BIPOLAR ANALOG INTEGRATED CIRCUIT

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 our 20 GHz f_T NESATIII 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)

APPLICATIONS

- 1.5 GHz to 2.5 GHz communication system : μPC2745TB
- 800 MHz to 900 MHz communication system : μPC2746TB

ORDERING INFORMATION

Part Number	Package	Marking	Supplying Form
μPC2745TB-E3-A	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-A		C1R	

Remark To order evaluation samples, contact your nearby sales office.
Part number for sample order: μPC2745TB-A, μPC2746TB-A

Caution Observe precautions when handling because these devices are sensitive to electrostatic discharge.

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

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Date Published November 2003 CP(K)

The mark ★ shows major revised points.

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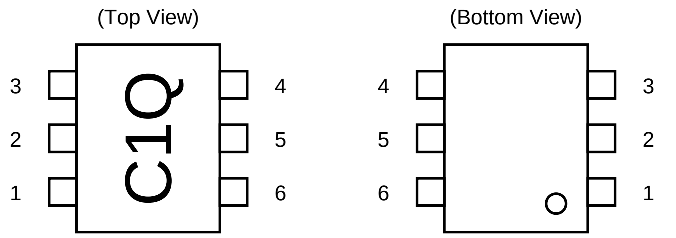
PIN CONNECTION



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)

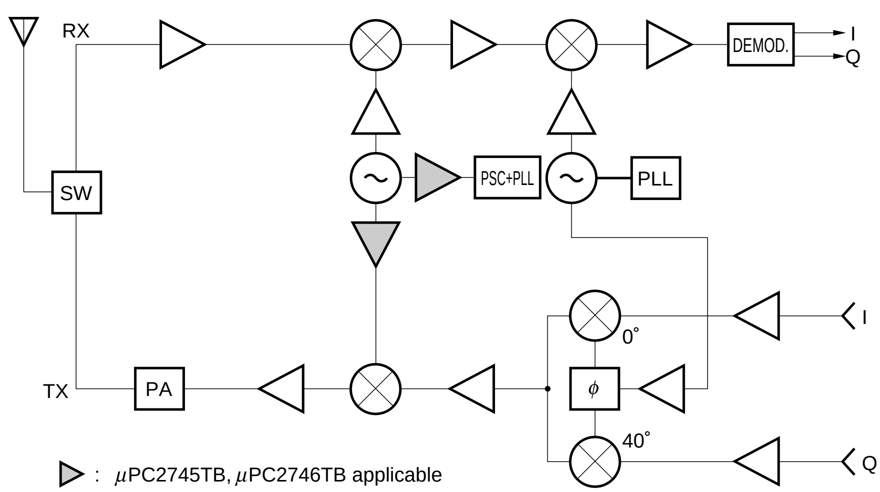
Part No.	f_u (GHz)	$P_{O(sat)}$ (dBm)	G_P (dB)	NF (dB)	I_{CC} (mA)	Package	Making
μPC2745T	2.7	−1.0	12	6.0	7.5	6-pin minimold	C1Q
μPC2745TB						6-pin super minimold	
μPC2746T	1.5	0	19	4.0	7.5	6-pin minimold	C1R
μPC2746TB						6-pin super minimold	
μPC2747T	1.8	−7.0	12	3.3	5.0	6-pin minimold	C1S
μPC2747TB						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.

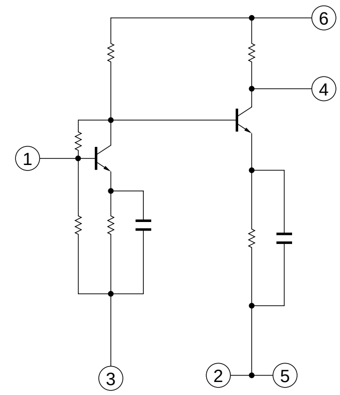
Caution The package size distinguish between minimold and super minimold.

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	T_A = +85°C **Note**	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

Note Mounted on double-sided copper-clad 50 × 50 × 1.6 mm epoxy glass PWB

RECOMMENDED OPERATING RANGE

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

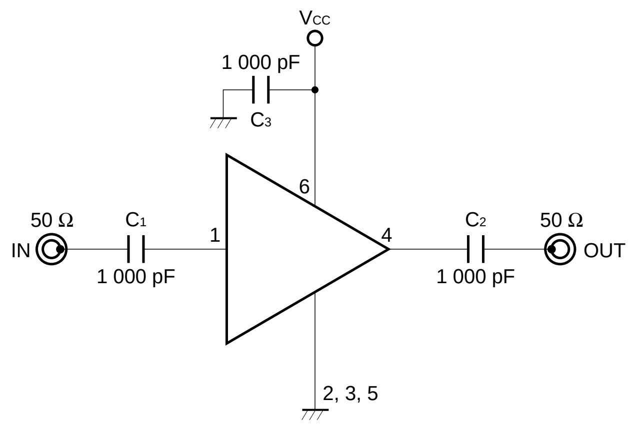
ELECTRICAL CHARACTERISTICS
(T_A = +25°C, V_{CC} = 3.0 V, $Z_S = Z_L$ = 50 Ω, unless otherwise specified)

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

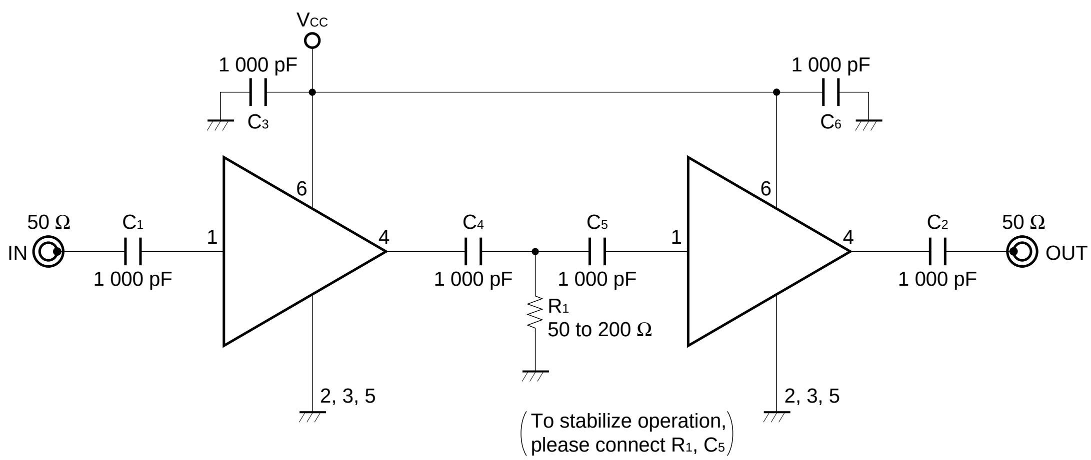
STANDARD CHARACTERISTICS FOR REFERENCE (T_A = +25°C, V_{CC} = 3.0 V, Z_S = Z_L = 50 Ω)

Parameter	Symbol	Test Conditions	Reference Value		Unit
			μPC2745TB	μPC2746TB	
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} = –10 dBm, f_1 = 500 MHz, f_2 = 502 MHz V_{CC} = 1.8 V, P_{out} = –20 dBm, f_1 = 500 MHz, f_2 = 502 MHz V_{CC} = 3.0 V, P_{out} = –10 dBm, f_1 = 1 000 MHz, f_2 = 1 002 MHz	–30.0 –31.0 –26.0	–26.0 –37.0 —	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.

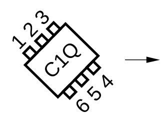
The bypass capacitor connected to the V_{CC} pin is used to minimize ground impedance of V_{CC} pin. So, stable bias can be supplied against V_{CC} fluctuation.

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.

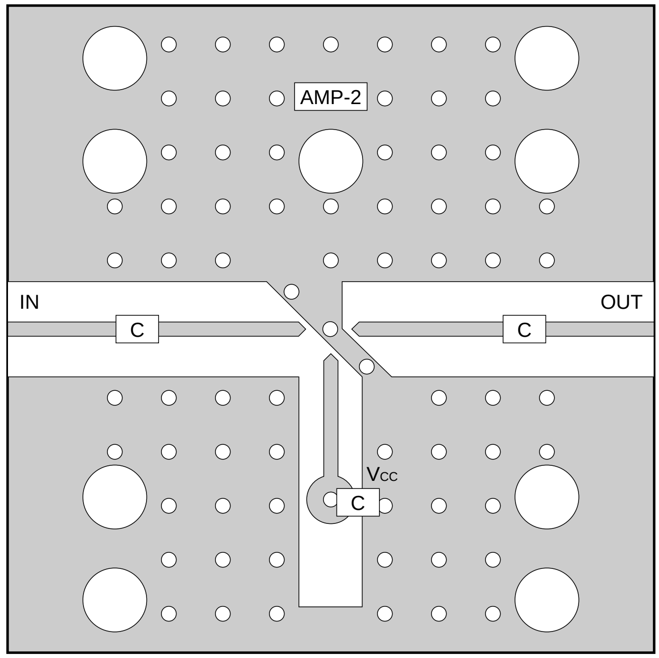
To obtain a flat gain from 100 MHz upwards, 1 000 pF capacitors are used in the test circuit. In the case of under 10 MHz operation, increase the value of coupling capacitor such as 10 000 pF. Because the coupling capacitors are determined by equation, $fc = 1/(2\pi RC)$.

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD

Top View



Mounting direction
(Marking is an example for μ PC2745TB)



COMPONENT LIST

	Value
C	1 000 pF

Notes

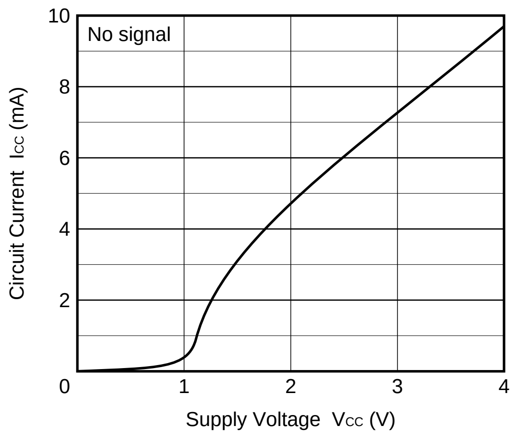
1. 30 × 30 × 0.4 mm double sided copper clad polyimide board.
2. Back side: GND pattern
3. Solder plated on pattern
4. ⊕⊕⊕: Through holes

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).**

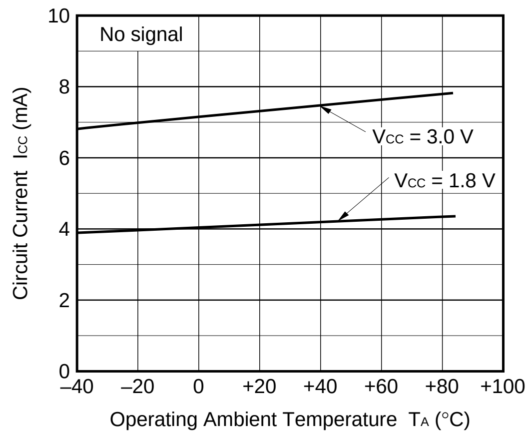
TYPICAL CHARACTERISTICS (T_A = +25°C, unless otherwise specified)

— μPC2745TB —

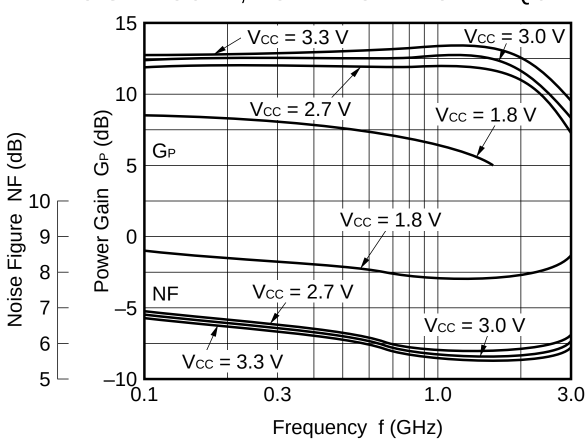
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



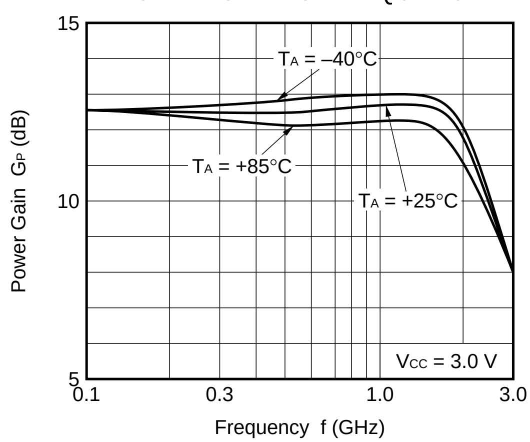
CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



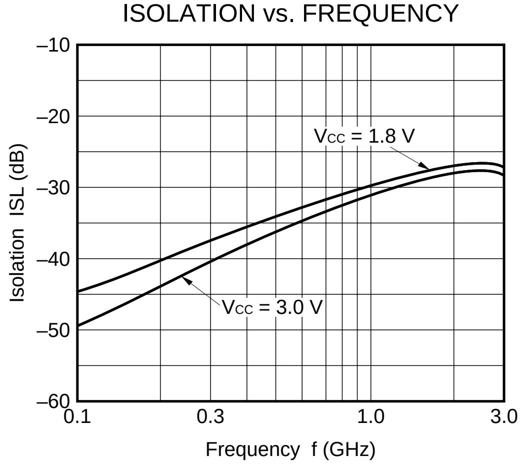
NOISE FIGURE, POWER GAIN vs. FREQUENCY



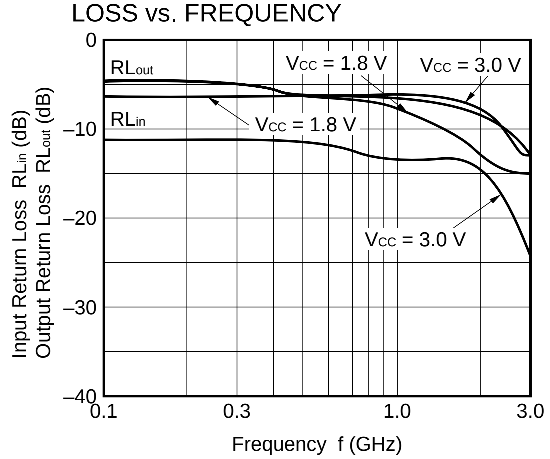
POWER GAIN vs. FREQUENCY



ISOLATION vs. FREQUENCY



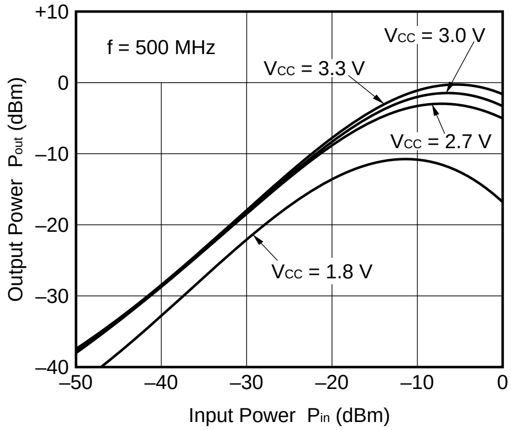
INPUT RETURN LOSS, OUTPUT RETURN LOSS vs. FREQUENCY



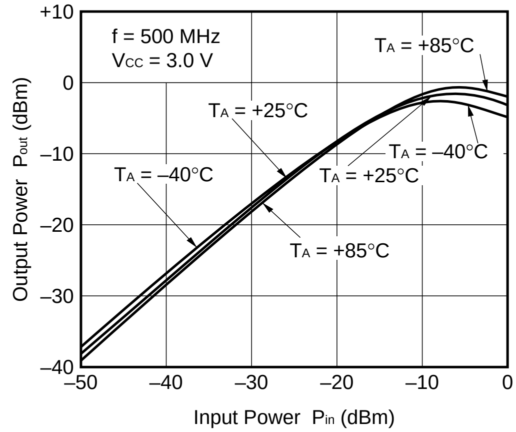
Remark The graphs indicate nominal characteristics.

— μPC2745TB —

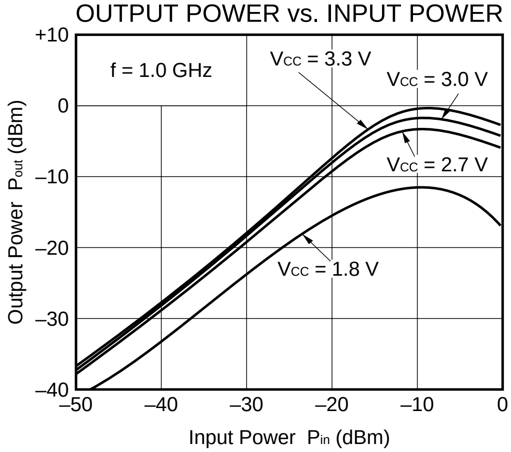
OUTPUT POWER vs. INPUT POWER



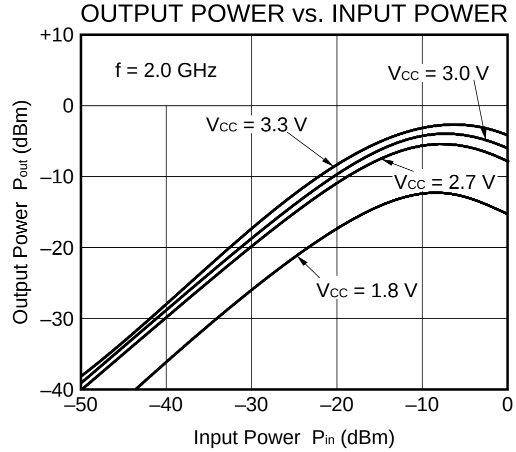
OUTPUT POWER vs. INPUT POWER



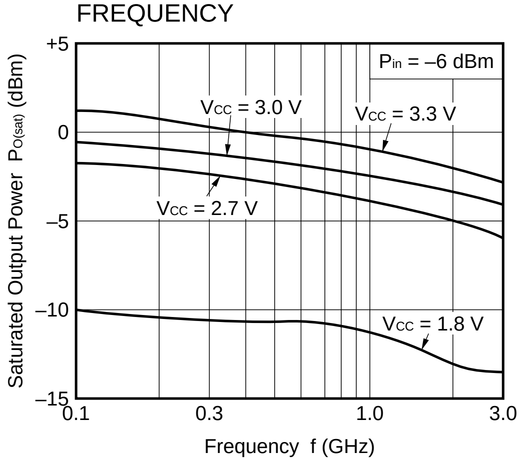
OUTPUT POWER vs. INPUT POWER



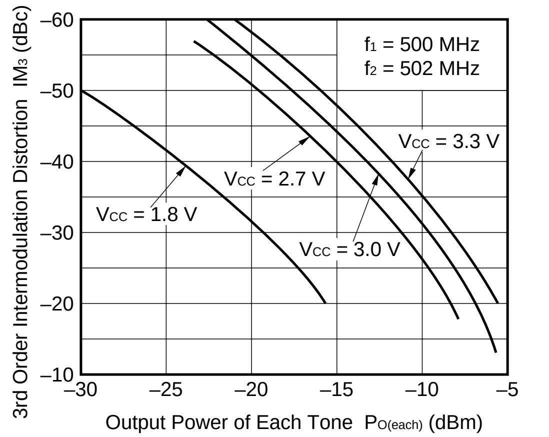
OUTPUT POWER vs. INPUT POWER



SATURATED OUTPUT POWER vs. FREQUENCY



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

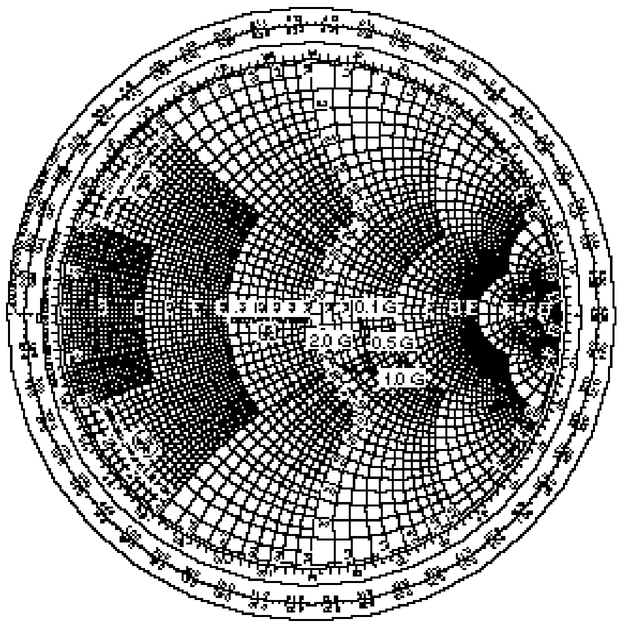


Remark The graphs indicate nominal characteristics.

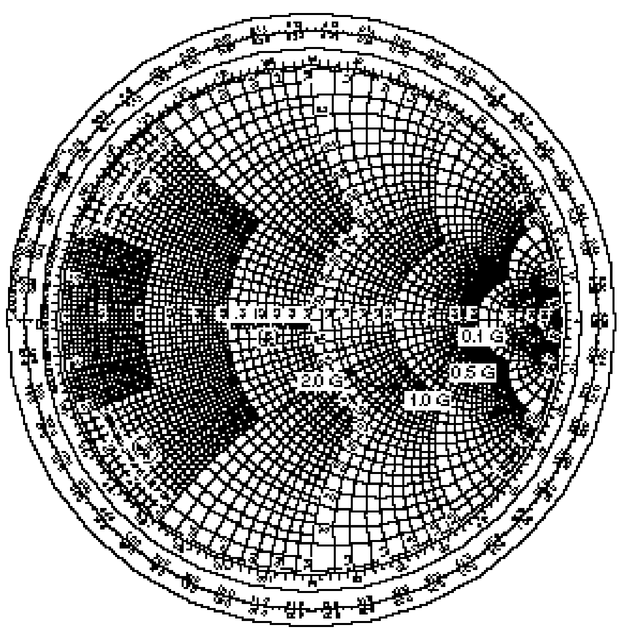
SMITH CHART (T_A = +25°C, V_{CC} = 3.0 V)

— μPC2745TB —

S_{11}-FREQUENCY



S_{22}-FREQUENCY



S-PARAMETERS

S-parameters/Noise parameters are provided on the NEC Compound Semiconductor Devices Web site in a form (S2P) that enables direct import to a microwave circuit simulator without keyboard input.

Click here to download S-parameters.

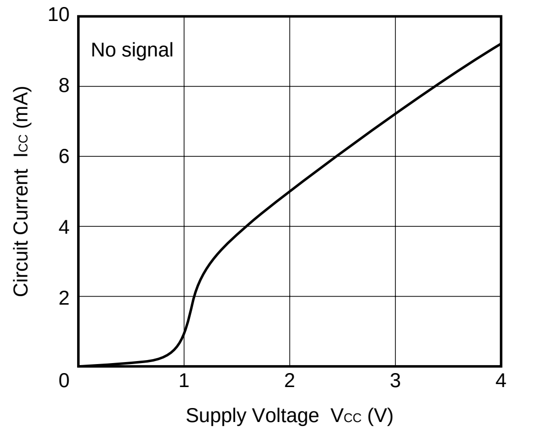
[RF and Microwave] → [Device Parameters]

URL http://www.ncsd.necel.com/

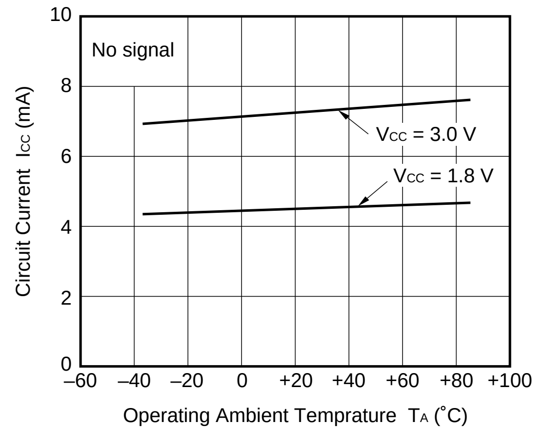
TYPICAL CHARACTERISTICS (T_A = +25°C, unless otherwise specified)

— μPC2746TB —

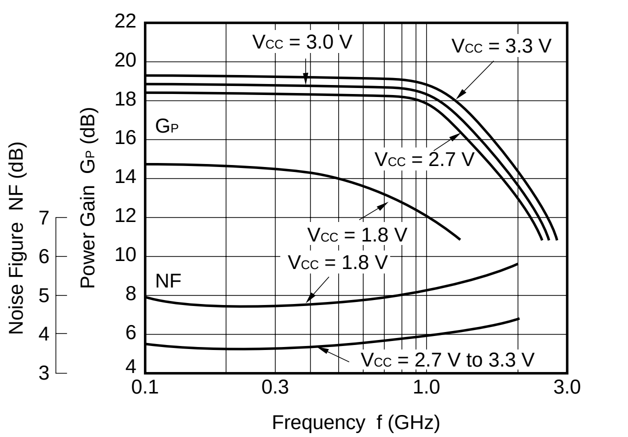
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



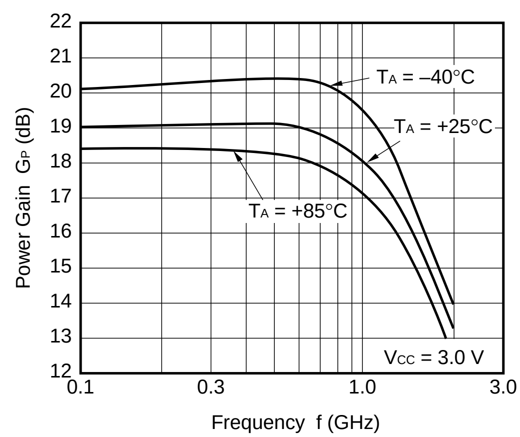
CIRCUIT CURRENT vs.
OPERATING AMBIENT TEMPERATURE



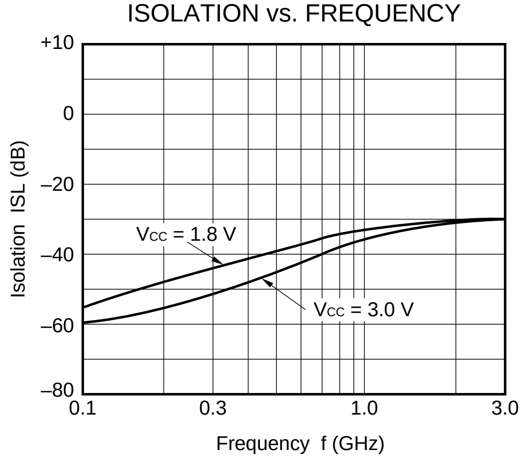
NOISE FIGURE, POWER GAIN vs. FREQUENCY



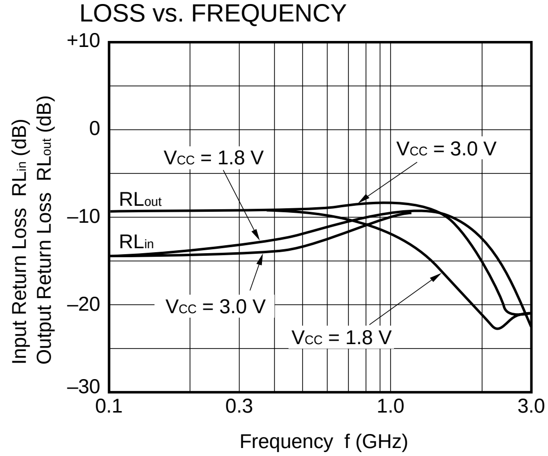
POWER GAIN vs. FREQUENCY



ISOLATION vs. FREQUENCY



INPUT RETURN LOSS, OUTPUT RETURN
LOSS vs. FREQUENCY



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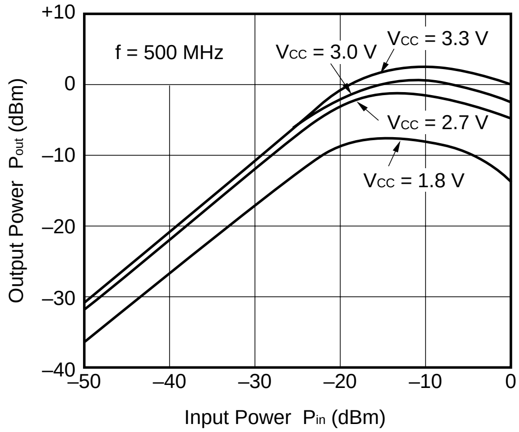
— μPC2746TB —

OUTPUT POWER vs. INPUT POWER



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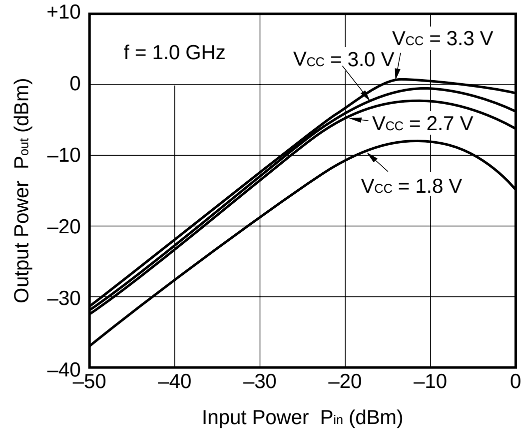

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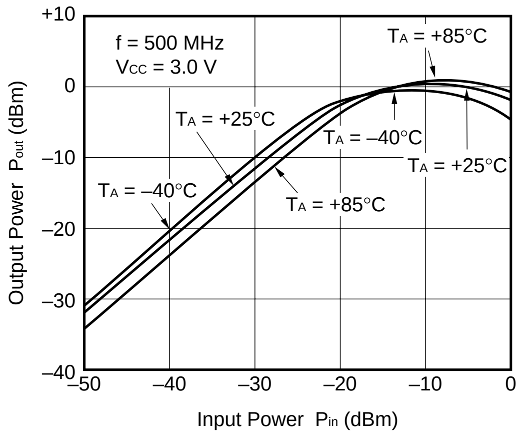

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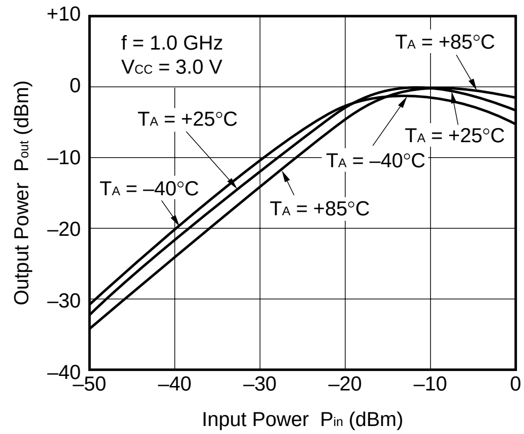
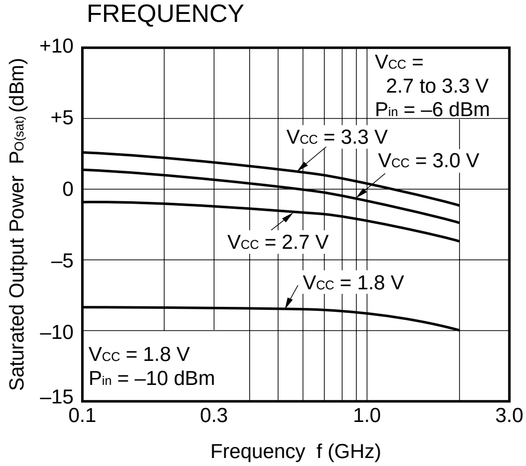
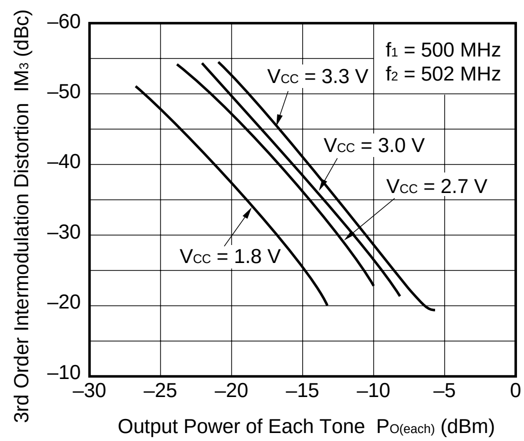


SATURATED OUTPUT POWER vs. FREQUENCY



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



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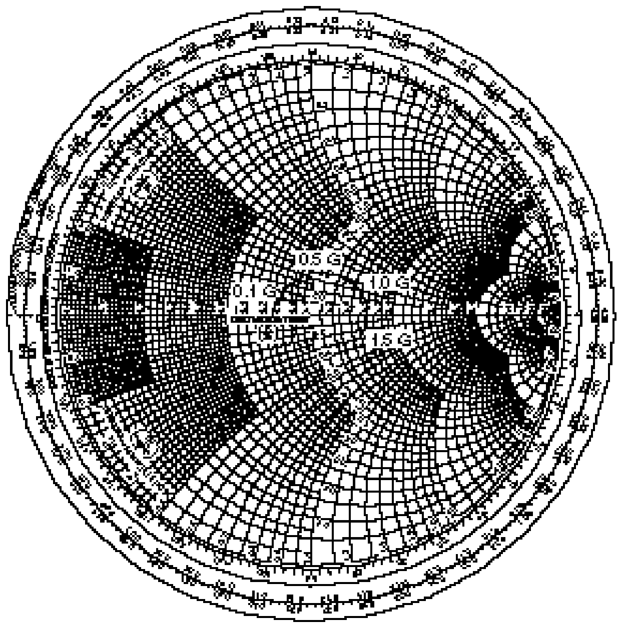
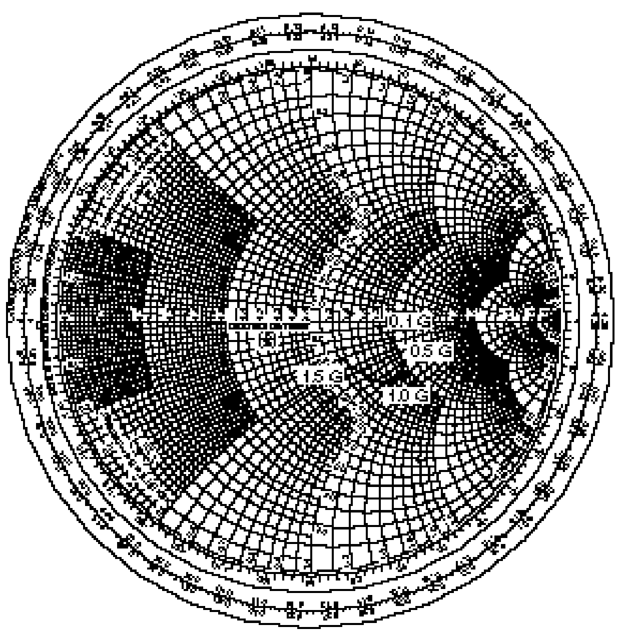
— μPC2746TB —

S_{11}-FREQUENCY



S_{22}-FREQUENCY



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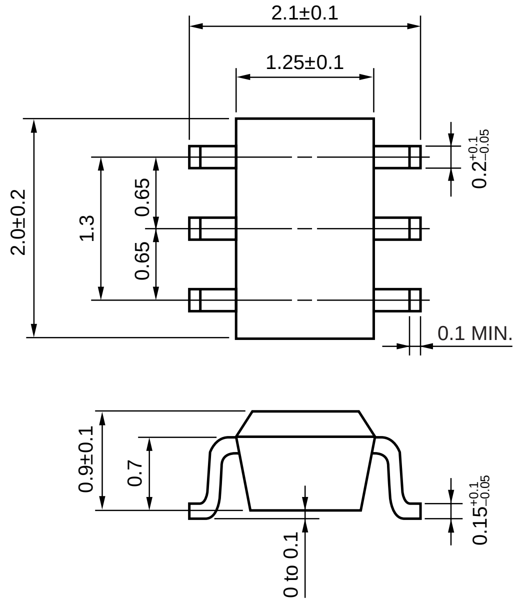
PACKAGE DIMENSIONS

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 and mounted under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your nearby sales office.

Soldering Method	Soldering Conditions		Condition Symbol
Infrared Reflow	Peak temperature (package surface temperature) Time at peak temperature Time at temperature of 220°C or higher Preheating time at 120 to 180°C Maximum number of reflow processes Maximum chlorine content of rosin flux (% mass)	: 260°C or below : 10 seconds or less : 60 seconds or less : 120±30 seconds : 3 times : 0.2%(Wt.) or below	IR260
VPS	Peak temperature (package surface temperature) Time at temperature of 200°C or higher Preheating time at 120 to 150°C Maximum number of reflow processes Maximum chlorine content of rosin flux (% mass)	: 215°C or below : 25 to 40 seconds : 30 to 60 seconds : 3 times : 0.2%(Wt.) or below	VP215
Wave Soldering	Peak temperature (molten solder temperature) Time at peak temperature Preheating temperature (package surface temperature) Maximum number of flow processes Maximum chlorine content of rosin flux (% mass)	: 260°C or below : 10 seconds or less : 120°C or below : 1 time : 0.2%(Wt.) or below	WS260
Partial Heating	Peak temperature (pin temperature) Soldering time (per side of device) Maximum chlorine content of rosin flux (% mass)	: 350°C or below : 3 seconds or less : 0.2%(Wt.) or below	HS350

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

- **The information in this document is current as of November, 2003. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC's data sheets or data books, etc., for the most up-to-date specifications of NEC semiconductor products. Not all products and/or types are available in every country. Please check with an NEC sales representative for availability and additional information.**
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Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL's understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

Restricted Substance per RoHS	Concentration Limit per RoHS (values are not yet fixed)	Concentration contained in CEL devices	
		-A	-AZ
Lead (Pb)	< 1000 PPM	Not Detected	(*)
Mercury	< 1000 PPM	Not Detected	
Cadmium	< 100 PPM	Not Detected	
Hexavalent Chromium	< 1000 PPM	Not Detected	
PBB	< 1000 PPM	Not Detected	
PBDE	< 1000 PPM	Not Detected	

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.

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