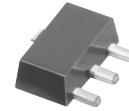


Monolithic Amplifier

DC-6 GHz

Product Features

- High gain, 25 dB typ. at 100 MHz
- High IP3, 35 dBm typ.
- High Pout, P1dB 19 dBm typ.
- Transient protected
- Excellent ESD Protection
- Unconditionally stable
- Protected by US patent 6,943,629

**Gali=24+**

+ RoHS compliant in accordance with EU Directive (2002/95/EC)

The +Suffix has been added in order to identify RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications.

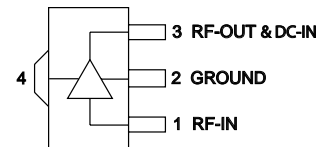
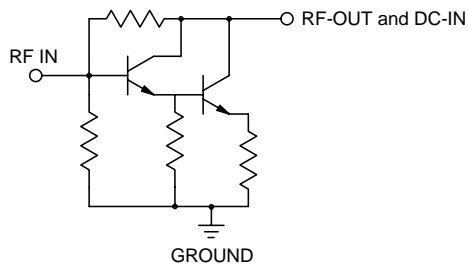
Typical Applications

- Base station infrastructure
- Portable Wireless
- CATV & DBS
- MMDS & Wireless LAN

General Description

Gali=24+ (RoHS compliant) is a wideband amplifier offering high dynamic range. Lead finish is SnAgNi. It has repeatable performance from lot to lot and is enclosed in a SOT-89 package. It uses patented Transient Protected Darlington configuration and is fabricated using InGaP HBT technology. Expected MTBF is 2750 years at 85°C case temperature. Gali=24+ is designed to be rugged for ESD and supply switch-on transients.

simplified schematic and pin description



Function	Pin Number	Description
RF IN	1	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation.
RF-OUT and DC-IN	3	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit".
GROUND	2,4	Connections to ground. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance.

Electrical Specifications at 25°C and 80 mA, unless noted

Parameter		Min.	Typ.	Max.	Units	Cpk
Frequency Range		DC		6	GHz	
Gain	f=0.1GHz f=1 GHz f=2 GHz f=3 GHz f=4 GHz f=6 GHz	24.0 18.1 14.2	25.3 22.6 19.1 16.6 14.9 12.4	26.6 20.1 15.6	dB	≥1.5
Magnitude of Gain Variation versus Temperature (values are negative)	f=0.1GHz f=1 GHz f=2 GHz f=3 GHz f=4 GHz f=6 GHz		.0021 .0035 .0045 .0056 .0074 .0154	0.0090	dB/°C	
Input Return Loss	f=0.1 GHz f=1 GHz f=2 GHz f=3 GHz f=4 GHz f=6 GHz	14	21.6 20.4 17.5 15.4 14.9 19.0		dB	
Output Return Loss	f=0.1 GHz f=1 GHz f=2 GHz f=3 GHz f=4 GHz f=6 GHz	7	18.5 11.5 9.1 8.8 8.8 7.2		dB	
Reverse Isolation	f=2 GHz		26.7		dB	
Output Power @1 dB compression	f=0.1 GHz f=1 GHz f=2 GHz f=3 GHz f=4 GHz f=6 GHz	18.3 18.2 18.4	19.3 19.2 19.4 19.3 18.1 14.7		dBm	≥1.5
Saturated Output Power (at 3dB compression)	f=0.1 GHz f=1 GHz f=2 GHz f=3 GHz f=4 GHz f=6 GHz		21.1 20.9 21.0 20.4 19.1 16.0		dBm	
Output IP3	f=0.1 GHz f=1 GHz f=2 GHz f=3 GHz f=4 GHz f=6 GHz	30.4 31.5 32.7	33.8 35.0 36.3 35.3 33.1 30.3		dBm	≥1.5
Noise Figure	f=0.1 GHz f=1 GHz f=2 GHz f=3 GHz f=4 GHz f=6 GHz		4.2 4.3 4.2 4.3 4.5 5.3	5.2 5.2 5.5	dB	≥1.5

Electrical Specifications at 25°C and 80 mA, unless noted

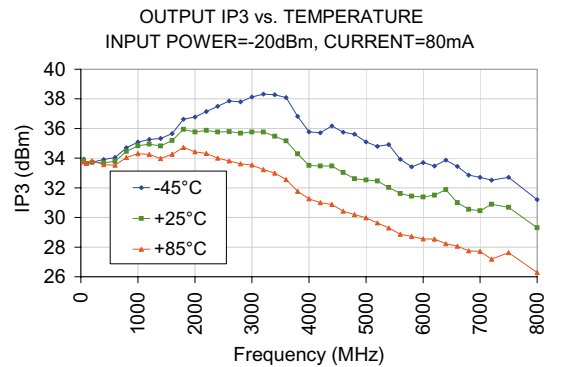
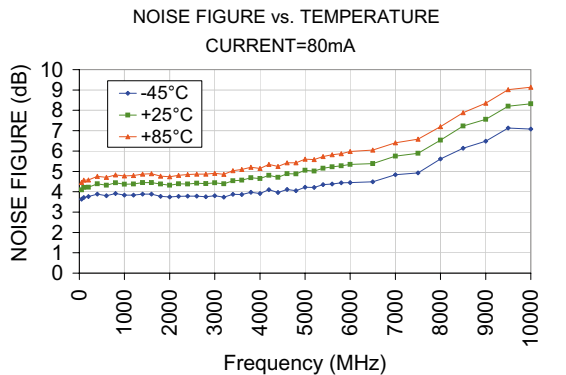
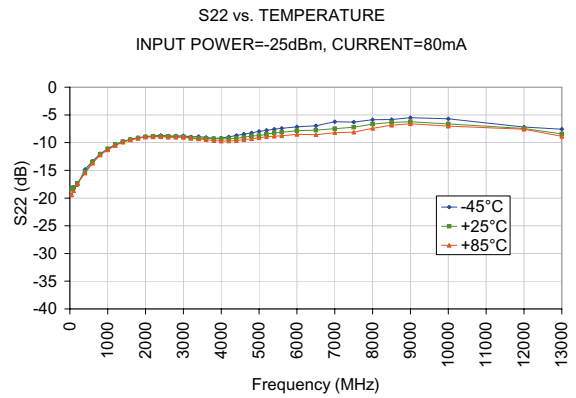
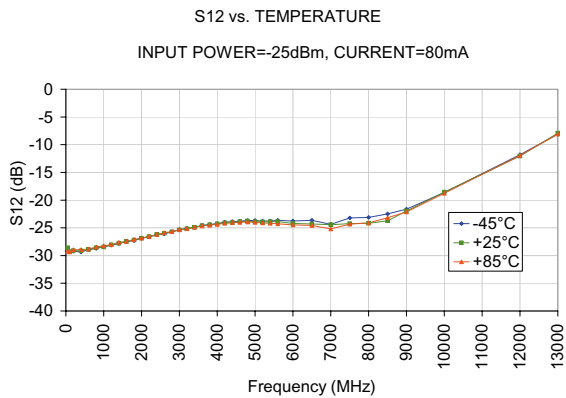
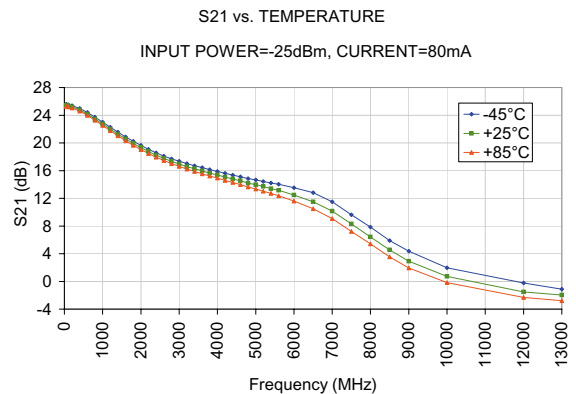
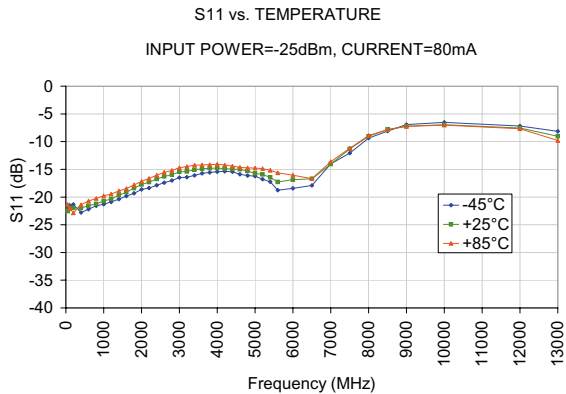
Parameter	Min.	Typ.	Max.	Units	Cpk
Group Delay		97		psec	
Recommended Device Operating Current		80		mA	
Device Operating Voltage	5.4	5.8	6.2	V	≥1.5
Device Voltage Variation vs. Temperature at 80mA		-3.6		mV/°C	
Device Voltage Variation vs. Current at 25°C		3.3		mV/mA	
Thermal Resistance, junction-to-case ¹		64		°C/W	

Absolute Maximum Ratings

Parameter	Ratings
Operating Temperature*	-45°C to 85°C
Storage Temperature	-65°C to 150°C
Operating Current	160mA
Power Dissipation	1W
Input Power	13 dBm

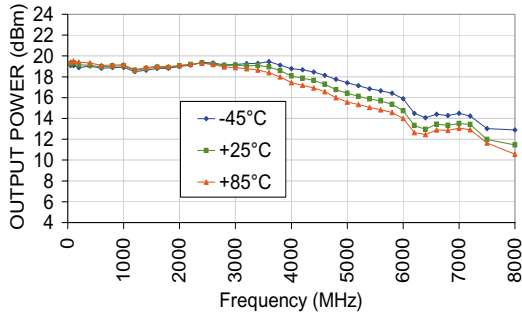
Note: Permanent damage may occur if any of these limits are exceeded.
 These ratings are not intended for continuous normal operation.
¹Case is defined as ground leads.
 *See Reliability curve on page 10.

Typical Performance Curves

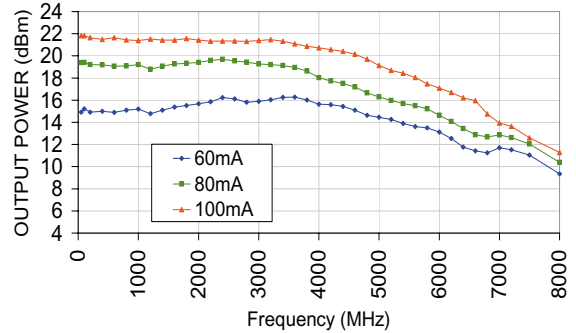


Typical Performance Curves

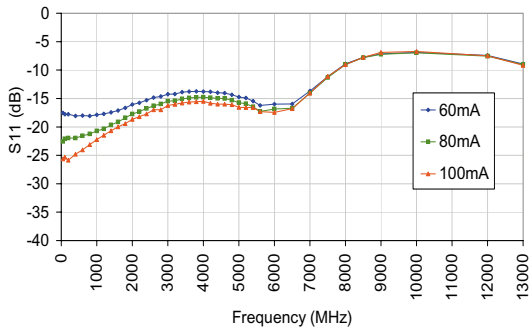
POWER OUTPUT at 1dB COMPRESSION vs. TEMPERATURE
CURRENT=80mA



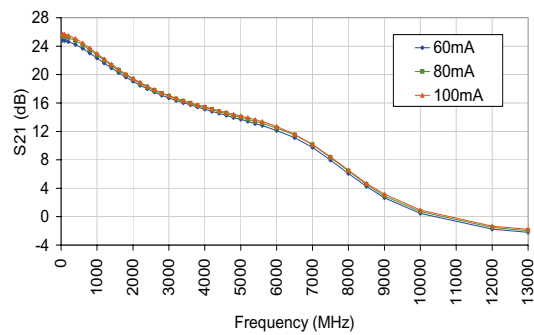
POWER OUTPUT at 1dB COMPRESSION vs. CURRENT
Temperature=+25°C



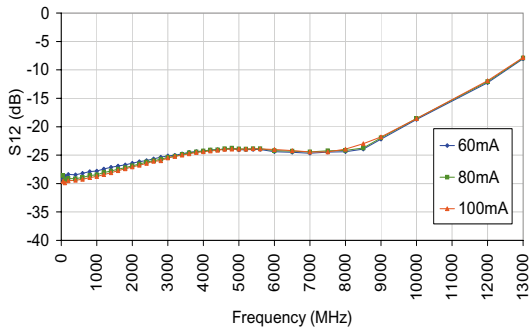
S11 vs. CURRENT
INPUT POWER=-25dBm, Temperature=+25°C



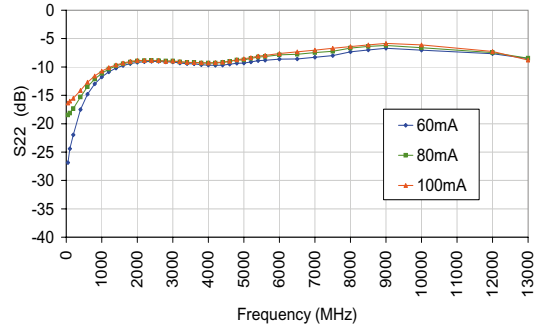
S21 vs. CURRENT
INPUT POWER=-25dBm @Temperature=+25°C



S12 vs. CURRENT
INPUT POWER=-25dBm, Temperature=+25°C



S22 vs. CURRENT
INPUT POWER=-25dBm @Temperature=+25°C



S-Parameters at 80 mA at 25°C

FREQ (MHz)	S11			S21			S12			S22			K
	(dB)	Mag	Angle	(dB)	Mag	Angle	(dB)	Mag	Angle	(dB)	Mag	Angle	
50.00	-22.54	0.07	-8.28	25.43	18.69	171.94	-28.60	0.04	-3.67	-18.45	0.12	179.01	1.04
100.00	-22.08	0.08	-15.78	25.36	18.54	165.01	-29.30	0.03	-5.77	-18.12	0.12	-178.11	1.08
200.00	-21.97	0.08	-37.36	25.21	18.22	150.66	-29.11	0.04	-11.31	-17.33	0.14	-177.58	1.07
400.00	-21.97	0.08	-72.60	24.79	17.36	122.67	-29.15	0.03	-22.91	-15.28	0.17	175.59	1.09
600.00	-21.57	0.08	-104.64	24.16	16.14	95.63	-28.92	0.04	-33.32	-13.49	0.21	161.68	1.09
800.00	-21.25	0.09	-135.93	23.47	14.91	69.84	-28.60	0.04	-45.53	-12.13	0.25	144.57	1.10
1000.00	-20.71	0.09	-162.36	22.74	13.71	45.16	-28.45	0.04	-57.42	-11.12	0.28	126.27	1.12
1200.00	-20.34	0.10	173.05	22.00	12.59	21.61	-28.06	0.04	-70.02	-10.37	0.30	108.45	1.13
1400.00	-19.66	0.10	150.57	21.28	11.59	-1.24	-27.81	0.04	-82.87	-9.82	0.32	90.29	1.15
1600.00	-19.11	0.11	129.84	20.59	10.70	-23.40	-27.47	0.04	-96.34	-9.45	0.34	72.27	1.16
1800.00	-18.41	0.12	111.02	19.92	9.91	-44.99	-27.20	0.04	-109.49	-9.16	0.35	54.65	1.19
2000.00	-17.75	0.13	93.39	19.34	9.27	-66.09	-26.88	0.05	-123.18	-8.96	0.36	37.41	1.20
2200.00	-17.31	0.14	76.83	18.75	8.66	-87.12	-26.57	0.05	-137.90	-8.89	0.36	20.18	1.22
2400.00	-16.75	0.15	61.41	18.23	8.16	-107.78	-26.22	0.05	-151.85	-8.86	0.36	3.31	1.22
2600.00	-16.29	0.15	45.90	17.77	7.74	-128.24	-25.99	0.05	-166.56	-8.87	0.36	-13.65	1.24
2800.00	-15.95	0.16	30.02	17.34	7.36	-148.62	-25.71	0.05	178.26	-8.95	0.36	-31.25	1.26
3000.00	-15.47	0.17	14.04	16.96	7.05	-168.96	-25.39	0.05	163.10	-8.96	0.36	-48.76	1.26
3200.00	-15.40	0.17	-2.58	16.56	6.73	170.65	-25.21	0.05	147.35	-9.12	0.35	-67.31	1.29
3400.00	-15.06	0.18	-19.79	16.27	6.51	150.36	-24.91	0.06	131.77	-9.20	0.35	-85.63	1.28
3600.00	-14.89	0.18	-38.77	15.96	6.28	129.78	-24.60	0.06	115.25	-9.22	0.35	-105.21	1.28
3800.00	-14.82	0.18	-57.39	15.64	6.05	109.40	-24.42	0.06	98.88	-9.31	0.34	-125.28	1.30
4000.00	-14.78	0.18	-76.78	15.37	5.87	88.91	-24.27	0.06	81.94	-9.32	0.34	-146.00	1.32
4200.00	-14.86	0.18	-97.28	15.07	5.67	68.33	-24.11	0.06	64.79	-9.31	0.34	-166.97	1.34
4400.00	-14.97	0.18	-118.60	14.79	5.49	47.63	-24.06	0.06	47.02	-9.22	0.35	171.55	1.37
4600.00	-15.00	0.18	-140.03	14.53	5.33	26.66	-23.87	0.06	29.83	-9.03	0.35	150.62	1.37
4800.00	-15.31	0.17	-163.10	14.20	5.13	5.79	-23.79	0.06	11.50	-8.80	0.36	129.08	1.40
5000.00	-15.72	0.16	177.04	13.99	5.01	-14.89	-23.92	0.06	-6.67	-8.75	0.37	108.45	1.45
5200.00	-15.92	0.16	152.39	13.71	4.85	-36.07	-23.93	0.06	-25.23	-8.50	0.38	87.53	1.48
5400.00	-16.47	0.15	126.62	13.40	4.68	-57.14	-23.88	0.06	-44.28	-8.25	0.39	66.30	1.52
5600.00	-17.29	0.14	101.38	13.16	4.55	-78.27	-23.88	0.06	-64.28	-8.16	0.39	44.77	1.56
6000.00	-16.86	0.14	47.01	12.47	4.20	-122.64	-24.19	0.06	-102.33	-7.85	0.41	3.71	1.70
6500.00	-16.72	0.15	-31.39	11.51	3.76	-178.11	-24.29	0.06	-153.32	-7.75	0.41	-52.52	1.91
7000.00	-14.04	0.20	-107.16	10.15	3.22	125.99	-24.42	0.06	156.85	-7.47	0.42	-110.54	2.20
7500.00	-11.31	0.27	-166.45	8.31	2.60	71.66	-24.24	0.06	106.82	-7.22	0.44	-164.96	2.53
8000.00	-9.02	0.35	145.36	6.44	2.10	20.81	-24.17	0.06	53.30	-6.67	0.46	145.66	2.84
8500.00	-7.81	0.41	100.48	4.55	1.69	-28.07	-23.74	0.07	8.81	-6.38	0.48	99.47	3.13
9000.00	-7.23	0.44	60.91	2.92	1.40	-73.73	-21.97	0.08	-38.86	-6.22	0.49	59.90	2.95
10000.00	-6.96	0.45	-17.55	0.72	1.09	-164.79	-18.57	0.12	-130.90	-6.62	0.47	-17.95	2.54

Definitions:

dB values=20 log (Mag)

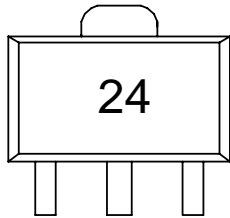
Input Return Loss= -(S11, dB)

Gain (Power Gain)= (S21, dB)

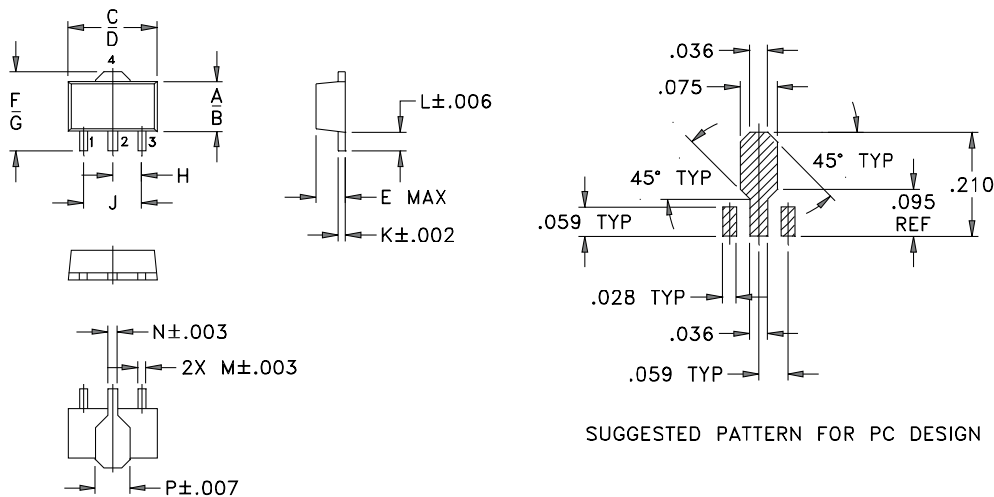
Reverse Isolation= -(S12, dB)

Output Return Loss= -(S22, dB)

Product Marking



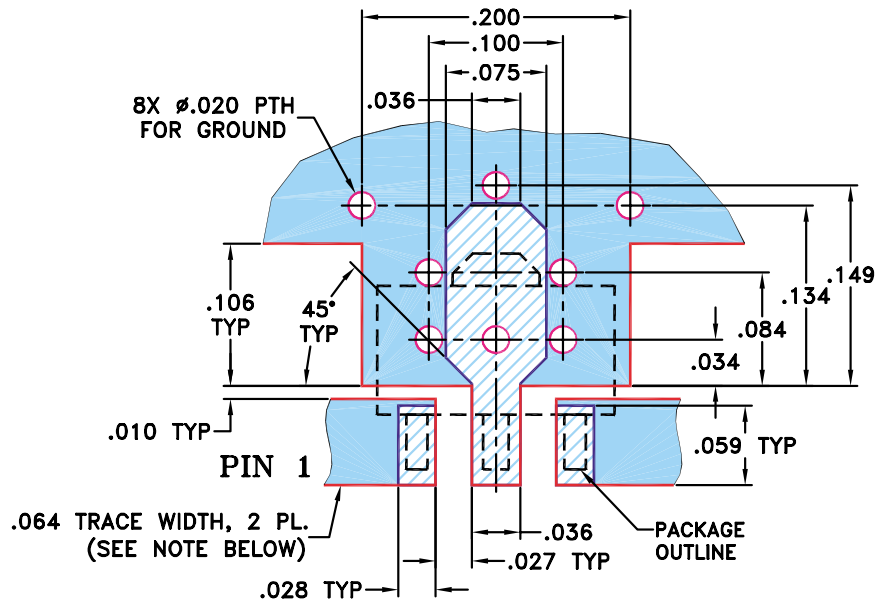
Outline Drawing (SOT-89) DF782





Outline Dimensions (inch mm)

A	B	C	D	E	F	G	H
.102	.090	.181	.173	.063	.167	.155	.059
2.59	2.29	4.60	4.39	1.60	4.24	3.94	1.50
J	K	L	M	N	P	wt	
.118	.015	.041	.016	.019	.065	grams	
3.00	0.38	1.04	0.41	0.48	1.65	0.2	

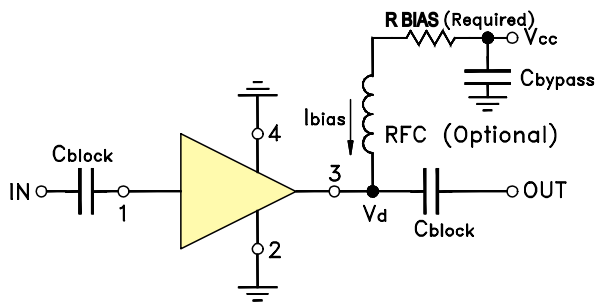
Suggested Layout for PCB Design (PL-019)



- NOTES:** 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030" ± .002"; COPPER: 1/2 OZ. EACH SIDE.
 FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
 2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

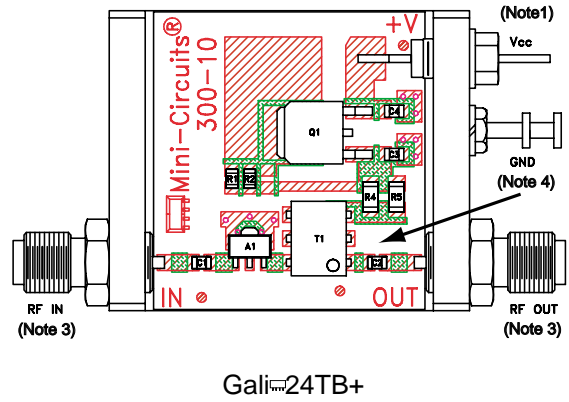
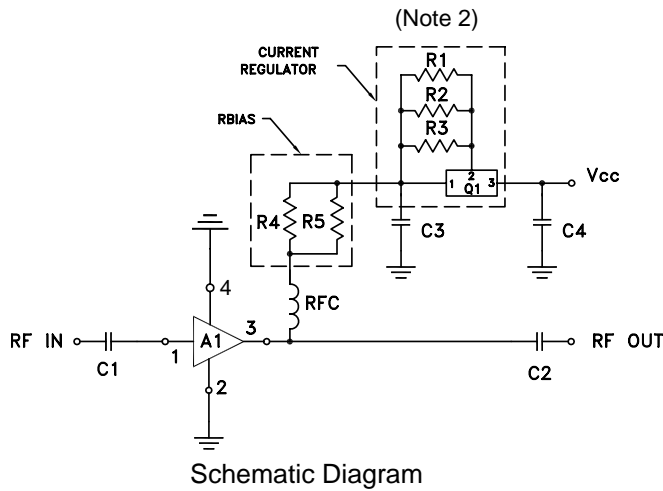
 DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
 DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Recommended Application Circuit



R BIAS "1%" Resistor Values (ohms)	
Vcc	Gali [™] 24+
8	28.7
9	41.2
10	53.7
11	66.5
12	78.7
13	90.9
14	105
15	115
16	127
17	140
18	154
19	165
20	178

Evaluation Board and Circuit



BOM of Evaluation Board

Component	Value	Function
A1	Gali [™] 24+	Device Under Test
C1 (Note 5)	2400 pF	DC Blocking (C block)
C2 (Note 5)	2400 pF	DC Blocking (C block)
C3	0.1 μF	RF bypass (C bypass)
C4	0.1 μF	RF bypass (C bypass)
R1 (Note 2)	36.5 ohms	Sets bias current I _{bias}
R2 (Note 2)	27.4 ohms	Sets bias current I _{bias}
R3	Not used	Sets bias current I _{bias}
R4	53.6 ohms	Enables low frequency performance.
R5	61.9 ohms	Sets bias current in the absence of the current regulator
Q1	LM317MABDTRK	Voltage Regulator, along with R1, R2, R3 works as constant current source
RFC	Mini-Circuits ADCH-80A	RF choke (50 MHz to 8.0 GHz)

Notes:

1. Vcc may be any voltage from +12 to +24V
2. Parallel combination of R1, R2, R3 (sets bias current). Each is a 0805-size chip rated at 1/8W.
3. SMA Female connectors
4. PCB material: Rogers RO4350 or equivalent, dielectric constant=3.5, dielectric thickness= .030 inch.
5. Capacitors, C1&C2 should be free of resonance up to the highest frequency specified.

ESD Rating

Human Body Model (HBM): Class 1C (1000V to < 2000V) in accordance with ANSI/ESD STM 5.1-2001

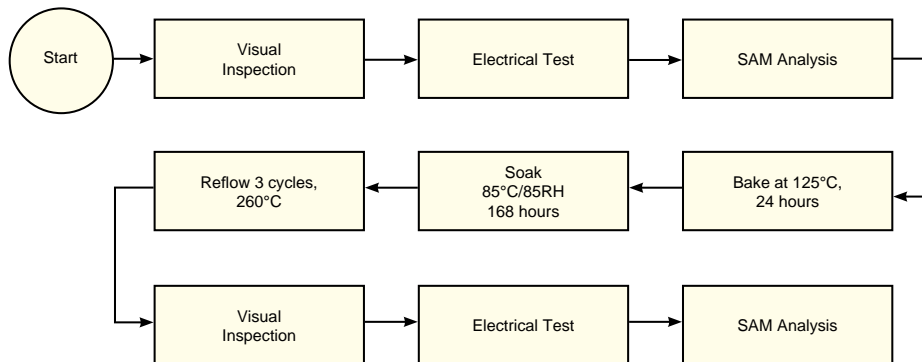
Machine Model (MM): Class M2 (100V to < 200V) in accordance with ANSI/ESD STM 5.2-1999

MSL Rating

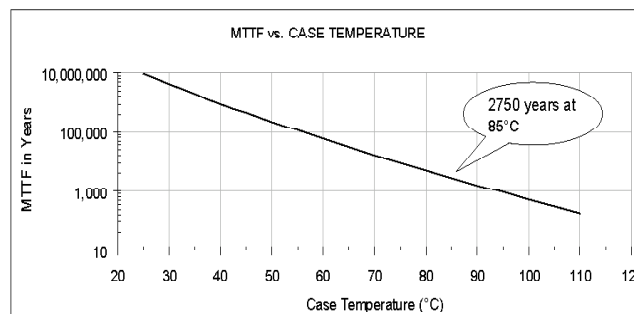
Moisture Sensitivity: MSL1 in accordance with IPC/JEDECJ-STD-020C

NO.	TEST REQUIRED	CONDITION	STANDARD	QUANTITY
1	Visual Inspection	Low Power Microscope Magnification 40x	MIP-IN-0003 (MCT spec)	45 units
2	Electrical Test	Room Temperature	SCD (MCL spec)	45 units
3	SAM Analysis	Less than 10% growth in term of delamination	J-Std-020C (Jedec Standard)	45 units
4	Moisture Sensitivity Level 1	Bake at 125°C for 24 hours Soak at 85°C/85%RH for 168 hours Reflow 3 cycles at 260°C peak	J-Std-020C (Jedec Standard)	45 units

MSL Test Flow Chart



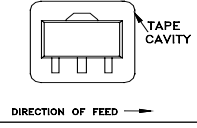
Reliability



Note: Good heat sink design will reduce case temperature rise above ambient and improve MTTF.

Tape and Reel Packaging Information

Table T&R

TR No.	No. of Devices	Designation Letter	Reel Size	Tape Width	Pitch	Unit Orientation
T-004	1000	K	7 inch	12mm	8mm	
	multiples of 10, less than full reel of 1K	PR	7 inch			
	multiples of 10, on tape only	E	not applicable			

Ordering Information

Model No.	Description	Packaging Designation Letter (See Table T&R)	Quantity Min. No. of Units	Price, \$ Per Unit	
				Qty. (10)	Qty. (30)
Gali ²⁴⁺	RoHS Compliant	E	10	3.40	1.75
Gali ^{24TB+}	Evaluation board with unit mounted	Not Applicable	1	59.95	

How to Order

Example: 1000 pieces of Gali²⁴⁺

