



CATV

Power Doubler Hybrid Module **ADCA3990**

75Ω 45 to 1218 MHz

FEATURES

High RF output: 76.8 dBmV total composite power or 67 dBmV virtual level
High gain of 24.5 dB at 1218 MHz
Very low distortion
 CTB and CSO: ≤ -82 dBc typical
 XMOD = -74 dBc typical
 CIN = 62 dB typical
Low noise figure: 3 dB at 45 MHz, 4 dB at 1218 MHz
Unconditionally stable
Transient and surge protection
V_{CC} range from 24 V to 34 V
Configurable current from 400 mA to 550 mA maximum
Industry-standard, 8-pin SOT115J module package

APPLICATIONS

45 MHz to 1218 MHz community access television (CATV)
 infrastructure amplifier systems
 Remote PHY (physical layer) and fiber deep nodes
 DOCSIS® 3.1 compliant

GENERAL DESCRIPTION

The ADCA3990 is a power doubler hybrid module packaged in the industry-standard SOT115J. The device achieves extremely high RF output, up to 76.8 dBmV composite power or 67 dBmV virtual level, by using advanced circuit design techniques, such as gallium arsenide (GaAs) pseudomorphic high electron mobility

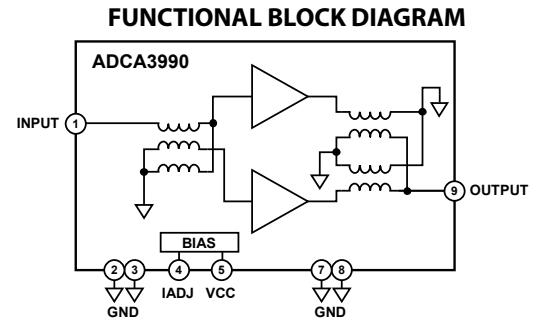


Figure 1.

transistor (pHEMT) die and gallium nitride (GaN) HEMT die. The dc current and supply voltage can be adjusted externally for optimum distortion performance vs. power consumption over a range of output levels.

This part was acquired by Mini-Circuits from Analog Devices on April 12, 2024.



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REVISION HISTORY

4/2024 - Revision A: Transferred from Analog Devices to Mini-Circuits

1/2020—Revision 0: Initial Version



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SPECIFICATIONS

GENERAL PERFORMANCE

Supply voltage (V_{CC}) = 34 V, flange temperature (T_{FLANGE}) = 35°C, source impedance (Z_S) = load impedance (Z_L) = 75 Ω, unless otherwise noted.

Table 1.

| Parameter | Symbol | Min | Typ | Max | Unit | Test Conditions/Comments |
|-------------------------------------|-------------------------|-----|------|-----|------|---|
| POWER GAIN | S ₂₁ | | 23.5 | | dB | f = 45 MHz |
| | | | 24.5 | | dB | f = 1218 MHz |
| SLOPE OF STRAIGHT LINE ¹ | SL | | 1.0 | | dB | f = 45 MHz to 1218 MHz |
| FLATNESS OF FREQUENCY RESPONSE | | | 0.6 | | dB | f = 45 MHz to 1218 MHz |
| RETURN LOSS | | | | | | |
| Input | S ₁₁ | | −23 | | dB | f = 45 MHz to 320 MHz |
| | | | −15 | | dB | f = 320 MHz to 640 MHz |
| | | | −15 | | dB | f = 640 MHz to 870 MHz |
| | | | −18 | | dB | f = 870 MHz to 1000 MHz |
| Output | S ₂₂ | | −14 | | dB | f = 1000 MHz to 1218 MHz |
| | | | −22 | | dB | f = 45 MHz to 320 MHz |
| | | | −24 | | dB | f = 320 MHz to 640 MHz |
| | | | −26 | | dB | f = 640 MHz to 870 MHz |
| | | | −24 | | dB | f = 870 MHz to 1000 MHz |
| | | | −22 | | dB | f = 1000 MHz to 1218 MHz |
| NOISE FIGURE | NF | | 3 | | dB | f = 45 MHz |
| | | | 4 | | dB | f = 1218 MHz |
| SUPPLY | | | | | | |
| Maximum Operating Voltage | V _{CC} | | 34 | | V | Can be biased down to 24 V |
| DC Current (Total) | I _{CC (TOTAL)} | | 535 | 550 | mA | Can be biased between 400 mA and 550 mA |

¹ Slope is defined as the delta between the gain at the start frequency and the gain at the stop frequency.

DISTORTION DATA (40 MHz TO 550 MHz)

V_{CC} = 34 V, T_{FLANGE} = 35°C, $Z_S = Z_L$ = 75 Ω, unless otherwise noted.

Table 2.

| Parameter | Symbol | Min | Typ | Max | Unit | Test Conditions/Comments |
|----------------------------------|--------|-----|------|-----|------|---|
| DISTORTION | | | | | | |
| Composite Triple Beat | CTB | | -82 | | dBc | Channel power (V_0) = 63 dBmV at 1218 MHz, 22 dB extrapolated tilt, 79 channels plus 111 digital channels (-6 dB offset) ¹ CTB is defined by the National Cable and Telecommunications Association (NCTA) |
| Crossmodulation | XMOD | | -74 | | dBc | XMOD is measured at baseband (selective voltmeter method) referenced to 100% modulation of the carrier being tested |
| Composite Second Order | CSO | | -87 | | dBc | CSO parameter (sum and difference products) is defined by the NCTA |
| Carrier to Intermodulation Noise | CIN | | 62 | | dB | CIN is defined by ANSI/SCTE 17 (test procedure for carrier to noise) |
| TOTAL COMPOSITE POWER | TCP | | 76.8 | | dBmV | See Figure 7 and Figure 8 |
| Virtual Level | | | 67 | | dBmV | |

¹ 79 analog channels plus 111 digital channels, National Television System Committee (NTSC) frequency raster = 55.25 MHz to 547.25 MHz, -6 dB offset to the equivalent analog carrier, and 22 dB extrapolated tilt.



**ABSOLUTE MAXIMUM RATINGS****Table 3.**

| Parameter | Rating |
|-------------------------------------|-----------------|
| VCC, IADJ | |
| DC Supply over Voltage (5 minute) | 38 V |
| RF Input Power | 75 dBmV |
| Operating Temperature Ranges | |
| Ambient (T_A) | -30°C to +85°C |
| Flange (T_{FLANGE}) | -30°C to +100°C |
| Storage Temperature (T_S) Range | -40°C to +100°C |

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

ESD CAUTION**ESD (electrostatic discharge) sensitive device.**

Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.



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PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

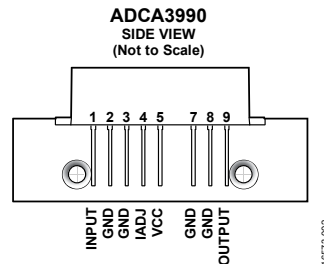


Figure 2. Pin Configuration

Table 4. Pin Function Descriptions

| Pin No. | Mnemonic | Description |
|------------|----------|--|
| 1 | INPUT | RF Input. |
| 2, 3, 7, 8 | GND | Ground. |
| 4 | IADJ | Bias Control Pin. Keep this pin floating for full bias operation. Do not pull negative voltages at this pin. |
| 5 | VCC | Positive Supply Voltage. 34 V typical. This pin can be biased down to 24 V. |
| 9 | OUTPUT | RF Output. |



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TYPICAL PERFORMANCE CHARACTERISTICS

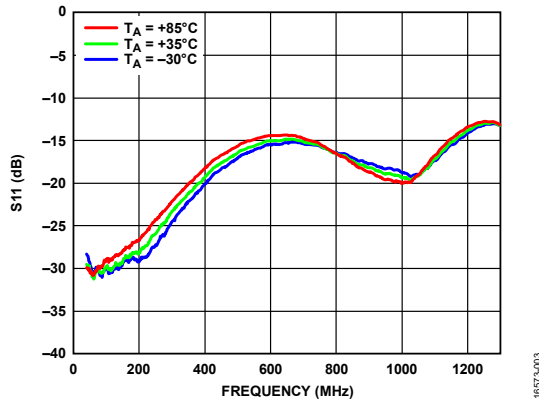
 $V_{CC} = 34\text{ V}$, $T_{FLANGE} = 35^\circ\text{C}$, $Z_S = Z_L = 75\ \Omega$, unless otherwise noted.

Figure 3. Input Return Loss (S11) vs. Frequency at Various Temperatures

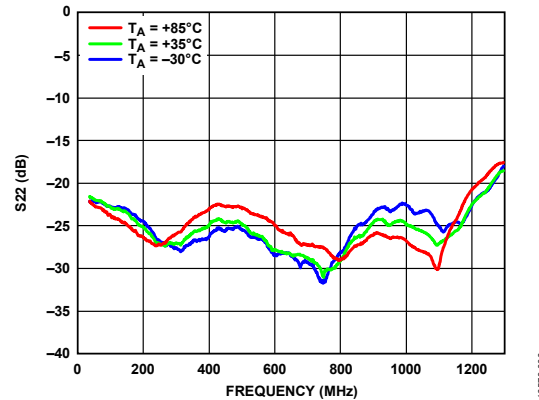


Figure 6. Output Return Loss (S22) vs. Frequency at Various Temperatures

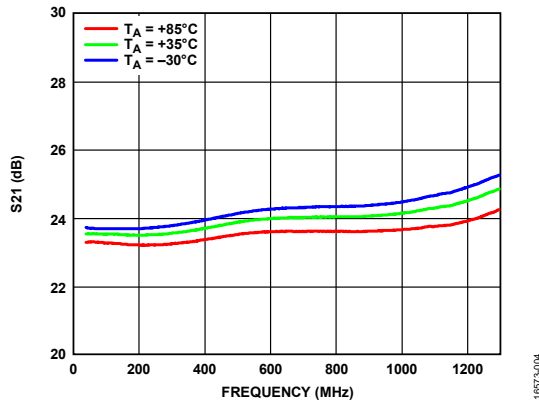


Figure 4. Gain (S21) vs. Frequency at Various Temperatures

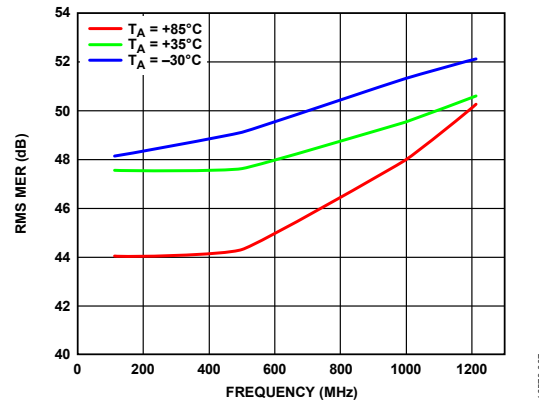
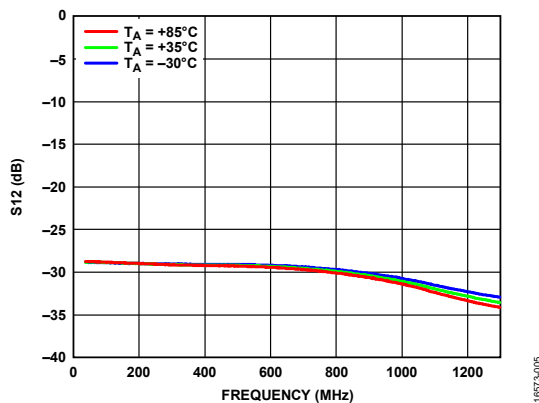
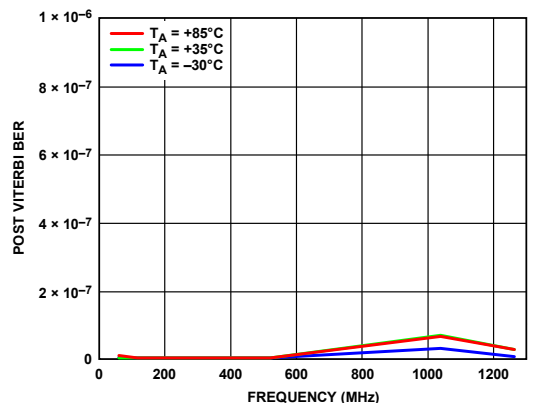
Figure 7. RMS Modulation Error Rate (MER) vs. Frequency at Various Temperatures, $V_0 = 61\text{ dBmV}$ at 1218 MHz, 23 dB Extrapolated Tilt, 190 Digital Channels, Total Composite Power = 76.8 dBmV

Figure 5. Reverse Isolation (S12) vs. Frequency at Various Temperatures

Figure 8. Post Viterbi Bit Error Rate (BER) vs. Frequency at Various Temperatures, $V_0 = 61\text{ dBmV}$ at 1218 MHz, 23 dB Extrapolated Tilt, 190 Digital Channels, Total Composite Power = 76.8 dBmV, 10 sec Integration Time



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THEORY OF OPERATION

The ADCA3990 is a 75 Ω input and output matched module designed for CATV applications. The ADCA3990 uses cascode field effect transistor (FET) feedback amplifiers in a Class A push pull configuration. The bottom half of the cascode stages are implemented in a single-die linear FET process that minimizes parasitics, thereby enabling higher gain. The top devices in the cascodes are implemented using a linear GaN process able to swing very high RF voltages. The frequency of operation is from 45 MHz to 1218 MHz.

Internally, the ADCA3990 module uses a balun to convert the input signal to a balanced signal that feeds the active stages. An output impedance transformer and balun combination converts the balanced GaN signals to an unbalanced 75 Ω output. The output transformer also feeds the dc to the active stages and cancels second-order distortion products coming from the active devices.

The module has a control pin (IADJ) to set the dc current consumption from low bias to the full bias of the device by connecting a resistor from this pin to ground or by the use of a positive voltage.

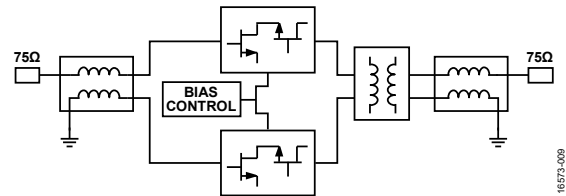


Figure 9. Simplified Schematic



APPLICATIONS INFORMATION

Basic connections for operating the ADCA3990 are shown in Figure 10. Both the input pin (Pin 1) and the output pin (Pin 9) of the ADCA3990 are matched to 75 Ω . Pin 5 is the VCC pin, which requires 34 V for typical operation, and can support as

low as 24 V for lower power operation. It is recommended to leave the IADJ pin (Pin 4) open for full bias operation. For bias control on the ADCA3990 supply current, apply an external control voltage between 0 V and 1 V at the IADJ pin.

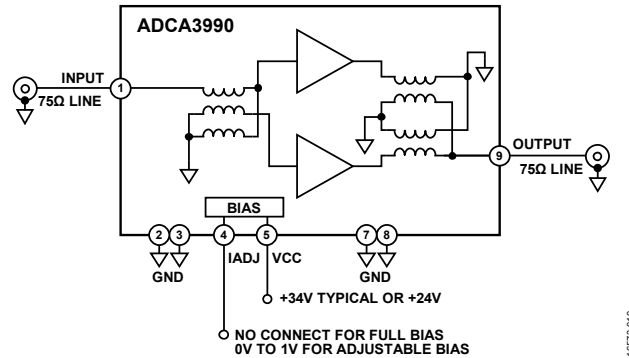


Figure 10. Basic Connections



OUTLINE DIMENSIONS

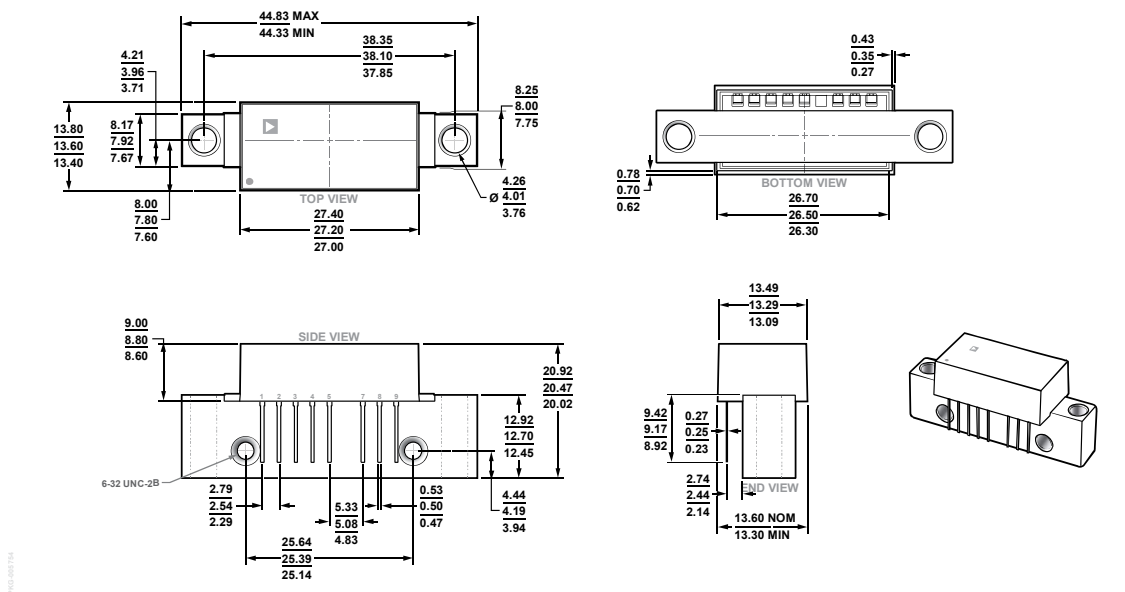


Figure 11. 8-Pin SOT115J Module Package [MODULE]
(ML-8-1)

Dimensions shown in millimeters

ORDERING GUIDE

| Model ¹ | Temperature Range | Package Description | Package Option |
|--------------------|-------------------|---|----------------|
| ADCA3990AMLZ | -30°C to +100°C | 8-Pin SOT115J Module Package [MODULE], Box with 25 Pieces | ML-8-1 |

¹ Z = RoHS Compliant Part.

NOTES

- Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
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