

BIPOLAR ANALOG INTEGRATED CIRCUIT

μ PC2776T

5 V -BIAS SILICON MMIC AMPLIFIER

2.7 GHz WIDEBAND, 23 dB GAIN, MEDIUM OUTPUT POWER

DESCRIPTION

μ PC2776T is a silicon monolithic integrated circuit designed as wideband, medium output amplifier. This IC operates wider frequency than μ PC2709T of which conventional amplifier has similar gain value. μ PC2776T has compatible package, pin connections and supply voltage to μ PC2708T/2709T/2710T. In the case of wideband operation from HF to L band, μ PC2776T is suitable.

FEATURES

- Wide Band Operation : $G_p = 23 \text{ dB TYP}$, $f_u = 2.7 \text{ GHz TYP}$.
- Medium output power : $P_{O(1dB)} = +6.5 \text{ dBm TYP}$.
- Supply voltage : $V_{CC} = 5.0 \text{ V} \pm 0.5 \text{ V}$
- 50Ω cascadable : 50Ω input/output impedance
- High-density surface mounting : 6 pins mini mold package

APPLICATION

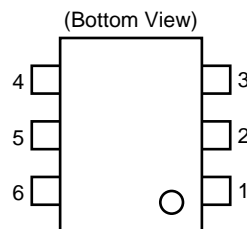
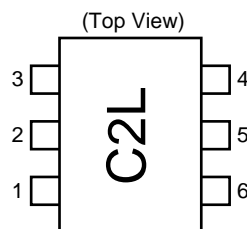
- Systems required wideband operation from HF to 2.0 GHz.

ORDER INFORMATION

ORDER NUMBER	PACKAGE	MARKING	SUPPLYING FORM
μ PC2776T-E3	6 pin mini mold	C2L	<ul style="list-style-type: none"> • Embossed tape 8 mm wide. • Pin 1, 2, 3 face to perforation side of the tape. • QTY 3K/Reel.

Remark To order evaluation samples, please contact your local NEC sales office. (Order number : μ PC2776T)

PIN CONNECTIONS



Pin No.	Pin name
1	IN
2	GND
3	GND
4	OUT
5	GND
6	V _{CC}

Caution: Electro-static sensitive devices

Product line-up of 6 pin moni mold 5 V medium output power ($T_A = +25\text{ }^\circ\text{C}$, $V_{CC} = V_{out} = 5.0\text{ V}$, $Z_L = Z_S = 50\ \Omega$)

FEATURES	PRODUCT NUMBER	f_u (GHz)	$P_{O(sat)}$ (dBm)	G_P (dB)	NF (dB)	I_{CC} (mA)
2.9 GHz, 15 dB gain	μ PC2708T	2.9	+10	15	6.5	26
2.3 GHz, 23 dB gain	μ PC2709T	2.3	+11.5	23	5	25
1.0 GHz, 33 dB gain	μ PC2710T	1.0	+13.5	33	3.5	22
2.6 GHz, 23 dB gain	μ PC2776T	2.7	+8.5	23	6	25

Remark Typical performance with TEST CIRCUIT. Please refer to ELECTRICAL CHARACTERISTICS in detail. To know the associated product, please refer to each latest data sheet.

Selection point among product line-up

μ PC2709T: Suits to 1 GHz 2.5 GHz operation due to small inductance (e.g. 10 nH) between V_{CC} and output pin.

μ PC2776T: Suits to HF to 2.0 GHz operation due to large inductance (e.g. 100 nH) between V_{CC} and output pin.

PIN FUNCTIONS

PIN	SYMBOL	APPLIED VOLTAGE (V)	DESCRIPTION	EQUIVALENT CIRCUIT
1	INPUT	—	High-frequency signal input pin. A internal matching circuit, configured with resistors, enables $50\ \Omega$ connection over a wide band. A multi-feedback circuit is designed to cancel the deviations of h_{FE} and resistance.	
2 3 5	GND	0	Ground pin. Form a ground pattern as wide as possible to maintain the minimum ground impedance.	
4	OUTPUT	4.5 - 5.5	High-frequency signal output pin. Connect an inductor between this pin and V_{CC} to supply current to the internal output transistors.	
6	V_{CC}		Power supply pin, which biases the internal input transistor. Excellent RF characteristics are obtained by a two-stage amplifier circuit.	

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	CONDITION	RATINGS	UNIT
Supply voltage	V_{CC}	$T_A = +25\text{ }^\circ\text{C}$	6	V
Total circuit current	I_{CC}	$T_A = +25\text{ }^\circ\text{C}$	60	mA
Total power dissipation	P_T	Mounted on $50 \times 50 \times 1.6$ mm epoxy glass PWB ($T_A = +85\text{ }^\circ\text{C}$)	280	mW
Operating temperature	$T_{A(opt)}$		-40 to +85	$^\circ\text{C}$
Storage temperature	$T_{A(stg)}$		-55 to +150	$^\circ\text{C}$

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTICE
Supply voltage	V_{CC}	4.5	5.0	5.5	V	The same voltage should be applied to 5 pin and 6 pin.
Operating temperature	$T_{A(opt)}$	-40	+25	+85	$^\circ\text{C}$	

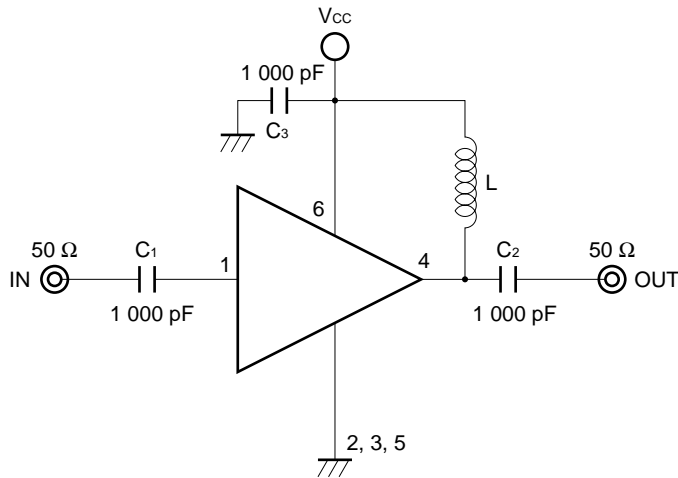
ELECTRICAL CHARACTERISTICS ($T_A = +25\text{ }^\circ\text{C}$, $V_{CC} = V_{out} = 5.0\text{ V}$, $Z_L = Z_S = 50\ \Omega$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Circuit current	I_{CC}	No signals	18	25	33	mA
Power Gain	G_P	$f = 1\text{ GHz}$	21	23	26	dB
Output 1 dB compression level	$P_{O(1dB)}$	$f = 1\text{ GHz}$	+4.0	+6.0	—	dBm
Noise figure	NF	$f = 1\text{ GHz}$	—	6.0	7.5	dB
Upper limit operating frequency	f_u	3 dB down below from gain at $f = 100\text{ MHz}$	2.3	2.7	—	GHz
Isolation	ISL	$f = 1\text{ GHz}$	27	32	—	dB
Input return loss	RL_{in}	$f = 1\text{ GHz}$	4.5	7.5	—	dB
Output return loss	RL_{out}	$f = 1\text{ GHz}$	15	20	—	dB

STANDARD CHARACTERISTICS FOR REFERENCE ($T_A = +25\text{ }^\circ\text{C}$, $V_{CC} = V_{out} = 5.0\text{ V}$, $Z_L = Z_S = 50\ \Omega$)

PARAMETER	SYMBOL	TEST CONDITION	REFERENCE	UNIT
Gain flatness	ΔG_P	$f = 0.1$ to 2.0 GHz	± 1	dB
Saturated output power	$P_{O(sat)}$	$f = 1\text{ GHz}$	+8.5	dBm
3rd order intermodulation distortion	IM_3	$P_{O(each)} = +0\text{ dBm}$, $f_1 = 1000\text{ MHz}$, $f_2 = 1002\text{ MHz}$	-30	dBc

TEST CIRCUIT



Components of test circuit for measuring electrical characteristics

	TYPE	VALUE
C ₃	Capacitor	1 000 pF
L	Bias Tee	1 000 nH
C ₁ to C ₂	Bias Tee	1 000 pF

Example of actual application components

	TYPE	VALUE	OPERATING FREQUENCY
C ₁ to C ₃	Chip capacitor	1 000 pF	100 MHz or higher
L	Chip inductor	100 nH	100 MHz or higher
		10 nH	1.0 GHz or higher

INDUCTOR FOR THE OUTPUT PIN

The internal output transistor of this IC consumes 20 mA, to output medium power. To supply current for output transistor, connect an inductor between the V_{cc} pin (pin 6) and output pin (pin 4). Select large value inductance, as listed above.

The inductor has both DC and AC effects. In terms of DC, the inductor biases the output transistor with minimum voltage drop to output enable high level. In terms of AC, the inductor make output-port impedance higher to get enough gain. In this case, large inductance and Q is suitable.

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

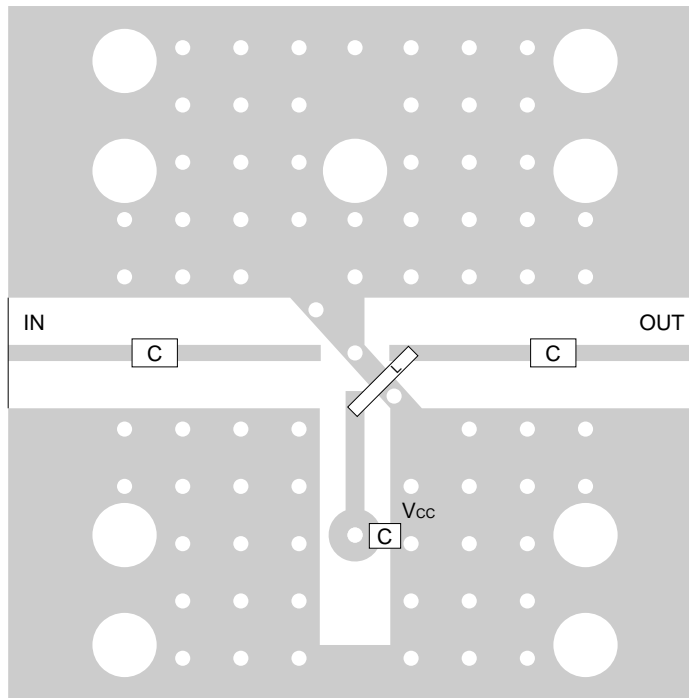
Capacitors of 1 000 pF are recommendable as the bypass capacitor for the V_{cc} pin and the coupling capacitors for the input and output pins.

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 APPLICATION CIRCUIT ASSEMBLED ON EVALUATION BOARD



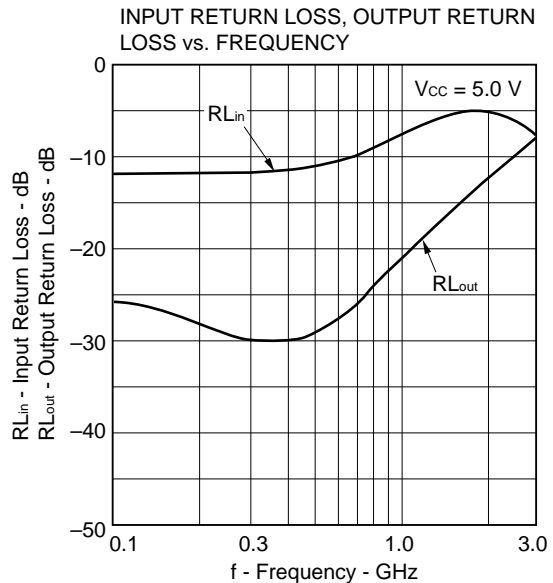
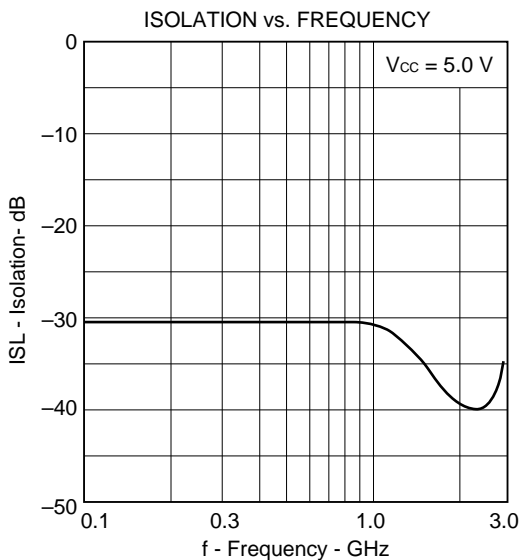
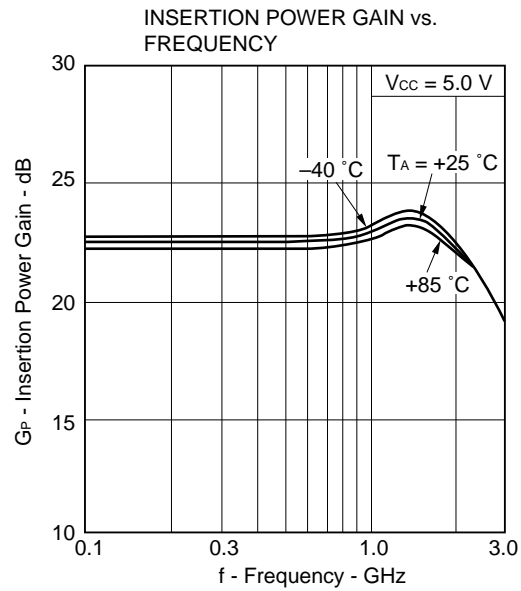
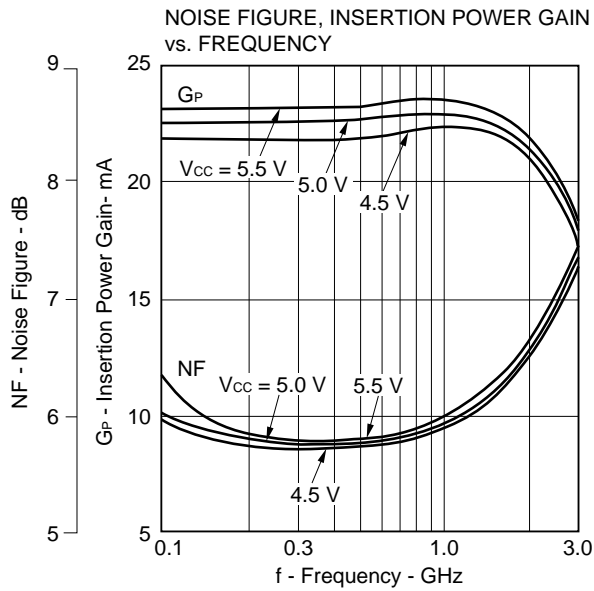
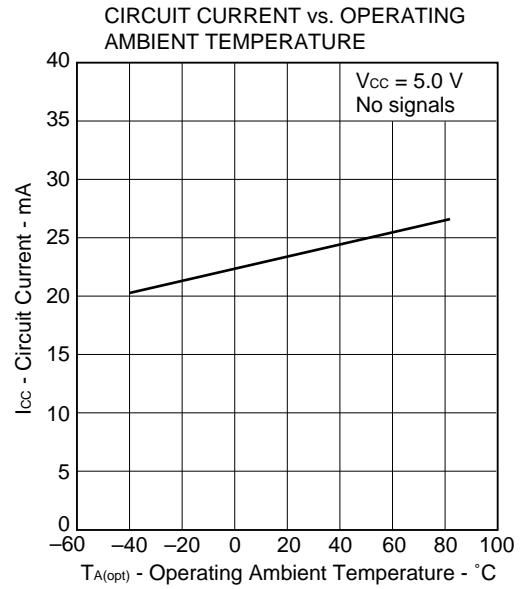
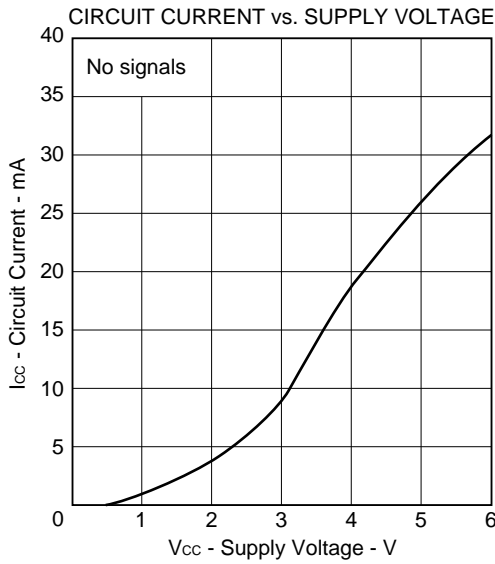
COMPONENT LIST FOR APPLICATION EXAMPLE

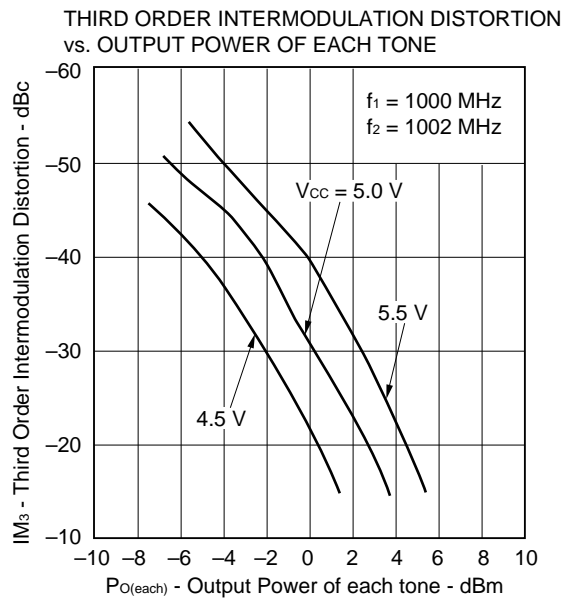
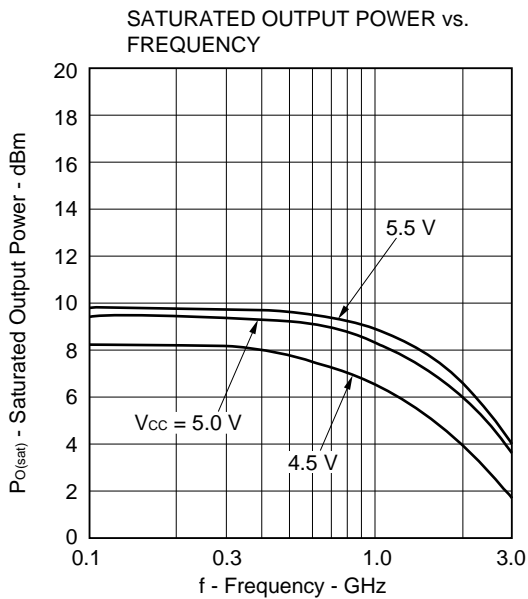
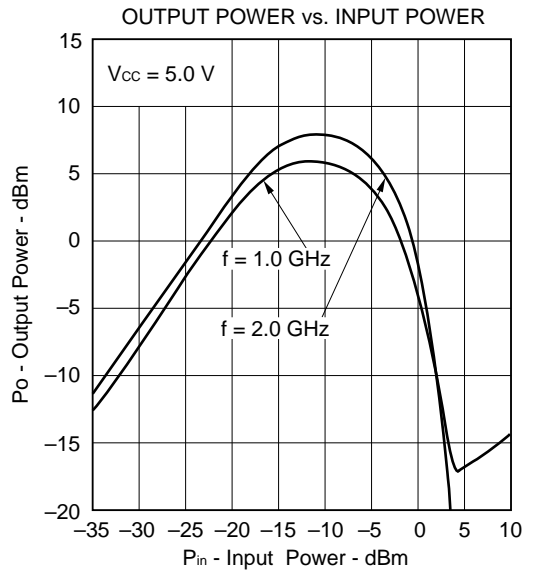
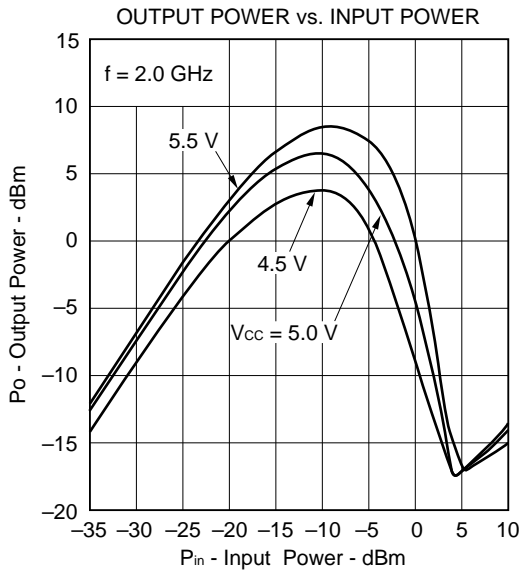
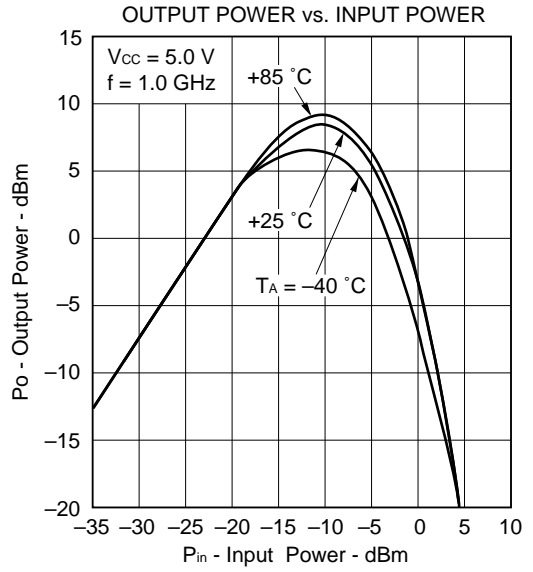
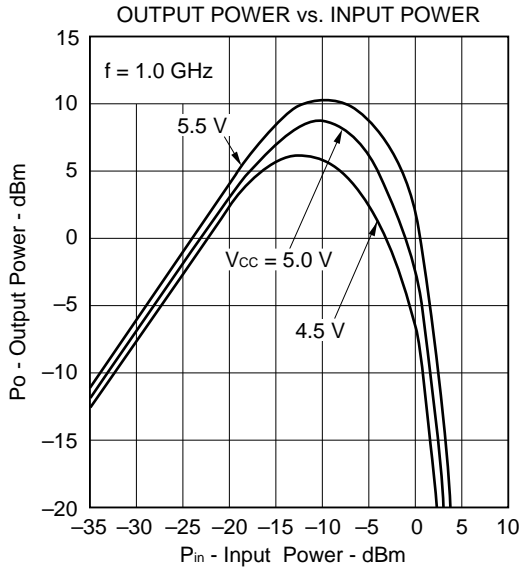
	VALUE
C	1 000 pF
L	100 nH

Note for evaluation board

1. 35 × 42 × 0.4 mm double copper clad polyimide board
2. Back side: GND pattern
3. Solder plated on pattern
4. ○○: Through holes

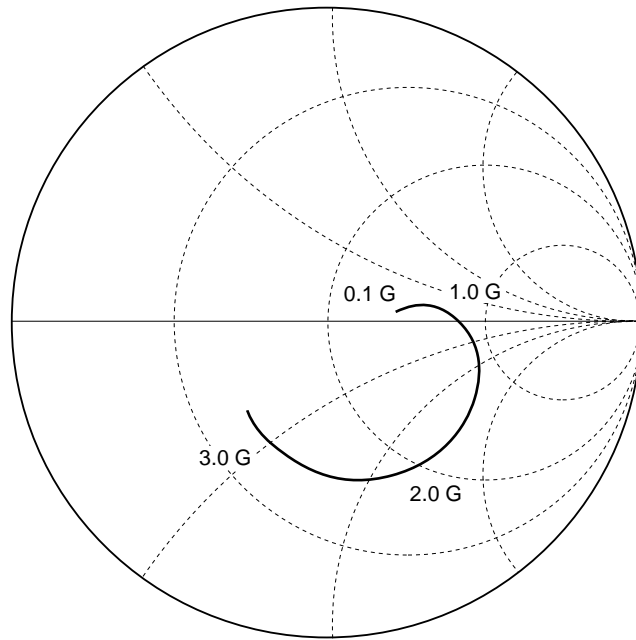
TYPICAL CHARACTERISTICS CURVES (Unless otherwise specified, $T_A = +25\text{ }^\circ\text{C}$, with components for measuring electrical characteristics)



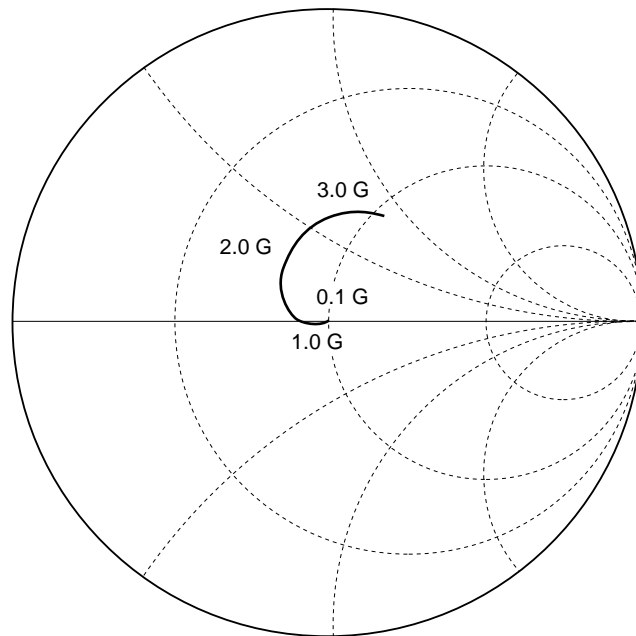


S PARAMETERS ($V_{CC} = 5.0$ V)

S₁₁-FREQUENCY



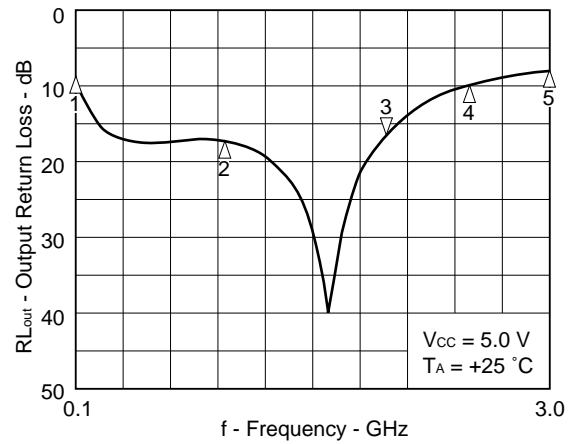
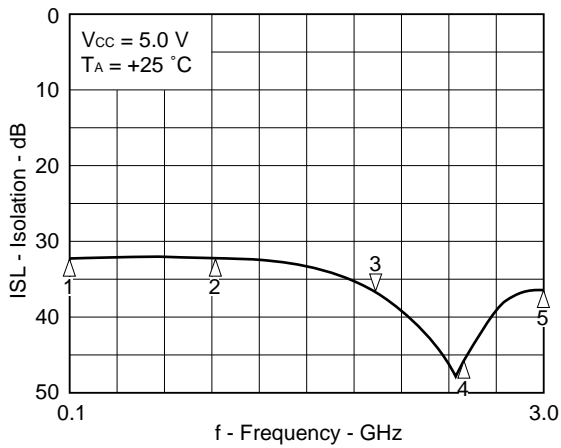
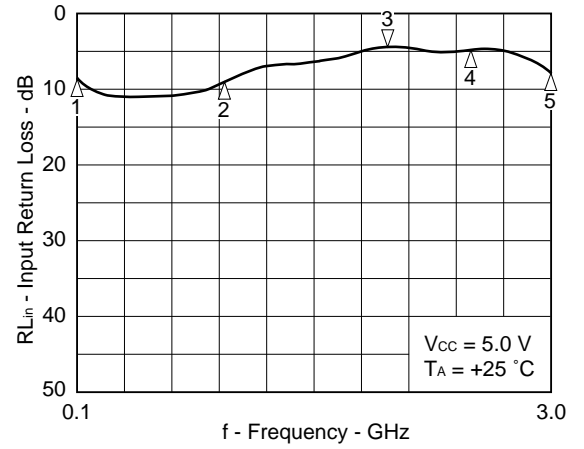
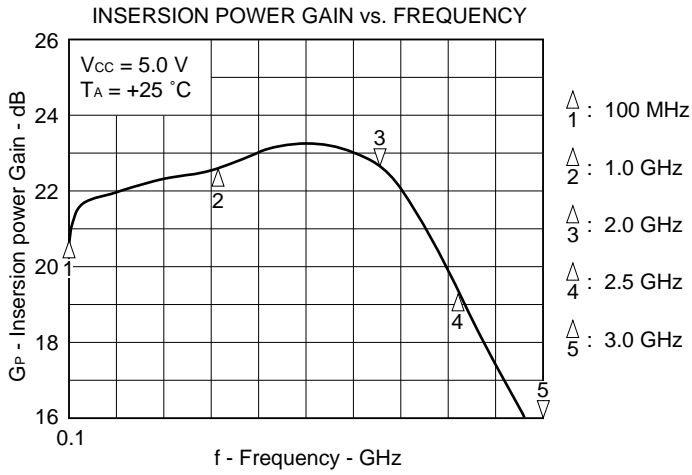
S₂₂-FREQUENCY



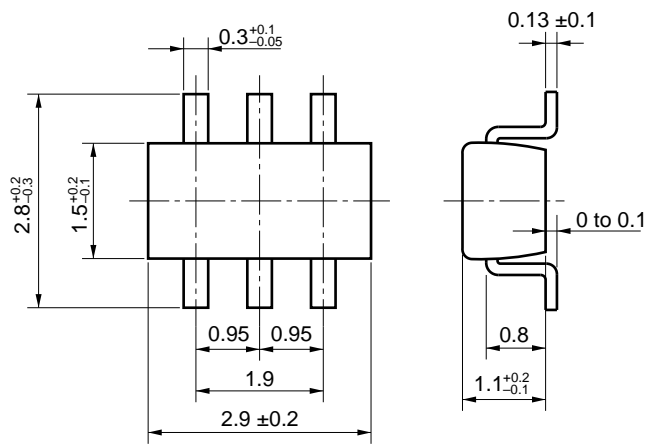
- CHARACTERISTIC CURVES WITH ACTUAL APPLICATION COMPONENT EXAMPLE -

Specifications of sample chip inductor

Manufacturer	Product Name	Inductance: nH	Q Peak	DC resistance Ω	Self resonance frequency	Allowable current mA
TOKO	FSLU2520-R10	100	50	0.21	730 MHz	540



DIMENSIONS OF 6-PIN MINI-MOLD PACKAGE (Unit: mm)



NOTE ON CORRECT USE

- (1) Observe precautions for handling because of electro-static sensitive devices.
- (2) Form a ground pattern as wide 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 (e.g. 1 000 pF) should be attached to the Vcc pin.
- (4) The inductor must be attached between Vcc and output pin (eg. 100 nH).
- (5) The DC cut capacitor must be each attached to the input and output pins.

RECOMMENDED SOLDERING CONDITIONS

This product should be soldered in the following recommended conditions. Other soldering methods and conditions than the recommended conditions are to be consulted with our sales representatives.

μPC2776T

Soldering method	Soldering conditions	Recommended condition symbol
Infrared ray reflow	Package peak temperature: 235 °C, Hour: within 30 s. (more than 210 °C), Time: 3 times, Limited days: no. Note	IR35-00-3
VPS	Package peak temperature: 215 °C, Hour: within 40 s. (more than 200 °C), Time: 3 times, Limited days: no. Note	VP15-00-3
Wave soldering	Soldering tub temperature: less than 260 °C, Hour: within 10 s. Time: 1 time, Limited days: no. Note	WS60-00-1
Pin part heating	Pin area temperature: less than 300 °C, Hour: within 3 s/pin. Limited days: no. Note	

Note It is the storage days after opening a dry pack, the storage conditions are 25 °C, less than 65 % RH.

Caution The combined use of soldering method is to be avoided (However, except the pin area heating method).

For details of recommended soldering conditions for surface mounting, refer to information document **SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535EJ7V0IF00)**.



ATTENTION

OBSERVE PRECAUTIONS
FOR HANDLING
ELECTROSTATIC
SENSITIVE
DEVICES

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Anti-radioactive design is not implemented in this product.