mmTron
Unleashing the mmWave Frontier

TMC162-D

DC-20 GHz Distributed Low Noise Amplifier

Product Features

- RF frequency: DC to 20 GHz
- Linear Gain: 19 dB
- Noise Figure: 2.0 dB
- Die Size: X=3.22 mm, Y=1.55 mm, Z=0.1mm
- DC Power: 8 VDC, 160 mA

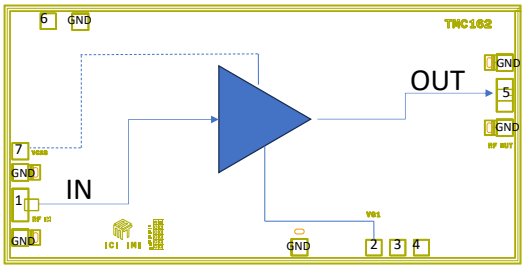
Applications

- Point-to-Point Radios and VSATs
- Test instrumentation
- Fiber Optics
- Military, EW and Space

Product Description

The TMC162-D GaAs PHEMT Distributed amplifier is a broadband low noise and high linearity device, designed for use in Radios, Test instrumentation, Military, OC192 LN/MZ Modulator Driver, EW and Space applications. The TMC162-D is a 50 Ω matched design providing < 2.0dB of noise figure, 19dB of gain and 31dBm of OIP3 and eliminates the need for RF port matching. The typical bias for TMC162-D is 8V and 160mA but it can be biased for lower noise operation to as low as 5V and 125mA with excellent performance. Both bond pad and backside metallization are Au-based that is compatible with ribbon and wedge bonding and high conductivity epoxy and eutectic die attach methods. The packaged version is available as TMC162-P5 in a 20 lead 5x5 QFN.

Functional Block Diagram



Ordering Information

Part No.	Description
TMC162-D	Bare Die[1]
TMC162-P5	20-lead 5x5 QFN

1- See assembly techniques for die attach options

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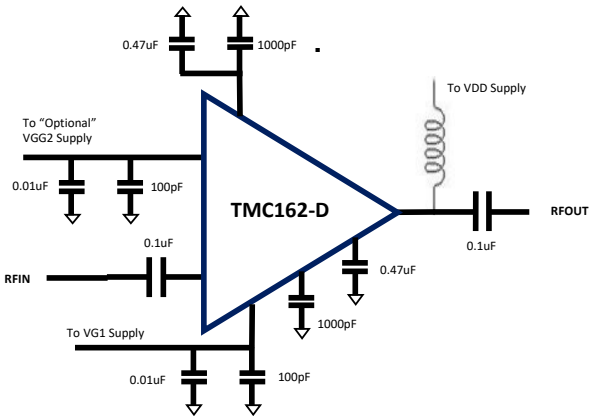
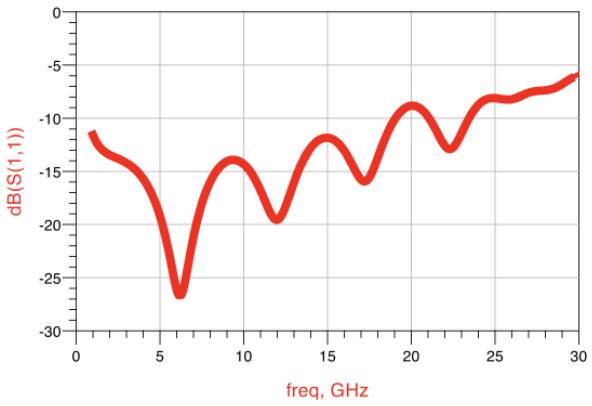
Typical Operating Conditions

	Min	Typ	Max	
Frequency	DC		20	GHz
Gain		19		dB
P1dB		24		dBm
Psat		25		dBm
Noise Figure		2.0		dB
OIP3		31		dBm
Bias Voltage		8		V
Bias Current		160		mA

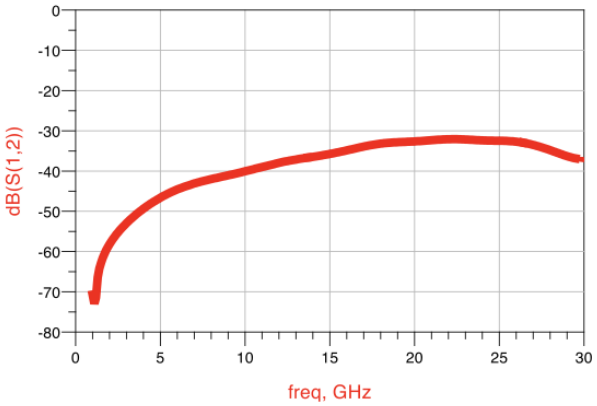
Application Circuit TMC162



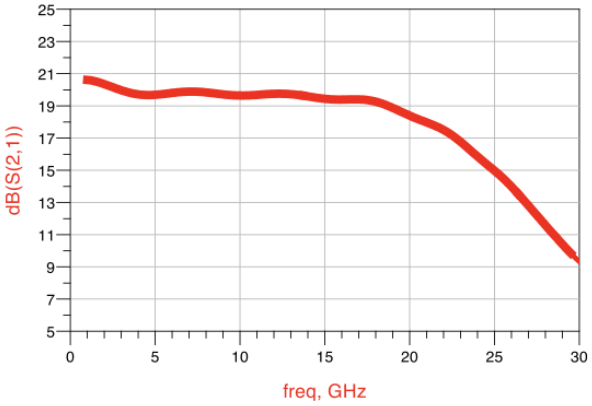
TMC162 Input Return Loss



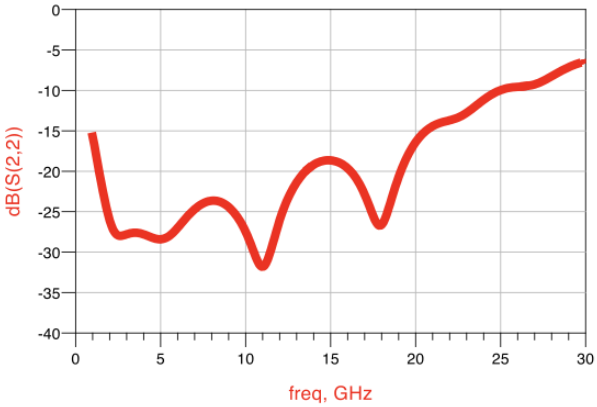
TMC162 Reverse Isolation



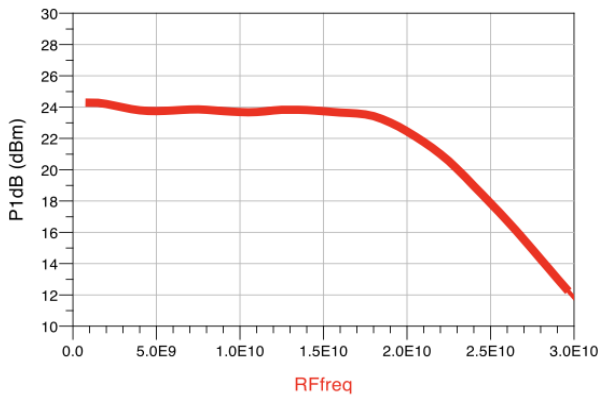
TMC162 Gain



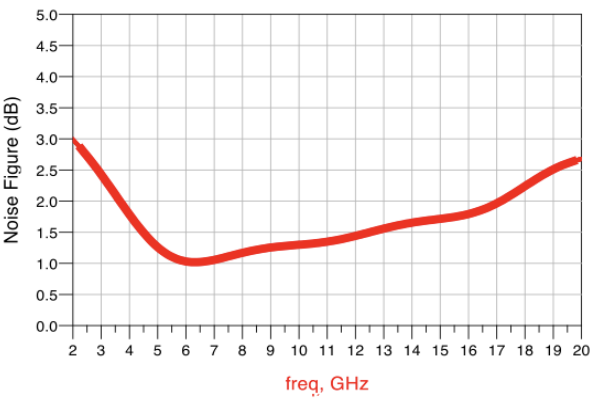
TMC162 Output Return Loss



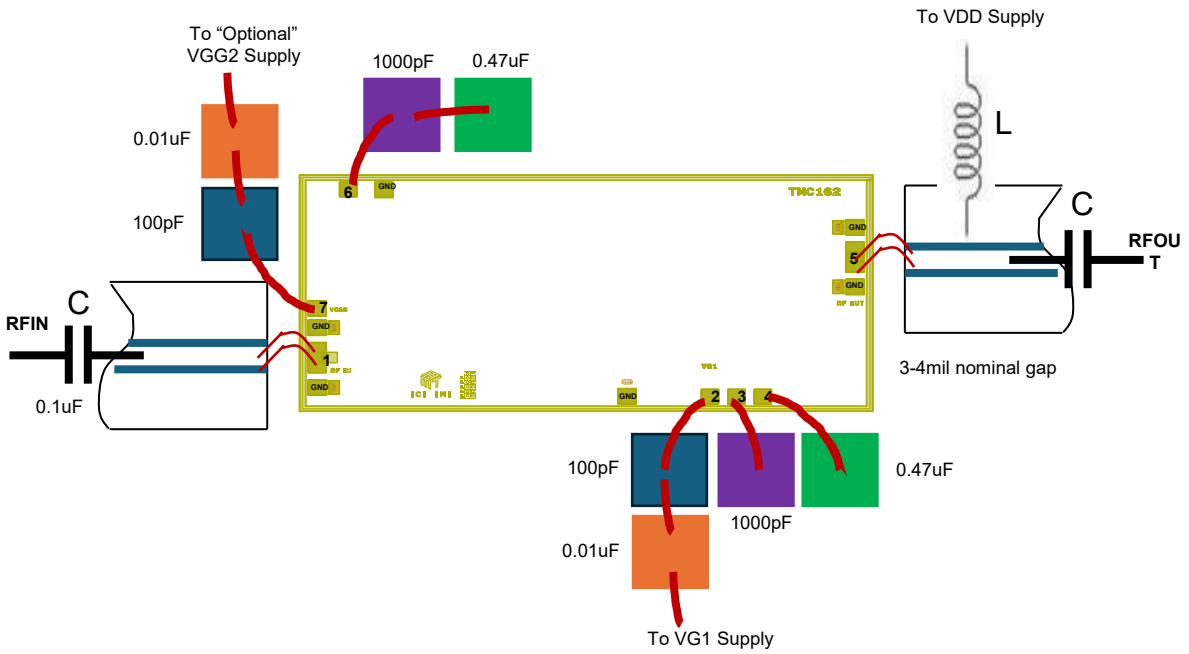
TMC162 P1dB



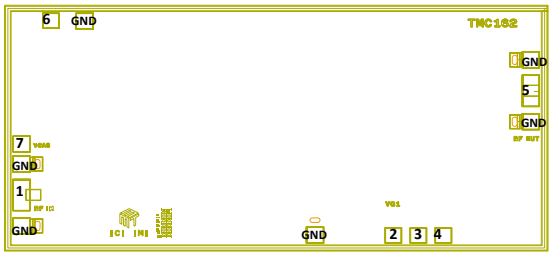
TMC162 Noise Figure



Assembly Drawing



Bare Die Layout Drawing and Functional Description



Pad#	Function	Description
1	RF INPUT	This pad is DC coupled and matched to 50 Ohms. Blocking capacitor is required.
2	VGG1 Bias	Gate control 1 for amplifier. Attach 100pF/0.01uF bypass capacitors.
3	ACG1	Low frequency termination. Attach 1000pF chip bypass capacitor.
4	ACG2	Low frequency termination. Attach 0.47uF chip bypass capacitor.
5	RF OUTPUT & VDD	RF output for amplifier. Connect DC bias (Vdd) network to provide drain current (Idd). See application circuit herein.
6	ACG3	Low frequency termination. Attach 100pF/0.01uF chip bypass capacitors.
7	VGG2 (VCAS)	Gate 2 for amplifier. Attach 100pF/0.01uF chip bypass capacitors. Typical operation has VGG2(VCAS) biased internal to IC. Setting VGG2 externally can be used to adjust NF, Gain and OIP3.

Recommended Biasing

The TMC162-D is operated with one positive supply VDD and one negative supply voltage VGG. The positive supply must be connected to the output pad through a bias-T. The negative voltage VGG should be connected to VG1 pad on the die. The VGG is biased to -1V first, then VDD is gradually biased to +8V and finally, VG1 is adjusted to around -0.6V for IDD=160mA DC current.

Reverse the sequence during power down, i.e. bring the VGG to -1V, lower VDD to 0V, and then VGG to 0.

Assembly Techniques

The TMC162-D is fabricated using a GaAs-based semiconductor material structure. All bare die are placed Gel based ESD protective containers, and then sealed in an ESD protective bag for shipment. Once the sealed ESD protective bag has been opened, all die should be stored in a humidity-controlled dry nitrogen environment.

Use a vacuum collet sized to handle the chip along the edges to avoid touching the air bridges. The die is back-metalized and can be mounted with standard AuSn eutectic or conductive epoxy assembly techniques. The mounting surface should be clean and flat.

Eutectic Die Attach:

The most common eutectic alloy used in die attach is the gold-tin (AuSn) alloy. With a melting point of 280°C, it provides a strong, reliable bond without requiring excessively high temperatures that could potentially damage the die or the substrate. Eutectic die attach is generally performed in a two-step process. First, the eutectic alloy is deposited onto the die or substrate, often by a process such as electroplating or sputtering. This forms what is known as the "preform". Next, the die is placed onto the preform, and the assembly is heated to the melting point of the alloy. This causes the alloy to reflow, spreading out to cover the entire interface between the die and the substrate. Once cooled, the alloy solidifies, creating a robust bond between the die and the substrate. A 80/20 AuSn preform with a work surface temperature of 255 °C is recommended. The tool temperature of 265 °should be used. The chip should not be exposed to a temperature greater than 300 °C for more than 45 seconds. A maximum 3 seconds of scrubbing should be sufficient for die attachment.

Epoxy Die Attach:

Apply a minimum amount of epoxy such as Ablestick 84-1LMI m(0.25-0.75mil) to the mounting surface so that a thin epoxy fillet is observed around the perimeter of the chip once it is placed into position. Cure epoxy per the manufacturer's schedule. The epoxy fillet around the die should be approximately half-way up the side of the 4-mil thick MMIC. Too little epoxy may lead to voids, too much epoxy may lead to stringers and shorts to the front-side metal.

Wire Bonding:

RF wedge bonds made with two 1 mil wires are recommended for RF ports. A single 1mil wire can be used for DC pads. Ensure the bonding tool is grounded. These bonds could be bonded thermosonically with a force of 50 grams and a stage temperature of 150 °C. Use a shim under the die to bring the top surface of the die level with the RF input and output transmission line to shorten wirebonds to < 10mil.

Absolute Maximum Ratings

Parameter	Value / Range
Drain Bias Voltage (VDD)	+10 V
Gate Bias Voltage (VG1)	-2 to 0 V
Gate Bias Current (IG1)	+4 mA
RF Input Power (RFIN) (VDD=+8V)	+25 dBm
Channel Temperature	175 °C
Continuous Pdiss, (T=85°C) (derate 40 mW/°C above 85 °C)	2.56 W
Thermal Resistance (channel to die bottom)	35.2 °C/W
Storage Temperature	-65 to +150 °C
Operating Temperature for MTTF>1E6 hrs.	-55 to +125 °C

NOTE: Operation of TMC162 outside the parameter ranges given above can cause irreversible damage.



Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. mmTron Inc. recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications. III-V MMICs are ESD-sensitive. Preventative ESD measures must be employed in all aspects of storage, handling, and assembly. MMIC ESD precautions, handling considerations, and die-attach and bonding methods are critical factors in successful III-V MMIC performance and reliability.



RoHS Compliant

This part is RoHS compliant, meeting the requirements of the EU Restriction of Hazardous Substances Directive 2002/95/EC, commonly known as RoHS. Six substances are regulated: lead, mercury, cadmium, chromium VI (hexavalent chromium), polybrominated biphenyls (PBB), and polybrominated biphenyl ethers (PBDE). RoHS compliance requires that any residual concentration of these substances is below the Directive's maximum concentration values (MCV): cadmium 100ppm by weight and all others 1000ppm by weight.

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