TAT7457

75Ω pHEMT Adjustable Gain RF Amplifier

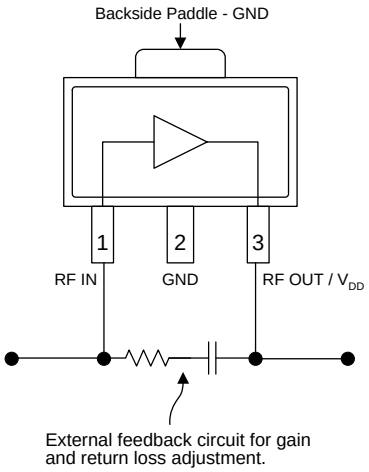
Product Overview

The TAT7457 is a low-cost RF amplifier designed for applications from DC to 2000 MHz. The balance of low noise and distortion provides an ideal solution for a wide range of broadband amplifiers used in cable television applications such as optical receivers and low noise front ends.

The TAT7457 has features allowing a great deal of design-in flexibility. Gain and return loss are adjustable with an external feedback resistor. An internal bias circuit mitigates the effect of temperature and process variation and an external resistor may be used to adjust the bias current to optimize distortion or noise performance. There are no on-chip capacitors limiting the low frequency response which extends down to DC.

The TAT7457 is fabricated using 6-inch GaAs pHEMT technology to optimize performance and cost. It provides excellent gain and return loss consistency inherent to the pHEMT process.

Functional Block Diagram



Top View

SOT-89 Package

Key Features

- Gain, return loss and bias externally adjustable
- On-chip active bias for consistent bias current and repeatable performance
- DC – 2000 MHz bandwidth
- Low noise: typical NF < 2 dB to 1000 MHz
- Flexible 5 V to 8 V biasing
- I_{DD} = 120 mA typical at V_{DD} 5 V in application circuit
- 19 dB typical gain in application circuit
- +40 dBm typical OIP3
- +61 dBm typical OIP2
- +21 dBm typical P1dB
- Low distortion: CSO -66 dBc, CTB -78 dBc
- (10 dBmV / ch at input, 80 ch NTSC flat)
- pHEMT device technology

Applications

- Single-ended and Push-pull Optical Receivers
- Low-noise Drop Amplifiers
- Distribution Amplifiers
- Multi-Dwelling Units
- Single-ended Gain Block

Ordering Information

Part Number	Ordering Info	Description
TAT7457	1074961	TAT7457 Sample (1 piece)
TAT7457EB	1074962	50-1200MHz Evaluation Board
TAT7457TR	1074959	1000 pieces on a 13” reel

Absolute Maximum Ratings

Parameter	Rating
Storage Temperature Range	−65 to +150 °C
Device Voltage	+10 V

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Unit
V_{DD}	5		8	V
I_{DD}		120		mA
Tj for >10^6 hours MTTF			+150	°C

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

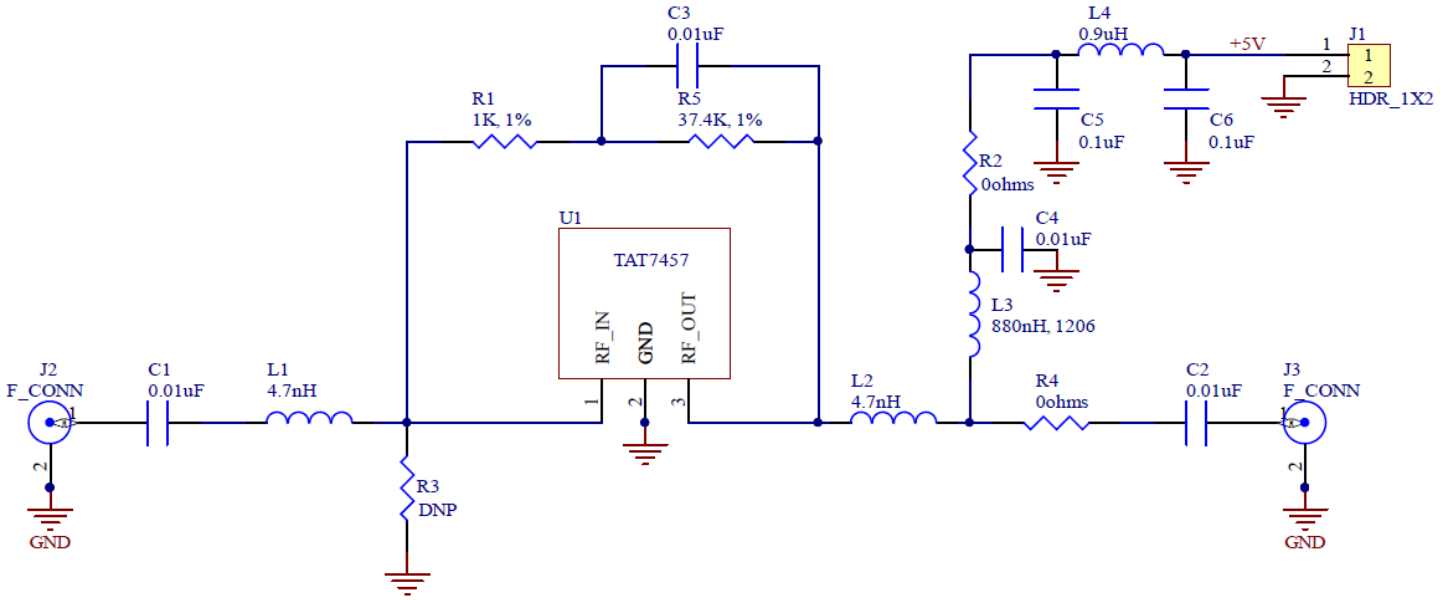
Electrical Specifications

Parameter	Condition (1)	Min	Typ	Max	Unit
Frequency Range		DC		1200	MHz
Gain	50-1000 MHz		19		dB
Gain Flatness			+/-0.7		dB
Noise Figure			2.0		dB
Input Return Loss			18		dB
Output Return Loss			18		dB
Gain	50-1200 MHz		19		dB
Gain Flatness			+/-0.7		dB
Noise Figure			2.3		dB
Input Return Loss			14		dB
Output Return Loss			17		dB
Output P1dB			+21		dBm
Output IP2	f1=225 MHz, f2= 325 MHz Pout=+5 dBm / tone		61		dBm
Output IP3			40		dBm
CSO	10 dBmV / ch at input, flat loading, 80 channels NTSC+QAM up tp 1218 MHz		-66		dBc
CTB			-78		dBc
Thermal Resistance, θ_{jc}	Junction to Case		38		°C/W

Notes:

1. Typical performance at these conditions: Temp = +25 °C, V_{DD} = +5 V, 75 Ω system

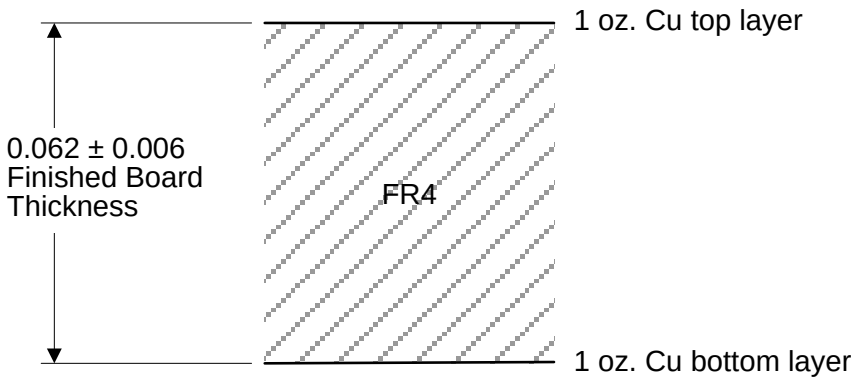
Evaluation Board Schematic

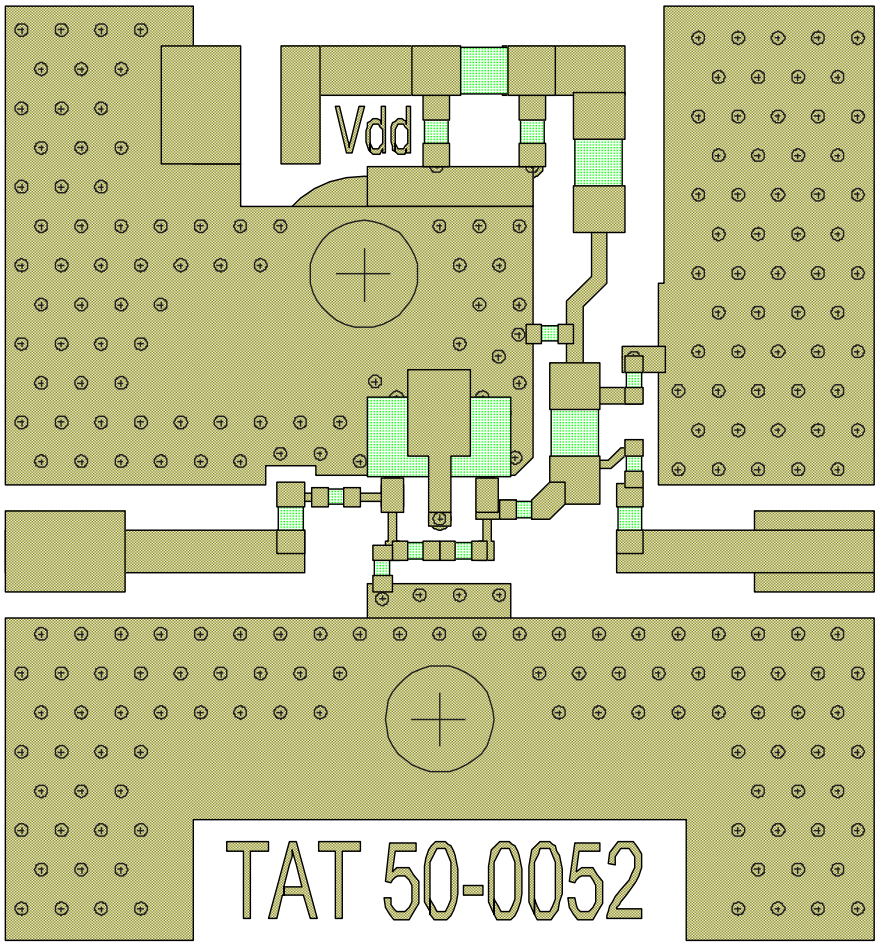


Evaluation Board Bill of Materials

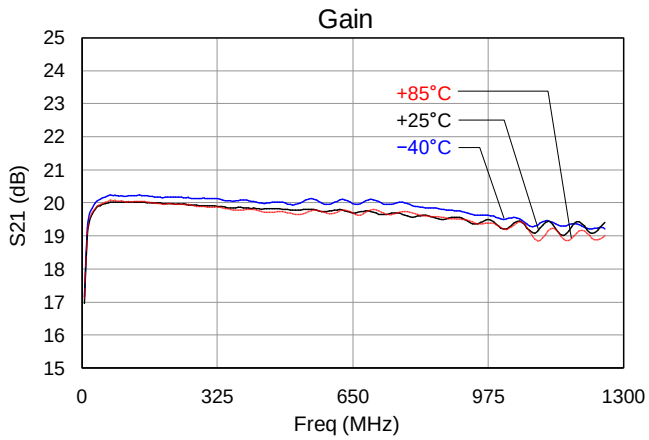
Ref Designator	Description	Manufacturer	Part Number
PCB	PCB, TAT7547	Qorvo	TAT 50-0052
U1	Amplifier, SOT-89	Qorvo	TAT7457
R1	RES, 1 kΩ, 1%, 1/10W, 0402	Kamaya	RMC1/16SK1001FTH
R2	RES, 0 Ω, 1/4W, 1206	Kamaya	RMC1/8JPTP
R3	DNP	N/A	N/A
R4	RES, 0 Ω, 0402	Kamaya	RMC1/16SJPTH
R5	RES, 37.4 kΩ, 1%, 1/10W, 0402	Panasonic	ERJ-2RKF3742X
C1, C2	CAP, 0.01uF, 10%, 50V, X7R, 0603	Kemet	C0603C103K5REC7867
C3, C4	CAP, 0.1uF, 10%, 25V, X7R, 0603	Murata	GCM155R71H103KA55D
C5, C6	CAP, 0.1uF, 10%, 25V, X7R, 0603	Kemet	C0603C104K3RACTU
L1, L2	IND, 4.7 nH, 5%, W/W, 0402	Coilcraft	0402CS-4N7XJLW
L3	IND, 880 nH, +/-5%, 1206	Murata	LQH31HNR88J03
L4	IND, 0.9 uH, 10%, 1.3A, W/W, 1008	Coilcraft	1008AF-901XZKL
J1	CONN, HDR, RT ANG, 2 PIN, 0.100", T/H	Molex	022-28-8021
J2, J3	CONN. 75 OHM, EDGE LAUNCH F	Lighthorse Technology	LTI-FSF55NT-P

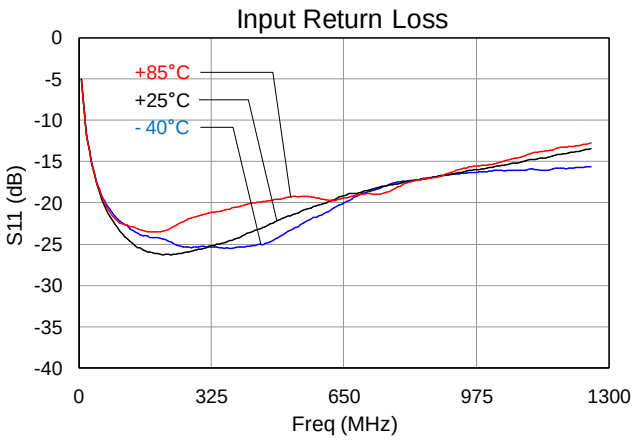
Evaluation Board PCB Stack Up and Material

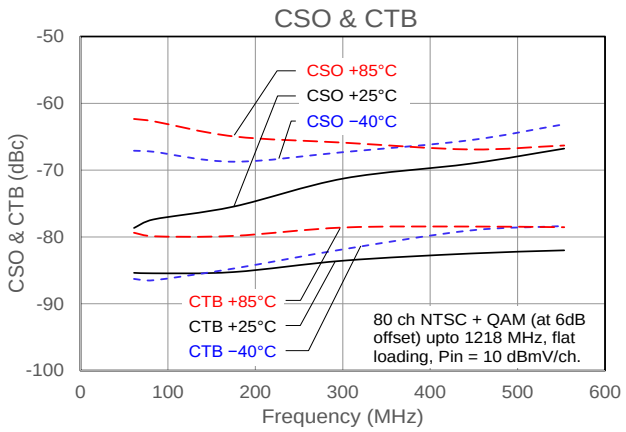


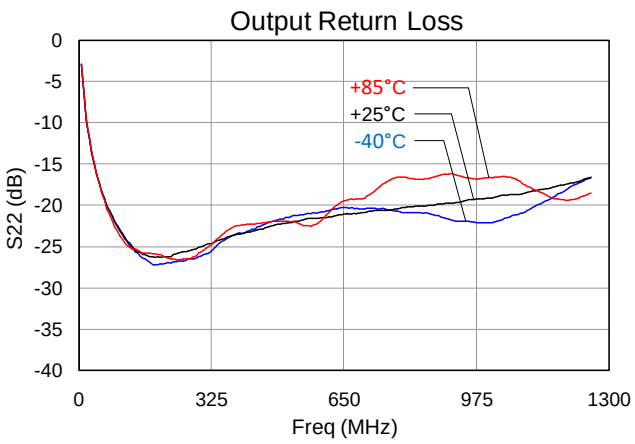


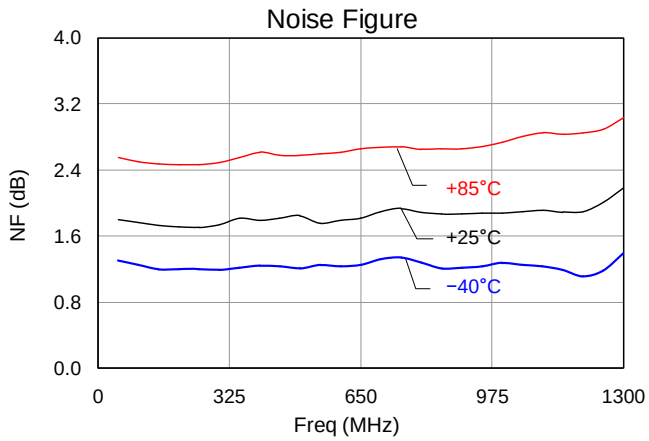
Performance Data at V_{DD} = 5 V









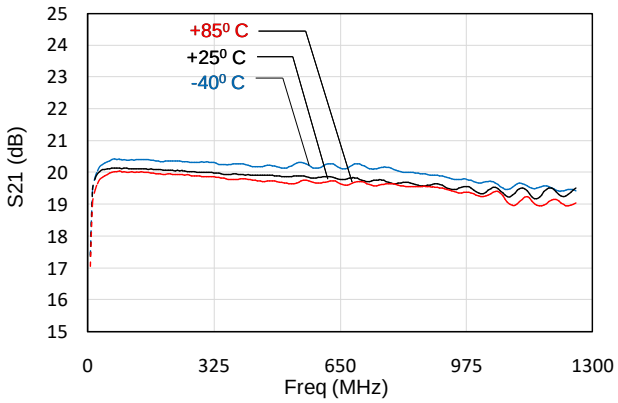


Notes:

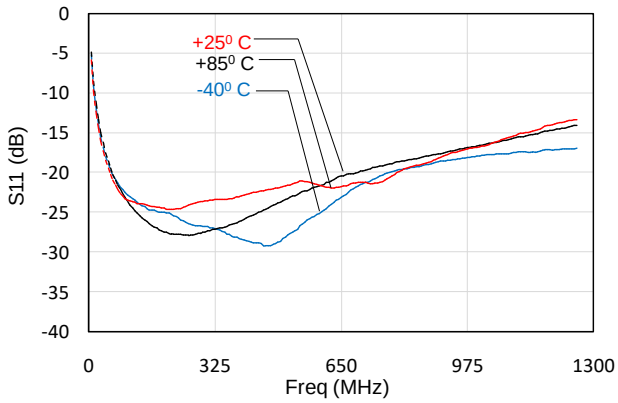
(1) VDD = +5 V, IDD = 120 mA

Performance Data at V_{DD} = 8 V

Gain

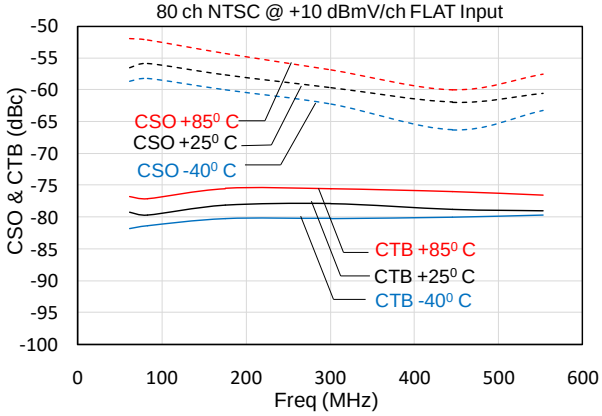


Input Return Loss

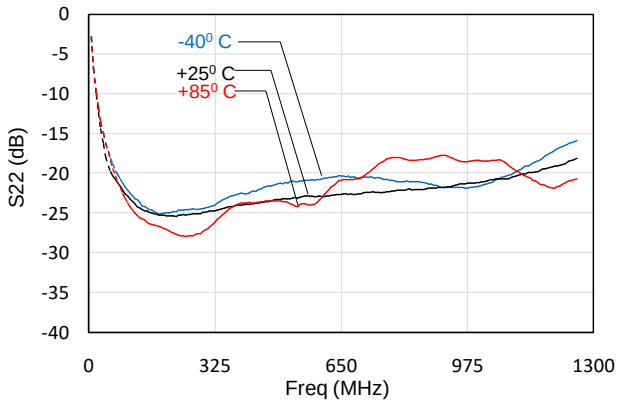


CSO & CTB

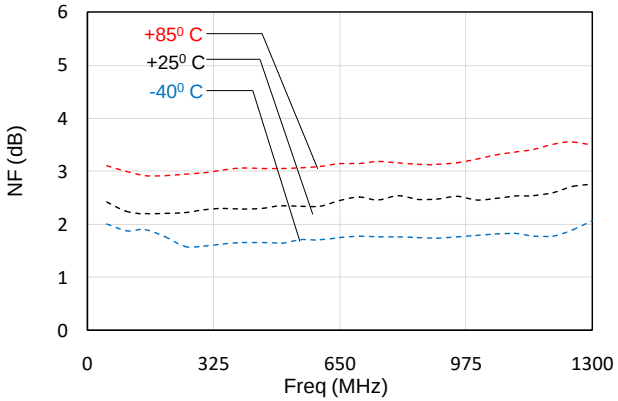
80 ch NTSC @ +10 dBmV/ch FLAT Input



Output Return Loss



Noise Figure

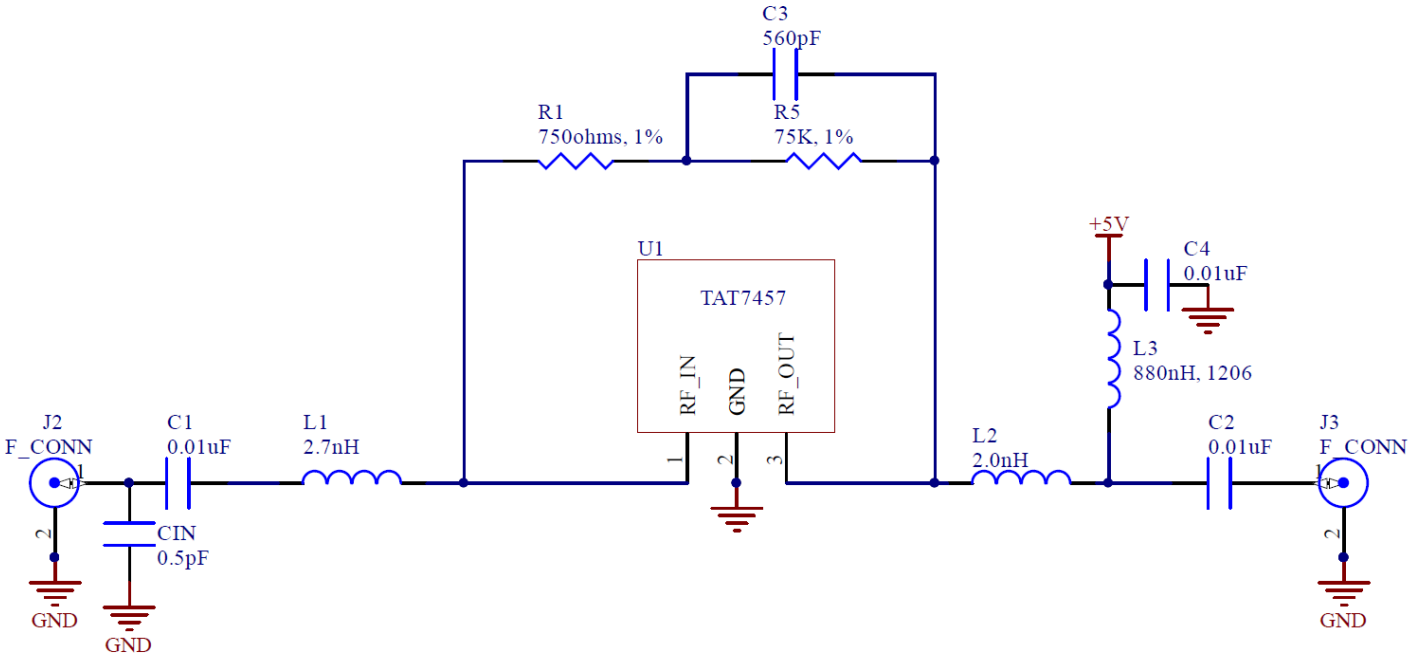


Notes:

(1) VDD = +8 V, IDD = 140 mA

(2) IDD adjusted with an external supply, similar to adjusting R3 and R5.

Additional Applications; 2 GHz Satellite

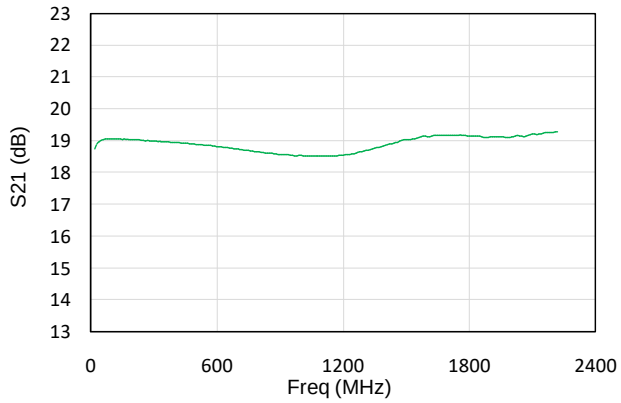


Evaluation Board Bill of Materials; 2.0 GHz Satellite

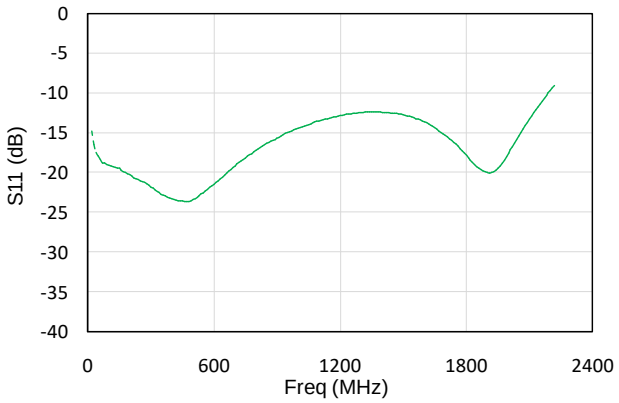
Ref Designator	Description	Manufacturer	Part Number
PCB	TAT7547	Qorvo	TAT 50-0052
U1	Amplifier, SOT-89	Qorvo	TAT7457
R1	RES, 750 Ω, 1%, 0402	Panasonic	ERJ-2RKF7500X
R5	RES, 75 kΩ, 5%, 0402	Panasonic	ERJ-2GEJ753X
C1, C2	CAP, 0.01 uF, 10%, X7R, 16V, 0603	Murata	GRM188R71H103KA010D
C3	CAP, 560 pF, 10%, X7R, 16V, 0402	Murata	GCM155C1H561J16D
C4	CAP, 0.01 uF, 10%, X7R, 25V, 0402	Murata	GRM155R71E103JA01D
CIN	CAP, 0.5 pF +/-0.1 pF, 50V, C0G, 0603	Murata	GRM1885C1HR50BA01D
L1	IND, 2.7 nH, 5%, 0402	Murata	LQG15HS2N7S02D
L2	IND, 2.0 nH, 5%, 0402	Murata	LQG15HS2N0S02D
L3	IND, 880 nH, 10%, 1206	Murata	LQH31HNR88J03
J1	CONN, HDR, RT ANG, 2 PIN, 0.100", T/H	Molex	022-28-8021
J2, J3	CONN. 75 OHM, EDGE LAUNCH F	Lighthorse Technology	LTI-FSF55NT-P

Performance Data; 2.0 GHz Satellite

Gain

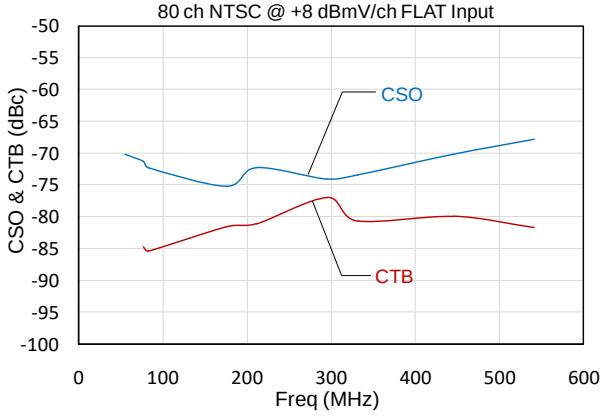


Input Return Loss

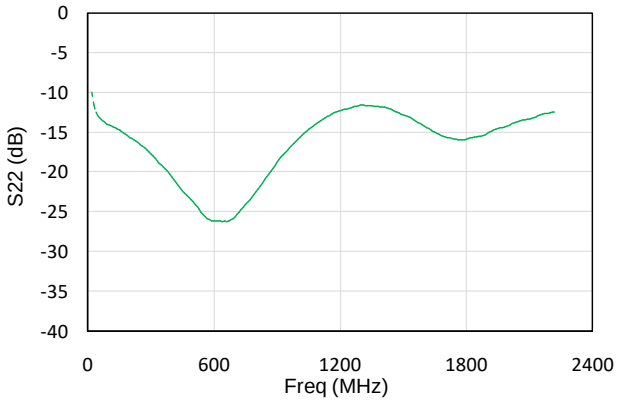


CSO & CTB

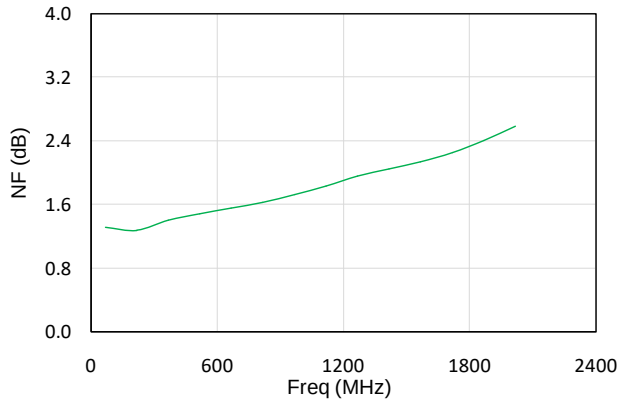
80 ch NTSC @ +8 dBmV/ch FLAT Input



Output Return Loss



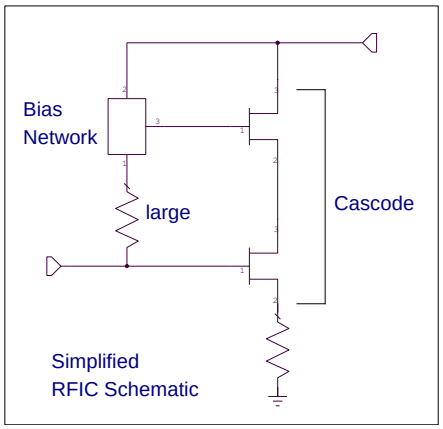
Noise Figure



Notes:

(1) VDD = +5 V, IDD = 120 mA

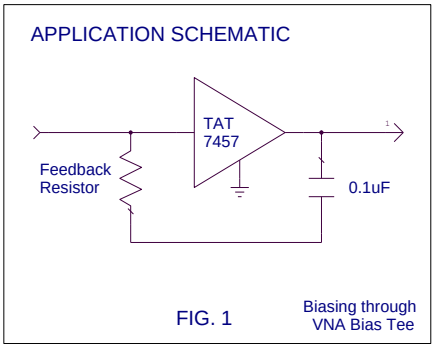
Detailed Device Description



The TAT7457 was designed to be a low cost general purpose amplifier suitable for a wide range of applications.

The TAT7457 is a high gain cascode amplifier with no internal shunt feedback.

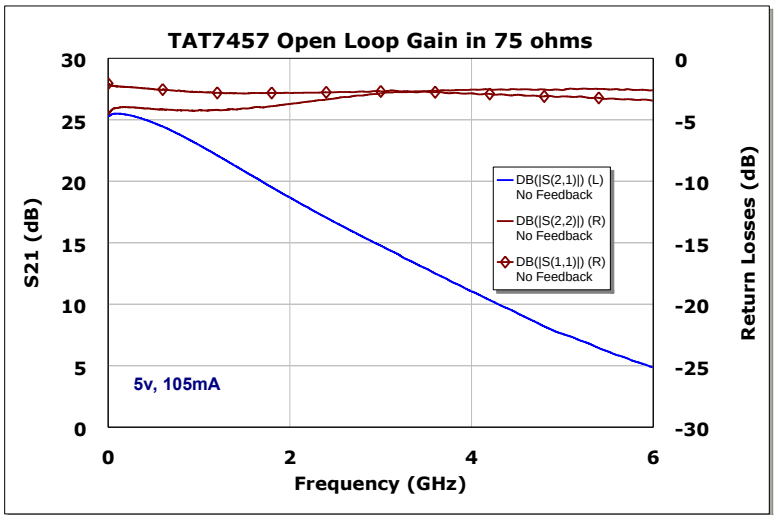
An on-chip biasing network sets the operating conditions for the FETs. This network stabilizes bias current against changes in temperature as well as against the normal process variations expected from wafer to wafer. Stabilized bias current will lead to more consistent RF performance.



Customers may set the gain and return loss of their amplifier by selecting an appropriate external feedback resistor.

Reducing the value of the feedback resistor will reduce the gain and lower the input and output impedances.

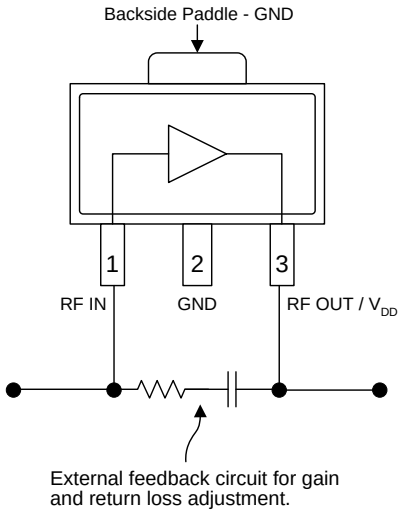
Low noise TIA designers may set the value of feedback to a high value (>1k ohm) for best performance.



There are no on-chip capacitors that limit the low frequency response, enabling the TAT7457 frequency response to extend to DC. The open loop gain (no external feedback) and high frequency gain performance is shown in the plot to the left.

Distortion and noise performance may be optimized with simple changes to the application circuit (refer to the EVB Schematic on page 3). Noise performance may be improved by adding a large resistor R3 of approximately 20K to ground. This resistor will reduce the bias current and improve noise. Best distortion occurs on a 6V supply; however, for improved distortion on a 5V supply, bias current may be increased by adding a large pull up resistor, R5, of approximately 75 kΩ in parallel with the feedback capacitor.

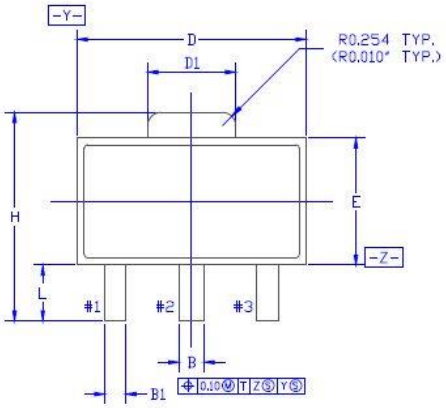
Pin Configuration and Description



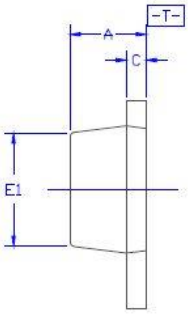
Top View

Pin Number	Label	Description
1	RF IN	RF Input
2	GND	Internally Not Connected
3	RF OUT/VDD	RF Output
Backside Paddle	GND	Ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint.

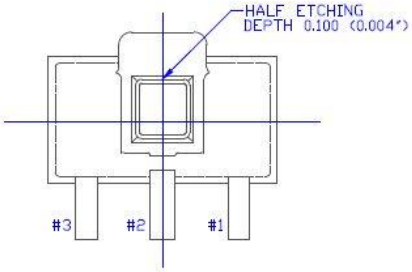
Package Dimensions



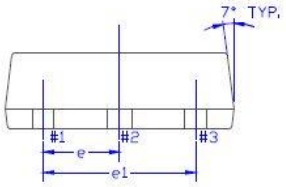
TOP VIEW



SIDE VIEW



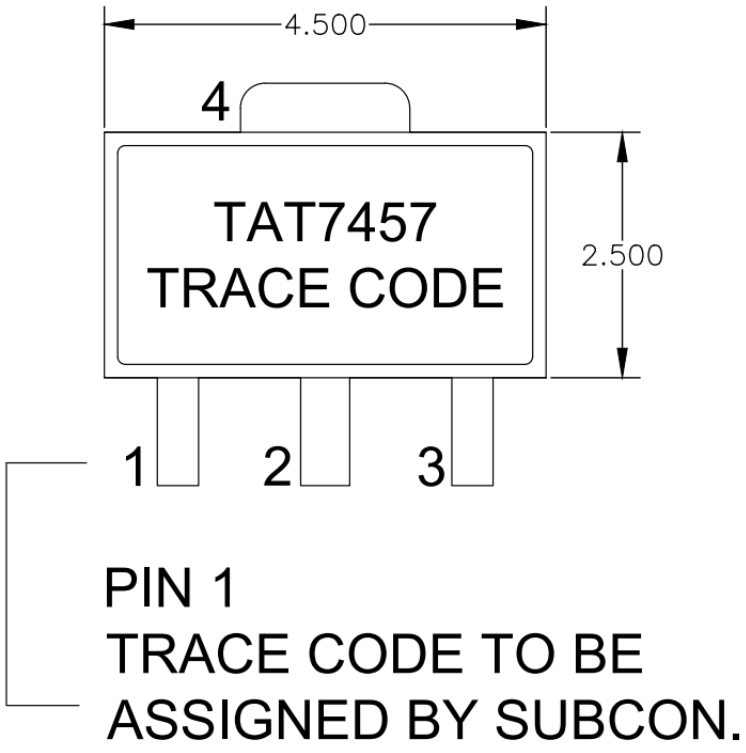
BOTTOM VIEW



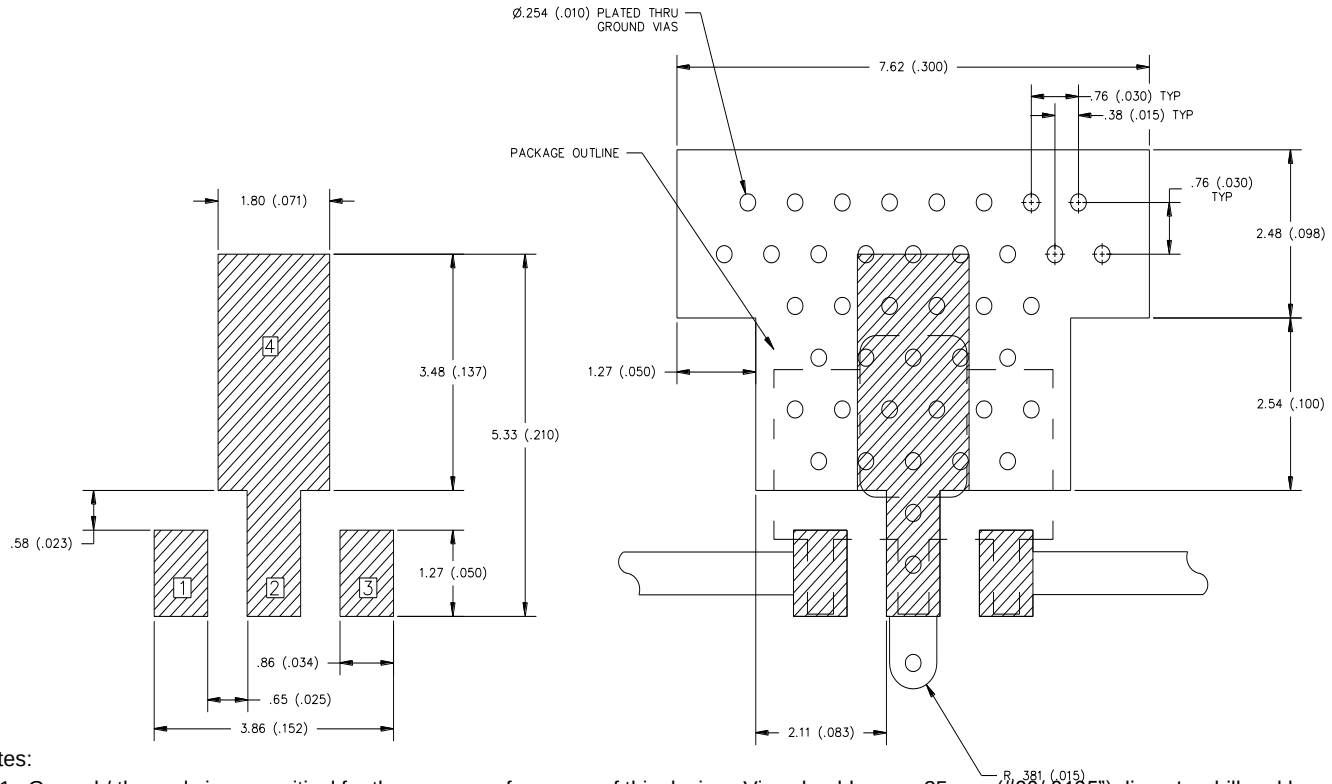
SIDE VIEW

SYMBOL	Common					
	DIMENSIONS MILLIMETER			DIMENSIONS INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.40	1.50	1.60	0.055	0.059	0.063
B	0.44	0.50	0.56	0.017	0.020	0.022
B1	0.36	0.42	0.48	0.014	0.017	0.019
C	0.35	0.40	0.44	0.014	0.016	0.017
D	4.40	4.50	4.60	0.173	0.177	0.181
D1	1.62	1.73	1.83	0.064	0.068	0.072
E	2.30	2.50	2.60	0.091	0.098	0.102
E1	2.13	2.20	2.29	0.084	0.087	0.090
e	1.50 BSC.			0.059 BSC.		
e1	3.00 BSC.			0.118 BSC.		
H	3.95	4.10	4.25	0.156	0.161	0.167
L	0.90	1.10	1.20	0.035	0.043	0.047

Package Marking



PCB Mounting Pattern



Notes:

1. Ground / thermal vias are critical for the proper performance of this device. Vias should use a .35 mm (#80/.0135") diameter drill and have a final, plated thru diameter of .25 mm (.010").
2. Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.
3. RF trace width depends upon the PC board material and construction.

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1C (2000V)	ESDA / JEDEC JS-001-2014
ESD – Charged Device Model (CDM)	Class C3 (>1000V)	JEDEC JESD22-C101F
MSL– Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

Solderability

Compatible with both lead-free (260 °C max. reflow temp.) and tin/lead (245 °C max. reflow temp.) soldering processes.
Solder profiles available upon request.

Contact plating: NiPdAu

RoHS Compliance

This part is compliant with 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

Tel: **1-844-890-8163**

Web: **www.qorvo.com**

Email: **customer.support@qorvo.com**

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