NEC

BIPOLAR ANALOG INTEGRATED CIRCUITS
μPC2747TB, μPC2748TB

3 V, SUPER MINIMOLD SILICON MMIC AMPLIFIER FOR MOBILE COMMUMICATIONS

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 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 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
- Upper limit operating frequency : μPC2747TB ; f_u = 1.8 GHz TYP.
  μPC2748TB ; f_u = 1.5 GHz TYP.
- 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, please contact your local NEC sales office.
Part number for sample order: μPC2747TB, μPC2748TB

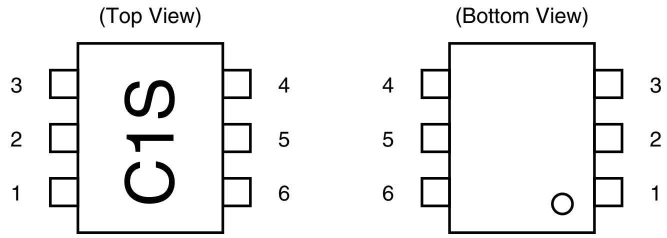
Caution Electro-static sensitive devices

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. P13444EJ3V0DS00 (3rd edition)
Date Published March 2001 N CP(K)
Printed in Japan

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)

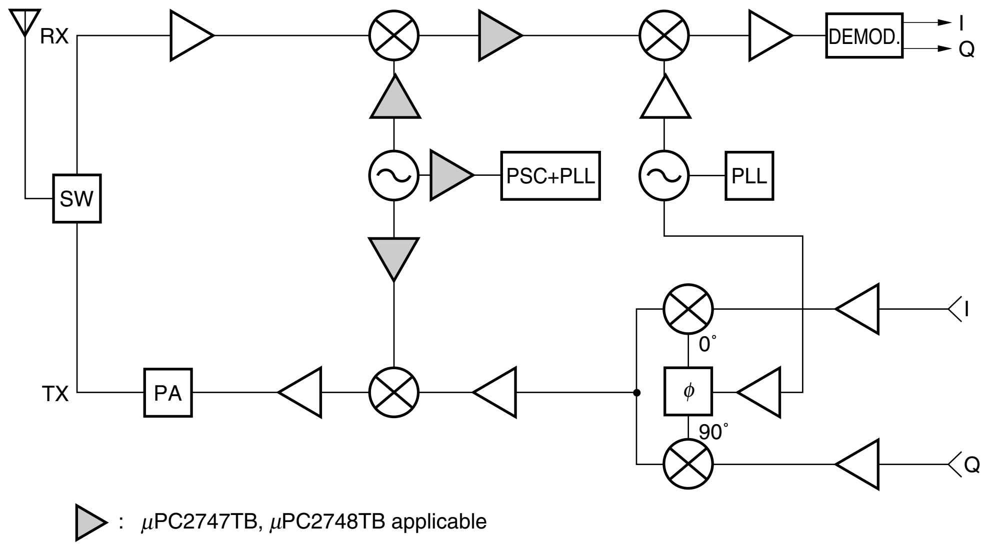
Part No.	f_u (GHz)	$P_{O(sat)}$ (dBm)	G_P (dB)	NF (dB)	I_{CC} (mA)	Package	Marking
μPC2747T	1.8	–7.0	12	3.3	5.0	6-pin minimold	C1S
μPC2747TB						6-pin super minimold	
μPC2748T	0.2 to 1.5	–3.5	19	2.8	6.0	6-pin minimold	C1T
μPC2748TB						6-pin super minimold	
μPC2745T	2.7	–1.0	12	6.0	7.5	6-pin minimold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

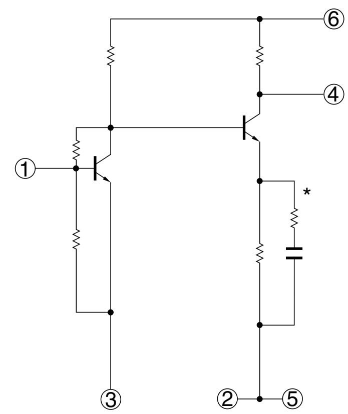
Cation The package size distinguishes between minimold and super minimold.

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.	 The above diagram is for the μPC2747TB. The resistor marked with an asterisk does not exist in the μPC2748TB.
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.	
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	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

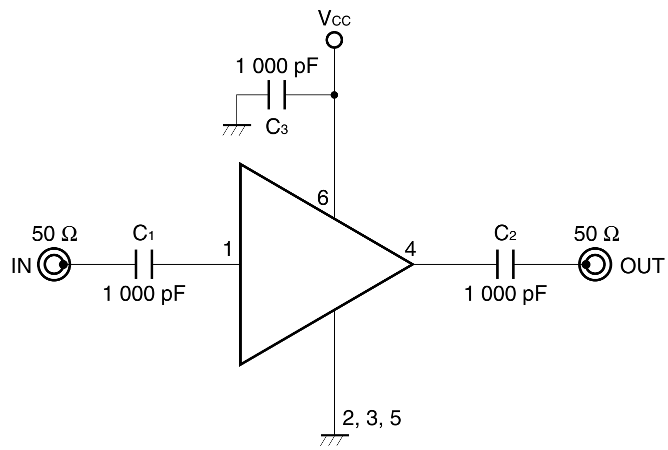
ELECTRICAL CHARACTERISTICS
(Unless otherwise specified, T_A = +25°C, V_{CC} = 3.0 V, Z_S = Z_L = 50 Ω)

Parameter	Symbol	Test Conditions	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 = 900 MHz	1.5	1.8	–	1.2	1.5	–	GHz
Lower Limit Operating Frequency	f_L	3 dB down below from gain at f = 900 MHz	–	–	–	–	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

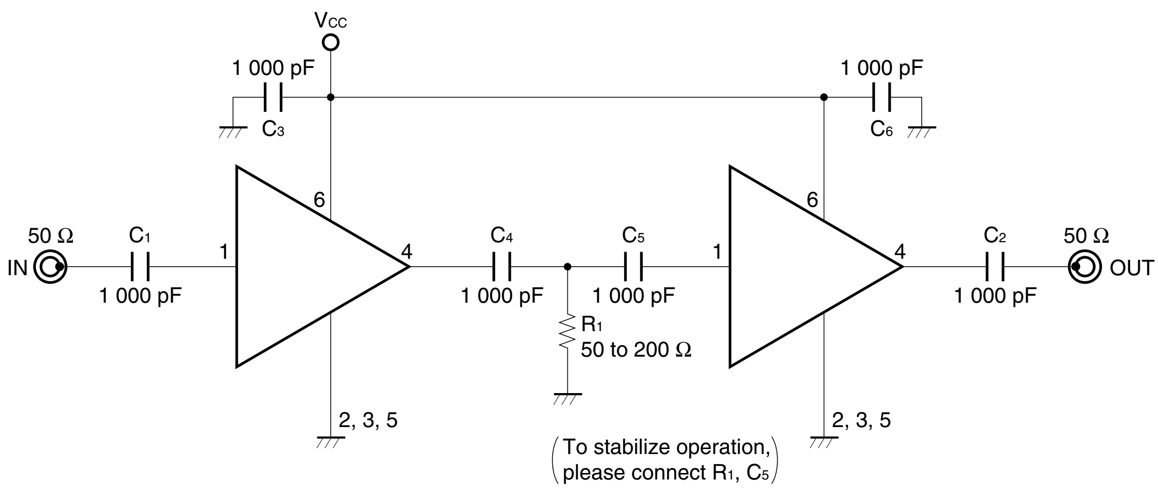
STANDARD CHARACTERISTICS FOR REFERENCE (T_A = +25°C, Z_S = Z_L = 50 Ω)

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 = 900 MHz	1.8	1.5	GHz
Lower Limit Operating Frequency	f_L	V_{CC} = 1.8 V, 3 dB down below from gain at f = 900 MHz	—	0.2	GHz
Isolation	ISL	V_{CC} = 1.8 V, f = 900MHz	34	34	dB
Input Return Loss	RL_{in}	V_{CC} = 1.8 V, f = 900MHz	11	10	dB
Output Return Loss	RL_{out}	V_{CC} = 1.8 V, f = 900MHz	13	12	dB
Saturated Output Power	$P_{O(sat)}$	V_{CC} = 1.8 V, f = 900MHz, 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

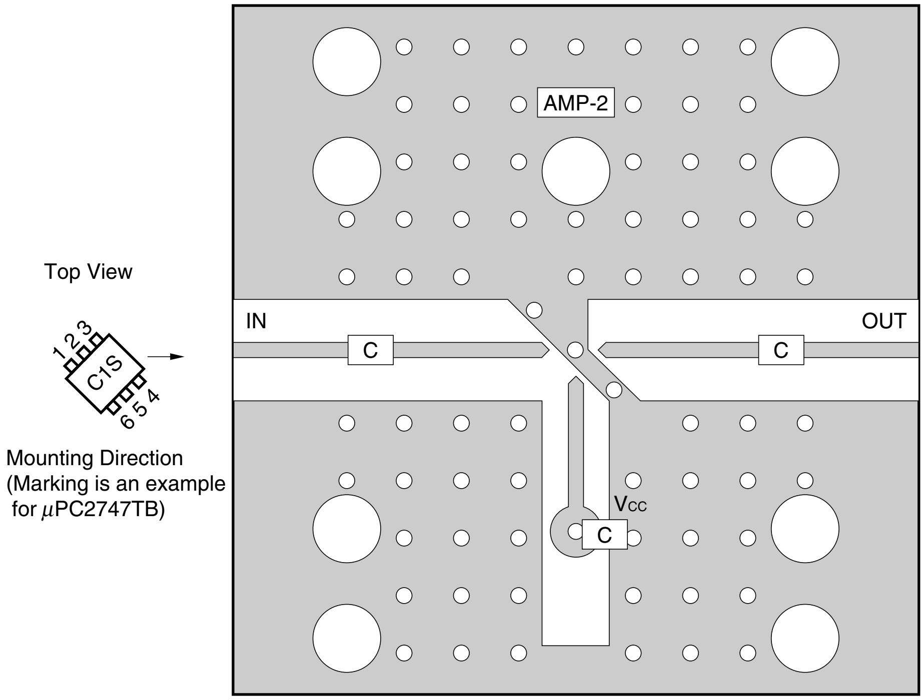
1 000 pF capacitors are recommendable as bypass capacitor for V_{CC} pin and coupling capacitors for input/output pins.

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 $C = 1/(2 \pi fZs)$.]

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

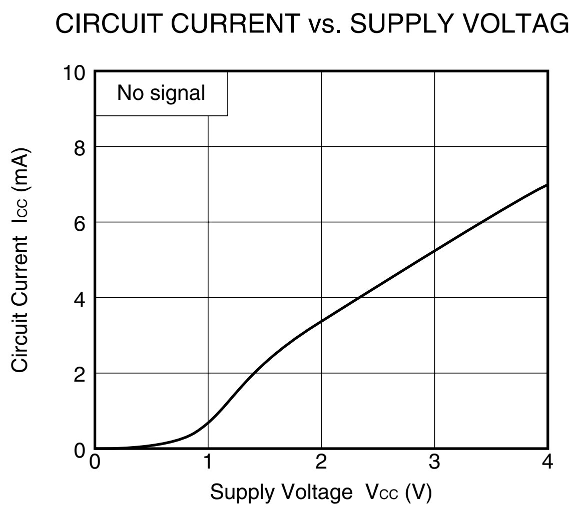
3. Solder plated on pattern

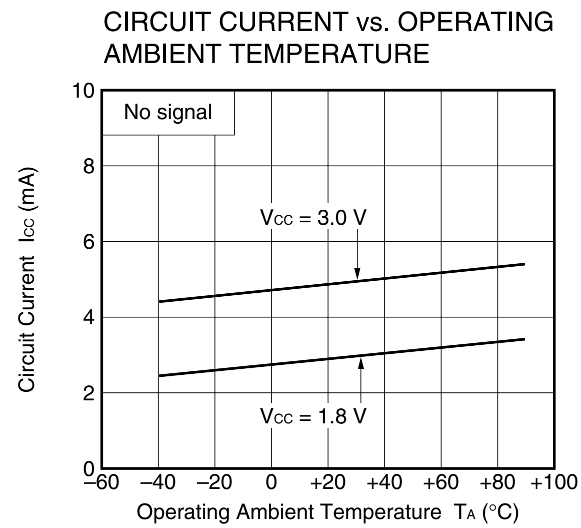
4. ○ ◯ : Through holes

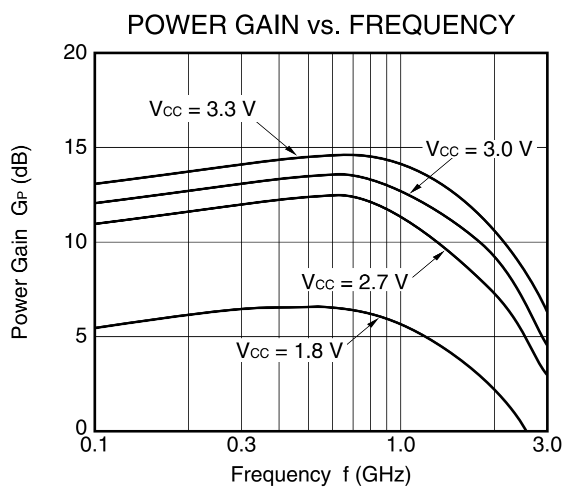
For more information on the use of this IC, refer to the following application note: **USAGE AND APPLICATIONS OF 6-PIN MINI-MOLD, 6-PIN SUPER MINI-MOLD SILICON HIGH-FREQUENCY WIDEBAND AMPLIFIER MMIC (P11976E).**

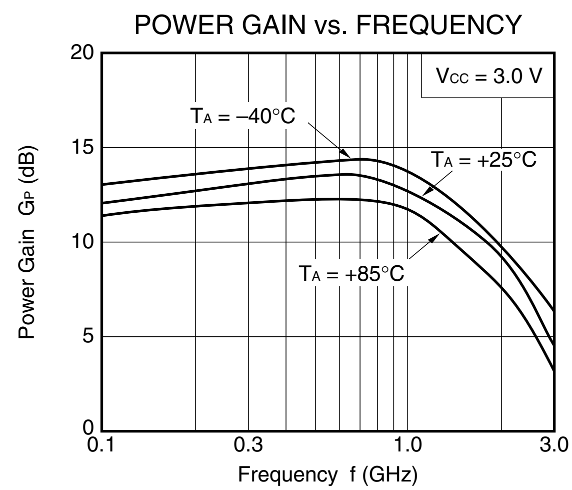
TYPICAL CHARACTERISTICS (Unless otherwise specified, T_A = +25°C)

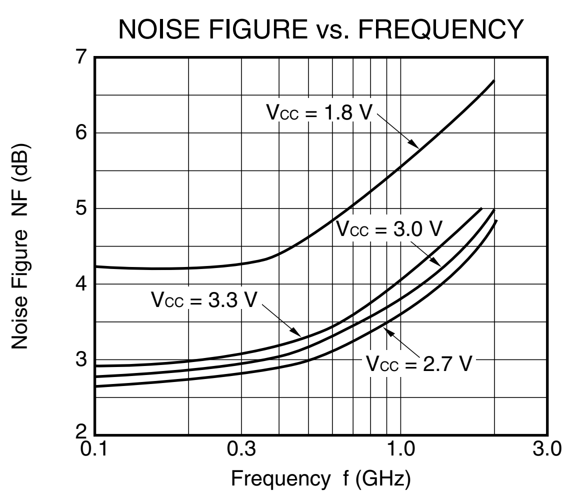
– μPC2747TB –





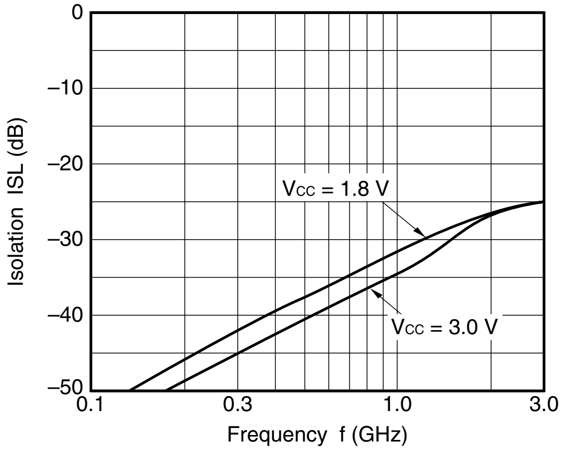




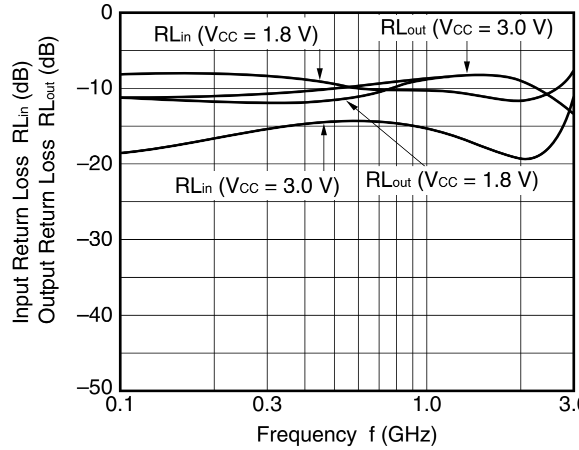


– μPC2747TB –

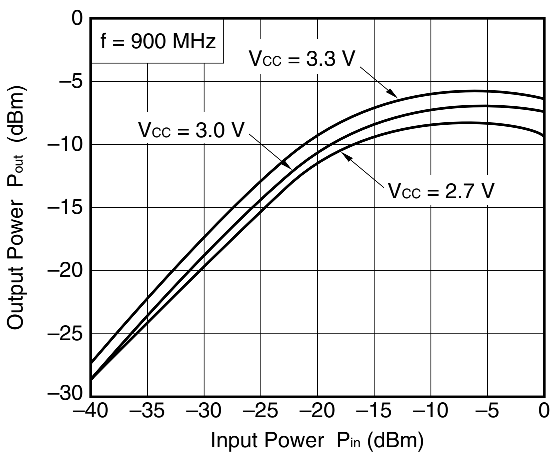
ISOLATION vs. FREQUENCY



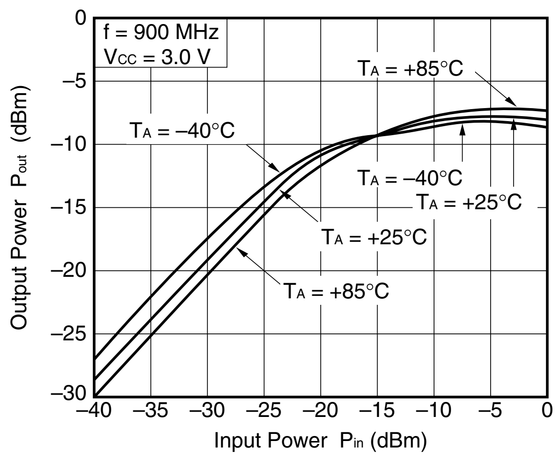
INPUT RETURN LOSS, OUTPUT RETURN LOSS vs. FREQUENCY



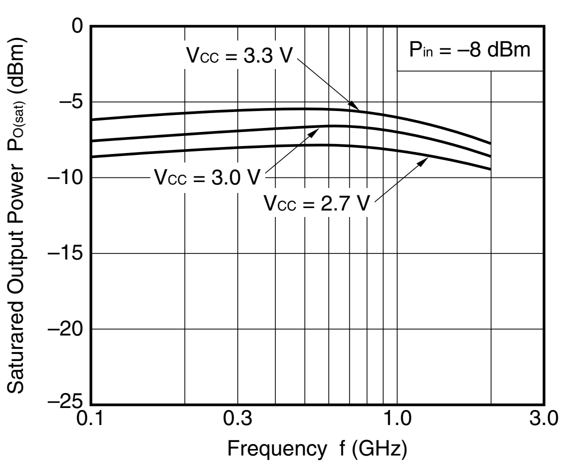
OUTPUT POWER vs. INPUT POWER



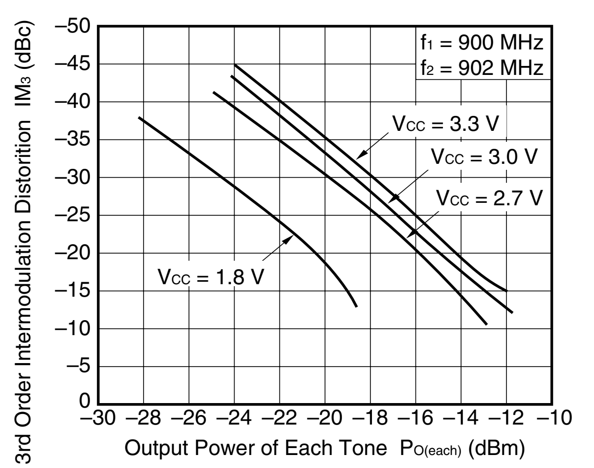
OUTPUT POWER vs. INPUT POWER



SATURATED OUTPUT POWER vs. FREQUENCY



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

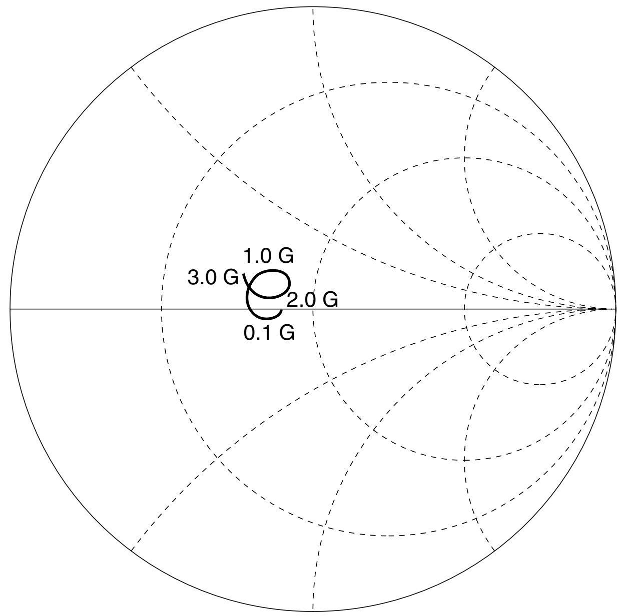


Remark The graphs indicate nominal characteristics.

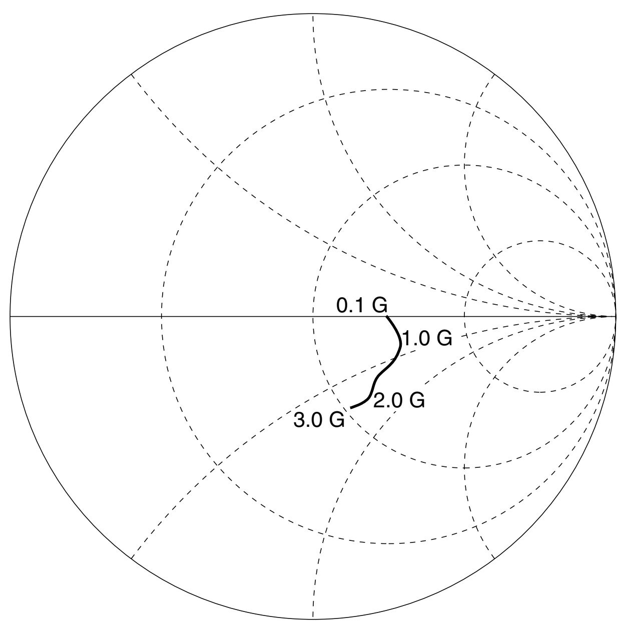
S-PARAMETERS (TA = +25°C, VCC = 3.0 V)

– μPC2747TB –

S11-FREQUENCY



S22-FREQUENCY



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

μPC2747TB

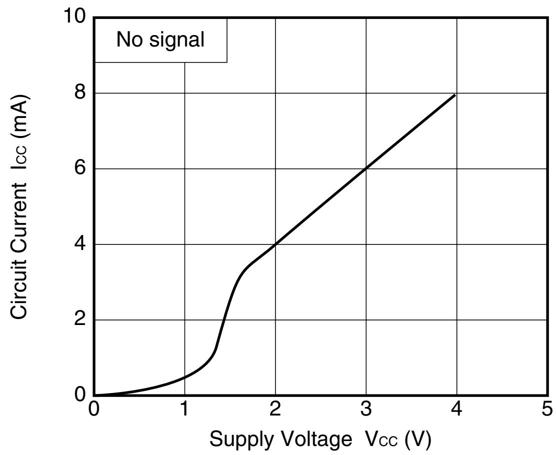
V_{CC} = 3.0 V, I_{CC} = 5.0 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K
MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	
100.0000	0.091	−178.3	3.732	−3.9	0.001	28.0	0.290	−3.7	98.96
200.0000	0.105	−161.2	3.997	−13.3	0.002	103.2	0.294	−4.3	64.71
300.0000	0.136	−166.8	4.075	−23.4	0.002	76.0	0.292	−3.9	46.80
400.0000	0.165	−172.9	4.105	−32.9	0.004	90.4	0.286	−5.6	29.99
500.0000	0.179	177.8	4.141	−41.2	0.004	89.4	0.298	−6.9	25.94
600.0000	0.185	170.1	4.098	−49.5	0.005	90.7	0.302	−8.4	20.69
700.0000	0.189	162.5	4.124	−57.9	0.006	96.6	0.307	−10.2	17.38
800.0000	0.189	155.1	4.104	−66.3	0.008	101.3	0.309	−12.2	12.59
900.0000	0.182	148.8	4.061	−74.5	0.009	99.2	0.313	−14.4	12.26
1000.0000	0.180	142.6	4.016	−83.0	0.012	99.9	0.316	−16.9	9.45
1100.0000	0.174	137.1	3.977	−91.8	0.013	100.3	0.318	−19.7	8.22
1200.0000	0.160	131.5	3.948	−99.5	0.015	105.5	0.318	−22.6	7.49
1300.0000	0.148	127.4	3.799	−108.4	0.016	96.6	0.318	−24.9	7.42
1400.0000	0.134	124.4	3.736	−115.9	0.019	93.8	0.313	−27.4	6.36
1500.0000	0.124	121.0	3.582	−124.0	0.022	93.8	0.311	−30.1	5.83
1600.0000	0.110	121.0	3.506	−131.7	0.023	88.1	0.312	−31.8	5.55
1700.0000	0.099	122.9	3.317	−138.8	0.025	88.6	0.308	−33.3	5.37
1800.0000	0.089	126.8	3.190	−145.7	0.028	88.3	0.305	−35.1	5.05
1900.0000	0.084	134.8	3.040	−152.8	0.030	80.2	0.305	−37.2	4.98
2000.0000	0.085	141.7	2.901	−159.0	0.032	78.7	0.303	−38.8	4.97
2100.0000	0.087	148.1	2.736	−164.8	0.034	77.6	0.299	−40.9	4.99
2200.0000	0.092	152.1	2.645	−170.8	0.035	73.0	0.304	−41.5	4.97
2300.0000	0.102	156.6	2.507	−176.3	0.037	72.5	0.304	−42.2	4.93
2400.0000	0.114	158.7	2.395	177.8	0.038	68.5	0.305	−44.7	5.01
2500.0000	0.126	161.4	2.312	172.9	0.041	66.2	0.317	−45.8	4.76
2600.0000	0.136	160.6	2.218	168.1	0.042	64.0	0.319	−47.8	4.78
2700.0000	0.154	161.3	2.136	162.1	0.042	60.4	0.323	−50.8	4.88
2800.0000	0.168	160.4	2.036	157.8	0.044	54.8	0.331	−54.1	4.88
2900.0000	0.180	157.9	1.952	151.6	0.044	53.0	0.330	−57.5	5.07
3000.0000	0.196	155.2	1.847	147.6	0.043	47.2	0.332	−60.9	5.45
3100.0000	0.208	152.5	1.757	141.6	0.045	44.0	0.331	−65.5	5.49

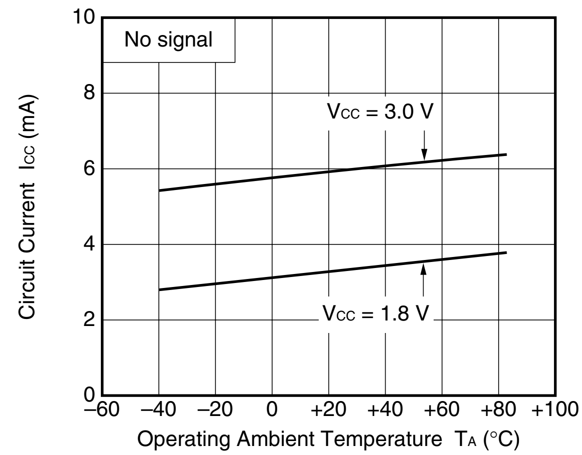
TYPICAL CHARACTERISTICS (Unless otherwise specified, T_A = +25°C)

– μPC2748TB –

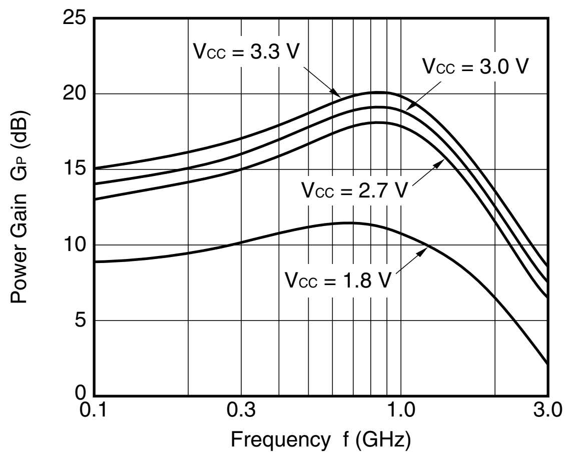
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



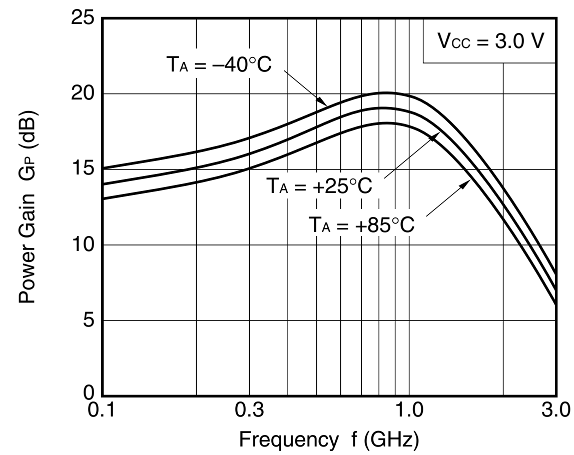
CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



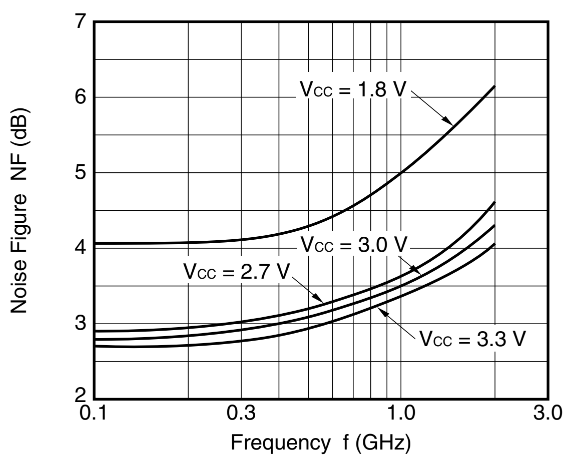
POWER GAIN vs. FREQUENCY



POWER GAIN vs. FREQUENCY

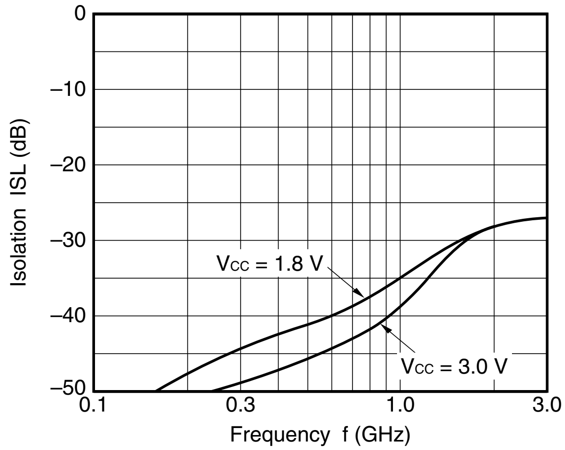


NOISE FIGURE vs. FREQUENCY

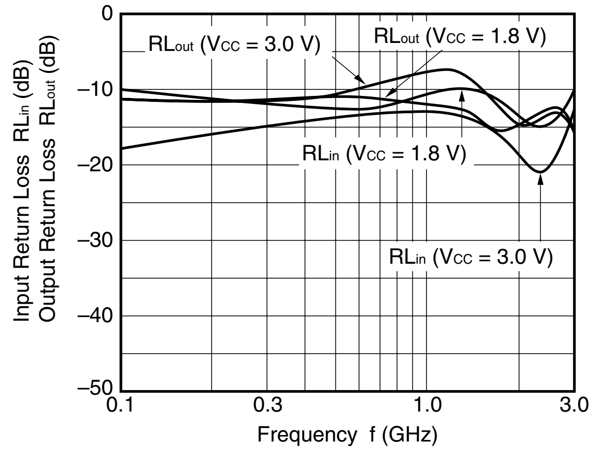


– μPC2748TB –

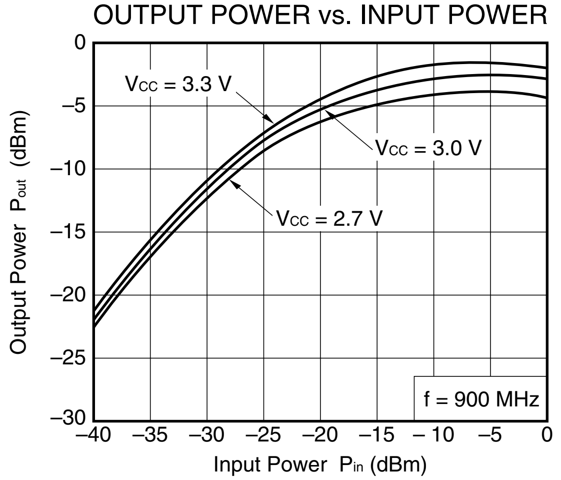
ISOLATION vs. FREQUENCY



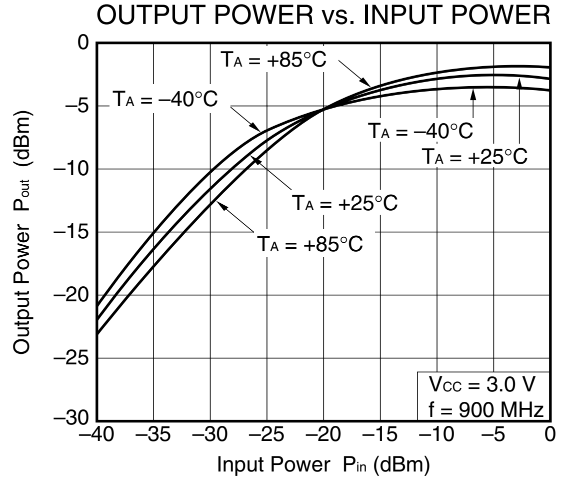
INPUT RETURN LOSS, OUTPUT RETURN LOSS vs. FREQUENCY



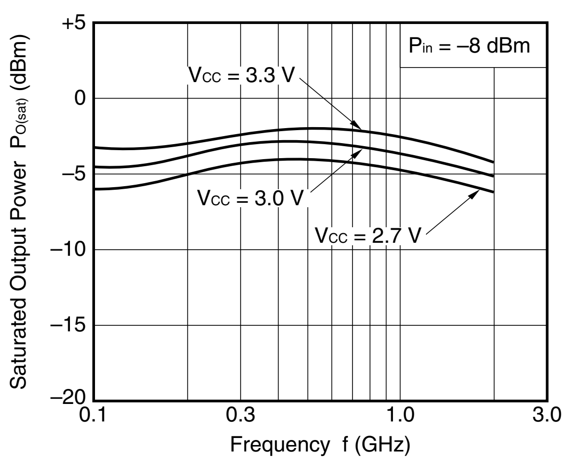
OUTPUT POWER vs. INPUT POWER



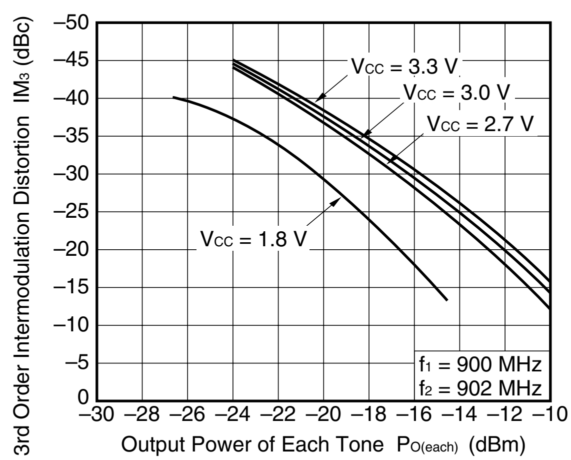
OUTPUT POWER vs. INPUT POWER



SATURATED OUTPUT POWER vs. FREQUENCY



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

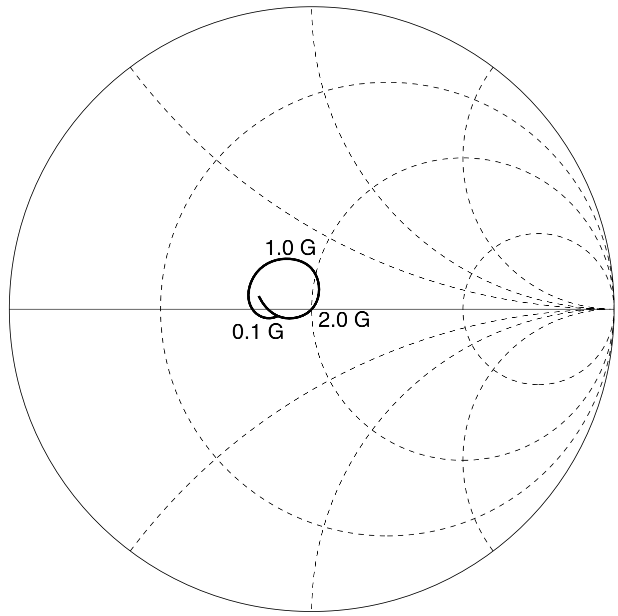


Remark The graphs indicate nominal characteristics.

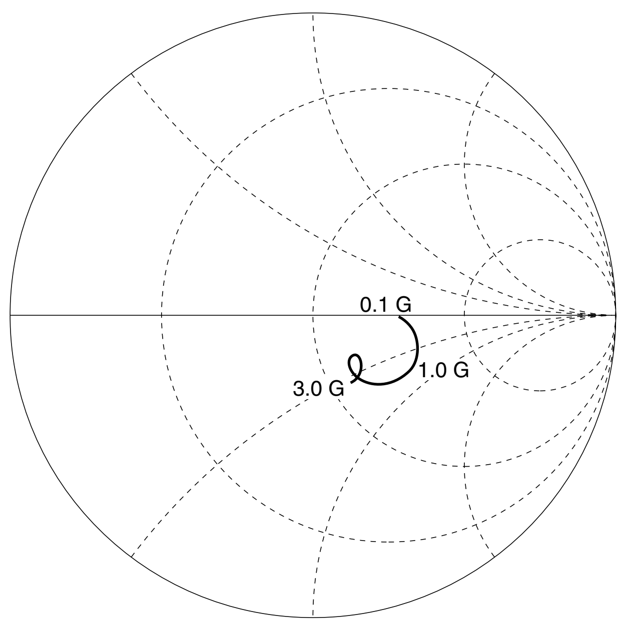
S-PARAMETERS (TA = +25°C, VCC = 3.0 V)

– μPC2748TB –

S11-FREQUENCY



S22-FREQUENCY



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

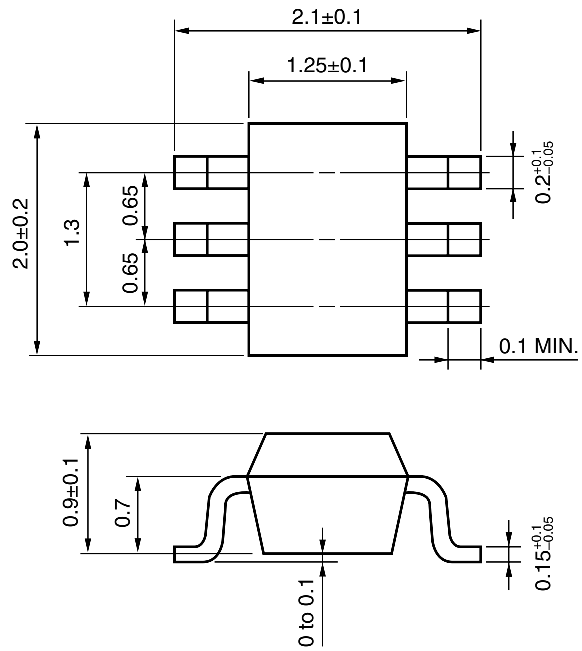
μPC2748TB

V_{CC} = 3.0 V, I_{CC} = 6.0 mA

FREQUENCY	S11		S21		S12		S22		K
MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	
100.0000	0.120	−177.2	4.730	5.3	0.000	−30.4	0.280	−2.2	352.73
200.0000	0.136	−167.3	5.430	−0.2	0.001	19.3	0.285	−2.4	72.83
300.0000	0.166	−174.2	5.930	−9.2	0.001	97.8	0.286	−0.9	52.47
400.0000	0.194	179.6	6.314	−18.8	0.003	125.4	0.291	−2.7	24.77
500.0000	0.210	169.6	6.701	−28.2	0.004	108.7	0.306	−3.7	16.82
600.0000	0.213	160.0	6.876	−38.8	0.005	107.4	0.319	−5.4	12.40
700.0000	0.213	150.2	7.203	−49.3	0.006	98.7	0.337	−8.4	10.09
800.0000	0.211	140.8	7.310	−60.6	0.009	114.1	0.349	−12.3	6.68
900.0000	0.203	131.1	7.354	−71.5	0.010	107.6	0.360	−17.4	5.68
1000.0000	0.193	121.1	7.371	−81.9	0.012	98.3	0.371	−22.7	4.71
1100.0000	0.180	110.8	7.346	−92.8	0.014	99.1	0.366	−28.9	3.98
1200.0000	0.159	100.6	7.334	−102.4	0.015	97.5	0.359	−35.3	4.01
1300.0000	0.136	90.6	7.001	−112.6	0.016	91.4	0.342	−40.7	3.95
1400.0000	0.115	79.2	6.834	−121.3	0.018	84.1	0.320	−46.0	3.71
1500.0000	0.096	70.4	6.437	−130.1	0.019	84.8	0.296	−50.5	3.77
1600.0000	0.072	60.9	6.181	−138.2	0.020	82.4	0.271	−53.0	3.81
1700.0000	0.049	47.5	5.710	−145.4	0.020	78.9	0.247	−55.1	4.13
1800.0000	0.024	36.5	5.372	−152.5	0.021	73.5	0.228	−55.7	4.22
1900.0000	0.007	−6.0	5.014	−158.6	0.021	74.1	0.208	−55.7	4.57
2000.0000	0.014	−126.0	4.724	−164.1	0.024	74.9	0.198	−52.8	4.37
2100.0000	0.034	−141.3	4.405	−169.7	0.024	71.5	0.188	−52.1	4.70
2200.0000	0.047	−147.7	4.175	−174.7	0.026	73.6	0.190	−47.8	4.44
2300.0000	0.063	−156.9	3.933	−179.5	0.026	71.2	0.185	−45.3	4.81
2400.0000	0.079	−161.1	3.738	175.3	0.028	69.1	0.192	−44.7	4.58
2500.0000	0.094	−165.5	3.579	171.2	0.030	63.8	0.202	−43.2	4.48
2600.0000	0.108	−169.0	3.411	166.5	0.030	64.7	0.214	−43.6	4.59
2700.0000	0.123	−174.7	3.283	161.4	0.032	64.6	0.222	−45.7	4.54
2800.0000	0.139	−178.9	3.107	157.3	0.031	58.9	0.238	−47.6	4.83
2900.0000	0.151	175.9	2.989	151.4	0.032	53.2	0.240	−52.4	4.84
3000.0000	0.164	170.5	2.814	147.3	0.033	51.6	0.251	−55.8	4.99
3100.0000	0.178	166.0	2.680	141.5	0.034	47.3	0.254	−61.4	5.07

★ **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 widely 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 under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your NEC sales representative.

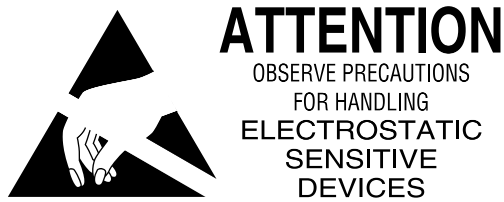
Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared Reflow	Package peak temperature: 235°C or below Time: 30 seconds or less (at 210°C) Count: 3, Exposure limit: None[Note]	IR35-00-3
VPS	Package peak temperature: 215°C or below Time: 40 seconds or less (at 200°C) Count: 3, Exposure 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]



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