

NPN SILICON EPITAXIAL TRANSISTOR  
L Band Power Amplifier

DESCRIPTION AND APPLICATIONS

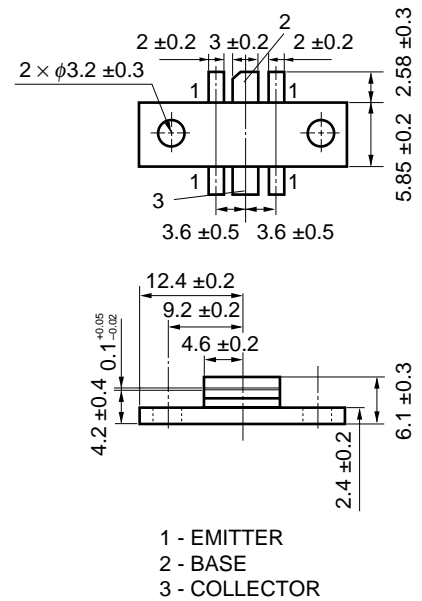
NEL2004F02-24 of NPN epitaxial microwave power transistors is designed for 1.8-2 GHz PHS/PCN/PCS base station applications.

It incorporates emitter ballast resistors, gold metallizations and offers a high degree of reliability.

FEATURES

- High Linear Power and Gain
- Low Internal Modulation Distortion
- High Reliability Gold Metallization
- Emitter Ballasting
- 24 V Operation

OUTLINE DIMENSIONS (Unit: mm)



ABSOLUTE MAXIMUM RATING (T<sub>A</sub> = 25 °C)

PARAMETER	SYMBOL	SPECIFIED CONDITION	RATINGS	UNIT
Collector to Base Voltage	V <sub>CB0</sub>		45	V
Collector to Emitter Voltage	V <sub>CER</sub>	R = 10 Ω	30	V
Emitter to Base Voltage	V <sub>EBO</sub>		3	V
Collector to Emitter Voltage	V <sub>CEO</sub>		18	V
Collector Current	I <sub>c</sub>		1.5	A
Power Dissipation	P <sub>T</sub>		19.4	W
Thermal Resistance	R <sub>th(j-c)</sub>		9	°C/W
Junction Temperature	T <sub>j</sub>		200	°C
Storage Temperature	T <sub>stg</sub>		-65 to 150	°C

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C)**

PARAMETER	SYMBOL	SPECIFIED CONDITION	MIN.	TYP.	MAX.	UNIT
Collector to Emitter Cutoff Current	I <sub>CEs</sub>	V <sub>CE</sub> = 24 V			3	mA
Collector to Emitter Voltage (Base to Emitter Resistor = 10 Ω)	V <sub>CER</sub>	I <sub>C</sub> = 3 mA, R = 10 Ω	30	85		V
Collector to Emitter Voltage (Open Base)	V <sub>CEO</sub>	I <sub>C</sub> = 3 mA	18	22		V
Collector to Base Voltage (Open Emitter)	V <sub>CBO</sub>	I <sub>C</sub> = 3 mA	45	85		V
Emitter to Base Voltage (Open Collector)	V <sub>EBO</sub>	I <sub>C</sub> = 8 mA	3	4.4		V
DC Forward Current Gain	h <sub>FE</sub>	V <sub>CE</sub> = 5 V, I <sub>C</sub> = 0.3 A	30	100	150	
Output Capacitance	C <sub>ob</sub>	V <sub>CE</sub> = 24 V, f = 1 MHz		6.2		pF

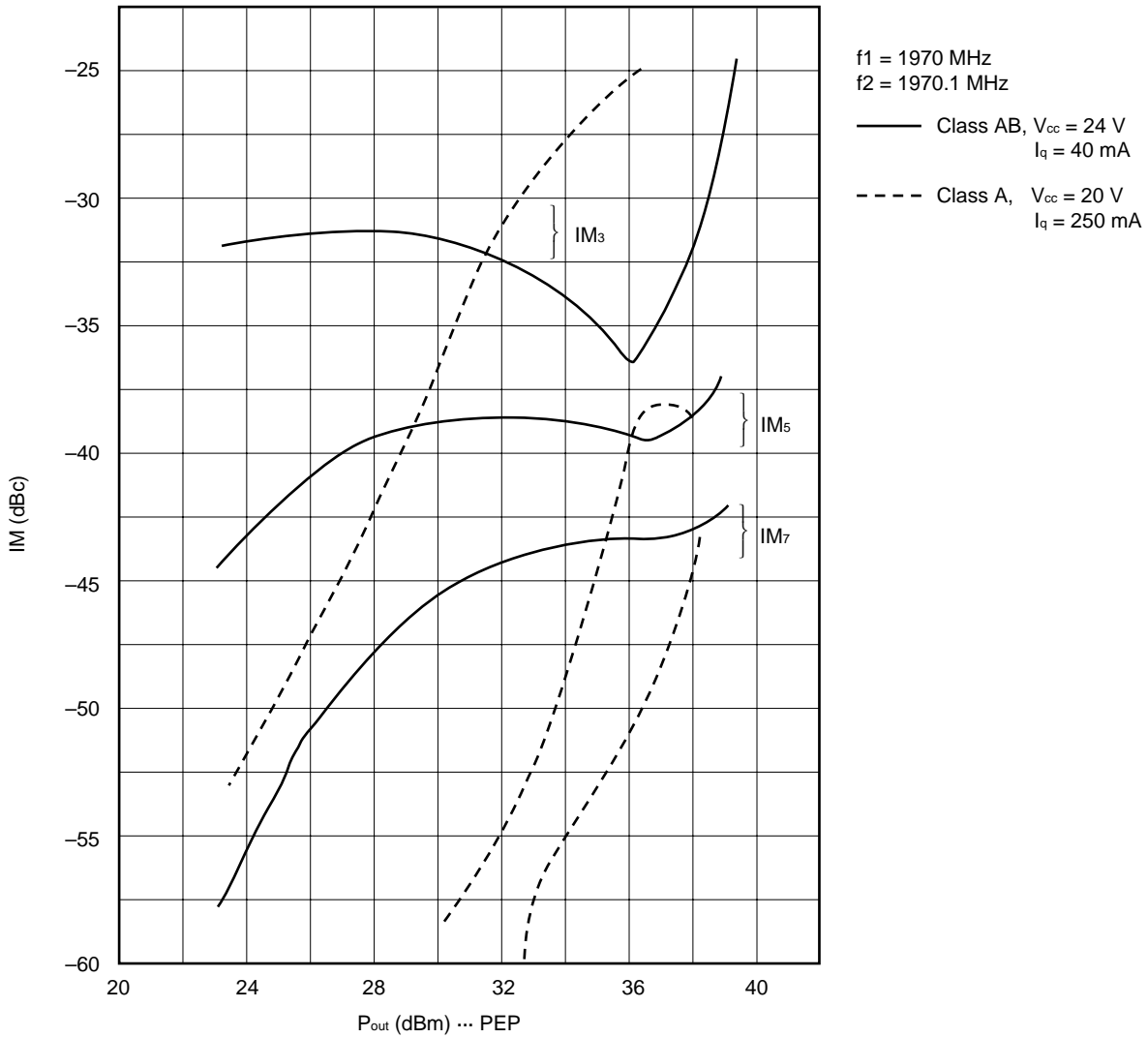
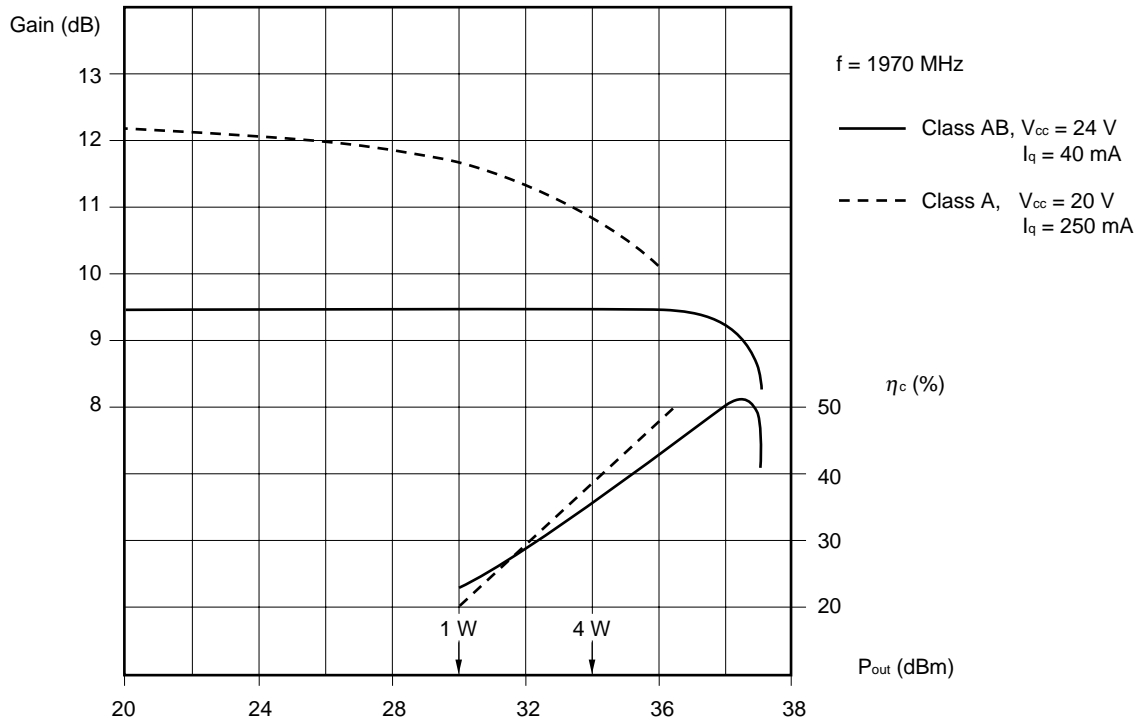
**PERFORMANCE SPECIFICATIONS (T<sub>A</sub> = 25 °C)**

**CLASS AB OPERATION**

PARAMETER	SYMBOL	SPECIFIED CONDITION	MIN.	TYP.	MAX.	UNIT
Output Power	P <sub>ldB</sub>	f = 1.97 GHz, I <sub>q</sub> = 40 mA, V <sub>CC</sub> = 24 V, CLASS AB	5	7		W
Collector Efficiency	η <sub>C</sub>	f = 1.97 GHz, P <sub>out</sub> = P <sub>ldB</sub> , I <sub>q</sub> = 40 mA, V <sub>CC</sub> = 24 V, CLASS AB	40	46		%
Linear Gain	GL	f = 1.97 GHz, P <sub>in</sub> = 0.2 W, I <sub>q</sub> = 40 mA, V <sub>CC</sub> = 24 V, CLASS AB		9.5		dB
3rd Order Intermodulation	IM <sub>3</sub>	f = 1.97 GHz, Δf = 100 kHz, 5 W PEP, V <sub>CC</sub> = 24 V, I <sub>q</sub> = 40 mA, CLASS AB		-34		dBc

**CLASS A OPERATION**

PARAMETER	SYMBOL	SPECIFIED CONDITION	MIN.	TYP.	MAX.	UNIT
Output Power	P <sub>ldB</sub>	f = 1.97 GHz, I <sub>q</sub> = 250 mA, V <sub>CC</sub> = 20 V, CLASS A		2		W
Collector Efficiency	η <sub>C</sub>	f = 1.97 GHz, P <sub>out</sub> = P <sub>ldB</sub> , I <sub>q</sub> = 250 mA, V <sub>CC</sub> = 20 V, CLASS A		35		%
Linear Gain	GL	f = 1.97 GHz, P <sub>in</sub> = 0.01 W, I <sub>q</sub> = 250 mA, V <sub>CC</sub> = 20 V, CLASS A		12		dB
3rd Order Intermodulation	IM <sub>3</sub>	f = 1.97 GHz, Δf = 100 kHz, 1 W PEP, V <sub>CC</sub> = 20 V, I <sub>q</sub> = 250 mA, CLASS A		-37		dBc



S-PARAMETER

NEL2004 Class A

V<sub>CC</sub> = 20 V, I<sub>cq</sub> = 0.25 A

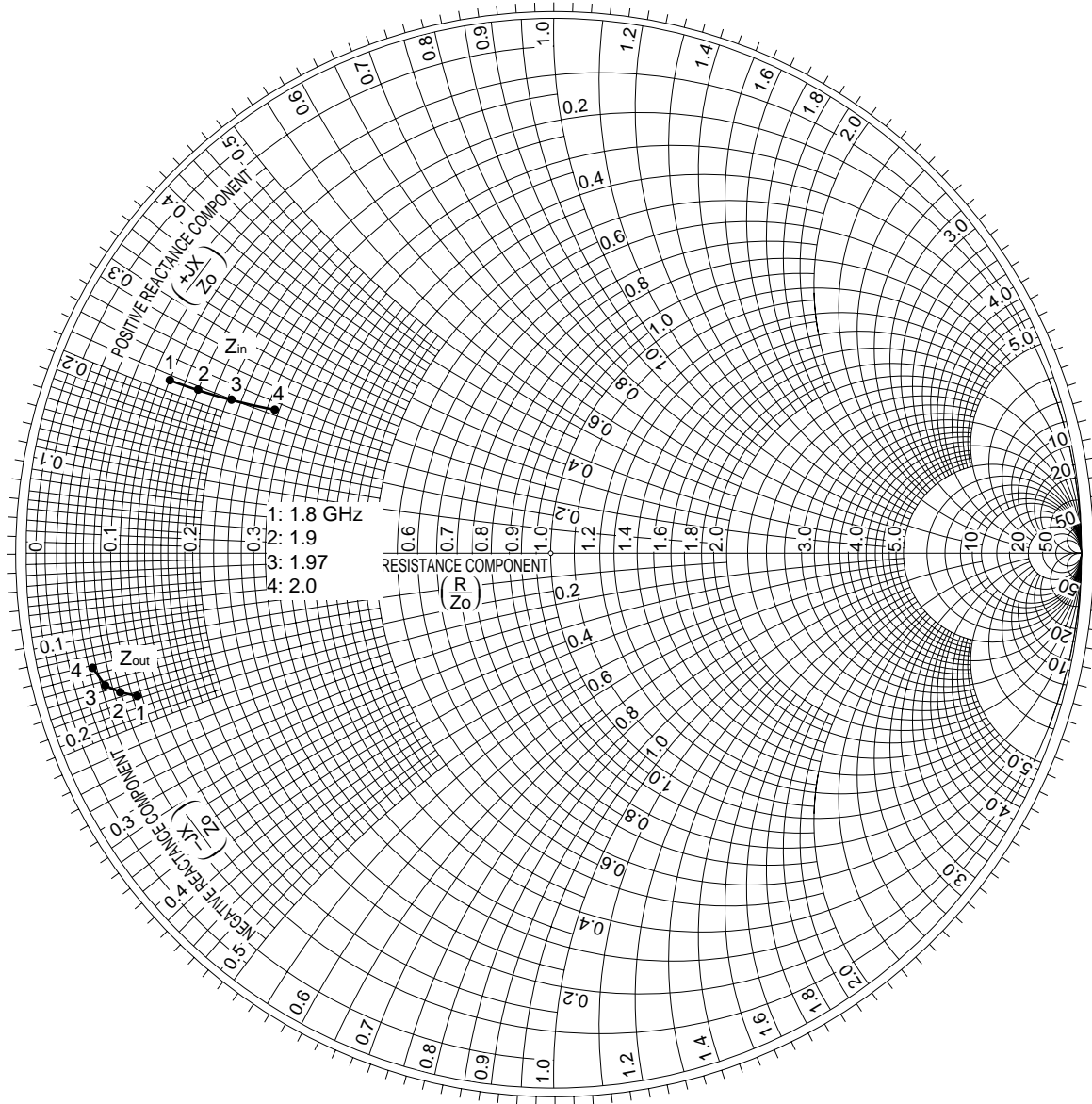
FREQUENCY GHz	S <sub>11</sub>		S <sub>12</sub>		S <sub>21</sub>		S <sub>22</sub>	
	MAG	ANG (DEG)	MAG	ANG (DEG)	MAG	ANG (DEG)	MAG	ANG (DEG)
1.70	0.70	171	0.05	-26	1.68	-16	0.77	-149
1.71	0.69	171	0.05	-26	1.70	-18	0.78	-150
1.72	0.69	172	0.05	-27	1.71	-19	0.79	-150
1.73	0.69	172	0.05	-29	1.71	-20	0.79	-150
1.74	0.69	172	0.05	-30	1.69	-22	0.80	-150
1.75	0.69	173	0.05	-31	1.67	-23	0.81	-151
1.76	0.69	173	0.05	-31	1.65	-24	0.81	-151
1.77	0.69	173	0.05	-32	1.66	-25	0.82	-151
1.78	0.69	173	0.05	-33	1.67	-26	0.83	-152
1.79	0.69	174	0.04	-35	1.67	-28	0.84	-152
1.80	0.69	174	0.04	-37	1.65	-30	0.84	-152
1.81	0.69	175	0.05	-37	1.62	-31	0.85	-153
1.82	0.69	175	0.05	-38	1.60	-32	0.85	-153
1.83	0.70	175	0.05	-45	1.61	-32	0.86	-153
1.84	0.69	175	0.04	-49	1.62	-34	0.87	-154
1.85	0.70	175	0.04	-50	1.62	-35	0.87	-154
1.86	0.70	176	0.04	-46	1.60	-38	0.88	-155
1.87	0.70	176	0.04	-46	1.56	-38	0.89	-155
1.88	0.70	176	0.04	-47	1.54	-39	0.89	-156
1.89	0.70	177	0.04	-49	1.55	-39	0.90	-156
1.90	0.71	177	0.03	-50	1.56	-41	0.90	-157
1.91	0.71	177	0.03	-51	1.56	-43	0.91	-157
1.92	0.71	177	0.03	-52	1.53	-46	0.92	-158
1.93	0.71	178	0.03	-54	1.50	-46	0.92	-158
1.94	0.72	178	0.03	-55	1.48	-47	0.92	-159
1.95	0.72	178	0.03	-57	1.48	-47	0.93	-159
1.96	0.73	178	0.03	-58	1.48	-49	0.93	-160
1.97	0.73	178	0.03	-60	1.47	-50	0.94	-160
1.98	0.73	179	0.03	-61	1.45	-52	0.94	-161
1.99	0.74	179	0.03	-62	1.44	-53	0.94	-161
2.00	0.74	179	0.02	-64	1.42	-54	0.95	-162

NEL2004 Class AB

V<sub>CC</sub> = 24 V, I<sub>cq</sub> = 0.04 A

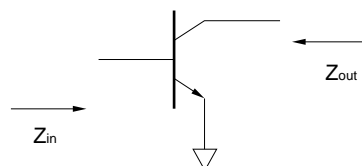
FREQUENCY GHz	S <sub>11</sub>		S <sub>12</sub>		S <sub>21</sub>		S <sub>22</sub>	
	MAG	ANG (DEG)	MAG	ANG (DEG)	MAG	ANG (DEG)	MAG	ANG (DEG)
1.70	0.75	167	0.04	-26	1.09	-25	0.87	-148
1.71	0.75	167	0.04	-27	1.11	-26	0.87	-149
1.72	0.75	167	0.04	-28	1.11	-28	0.88	-149
1.73	0.75	167	0.04	-29	1.12	-29	0.88	-149
1.74	0.74	167	0.04	-30	1.11	-31	0.88	-149
1.75	0.74	167	0.04	-30	1.10	-32	0.89	-150
1.76	0.74	168	0.04	-30	1.09	-33	0.89	-150
1.77	0.73	168	0.04	-31	1.09	-33	0.89	-150
1.78	0.73	168	0.04	-33	1.11	-34	0.90	-151
1.79	0.73	168	0.04	-35	1.11	-36	0.90	-151
1.80	0.73	168	0.04	-36	1.10	-39	0.91	-152
1.81	0.73	169	0.04	-39	1.09	-40	0.91	-152
1.82	0.73	169	0.04	-41	1.08	-41	0.91	-152
1.83	0.73	169	0.03	-42	1.08	-41	0.92	-153
1.84	0.72	169	0.03	-42	1.09	-42	0.92	-153
1.85	0.72	169	0.03	-43	1.10	-44	0.92	-153
1.86	0.72	169	0.03	-45	1.08	-46	0.93	-154
1.87	0.72	170	0.03	-45	1.06	-47	0.93	-154
1.88	0.72	170	0.03	-46	1.05	-48	0.94	-155
1.89	0.72	170	0.03	-48	1.06	-48	0.94	-155
1.90	0.72	170	0.03	-50	1.07	-50	0.94	-155
1.91	0.72	170	0.03	-52	1.07	-52	0.94	-156
1.92	0.72	171	0.03	-52	1.06	-54	0.95	-156
1.93	0.72	171	0.03	-53	1.04	-55	0.95	-157
1.94	0.72	171	0.03	-54	1.03	-56	0.95	-157
1.95	0.72	172	0.03	-57	1.03	-56	0.95	-158
1.96	0.72	172	0.03	-59	1.04	-58	0.96	-158
1.97	0.72	172	0.02	-61	1.03	-60	0.96	-159
1.98	0.72	173	0.02	-62	1.02	-61	0.96	-159
1.99	0.72	173	0.02	-64	1.01	-63	0.96	-160
2.00	0.72	173	0.02	-66	1.00	-64	0.97	-160

NEL2004F02-24  $Z_{in}/Z_{out}$

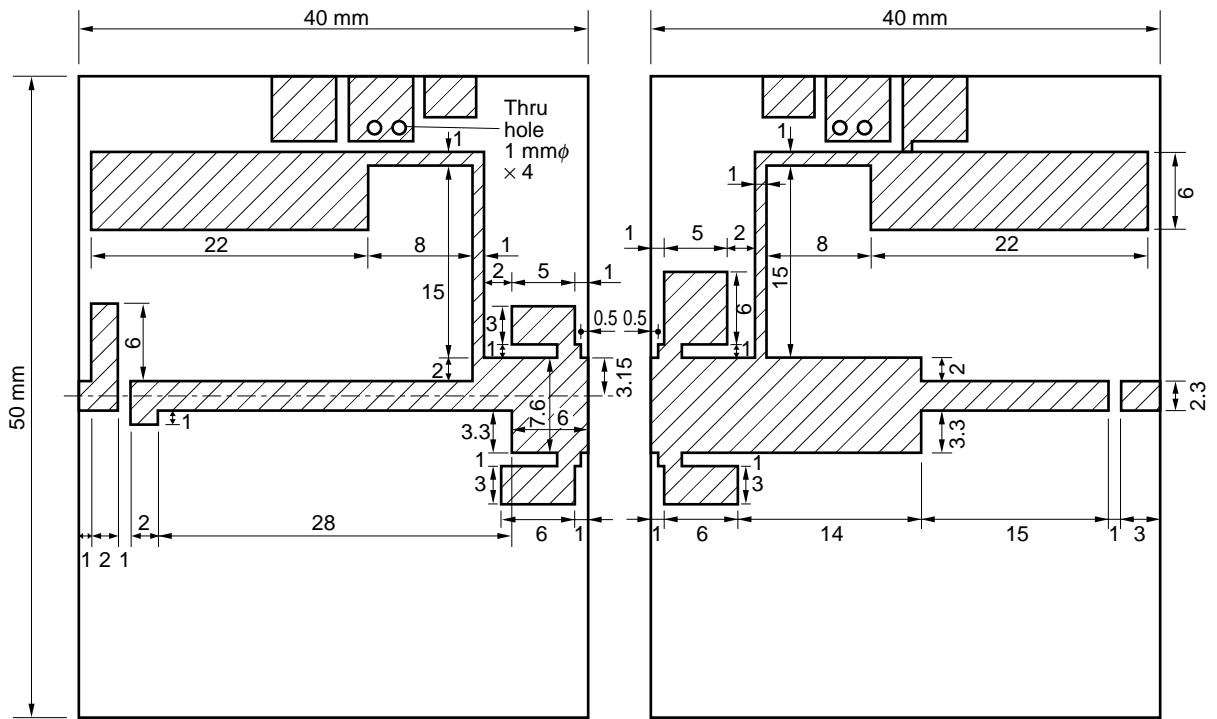


$Z_0 = 50 \text{ ohm}$

f [GHz]	$Z_{in}$ [ohm]	$Z_{out}$ [ohm]
1.80	$7.2 + j11$	$4.8 - j8.4$
1.90	$8.0 + j10$	$4.1 - j7.8$
1.97	$10.4 + j11$	$3.7 - j7.4$
2.00	$13.5 + j11$	$3.0 - j6.1$



Circuit Drawing

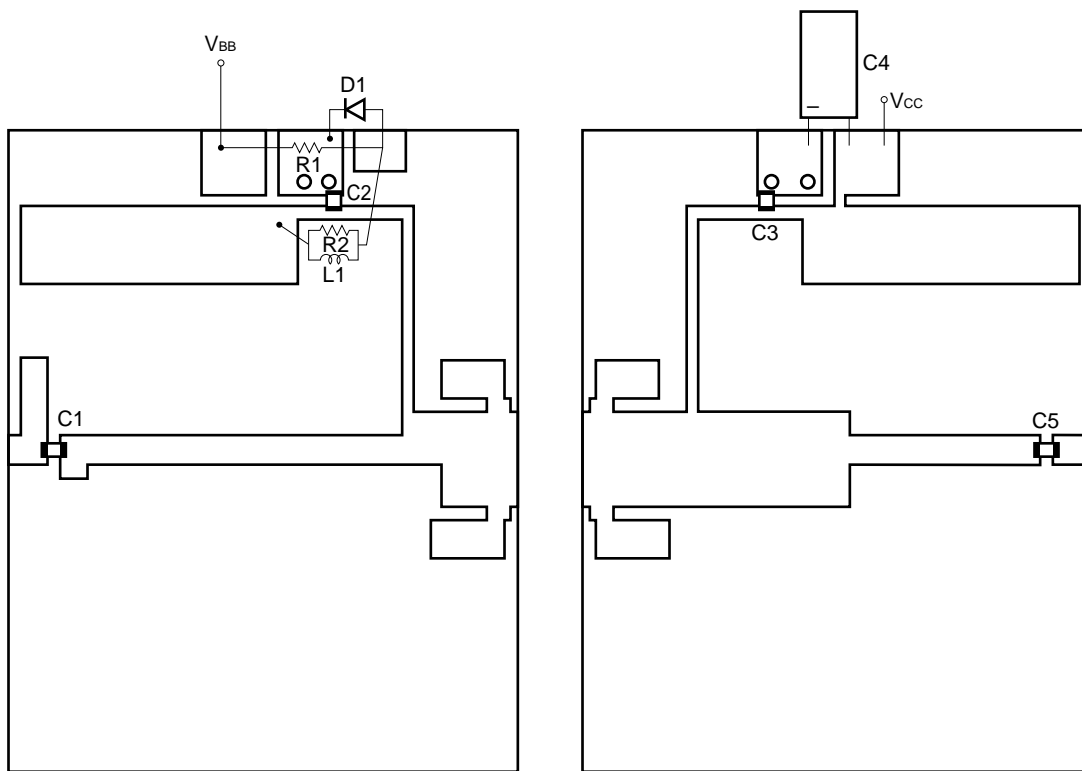


input

output

SUBSTRATE  
 DICLAD 522T®  
 THICKNESS = 0.79 mm  
 DOUBLE SIDE 35 μm Cu  
 $\epsilon_r = 2.6$

Components Layout



input

output

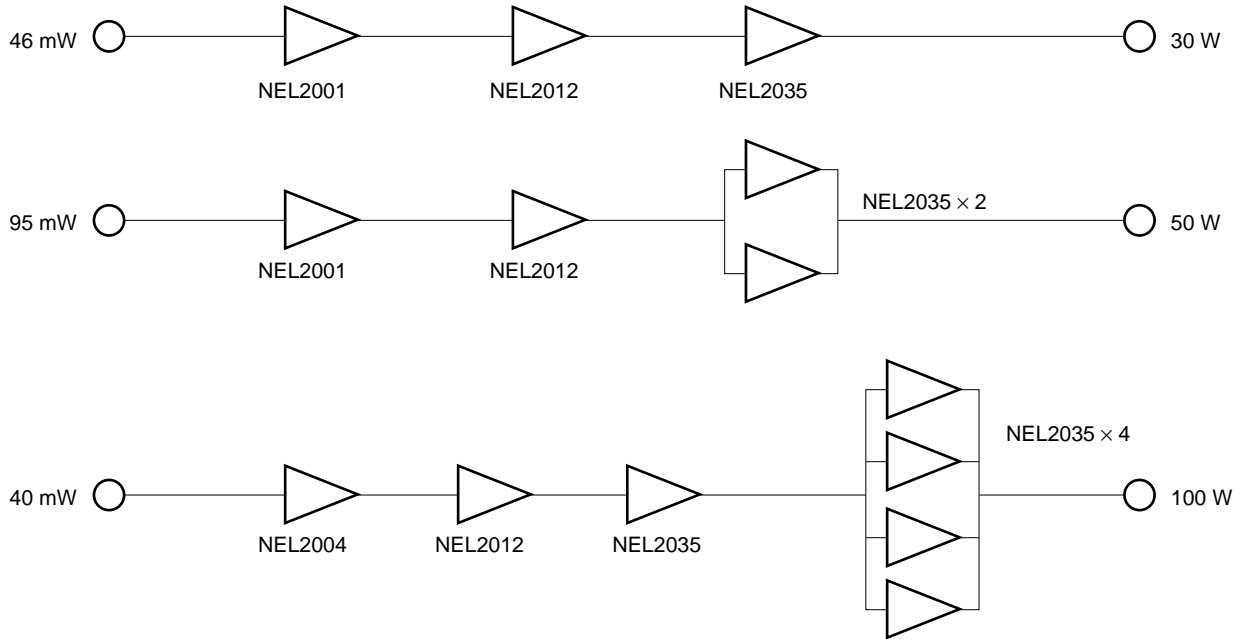
R1: 5.1 Ω  
 R2: 30 Ω  
 L1: 5 mmφ 10T Coil

D1: VO6C  
 C1, C2, C3, C5: MURATA  
 47 pF  
 C4: 22 μF, 50 V  
 Electrolytic Capacitor



APPLICATION

= Amplifier Diagrams =



[MEMO]

[MEMO]

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Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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Anti-radioactive design is not implemented in this product.