CEL

BIPOLAR ANALOG INTEGRATED CIRCUITS

μPC2747TB, μPC2748TB

3 V, SUPER MINIMOLD SILICON MMIC AMPLIFIER FOR MOBILE COMMUNICATIONS

DESCRIPTION

The μPC2747TB, μPC2748TB are silicon monolithic integrated circuits designed as amplifier for mobile communications. These ICs are packaged in super minimold package which is smaller than conventional minimold.

These ICs are manufactured using our 20 GHz f_T NESAT lll 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 ICs have excellent performance, uniformity and reliability.

FEATURES

- Supply voltage : V_{CC} = 2.7 to 3.3 V
- Noise figure : μPC2747TB ; NF = 3.3 dB TYP. @ f = 900 MHz
  μPC2748TB ; NF = 2.8 dB TYP. @ f = 900 MHz
- Power gain : μPC2747TB ; G_P = 12 dB TYP. @ f = 900 MHz
  μPC2748TB ; G_P = 19 dB TYP. @ f = 900 MHz
- Operating frequency : μPC2747TB ; DC to 1.8 GHz
  μPC2748TB ; 0.2 to 1.5 GHz
- Isolation : μPC2747TB ; ISL = 40 dB TYP. @ f = 900 MHz
  μPC2748TB ; ISL = 40 dB TYP. @ f = 900 MHz
- High-density surface mounting : 6-pin super minimold package (2.0 × 1.25 × 0.9 mm)

APPLICATION

- Buffer amplifiers for mobile telephones, etc. (PDC800M, GSM)

ORDERING INFORMATION

Part Number	Package	Marking	Supplying Form
μPC2747TB-E3	6-pin super minimold	C1S	• Embossed tape 8 mm wide • 1, 2, 3 pins face the perforation side of the tape • Qty 3 kpcs/reel
μPC2748TB-E3		C1T	

Remark To order evaluation samples, contact your nearby sales office.
Part number for sample order: μPC2747TB-A, μPC2748TB-A

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

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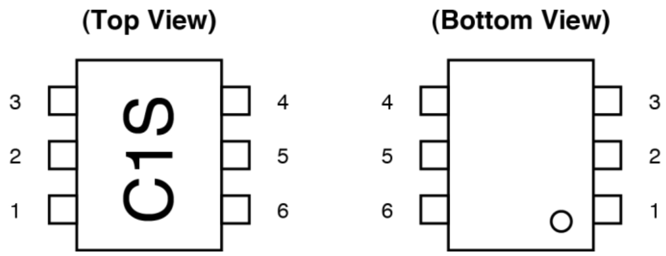
(Previous No. P13444EJ3V0DS00)
Date Published December 2002 CP(K)

The mark ★ shows major revised points.

PIN CONNECTIONS



Marking is an example of μPC2747TB

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)

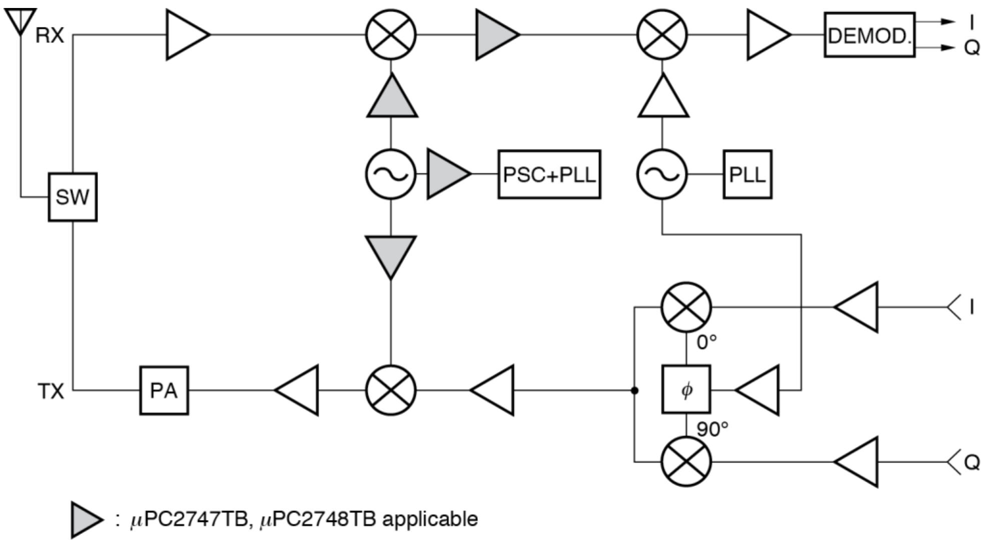
Part No.	f_u (GHz)	$P_{O\ (sat)}$ (dBm)	G_P (dB)	NF (dB)	I_{CC} (mA)	Package	Marking
μPC2745T	2.7	−1.0	12	6.0	7.5	6-pin minimold	C1Q
μPC2745TB						6-pin super minimold	
μPC2746T	1.5	0	19	4.0	7.5	6-pin minimold	C1R
μPC2746TB						6-pin super minimold	
μPC2747T	1.8	−7.0	12	3.3	5.0	6-pin minimold	C1S
μPC2747TB						6-pin super minimold	
μPC2748T	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.

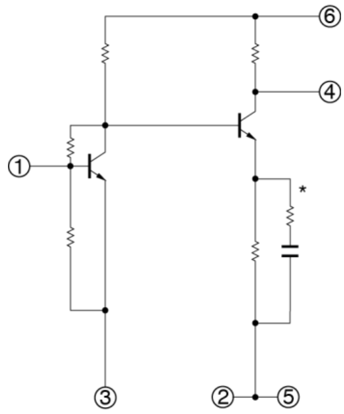
Caution The package size distinguishes between minimold and super minimold.

SYSTEM APPLICATION EXAMPLE

EXAMPLE OF DIGITAL CELLULER TELEPHONE



PIN EXPLANATION

Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (V) Note	Function and Applications	Internal Equivalent Circuit
1	INPUT	–	0.80 0.80	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	–	2.79 2.72	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.	The above diagram is for the μPC2747TB. The resistor marked with an asterisk does not exist in the μPC2748TB.
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: μPC2747TB, Below: μPC2748TB

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	15	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 RENGE

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

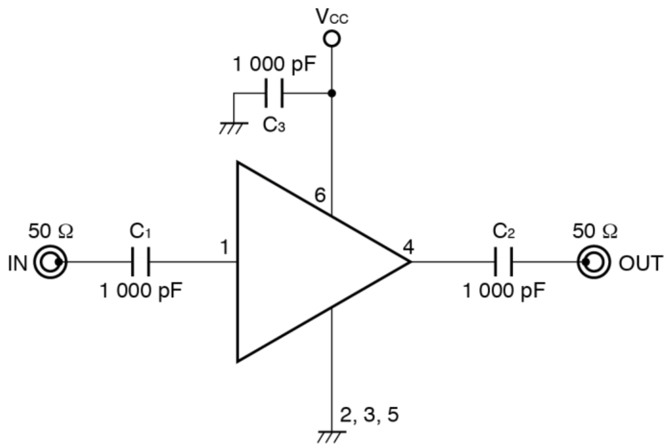
ELECTRICAL CHARACTERISTICS
(T_A = +25°C, V_{CC} = 3.0 V, Z_S = Z_L = 50 Ω, unless otherwise specified)

Parameter	Symbol	Test Conditions	μPC2747TB			μPC2748TB			Unit
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Circuit Current	I_{CC}	No Signal	3.8	5.0	7.0	4.5	6.0	8.0	mA
Power Gain	G_P	f = 900 MHz	9	12	14	16	19	21	dB
Noise Figure	NF	f = 900 MHz	–	3.3	4.5	–	2.8	4.0	dB
Upper Limit Operating Frequency	f_u	3 dB down below from gain at f = 0.9 GHz	1.5	1.8	–	1.2	1.5	–	GHz
Lower Limit Operating Frequency	f_L	3 dB down below from gain at f = 0.9 GHz	–	–	–	–	0.2	0.4	GHz
Isolation	ISL	f = 900 MHz	35	40	–	35	40	–	dB
Input Return Loss	RL_{in}	f = 900 MHz	11	14	–	8.5	11.5	–	dB
Output Return Loss	RL_{out}	f = 900 MHz	7	10	–	5.5	8.5	–	dB
Saturated Output Power	$P_{O (sat)}$	f = 900 MHz, P_{in} = –8 dBm	–9.5	–7.0	–	–6.0	–3.5	–	dBm

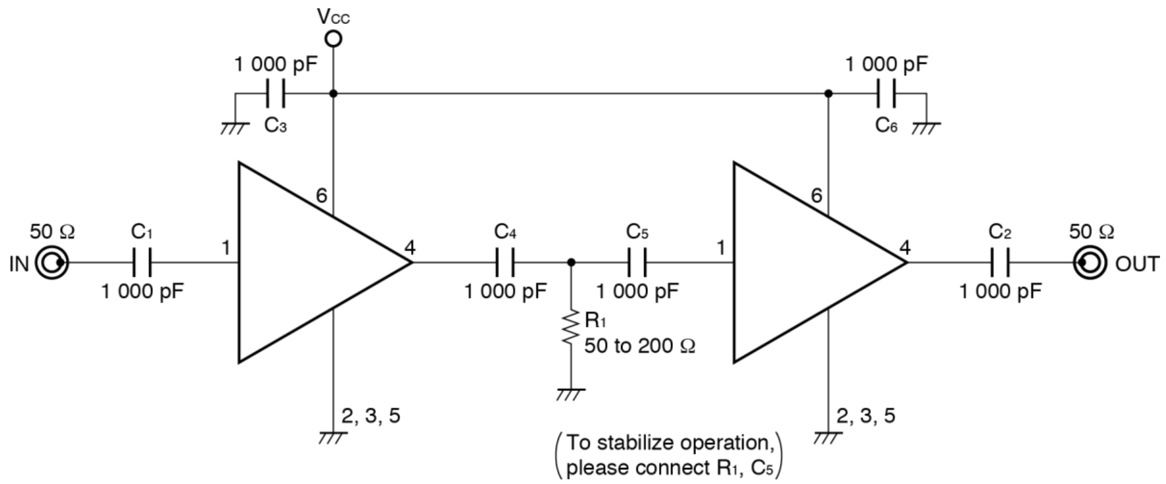
STANDARD CHARACTERISTICS FOR REFERENCE (T_A = +25°C, Z_S = Z_L =50 Ω)

Parameter	Symbol	Test Conditions	Reference		Unit
			μPC2747TB	μPC2748TB	
Circuit Current	I_{CC}	V_{CC} = 1.8 V, No signal	3.0	3.5	mA
Power Gain	G_P	V_{CC} = 1.8 V, f = 900 MHz	5.5	11.5	dB
Noise Figure	NF	V_{CC} = 1.8 V, f = 900 MHz	5.2	4.5	dB
Upper Limit Operating Frequency	f_u	V_{CC} = 1.8 V, 3 dB down below from gain at f = 0.9 GHz	1.8	1.5	GHz
Lower Limit Operating Frequency	f_L	V_{CC} = 1.8 V, 3 dB down below from gain at f = 0.9 GHz	–	0.2	GHz
Isolation	ISL	V_{CC} = 1.8 V, f = 900 MHz	34	34	dB
Input Return Loss	RL_{in}	V_{CC} = 1.8 V, f = 900 MHz	11	10	dB
Output Return Loss	RL_{out}	V_{CC} = 1.8 V, f = 900 MHz	13	12	dB
Saturated Output Power	$P_{O (sat)}$	V_{CC} = 1.8 V, f = 900 MHz, P_{in} = −8 dBm	−13.7	−10.0	dBm
3rd Order Intermodulation Distortion	IM_3	V_{CC} = 3.0 V, P_{out} = −20 dBm, f_1 = 900 MHz, f_2 = 902 MHz	−34	−38	dBc
		V_{CC} = 1.8 V, P_{out} = −20 dBm, f_1 = 900 MHz, f_2 = 902 MHz	−20	−28	

TEST CIRCUIT



EXAMPLE OF APPLICATION CIRCUIT



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

CAPACITORS FOR V_{CC}, INPUT AND OUTPUT PINS

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

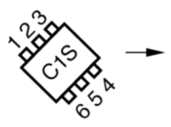
Bypass capacitor for V_{CC} pin is intended to minimize V_{CC} pin's ground impedance. Therefore, stable bias can be supplied against V_{CC} fluctuation.

Coupling capacitors for input/output pins are intended to minimize RF serial impedance and cut DC.

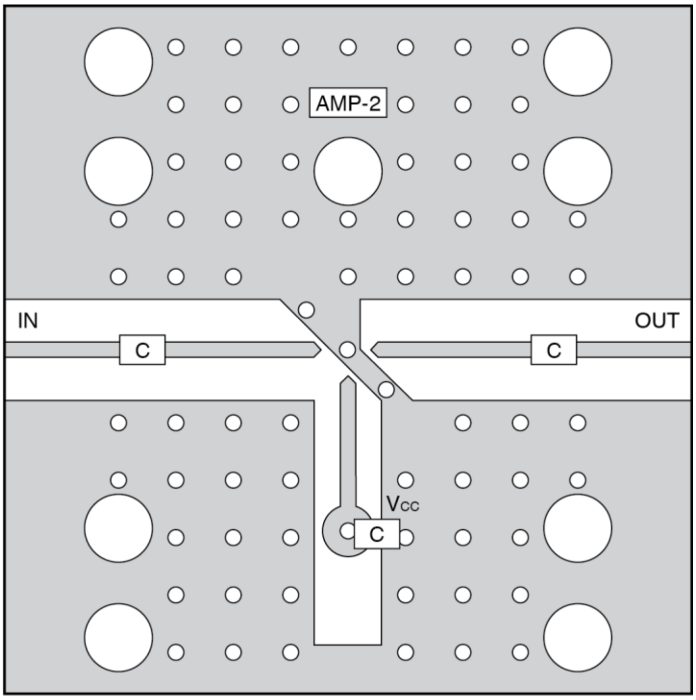
To get flat gain from 100 MHz up, 1 000 pF capacitors are assembled on the test circuit. [Actually, 1 000 pF capacitors give flat gain at least 10 MHz. In the case of under 10 MHz operation, increase the value of coupling capacitor such as 2 200 pF. Because the coupling capacitors are determined by the equation of $f_C = 1/(2\pi RC)$.]

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD

(Top View)



Mounting Direction
(Marking is an example for μPC2747TB)



COMPONENT LIST

	Value
C	1 000 pF

Notes

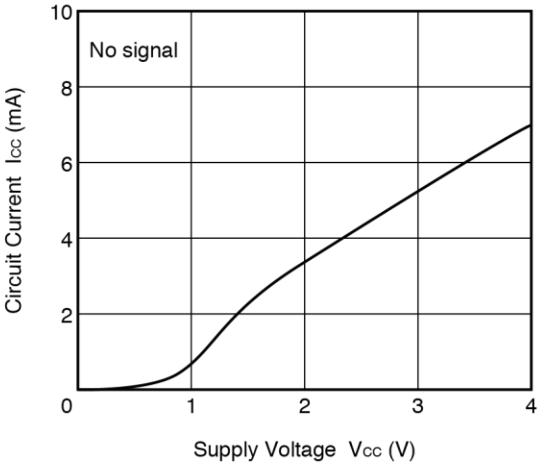
1. 30 × 30 × 0.4 mm double-sided copper-clad polyimide board.
2. Back side: GND pattern
3. Solder plated on pattern
4. ○ ◯ : Through holes

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)**.

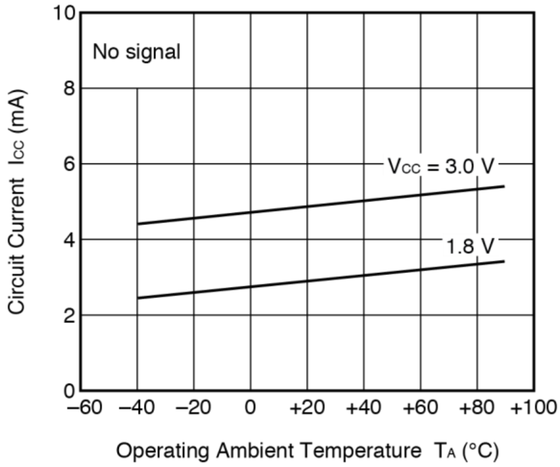
TYPICAL CHARACTERISTICS (T_A = +25°C, unless otherwise specified)

– μPC2747TB –

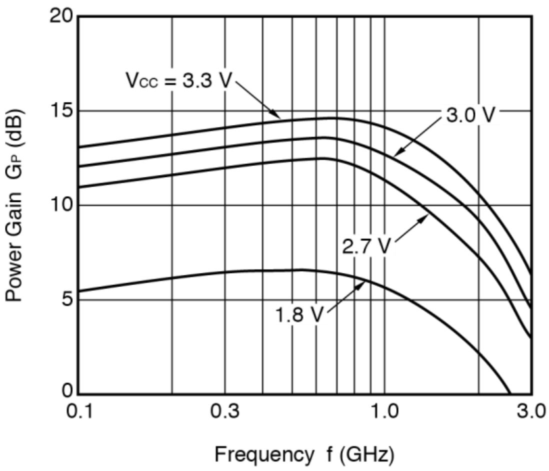
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



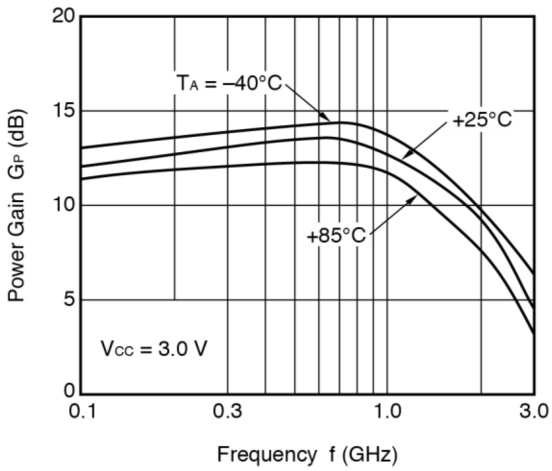
CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



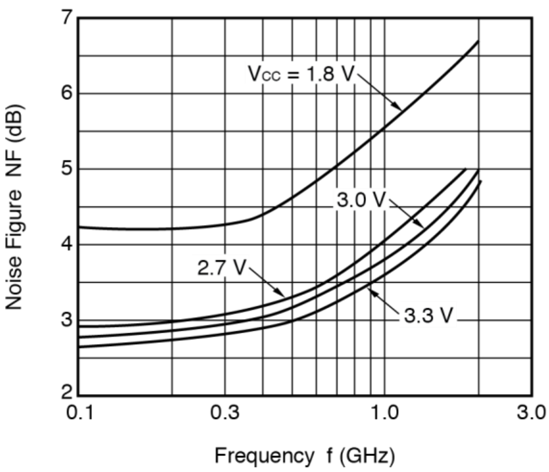
POWER GAIN vs. FREQUENCY



POWER GAIN vs. FREQUENCY

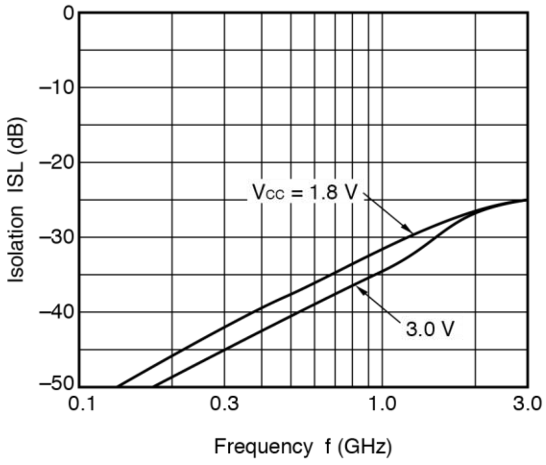


NOISE FIGURE vs. FREQUENCY

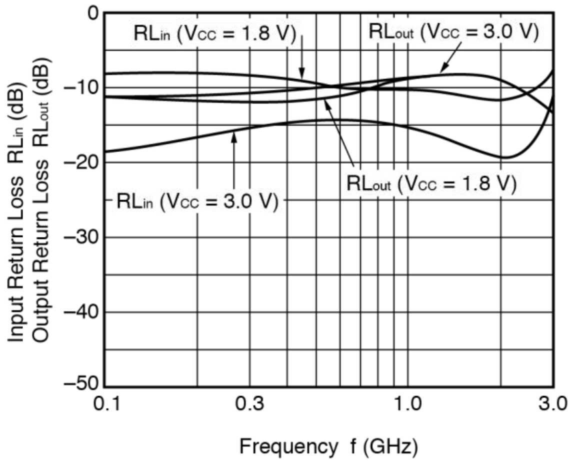


– μ**PC2747TB** –

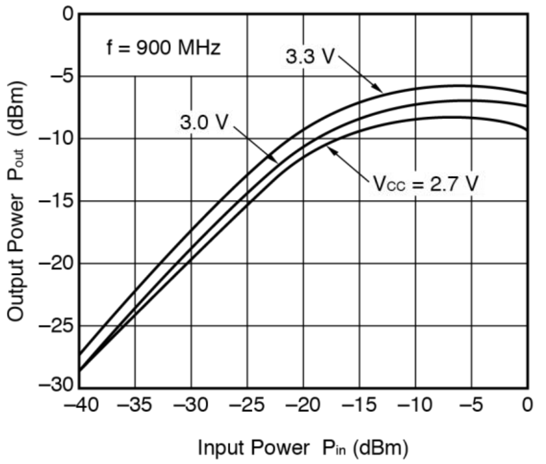
ISOLATION vs. FREQUENCY



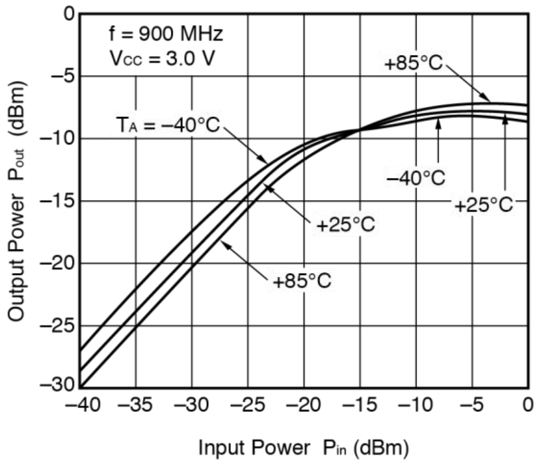
INPUT RETURN LOSS, OUTPUT RETURN LOSS vs. FREQUENCY



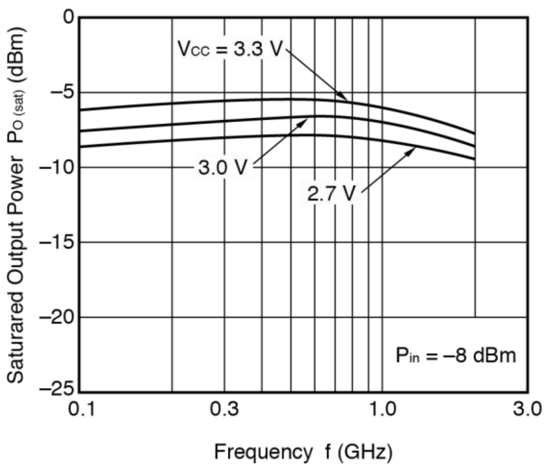
OUTPUT POWER vs. INPUT POWER



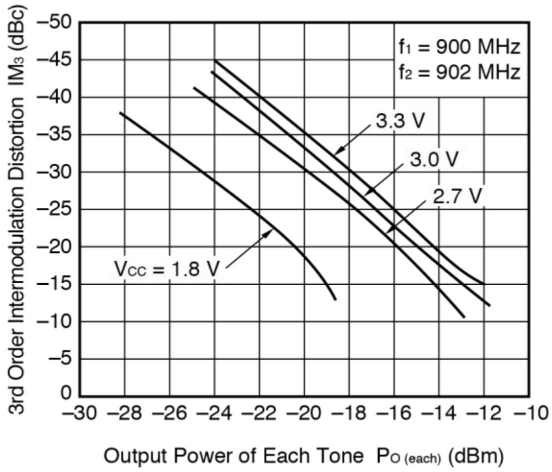
OUTPUT POWER vs. INPUT POWER



SATURATED OUTPUT POWER vs. FREQUENCY



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

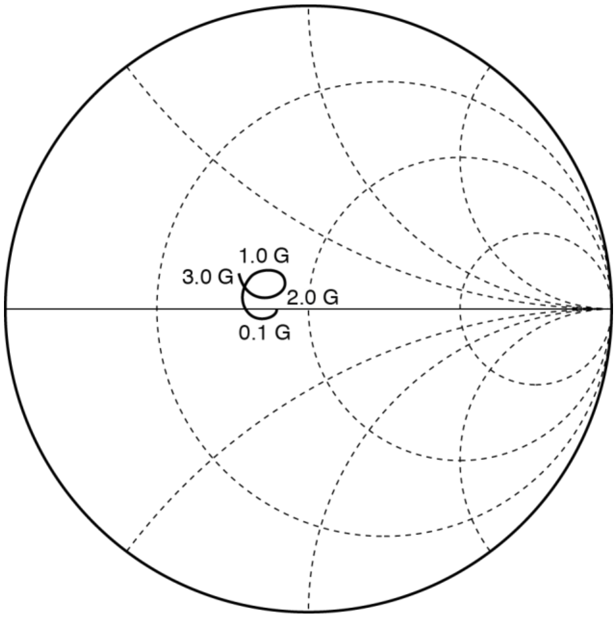


Remark The graphs indicate nominal characteristics.

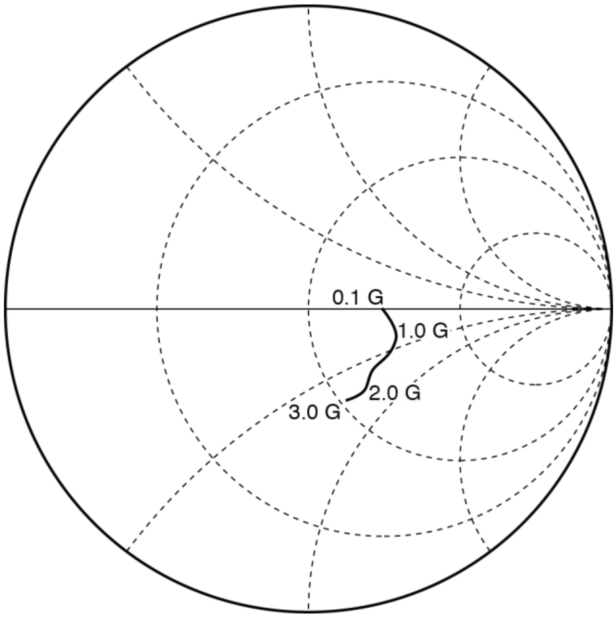
SMITH CHART (T_A = +25°C, V_{CC} = 3.0 V)

– μPC2747TB –

S_{11}-FREQUENCY



S_{22}-FREQUENCY



S-PARAMETERS

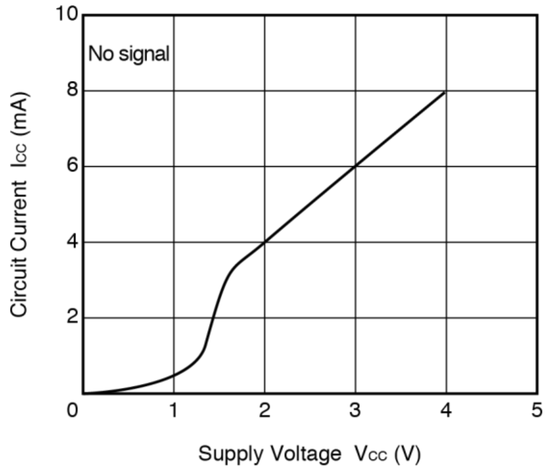
– μPC2747TB –

- S-parameters and noise parameters are provided on our Web site in a format (S2P) that enables the direct import of the parameters to microwave circuit simulators without the need for keyboard inputs.
- Click here to download S-parameters.
- [RF and Microwave] ® [Device Parameters]
- URL http://www.necel.com/microwave/en/

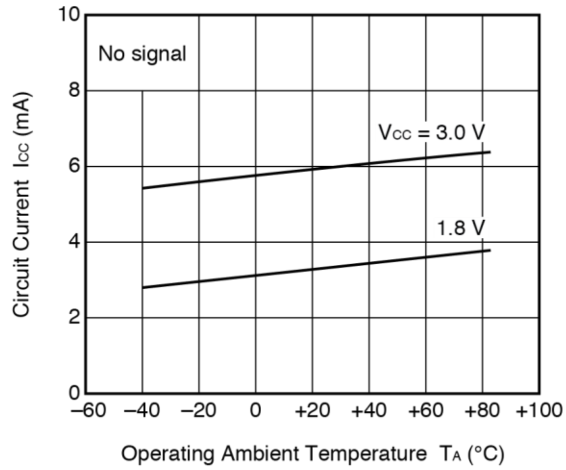
TYPICAL CHARACTERISTICS (T_A = +25°C, unless otherwise specified)

– μPC2748TB –

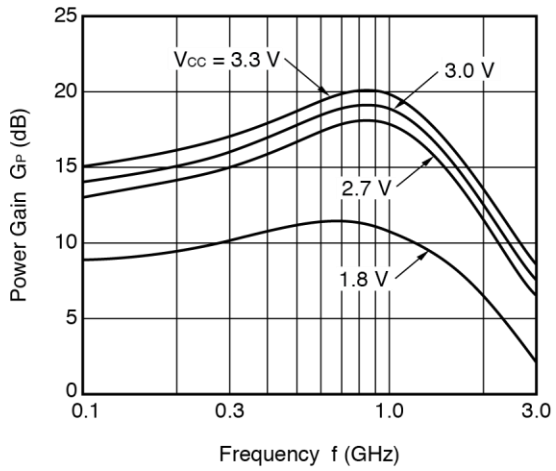
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



POWER GAIN vs. FREQUENCY



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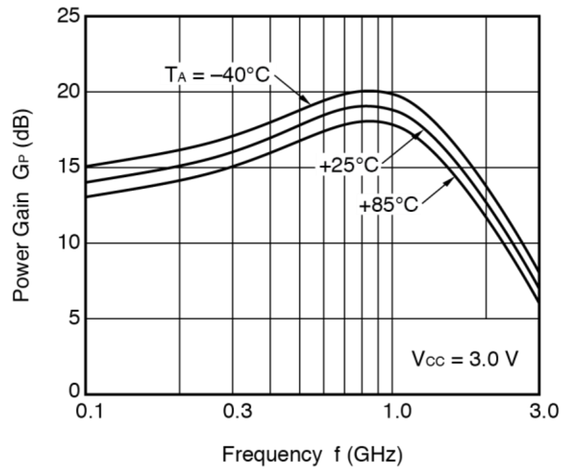
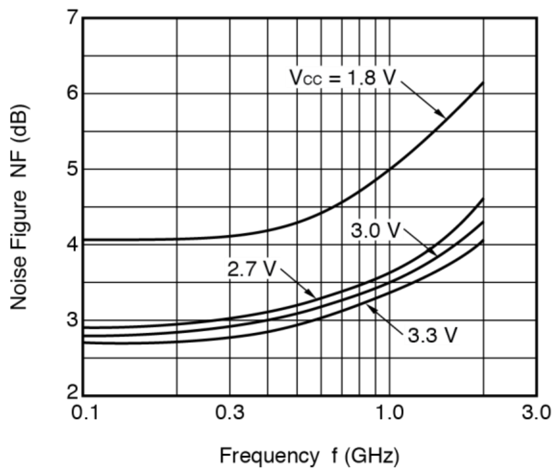
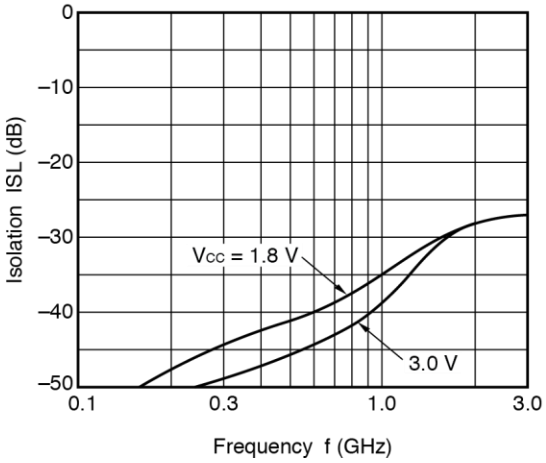


NOISE FIGURE vs. FREQUENCY

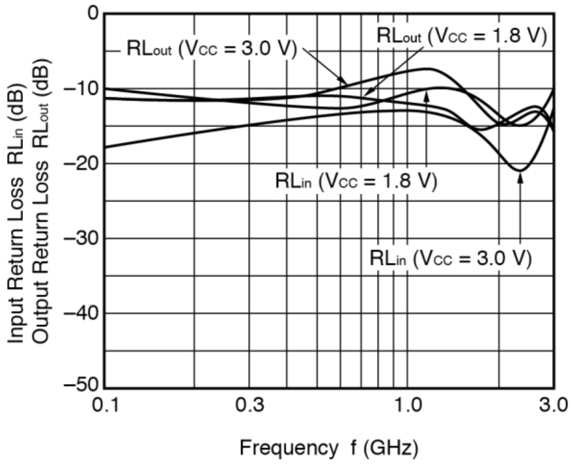


– μPC2748TB –

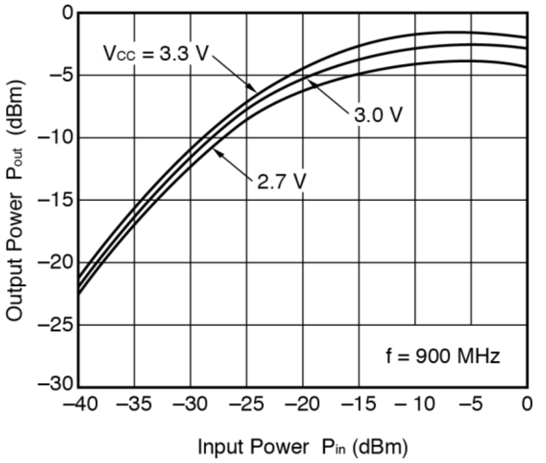
ISOLATION vs. FREQUENCY



INPUT RETURN LOSS, OUTPUT RETURN LOSS vs. FREQUENCY



OUTPUT POWER vs. INPUT POWER



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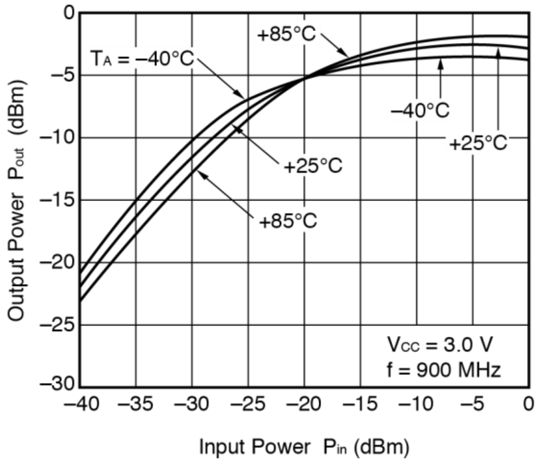
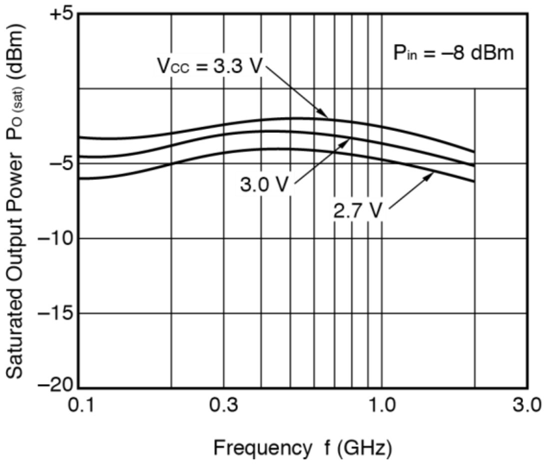
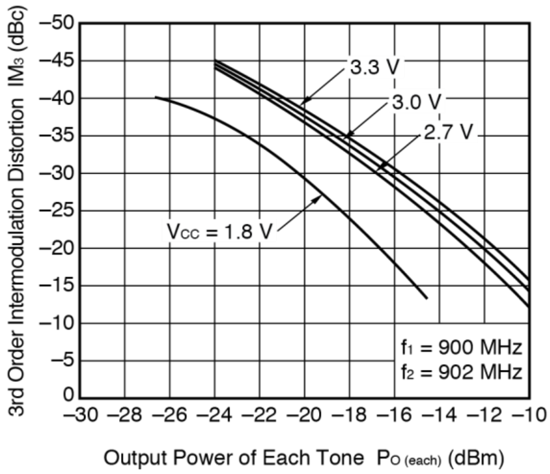


SATURATED OUTPUT POWER vs. FREQUENCY



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



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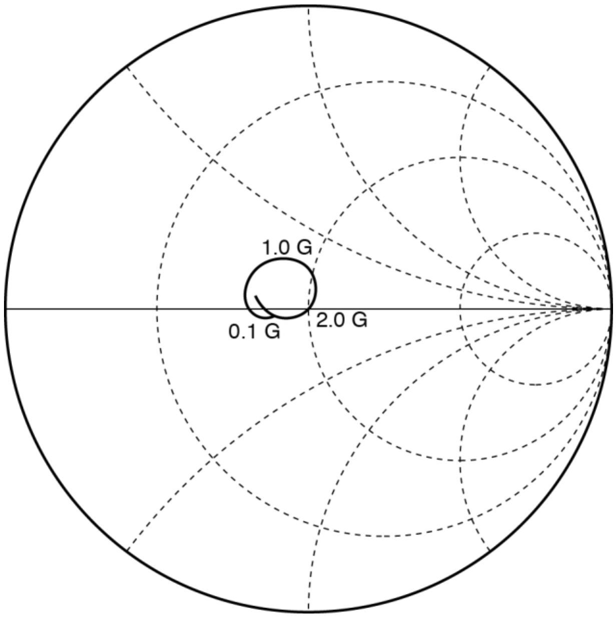
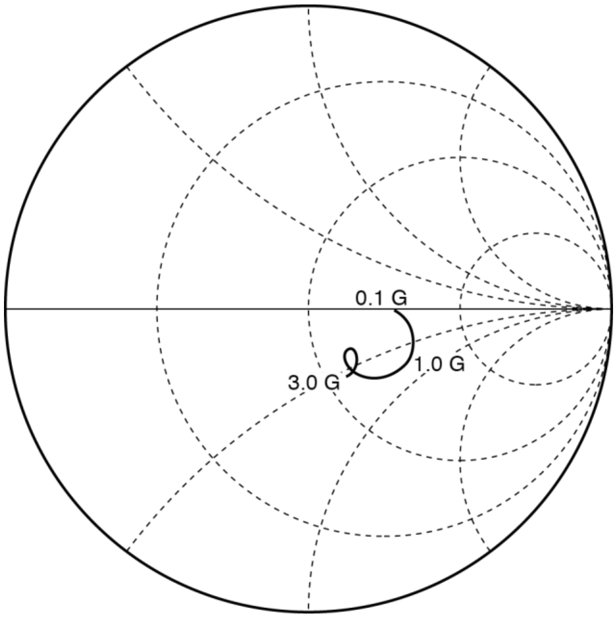
SMITH CHART (T_A = +25°C, V_{CC} = 3.0 V)

– μPC2748TB –

S_{11}-FREQUENCY



S_{22}-FREQUENCY



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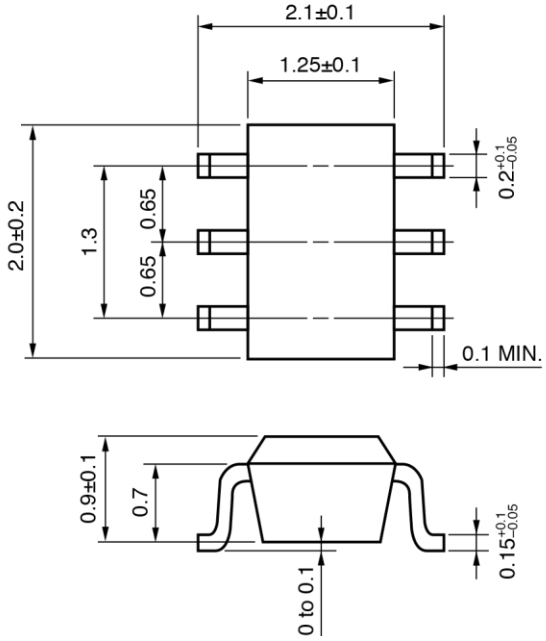
PACKAGE DIMENSIONS

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 V_{CC} line.

(4) The DC cut capacitor must be attached to input 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).