NEC

SILICON POWER TRANSISTOR
NEL2035F03-24

NPN SILICON EPITAXIAL TRANSISTOR
L Band Power Amplifier

DESCRIPTION AND APPLICATIONS

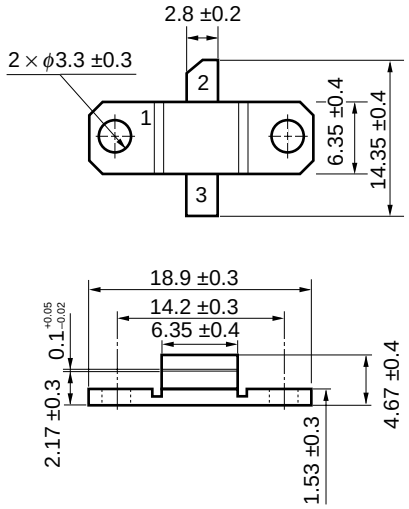
NEL2035F03-24 of NPN epitaxial microwave power transistors is designed for 1.8-2 GHz PHS/PCN/PCS base station applications.

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)



1 - EMITTER
2 - BASE
3 - COLLECTOR

ABSOLUTE MAXIMUM RATING (T_A = 25 °C)

PARAMETER	SYMBOL	SPECIFIED CONDITION	RATINGS	UNIT
Collector to Base Voltage	V_{CBO}		45	V
Collector to Emitter Voltage	V_{CER}	R = 10 Ω	30	V
Emitter to Base Voltage	V_{EBO}		3	V
Collector to Emitter Voltage	V_{CEO}		18	V
Collector Current	I_C		14	A
Power Dissipation	P_T		79.5	W
Thermal Resistance	Rth(j-c)		2.2	°C/W
Junction Temperature	Tj		200	°C
Storage Temperature	T_{stg}		–65 to 150	°C

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ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

PARAMETER	SYMBOL	SPECIFIED CONDITION	MIN.	TYP.	MAX.	UNIT
Collector to Emitter Cutoff Current	I_{CES}	V_{CE} = 24 V			10	mA
Collector to Emitter Voltage (Base to Emitter Registor = 10 Ω)	V_{CER}	I_C = 20 mA, R = 10 Ω	30	85		V
Collector to Emitter Voltage (Open Base)	V_{CEO}	I_C = 20 mA	18	22		V
Collector to Base Voltage (Open Emitter)	V_{CBO}	I_C = 20 mA	45	85		V
Emitter to Base Voltage (Open Collector)	V_{EBO}	I_C = 25 mA	3	5.3		V
DC Forward Current Gain	h_{FE}	V_{CE} = 5 V, I_C = 1 A	30	100	150	
Output Capacitance	C_{ob}	V_{CE} = 24 V, f = 1 MHz		189		pF

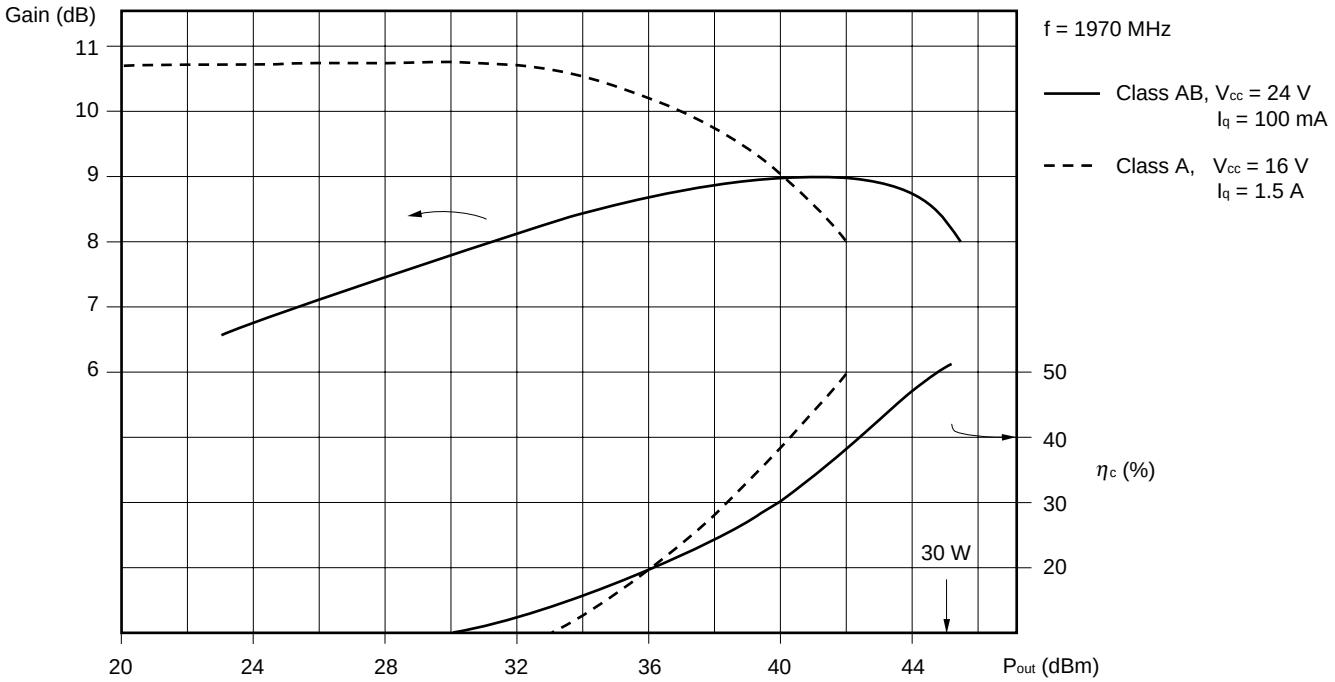
PERFORMANCE SPECIFICATIONS (T_A = 25 °C)

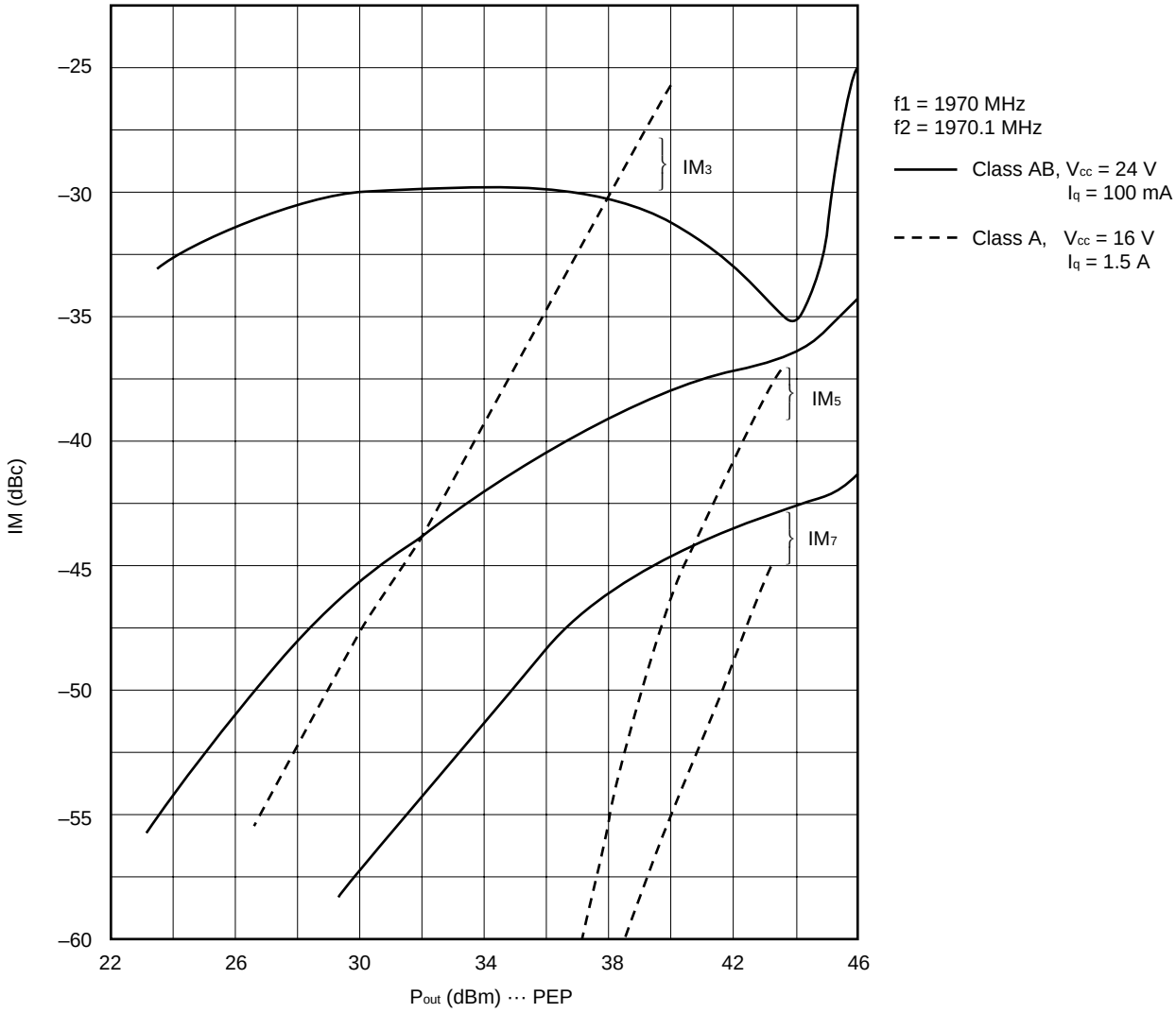
CLASS AB OPERATION

PARAMETER	SYMBOL	SPECIFIED CONDITION	MIN.	TYP.	MAX.	UNIT
Output Power	P_{1dB}	f = 1.97 GHz, Iq = 100 mA, V_{CC} = 24 V, CLASS AB	30	33		W
Collector Efficiency	ηc	f = 1.97 GHz, P_{out} = P_{1dB}, Iq = 100 mA, V_{CC} = 24 V, CLASS AB	40	50		%
Linear Gain	GL	f = 1.97 GHz, P_{in} = 2 W, Iq = 100 mA, V_{CC} = 24 V, CLASS AB		9		dB
3rd Order Intermodulation	IM_3	f = 1.97 GHz, Δf = 100 kHz, 30 W PEP, V_{CC} = 24 V, Iq = 100 mA, CLASS AB		–33		dBc

CLASS A OPERATION

PARAMETER	SYMBOL	SPECIFIED CONDITION	MIN.	TYP.	MAX.	UNIT
Output Power	P_{1dB}	f = 1.97 GHz, Iq = 1.5 A, V_{CC} = 16 V, CLASS A		7		W
Collector Efficiency	ηc	f = 1.97 GHz, P_{out} = P_{1dB}, Iq = 1.5 A, V_{CC} = 16 V, CLASS A		30		%
Linear Gain	GL	f = 1.97 GHz, P_{in} = 0.1 W, Iq = 1.5 A, V_{CC} = 16 V, CLASS A		10.7		dB
3rd Order Intermodulation	IM_3	f = 1.97 GHz, Δf = 100 kHz, 5 W PEP, V_{CC} = 16 V, Iq = 1.5 A, CLASS A		–33		dBc


Gain (dB)
11
10
9
8
7
6
50
40
30
20
η_c (%)
30 W
20
24
28
32
36
40
44
P_{out} (dBm)
f = 1970 MHz
Class AB, V_{cc} = 24 V
I_q = 100 mA
Class A, V_{cc} = 16 V
I_q = 1.5 A


IM (dBc)
–25
–30
–35
–40
–45
–50
–55
–60
IM3
IM5
IM7
22
26
30
34
38
42
46
P_{out} (dBm) ⋯ PEP
f1 = 1970 MHz
f2 = 1970.1 MHz
Class AB, V_{cc} = 24 V
I_q = 100 mA
Class A, V_{cc} = 16 V
I_q = 1.5 A

S-PARAMETER

NEL2035 Class A

V_{CC} = 16 V, I_{cq} = 1.5 A

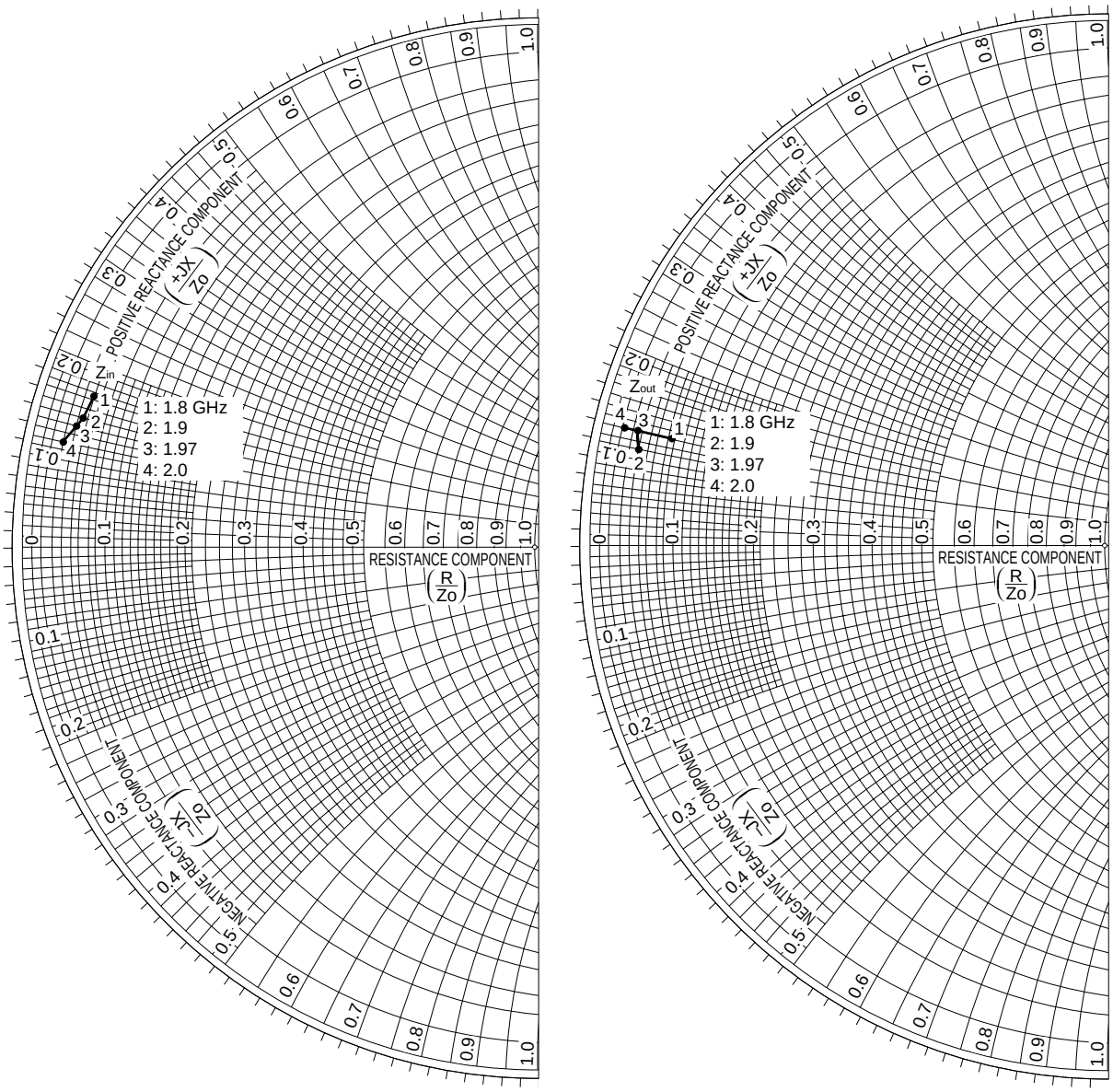
FREQUENCY	S_{11}		S_{12}		S_{21}		S_{22}	
GHz	MAG	ANG (DEG)	MAG	ANG (DEG)	MAG	ANG (DEG)	MAG	ANG (DEG)
1.70	0.98	165	0.04	48	0.42	73	0.92	160
1.71	0.98	165	0.04	47	0.44	71	0.91	160
1.72	0.98	165	0.04	47	0.47	68	0.90	160
1.73	0.97	164	0.04	45	0.49	65	0.89	160
1.74	0.97	164	0.04	43	0.51	62	0.88	160
1.75	0.96	164	0.04	40	0.54	59	0.87	160
1.76	0.95	163	0.04	37	0.57	57	0.86	160
1.77	0.94	163	0.04	33	0.61	53	0.85	160
1.78	0.93	163	0.04	29	0.65	48	0.84	161
1.79	0.92	162	0.04	25	0.69	43	0.82	161
1.80	0.90	162	0.04	21	0.71	37	0.81	162
1.81	0.89	162	0.05	15	0.74	32	0.80	163
1.82	0.87	163	0.05	10	0.78	26	0.79	165
1.83	0.86	163	0.05	–1	0.81	19	0.79	166
1.84	0.85	164	0.04	–8	0.83	11	0.79	168
1.85	0.84	165	0.04	–14	0.84	3	0.80	170
1.86	0.83	167	0.04	–15	0.81	–5	0.82	171
1.87	0.84	168	0.03	–20	0.78	–11	0.84	172
1.88	0.84	169	0.03	–25	0.75	–18	0.87	172
1.89	0.85	170	0.03	–28	0.72	–24	0.89	172
1.90	0.86	171	0.02	–33	0.69	–30	0.91	172
1.91	0.87	171	0.02	–36	0.65	–36	0.93	172
1.92	0.89	171	0.01	–38	0.60	–42	0.94	171
1.93	0.90	171	0.01	–34	0.55	–46	0.95	171
1.94	0.90	171	0.01	–26	0.51	–49	0.96	170
1.95	0.91	171	0.01	–21	0.49	–51	0.97	169
1.96	0.92	171	0.01	–13	0.46	–55	0.97	169
1.97	0.93	171	0.01	–1	0.43	–58	0.98	168
1.98	0.93	171	0.01	16	0.40	–61	0.98	168
1.99	0.94	171	0.01	30	0.37	–63	0.98	167
2.00	0.94	171	0.01	38	0.35	–65	0.99	167

NEL2035 Class AB

V_{CC} = 24 V, I_{cq} = 0.1 A

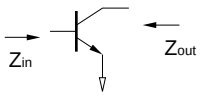
FREQUENCY	S_{11}		S_{12}		S_{21}		S_{22}	
GHz	MAG	ANG (DEG)	MAG	ANG (DEG)	MAG	ANG (DEG)	MAG	ANG (DEG)
1.70	0.98	167	0.04	68	0.20	90	0.95	156
1.71	0.98	167	0.04	65	0.22	88	0.95	155
1.72	0.98	167	0.04	63	0.23	86	0.94	155
1.73	0.98	166	0.04	61	0.25	84	0.93	154
1.74	0.98	166	0.04	60	0.26	82	0.92	154
1.75	0.97	166	0.05	59	0.28	80	0.92	153
1.76	0.97	166	0.05	56	0.30	79	0.90	152
1.77	0.97	165	0.05	53	0.33	76	0.89	151
1.78	0.97	165	0.05	51	0.36	72	0.87	150
1.79	0.96	165	0.06	48	0.38	68	0.85	149
1.80	0.96	164	0.06	45	0.42	65	0.82	147
1.81	0.95	164	0.07	41	0.45	60	0.78	146
1.82	0.94	164	0.07	35	0.51	55	0.74	145
1.83	0.93	164	0.08	31	0.56	49	0.68	144
1.84	0.92	163	0.08	23	0.62	41	0.62	145
1.85	0.90	163	0.08	15	0.67	32	0.55	148
1.86	0.88	164	0.08	4	0.71	21	0.49	155
1.87	0.87	165	0.08	–7	0.73	10	0.47	165
1.88	0.86	166	0.08	–18	0.74	–1	0.49	56
1.89	0.86	167	0.07	–29	0.72	–13	0.56	–56
1.90	0.87	169	0.06	–39	0.68	–23	0.64	–173
1.91	0.88	169	0.05	–48	0.63	–33	0.72	–173
1.92	0.89	170	0.05	–56	0.57	–42	0.78	–174
1.93	0.90	170	0.04	–62	0.51	–49	0.83	–176
1.94	0.91	170	0.03	–67	0.46	–54	0.86	–58
1.95	0.92	170	0.03	–71	0.42	–58	0.89	60
1.96	0.93	170	0.02	–74	0.39	–63	0.91	178
1.97	0.93	170	0.02	–77	0.35	–67	0.92	177
1.98	0.94	170	0.02	–80	0.32	–70	0.93	175
1.99	0.94	169	0.01	–84	0.30	–73	0.94	174
2.00	0.95	169	0.01	–89	0.27	–76	0.95	173

NEL2035F03-24 Z_{in}/Z_{out}

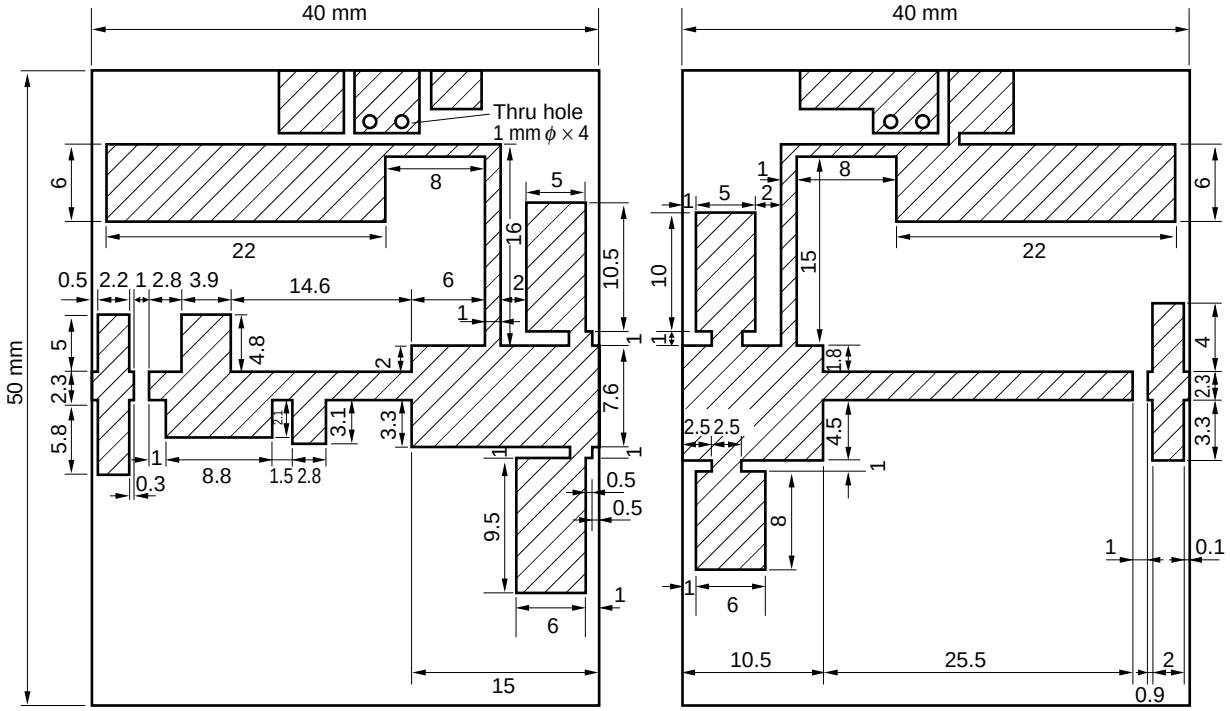


Z_O = 50 ohm

f [GHz]	Z_{in} [ohm]	Z_{out} [ohm]
1.80	2.6 + j8.4	4.6 + j5.8
1.90	2.3 + j7.0	2.0 + j5.2
1.97	2.3 + j6.5	2.3 + j6.0
2.00	1.6 + j5.6	1.3 + j6.2



Circuit Drawing

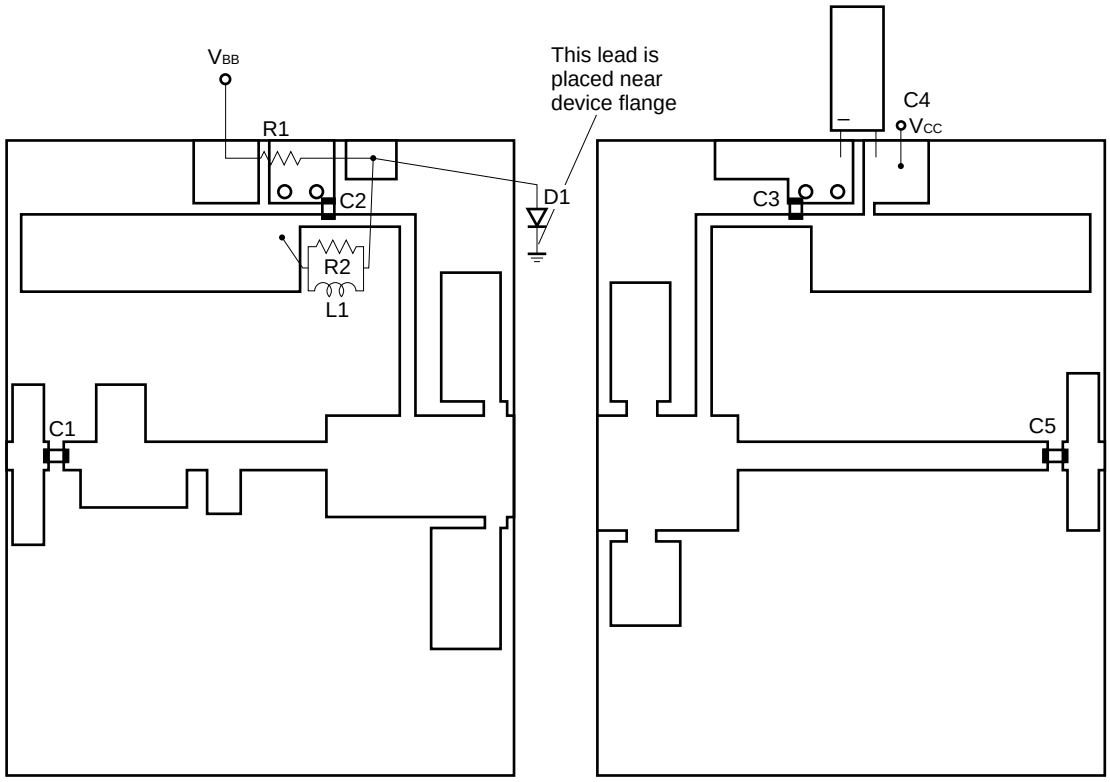


SUBSTRATE (TEFLON)

DICLAD522T®

- THICKNESS = 0.79 mm
- DOUBLE SIDE 35 μm Cu
- εr = 2.60

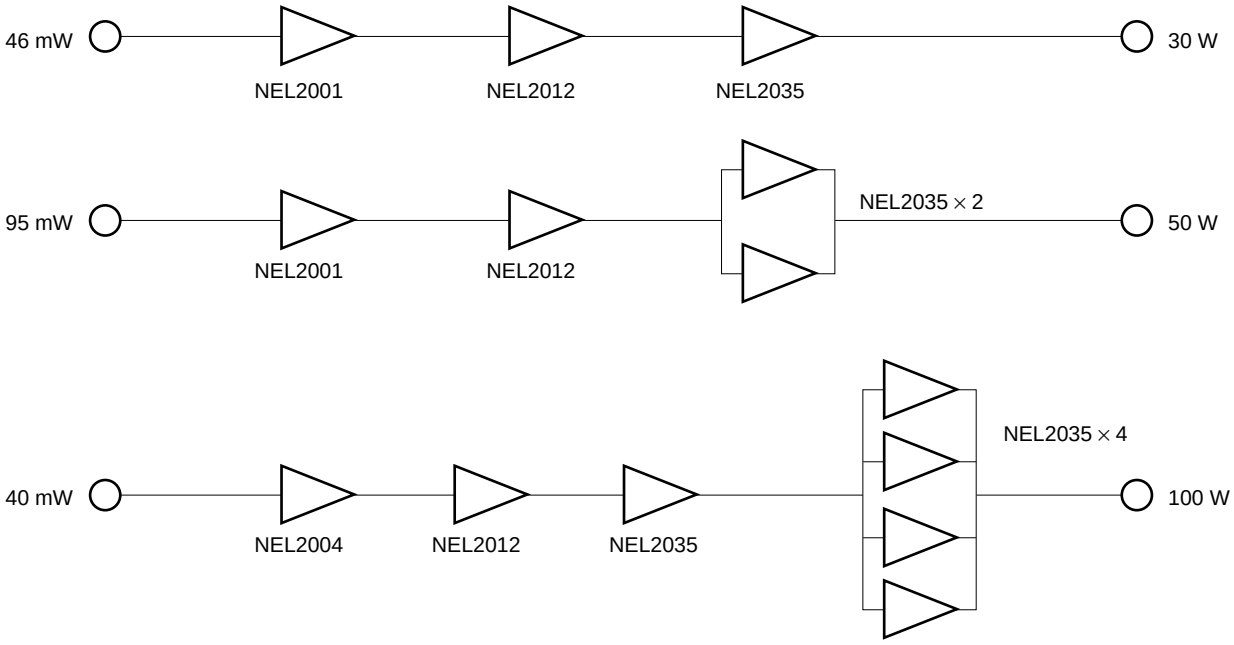
Components Layout



R1: 5.1 Ω
R2: 30 Ω
L1 : 5 mmϕ 10T
C1, C2, C3, C5: MURATA 47 pF
C4: 22 μF (50 V)
Electrolytic Capacitor
D1: V06C

APPLICATION

= Amplifier Diagrams =



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M4 96.5