

### 3.2 V OPERATION SILICON RF POWER LD-MOS FET FOR GSM/DCS DUAL-BAND PHONE TRANSMISSION AMPLIFIERS

#### DESCRIPTION

The NE5520379A is an N-channel silicon power MOS FET specially designed as the transmission power amplifier for 3.2 V GSM 900 handsets. Dies are manufactured using NEC's NEWMOS technology (NEC's 0.6  $\mu$ m WSi gate lateral-diffusion MOS FET) and housed in a surface mount package. This device can deliver 34.6 dBm output power with 68% power efficiency at 915 MHz under the 2.8 V supply voltage.

#### FEATURES

- High output power :  $P_{out} = 35.5$  dBm TYP. ( $V_{DS} = 3.2$  V,  $V_{GS} = 2.5$  V,  $f = 915$  MHz,  $P_{in} = 25$  dBm)  
:  $P_{out} = 33.0$  dBm TYP. ( $V_{DS} = 3.2$  V,  $V_{GS} = 2.5$  V,  $f = 1785$  MHz,  $P_{in} = 25$  dBm)
- High power added efficiency :  $\eta_{add} = 65\%$  TYP. ( $V_{DS} = 3.2$  V,  $V_{GS} = 2.5$  V,  $f = 915$  MHz,  $P_{in} = 25$  dBm)  
:  $\eta_{add} = 35\%$  TYP. ( $V_{DS} = 3.2$  V,  $V_{GS} = 2.5$  V,  $f = 1785$  MHz,  $P_{in} = 25$  dBm)
- High linear gain :  $G_L = 16.0$  dB TYP. ( $V_{DS} = 3.2$  V,  $V_{GS} = 2.5$  V,  $f = 915$  MHz,  $P_{in} = 10$  dBm)  
:  $G_L = 8.5$  dB TYP. ( $V_{DS} = 3.2$  V,  $V_{GS} = 2.5$  V,  $f = 1785$  MHz,  $P_{in} = 10$  dBm)
- Surface mount package :  $5.7 \times 5.7 \times 1.1$  mm MAX.
- Single supply :  $V_{DS} = 2.8$  to  $3.8$  V

#### APPLICATIONS

- Digital cellular phones : 3.2 V GSM/DCS Dual-Band handsets
- Others : General purpose amplifiers for 1.6 to 2.0 GHz TDMA applications

#### ORDERING INFORMATION

Part Number	Package	Marking	Supplying Form
NE5520379A-T1	79A	A3	<ul style="list-style-type: none"> <li>• 12 mm wide embossed taping</li> <li>• Gate pin face the perforation side of the tape</li> <li>• Qty 1 kpcs/reel</li> </ul>
NE5520379A-T1A			<ul style="list-style-type: none"> <li>• 12 mm wide embossed taping</li> <li>• Gate pin face the perforation side of the tape</li> <li>• Qty 5 kpcs/reel</li> </ul>

**Remark** To order evaluation samples, consult your NEC sales representative.

Part number for sample order: NE5520379A

**Caution** Please handle this device at static-free workstation, because this is an electrostatic sensitive device.

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Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = +25°C)**

Parameter	Symbol	Ratings	Unit
Drain to Source Voltage	V <sub>DS</sub>	6.0	V
Gate to Source Voltage	V <sub>GSO</sub>	5.0	V
Drain Current	I <sub>D</sub>	1.5	A
Drain Current (Pulse Test)	I <sub>D</sub> <sup>Note</sup>	3.0	A
Total Power Dissipation	P <sub>tot</sub>	1.6	W
Channel Temperature	T <sub>ch</sub>	125	°C
Storage Temperature	T <sub>stg</sub>	-65 to +125	°C

**Note** Duty Cycle ≤ 50%, T<sub>on</sub> ≤ 1 ms

**RECOMMENDED OPERATING CONDITIONS**

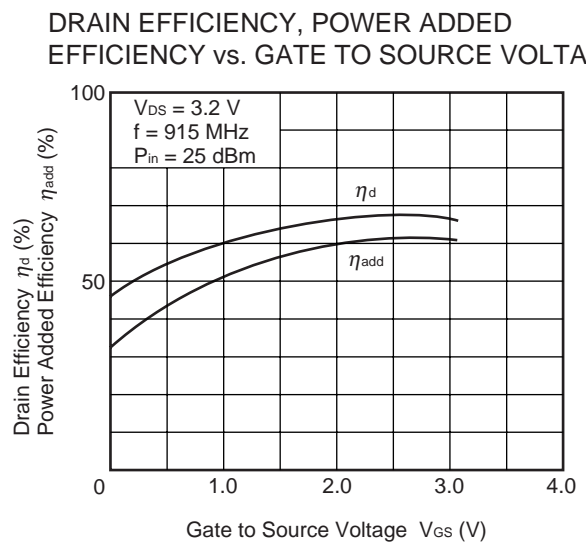
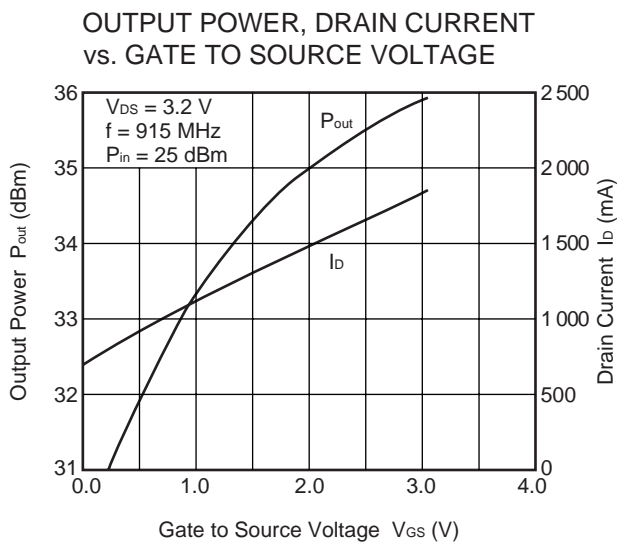
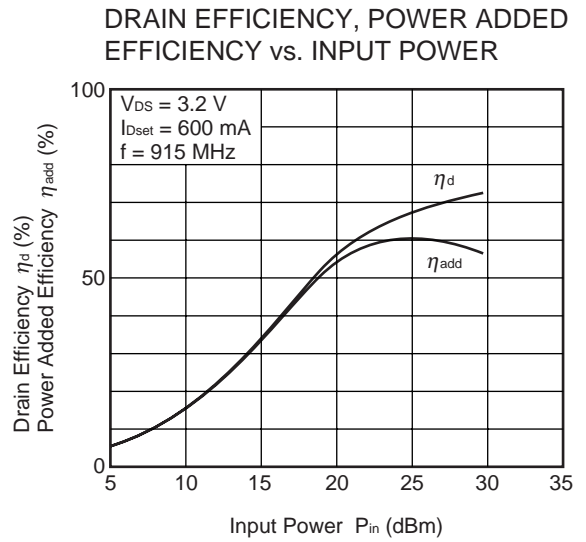
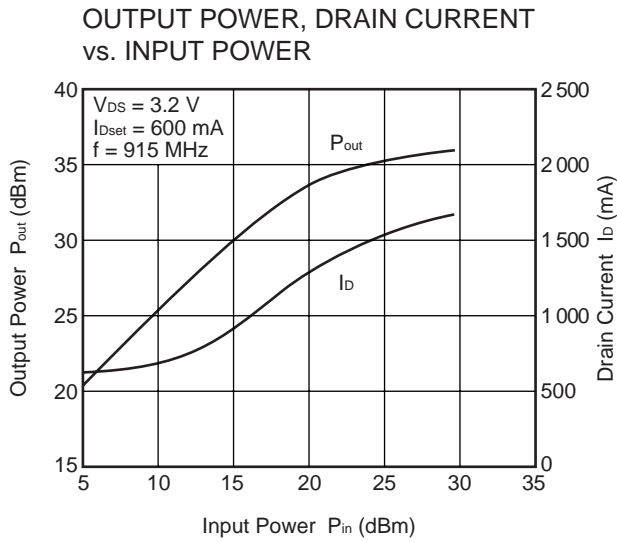
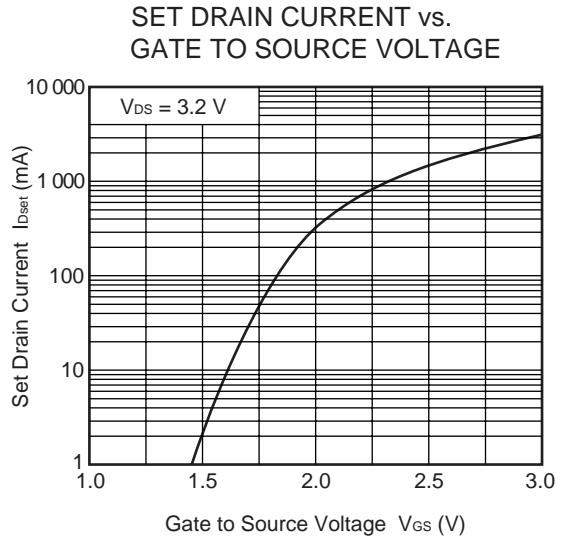
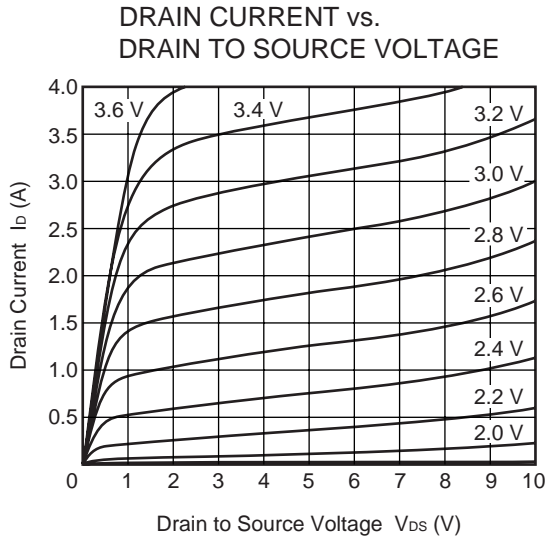
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Drain to Source Voltage	V <sub>DS</sub>		2.8	3.2	3.8	V
Gate to Source Voltage	V <sub>GSO</sub>		0	2.5	3.5	V
Drain Current (Pulse Test)	I <sub>D</sub>	Duty Cycle ≤ 50%, T <sub>on</sub> ≤ 1 ms	–	1.75	2.0	A
Input Power	P <sub>in</sub>	f = 1.8 GHz, V <sub>DS</sub> = 3.6 V	24	25	26	dBm

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

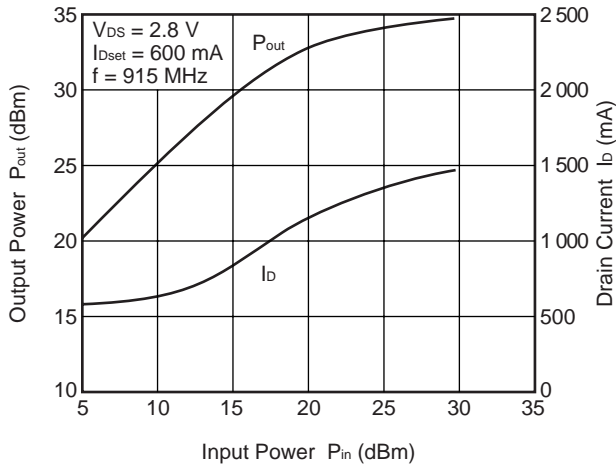
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Gate to Source Leak Current	I <sub>GSO</sub>	V <sub>GSS</sub> = 5.0 V	–	–	100	nA
Saturated Drain Current (Zero Gate Voltage Drain Current)	I <sub>DSS</sub>	V <sub>DSS</sub> = 6.0 V	–	–	100	nA
Gate Threshold Voltage	V <sub>th</sub>	V <sub>DS</sub> = 3.5 V, I <sub>DS</sub> = 1 mA	1.0	1.35	2.0	V
Transconductance	g <sub>m</sub>	V <sub>DS</sub> = 3.5 V, I <sub>DS</sub> = 0.8 to 1.0 A	–	2.5	–	S
Drain to Source Breakdown Voltage	BV <sub>DS</sub>	I <sub>DSS</sub> = 10 μA	15	20	–	V
Thermal Resistance	R <sub>th</sub>	Channel to Case	–	–	5	°C/W
Linear Gain	G <sub>L</sub>	f = 915 MHz, P <sub>in</sub> = 10 dBm, V <sub>DS</sub> = 3.2 V, V <sub>GS</sub> = 2.5 V, <b>Note</b>	–	16.0	–	dB
Output Power	P <sub>out</sub>	f = 915 MHz, P <sub>in</sub> = 25 dBm, V <sub>DS</sub> = 3.2 V, V <sub>GS</sub> = 2.5 V, <b>Note</b>	–	35.5	–	dBm
Operating Current	I <sub>op</sub>		–	1 000	–	mA
Drain Efficiency	η <sub>d</sub>		–	68	–	%
Power Added Efficiency	η <sub>add</sub>		–	65	–	%
Linear Gain	G <sub>L</sub>	f = 1 785 MHz, P <sub>in</sub> = 10 dBm, V <sub>DS</sub> = 3.2 V, V <sub>GS</sub> = 2.5 V, <b>Note</b>	–	8.5	–	dB
Output Power	P <sub>out</sub>	f = 1 785 MHz, P <sub>in</sub> = 25 dBm, V <sub>DS</sub> = 3.2 V, V <sub>GS</sub> = 2.5 V, <b>Note</b>	31.0	33.0	–	dBm
Operating Current	I <sub>op</sub>		–	750	–	mA
Drain Efficiency	η <sub>d</sub>		29	38	–	%
Power Added Efficiency	η <sub>add</sub>		–	35	–	%

**Note** DC performance is 100% testing. RF performance is testing several samples per wafer.  
Wafer rejection criteria for standard devices is 1 reject for several samples.

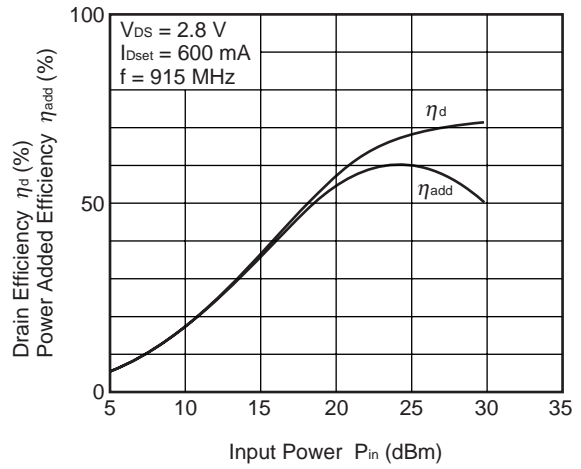
TYPICAL CHARACTERISTICS (T<sub>A</sub> = +25°C)



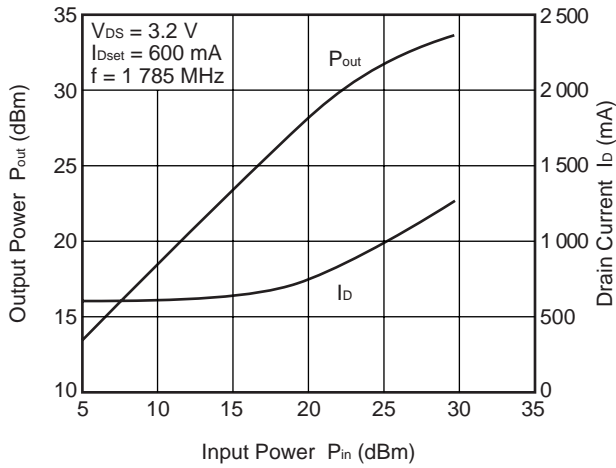
OUTPUT POWER, DRAIN CURRENT vs. INPUT POWER



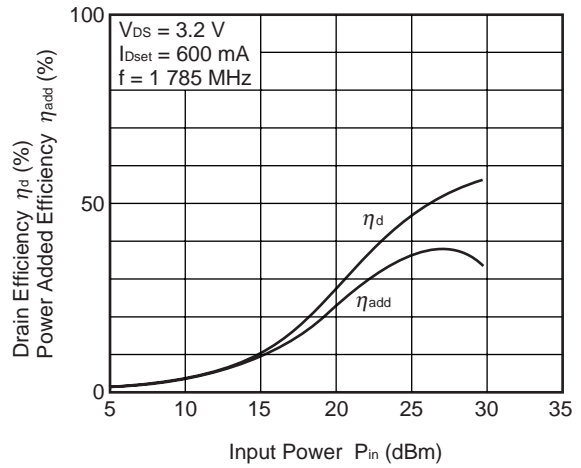
DRAIN EFFICIENCY, POWER ADDED EFFICIENCY vs. INPUT POWER



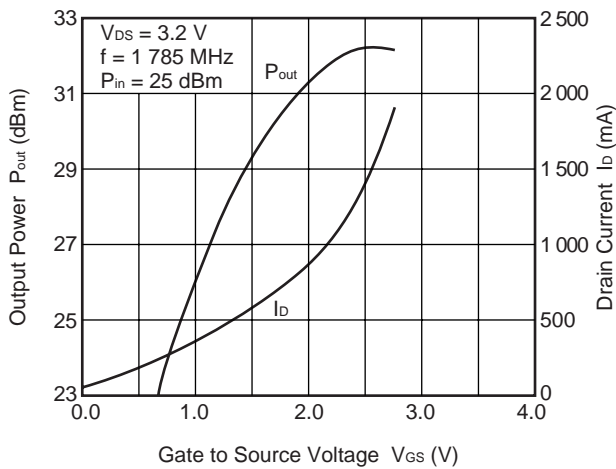
OUTPUT POWER, DRAIN CURRENT vs. INPUT POWER



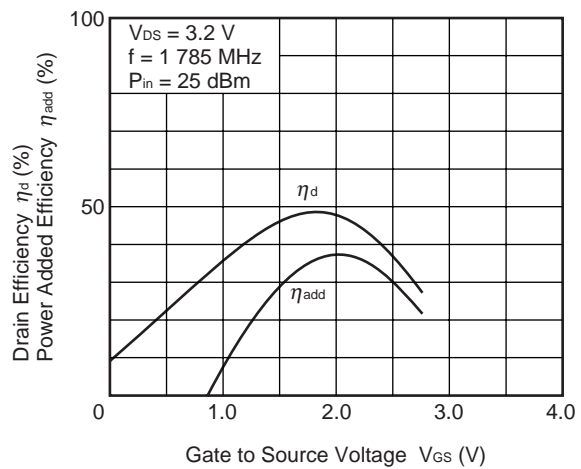
DRAIN EFFICIENCY, POWER ADDED EFFICIENCY vs. INPUT POWER



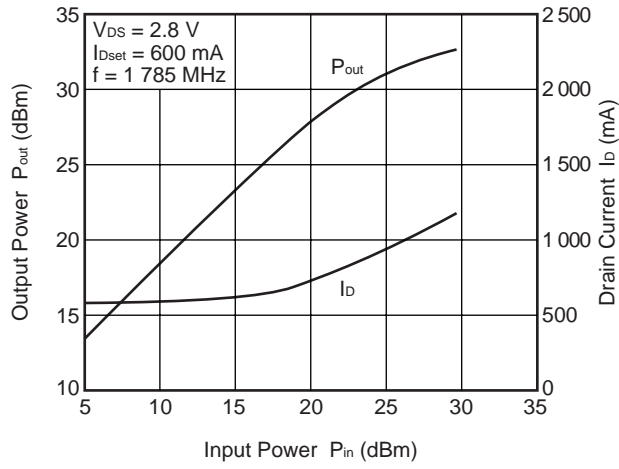
OUTPUT POWER, DRAIN CURRENT vs. GATE TO SOURCE VOLTAGE



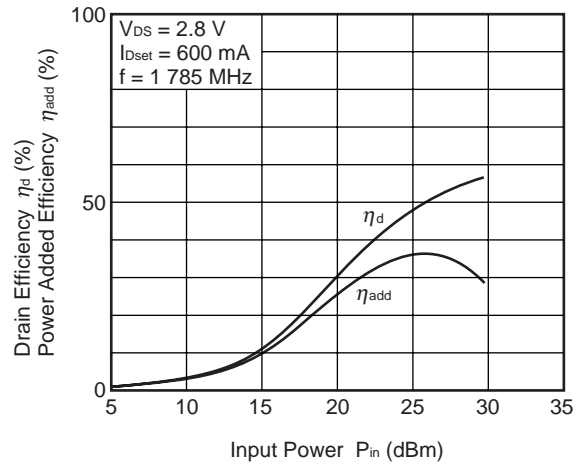
DRAIN EFFICIENCY, POWER ADDED EFFICIENCY vs. GATE TO SOURCE VOLTAGE



OUTPUT POWER, DRAIN CURRENT vs. INPUT POWER



DRAIN EFFICIENCY, POWER ADDED EFFICIENCY vs. INPUT POWER



**Remark** The graphs indicate nominal characteristics.

**S-PARAMETERS**

Test Conditions:  $V_{DS} = 3.5\text{ V}$ ,  $I_{DS} = 300\text{ mA}$

Frequency GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>		MAG <sup>Note</sup>	MSG <sup>Note</sup>	K
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	dB	dB	
0.1	0.91	-166.0	4.96	91.5	0.02	2.8	0.87	-177.5		24.8	0.12
0.2	0.91	-174.2	2.48	82.3	0.02	-4.8	0.87	-179.7		21.7	0.24
0.3	0.92	-177.5	1.63	75.6	0.02	-9.0	0.87	-179.1		19.8	0.37
0.4	0.92	-179.6	1.20	69.7	0.02	-14.4	0.88	-178.3		18.7	0.50
0.5	0.92	178.8	0.94	64.1	0.02	-18.7	0.88	177.4		17.8	0.63
0.6	0.92	177.4	0.77	58.9	0.01	-19.7	0.88	176.6		17.3	0.87
0.7	0.93	176.1	0.64	53.8	0.01	-24.7	0.89	175.6		16.4	0.93
0.8	0.93	174.9	0.54	49.3	0.01	-27.0	0.89	174.8	14.0		1.12
0.9	0.93	173.6	0.47	44.9	0.01	-29.5	0.90	173.9	12.2		1.33
1.0	0.94	172.4	0.41	40.7	0.01	-31.7	0.90	173.0	10.8		1.61
1.1	0.95	171.2	0.37	36.9	0.01	-33.5	0.91	172.1	9.9		1.85
1.2	0.95	170.0	0.32	33.1	0.01	-35.3	0.91	171.1	9.0		2.08
1.3	0.95	168.9	0.28	29.6	0.01	-38.7	0.91	170.2	8.1		2.43
1.4	0.95	167.7	0.25	26.3	0.01	-40.1	0.91	169.1	7.2		2.88
1.5	0.95	166.6	0.23	23.2	0.01	-40.3	0.92	168.1	6.6		3.31
1.6	0.95	165.5	0.21	20.2	0.01	-42.1	0.92	167.2	5.9		4.05
1.7	0.95	164.3	0.19	17.6	0.01	-41.5	0.92	166.4	5.1		4.91
1.8	0.96	163.3	0.17	15.0	0.00	-41.4	0.92	165.4	4.4		5.68
1.9	0.96	162.2	0.16	12.6	0.00	-40.2	0.93	164.4	3.8		7.09
2.0	0.96	161.2	0.14	10.4	0.00	-35.5	0.93	163.6	3.5		8.29
2.1	0.96	160.1	0.13	8.4	0.00	-30.1	0.93	162.8	2.9		11.07
2.2	0.96	159.2	0.12	6.5	0.00	-21.3	0.93	161.9	2.2		14.89
2.3	0.96	158.3	0.11	4.6	0.00	-15.3	0.94	161.0	1.7		16.85
2.4	0.96	157.4	0.11	3.1	0.00	-2.0	0.94	160.2	1.6		18.02
2.5	0.96	156.5	0.10	1.9	0.00	9.5	0.95	159.6	1.5		16.22
2.6	0.97	155.7	0.09	0.7	0.00	17.4	0.95	158.9	1.0		18.87
2.7	0.97	154.9	0.09	-0.8	0.00	49.6	0.95	158.0	0.6		17.17
2.8	0.97	154.2	0.08	-2.1	0.00	54.6	0.95	157.2	0.8		17.91
2.9	0.97	153.4	0.08	-3.3	0.00	75.7	0.96	156.6	0.9		11.30
3.0	0.97	152.7	0.07	-4.0	0.00	84.8	0.96	155.9	0.7		12.00

**Note** When  $K \geq 1$ , the MAG (Maximum Available Gain) is used.  $MAG = \left| \frac{S_{21}}{S_{12}} \right| (K - \sqrt{K^2 - 1})$

When  $K < 1$ , the MSG (Maximum Stable Gain) is used.  $MSG = \left| \frac{S_{21}}{S_{12}} \right|, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 \cdot |S_{12}| \cdot |S_{21}|}$ ,

$$\Delta = S_{11} \cdot S_{22} - S_{21} \cdot S_{12}$$

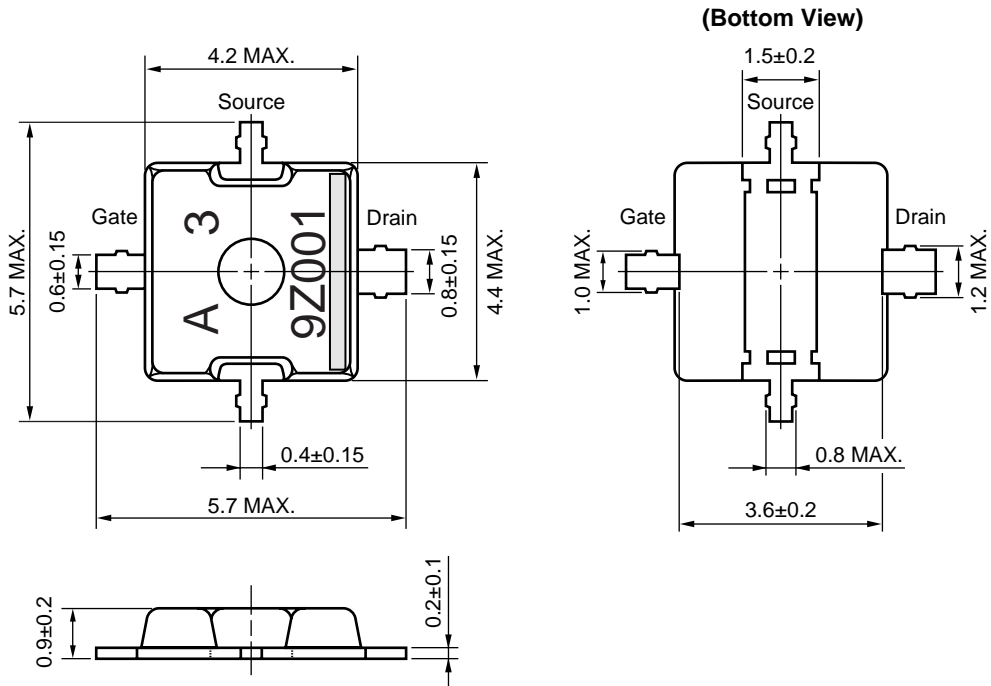
**LARGE SIGNAL IMPEDANCE ( $V_{DS} = 3.2\text{ V}$ ,  $I_{Dset} = 600\text{ mA}$ ,  $P_{in} = 25\text{ dBm}$ )**

f (MHz)	Z <sub>in</sub> (Ω)	Z <sub>OL</sub> (Ω) <sup>Note</sup>
1 785	TBD	TBD

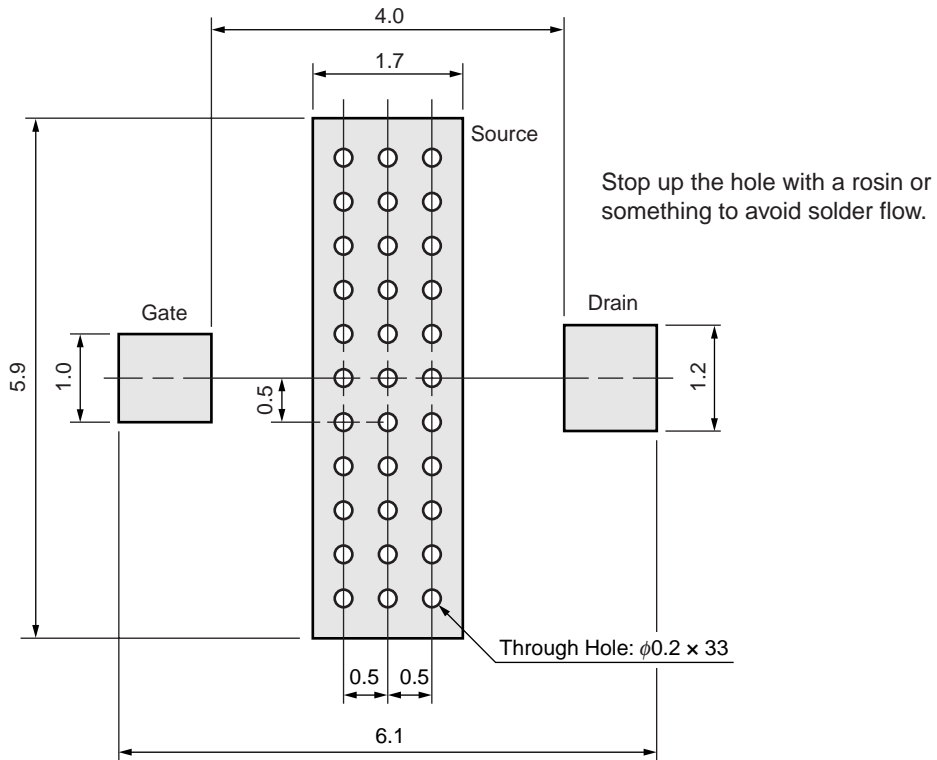
**Note** Z<sub>OL</sub> is the conjugate of optimum load impedance at given voltage, idling current, input power and frequency.

PACKAGE DIMENSIONS

79A (UNIT: mm)



79A PACKAGE RECOMMENDED P.C.B. LAYOUT (UNIT: mm)





**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: 235°C or below, Time: 30 seconds or less (at 210°C or higher), Count: 2 times or less, Exposure: limit: None <sup>Note</sup>	IR35-00-2
Partial Heating	Pin temperature: 260°C or below, Time: 5 seconds or less (per pin row) Exposure: limit: None <sup>Note</sup>	-

**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).

[MEMO]

[MEMO]

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