DATA SHEET

NEC

BIPOLAR ANALOG INTEGRATED CIRCUITS

μPC2745TB, μPC2746TB

3 V, SUPER MINIMOLD SILICON MMIC WIDEBAND AMPLIFIER FOR MOBILE COMMUNICATIONS

DESCRIPTION

The μPC2745TB and μPC2746TB are silicon monolithic integrated circuits designed as buffer amplifier for mobile communications. These low current amplifiers operate on 3.0 V (1.8 V MIN.).

These ICs are manufactured using NEC's 20 GHz f_T NESAT™III silicon bipolar process. This process uses silicon nitride passivation film and gold electrodes. These materials can protect chip surface from external pollution and prevent corrosion/migration. Thus, these IC have excellent performance, uniformity and reliability.

★ FEATURES

- Supply voltage : Recommended V_{CC} = 2.7 to 3.3 V
  Circuit operation V_{CC} = 1.8 to 3.3 V
- Upper limit operating frequency : μPC2745TB; f_u = 2.7 GHz TYP. @3 dB bandwidth
  μPC2746TB; f_u = 1.5 GHz TYP. @3 dB bandwidth
- High isolation : μPC2745TB; ISL = 38 dB TYP. @f = 500 MHz
  μPC2746TB; ISL = 45 dB TYP. @f = 500 MHz
- Power gain : μPC2745TB; G_P = 12 dB TYP. @f = 500 MHz
  μPC2746TB; G_P = 19 dB TYP. @f = 500 MHz
- Saturated output power : μPC2745TB; $P_{O(sat)}$ = −1 dBm TYP. @f = 500 MHz
  μPC2746TB; $P_{O(sat)}$ = 0 dBm TYP. @f = 500 MHz
- High-density surface mounting : 6-pin super minimold package (2.0 × 1.25 × 0.9 mm)

APPLICATION

- 1.5 GHz to 2.5 GHz communication system (PHS, wireless LAN; etc.): μPC2745TB
- 800 MHz to 900 MHz cellular telephone (CT2, GSM, etc.) : μPC2746TB

ORDERING INFORMATION

Part Number	Package	Marking	Supplying Form
μPC2745TB-E3	6-pin super minimold	C1Q	• Embossed tape 8 mm wide • 1, 2, 3 pins face the perforation side of the tape • Qty 3 kpcs/reel
μPC2746TB-E3		C1R	

Remark To order evaluation samples, please contact your local NEC sales office.
Part number: μPC2745TB, μPC2746TB

Caution Electro-static sensitive devices

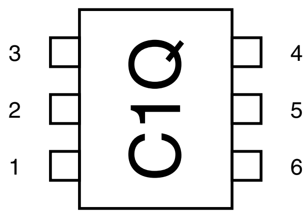
The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

Document No. P11511EJ3V0DS00 (3rd edition)
Date Published February 2001 N CP(K)
Printed in Japan

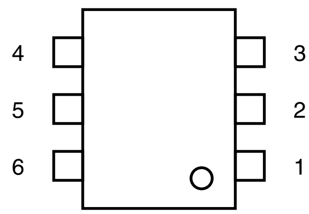
The mark ★ shows major revised points.

PIN CONNECTIONS

(Top View)



(Bottom View)



Marking is an example of μPC2745TB

Pin No.	Pin Name
1	INPUT
2	GND
3	GND
4	OUTPUT
5	GND
6	V_{CC}

★ PRODUCT LINE-UP (T_A = +25°C, V_{CC} = 3.0 V, Z_S = Z_L = 50 Ω)

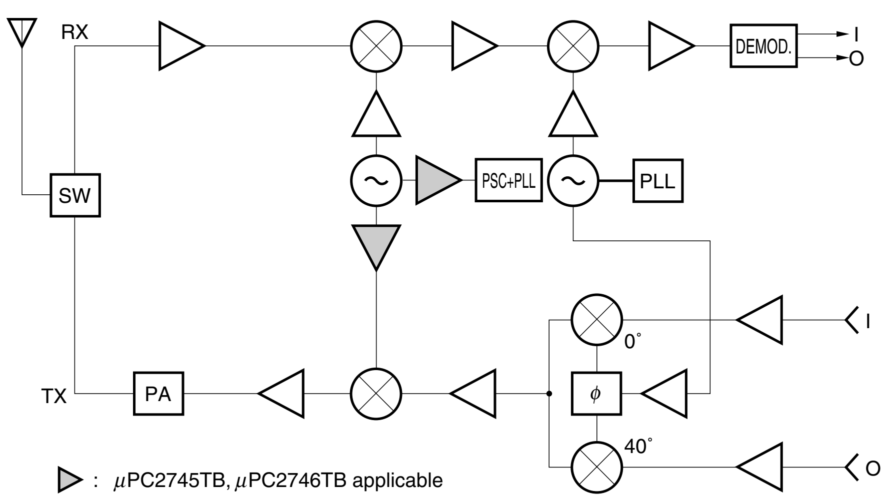
Part No.	f_u (GHz)	$P_{O(sat)}$ (dBm)	G_P (dB)	NF (dB)	I_{CC} (mA)	Package	Making
μPC2745T	2.7	–1.0	12	6.0	7.5	6-pin minimold	C1Q
μPC2745TB						6-pin super minimold	
μPC2746T	1.5	0	19	4.0	7.5	6-pin minimold	C1R
μPC2746TB						6-pin super minimold	
μPC2747T	1.8	–7.0	12	3.3	5.0	6-pin minimold	C1S
μPC2747TB						6-pin super minimold	
μPC2748T	0.2 to 1.5	–3.5	19	2.8	6.0	6-pin minimold	C1T
μPC2748TB						6-pin super minimold	
μPC2749T	2.9	–6.0	16	4.0	6.0	6-pin minimold	C1U
μPC2749TB						6-pin super minimold	

Remark Typical performance. Please refer to ELECTRICAL CHARACTERISTICS in detail.

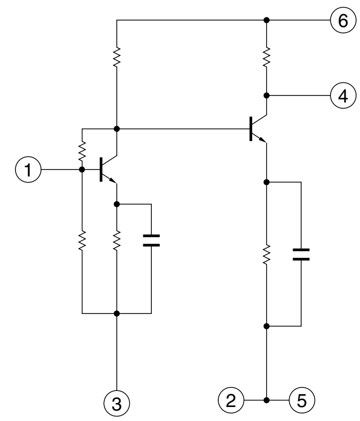
Caution The package size distinguish between minimold and super minimold.

SYSTEM APPLICATION EXAMPLE

DIGITAL CELLULAR SYSTEM BLOCK DIAGRAM



PIN EXPLANATION

Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (V)Note	Function and Applications	Internal Equivalent Circuit
1	INPUT	—	0.87 0.82	Signal input pin. A internal matching circuit, configured with resistors, enables 50 Ω connection over a wide band. this pin must be coupled to signal source with capacitor for DC cut.	
2 3 5	GND	0	—	Ground pin. This pin should be connected to system ground with minimum inductance. Ground pattern on the board should be formed as wide as possible. All the ground pins must be connected together with wide ground pattern to decrease impedance difference.	
4	OUTPUT	—	1.95 2.54	Signal output pin. A internal matching circuit, configured with resistors, enables 50 Ω connection over a wide band. This pin must be coupled to next stage with capacitor for DC cut.	
6	V_{CC}	2.7 to 3.3	—	Power supply pin. This pin should be externally equipped with bypass capacity to minimize ground impedance.	

Note Pin voltage is measured at V_{CC} = 3.0 V. Above: μPC2745TB, Below: μPC2746TB

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	V_{CC}	T_A = +25°C	4.0	V
Circuit Current	I_{CC}	T_A = +25°C	16	mA
★ Power Dissipation	P_D	Mounted on double sided copper clad 50 × 50 × 1.6 mm epoxy glass PWB, T_A = +85°C	270	mW
Operating Ambient Temperature	T_A		–40 to +85	°C
Storage Temperature	T_{stg}		–55 to +150	°C
Input Power	P_{in}	T_A = +25°C	0	dBm

RECOMMENDED OPERATING RANGE

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V_{CC}	2.7	3.0	3.3	V

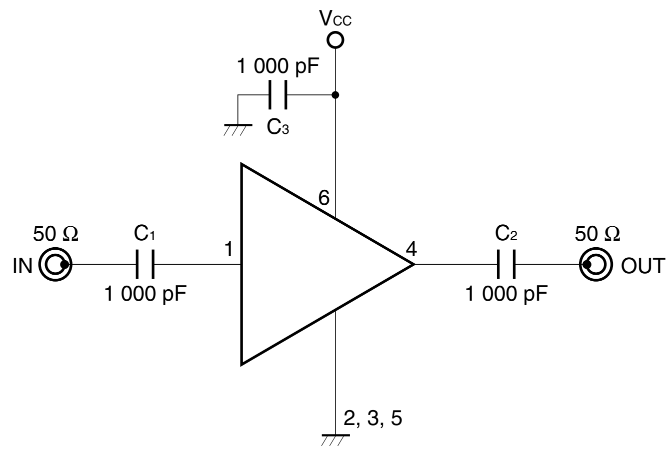
ELECTRICAL CHARACTERISTICS
(Unless otherwise specified, T_A = +25°C, V_{CC} = 3.0 V, $Z_S = Z_L$ = 50 Ω)

Parameter	Symbol	Test Conditions	μPC2745TB			μPC2746TB			Unit
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Circuit Current	I_{CC}	No signal	5.0	7.5	10.0	5.0	7.5	10.0	mA
Power Gain	G_P	f = 500 MHz	9	12	14	16	19	21	dB
Noise Figure	NF	f = 500 MHz	—	6.0	7.5	—	4.0	5.5	dB
Upper Limit Operating Frequency	f_u	3 dB down below from gain at f = 0.1 GHz	2.3	2.7	—	1.1	1.5	—	GHz
Isolation	ISL	f = 500 MHz	33	38	—	40	45	—	dB
Input Return Loss	RL_{in}	f = 500 MHz	8	11	—	10	13	—	dB
Output Return Loss	RL_{out}	f = 500 MHz	2.5	5.5	—	5.5	8.5	—	dB
Saturated Output Power	$P_{O(sat)}$	f = 500 MHz, P_{in} = –6 dBm	–4.0	–1.0	—	–3.0	0	—	dBm

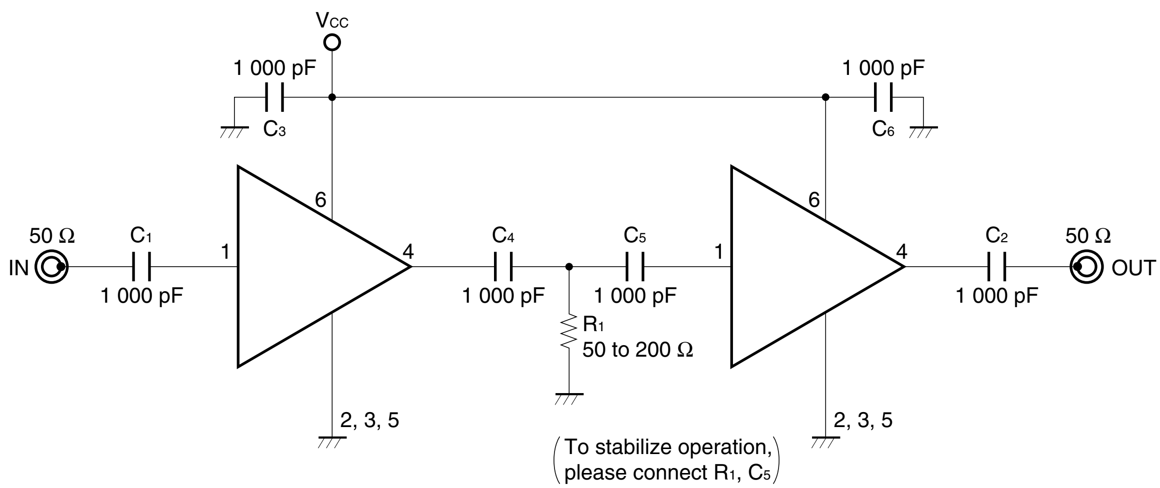
STANDARD CHARACTERISTICS FOR REFERENCE (T_A = +25°C, V_{CC} = 3.0 V, Z_S = Z_L = 50 Ω)

Parameter	Symbol	Test Conditions	μPC2745TB	μPC2746TB	Unit
Circuit Current	I_{CC}	V_{CC} = 1.8 V, No signal	4.5	4.5	mA
Power Gain	G_P	V_{CC} = 3.0 V, f = 1.0 GHz V_{CC} = 3.0 V, f = 2.0 GHz V_{CC} = 1.8 V, f = 0.5 GHz	12.0 11.0 7.0	18.5 — 14.0	dB
Noise Figure	NF	V_{CC} = 3.0 V, f = 1.0 GHz V_{CC} = 3.0 V, f = 2.0 GHz V_{CC} = 1.8 V, f = 0.5 GHz	5.5 5.7 8.0	4.2 — 5.0	dB
Upper Limit Operating Frequency	f_u	V_{CC} = 1.8 V, 3 dB down below from gain at f = 0.1 GHz	1.8	1.1	GHz
Isolation	ISL	V_{CC} = 3.0 V, f = 1.0 GHz V_{CC} = 3.0 V, f = 2.0 GHz V_{CC} = 1.8 V, f = 0.5 GHz	33 30 35	38 — 37	dB
Input Return Loss	RL_{in}	V_{CC} = 3.0 V, f = 1.0 GHz V_{CC} = 3.0 V, f = 2.0 GHz V_{CC} = 1.8 V, f = 0.5 GHz	13.0 14.0 6.5	10.0 — 10.0	dB
Output Return Loss	RL_{out}	V_{CC} = 3.0 V, f = 1.0 GHz V_{CC} = 3.0 V, f = 2.0 GHz V_{CC} = 1.8 V, f = 0.5 GHz	6.5 8.5 6.0	8.5 — 9.5	dB
Saturated Output Power	$P_{O(sat)}$	V_{CC} = 3.0 V, f = 1.0 GHz, P_{in} = –6 dBm V_{CC} = 3.0 V, f = 2.0 GHz, P_{in} = –6 dBm V_{CC} = 1.8 V, f = 0.5 GHz, P_{in} = –10 dBm	–2.5 –3.5 –11.0	–1.0 — –8.0	dBm
3rd Order Intermodulation Distortion	IM_3	V_{CC} = 3.0 V, P_{out} = –20 dBm, f_1 = 500 MHz, f_2 = 502 MHz V_{CC} = 3.0 V, P_{out} = –20 dBm, f_1 = 1 000 MHz, f_2 = 1 002 MHz V_{CC} = 1.8 V, P_{out} = –20 dBm, f_1 = 500 MHz, f_2 = 502 MHz	–54 –50 –31	–51 — –37	dBc

TEST CIRCUIT



EXAMPLE OF APPLICATION CIRCUIT



The application circuits and their parameters are for references only and are not intended for use in actual design-ins.

CAPACITORS FOR THE V_{CC}, INPUT, AND OUTPUT PINS

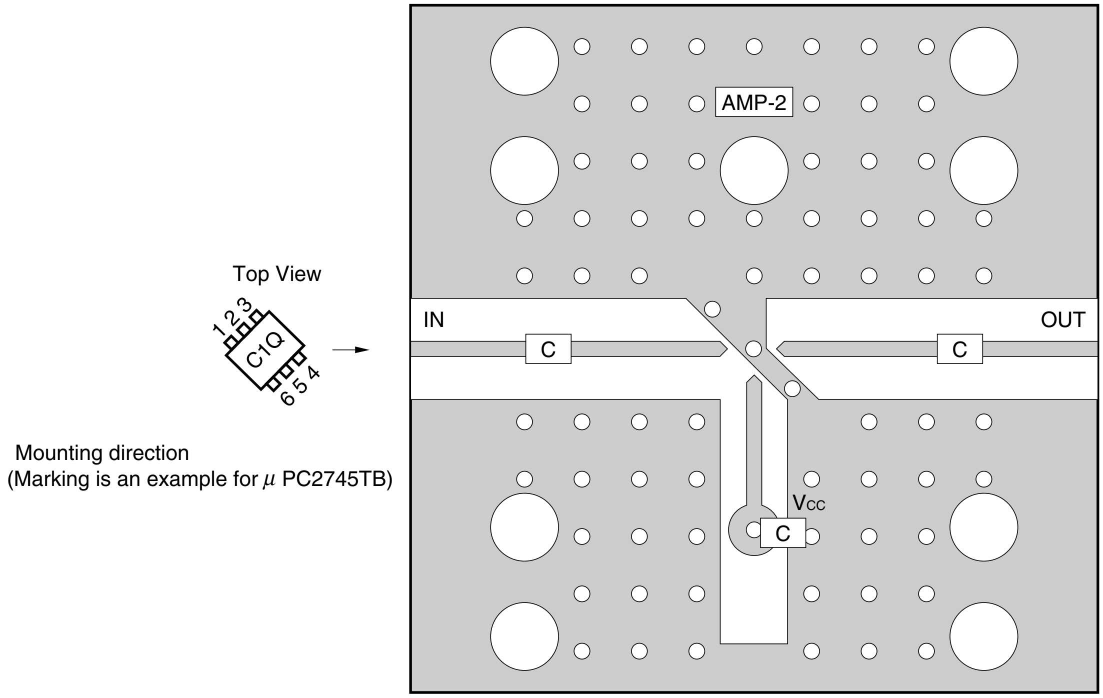
Capacitors of 1 000 pF are recommendable as the bypass capacitor for the V_{CC} pin and the coupling capacitors for the input and output pins.

The bypass capacitor connected to the V_{CC} pin is used to minimize ground impedance of V_{CC} pin. So, stable bias can be supplied against V_{CC} fluctuation.

The coupling capacitors, connected to the input and output pins, are used to cut the DC and minimize RF serial impedance. Their capacitance are therefore selected as lower impedance against a 50 Ω load. The capacitors thus perform as high pass filters, suppressing low frequencies to DC.

To obtain a flat gain from 100 MHz upwards, 1 000 pF capacitors are used in the test circuit. In the case of under 10 MHz operation, increase the value of coupling capacitor such as 10 000 pF. Because the coupling capacitors are determined by equation, $C = 1/(2\pi Rfc)$.

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD



COMPONENT LIST

	Value
C	1 000 pF

Notes

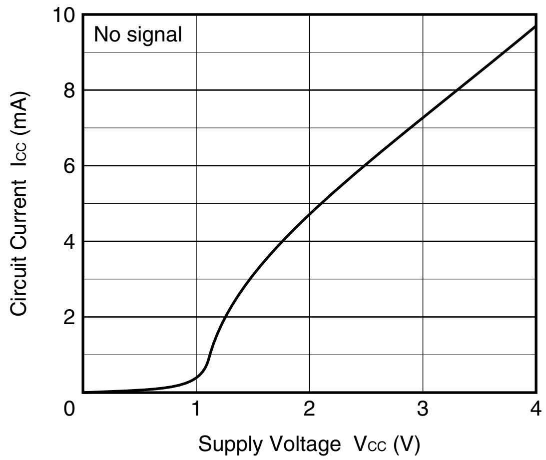
1. 30 × 30 × 0.4 mm double sided copper clad polyimide board.
2. Back side: GND pattern
3. Solder plated on pattern
4. : Through holes

For more information on the use of this IC, refer to the following application note: **USAGE AND APPLICATIONS OF 6-PIN MINI-MOLD, 6-PIN SUPER MINI-MOLD SILICON HIGH-FREQUENCY WIDEBAND AMPLIFIER MMIC (P11976E).**

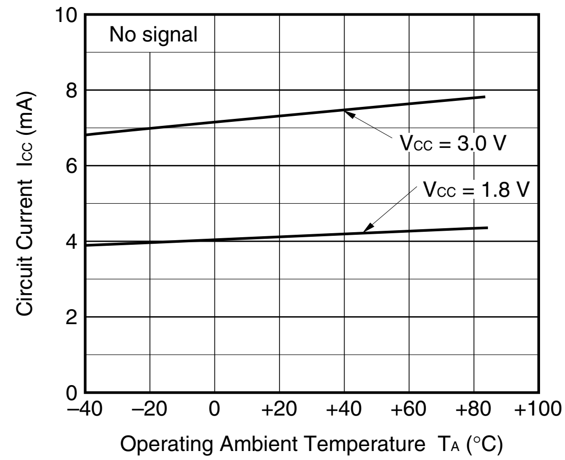
TYPICAL CHARACTERISTICS (Unless otherwise specified, T_A = +25°C)

— μPC2745TB —

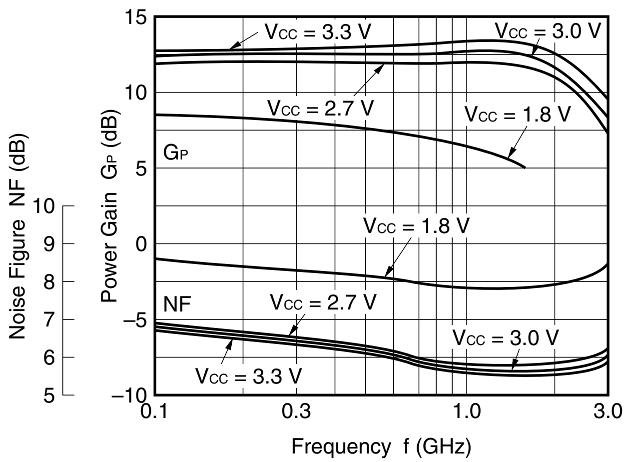
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



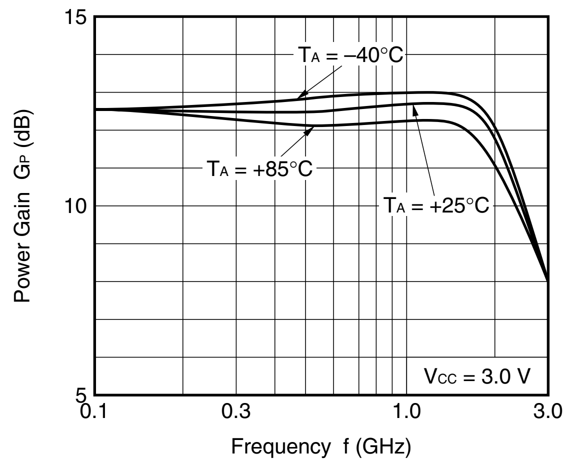
CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



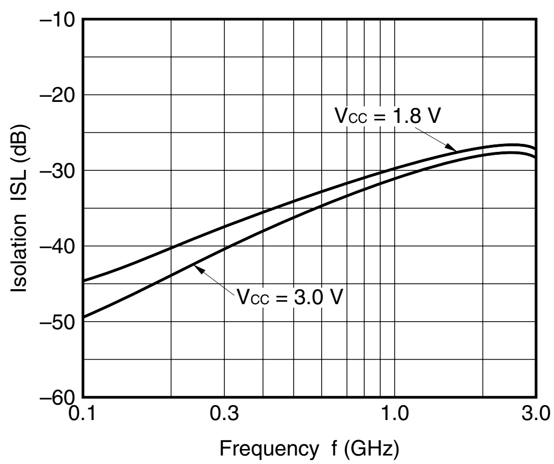
NOISE FIGURE, POWER GAIN vs. FREQUENCY



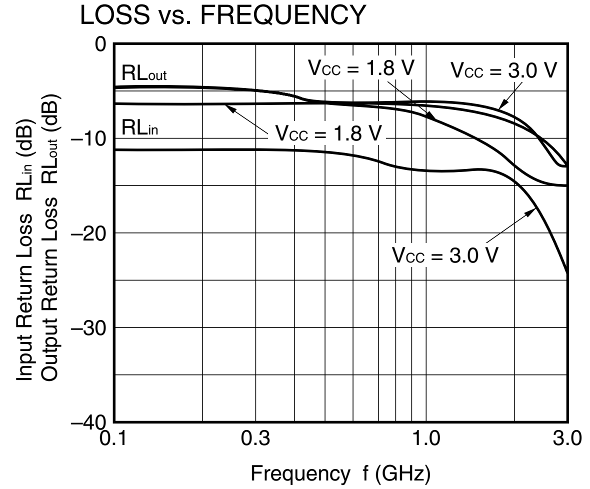
POWER GAIN vs. FREQUENCY



ISOLATION vs. FREQUENCY

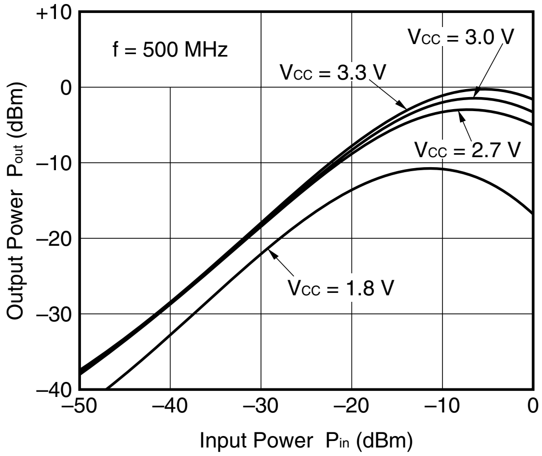


INPUT RETURN LOSS, OUTPUT RETURN LOSS vs. FREQUENCY

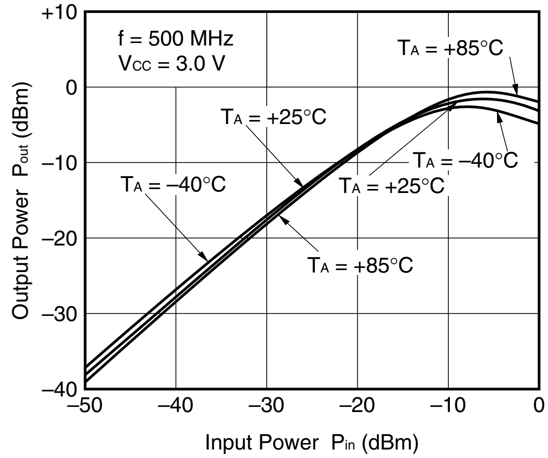


— μPC2745TB —

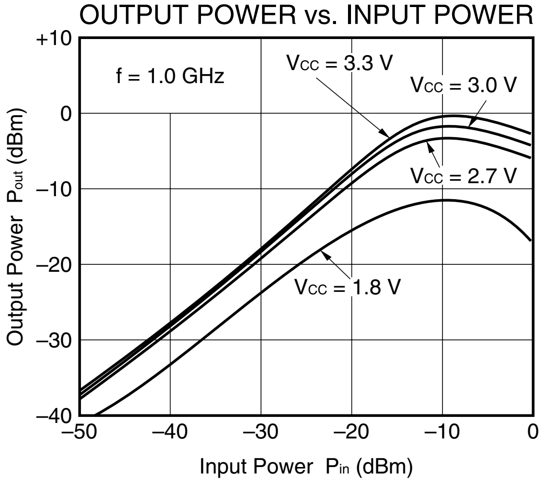
OUTPUT POWER vs. INPUT POWER



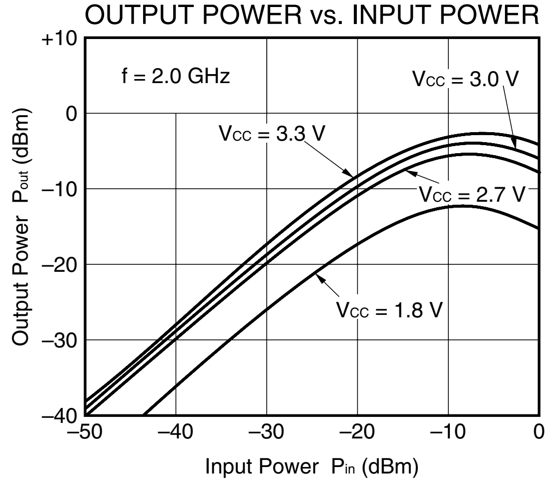
OUTPUT POWER vs. INPUT POWER



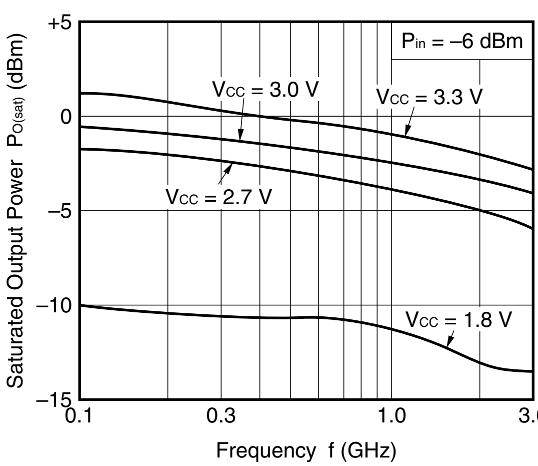
OUTPUT POWER vs. INPUT POWER



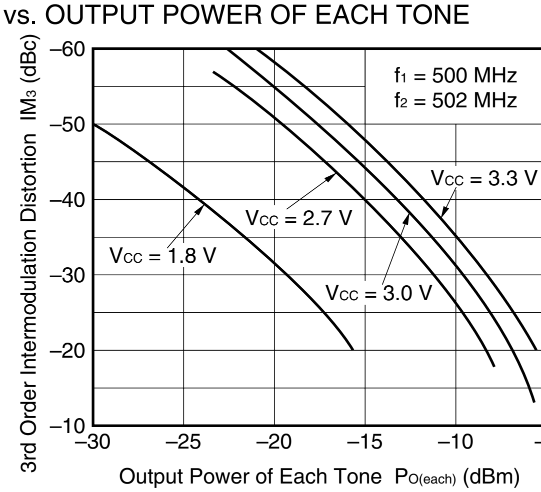
OUTPUT POWER vs. INPUT POWER



SATURATED OUTPUT POWER vs. FREQUENCY



3RD ORDER INTERMODULATION DISTORTION vs. OUTPUT POWER OF EACH TONE

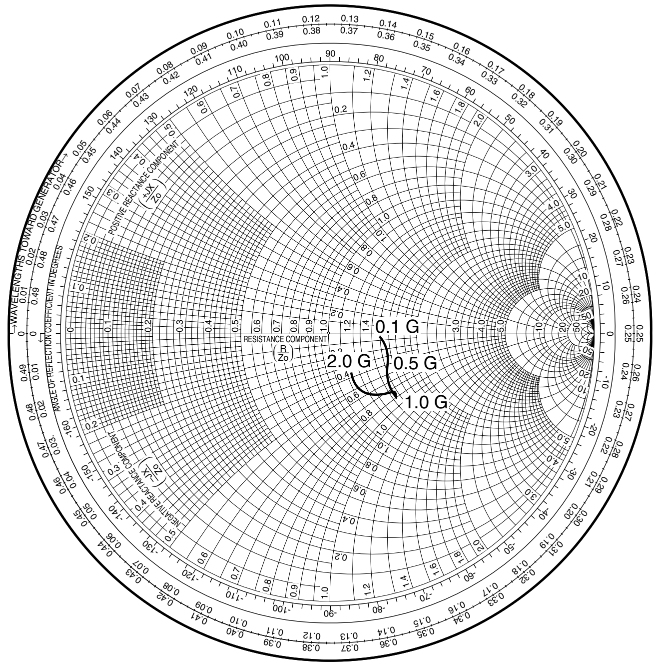


Remark The graphs indicate nominal characteristics.

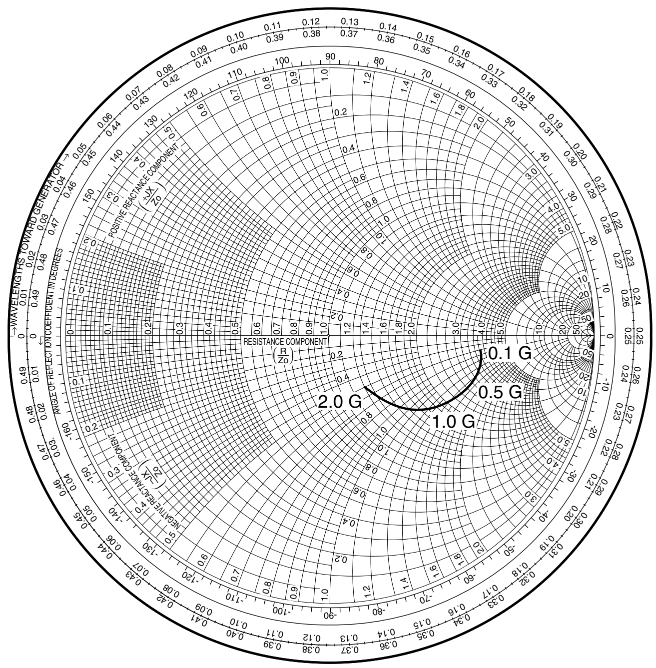
S-PARAMETERS (T_A = +25°C, V_{CC} = 3.0 V)

— μPC2745TB —

S_{11}-FREQUENCY



S_{22}-FREQUENCY



TYPICAL S-PARAMETER VALUES (T_A = +25°C)

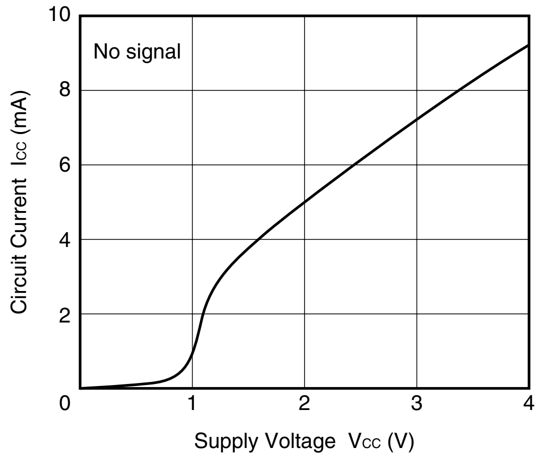
μPC2745TB
V_{CC} = 3.0 V, I_{CC} = 8.4 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K
MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	
100.0000	0.318	–3.9	4.055	–17.2	0.003	62.9	0.593	–6.6	20.94
200.0000	0.325	–5.9	4.030	–35.5	0.006	54.2	0.584	–12.1	11.68
300.0000	0.346	–7.2	3.985	–52.5	0.009	42.0	0.579	–16.5	8.29
400.0000	0.341	–8.9	3.916	–70.7	0.012	29.4	0.562	–20.6	6.26
500.0000	0.339	–10.8	3.842	–87.3	0.013	11.8	0.546	–23.0	6.29
600.0000	0.326	–13.9	3.775	–104.7	0.015	1.6	0.527	–26.2	5.50
700.0000	0.311	–20.8	3.668	–121.5	0.017	–11.9	0.515	–29.9	5.46
800.0000	0.312	–25.8	3.594	–138.1	0.018	–24.2	0.511	–32.4	5.36
900.0000	0.325	–31.9	3.525	–154.2	0.020	–38.4	0.512	–34.8	4.91
1000.0000	0.356	–32.8	3.497	–170.3	0.019	–45.9	0.523	–35.8	4.93
1100.0000	0.382	–32.7	3.503	173.7	0.020	–54.3	0.525	–36.3	4.56
1200.0000	0.416	–31.2	3.542	156.7	0.022	–70.5	0.530	–36.8	4.14
1300.0000	0.416	–30.9	3.569	139.1	0.023	–78.4	0.518	–37.5	3.92
1400.0000	0.415	–30.8	3.520	121.4	0.025	–88.4	0.509	–38.8	3.53
1500.0000	0.393	–30.3	3.501	103.7	0.025	–102.9	0.492	–40.5	3.68
1600.0000	0.386	–31.3	3.429	86.8	0.025	–114.1	0.481	–42.5	3.78
1700.0000	0.373	–30.5	3.355	69.7	0.026	–125.7	0.474	–43.8	3.68
1800.0000	0.369	–31.6	3.303	52.7	0.028	–130.3	0.468	–44.8	3.50
1900.0000	0.366	–29.6	3.229	35.8	0.028	–142.5	0.457	–44.8	3.63
2000.0000	0.353	–30.0	3.179	18.8	0.030	–152.4	0.440	–45.0	3.62
2100.0000	0.344	–28.6	3.081	1.5	0.031	–164.9	0.416	–45.0	3.85
2200.0000	0.313	–29.5	2.999	–15.4	0.031	–177.1	0.389	–45.4	4.23
2300.0000	0.293	–31.6	2.911	–32.5	0.033	171.1	0.365	–46.4	4.23
2400.0000	0.267	–35.1	2.802	–49.4	0.034	160.8	0.346	–47.4	4.40
2500.0000	0.262	–39.9	2.695	–66.0	0.036	148.3	0.331	–48.2	4.45
2600.0000	0.253	–40.3	2.598	–82.3	0.036	134.8	0.321	–48.3	4.54
2700.0000	0.253	–40.9	2.496	–98.6	0.034	121.4	0.311	–47.6	5.08
2800.0000	0.248	–35.5	2.400	–114.6	0.036	106.5	0.299	–46.7	5.01
2900.0000	0.237	–30.2	2.306	–130.2	0.032	92.8	0.279	–46.3	5.88
3000.0000	0.230	–20.6	2.209	–146.4	0.031	83.6	0.254	–46.2	6.49

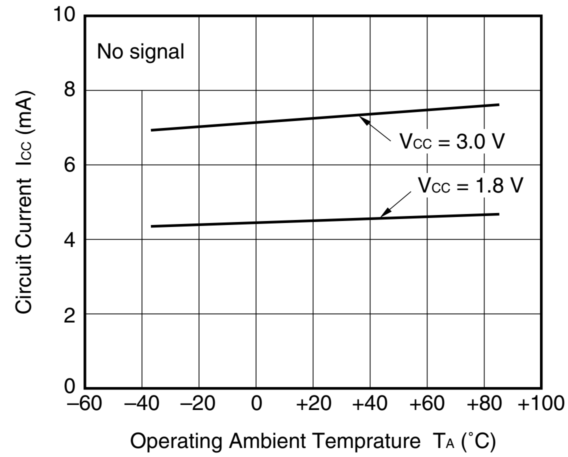
TYPICAL CHARACTERISTICS (Unless otherwise specified, T_A = +25°C)

— μPC2746TB —

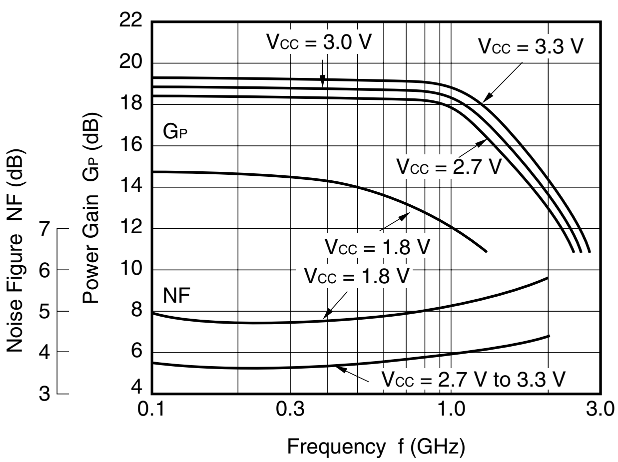
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



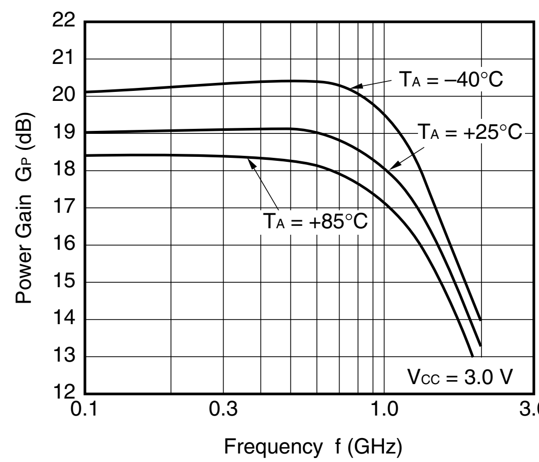
CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



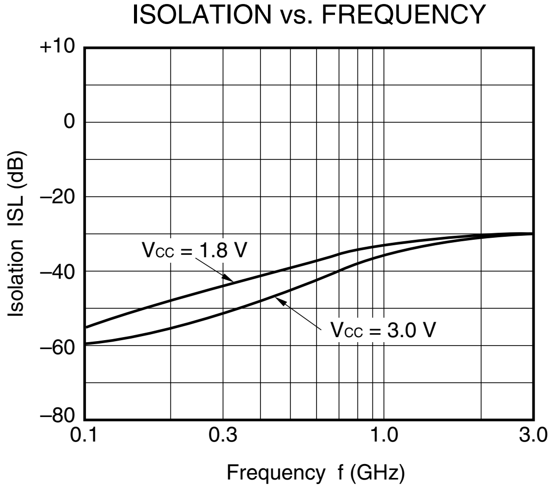
NOISE FIGURE, POWER GAIN vs. FREQUENCY



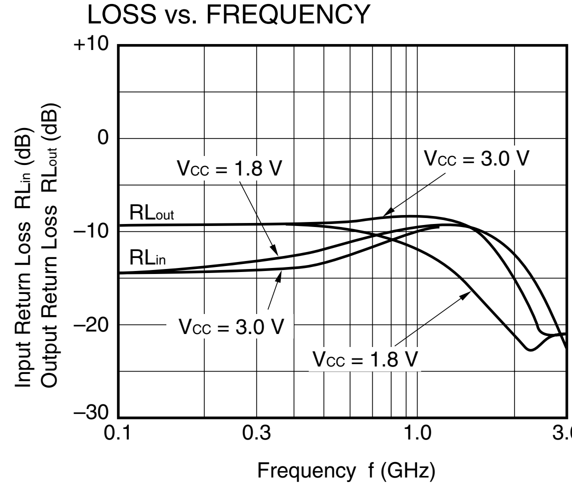
POWER GAIN vs. FREQUENCY



ISOLATION vs. FREQUENCY

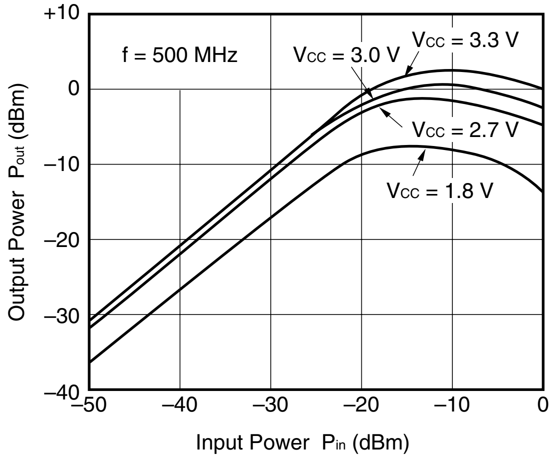


INPUT RETURN LOSS, OUTPUT RETURN LOSS vs. FREQUENCY

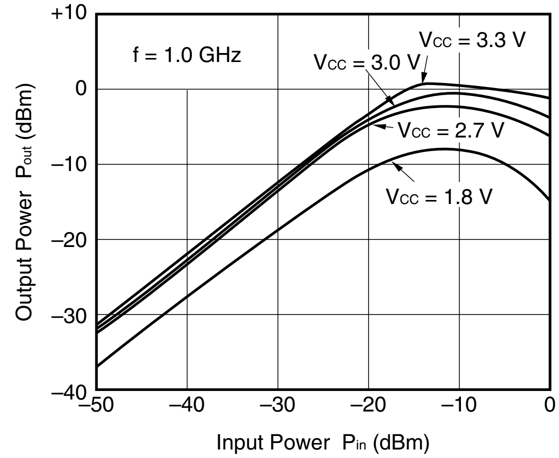


— μPC2746TB —

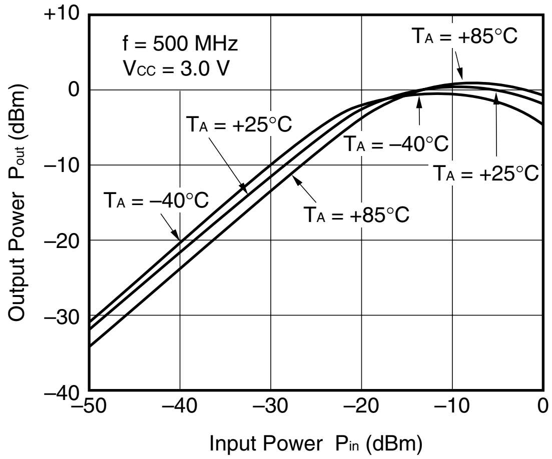
OUTPUT POWER vs. INPUT POWER



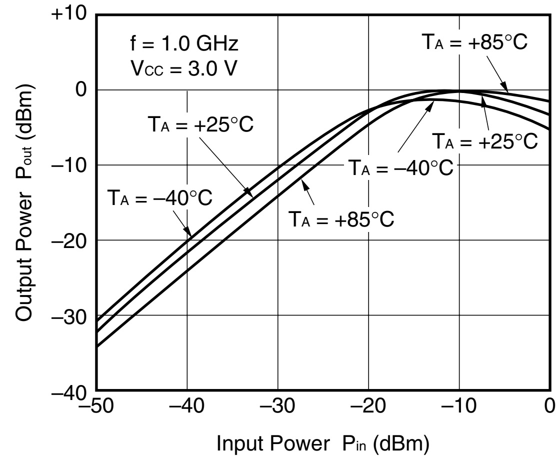
OUTPUT POWER vs. INPUT POWER



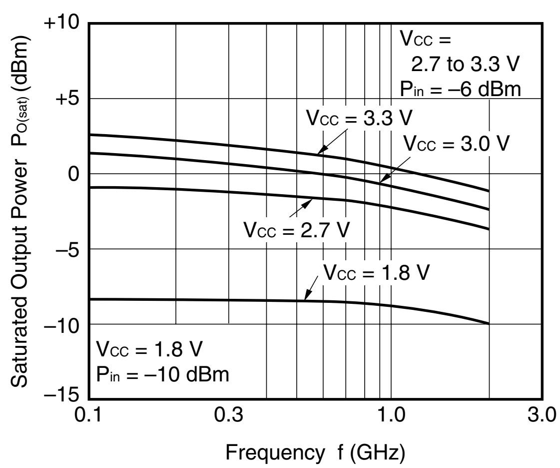
OUTPUT POWER vs. INPUT POWER



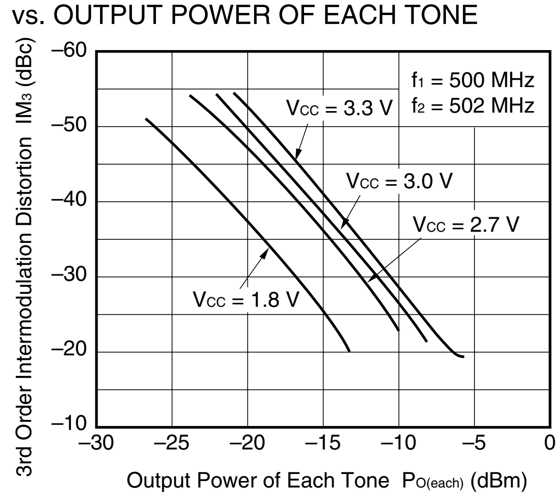
OUTPUT POWER vs. INPUT POWER



SATURATED OUTPUT POWER vs. FREQUENCY



3RD ORDER INTERMODULATION DISTORTION vs. OUTPUT POWER OF EACH TONE

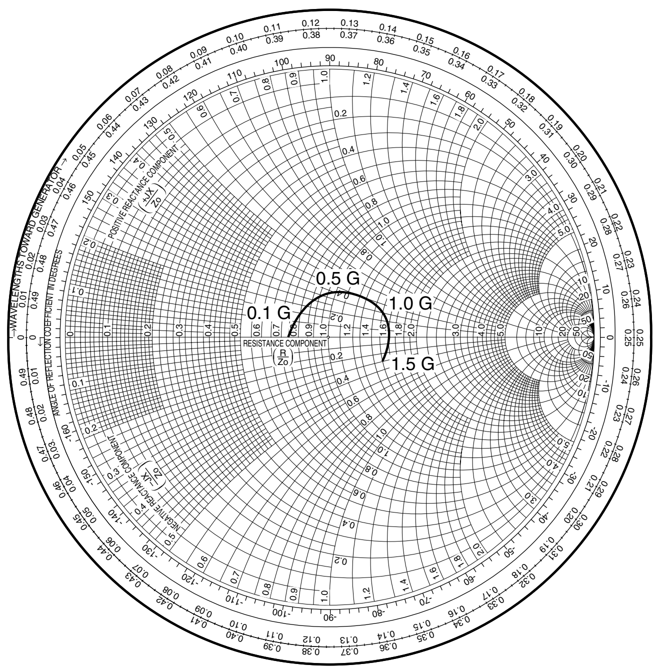


Remark The graphs indicate nominal characteristics.

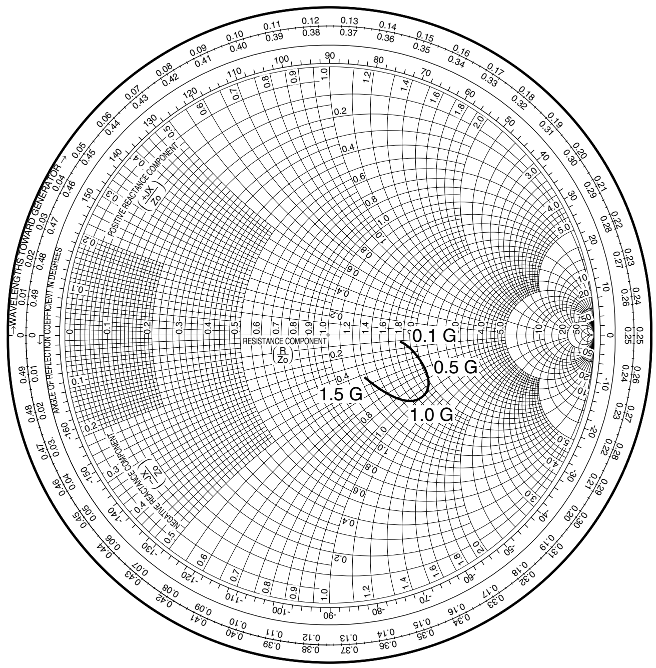
S-PARAMETERS (TA = +25°C, VCC = 3.0 V)

— μPC2746TB —

S11-FREQUENCY



S22-FREQUENCY



TYPICAL S-PARAMETER VALUES (T_A = +25°C)

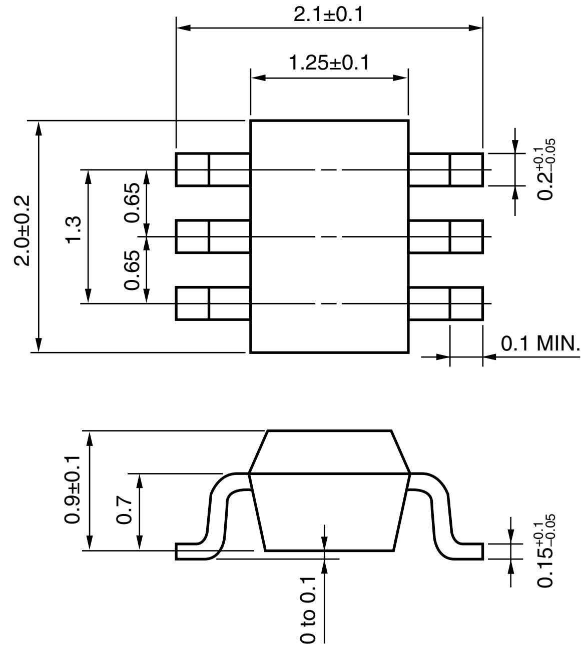
μPC2746TB

V_{CC} = 3.0 V, I_{CC} = 7.7 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K
MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	
100.0000	0.146	165.0	6.443	–19.4	0.001	77.0	0.403	–5.3	108.63
200.0000	0.130	141.7	6.594	–38.7	0.003	51.8	0.406	–8.6	20.56
300.0000	0.117	117.9	6.623	–58.1	0.004	47.7	0.418	–11.0	16.33
400.0000	0.128	100.8	6.522	–77.5	0.005	51.1	0.417	–14.0	12.34
500.0000	0.139	90.8	6.613	–96.9	0.008	33.1	0.424	–16.2	8.14
600.0000	0.145	83.1	6.481	–116.1	0.009	21.7	0.422	–19.4	7.22
700.0000	0.135	77.0	6.424	–135.1	0.010	14.7	0.426	–23.8	6.52
800.0000	0.131	67.4	6.353	–153.6	0.011	–0.4	0.433	–27.7	5.63
900.0000	0.119	49.3	6.234	–172.1	0.014	–10.5	0.442	–32.1	4.80
1000.0000	0.142	30.4	6.137	169.6	0.015	–24.2	0.455	–34.7	4.44
1100.0000	0.170	18.0	5.992	151.1	0.016	–28.7	0.455	–37.5	4.02
1200.0000	0.219	10.6	5.972	133.3	0.019	–48.0	0.453	–39.7	3.49
1300.0000	0.245	7.4	5.867	115.1	0.019	–63.4	0.433	–42.7	3.40
1400.0000	0.268	3.1	5.679	97.0	0.022	–72.2	0.409	–45.5	3.16
1500.0000	0.270	1.5	5.582	79.1	0.021	–86.9	0.375	–48.3	3.38
1600.0000	0.268	–3.9	5.380	61.8	0.022	–99.6	0.349	–49.9	3.36
1700.0000	0.258	–7.8	5.122	44.5	0.024	–110.7	0.318	–50.0	3.42
1800.0000	0.251	–14.3	4.880	27.9	0.024	–122.9	0.294	–49.2	3.67
1900.0000	0.249	–16.7	4.634	11.7	0.025	–135.3	0.268	–45.4	3.73
2000.0000	0.240	–20.5	4.475	–4.4	0.026	–146.0	0.248	–40.5	3.91

★ **PACKAGE DIMENSIONS**

6-PIN SUPER MINIMOLD (UNIT: mm)



NOTES ON CORRECT USE

(1) Observe precautions for handling because of electro-static sensitive devices.
(2) Form a ground pattern as widely as possible to minimize ground impedance (to prevent undesired oscillation). All the ground pins must be connected together with wide ground pattern to decrease impedance difference.
(3) The bypass capacitor should be attached to the V_{CC} pin.
(4) The DC cut capacitor must be attached to input pin and output pin.

RECOMMENDED SOLDERING CONDITIONS

This product should be soldered 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) Count: 3, Exposure limit: None[Note]	IR35-00-3
VPS	Package peak temperature: 215°C or below Time: 40 seconds or less (at 200°C) Count: 3, Exposure limit: None[Note]	VP15-00-3
Wave Soldering	Soldering bath temperature: 260°C or below Time: 10 seconds or less Count: 1, Exposure limit: None[Note]	WS60-00-1
Partial Heating	Pin temperature: 300°C or below Time: 3 seconds or less (per side of device) Exposure limit: None[Note]	–

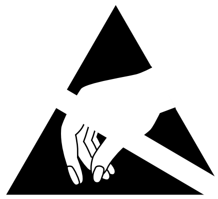
Note After opening the dry pack, keep it in a place below 25°C and 65% RH for the allowable storage period.

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

For details of recommended soldering conditions for surface mounting, refer to information document **SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E)**.

[MEMO]

[MEMO]



ATTENTION
OBSERVE PRECAUTIONS
FOR HANDLING
ELECTROSTATIC
SENSITIVE
DEVICES

NESAT (NEC Silicon Advanced Technology) is a trademark of NEC Corporation.