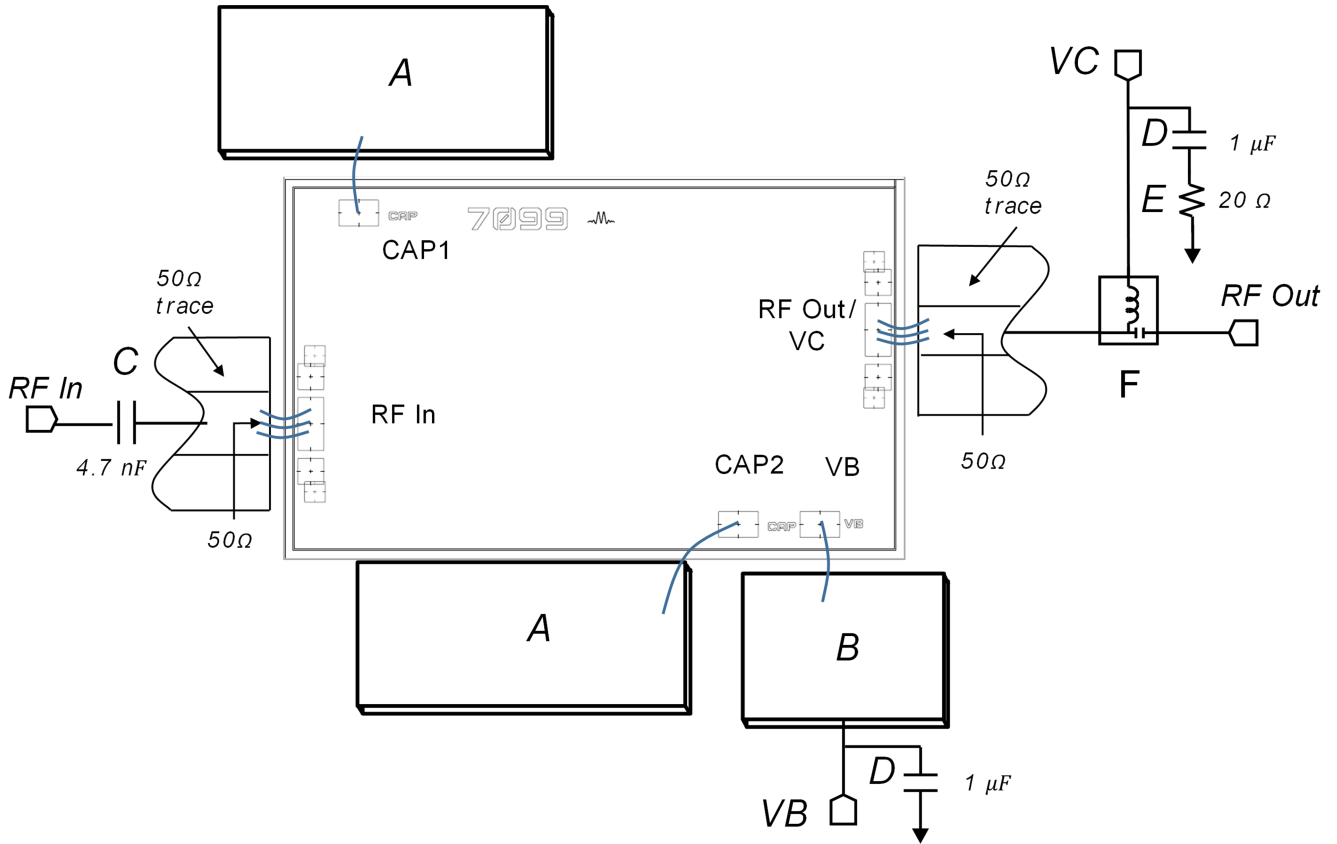
Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.



### **Application Information**

Below is the recommended application circuit for the APM-7099CH.

**Application Circuit**



**Application Circuit Description**

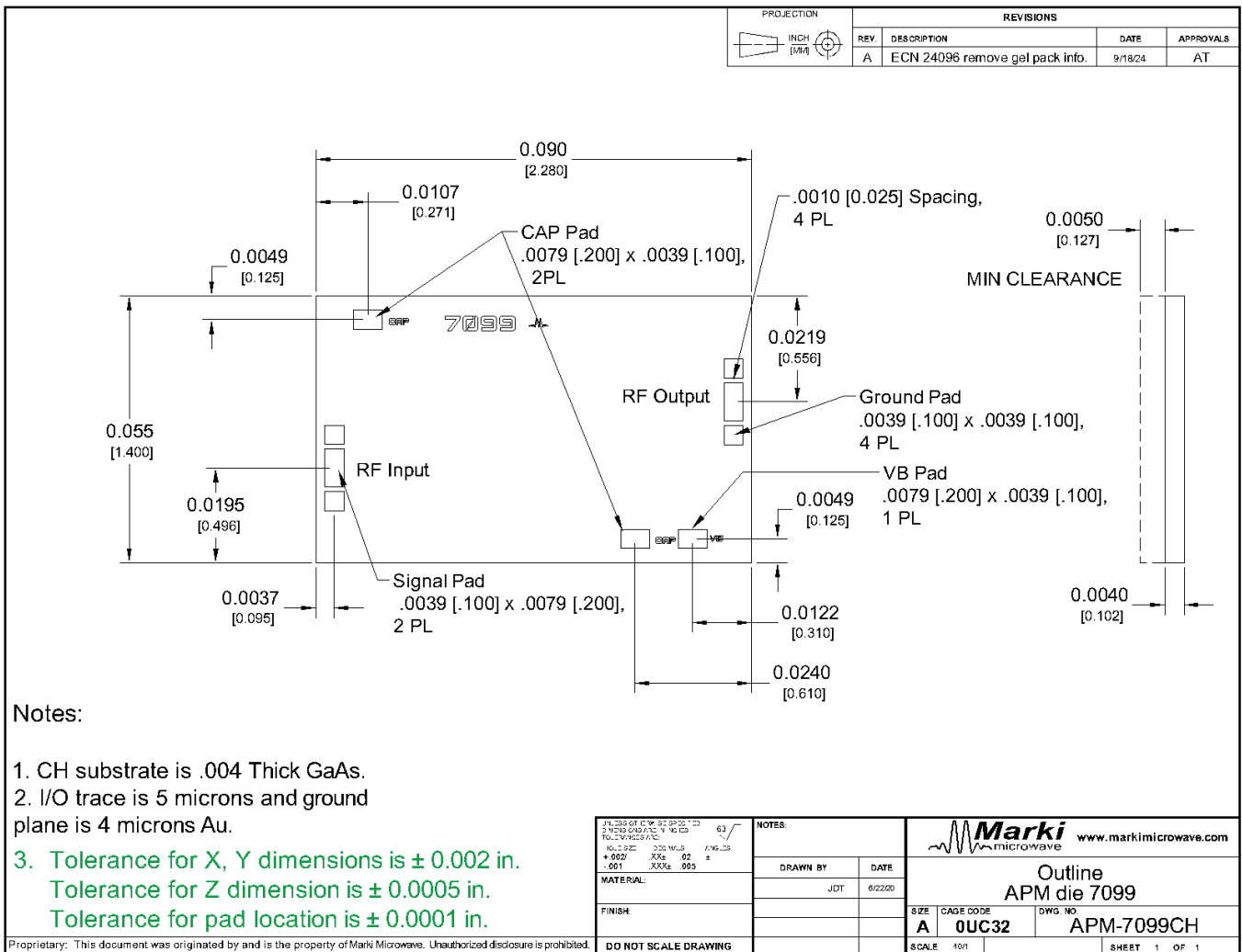
Designator	Description	Sample Part Number
A	Presidio 0.1 $\mu$ F + 1800 pF Capacitor	MVB4080X104ZGH5R3
B	Tecdia 0.030"x0.030" 150 pF Capacitor	CMS151Z2NC-CK
C*	0402 4.7 nF SMT Capacitor	CLO5B472KB5NNNC
D	0402 1.0 $\mu$ F SMT Capacitor	CLO5A105K05NNNC
E	0402 20 $\Omega$ SMT Resistor	CPF0402B20RE1
F	Marki Surface-Mount Bias Tee; 5 MHz – 34 GHz	BT-0034SMG

**Note\*:** If the user intends to operate the APM-7099CH at less than 10MHz input frequency, then the input DC blocking capacitor value must be no greater 4.7nF to avoid catastrophic damage.

### Mechanical Data

### Outline Drawing

Download : [Outline 2D Drawing](#)



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