

# APM-7098CH

## 0.1GHz – 22GHz Low Phase Noise Amplifier

### DEVICE OVERVIEW

#### General Description

The APM-7098 is a broadband distributed, low phase noise LO driver amplifier designed to provide a saturated +23 dBm output 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 100 MHz to 18 GHz or of an H or L diode mixer from 100 MHz to 22 GHz. This amplifier can be operated with a variety of bias conditions for both low power and high-power applications.



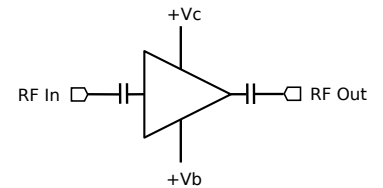
#### Features

- -165 dBc/Hz phase noise at 10 kHz offset frequency
- +23 dBm output power
- Low DC power consumption
- Positive-only biasing
- No sequencing required
- Unconditionally stable

#### Applications

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

#### Functional Block Diagram



#### Part Ordering Options

| Part Number | Description                              | Package | Connectors | Green Status  | Product Lifecycle | Export Classification |
|-------------|--|---------|------------|---------------|-------------------|-----------------------|
| APM-7098PA  | 0.1GHz – 22GHz Low Phase Noise Amplifier | PA      | Standard   | REACH<br>RoHS | Released          | EAR99                 |
| APM-7098CH  | 0.1GHz – 22GHz Low Phase Noise Amplifier | CH      | -          | REACH<br>RoHS | Released          | EAR99                 |

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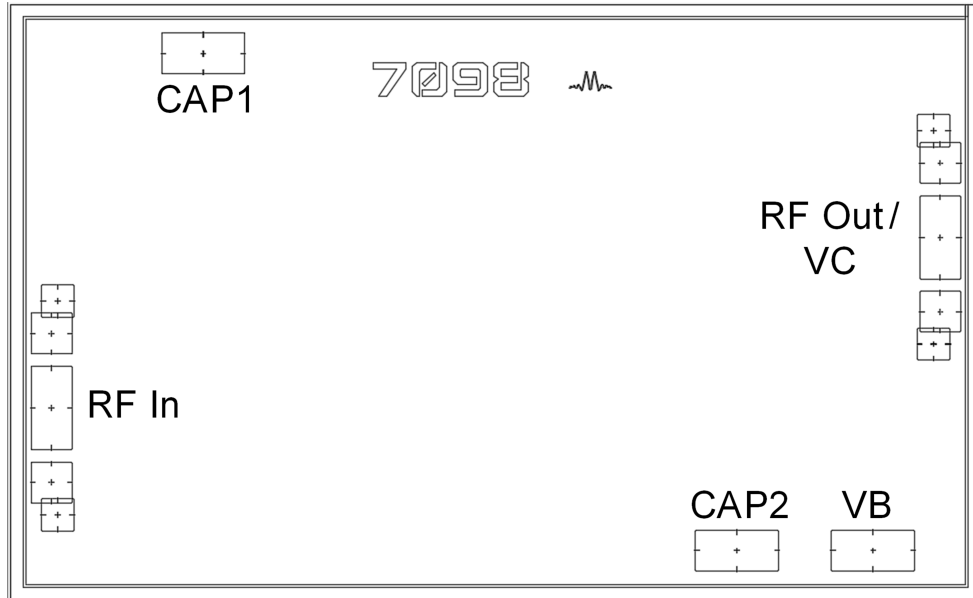
**Revision History**

| Revision Code | Revision Date | Comment  |
|---------------|---------------|--|
| -             | 2020-08-01    | Datasheet Initial Release  |
| A             | 2020-09-01    | Updated Maximum Thermal Specifications, Recommended Operating Conditions, Performance Plots, and Application Information |

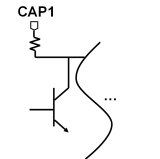
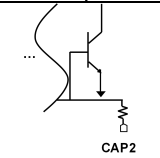

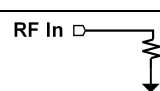
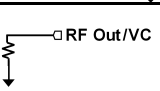
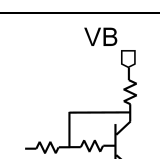
**Port Configuration and Functions**

**Port Diagram**

A port diagram of the APM-7098CH is shown below.



**Port Functions**

| Port      | Function                            | Description   | DC Equivalent Circuit   |
|-----------|-------------------------------------|---|---|
| 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.   |    |
| 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 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)                                      | 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 | 630            | mW   |
| Minimum Operating Temperature   | -40            | °C   |
| Minimum Storage Temperature   | -65            | °C   |
| Output Load VSWR  | 7              | -    |
| Positive Bias Current (Ic)  | 150            | mA   |
| Positive DC Current Mirror Voltage (Vb)                                   | 9              | V    |
| RF Input Power  | 20             | dBm  |
| θJC, Junction to Ambient Thermal Resistance                               | 63             | °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.

| 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>    | -   | -       | 120 | mA   |
| Power Supply DC Current (Ic) (No RF Input) <sup>2</sup> | 26  | 44      | 65  | mA   |

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

[2] 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

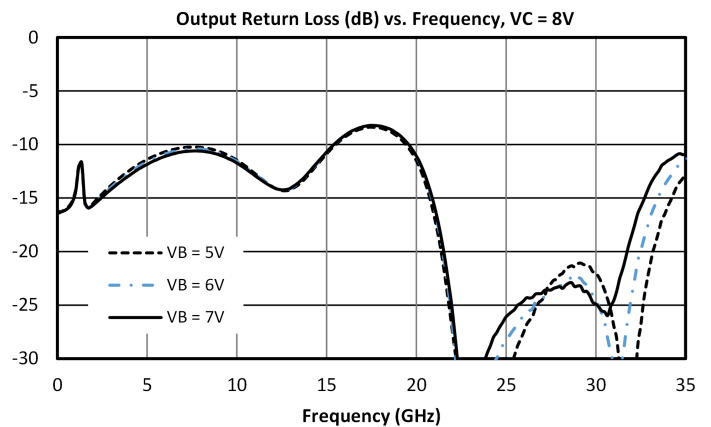
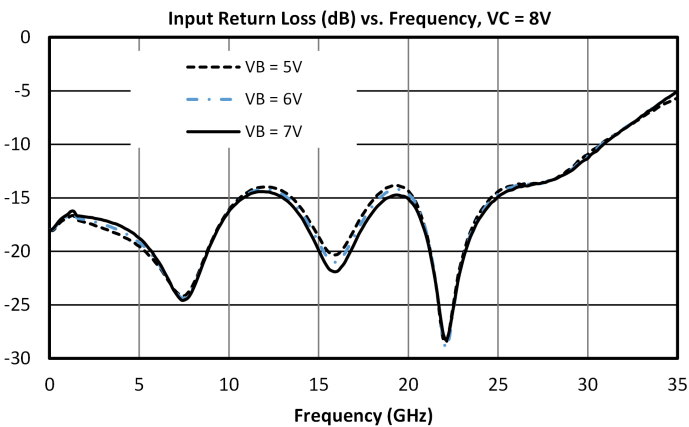
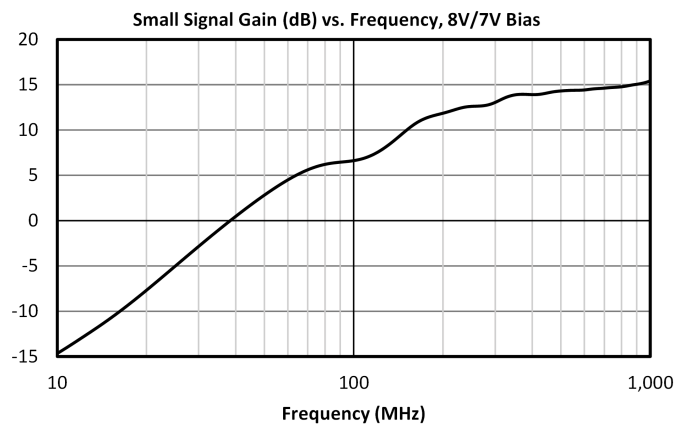
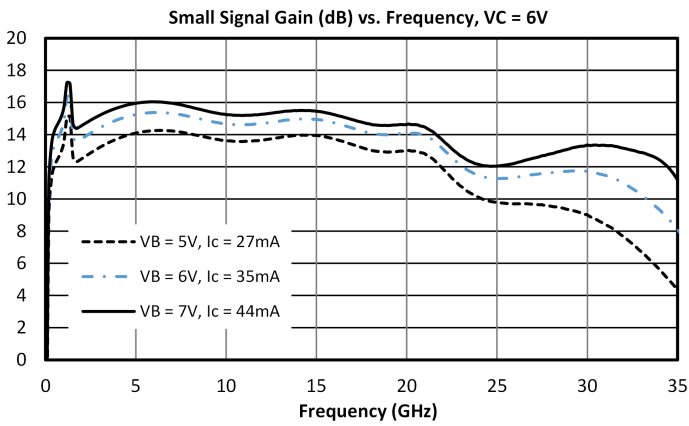
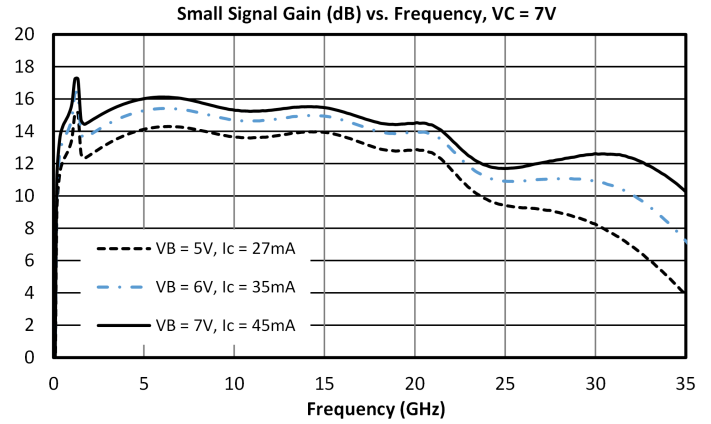
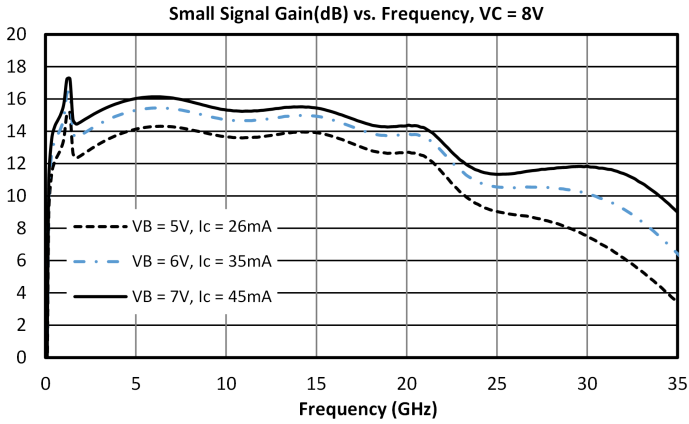
There is no sequencing required to power up or power down the amplifier. Amplifier must have an output load connected during operation.

**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   |
|-----------------------------|---------------------------------|-------------------------|-------------------------|-----|------|-----|--------|
| Current Consumption         | 8V/6V                           | -                       | -                       | -   | 35   | -   | mA     |
| Current Consumption         | 8V/7V                           | -                       | -                       | -   | 44   | -   | mA     |
| Current Consumption         | 8V/8V                           | -                       | -                       | -   | 54   | -   | mA     |
| Current Mirror, Ib          | 8V/6V                           | -                       | -                       | -   | 3.6  | -   | mA     |
| Current Mirror, Ib          | 8V/7V                           | -                       | -                       | -   | 4.4  | -   | mA     |
| Current Mirror, Ib          | 8V/8V                           | -                       | -                       | -   | 5.1  | -   | mA     |
| Input IP3                   | 8V/7V bias, -20 dBm Input Power | 0.1                     | 22                      | -   | 10   | -   | dBm    |
| Input Power for Saturation  | 8V/7V bias                      | 0.1                     | 22                      | -   | 10   | -   | dBm    |
| Input Return Loss           | 8V/7V bias, -25 dBm Input Power | 0.1                     | 22                      | -   | 19   | -   | dB     |
| Noise Figure                | -                               | 0.1                     | 21                      | -   | 4.6  | -   | dB     |
| Output IP3                  | 8V/7V bias, -20 dBm Input Power | 0.1                     | 22                      | -   | 24   | -   | dBm    |
| Output P1dB                 | 8V/7V bias                      | 0.5                     | 22                      | -   | 18   | -   | dBm    |
| Output Return Loss          | 8V/7V bias, -25 dBm Input Power | 0.1                     | 22                      | -   | 13   | -   | dB     |
| Phase Noise @ 10 kHz Offset | +10 dBm Input power             | 1                       | -                       | -   | -165 | -   | dBc/Hz |
| Reverse Isolation           | 8V/7V bias, -25 dBm Input Power | 0.1                     | 22                      | -   | 38   | -   | dB     |
| Saturated Output Power      | 8V/7V bias                      | 0.5                     | 22                      | 19  | 23   | -   | dBm    |
| Small Signal Gain           | 8V/7V bias, -25 dBm Input Power | 0.1                     | 22                      | 7   | 14   | -   | dB     |

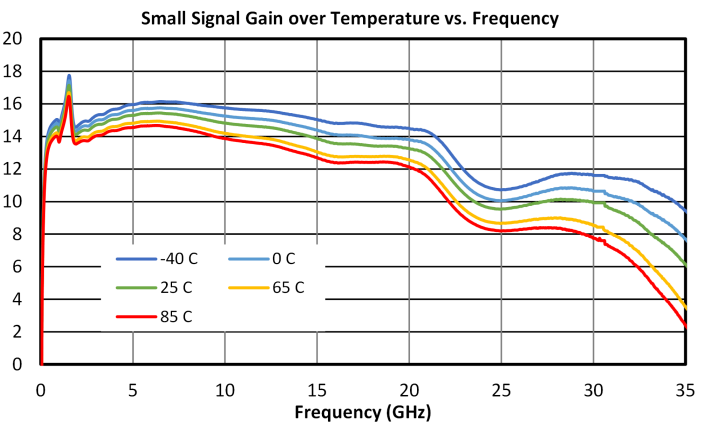
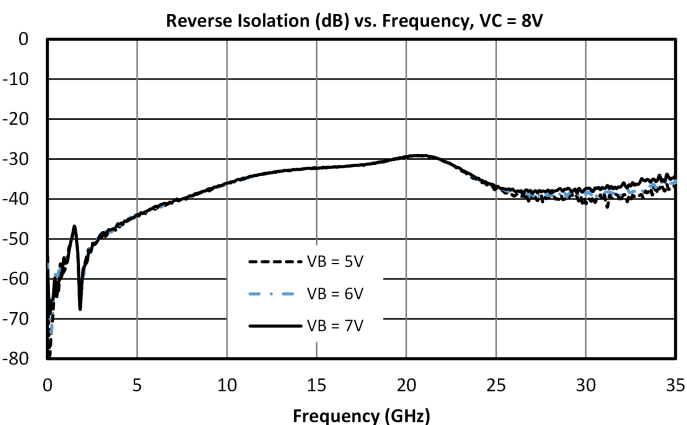
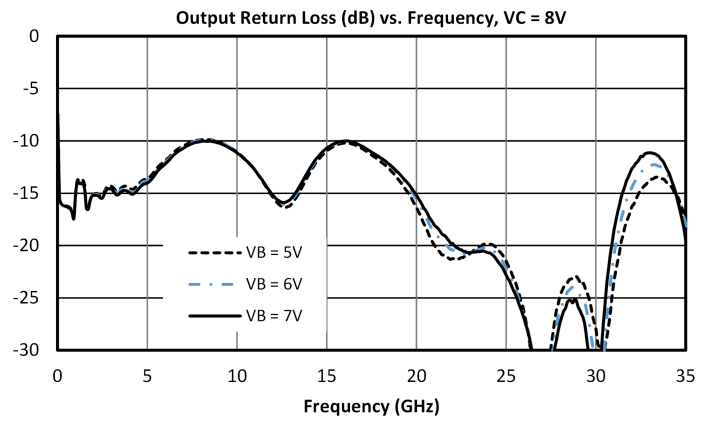
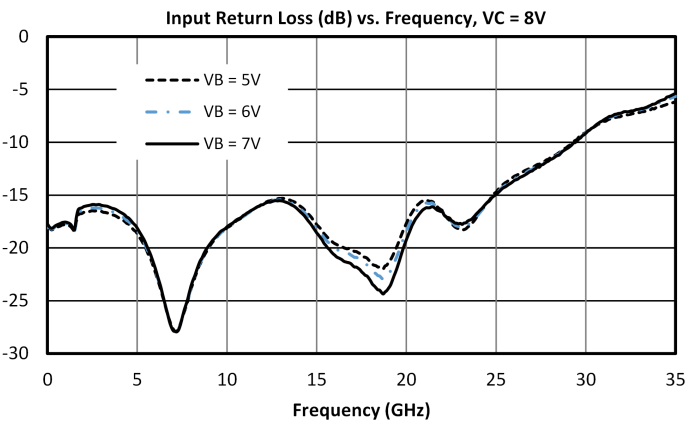
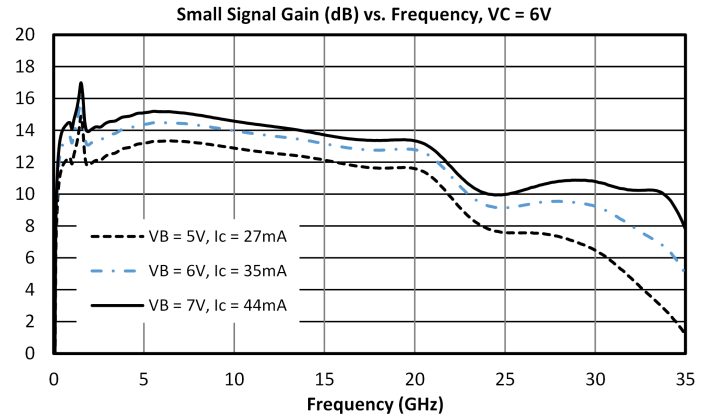
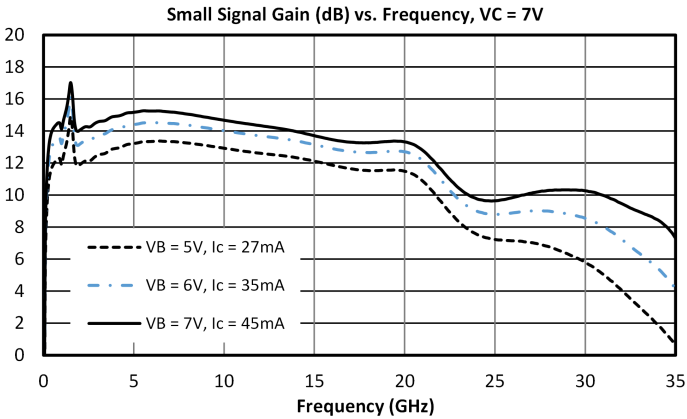
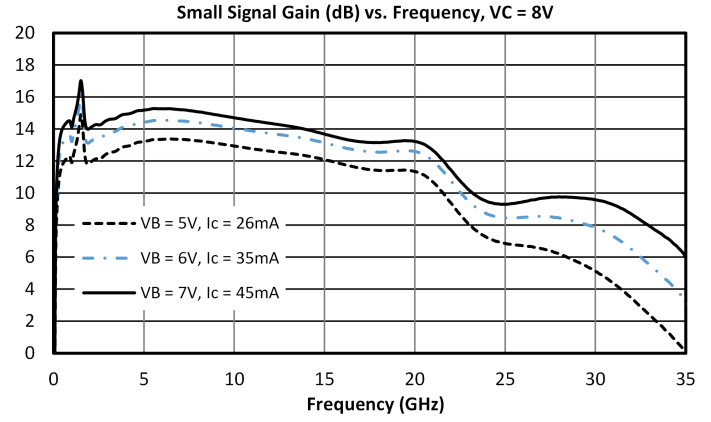
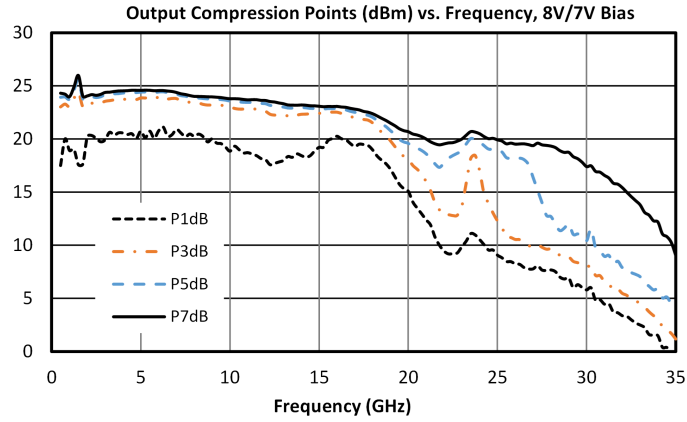
### Typical Performance Plots



### APM-7098PA - Typical Performance Plots

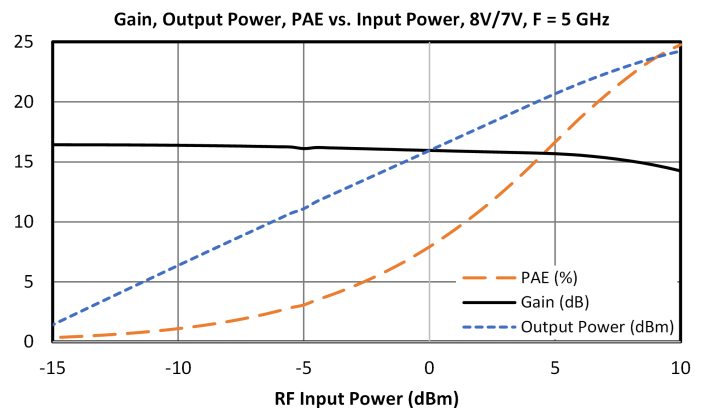
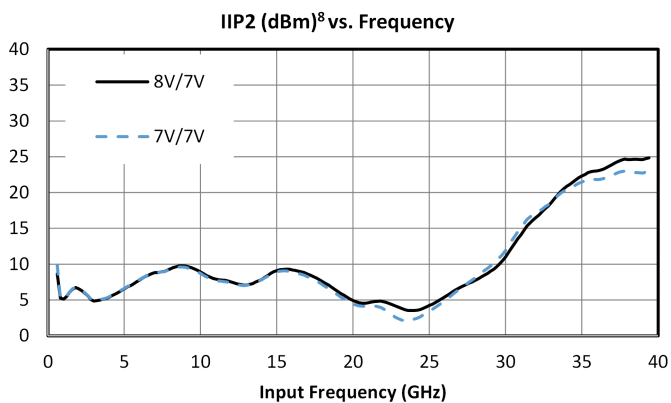
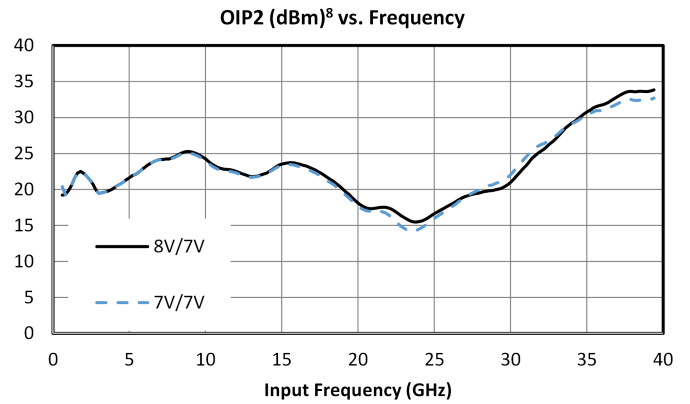
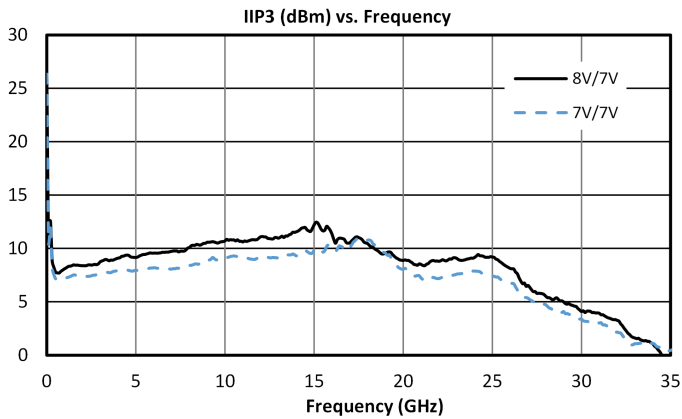
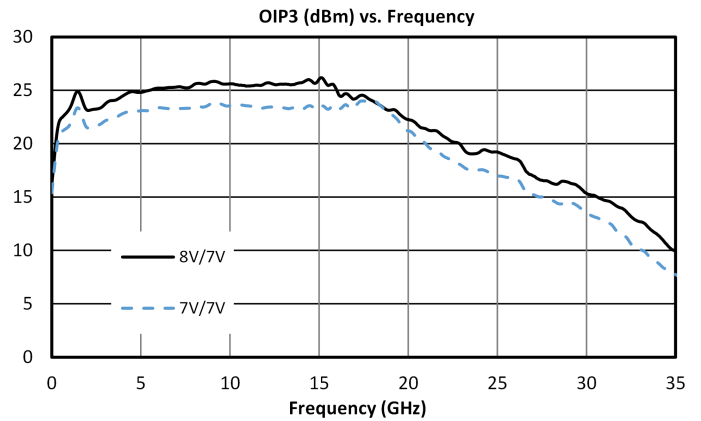
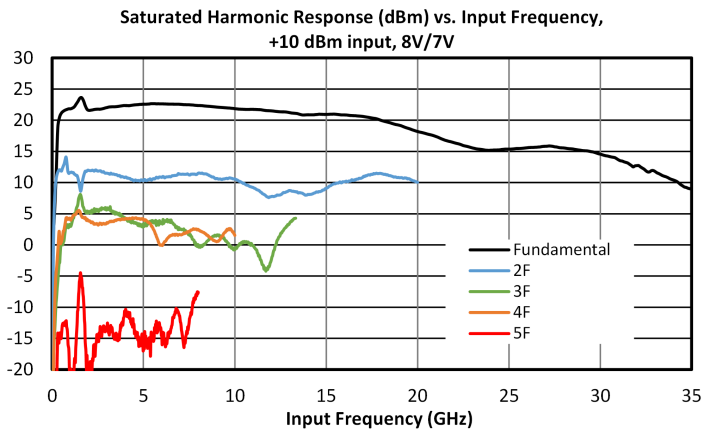
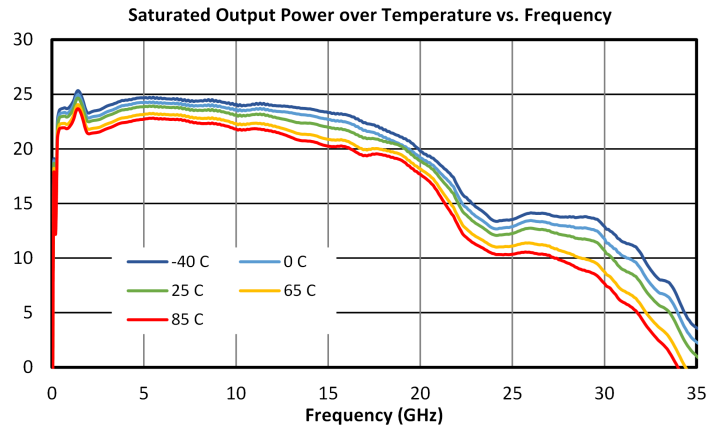
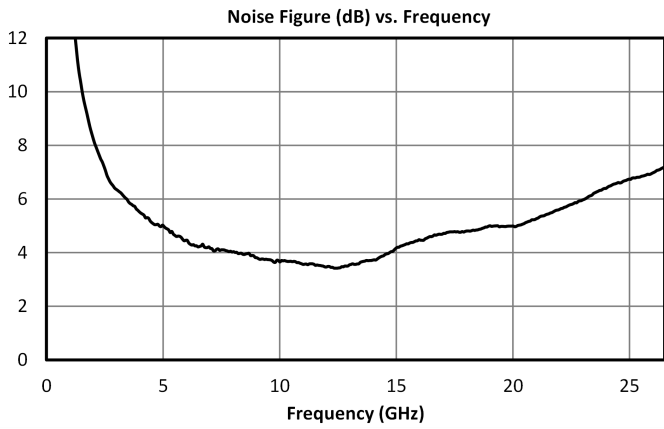
Operation above Max  $I_c = 120\text{mA}$  will result in reduced MTTF.

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-7098CH

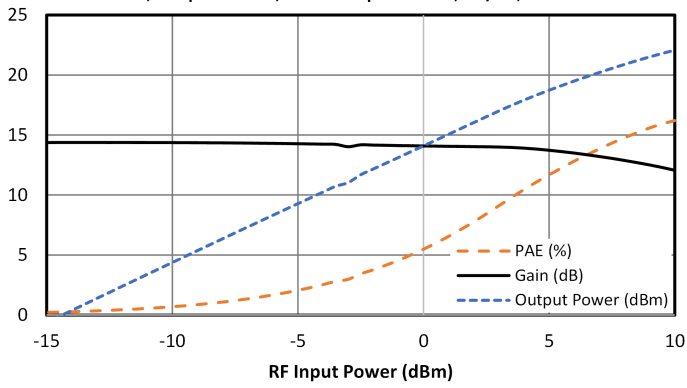
## 0.1GHz – 22GHz Low Phase Noise Amplifier



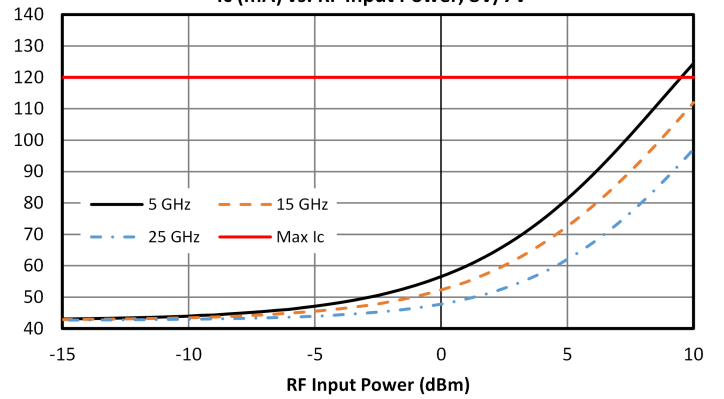
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## 0.1GHz – 22GHz Low Phase Noise Amplifier

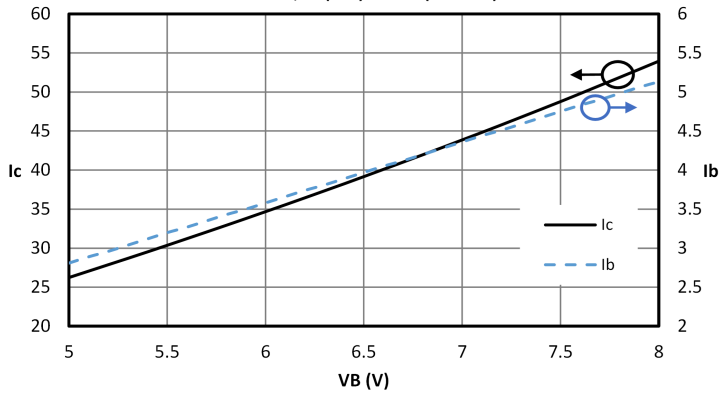
Gain, Output Power, PAE vs. Input Power, 8V/7V, F = 15 GHz



Ic (mA) vs. RF Input Power, 8V/7V<sup>8</sup>



Ic, Ib (mA) vs. Vb (Vc = 8V)

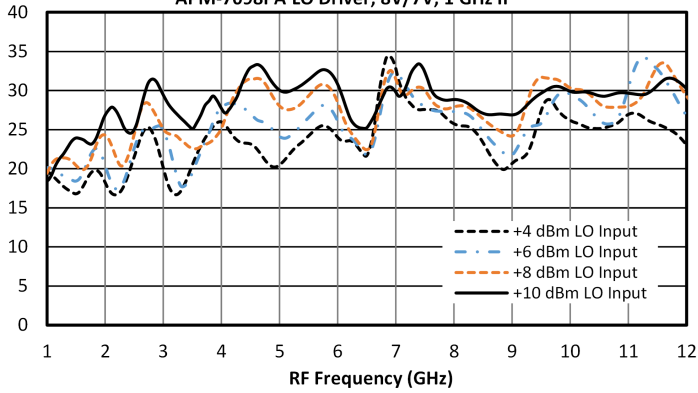


### APM-7098PA - Typical Performance Plots of Marki MT3H-0113H Driven With APM-7098PA

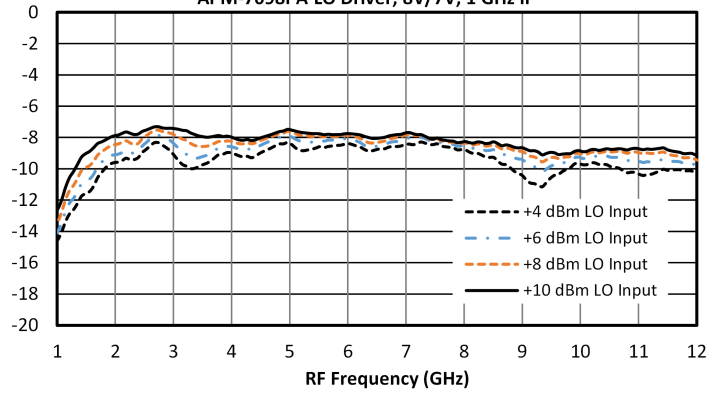
Specified LO input power is defined as the input to the APM-7098PA LO driver.

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.

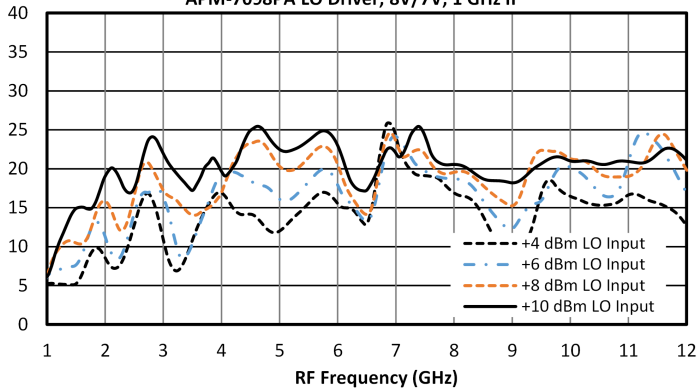
MT3H-0113H Config. A, IIP3 (dBm) vs. Frequency,  
APM-7098PA LO Driver, 8V/7V, 1 GHz IF



MT3H-0113H Config. A, Conv. Loss (dB) vs. Frequency,  
APM-7098PA LO Driver, 8V/7V, 1 GHz IF



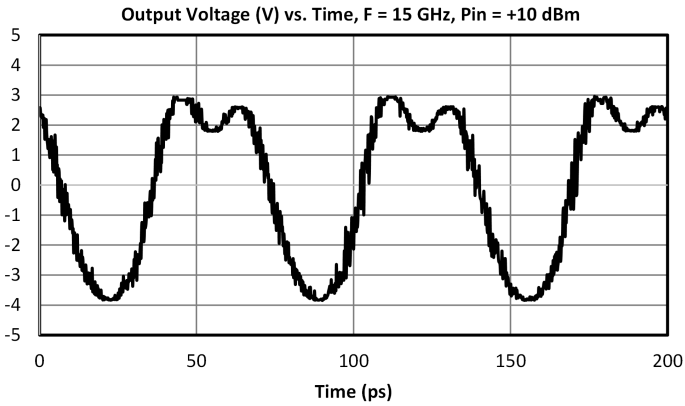
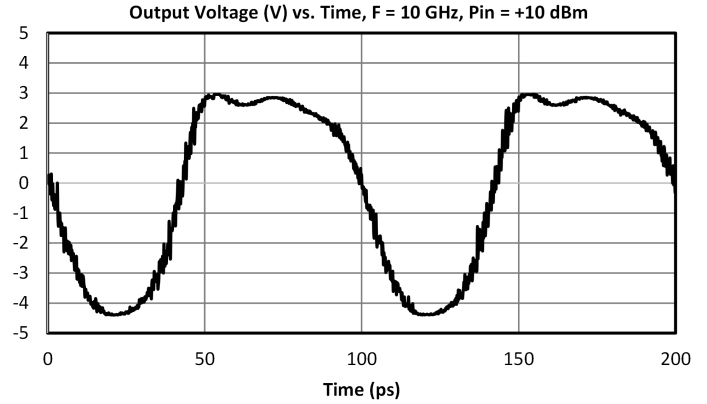
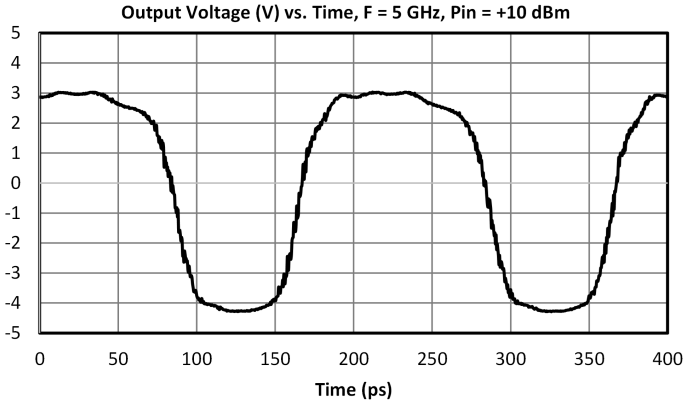
MT3H-0113H Config. A, OIP3 (dBm) vs. Frequency,  
APM-7098PA LO Driver, 8V/7V, 1 GHz IF



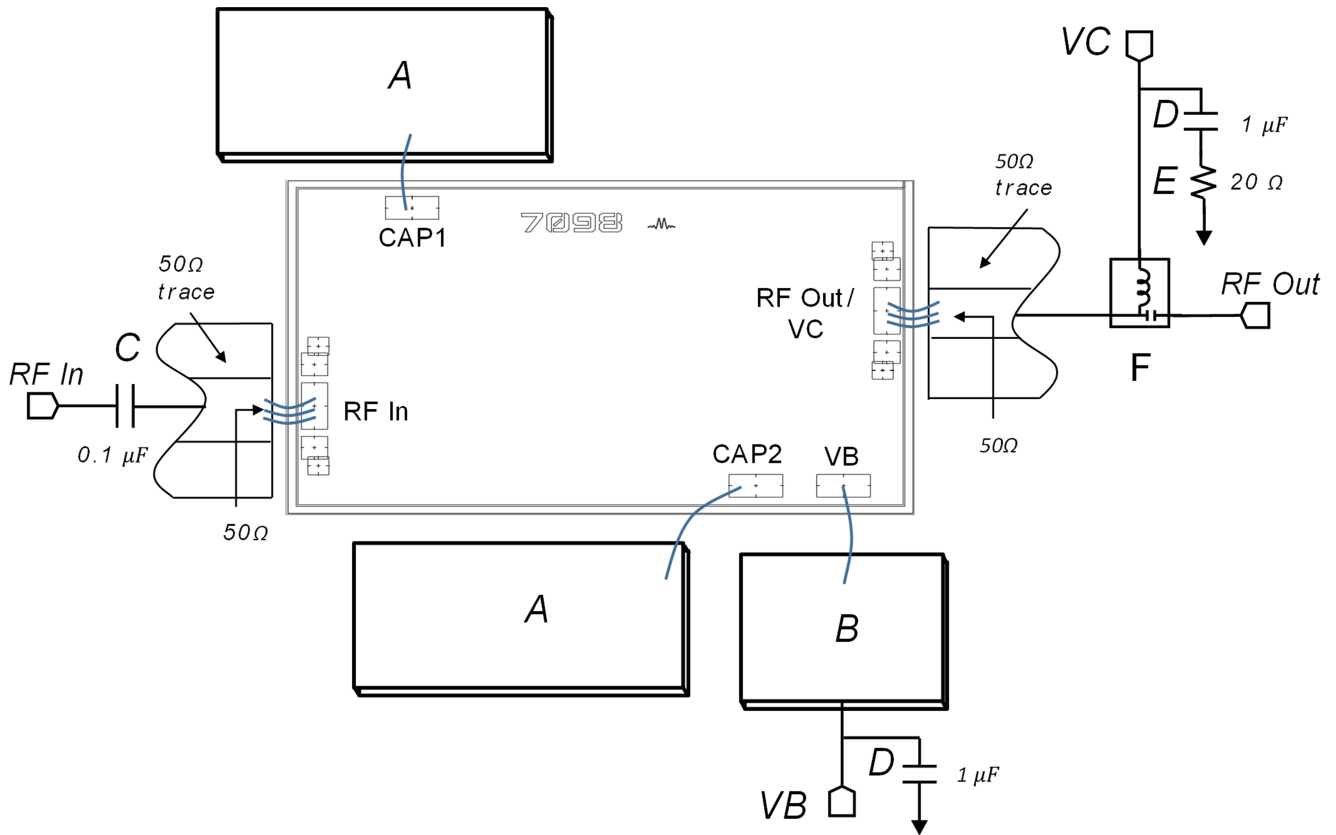
#### APM-7098PA - 9 Time Domain Plots

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 Circuit**



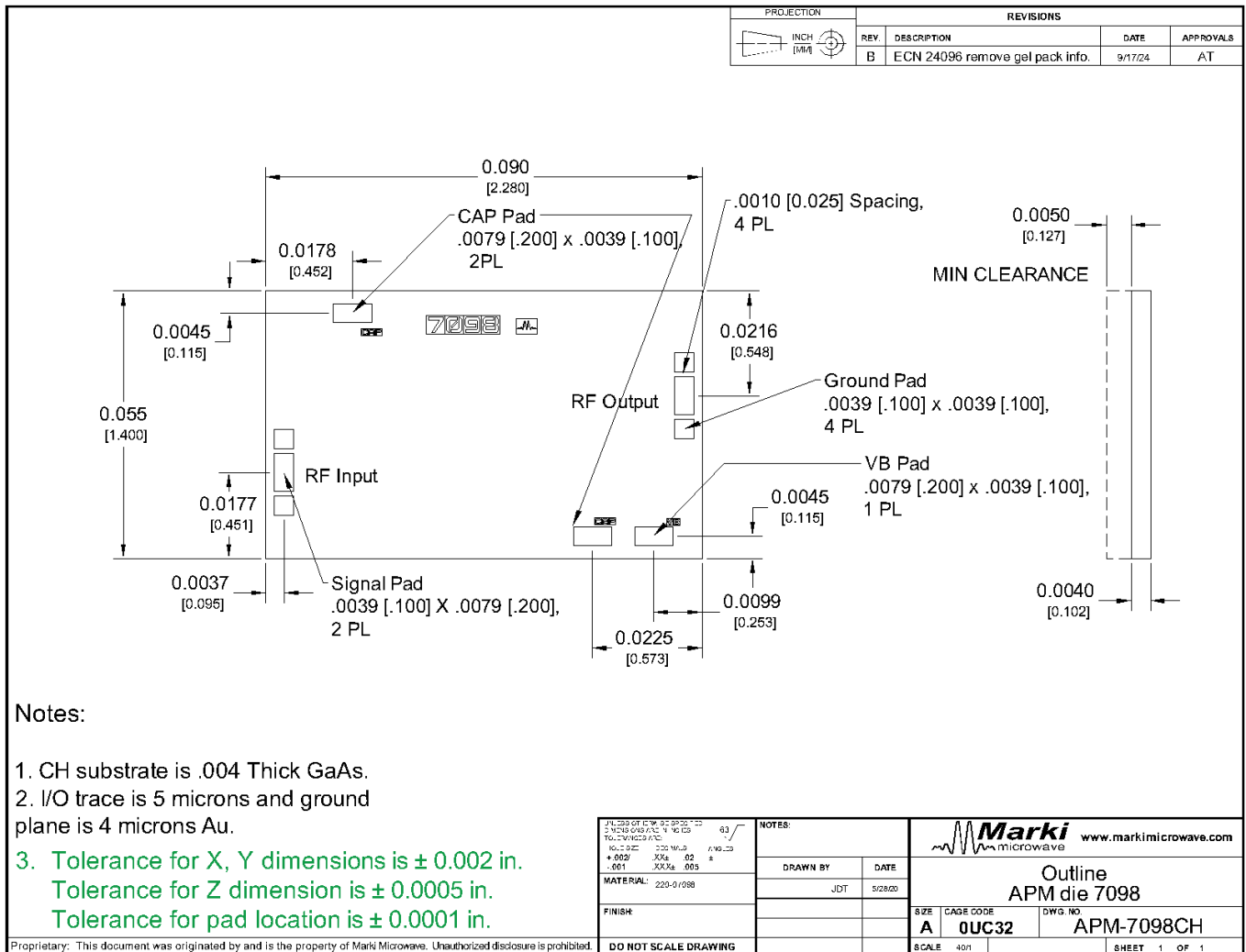
**Application Circuit Description**

| Designator | Description                                   | Sample Part Number |
|------------|---|--------------------|
| A          | Presidio 0.1 $\mu$ F + 1800 pF Capacitor      | MVB4080X104ZGH5R3  |
| B          | Tecdia 0.030" x 0.030" 150 pF Capacitor       | CMS151Z2NC-CK      |
| C          | 0402 0.1 $\mu$ F SMT Capacitor                | CLO5F104Z05NNNC    |
| D          | 0402 1.0 $\mu$ F SMT Capacitor                | CLO5A105K05NNNC    |
| E          | 0402 20 $\Omega$ SMT Resistor                 | CPF0402B20RE1      |
| F          | Marki Surface-Mount Bias Tee; 20 MHz – 30 GHz | BT-0030SMG         |

### Mechanical Data

### Outline Drawing

Download : [Outline 2D Drawing](#)



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