DATA SHEET

NEC

GaAs HETEROJUNCTION BIPOLAR TRANSISTOR

NE52418

L to S BAND LOW NOISE AND HIGH GAIN AMPLIFIER NPN GaAs HBT

DESCRIPTION

The NE52418 is an NPN GaAs HBT (Heterojunction Bipolar Transistor) developed for L to S band mobile communication equipment.

FEATURES

- Ideal for low noise and high gain amplifiers
  NF = 0.95 dB TYP., G_a = 17 dB TYP. (@ V_{CE} = 2 V, I_C = 3 mA, f = 2 GHz, $Z_S = Z_L$ = 50 Ω)
  IIP_3 = +8 dBm TYP. (@ V_{CE} = 2.5 V, I_C = 8 mA, f = 2 GHz, 1 tone, $Z_S = Z_L = Z_{opt}$)
- 4-pin super minimold package employed (SOT-343 style)
- Grounded emitter transistor

APPLICATIONS

- Mobile communication terminals and other L to S band microwave communication applications

ORDERING INFORMATION

Part Number	Package	Marking	Supplying Form
NE52418-T1	4-pin super minimold	V45	• 8 mm wide embossed taping • Pin 3 (Emitter), Pin 4 (Collector) face the perforation side of the tape • Qty 3 kpcs/reel

Remark To order evaluation samples, consult your NEC sales representative.
Part number for sample order: NE52418

Because this product uses high-frequency technology, avoid excessive static electricity, etc.

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ABSOLUTE MAXIMUM RATINGS (T_A = +25°C)

Parameter	Symbol	Ratings	Unit
Collector to Emitter Voltage	V_{CEO}	5.0	V
Collector to Base Voltage	V_{CBO}	3.0	V
Emitter to Base Voltage	V_{EBO}	3.0	V
Collector Current	I_C	40	mA
Base Current	I_B	0.3	mA
Total Power Dissipation	P_{tot}	150	mW
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–65 to +125	°C

RECOMMENDED OPERATING CONDITIONS (T_A = +25°C)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Collector to Emitter Voltage	V_{CE}	1.5	2.0	3.0	V
Collector Current	I_C	–	3	10	mA
Input Power	P_{in}	–	–	0	dBm

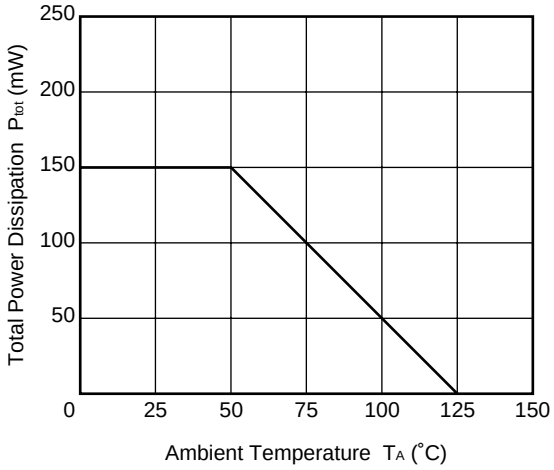
ELECTRICAL CHARACTERISTICS (Unless otherwise specified, T_A = +25°C)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Emitter to Base Leak Current	I_{EBO}	V_{EBO} = 3 V	–	0.2	1.0	μA
Collector to Base Leak Current	I_{CBO}	V_{CBO} = 3 V	–	0.2	1.0	μA
DC Current Gain	h_{FE}	V_{CE} = 2 V, I_C = 3 mA	110	150	190	–
Noise Figure	NF	V_{CE} = 2 V, I_C = 3 mA, f = 2 GHz,	–	0.95	1.35	dB
Associated Gain	G_a	$Z_S = Z_L$ = 50 Ω	15	17	–	dB
3rd Order Intermodulation Distortion Input Intercept Point	IIP_3	V_{CE} = 2.5 V, I_C = 8 mA, f = 2 GHz, 1 tone, $Z_S = Z_L = Z_{opt}$	–	+8	–	dBm

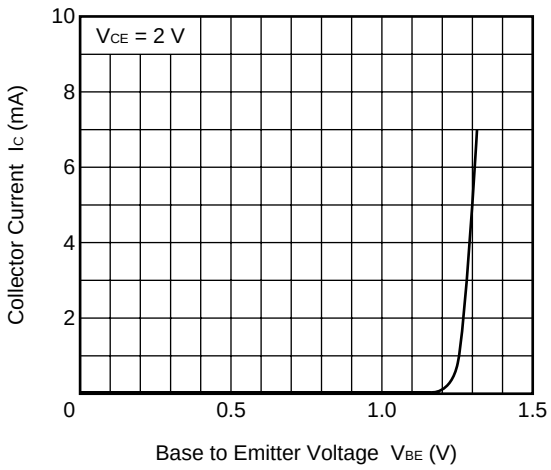
TYPICAL CHARACTERISTICS (Unless otherwise specified, T_A = +25°C)

DC CHARACTERISTICS

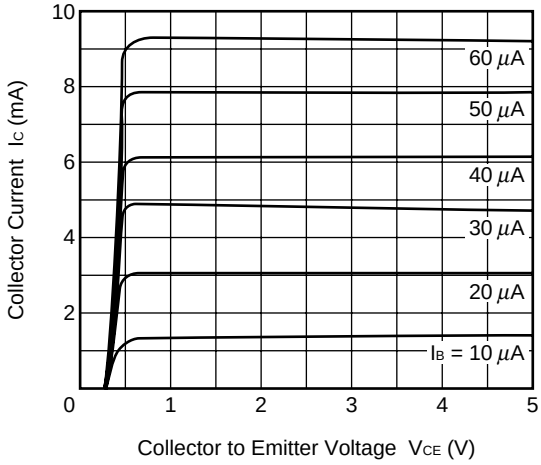
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



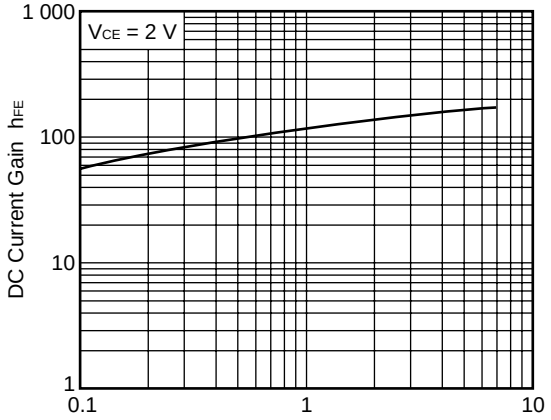
COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE

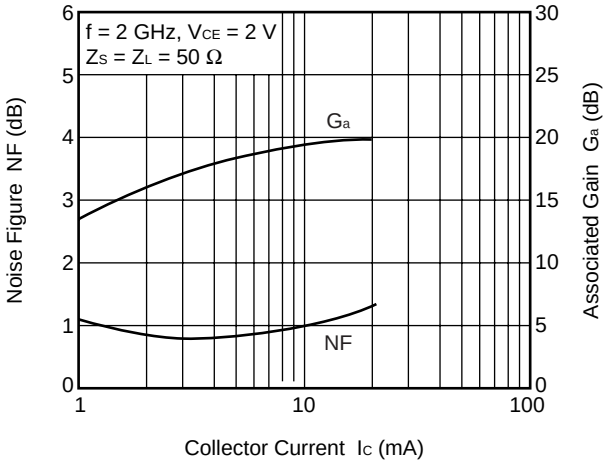


DC CURRENT GAIN vs. COLLECTOR CURRENT



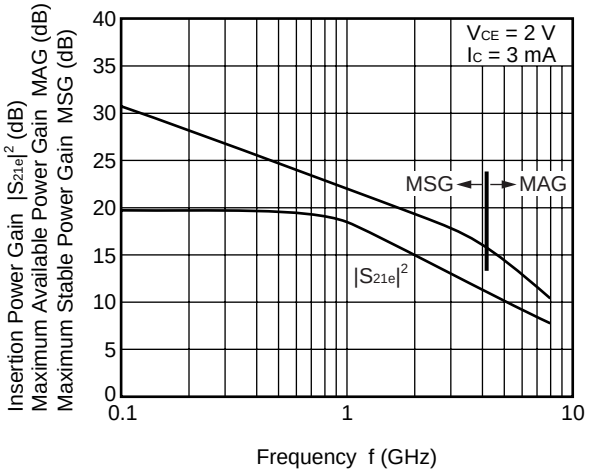
NOISE CHARACTERISTICS

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



GAIN CHARACTERISTICS

INSERTION POWER GAIN, MAXIMUM
AVAILABLE POWER GAIN, MAXIMUM
STABLE POWER GAIN vs. FREQUENCY



Remark The graphs indicate nominal characteristics.

S-PARAMETERS

V_{CE} = 2 V, I_C = 3 mA

Frequency	S_{11}		S_{21}		S_{12}		S_{22}		$\|S_{21}\|^2$	$\|S_{12}\|^2$	K
MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	dB	dB	
2000	0.607	–78.4	5.550	108.2	0.066	48.4	0.743	–37.2	14.89	–23.55	0.55
2100	0.581	–80.8	5.392	105.7	0.068	47.4	0.729	–37.8	14.64	–23.30	0.59
2200	0.556	–84.4	5.291	103.4	0.067	46.3	0.712	–39.1	14.47	–23.42	0.63
2300	0.540	–87.3	5.133	100.7	0.069	46.8	0.702	–40.3	14.21	–23.16	0.65
2400	0.529	–90.6	5.043	98.4	0.072	45.2	0.695	–41.4	14.05	–22.88	0.66
2500	0.521	–92.0	4.923	96.8	0.073	45.0	0.690	–41.8	13.84	–22.70	0.67
2600	0.495	–96.6	4.837	93.8	0.071	45.6	0.668	–43.0	13.69	–22.94	0.73
2700	0.480	–98.4	4.713	91.9	0.075	43.4	0.663	–43.7	13.47	–22.45	0.74
2800	0.453	–102.8	4.618	89.3	0.074	44.0	0.646	–44.5	13.29	–22.56	0.79
2900	0.449	–106.2	4.508	87.5	0.078	42.7	0.647	–45.9	13.08	–22.21	0.78
3000	0.432	–108.3	4.376	85.4	0.076	42.6	0.629	–47.0	12.82	–22.37	0.84
3100	0.408	–112.4	4.309	83.3	0.079	41.3	0.621	–47.5	12.69	–22.09	0.86
3200	0.406	–115.8	4.231	81.0	0.078	42.2	0.614	–48.5	12.53	–22.10	0.87
3300	0.400	–119.1	4.171	79.3	0.081	42.4	0.608	–49.5	12.41	–21.82	0.87
3400	0.387	–122.5	4.081	77.0	0.078	40.7	0.598	–50.5	12.22	–22.18	0.94
3500	0.373	–124.4	4.012	75.6	0.081	40.2	0.587	–51.3	12.07	–21.87	0.95
3600	0.368	–129.9	3.946	73.2	0.083	40.8	0.582	–52.1	11.92	–21.61	0.94
3700	0.361	–132.4	3.867	71.5	0.082	40.8	0.575	–53.0	11.75	–21.74	0.98
3800	0.348	–136.2	3.797	69.7	0.083	40.7	0.565	–54.4	11.59	–21.65	1.01
3900	0.335	–138.6	3.720	68.0	0.085	40.1	0.564	–55.1	11.41	–21.40	1.01
4000	0.329	–141.3	3.658	66.4	0.084	40.0	0.561	–56.0	11.27	–21.53	1.05
4500	0.310	–159.4	3.415	57.3	0.089	40.8	0.534	–60.3	10.67	–21.03	1.09
5000	0.299	–176.4	3.158	49.0	0.097	41.2	0.524	–67.1	9.99	–20.28	1.09
5500	0.298	170.1	2.944	41.3	0.106	42.3	0.501	–72.6	9.38	–19.51	1.11
6000	0.314	157.1	2.761	33.5	0.108	42.0	0.492	–78.1	8.82	–19.37	1.14
6500	0.327	144.8	2.629	25.8	0.120	41.7	0.477	–84.3	8.40	–18.44	1.10
7000	0.344	133.1	2.482	18.2	0.134	40.2	0.454	–90.3	7.89	–17.44	1.07
7500	0.366	122.7	2.363	10.2	0.145	37.6	0.429	–97.1	7.47	–16.78	1.06
8000	0.398	113.0	2.276	3.1	0.159	36.1	0.399	–106.2	7.14	–15.97	1.02
8500	0.440	104.8	2.184	–5.3	0.176	33.0	0.374	–119.0	6.79	–15.09	0.97
9000	0.485	97.8	2.098	–13.7	0.194	27.5	0.359	–136.5	6.44	–14.26	0.92
9500	0.542	89.5	1.985	–22.8	0.206	23.0	0.367	–155.6	5.95	–13.72	0.87
10000	0.600	82.4	1.877	–31.9	0.225	16.4	0.398	–174.3	5.47	–12.97	0.79
10500	0.650	76.1	1.762	–41.2	0.234	10.2	0.440	167.8	4.92	–12.60	0.75
11000	0.697	70.7	1.629	–49.6	0.242	3.6	0.484	152.9	4.24	–12.32	0.70
11500	0.739	65.2	1.516	–58.7	0.252	–3.2	0.522	137.8	3.62	–11.97	0.66
12000	0.772	60.3	1.401	–67.4	0.255	–9.6	0.556	123.6	2.93	–11.88	0.64
12500	0.797	54.3	1.282	–76.4	0.255	–17.0	0.600	109.7	2.16	–11.86	0.62
13000	0.815	48.8	1.152	–85.1	0.252	–24.5	0.643	96.5	1.23	–11.98	0.62
13500	0.827	42.5	1.019	–94.3	0.242	–31.4	0.705	85.4	0.16	–12.32	0.61
14000	0.832	35.9	0.895	–102.7	0.229	–38.8	0.742	75.6	–0.97	–12.81	0.62
14500	0.837	30.6	0.787	–110.1	0.216	–43.2	0.808	69.7	–2.08	–13.33	0.58
15000	0.831	26.2	0.678	–118.6	0.209	–50.8	0.838	62.6	–3.38	–13.58	0.54
15500	0.837	23.3	0.589	–126.0	0.196	–54.5	0.881	58.0	–4.60	–14.15	0.45
16000	0.818	21.7	0.498	–133.5	0.186	–59.7	0.897	52.8	–6.05	–14.61	0.42

V_{CE} = 2 V, I_C = 5 mA

Frequency	S_{11}		S_{21}		S_{12}		S_{22}		$\|S_{21}\|^2$	$\|S_{12}\|^2$	K
MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	dB	dB	
2000	0.471	–86.1	6.989	100.2	0.058	54.3	0.661	–37.8	16.89	–24.74	0.70
2100	0.444	–88.2	6.726	98.1	0.059	51.9	0.648	–38.3	16.55	–24.52	0.75
2200	0.420	–91.6	6.521	95.9	0.060	51.0	0.630	–39.0	16.29	–24.37	0.79
2300	0.403	–94.8	6.310	93.5	0.063	50.9	0.620	–40.1	16.00	–24.02	0.81
2400	0.397	–97.8	6.156	91.4	0.063	50.8	0.614	–40.9	15.79	–23.96	0.82
2500	0.385	–99.0	5.971	89.8	0.066	50.8	0.611	–40.9	15.52	–23.67	0.83
2600	0.366	–103.5	5.839	87.3	0.067	49.4	0.592	–42.1	15.33	–23.50	0.87
2700	0.354	–105.2	5.675	85.7	0.069	50.1	0.584	–42.8	15.08	–23.28	0.89
2800	0.329	–109.9	5.516	83.4	0.070	49.7	0.573	–43.4	14.83	–23.08	0.91
2900	0.327	–113.2	5.366	81.6	0.070	50.1	0.571	–44.8	14.59	–23.11	0.93
3000	0.315	–115.8	5.191	80.0	0.072	49.5	0.555	–45.3	14.31	–22.90	0.96
3100	0.293	–119.0	5.088	77.8	0.071	50.1	0.549	–45.8	14.13	–22.95	1.00
3200	0.291	–123.3	4.981	76.0	0.077	49.3	0.543	–46.7	13.95	–22.33	0.97
3300	0.287	–126.2	4.894	74.5	0.077	49.9	0.537	–47.7	13.79	–22.22	0.98
3400	0.276	–129.9	4.759	72.4	0.079	50.0	0.532	–48.3	13.55	–22.05	0.99
3500	0.266	–132.0	4.661	71.3	0.080	50.9	0.525	–49.1	13.37	–21.98	1.02
3600	0.266	–138.9	4.580	69.0	0.081	50.3	0.519	–49.7	13.22	–21.86	1.02
3700	0.261	–140.5	4.483	67.7	0.081	50.1	0.513	–50.1	13.03	–21.86	1.05
3800	0.248	–144.3	4.392	66.0	0.082	48.5	0.508	–52.1	12.85	–21.73	1.06
3900	0.238	–147.6	4.292	64.4	0.086	49.6	0.502	–52.3	12.65	–21.26	1.05
4000	0.236	–150.1	4.212	62.9	0.087	50.1	0.498	–53.5	12.49	–21.25	1.07
4500	0.225	–169.6	3.899	54.8	0.096	48.4	0.478	–57.3	11.82	–20.36	1.07
5000	0.229	173.0	3.591	47.3	0.102	48.5	0.468	–63.5	11.10	–19.86	1.09
5500	0.231	160.1	3.332	40.2	0.112	47.3	0.449	–69.4	10.45	–19.01	1.09
6000	0.254	147.7	3.135	33.0	0.122	45.2	0.438	–74.9	9.92	–18.31	1.07
6500	0.273	137.6	2.960	25.8	0.133	43.3	0.423	–80.8	9.43	–17.50	1.05
7000	0.295	125.9	2.800	18.7	0.145	39.5	0.401	–86.2	8.94	–16.75	1.03
7500	0.321	117.5	2.666	11.3	0.158	36.7	0.377	–92.5	8.52	–16.01	1.01
8000	0.355	108.9	2.563	4.3	0.168	33.4	0.342	–101.5	8.17	–15.49	1.01
8500	0.399	101.6	2.462	–3.6	0.186	30.6	0.315	–114.3	7.82	–14.63	0.96
9000	0.445	94.7	2.359	–11.4	0.200	26.0	0.294	–133.4	7.45	–13.97	0.93
9500	0.507	87.6	2.251	–19.8	0.212	19.6	0.300	–153.2	7.05	–13.47	0.88
10000	0.564	81.6	2.149	–28.6	0.229	14.6	0.333	–174.3	6.65	–12.80	0.83
10500	0.620	74.9	2.031	–37.5	0.235	8.7	0.371	167.3	6.15	–12.56	0.79
11000	0.671	70.2	1.898	–46.0	0.242	1.5	0.418	151.8	5.57	–12.32	0.74
11500	0.709	64.9	1.776	–54.5	0.253	–4.2	0.453	137.4	4.99	–11.95	0.71
12000	0.748	60.4	1.651	–63.2	0.252	–10.1	0.489	122.3	4.35	–11.97	0.70
12500	0.779	54.3	1.530	–72.1	0.254	–17.7	0.541	109.1	3.69	–11.89	0.67
13000	0.799	48.2	1.385	–81.5	0.251	–25.4	0.591	96.1	2.83	–12.00	0.66
13500	0.812	42.7	1.252	–90.5	0.243	–33.0	0.658	85.0	1.95	–12.29	0.64
14000	0.821	35.9	1.106	–100.2	0.233	–40.1	0.698	75.4	0.87	–12.65	0.63
14500	0.821	29.9	0.987	–108.3	0.218	–44.8	0.773	69.6	–0.12	–13.25	0.60
15000	0.814	25.6	0.848	–117.4	0.207	–50.4	0.811	63.8	–1.44	–13.66	0.56
15500	0.810	22.8	0.748	–125.6	0.188	–55.8	0.847	58.4	–2.53	–14.53	0.50
16000	0.786	21.1	0.631	–134.7	0.182	–61.0	0.881	53.9	–4.00	–14.82	0.42

V_{CE} = 2 V, I_C = 8 mA

Frequency	S_{11}		S_{21}		S_{12}		S_{22}		$\|S_{21}\|^2$	$\|S_{12}\|^2$	K
MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	dB	dB	
2000	0.358	–89.7	8.123	94.6	0.055	57.1	0.596	–37.0	18.19	–25.22	0.82
2100	0.334	–91.4	7.762	92.5	0.055	57.4	0.585	–37.0	17.80	–25.12	0.87
2200	0.316	–94.4	7.496	90.7	0.057	55.9	0.568	–37.3	17.50	–24.95	0.90
2300	0.303	–97.2	7.214	88.5	0.058	57.8	0.560	–38.5	17.16	–24.67	0.92
2400	0.293	–100.4	7.013	86.6	0.060	57.0	0.555	–39.4	16.92	–24.42	0.92
2500	0.286	–100.5	6.781	85.1	0.062	57.5	0.551	–39.7	16.63	–24.11	0.93
2600	0.273	–105.4	6.606	83.1	0.062	55.5	0.538	–39.9	16.40	–24.09	0.97
2700	0.260	–106.3	6.393	81.4	0.065	57.7	0.532	–40.6	16.11	–23.74	0.97
2800	0.237	–111.4	6.201	79.5	0.068	57.6	0.521	–41.6	15.85	–23.38	0.99
2900	0.236	–116.0	6.046	77.8	0.069	58.3	0.520	–42.5	15.63	–23.22	0.98
3000	0.225	–116.9	5.828	76.3	0.069	58.8	0.505	–42.9	15.31	–23.28	1.04
3100	0.212	–121.4	5.687	74.6	0.073	57.6	0.501	–43.6	15.10	–22.74	1.02
3200	0.209	–125.7	5.567	72.8	0.075	57.2	0.496	–44.2	14.91	–22.46	1.02
3300	0.206	–129.4	5.444	71.5	0.074	56.4	0.491	–45.0	14.72	–22.58	1.05
3400	0.196	–133.1	5.289	69.6	0.078	54.9	0.486	–46.0	14.47	–22.19	1.05
3500	0.184	–134.9	5.187	68.5	0.080	56.7	0.479	–46.5	14.30	–21.94	1.05
3600	0.186	–142.0	5.084	66.5	0.082	55.3	0.477	–46.9	14.12	–21.72	1.05
3700	0.184	–144.7	4.963	65.4	0.084	54.8	0.471	–48.2	13.92	–21.48	1.05
3800	0.174	–149.0	4.857	63.8	0.085	53.2	0.464	–49.2	13.73	–21.45	1.07
3900	0.170	–152.4	4.744	62.3	0.089	53.7	0.462	–49.6	13.52	–21.00	1.06
4000	0.167	–154.4	4.665	61.1	0.088	53.5	0.457	–50.5	13.38	–21.08	1.08
4500	0.164	–176.7	4.296	53.5	0.099	52.0	0.440	–54.6	12.66	–20.06	1.07
5000	0.174	165.3	3.947	46.7	0.108	49.9	0.426	–61.2	11.93	–19.32	1.07
5500	0.182	151.5	3.657	40.1	0.121	49.5	0.409	–66.7	11.26	–18.37	1.06
6000	0.207	139.9	3.430	33.3	0.130	45.9	0.401	–72.1	10.71	–17.70	1.04
6500	0.228	132.4	3.243	26.5	0.141	44.2	0.384	–77.6	10.22	–17.02	1.03
7000	0.255	121.5	3.061	19.6	0.156	40.6	0.361	–83.0	9.72	–16.13	1.00
7500	0.281	112.9	2.911	12.6	0.164	36.9	0.331	–88.2	9.28	–15.73	1.02
8000	0.316	105.3	2.794	6.2	0.178	32.2	0.301	–97.0	8.93	–15.01	0.99
8500	0.360	99.0	2.690	–1.6	0.188	29.9	0.269	–109.7	8.59	–14.51	0.98
9000	0.410	93.6	2.589	–8.9	0.208	25.1	0.245	–129.5	8.26	–13.63	0.93
9500	0.469	86.6	2.476	–17.2	0.222	19.9	0.249	–152.1	7.88	–13.09	0.90
10000	0.533	80.9	2.371	–25.4	0.229	14.4	0.277	–174.2	7.50	–12.79	0.86
10500	0.590	75.0	2.256	–34.1	0.243	7.9	0.318	165.0	7.07	–12.29	0.82
11000	0.640	70.2	2.108	–42.3	0.244	1.3	0.367	149.7	6.48	–12.26	0.79
11500	0.684	64.8	1.991	–50.8	0.254	–5.9	0.403	135.1	5.98	–11.90	0.76
12000	0.725	60.4	1.869	–59.5	0.256	–12.1	0.439	120.6	5.43	–11.83	0.73
12500	0.755	54.9	1.738	–68.1	0.253	–18.5	0.492	107.3	4.80	–11.92	0.72
13000	0.787	48.8	1.596	–77.5	0.254	–26.5	0.543	95.1	4.06	–11.90	0.70
13500	0.796	42.3	1.458	–86.7	0.240	–32.4	0.613	84.4	3.27	–12.41	0.70
14000	0.806	35.5	1.300	–96.8	0.232	–39.1	0.664	76.0	2.28	–12.68	0.68
14500	0.808	29.3	1.166	–105.3	0.218	–44.7	0.741	70.0	1.33	–13.22	0.65
15000	0.795	25.0	1.021	–115.2	0.203	–51.2	0.790	63.8	0.18	–13.86	0.60
15500	0.789	22.4	0.889	–124.5	0.190	–55.4	0.829	59.2	–1.02	–14.43	0.53
16000	0.753	21.4	0.759	–135.0	0.181	–61.5	0.868	54.6	–2.39	–14.84	0.43

NOISE PARAMETERS

V_{CE} = 2 V, I_C = 3 mA

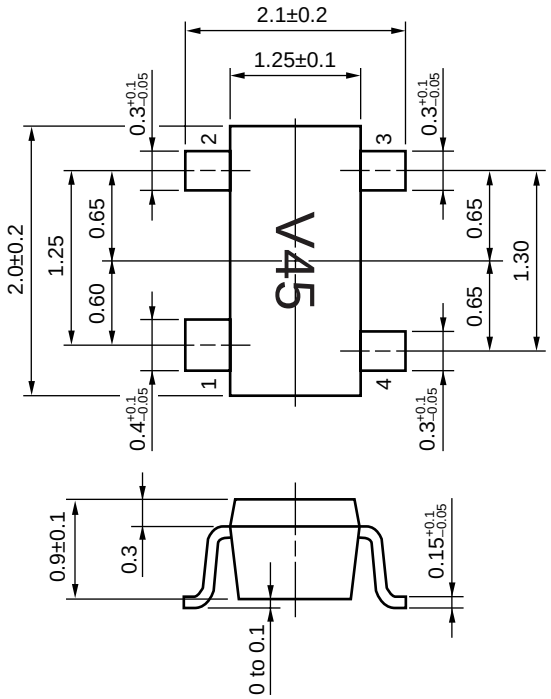
Frequency (GHz)	$NF_{min.}$ (dB)	G_a (dB)	Γopt		Rn/50
			MAG.	ANG. (deg.)	
0.8	0.24	25.2	0.39	6.0	0.20
1.0	0.43	24.4	0.42	13.0	0.21
1.2	0.44	21.6	0.44	17.0	0.22
1.4	0.56	18.9	0.54	16.6	0.20
1.6	0.60	19.0	0.45	21.6	0.21
1.8	0.67	18.3	0.43	26.0	0.21
2.0	0.75	17.2	0.43	31.4	0.21
2.2	0.83	16.2	0.42	35.1	0.21
2.4	0.91	16.0	0.41	37.0	0.20
2.6	0.99	15.3	0.35	44.0	0.20

V_{CE} = 2 V, I_C = 5 mA

Frequency (GHz)	$NF_{min.}$ (dB)	G_a (dB)	Γopt		Rn/50
			MAG.	ANG. (deg.)	
0.8	0.51	26.2	0.40	8.3	0.19
1.0	0.54	24.2	0.38	10.0	0.20
1.2	0.59	22.7	0.39	11.9	0.20
1.4	0.69	21.3	0.38	13.2	0.20
1.6	0.73	19.8	0.38	14.4	0.19
1.8	0.84	18.9	0.38	17.2	0.19
2.0	0.84	18.1	0.35	21.1	0.19
2.2	0.89	17.6	0.32	28.0	0.18
2.4	0.95	17.1	0.30	33.4	0.18
2.6	0.95	16.6	0.26	42.8	0.18

PACKAGE DIMENSIONS

4-PIN SUPER MINIMOLD (UNIT: mm)



PIN CONNECTIONS

1. Emitter
2. Base
3. Emitter
4. Collector

PRECAUTION

Because this product uses high-frequency technology, sufficient care must be taken regarding static electricity and strong electric fields.

Take measures against static electricity and make sure the body is earthed when mounting the device.

RECOMMENDED SOLDERING CONDITIONS

This product should be soldered and mounted under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your NEC sales representative.

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared Reflow	Package peak temperature: 240°C or below, Time: 30 seconds or less (at 210°C or higher), Count: 3 times or less, Exposure limit: None [Note]	IR40-00-3
Partial Heating	Pin temperature: 300°C or below, Time: 3 seconds or less (per side of device), Exposure limit: None [Note]	–

Note After opening the dry pack, store it at 25°C or less and 65% RH or less for the allowable storage period.

Caution Do not use different soldering methods together (except for partial heating).

For the details the recommended soldering conditions, refer to the document **SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E)**.

[MEMO]

SAFETY INFORMATION ON THIS PRODUCT

Caution GaAs Products	The product contains gallium arsenide, GaAs. GaAs vapor and powder are hazardous to human health if inhaled or ingested. • Do not destroy or burn the product. • Do not cut or cleave off any part of the product. • Do not crush or chemically dissolve the product. • Do not put the product in the mouth. Follow related laws and ordinances for disposal. The product should be excluded from general industrial waste or household garbage.