

RQA0002DNS

Silicon N-Channel MOS FET

REJ03G0583-0301

Rev.3.01

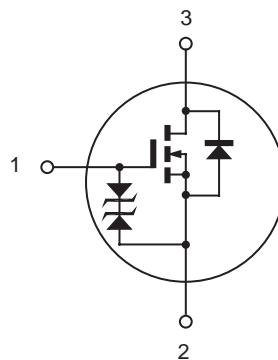
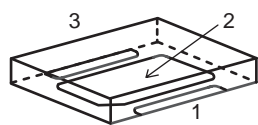
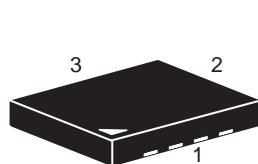
Nov 21, 2007

Features

- High output power, High gain, High efficiency
Pout = +39.6 dBm, Linear gain = 20 dB, PAE = 68% (f = 520 MHz)
- Small outline package (WSON0504-2: 5.0 × 4.0 × 0.8 mm)

Outline

RENESAS Package code: PWSN0002ZA-B
(Package name: HWSN-2 <WSON0504-2>)



1. Gate
2. Source
3. Drain

Note: Marking is "RQA0002".

Absolute Maximum Ratings

(Ta = 25°C)

Item	Symbol	Ratings	Unit
Drain to source voltage	V _{DSS}	16	V
Gate to source voltage	V _{GSS}	±5	V
Drain current	I _D	3.8	A
Channel dissipation	P _{ch} ^{Note}	15	W
Channel temperature	T _{ch}	150	°C
Storage temperature	T _{stg}	-55 to +150	°C

Note: Value at T_c = 25°C

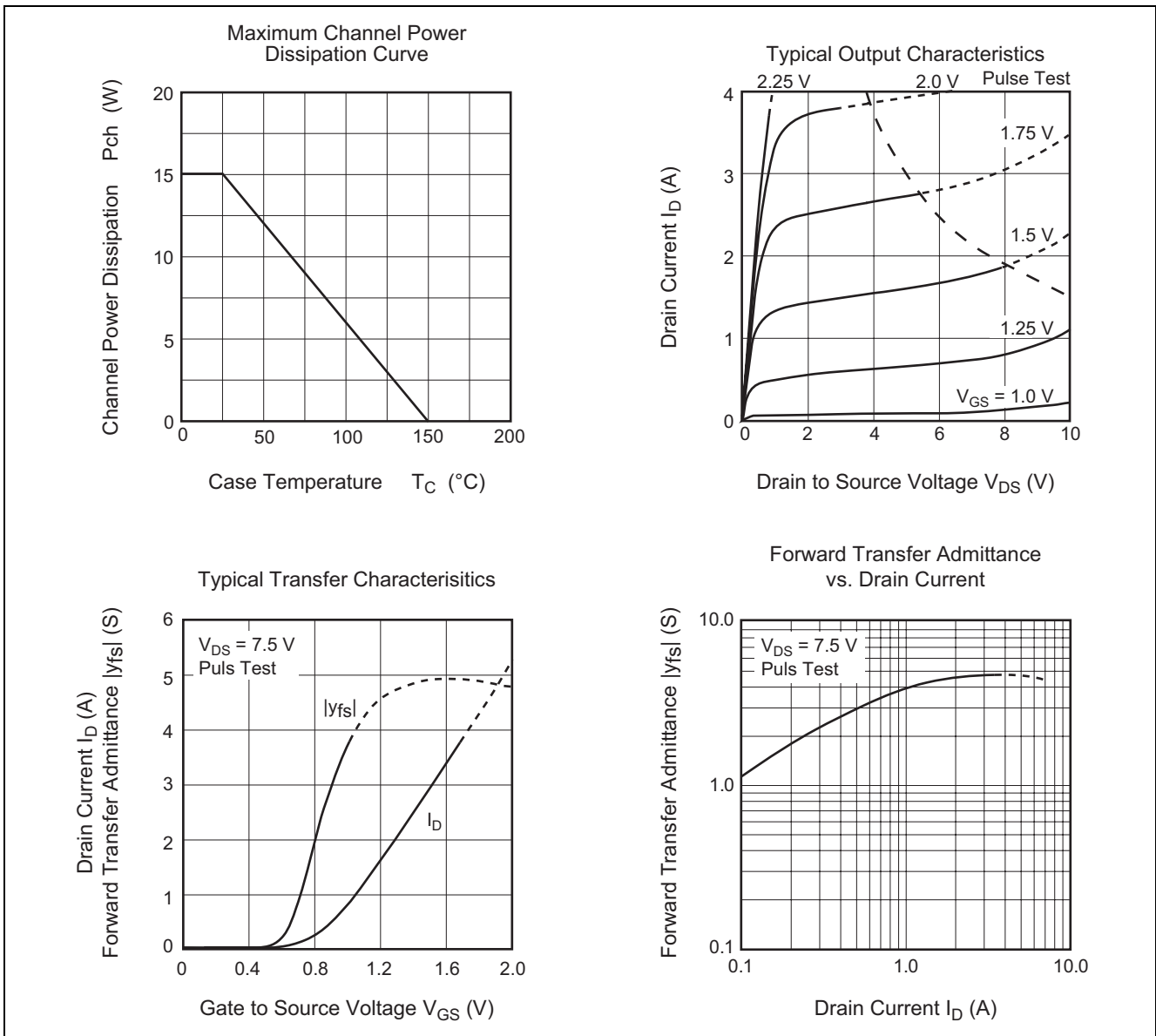
This Device is sensitive to electro static discharge. An Adequate careful handling procedure is requested.

Electrical Characteristics

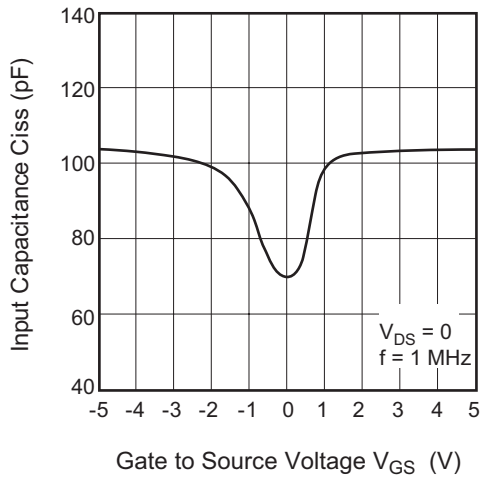
(Ta = 25°C)

Item	Symbol	Min.	Typ	Max.	Unit	Test Conditions
Zero gate voltage drain current	I_{DSS}	—	—	20	μA	$V_{DS} = 16 V, V_{GS} = 0$
Gate to source leak current	I_{GSS}	—	—	± 3	μA	$V_{GS} = \pm 5 V, V_{DS} = 0$
Gate to source cutoff voltage	$V_{GS(off)}$	0.25	0.4	0.75	V	$I_D = 1 mA, V_{DS} = 7.5 V$
Forward transfer admittance	$ y_{fs} $	4.0	4.8	5.8	S	$V_{DS} = 7.5 V, I_D = 2 A$
Input capacitance	C_{iss}	—	102	—	pF	$V_{GS} = 5 V, V_{DS} = 0, f = 1 MHz$
Output capacitance	C_{oss}	—	50	—	pF	$V_{DS} = 7.5 V, V_{GS} = 0, f = 1 MHz$
Reverse transfer capacitance	C_{rss}	—	4.5	—	pF	$V_{DG} = 7.5 V, V_{GS} = 0, f = 1 MHz$
Output power	P_{out}	38.7	39.6	—	dBm	$V_{DS} = 7.5 V, I_{DQ} = 200 mA$ $f = 520 MHz,$ $P_{in} = +25 dBm (316 mW)$
		7.41	9.12	—	W	
Power added efficiency	PAE	60	68	—	%	
Output power	P_{out}	—	35.8	—	dBm	$V_{DS} = 3.6 V, I_{DQ} = 200 mA$ $f = 520 MHz,$ $P_{in} = +25 dBm (316 mW)$
		—	3.8	—	W	
Power added efficiency	PAE	—	60	—	%	

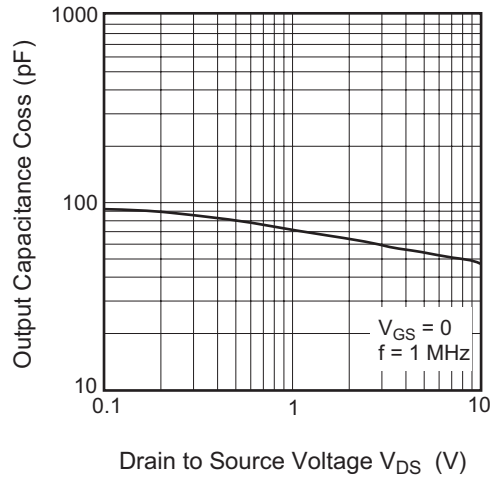
Main Characteristics



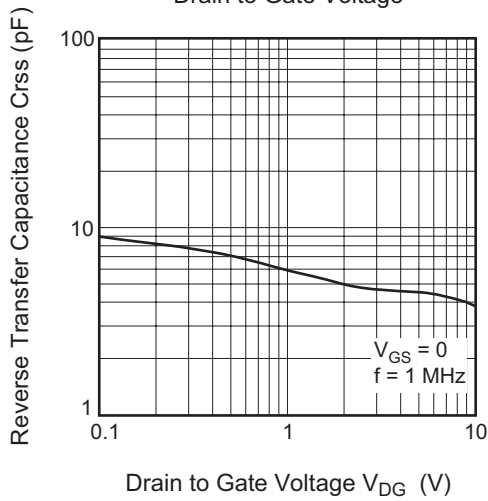
Input Capacitance vs.
Gate to Source Voltage



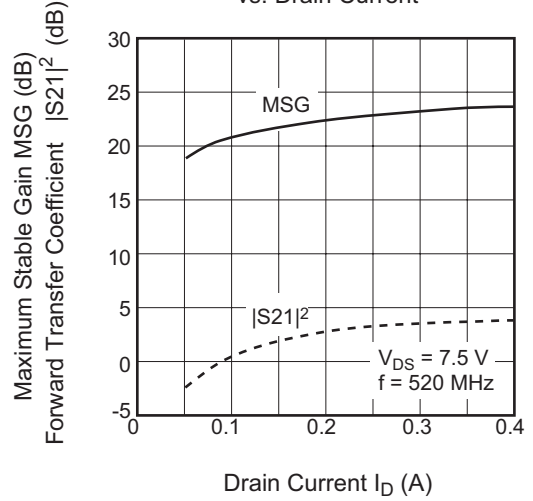
Output Capacitance vs.
Drain to Source Voltage

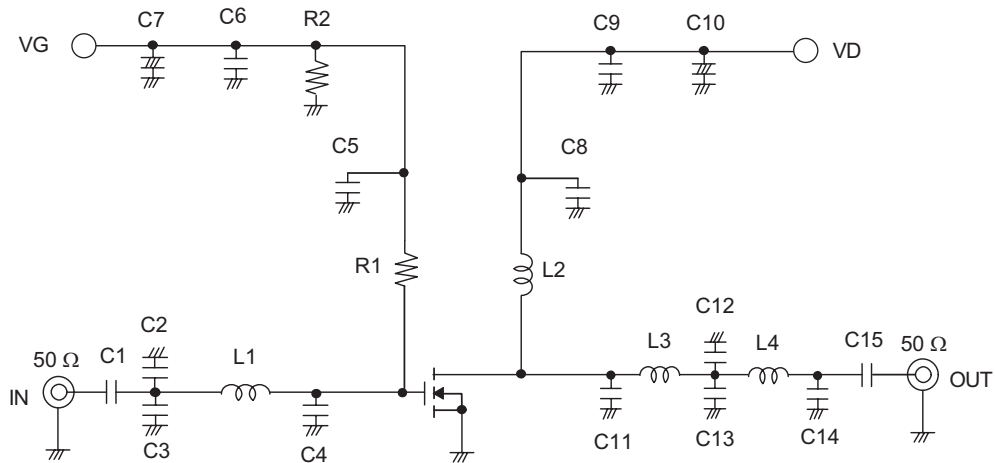


Reverse Transfer Capacitance vs.
Drain to Gate Voltage



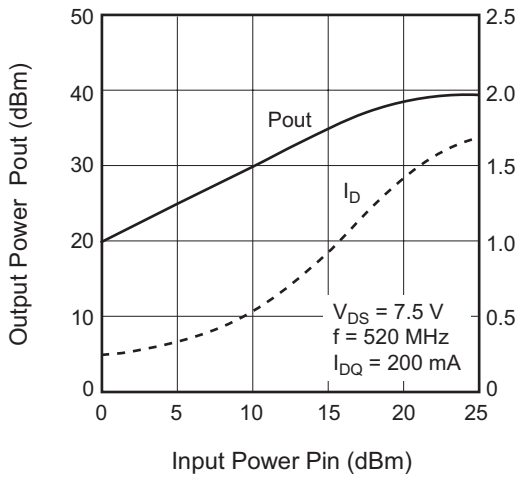
Maximum Stable Gain, $|S_{21}|^2$
vs. Drain Current



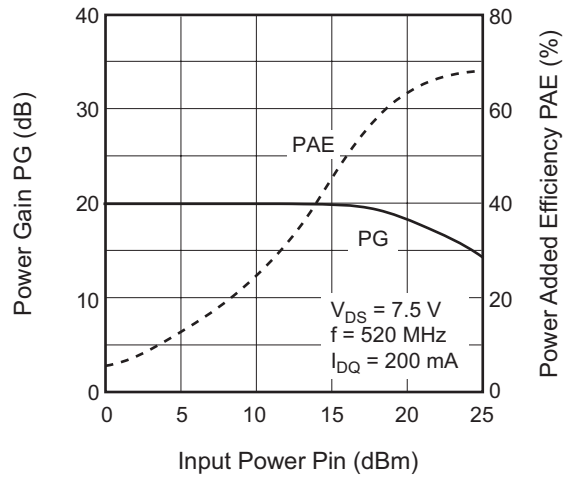
Evaluation Circuit (@ $V_{DD} = 7.5V$ Tuning, $f = 520$ MHz)

C1, C6, C9, C15:	1000 pF Chip Capacitor
C2:	4 pF Chip Capacitor
C3:	15 pF Chip Capacitor
C4, C11:	5 pF Chip Capacitor
C5, C8:	100pF Chip Capacitor
C7, C10:	1 μ F Electrolysis Capacitor
C12, C14:	10 pF Chip Capacitor
C13:	7 pF Chip Capacitor
L1:	1.8 nH Chip Inductor
L2:	8 Turns D : 0.5 mm, ϕ 2.4 mm Enamel Wire
L3:	1.0 nH Chip Inductor
L4:	1.5 nH Chip Inductor
R1:	6.8 k Ω Chip Resistor
R2:	40 k Ω Chip Resistor

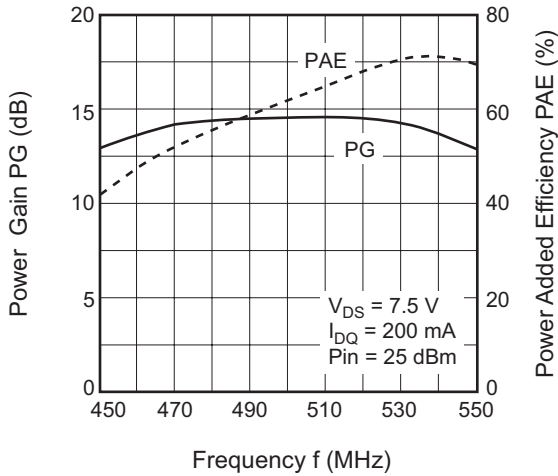
Output Power, Drain Current vs. Input Power



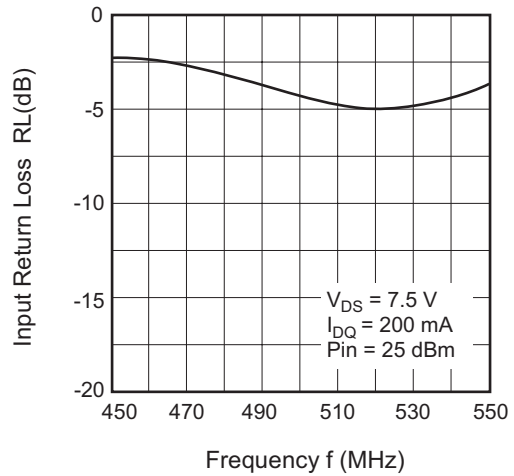
Power Gain, Power Added Efficiency vs. Input Power



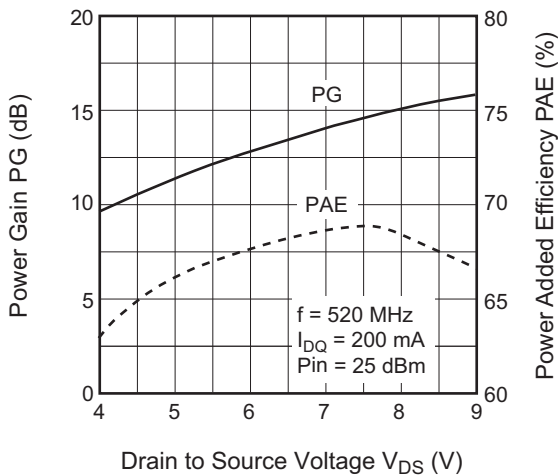
Power Gain, Power Added Efficiency vs. Frequency



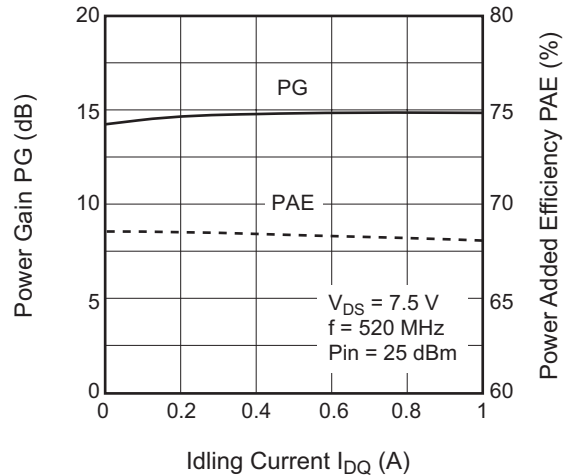
Input Return Loss vs. Frequency



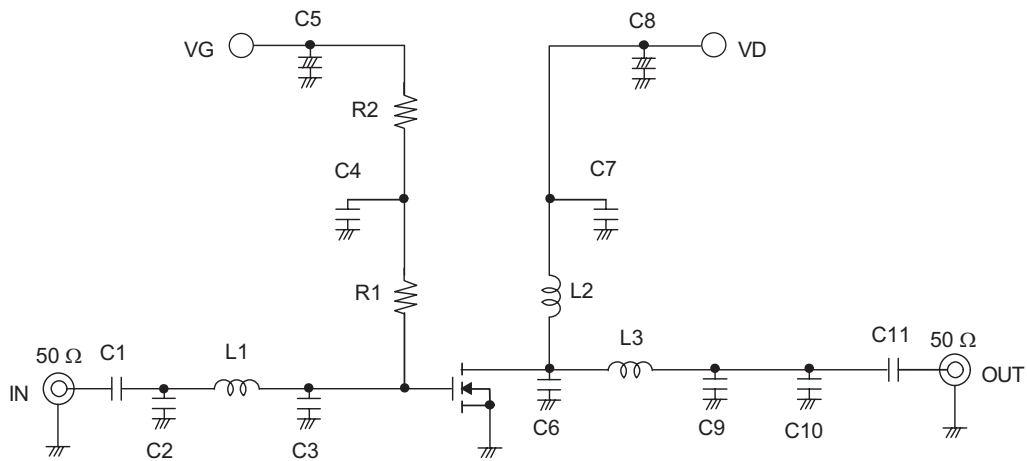
Power Gain, Power Added Efficiency, vs. Drain to Source Voltage



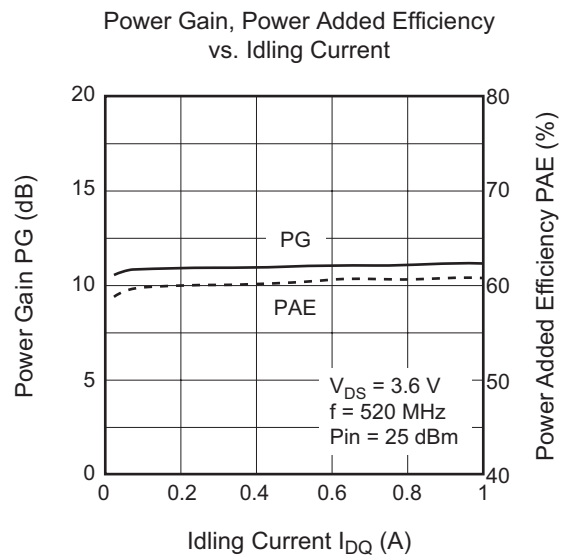
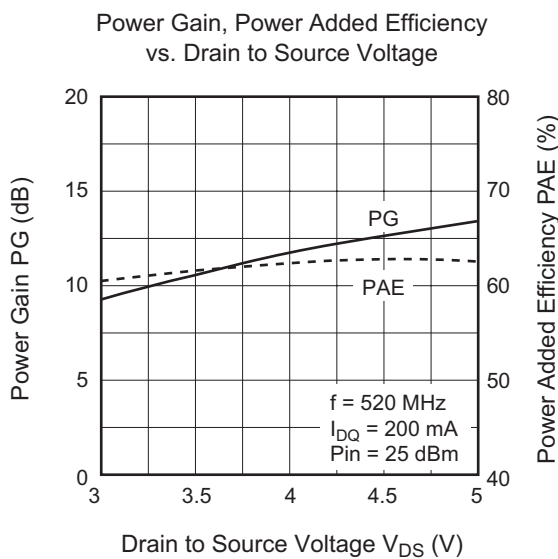
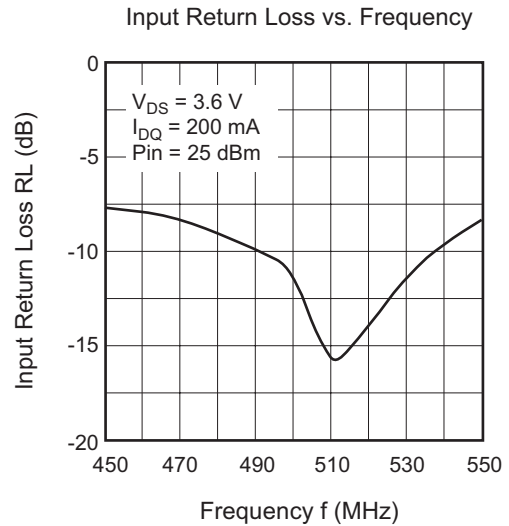
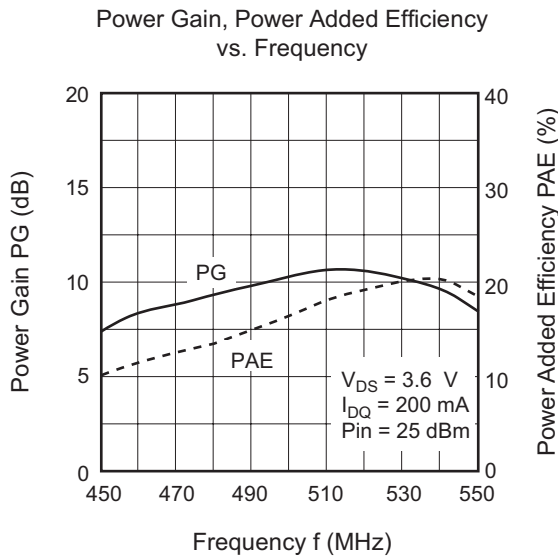
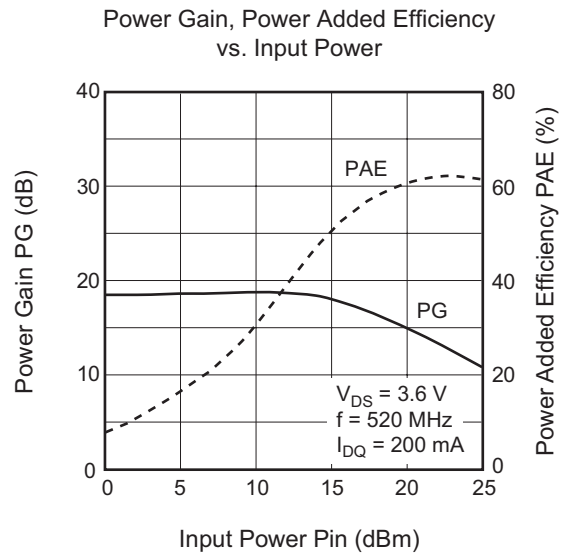
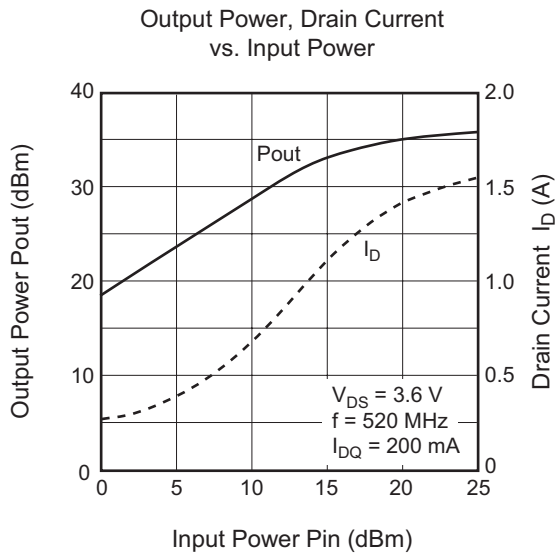
Power Gain, Power Added Efficiency vs. Idling Current



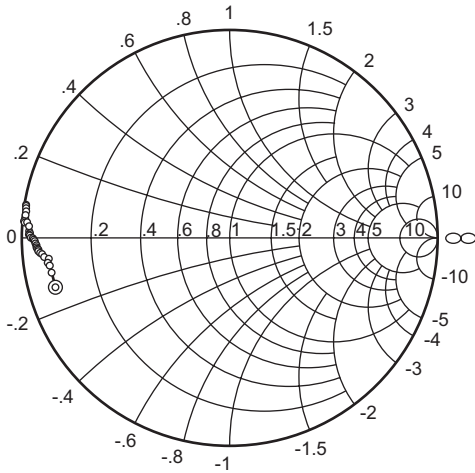
Evaluation Circuit 2 (@ $V_{DD} = 3.6V$ Tuning, $f = 520$ MHz)



- C1, C11: 1000 pF Chip Capacitor
- C2: 20 pF Chip Capacitor
- C3, C10: 10 pF Chip Capacitor
- C4, C7: 100 pF Chip Capacitor
- C5, C8: 1 μ F Electrolysis Capacitor
- C6: 5 pF Chip Capacitor
- C9: 27 pF Chip Capacitor
- L1: 1.5 nH Chip Inductor
- L2: 8 Turns D : 0.5 mm , ϕ 2.4 mm Enamel Wire
- L3: 1.2 nH Chip Inductor
- R1: 200 Ω Chip Resistor
- R2: 3 k Ω Chip Resistor

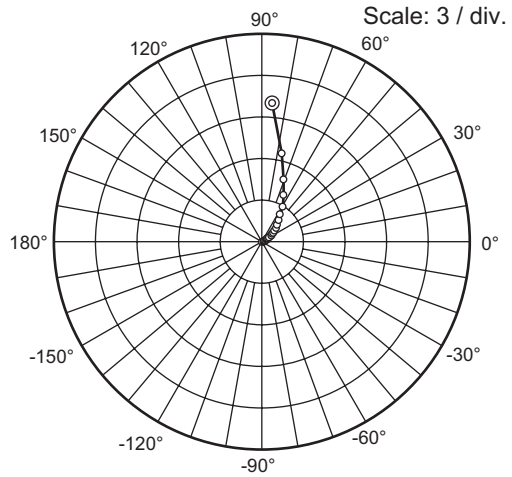


S₁₁ Parameter vs. Frequency



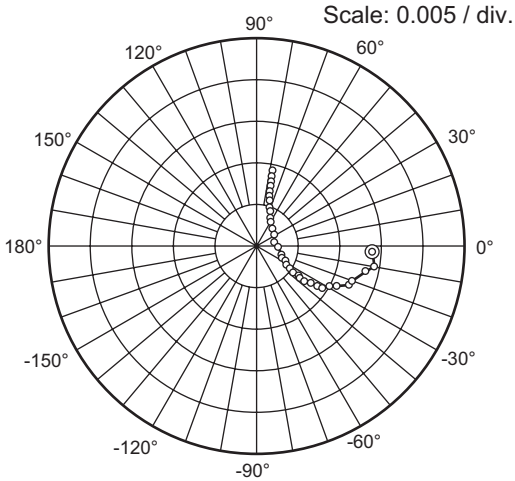
Condition: $V_{DS} = 7.5\text{ V}$, $I_{DQ} = 200\text{ mA}$, $Z_0 = 50\ \Omega$
 100 to 1000 MHz (50 MHz Step)
 1000 to 2500 MHz (100 MHz Step)

S₂₁ Parameter vs. Frequency



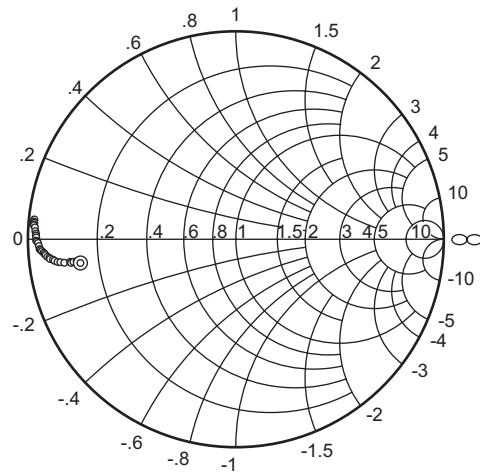
Condition: $V_{DS} = 7.5\text{ V}$, $I_{DQ} = 200\text{ mA}$, $Z_0 = 50\ \Omega$
 100 to 1000 MHz (50 MHz Step)
 1000 to 2500 MHz (100 MHz Step)

S₁₂ Parameter vs. Frequency



Condition: $V_{DS} = 7.5\text{ V}$, $I_{DQ} = 200\text{ mA}$, $Z_0 = 50\ \Omega$
 100 to 1000 MHz (50 MHz Step)
 1000 to 2500 MHz (100 MHz Step)

S₂₂ Parameter vs. Frequency



Condition: $V_{DS} = 7.5\text{ V}$, $I_{DQ} = 200\text{ mA}$, $Z_0 = 50\ \Omega$
 100 to 1000 MHz (50 MHz Step)
 1000 to 2500 MHz (100 MHz Step)

S parameter

(V_{DS} = 3.6 V, I_D = 200 mA, Z_o = 50 Ω)

f (MHz)	S11		S21		S12		S22	
	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)
100	0.861	-166.1	9.02	82.8	0.016	-1.9	0.774	-171.0
150	0.865	-169.7	5.92	74.0	0.016	-13.1	0.788	-171.9
200	0.876	-171.3	4.30	67.4	0.014	-18.3	0.805	-171.8
250	0.883	-172.3	3.29	61.4	0.013	-23.9	0.823	-171.9
300	0.880	-173.1	2.62	56.0	0.013	-27.2	0.824	-172.1
350	0.903	-174.0	2.09	51.4	0.011	-31.8	0.855	-172.4
400	0.915	-174.5	1.72	47.2	0.011	-33.5	0.872	-172.6
450	0.920	-175.0	1.45	43.3	0.010	-38.2	0.886	-172.9
500	0.930	-175.5	1.24	39.8	0.009	-38.5	0.895	-173.4
550	0.935	-176.0	1.06	36.7	0.008	-40.6	0.906	-173.9
600	0.937	-176.4	0.92	33.8	0.007	-41.7	0.914	-174.4
650	0.941	-176.9	0.81	31.2	0.007	-40.9	0.920	-174.7
700	0.941	-177.5	0.71	28.7	0.006	-41.0	0.928	-175.1
750	0.944	-177.9	0.64	26.4	0.005	-41.0	0.934	-175.6
800	0.951	-178.6	0.57	24.4	0.005	-40.3	0.937	-176.0
850	0.952	-179.2	0.51	22.4	0.004	-40.1	0.942	-176.5
900	0.959	-179.6	0.46	21.2	0.004	-33.9	0.945	-177.0
950	0.966	-179.9	0.42	19.8	0.003	-31.0	0.951	-177.3
1000	0.968	-179.8	0.38	18.7	0.003	-25.8	0.954	-177.7
1050	0.969	179.8	0.34	17.5	0.003	-16.0	0.956	-178.0
1100	0.972	179.8	0.32	16.3	0.002	-9.2	0.957	-178.5
1150	0.972	179.7	0.29	15.2	0.002	2.2	0.962	-178.8
1200	0.974	179.4	0.27	14.3	0.002	9.9	0.962	-179.2
1250	0.974	179.2	0.25	13.2	0.002	24.6	0.963	-179.6
1300	0.975	178.9	0.23	12.1	0.002	33.5	0.965	-179.7
1350	0.973	178.6	0.21	11.1	0.002	43.3	0.966	-180.0
1400	0.971	178.2	0.20	9.9	0.003	48.3	0.967	179.8
1450	0.968	177.5	0.19	9.0	0.003	55.8	0.968	179.4
1500	0.970	176.8	0.17	8.0	0.003	62.8	0.967	179.1
1550	0.979	176.5	0.17	7.4	0.004	65.0	0.967	178.9
1600	0.990	175.9	0.16	7.0	0.004	67.1	0.968	178.4
1650	0.995	175.9	0.15	6.9	0.004	68.7	0.968	178.3
1700	0.999	175.8	0.14	6.6	0.004	71.0	0.969	177.9
1750	0.999	175.8	0.13	6.2	0.005	72.3	0.969	177.6
1800	0.999	175.7	0.13	6.2	0.005	74.8	0.972	177.3
1850	0.999	175.7	0.12	6.3	0.005	75.0	0.970	177.0
1900	0.999	175.6	0.12	6.4	0.006	75.5	0.971	176.7
1950	0.999	175.3	0.11	6.4	0.006	75.2	0.972	176.4
2000	0.999	174.9	0.10	6.4	0.006	75.4	0.974	176.2
2050	0.999	174.4	0.10	6.3	0.006	78.5	0.975	175.9
2100	0.999	173.7	0.09	5.9	0.007	78.0	0.975	175.7
2150	0.999	173.0	0.09	5.2	0.007	78.0	0.979	175.5
2200	0.999	172.4	0.09	4.9	0.007	77.6	0.980	175.4
2250	0.999	172.2	0.08	4.2	0.008	78.2	0.979	175.1
2300	0.999	171.5	0.08	4.0	0.008	78.6	0.978	174.9
2350	0.999	171.2	0.08	3.2	0.008	78.8	0.983	174.7
2400	0.999	171.0	0.08	3.3	0.009	79.3	0.979	174.6
2450	0.999	171.2	0.07	2.7	0.009	78.9	0.978	174.4
2500	0.999	170.8	0.07	3.3	0.009	78.7	0.980	174.1

S parameter

 $(V_{DS} = 6\text{ V}, I_D = 200\text{ mA}, Z_o = 50\ \Omega)$

f (MHz)	S11		S21		S12		S22	
	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)
100	0.869	-165.2	9.86	83.9	0.016	-1.6	0.758	-170.4
150	0.872	-169.3	6.45	75.2	0.015	-10.6	0.773	-171.4
200	0.878	-171.1	4.68	68.4	0.014	-17.0	0.791	-171.3
250	0.887	-172.2	3.59	62.7	0.013	-23.2	0.808	-171.2
300	0.882	-173.2	2.87	57.1	0.012	-26.0	0.811	-171.6
350	0.907	-173.9	2.29	52.6	0.011	-30.3	0.843	-171.7
400	0.915	-174.6	1.90	48.4	0.010	-32.0	0.861	-172.0
450	0.922	-174.9	1.60	44.4	0.009	-36.7	0.874	-172.3
500	0.932	-175.2	1.37	41.1	0.009	-37.5	0.885	-172.9
550	0.933	-175.9	1.18	37.8	0.008	-39.5	0.897	-173.3
600	0.937	-176.4	1.02	35.2	0.007	-40.4	0.905	-173.6
650	0.940	-176.8	0.90	32.5	0.007	-39.4	0.912	-174.0
700	0.941	-177.4	0.79	29.8	0.006	-38.9	0.922	-174.5
750	0.946	-178.0	0.71	27.4	0.005	-40.1	0.927	-174.9
800	0.947	-178.4	0.63	25.1	0.005	-38.9	0.931	-175.4
850	0.955	-179.2	0.57	23.7	0.004	-37.9	0.936	-175.9
900	0.961	-179.8	0.52	21.9	0.004	-32.8	0.941	-176.3
950	0.967	-180.0	0.47	20.6	0.003	-29.5	0.946	-176.7
1000	0.968	-179.9	0.42	19.7	0.003	-26.7	0.949	-177.2
1050	0.969	179.6	0.38	18.3	0.003	-17.2	0.951	-177.6
1100	0.972	179.8	0.35	17.1	0.002	-10.4	0.954	-178.0
1150	0.971	179.7	0.33	15.9	0.002	4.4	0.956	-178.3
1200	0.975	179.5	0.30	15.0	0.002	9.0	0.959	-178.6
1250	0.973	179.3	0.28	14.0	0.002	19.7	0.959	-179.0
1300	0.974	178.9	0.26	12.8	0.002	34.9	0.962	-179.2
1350	0.973	178.8	0.24	11.8	0.002	41.8	0.965	-179.5
1400	0.971	178.3	0.22	10.5	0.003	48.9	0.963	-179.8
1450	0.968	177.7	0.21	9.5	0.003	55.0	0.965	179.9
1500	0.971	177.2	0.20	8.4	0.003	60.4	0.964	179.6
1550	0.975	176.6	0.19	7.8	0.003	63.0	0.966	179.4
1600	0.993	176.1	0.18	7.3	0.004	63.7	0.966	178.9
1650	0.997	175.8	0.17	7.1	0.004	67.9	0.966	178.8
1700	0.999	175.9	0.16	6.7	0.004	69.2	0.967	178.4
1750	0.999	175.8	0.15	6.6	0.004	70.5	0.967	178.0
1800	0.999	175.8	0.14	6.5	0.005	72.7	0.970	177.7
1850	0.999	175.9	0.14	6.4	0.005	74.6	0.969	177.3
1900	0.999	175.9	0.13	6.9	0.006	75.6	0.969	177.1
1950	0.999	175.4	0.12	6.5	0.006	75.6	0.971	176.8
2000	0.999	174.9	0.12	6.3	0.006	76.7	0.972	176.5
2050	0.999	174.6	0.11	6.5	0.006	78.5	0.973	176.3
2100	0.999	173.8	0.11	5.9	0.007	78.2	0.974	176.0
2150	0.999	173.1	0.10	5.0	0.007	77.7	0.978	175.8
2200	0.999	172.6	0.10	4.8	0.007	77.4	0.979	175.8
2250	0.999	172.1	0.09	3.8	0.008	78.2	0.977	175.5
2300	0.999	171.7	0.09	3.4	0.008	77.3	0.978	175.1
2350	0.999	171.2	0.09	2.9	0.008	78.4	0.982	175.1
2400	0.999	171.1	0.08	2.9	0.008	78.9	0.978	174.9
2450	0.999	171.1	0.08	2.5	0.009	78.5	0.978	174.7
2500	0.999	171.1	0.08	2.7	0.009	78.4	0.979	174.4

S parameter

 $(V_{DS} = 7.2 \text{ V}, I_D = 200 \text{ mA}, Z_o = 50 \Omega)$

f (MHz)	S11		S21		S12		S22	
	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)
100	0.875	-164.1	10.08	85.2	0.015	-0.6	0.757	-170.9
150	0.877	-168.9	6.59	76.3	0.014	-9.4	0.771	-171.7
200	0.884	-170.8	4.78	69.7	0.013	-16.3	0.787	-171.5
250	0.892	-172.0	3.69	63.7	0.012	-20.8	0.804	-171.5
300	0.887	-173.0	2.95	58.3	0.012	-23.6	0.807	-171.7
350	0.908	-173.9	2.35	53.8	0.011	-28.4	0.838	-171.7
400	0.917	-174.4	1.96	49.4	0.010	-30.7	0.854	-172.0
450	0.922	-174.8	1.66	45.8	0.010	-34.6	0.869	-172.3
500	0.931	-175.3	1.42	42.4	0.009	-35.9	0.880	-172.7
550	0.934	-176.0	1.23	39.3	0.008	-38.4	0.893	-173.2
600	0.939	-176.2	1.06	36.3	0.007	-38.5	0.902	-173.6
650	0.943	-176.8	0.93	33.4	0.007	-38.9	0.908	-173.9
700	0.944	-177.4	0.83	31.0	0.006	-36.6	0.917	-174.4
750	0.948	-177.8	0.74	28.4	0.005	-38.0	0.925	-174.8
800	0.949	-178.5	0.66	26.5	0.005	-37.0	0.928	-175.3
850	0.953	-179.1	0.60	24.7	0.004	-36.2	0.933	-175.7
900	0.963	-179.6	0.54	23.3	0.004	-30.7	0.938	-176.2
950	0.972	-179.8	0.50	21.7	0.003	-29.5	0.944	-176.6
1000	0.968	-179.9	0.45	20.3	0.003	-25.6	0.947	-176.9
1050	0.969	180.0	0.41	19.4	0.003	-13.4	0.949	-177.4
1100	0.970	179.8	0.37	18.0	0.002	-7.9	0.953	-177.8
1150	0.972	179.6	0.34	16.8	0.002	3.2	0.955	-178.2
1200	0.975	179.6	0.32	15.8	0.002	8.7	0.958	-178.5
1250	0.975	179.4	0.29	14.8	0.002	24.7	0.958	-178.9
1300	0.977	179.0	0.27	13.5	0.002	33.6	0.960	-179.1
1350	0.972	178.7	0.25	12.4	0.002	43.9	0.962	-179.3
1400	0.972	178.3	0.23	11.2	0.003	45.9	0.963	-179.6
1450	0.967	177.6	0.22	10.0	0.003	53.6	0.963	-180.0
1500	0.971	177.1	0.21	9.0	0.003	61.2	0.963	179.8
1550	0.979	176.6	0.20	8.4	0.003	63.4	0.964	179.5
1600	0.988	176.2	0.19	7.8	0.004	65.1	0.964	179.0
1650	0.996	176.0	0.18	7.6	0.004	68.0	0.965	178.9
1700	0.998	175.7	0.17	7.1	0.004	69.1	0.965	178.5
1750	0.999	175.8	0.16	6.9	0.005	72.3	0.965	178.2
1800	0.999	175.8	0.15	6.8	0.005	72.6	0.969	177.8
1850	0.999	175.9	0.14	6.6	0.005	74.8	0.968	177.5
1900	0.999	175.9	0.14	6.9	0.006	74.8	0.968	177.2
1950	0.999	175.3	0.13	6.6	0.006	76.7	0.970	176.9
2000	0.999	175.0	0.12	6.7	0.006	76.3	0.972	176.7
2050	0.999	174.5	0.12	6.6	0.006	77.7	0.973	176.5
2100	0.999	173.7	0.11	6.2	0.007	76.2	0.974	176.1
2150	0.999	173.1	0.11	5.4	0.007	78.1	0.978	175.9
2200	0.999	172.5	0.10	4.7	0.007	76.9	0.977	175.9
2250	0.999	172.2	0.10	3.9	0.008	78.0	0.977	175.5
2300	0.999	171.7	0.10	3.3	0.008	76.4	0.977	175.2
2350	0.999	171.2	0.09	2.7	0.008	78.6	0.981	175.2
2400	0.999	171.0	0.09	2.7	0.008	79.3	0.978	175.1
2450	0.999	171.1	0.09	2.3	0.009	78.2	0.977	174.8
2500	0.999	170.9	0.08	2.5	0.009	78.6	0.978	174.5

S parameter

 $(V_{DS} = 7.5 \text{ V}, I_D = 50 \text{ mA}, Z_o = 50 \Omega)$

f (MHz)	S11		S21		S12		S22	
	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)
100	0.823	-154.9	7.70	78.6	0.029	-10.5	0.659	-153.1
150	0.844	-160.8	4.82	66.1	0.027	-23.3	0.715	-156.5
200	0.865	-163.9	3.33	56.7	0.023	-31.6	0.767	-158.5
250	0.887	-166.2	2.44	49.1	0.021	-39.6	0.809	-160.5
300	0.891	-168.1	1.86	42.6	0.019	-44.9	0.829	-162.7
350	0.922	-169.6	1.42	37.5	0.016	-49.4	0.869	-164.4
400	0.932	-171.0	1.14	33.1	0.015	-52.4	0.893	-165.9
450	0.941	-172.0	0.93	29.4	0.013	-56.4	0.908	-167.3
500	0.949	-173.1	0.77	26.1	0.012	-58.1	0.920	-168.6
550	0.953	-173.8	0.65	23.5	0.011	-59.9	0.931	-169.7
600	0.955	-174.4	0.54	21.0	0.009	-61.1	0.939	-170.7
650	0.955	-175.4	0.47	18.8	0.008	-62.3	0.944	-171.6
700	0.957	-176.2	0.41	16.6	0.007	-61.7	0.950	-172.3
750	0.965	-176.8	0.36	14.7	0.007	-62.9	0.955	-173.1
800	0.962	-177.6	0.32	13.1	0.006	-62.2	0.958	-173.8
850	0.969	-178.3	0.28	11.5	0.005	-63.0	0.961	-174.5
900	0.973	-178.8	0.26	10.9	0.004	-60.5	0.963	-175.1
950	0.979	-179.3	0.23	9.6	0.004	-58.6	0.967	-175.6
1000	0.977	-179.2	0.21	8.9	0.003	-57.6	0.969	-176.2
1050	0.982	-179.7	0.19	7.9	0.002	-53.5	0.969	-176.7
1100	0.984	180.0	0.17	7.2	0.002	-46.6	0.971	-177.2
1150	0.982	179.7	0.16	6.3	0.002	-38.0	0.973	-177.5
1200	0.982	179.6	0.15	5.8	0.001	-27.7	0.975	-177.9
1250	0.983	179.5	0.13	5.1	0.001	-1.9	0.975	-178.4
1300	0.984	179.1	0.12	4.2	0.001	21.6	0.976	-178.6
1350	0.986	178.9	0.12	3.5	0.001	37.7	0.977	-178.9
1400	0.987	178.6	0.11	2.9	0.002	47.3	0.978	-179.2
1450	0.987	177.9	0.10	2.2	0.002	56.0	0.977	-179.6
1500	0.989	177.1	0.09	1.4	0.002	64.7	0.976	180.0
1550	0.989	176.5	0.09	0.8	0.003	69.3	0.977	179.7
1600	0.989	175.9	0.08	0.9	0.003	71.4	0.977	179.3
1650	0.999	175.8	0.08	1.3	0.003	73.5	0.976	179.2
1700	0.999	175.8	0.08	1.0	0.004	74.6	0.976	178.7
1750	0.999	176.0	0.07	1.2	0.004	75.2	0.976	178.4
1800	0.999	175.9	0.07	1.9	0.004	76.6	0.978	178.1
1850	0.999	175.8	0.06	1.9	0.005	78.8	0.978	177.7
1900	0.999	175.7	0.06	3.0	0.005	78.7	0.977	177.3
1950	0.999	175.4	0.06	3.1	0.005	79.7	0.980	177.1
2000	0.999	174.9	0.06	3.4	0.006	79.1	0.981	176.8
2050	0.999	174.6	0.05	3.5	0.006	81.0	0.982	176.6
2100	0.999	174.2	0.05	3.6	0.006	80.3	0.982	176.3
2150	0.999	173.6	0.05	3.2	0.007	80.9	0.986	176.1
2200	0.999	173.0	0.05	3.0	0.007	80.5	0.985	176.0
2250	0.999	172.8	0.04	3.0	0.007	80.7	0.985	175.7
2300	0.999	172.1	0.04	3.0	0.007	80.5	0.984	175.4
2350	0.999	171.6	0.04	3.4	0.008	81.6	0.988	175.2
2400	0.999	171.6	0.04	3.7	0.008	81.2	0.985	175.2
2450	0.999	171.6	0.04	3.8	0.008	80.7	0.984	174.9
2500	0.999	171.4	0.04	4.6	0.009	80.5	0.985	174.6

S parameter

 $(V_{DS} = 7.5 \text{ V}, I_D = 100 \text{ mA}, Z_o = 50 \Omega)$

f (MHz)	S11		S21		S12		S22	
	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)
100	0.844	-161.0	9.17	82.5	0.020	-3.8	0.702	-165.1
150	0.855	-165.9	5.87	72.1	0.019	-16.1	0.731	-166.4
200	0.867	-168.1	4.19	64.4	0.017	-22.8	0.760	-166.6
250	0.880	-169.6	3.17	57.7	0.017	-29.0	0.789	-166.9
300	0.880	-170.8	2.49	51.8	0.015	-31.9	0.802	-167.7
350	0.906	-172.0	1.96	46.7	0.014	-37.6	0.840	-168.3
400	0.913	-172.7	1.60	42.2	0.012	-40.1	0.862	-169.1
450	0.925	-173.5	1.33	38.4	0.011	-44.6	0.878	-169.8
500	0.932	-174.4	1.12	35.1	0.010	-45.7	0.892	-170.5
550	0.939	-175.0	0.96	31.9	0.009	-49.7	0.903	-171.4
600	0.944	-175.4	0.83	29.3	0.008	-50.1	0.912	-172.1
650	0.944	-176.1	0.72	26.6	0.007	-50.3	0.919	-172.7
700	0.946	-176.9	0.63	24.2	0.007	-50.0	0.928	-173.3
750	0.951	-177.4	0.56	22.0	0.006	-50.8	0.934	-173.8
800	0.952	-178.1	0.49	20.0	0.005	-50.0	0.937	-174.4
850	0.958	-178.9	0.44	18.5	0.004	-50.1	0.941	-174.9
900	0.961	-179.2	0.40	17.3	0.004	-44.7	0.947	-175.5
950	0.967	-179.3	0.36	16.0	0.003	-44.2	0.951	-175.9
1000	0.971	-179.7	0.33	15.0	0.003	-42.4	0.954	-176.5
1050	0.969	-180.0	0.30	13.9	0.002	-35.6	0.957	-177.0
1100	0.972	179.7	0.27	12.7	0.002	-27.0	0.959	-177.5
1150	0.976	179.7	0.25	11.6	0.002	-15.0	0.961	-177.7
1200	0.976	179.5	0.23	11.0	0.002	-6.4	0.963	-178.2
1250	0.978	179.1	0.21	9.7	0.002	10.7	0.963	-178.6
1300	0.976	179.1	0.20	9.0	0.002	21.9	0.965	-178.8
1350	0.979	178.7	0.18	8.0	0.002	37.1	0.966	-179.1
1400	0.980	178.3	0.17	7.0	0.002	45.3	0.966	-179.3
1450	0.982	177.7	0.16	5.9	0.002	53.3	0.967	-179.8
1500	0.983	177.0	0.15	4.9	0.003	61.1	0.967	180.0
1550	0.984	176.4	0.14	4.3	0.003	64.9	0.968	179.7
1600	0.985	175.8	0.13	4.1	0.003	66.4	0.969	179.2
1650	0.999	175.9	0.13	4.2	0.004	67.9	0.969	179.1
1700	0.999	175.6	0.12	3.7	0.004	69.8	0.969	178.7
1750	0.999	175.9	0.12	3.9	0.004	73.2	0.970	178.3
1800	0.999	175.7	0.11	3.8	0.004	72.8	0.972	178.0
1850	0.999	175.7	0.10	4.0	0.005	75.9	0.970	177.7
1900	0.999	175.8	0.10	4.5	0.005	76.8	0.971	177.2
1950	0.999	175.3	0.09	4.5	0.006	76.8	0.973	177.0
2000	0.999	174.9	0.09	4.2	0.006	77.5	0.974	176.8
2050	0.999	174.6	0.08	4.7	0.006	79.9	0.973	176.6
2100	0.999	174.0	0.08	4.2	0.007	77.7	0.975	176.3
2150	0.999	173.4	0.08	3.6	0.007	79.2	0.979	176.0
2200	0.999	172.8	0.07	2.8	0.007	79.7	0.979	176.0
2250	0.999	172.6	0.07	2.6	0.007	79.0	0.979	175.7
2300	0.999	172.0	0.07	2.4	0.008	79.0	0.979	175.4
2350	0.999	171.4	0.07	2.0	0.008	79.9	0.983	175.3
2400	0.999	171.3	0.06	1.9	0.008	80.2	0.978	175.1
2450	0.999	171.3	0.06	1.8	0.008	79.5	0.979	174.8
2500	0.999	171.3	0.06	2.3	0.009	79.2	0.980	174.6

S parameter

 $(V_{DS} = 7.5 \text{ V}, I_D = 200 \text{ mA}, Z_o = 50 \Omega)$

f (MHz)	S11		S21		S12		S22	
	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)
100	0.879	-164.2	10.01	85.5	0.014	-3.4	0.758	-171.4
150	0.880	-168.9	6.55	77.0	0.014	-10.6	0.773	-172.1
200	0.884	-170.9	4.75	70.5	0.013	-13.8	0.787	-172.0
250	0.893	-172.1	3.69	64.7	0.012	-20.8	0.803	-171.8
300	0.884	-173.3	2.95	59.3	0.012	-23.7	0.805	-172.0
350	0.906	-173.9	2.37	54.9	0.011	-27.5	0.835	-172.1
400	0.913	-174.8	1.97	50.7	0.010	-29.4	0.852	-172.4
450	0.922	-175.3	1.67	46.9	0.009	-33.1	0.866	-172.6
500	0.931	-175.7	1.43	43.5	0.009	-34.6	0.878	-173.0
550	0.932	-176.0	1.24	40.3	0.008	-35.6	0.887	-173.4
600	0.935	-176.4	1.08	37.4	0.007	-37.2	0.897	-173.7
650	0.938	-177.0	0.95	34.6	0.007	-38.0	0.903	-174.1
700	0.939	-177.7	0.84	32.1	0.006	-36.3	0.913	-174.5
750	0.944	-178.2	0.75	29.5	0.005	-37.3	0.919	-175.0
800	0.946	-178.6	0.67	27.7	0.005	-35.8	0.923	-175.4
850	0.953	-179.3	0.61	25.8	0.004	-34.3	0.929	-175.7
900	0.957	-179.7	0.55	24.0	0.004	-28.9	0.934	-176.2
950	0.964	-180.0	0.50	22.6	0.003	-27.9	0.939	-176.6
1000	0.965	-180.0	0.46	21.5	0.003	-22.4	0.943	-176.9
1050	0.969	179.5	0.42	20.0	0.003	-14.2	0.945	-177.4
1100	0.969	179.6	0.38	18.6	0.002	-7.2	0.949	-177.9
1150	0.968	179.3	0.35	17.4	0.002	5.2	0.951	-178.2
1200	0.973	179.3	0.32	16.6	0.002	8.9	0.954	-178.6
1250	0.972	178.7	0.30	15.0	0.002	24.2	0.954	-179.0
1300	0.972	178.8	0.28	14.1	0.002	31.9	0.957	-179.1
1350	0.971	178.7	0.26	13.1	0.002	41.1	0.959	-179.4
1400	0.975	178.1	0.24	11.9	0.003	46.9	0.959	-179.6
1450	0.974	177.7	0.22	10.6	0.003	51.3	0.959	-180.0
1500	0.975	177.0	0.21	9.4	0.003	59.2	0.961	179.7
1550	0.978	176.5	0.20	9.0	0.003	61.8	0.961	179.5
1600	0.984	175.8	0.19	8.4	0.004	63.3	0.962	179.1
1650	0.990	175.8	0.18	8.1	0.004	67.9	0.962	178.9
1700	0.995	175.5	0.17	7.6	0.004	68.4	0.963	178.5
1750	0.998	175.8	0.16	7.4	0.005	71.3	0.964	178.2
1800	0.999	176.0	0.16	7.3	0.005	71.6	0.967	177.8
1850	0.999	175.7	0.15	7.1	0.005	74.7	0.966	177.5
1900	0.999	175.6	0.14	7.3	0.005	74.8	0.965	177.2
1950	0.999	175.3	0.13	7.2	0.006	75.1	0.967	176.9
2000	0.999	174.8	0.13	7.0	0.006	75.7	0.969	176.7
2050	0.999	174.3	0.12	7.0	0.006	78.5	0.969	176.5
2100	0.999	173.8	0.12	6.4	0.007	76.6	0.971	176.2
2150	0.999	173.3	0.11	5.6	0.007	77.1	0.974	176.0
2200	0.999	172.6	0.11	4.9	0.007	77.0	0.975	175.9
2250	0.999	172.2	0.10	4.1	0.008	77.6	0.974	175.6
2300	0.999	171.8	0.10	3.4	0.008	77.3	0.976	175.3
2350	0.999	171.3	0.09	3.0	0.008	78.4	0.980	175.2
2400	0.999	171.4	0.09	3.1	0.008	78.5	0.977	175.1
2450	0.999	171.3	0.09	2.9	0.009	78.4	0.977	174.8
2500	0.999	171.2	0.09	2.9	0.009	78.8	0.977	174.5

S parameter

(V_{DS} = 7.5 V, I_D = 300 mA, Z_o = 50 Ω)

f (MHz)	S11		S21		S12		S22	
	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)
100	0.896	-165.0	10.25	87.2	0.013	3.4	0.785	-173.3
150	0.892	-169.8	6.73	79.1	0.012	-4.6	0.795	-174.1
200	0.895	-171.6	4.94	73.2	0.011	-10.3	0.805	-173.9
250	0.901	-173.1	3.85	67.9	0.011	-16.0	0.816	-173.7
300	0.891	-174.1	3.11	62.9	0.011	-18.7	0.814	-173.8
350	0.912	-175.0	2.51	58.5	0.010	-22.0	0.840	-173.7
400	0.918	-175.1	2.11	54.8	0.009	-23.4	0.855	-173.9
450	0.924	-175.8	1.80	50.9	0.009	-27.0	0.865	-174.0
500	0.933	-176.3	1.56	47.5	0.008	-28.2	0.875	-174.2
550	0.931	-176.7	1.35	44.3	0.007	-29.4	0.885	-174.5
600	0.932	-176.9	1.19	41.5	0.007	-30.5	0.893	-174.7
650	0.937	-177.5	1.05	38.8	0.006	-29.9	0.899	-175.0
700	0.936	-178.0	0.93	35.8	0.006	-27.9	0.907	-175.3
750	0.938	-178.4	0.84	33.6	0.005	-28.5	0.914	-175.7
800	0.945	-179.0	0.75	31.4	0.005	-26.9	0.918	-175.9
850	0.948	-179.7	0.69	29.3	0.004	-26.6	0.924	-176.4
900	0.953	180.0	0.63	27.5	0.004	-20.4	0.929	-176.6
950	0.961	179.8	0.57	26.0	0.003	-16.5	0.935	-177.0
1000	0.963	179.9	0.52	25.0	0.003	-14.1	0.938	-177.4
1050	0.966	179.6	0.48	23.1	0.003	-5.8	0.940	-177.8
1100	0.966	179.3	0.44	21.9	0.003	3.2	0.944	-178.2
1150	0.966	179.3	0.41	20.8	0.003	11.0	0.948	-178.4
1200	0.967	179.2	0.37	19.6	0.002	15.9	0.949	-178.8
1250	0.969	179.0	0.34	18.3	0.003	26.3	0.950	-179.2
1300	0.970	178.7	0.32	17.1	0.003	33.7	0.953	-179.3
1350	0.972	178.4	0.30	15.8	0.003	44.4	0.954	-179.6
1400	0.976	178.2	0.28	14.5	0.003	49.3	0.955	-179.8
1450	0.974	177.4	0.26	13.4	0.003	52.7	0.956	179.9
1500	0.974	176.8	0.24	12.1	0.004	59.3	0.956	179.6
1550	0.980	176.3	0.23	11.5	0.004	62.8	0.959	179.4
1600	0.985	175.8	0.22	10.8	0.004	63.8	0.959	178.9
1650	0.997	175.7	0.21	10.3	0.004	66.1	0.959	178.8
1700	0.999	175.7	0.20	10.0	0.005	68.4	0.960	178.4
1750	0.999	175.7	0.19	9.7	0.005	69.6	0.961	178.1
1800	0.999	175.6	0.18	9.3	0.005	69.4	0.964	177.7
1850	0.999	175.7	0.17	9.0	0.005	70.8	0.962	177.4
1900	0.999	175.5	0.16	9.2	0.006	72.8	0.963	177.1
1950	0.999	175.2	0.16	9.0	0.006	74.1	0.965	176.8
2000	0.999	174.7	0.15	8.8	0.006	74.9	0.966	176.6
2050	0.999	174.3	0.14	8.6	0.007	76.4	0.967	176.4
2100	0.999	173.7	0.13	8.0	0.007	75.7	0.969	176.1
2150	0.999	173.1	0.13	7.2	0.007	77.2	0.972	175.9
2200	0.999	172.5	0.12	6.4	0.007	77.1	0.972	175.8
2250	0.999	172.1	0.12	5.5	0.008	77.9	0.972	175.5
2300	0.999	171.6	0.11	5.0	0.008	76.4	0.973	175.3
2350	0.999	171.2	0.11	4.1	0.008	78.3	0.977	175.1
2400	0.999	171.1	0.11	4.1	0.009	78.1	0.974	175.0
2450	0.999	171.1	0.10	3.6	0.009	78.3	0.974	174.7
2500	0.999	171.0	0.10	3.7	0.009	78.3	0.974	174.4

S parameter

 $(V_{DS} = 7.5 \text{ V}, I_D = 400 \text{ mA}, Z_o = 50 \Omega)$

f (MHz)	S11		S21		S12		S22	
	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)	MAG	ANG (deg.)
100	0.903	-165.5	10.28	88.0	0.013	4.2	0.799	-174.4
150	0.903	-170.2	6.78	80.2	0.011	-6.6	0.808	-175.1
200	0.901	-172.3	4.99	74.6	0.010	-9.4	0.816	-174.9
250	0.907	-173.5	3.91	69.6	0.010	-13.8	0.826	-174.7
300	0.895	-174.7	3.17	64.6	0.010	-15.9	0.821	-174.8
350	0.916	-175.4	2.58	60.6	0.009	-20.6	0.847	-174.9
400	0.922	-175.8	2.17	56.7	0.008	-20.5	0.859	-174.7
450	0.927	-176.2	1.86	53.1	0.008	-23.5	0.868	-174.8
500	0.932	-176.7	1.62	49.6	0.007	-24.4	0.876	-175.0
550	0.936	-177.0	1.42	46.7	0.007	-25.3	0.884	-175.1
600	0.937	-177.3	1.25	43.7	0.006	-26.5	0.892	-175.3
650	0.938	-177.7	1.10	40.9	0.006	-26.1	0.898	-175.5
700	0.939	-178.4	0.98	38.3	0.006	-25.0	0.907	-175.8
750	0.943	-178.8	0.88	35.6	0.005	-23.6	0.912	-176.0
800	0.946	-179.3	0.80	33.5	0.004	-19.9	0.915	-176.3
850	0.948	-179.9	0.73	31.5	0.004	-18.5	0.922	-176.7
900	0.956	179.7	0.67	29.8	0.004	-15.7	0.927	-177.0
950	0.960	179.6	0.61	28.1	0.003	-12.0	0.933	-177.3
1000	0.964	179.7	0.56	26.9	0.003	-7.7	0.937	-177.7
1050	0.963	179.3	0.51	25.5	0.003	-0.5	0.939	-178.0
1100	0.966	179.3	0.47	23.8	0.003	7.8	0.942	-178.4
1150	0.966	179.3	0.43	22.6	0.003	15.4	0.945	-178.6
1200	0.969	179.1	0.40	21.4	0.003	22.3	0.947	-179.0
1250	0.970	178.7	0.37	20.1	0.003	31.2	0.948	-179.4
1300	0.972	178.5	0.34	18.8	0.003	39.9	0.951	-179.5
1350	0.970	178.4	0.32	17.5	0.003	44.3	0.953	-179.7
1400	0.973	177.9	0.30	16.1	0.003	47.7	0.954	-179.9
1450	0.975	177.4	0.28	14.7	0.003	51.8	0.954	179.7
1500	0.974	176.6	0.26	13.6	0.004	60.0	0.955	179.4
1550	0.980	176.3	0.25	12.9	0.004	60.3	0.957	179.2
1600	0.983	175.7	0.24	12.0	0.004	62.3	0.958	178.8
1650	0.990	175.5	0.23	11.8	0.004	65.9	0.958	178.6
1700	0.996	175.6	0.21	11.2	0.005	66.9	0.959	178.3
1750	0.999	175.6	0.20	10.9	0.005	68.5	0.959	178.0
1800	0.999	175.6	0.20	10.4	0.005	69.5	0.961	177.7
1850	0.999	175.5	0.19	10.3	0.005	72.5	0.960	177.3
1900	0.999	175.4	0.18	10.4	0.006	72.6	0.962	177.0
1950	0.999	175.1	0.17	10.1	0.006	74.0	0.963	176.7
2000	0.999	174.6	0.16	10.0	0.006	75.7	0.965	176.5
2050	0.999	174.3	0.15	9.5	0.007	76.3	0.966	176.3
2100	0.999	173.6	0.14	9.0	0.007	74.3	0.968	176.0
2150	0.999	172.9	0.14	8.0	0.007	76.1	0.970	175.8
2200	0.999	172.2	0.13	7.1	0.008	77.1	0.972	175.7
2250	0.999	171.9	0.13	6.4	0.008	77.6	0.971	175.4
2300	0.999	171.6	0.12	5.8	0.008	77.0	0.972	175.2
2350	0.999	171.2	0.12	5.0	0.008	78.5	0.975	175.0
2400	0.999	170.9	0.11	4.5	0.009	78.2	0.973	174.9
2450	0.999	171.0	0.11	4.4	0.009	77.2	0.973	174.6
2500	0.999	170.8	0.11	4.4	0.009	77.7	0.974	174.4

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