BB404M

Build in Biasing Circuit MOS FET IC
UHF/VHF RF Amplifier

HITACHI

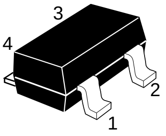
ADE-208-717B (Z)
3rd. Edition
Mar. 2001

Features

- Build in Biasing Circuit; To reduce using parts cost & PC board space.
- High gain;
  (PG = 29 dB typ. at f = 200 MHz)
- Low noise characteristics;
  (NF = 1.2 dB typ. at f = 200 MHz)
- Wide supply voltage range;
  Applicable with 5V to 9V supply voltage.
- Withstanding to ESD;
  Build in ESD absorbing diode. Withstand up to 200V at C=200pF, Rs=0 conditions.
- Provide mini mold packages; MPAK-4R(SOT-143 var.)

Outline

MPAK-4R



1. Source
2. Drain
3. Gate2
4. Gate1

Notes:
1. Marking is “DX –”.
2. BB404M is individual type number of HITACHI BBFET.

Absolute Maximum Ratings (Ta = 25°C)

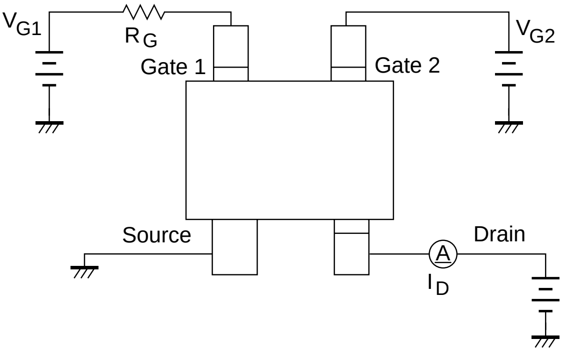
Item	Symbol	Ratings	Unit
Drain to source voltage	V_{DS}	12	V
Gate1 to source voltage	V_{G1S}	±10 – 0	V
Gate2 to source voltage	V_{G2S}	Å}10	V
Drain current	I_D	25	mA
Channel power dissipation	Pch	150	mW
Channel temperature	Tch	150	°C
Storage temperature	Tstg	–55 to +150	°C

Electrical Characteristics (Ta = 25°C)

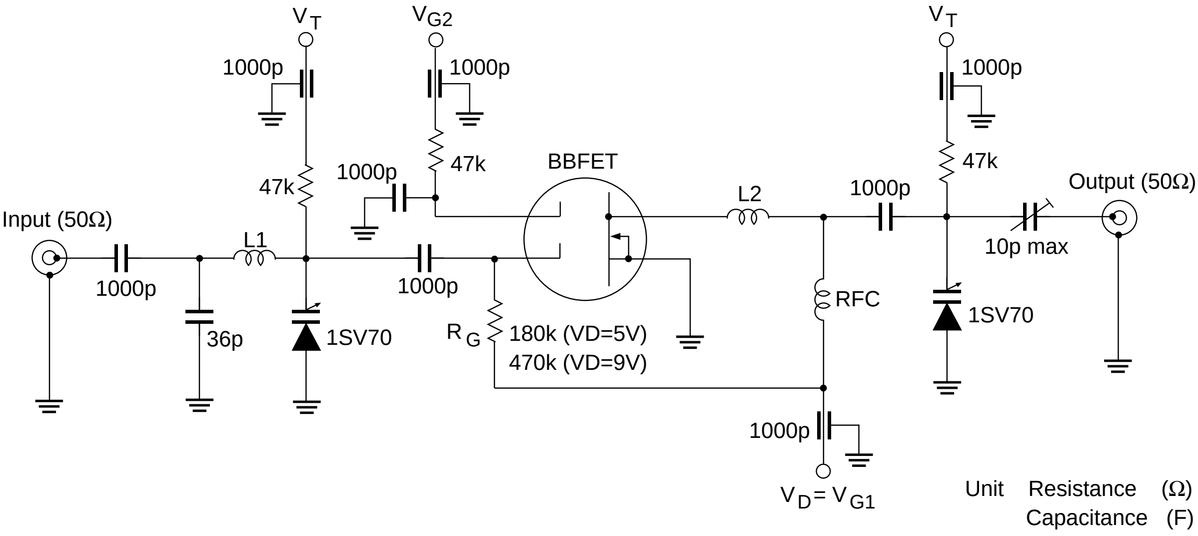
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain to source breakdown voltage	$V_{(BR)DSS}$	12	—	—	V	I_D = 200µA, V_{G1S} = V_{G2S} = 0
Gate1 to source breakdown voltage	$V_{(BR)G1SS}$	+10	—	—	V	I_{G1} = +10µA, V_{G2S} = V_{DS} = 0
Gate2 to source breakdown voltage	$V_{(BR)G2SS}$	±10	—	—	V	I_{G2} = ±10µA, V_{G1S} = V_{DS} = 0
Gate1 to source cutoff current	I_{G1SS}	—	—	+100	nA	V_{G1S} = +9V, V_{G2S} = V_{DS} = 0
Gate2 to source cutoff current	I_{G2SS}	—	—	±100	nA	V_{G2S} = ±9V, V_{G1S} = V_{DS} = 0
Gate1 to source cutoff voltage	$V_{G1S(off)}$	0.4	0.7	1.0	V	V_{DS} = 5V, V_{G2S} = 4V, I_D = 100µA
Gate2 to source cutoff voltage	$V_{G2S(off)}$	0.5	0.7	1.0	V	V_{DS} = 5V, V_{G1S} = 5V, I_D = 100µA
Input capacitance	c_{iss}	2.3	2.8	3.6	pF	V_{DS} = 5V, V_{G1} = 5V V_{G2S} =4V, R_G = 180kΩ f = 1MHz
Output capacitance	c_{oss}	0.9	1.3	2.0	pF	
Reverse transfer capacitance	c_{rss}	0.003	0.02	0.05	pF	
Drain current	$I_{D(op)}$ 1	9	15	19	mA	V_{DS} = 5V, V_{G1} = 5V V_{G2S} = 4V, R_G = 180kΩ
	$I_{D(op)}$ 2	—	13	—	mA	V_{DS} = 9V, V_{G1} = 9V V_{G2S} =6V, R_G = 470kΩ
Forward transfer admittance	$|y_{fs}|$1	22	27	34	mS	V_{DS} = 5V, V_{G1} = 5V, V_{G2S} =4V R_G = 180kΩ, f = 1kHz
	$|y_{fs}|$2	—	27	—	mS	V_{DS} = 9V, V_{G1} = 9V, V_{G2S} =6V R_G = 470kΩ, f = 1kHz
Power gain	PG1	24	29	32	dB	V_{DS} = 5V, V_{G1} = 5V, V_{G2S} =4V R_G = 180kΩ, f = 200MHz
	PG2	—	29	—	dB	V_{DS} = 9V, V_{G1} = 9V, V_{G2S} =6V R_G = 470kΩ, f = 200MHz
Noise figure	NF1	—	1.2	1.9	dB	V_{DS} = 5V, V_{G1} = 5V, V_{G2S} =4V R_G = 180kΩ, f = 200MHz
	NF2	—	1.2	—	dB	V_{DS} = 9V, V_{G1} = 9V, V_{G2S} =6V R_G = 470kΩ, f = 200MHz

Main Characteristics

Test Circuit for Operating Items ($I_{D(op)}$, |yfs|, Ciss, Coss, Crss, NF, PG)



200MHz Power Gain, Noise Figure Test Circuit



L1 :ϕ1mm Enameled Copper Wire,Inside dia 10mm, 2Turns
L2 :ϕ1mm Enameled Copper Wire,Inside dia 10mm, 2Turns
RFC :ϕ1mm Enameled Copper Wire,Inside dia 5mm, 2Turns

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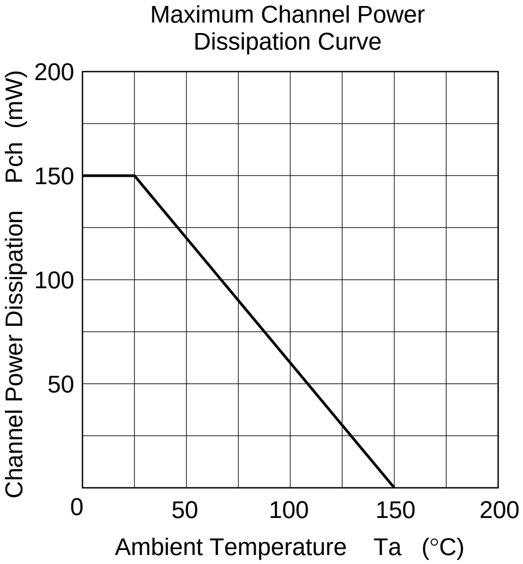
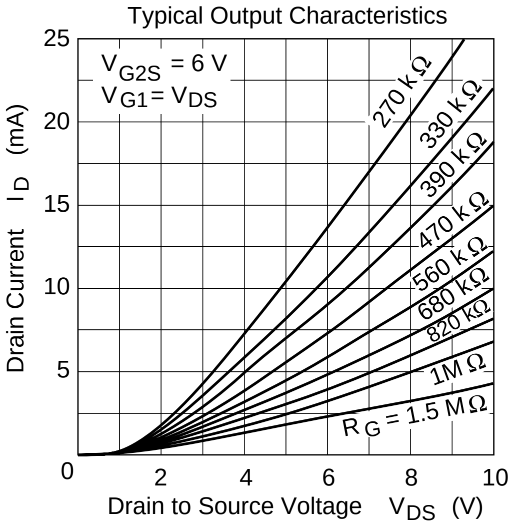
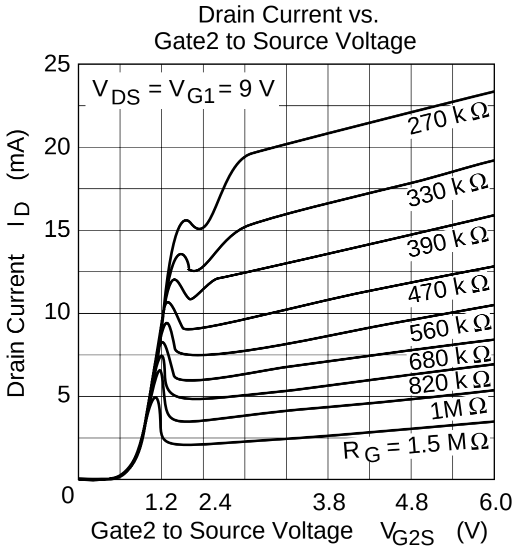
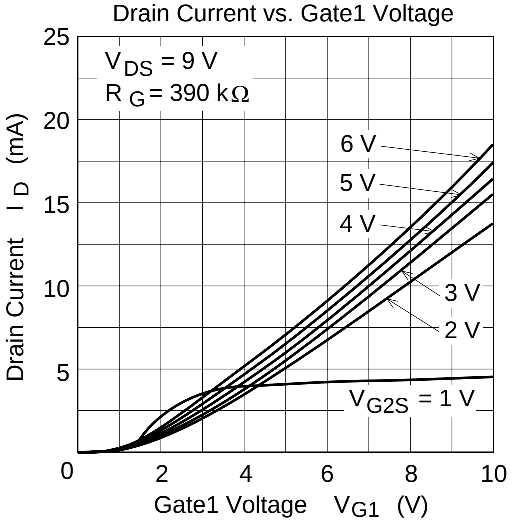
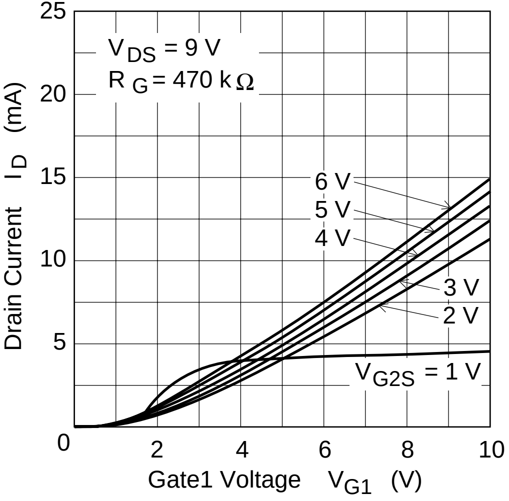

Maximum Channel Power Dissipation Curve


Typical Output Characteristics

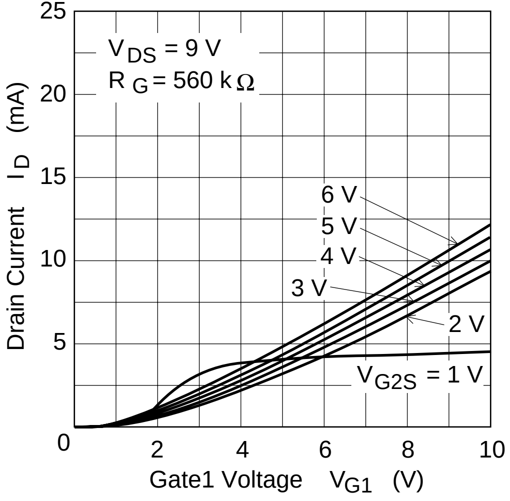

Drain Current vs. Gate2 to Source Voltage


Drain Current vs. Gate1 Voltage

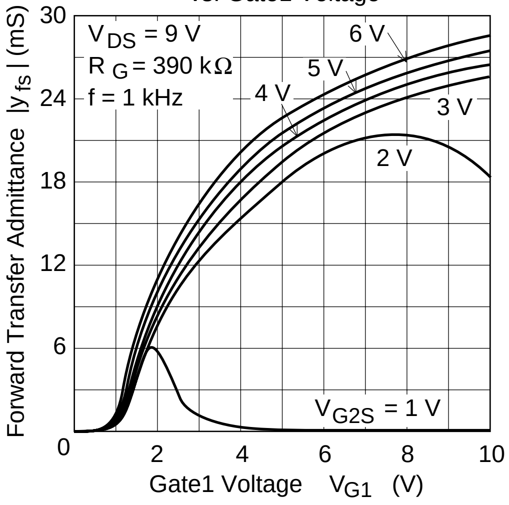
Drain Current vs. Gate1 Voltege



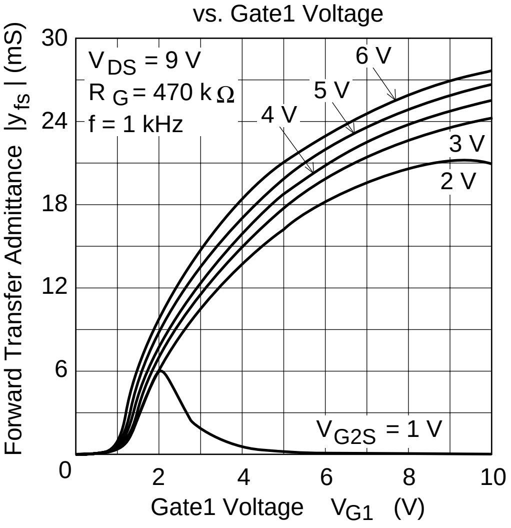
Drain Current vs. Gate1 Voltege

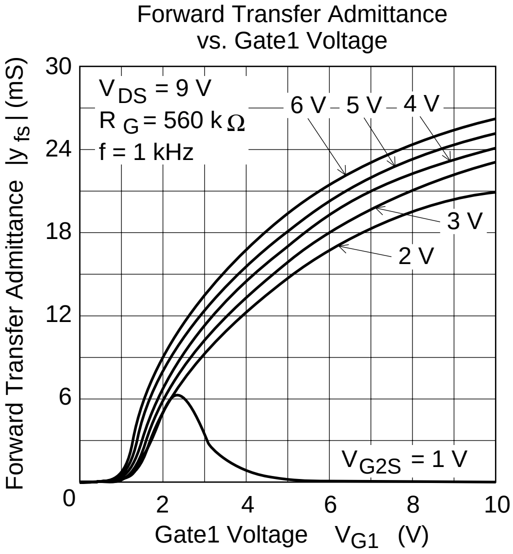


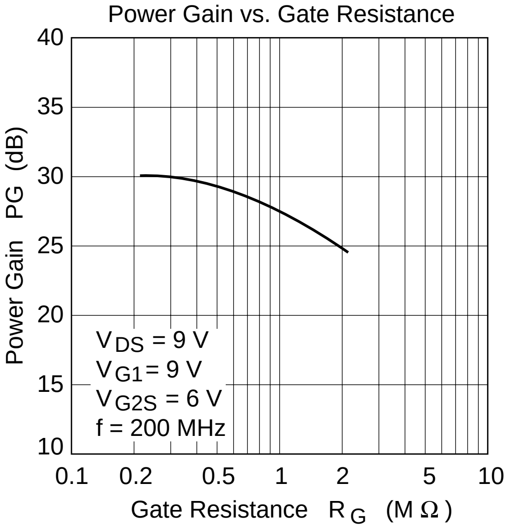
Forward Transfer Admittance vs. Gate1 Voltage

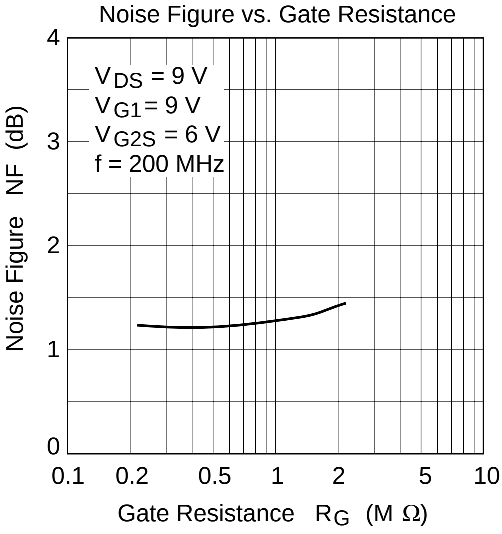


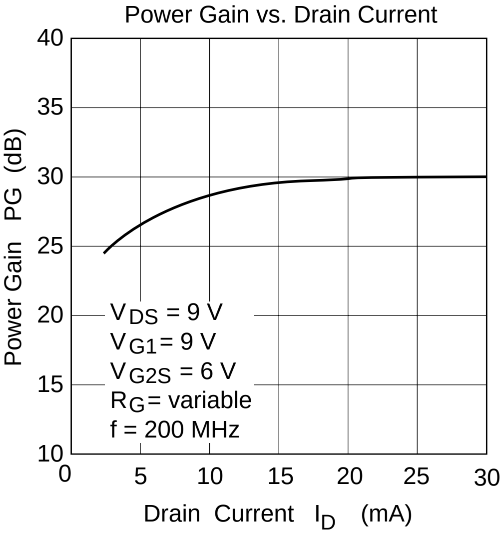
Forward Transfer Admittance vs. Gate1 Voltage



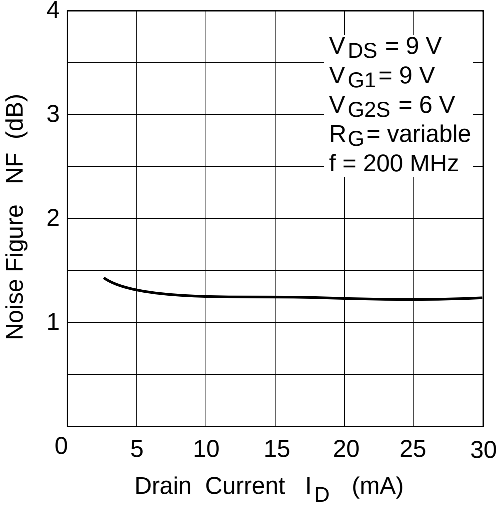

Forward Transfer Admittance vs. Gate1 Voltage


Power Gain vs. Gate Resistance

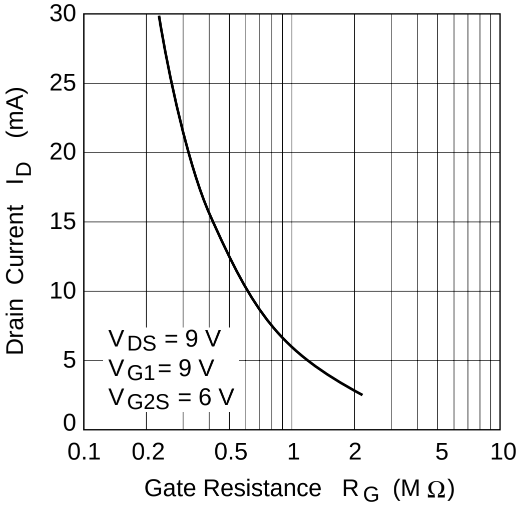

Noise Figure vs. Gate Resistance


Power Gain vs. Drain Current

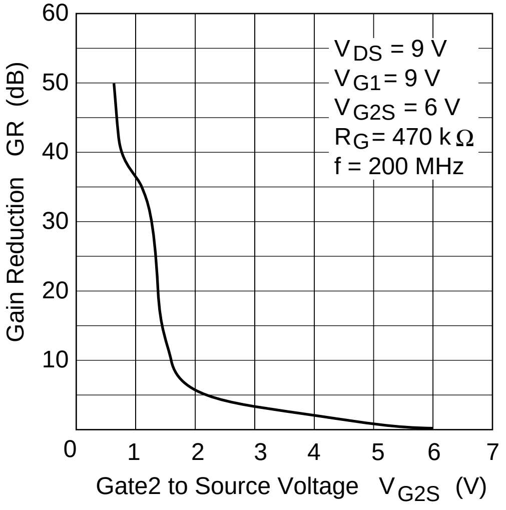
Noise Figure vs. Drain Current



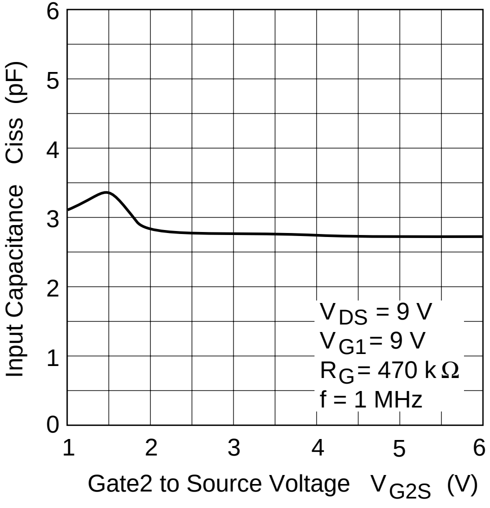
Drain Current vs. Gate Resistance



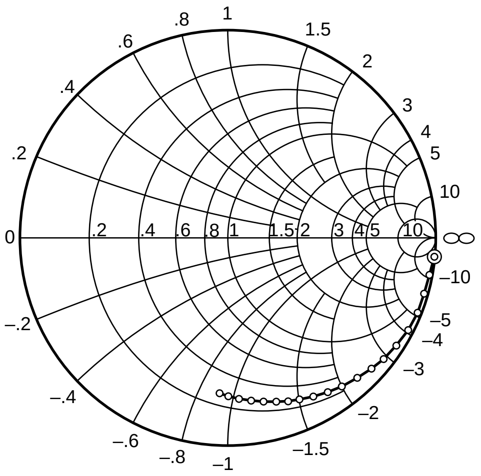
Gain Reduction vs.
Gate2 to Source Voltage



Input Capacitance vs.
Gate2 to Source Voltage

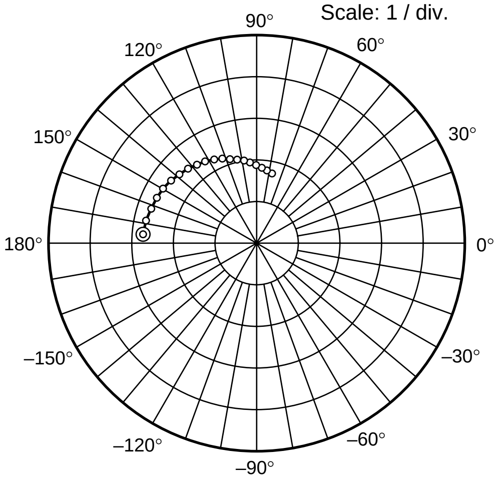


S11 Parameter vs. Frequency



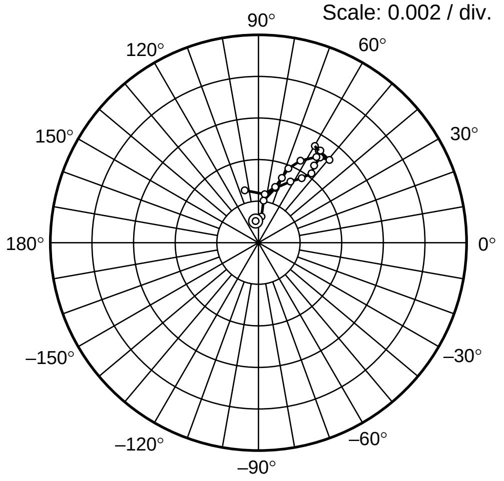
Test Condition : V_{DS}= 9 V , V_{G1}= 9 V
V_{G2S} = 6 V , R_G = 470 kΩ
50—1000 MHz (50 MHz step)
◎——○

S21 Parameter vs. Frequency



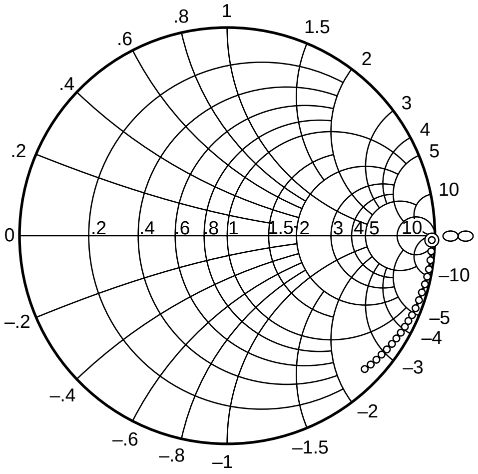
Test Condition : V_{DS}= 9 V , V_{G1}= 9 V
V_{G2S} = 6 V , R_G = 470 kΩ
50—1000 MHz (50 MHz step)
◎——○

S12 Parameter vs. Frequency



Test Condition : V_{DS}= 9 V , V_{G1}= 9 V
V_{G2S} = 6 V , R_G = 470 kΩ
50—1000 MHz (50 MHz step)
◎——○

S22 Parameter vs. Frequency



Test Condition : V_{DS}= 9 V , V_{G1}= 9 V
V_{G2S} = 6 V , R_G = 470 kΩ
50—1000 MHz (50 MHz step)
◎——○

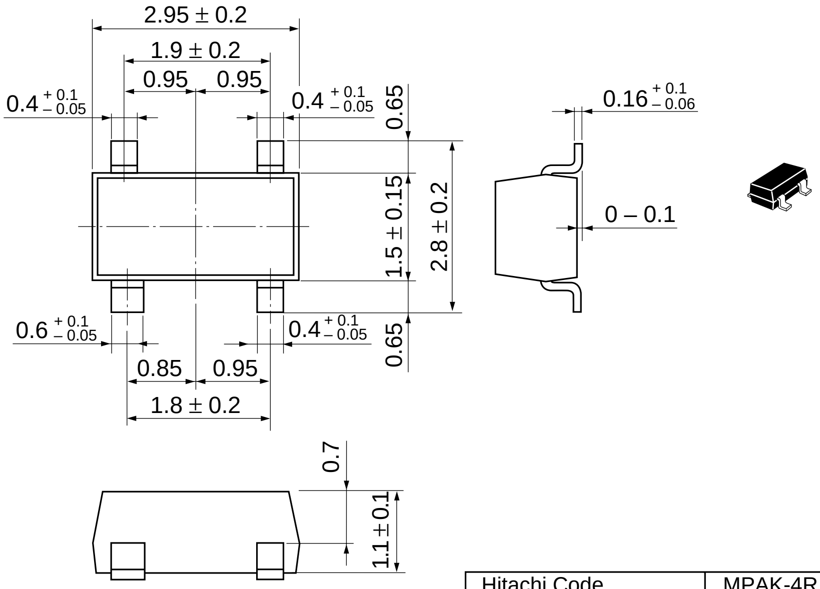
Sparameter (V_{DS} = V_{G1} = 9V, V_{G2S} = 6V, R_G = 470kΩ, Zo = 50Ω)

	S11		S21		S12		S22	
f (MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
50	0.996	–5.3	2.74	174.0	0.00096	98.6	0.985	–1.9
100	0.993	–10.9	2.73	168.0	0.00130	84.4	0.991	–4.5
150	0.987	–16.6	2.68	162.3	0.00203	83.6	0.990	–6.5
200	0.978	–21.9	2.66	156.3	0.00285	72.3	0.988	–9.4
250	0.972	–27.4	2.63	150.4	0.00335	69.7	0.985	–11.6
300	0.954	–33.2	2.57	144.3	0.00385	68.3	0.982	–14.0
350	0.943	–38.2	2.50	138.7	0.00455	63.2	0.979	–16.2
400	0.925	–43.2	2.43	133.3	0.00488	55.4	0.975	–18.4
450	0.910	–48.0	2.37	128.0	0.00526	59.8	0.971	–21.0
500	0.893	–52.5	2.30	122.6	0.00522	56.1	0.967	–23.0
550	0.880	–57.4	2.24	117.5	0.00498	53.2	0.962	–25.2
600	0.861	–62.1	2.17	112.7	0.00512	49.1	0.957	–27.3
650	0.847	–66.1	2.10	108.1	0.00497	53.4	0.952	–29.4
700	0.829	–69.9	2.02	103.6	0.00455	53.6	0.947	–31.6
750	0.816	–74.1	1.96	99.1	0.00418	51.6	0.943	–33.7
800	0.804	–78.2	1.91	94.8	0.00372	55.7	0.937	–35.8
850	0.791	–82.4	1.85	80.4	0.00329	62.4	0.933	–38.0
900	0.779	–86.1	1.79	86.3	0.00275	73.0	0.928	–40.0
950	0.764	–89.5	1.73	82.2	0.00233	82.4	0.921	–42.1
1000	0.753	–92.4	1.68	78.3	0.00258	105.1	0.918	–44.2

Package Dimensions

As of January, 2001

Unit: mm



Hitachi Code	MPAK-4R
JEDEC	—
EIAJ	—
Mass (reference value)	0.013 g

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