NEC®

LOW NOISE Ku-K BAND GaAs MESFET | NE760 SERIES

FEATURES

- **LOW NOISE FIGURE**
  NF = 1.6 dB TYP at f = 12 GHz
- **HIGH ASSOCIATED GAIN**
  G_A = 9 dB TYP at f = 12 GHz
- **GATE LENGTH:** Lg = 0.3 µm
- **GATE WIDTH:** Wg = 280 µm
- **ION IMPLATION**
- **AVAILABILITY:** Chip, Hermetic Package, Low Cost Package

DESCRIPTION AND APPLICATIONS

The NE76000 provides a low noise figure and high associated gain thru K-Band. The NE760 devices are fabricated by ion implantion for improved RF and DC performance, reliability, and uniformity. These devices feature a recessed 0.3 micron gate and triple epitaxial technology.

The surface of the device, except for bonding pads, is passivated with SiO_2 and SiN_4 for scratch protection as well as surface stability.

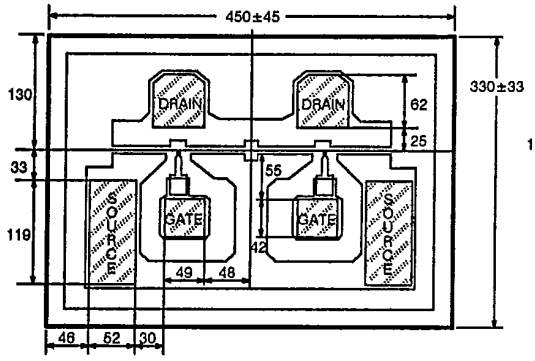
The device is available in chip form (NE76000) and packages. The NE76083A for industrial and military and the NE76084 for low cost consumer applications.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{DS}	Drain to Source Voltage	V	5
V_{GDO}	Gate to Drain Voltage	V	-5
V_{GSO}	Gate to Source Voltage	V	-3
I_{DS}	Drain Current	mA	50
P_{IN}	RF Input (CW)	dBm	+15
T_{CH}	Channel Temperature	°C	175
T_{STG}	Storage Temperature	°C	-65 to +175

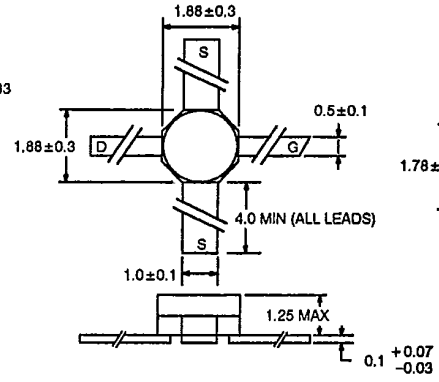
OUTLINE DIMENSIONS (Units in mm)

NE76000 (CHIP)
(Units in µm)

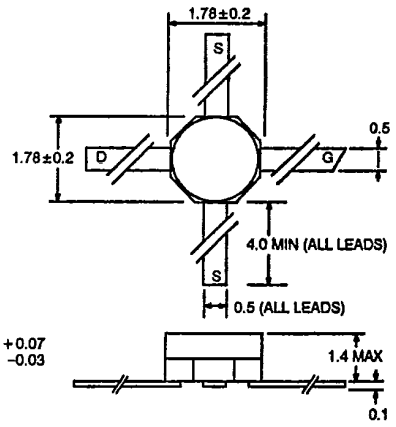


Bonding Pad Area Chip Thickness: 140 µm±20 µm

OUTLINE 83A



OUTLINE 84



ELECTRICAL SPECIFICATIONS (TA = 25°C)

PART NUMBER PACKAGE OUTLINE			NE76000 CHIP			NE76083A 83A			NE76084[5] 84			NE76084-2.4[5] 84		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
f_{MAX}	Maximum Frequency of Oscillation at V_{DS} = 3 V, I_{DS} = 30 mA	GHz		90			90			90			90	
MAG	Maximum Available Gain[1] at V_{DS} = 3 V, I_{DS} = 20 mA, f = 4 GHz f = 12 GHz	dB dB		17 12			17 12							
NF_{OPT}	Optimum Noise Figure[2] at V_{DS} = 3 V, I_{DS} = 10 mA, f = 4 GHz f = 12 GHz	dB dB		0.6 1.6	1.8[4]		0.6 1.6	0.7 1.8		1.6	1.8		1.8	2.4
G_A	Associated Gain V_{DS} = 3 V, I_{DS} = 10 mA, f = 4 GHz f = 12 GHz	dB dB	8	13.0[4] 9		11.5 8	13.0 9		8	9			8	9
P_{1dB}	Output Power at 1 dB Compression V_{DS} = 3 V, I_{DS} = 10 mA, f = 12 GHz	dBm		14.5			14.5				14.5			14.5
I_{DSS}	Drain Current at V_{DS} = 3 V, V_{GS} = 0	mA	15	30	50	15	30	50	15	30	50	15	30	50
V_P	Pinch-off Voltage at V_{DS} = 3 V, I_{DS} = 0.1 mA	V	-3	-0.8	-0.5	-3	-0.8	-0.5	-3	-0.8	-0.5	-3	-0.8	-0.5
gm	Transconductance V_{DS} = 3 V, I_{DS} = 10 mA	mS	30	40	70	30	40	70	30	40	70	30	40	70
I_{GSO}	Gate to Source Leakage Current V_{GS} = -4 V	µA		1	10		1	10		1	10		1	10
R_{TH}	Thermal Resistance (Channel to Ambient)	°C/W			190[3]			625			625			625
P_T	Total Power Dissipation	mW			500			240			240			240

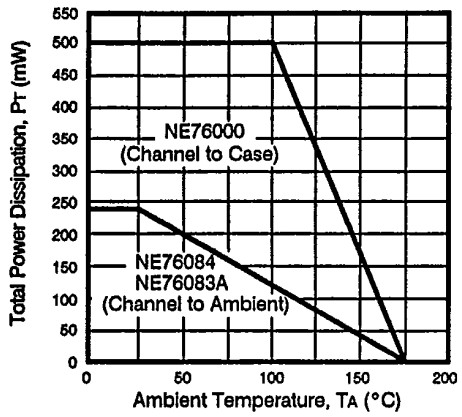
Notes:

1. Gain Calculations: $MAG = \frac{|S_{21}|}{|S_{12}|}(K \pm \sqrt{K^2 - 1})$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}||S_{21}|}$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$. When $K \leq 1$, MAG = MSG.
   MAG = Maximum Available Gain
   MSG = Maximum Stable Gain
2. Typical values of noise figures are those obtained when 50% of the devices from a large number of lots were individually measured in a circuit with the input individually tuned to obtain the minimum value. Maximum values are criteria established on the production line as a "go-no-go" screening test with the fixture tuned for the "generic" type but not for each specimen.
3. R_{TH} for chip mounted on a copper heatsink.
4. RF performance is determined by packaging and testing 10 samples per wafer; wafer rejection criteria for standard devices is 2 rejects for 10 samples.
5. Package type 84 recommended for use below 13 GHz. Refer to NE76083A for use above 13 GHz.

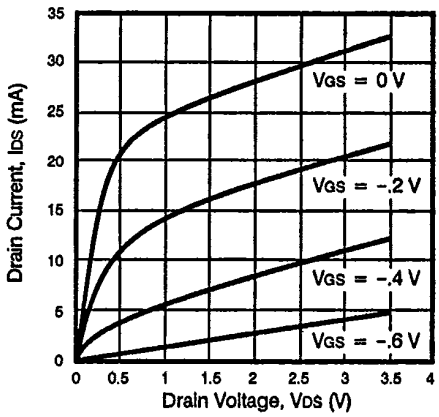
3

TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

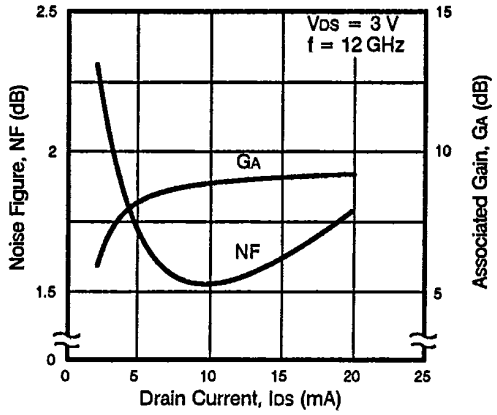
POWER DERATING CURVE



DC PERFORMANCE



NOISE FIGURE, ASSOCIATED GAIN vs. DRAIN CURRENT



NE76000 TYPICAL NOISE PARAMETERS[1]

FREQ. (GHz)	NFOPT (dB)	GA (dB)	ΓOPT (MAG)	ΓOPT (ANG)	Rn/50
1	0.50	20	.84	12	.69
2	0.55	17	.76	25	.63
4	0.60	14.0	.70	45	.49
6	0.80	12	.64	65	.41
8	1.00	11	.60	83	.36
10	1.30	10	.56	99	.32
12	1.60	9	.52	114	.27
14	1.90	8.5	.49	125	.23
16	2.20	7.9	.48	135	.20
18	2.50	7.3	.47	145	.18

Γ opt. includes bond wires.
Bond wires used during testing.
Gate: 2 wires total, 1 per bond pad, 0.0139" long each wire.
Drain: 2 wires total, 1 per bond pad, 0.0115" long each wire.
Sources: 4 wires total, 2 per side, 0.0066" long each wire.
Wire: 0.0007" diameter, gold.

NE76083A TYPICAL NOISE PARAMETERS[1]

(VDS = 3 V, IDS = 10 mA)

FREQ. (GHz)	NFOPT (dB)	GA (dB)	ΓOPT (MAG)	ΓOPT (ANG)	Rn/50
1	0.50	20	.92	16	.69
2	0.55	17	.86	35	.64
4	0.60	14	.73	73	.55
6	0.80	12	.62	109	.47
8	1.00	11	.55	138	.39
10	1.30	10	.48	168	.27
12	1.60	9	.46	-161	.24
14	1.90	8.4	.42	-133	.22
16	2.30	7.8	.40	-105	.19
18	2.60	7.2	.38	-69	.17

NE76084 TYPICAL NOISE PARAMETERS[1]

(VDS = 3 V, IDS = 10 mA)

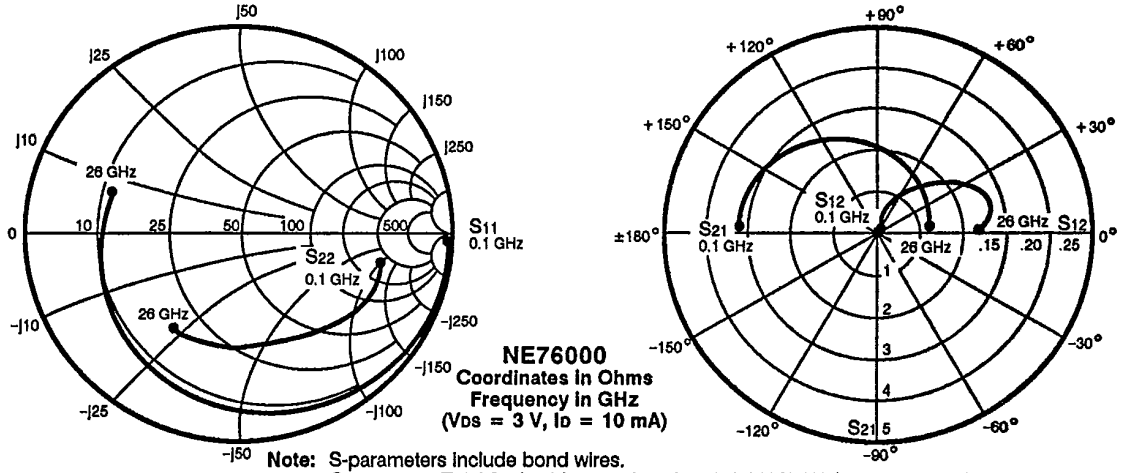
FREQ. (GHz)	NFOPT (dB)	GA (dB)	ΓOPT (MAG)	ΓOPT (ANG)	Rn/50
1	0.50	20	.93	11	.58
2	0.55	17	.88	31	.51
4	0.60	14	.72	69	.46
6	0.80	12	.60	107	.37
8	1.00	11	.52	148	.32
10	1.30	10	.46	-175	.26
12	1.60	9	.45	-138	.21

3

Notes:

1. Typical values of noise figures are those obtained when 50% of the devices from a large number of lots were individually measured in a circuit with the input individually tuned to obtain the minimum value. Maximum values are criteria established on the production line as a "go-no-go" screening test with the fixture tuned for the "generic" type but not for each specimen.

TYPICAL COMMON SOURCE SCATTERING PARAMETERS



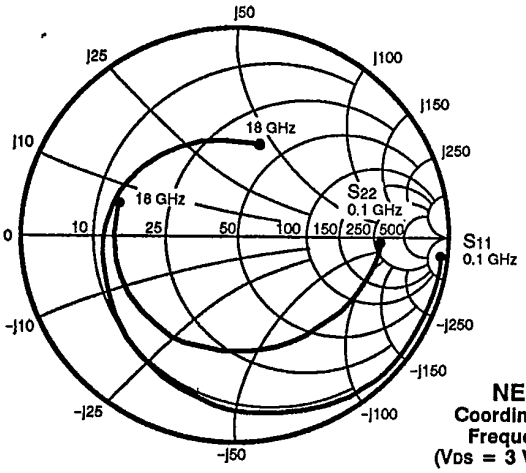
NE76000
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 3 V, I_D = 10 mA)

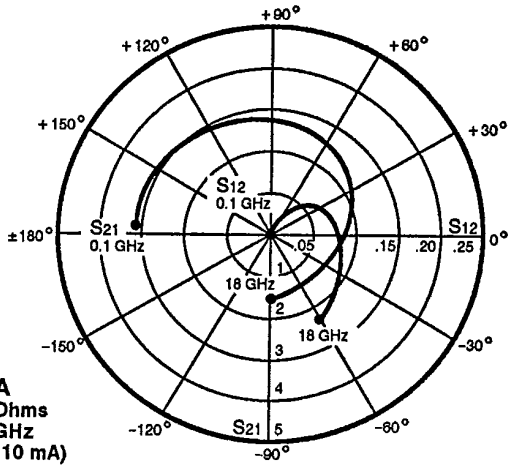
Note: S-parameters include bond wires.
Gate: Total 2 wire (s), 1 per bond pad, 0.0139" (354 µm) long each wire.
Drain: Total 2 wire (s), 1 per bond pad, 0.0115" (291 µm) long each wire.
Source: Total 4 wire (s), 2 per side, 0.0066" (168 µm) long each wire.
Wire: 0.0007" (17.8 µm) Diameter, Gold.

S-MAGN AND ANGLES:
VDS = 3 V, ID = 10 mA

FREQUENCY (GHz)	S11		S21		S12		S22		k[1]	MAG[1]
0.05	0.99	-1	3.32	180	0.001	89	0.68	-1	0.15	35.2
0.10	0.99	-2	3.30	179	0.002	87	0.68	-1	0.10	32.2
0.20	0.99	-3	3.29	178	0.004	86	0.68	-2	0.10	29.2
0.50	0.99	-7	3.28	175	0.009	85	0.68	-3	0.05	25.6
1.0	0.99	-14	3.27	169	0.02	81	0.67	-8	.05	21.9
2.0	0.99	-27	3.19	158	0.04	74	0.67	-16	.08	19.1
3.0	0.97	-39	3.08	148	0.06	66	0.66	-23	.13	17.3
4.0	0.95	-50	2.95	138	0.07	59	0.64	-30	.18	16.1
5.0	0.92	-61	2.81	129	0.09	51	0.62	-36	.24	15.2
6.0	0.89	-70	2.67	120	0.09	47	0.60	-42	.30	14.5
7.0	0.87	-78	2.55	113	0.10	41	0.59	-47	.34	13.9
8.0	0.86	-87	2.45	104	0.11	36	0.58	-53	.38	13.5
9.0	0.83	-96	2.33	97	0.11	30	0.57	-58	.45	13.1
10.0	0.81	-104	2.24	90	0.12	29	0.57	-63	.45	12.7
11.0	0.80	-112	2.16	83	0.13	23	0.56	-68	.48	12.3
12.0	0.77	-120	2.08	76	0.13	19	0.56	-73	.52	12.0
13.0	0.75	-128	2.00	70	0.13	16	0.55	-77	.56	11.9
14.0	0.74	-135	1.93	63	0.13	12	0.55	-81	.59	11.6
15.0	0.73	-141	1.85	58	0.13	9	0.55	-85	.62	11.4
16.0	0.72	-147	1.80	53	0.13	6	0.55	-88	.65	11.3
17.0	0.71	-152	1.73	47	0.13	5	0.55	-91	.72	11.3
18.0	0.70	-155	1.65	43	0.13	3	0.55	-94	.80	11.0
19.0	0.69	-159	1.57	38	0.12	2	0.55	-96	.97	11.1
20.0	0.68	-162	1.53	35	0.12	4	0.55	-99	.99	11.0
21.0	0.67	-166	1.49	30	0.12	5	0.55	-102	1.02	10.0
22.0	0.67	-171	1.46	26	0.12	4	0.55	-107	1.09	9.3
23.0	0.65	-176	1.41	21	0.12	5	0.55	-111	1.13	8.7
24.0	0.64	178	1.39	16	0.12	5	0.55	-116	1.08	8.9
25.0	0.63	171	1.32	11	0.12	5	0.55	-120	1.17	7.9
26.0	0.62	164	1.29	7	0.12	4	0.55	-123	1.18	7.6

TYPICAL COMMON SOURCE SCATTERING PARAMETERS





NE76083A
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 3 V, I_{DS} = 10 mA)

S-MAGN AND ANGLES:

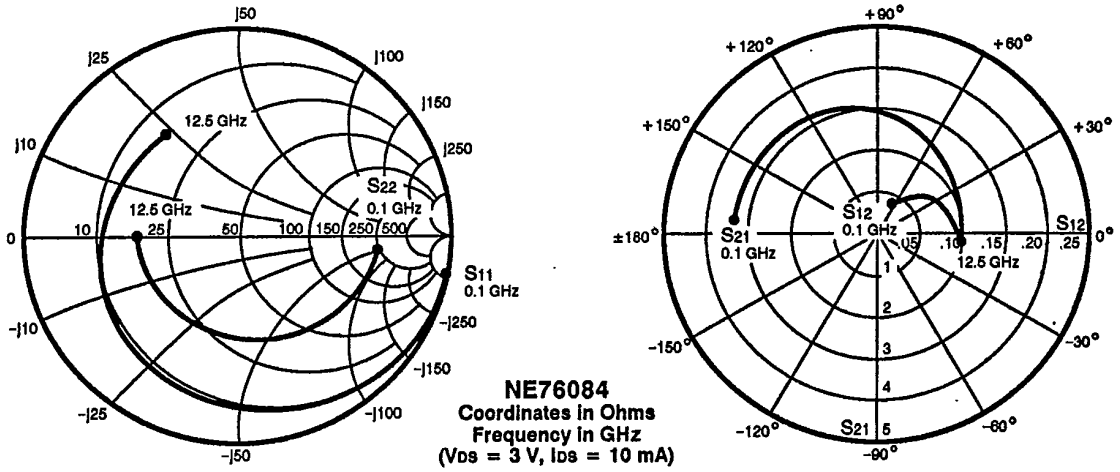
V_{DS} = 3 V, I_{DS} = 10 mA

FREQUENCY (GHz)	S_{11}		S_{21}		S_{12}		S_{22}		k^1	MAG^1
0.1	0.99	-2	3.22	178	0.001	87	0.65	-1	0.20	35.1
0.2	0.99	-4	3.20	177	0.002	85	0.65	-3	0.12	32.0
0.5	0.99	-11	3.18	170	0.007	80	0.65	-8	0.05	26.6
1.0	0.99	-20	3.15	160	0.02	78	0.65	-15	0.10	22.7
2.0	0.97	-40	3.05	142	0.04	62	0.64	-29	0.17	18.8
3.0	0.93	-59	2.95	123	0.05	48	0.62	-43	0.32	17.7
4.0	0.89	-78	2.80	106	0.07	37	0.61	-56	0.36	16.02
5.0	0.84	-96	2.65	89	0.07	25	0.59	-69	0.53	15.8
6.0	0.80	-114	2.48	73	0.08	14	0.57	-81	0.62	14.9
7.0	0.76	-130	2.30	58	0.08	4	0.56	-93	0.83	14.6
8.0	0.74	-145	2.15	44	0.08	-2	0.56	-103	0.85	14.3
9.0	0.72	-158	2.03	31	0.08	-9	0.56	-112	0.95	14.0
10.0	0.68	-172	1.94	17	0.08	-16	0.56	-121	1.11	11.8
11.0	0.66	173	1.85	4	0.09	-21	0.56	-130	1.06	11.6
12.0	0.64	158	1.77	-10	0.09	-27	0.55	-140	1.05	11.5
13.0	0.64	145	1.71	-23	0.09	-32	0.55	-150	1.19	10.1
14.0	0.63	132	1.65	-35	0.09	-34	0.55	-159	1.23	9.7
15.0	0.60	120	1.61	-48	0.10	-42	0.56	-168	1.19	9.4
16.0	0.56	104	1.58	-63	0.11	-50	0.56	-177	1.20	8.8
17.0	0.54	86	1.56	-77	0.11	-59	0.54	173	1.31	8.2
18.0	0.55	70	1.54	-91	0.12	-67	0.53	164	1.20	8.3

V_{DS} = 3 V, I_{DS} = 30 mA

0.1	0.99	-2	4.45	178	0.001	90	0.59	-1	0.14	36.4
0.2	0.99	-5	4.41	176	0.002	88	0.59	-3	0.06	33.4
0.5	0.99	-13	4.38	169	0.004	86	0.59	-7	0.32	30.4
1.0	0.99	-22	4.35	159	0.02	79	0.59	-15	0.07	23.4
2.0	0.95	-43	4.17	140	0.03	64	0.58	-29	0.26	21.4
3.0	0.90	-64	3.93	121	0.04	50	0.56	-42	0.43	19.9
4.0	0.85	-83	3.68	103	0.05	41	0.55	-55	0.52	18.7
5.0	0.79	-102	3.42	86	0.06	29	0.53	-67	0.66	17.6
6.0	0.74	-120	3.15	70	0.07	22	0.52	-79	0.72	16.5
7.0	0.71	-136	2.90	55	0.07	13	0.51	-90	0.86	16.2
8.0	0.68	-151	2.68	42	0.07	9	0.51	-100	0.97	15.8
9.0	0.65	-164	2.51	28	0.07	3	0.52	-109	1.09	13.6
10.0	0.62	-177	2.38	15	0.08	-1	0.52	-118	1.07	13.1
11.0	0.59	168	2.26	2	0.08	-6	0.52	-126	1.19	11.9
12.0	0.57	153	2.14	-11	0.09	-12	0.52	-135	1.15	11.4
13.0	0.57	140	2.06	-24	0.09	-18	0.52	-145	1.18	11.0
14.0	0.56	128	1.98	-37	0.10	-21	0.52	-154	1.12	10.9
15.0	0.53	115	1.93	-50	0.10	-30	0.54	-163	1.17	10.3
16.0	0.49	100	1.87	-64	0.11	-40	0.54	-172	1.19	9.7
17.0	0.48	82	1.84	-78	0.12	-49	0.54	179	1.12	9.8
18.0	0.49	67	1.81	-92	0.13	-60	0.52	170	1.10	9.6

TYPICAL COMMON SOURCE SCATTERING PARAMETERS



NE76084
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 3 V, I_{DS} = 10 mA)

S-MAGN AND ANGLES:

V_{DS} = 3 V, I_{DS} = 10 mA

FREQUENCY (GHz)	S_{11}		S_{21}		S_{12}		S_{22}		k^1	MAG^1
0.1	0.99	-2	3.42	177	0.001	88	0.66	-2	0.18	35.3
0.2	0.99	-4	3.40	176	0.002	86	0.66	-3	0.18	32.3
0.5	0.99	-11	3.38	170	0.007	84	0.66	-8	0.17	26.8
1.0	0.99	-20	3.36	160	0.02	76	0.65	-15	0.08	21.9
2.0	0.96	-41	3.31	141	0.04	64	0.63	-28	0.23	18.8
3.0	0.90	-62	3.12	121	0.06	49	0.60	-42	0.39	17.2
4.0	0.85	-81	2.92	103	0.07	37	0.58	-55	0.51	16.0
5.0	0.79	-101	2.78	87	0.08	29	0.54	-69	0.59	15.2
6.0	0.73	-120	2.54	69	0.09	18	0.51	-82	0.77	14.7
7.0	0.69	-139	2.46	53	0.09	10	0.49	-97	0.80	14.2
8.0	0.66	-157	2.27	39	0.09	5	0.47	-110	0.95	13.9
9.0	0.64	-174	2.14	26	0.10	-1	0.47	-124	0.97	13.4
10.0	0.62	167	1.97	10	0.10	-7	0.46	-139	1.11	11.1
11.0	0.60	150	1.85	4	0.11	-4	0.46	-156	1.09	10.5
12.0	0.61	133	1.71	-13	0.10	-13	0.47	-171	1.22	9.4
12.5	0.60	125	1.73	-19	0.11	-17	0.46	-180	1.15	9.6

V_{DS} = 3 V, I_{DS} = 30 mA

0.1	0.99	-3	4.91	177	0.001	88	0.59	-2	0.17	37.6
0.2	0.99	-5	4.87	176	0.001	86	0.58	-3	0.11	35.7
0.5	0.99	-13	4.81	169	0.00	84	0.58	-7	0.37	31.3
1.0	0.98	-24	4.77	159	0.02	76	0.58	-15	0.14	24.5
2.0	0.93	-48	4.65	137	0.04	64	0.55	-27	0.34	21.2
3.0	0.86	-71	4.28	117	0.05	52	0.52	-40	0.51	19.5
4.0	0.78	-92	3.89	98	0.06	42	0.49	-51	0.69	18.3
5.0	0.72	-114	3.60	82	0.07	34	0.46	-64	0.78	17.3
6.0	0.66	-133	3.20	64	0.07	27	0.44	-76	0.99	16.6
7.0	0.63	-154	3.02	49	0.08	19	0.42	-89	1.01	15.2
8.0	0.60	-171	2.73	35	0.08	17	0.41	-101	1.15	13.0
9.0	0.58	171	2.55	22	0.09	12	0.41	-115	1.14	12.4
10.0	0.57	153	2.32	7	0.09	6	0.40	-129	1.21	11.3
11.0	0.56	136	2.16	2	0.11	6	0.40	-147	1.15	10.7
12.0	0.57	121	1.97	-15	0.11	-3	0.41	-163	1.22	9.8
12.5	0.56	114	1.98	-19	0.12	-8	0.41	-172	1.16	9.9