NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC2776T

5 V -BIAS SILICON MMIC AMPLIFIER
2.7 GHz WIDEBAND, 23 dB GAIN, MEDIUM OUTPUT POWER

DESCRIPTION

μPC2776T is a silicon monolithic integrated circuit designed as wideband, medium output amplifier. This IC operates wider frequency than μPC2709T of which conventional amplifier has similar gain value. μPC2776T has compatible package, pin connections and supply voltage to μPC2708T/2709T/2710T. In the case of wideband operation from HF to L band, μPC2776T is suitable.

FEATURES

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

APPLICATION

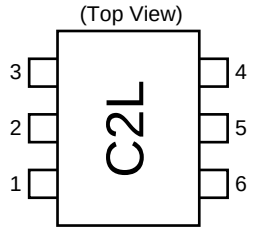
- Systems required wideband operation from HF to 2.0 GHz.

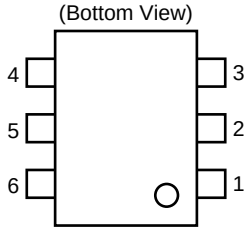
ORDER INFORMATION

ORDER NUMBER	PACKAGE	MARKING	SUPPLYING FORM
μPC2776T-E3	6 pin mini mold	C2L	• 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 : μPC2776T)

PIN CONNECTIONS





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

Caution: Electro-static sensitive devices

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Product line-up of 6 pin moni mold 5 V medium output power (T_A = +25 °C, V_{CC} = V_{out} = 5.0 V, Z_L = Z_S = 50 Ω)

FEATURES	PRODUCT NUMBER	f_u (GHz)	$P_{O(sat)}$ (dBm)	G_P (dB)	NF (dB)	I_{CC} (mA)
2.9 GHz, 15 dB gain	μPC2708T	2.9	+10	15	6.5	26
2.3 GHz, 23 dB gain	μPC2709T	2.3	+11.5	23	5	25
1.0 GHz, 33 dB gain	μPC2710T	1.0	+13.5	33	3.5	22
2.6 GHz, 23 dB gain	μPC2776T	2.7	+8.5	23	6	25

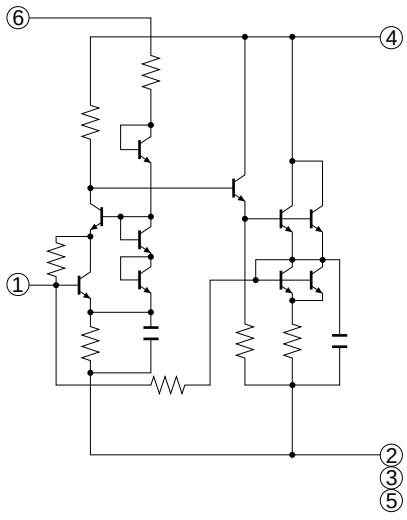
Remark Typical performance with TEST CIRCUIT. Please refer to ELECTRICAL CHARACTERISTICS in detail. To know the associated product, please refer to each lastest data sheet.

Selection point among product line-up

μPC2709T: Suits to 1 GHz 2.5 GHz operation due to small inductance (e.g. 10 nH) between V_{CC} and output pin.

μPC2776T: 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 Ω 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 °C	6	V
Total circuit current	I_{CC}	T_A = +25 °C	60	mA
Total power dissipation	P_T	Mounted on 50 × 50 × 1.6 mm epoxy glass PWB (T_A = +85 °C)	280	mW
Operating temperature	$T_{A(opt)}$		–40 to +85	°C
Storage temperature	$T_{A(stg)}$		–55 to +150	°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	°C	

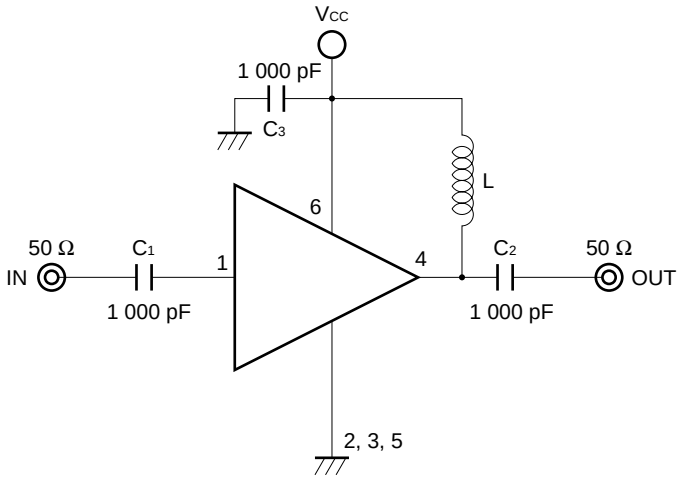
ELECTRICAL CHARACTERISTICS (T_A = +25 °C, V_{CC} = V_{out} = 5.0 V, Z_L = Z_S = 50 Ω)

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

STANDARD CHARACTERISTICS FOR REFERENCE (T_A = +25 °C, V_{CC} = V_{out} = 5.0 V, Z_L = Z_S = 50 Ω)

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

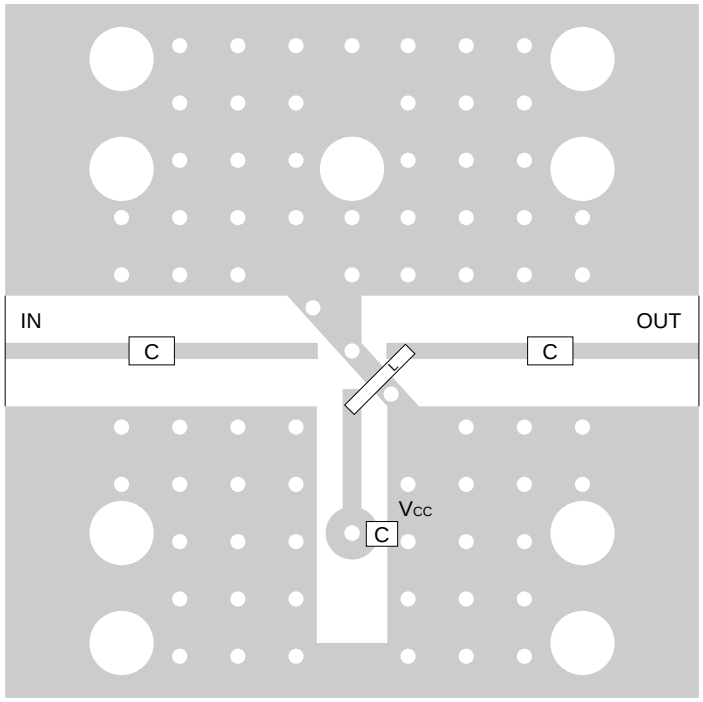
Capacitors of 1 000 pF are recommendable as the bypass capacitor for the V_{CC} pin and the coupling capacitors for the input and output pins.

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



CONPONENT LIST FOR APPLICATION EXAMPLE

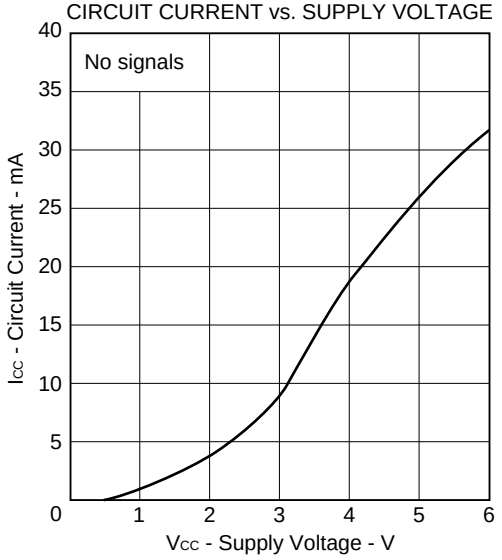
	VALUE
C	1 000 pF
L	100 nH

Note for evaluation board

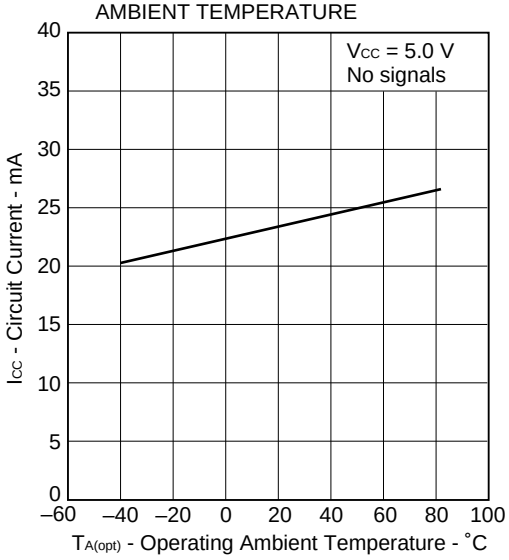
1. 35 × 42 × 0.4 mm double copper clad polyimide board
2. Back side: GND pattern
3. Solder plated on pattern
4. ○ ◯: Through holes

TYPICAL CHARACTERISTICS CURVES (Unless otherwise specified, T_A = +25 °C, with components for measuring electrical characteristics)

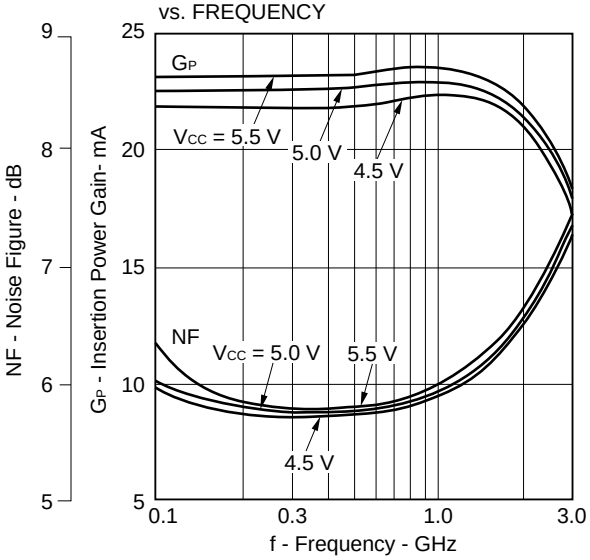
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



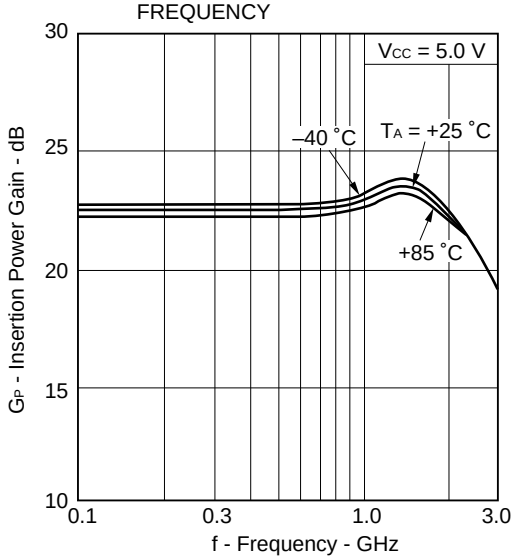
CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



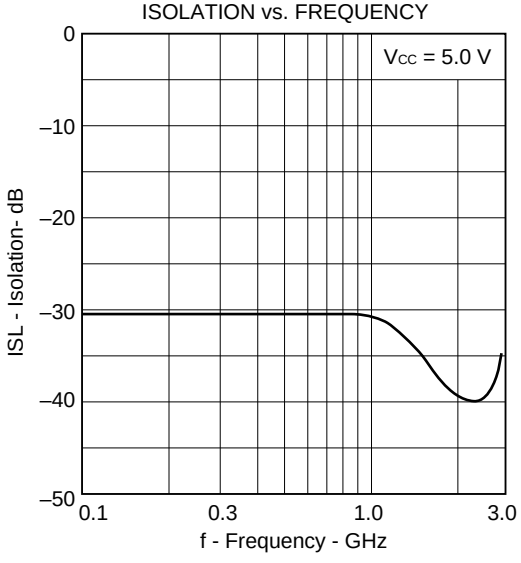
NOISE FIGURE, INSERTION POWER GAIN vs. FREQUENCY



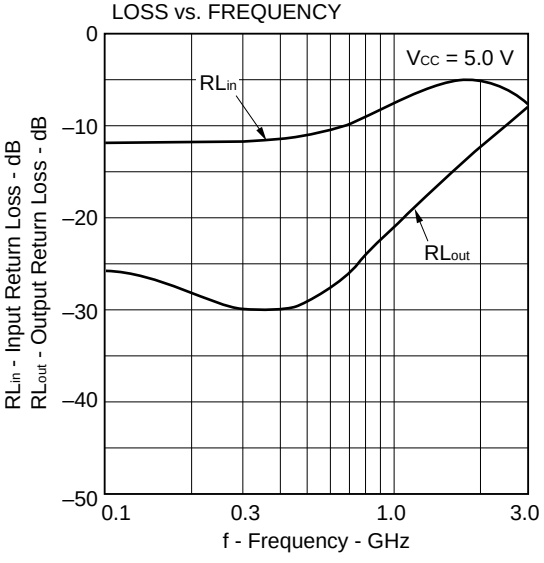
INSERTION POWER GAIN vs. FREQUENCY



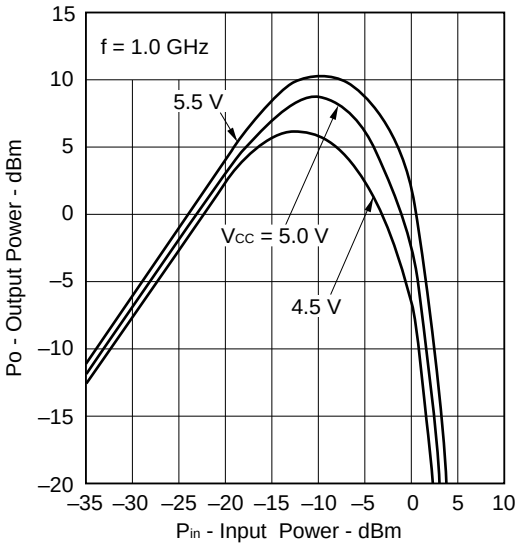
ISOLATION vs. FREQUENCY



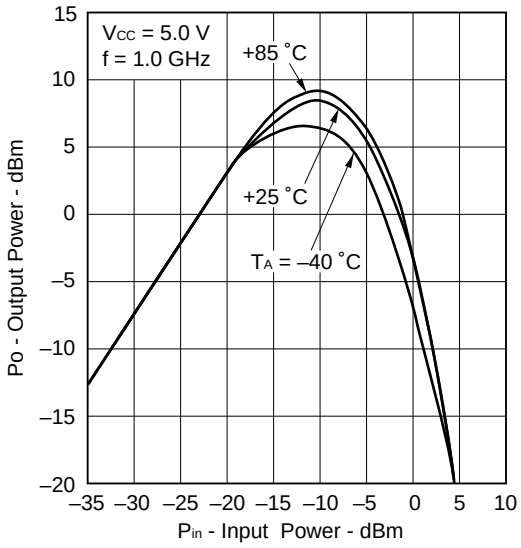
INPUT RETURN LOSS, OUTPUT RETURN LOSS vs. FREQUENCY



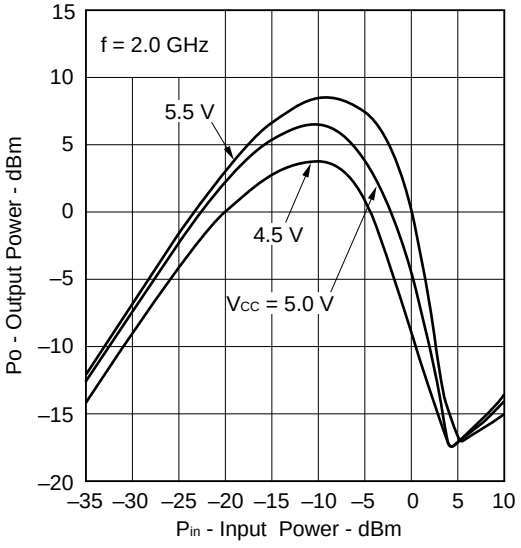
OUTPUT POWER vs. INPUT POWER



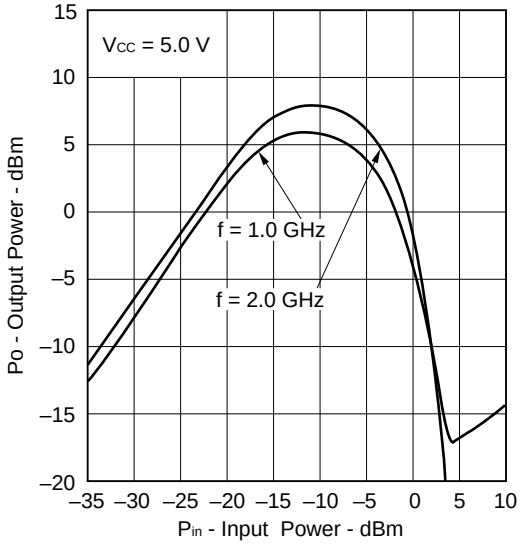
OUTPUT POWER vs. INPUT POWER



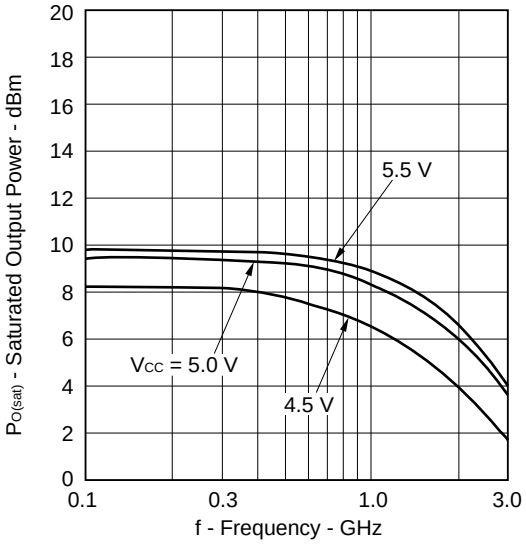
OUTPUT POWER vs. INPUT POWER



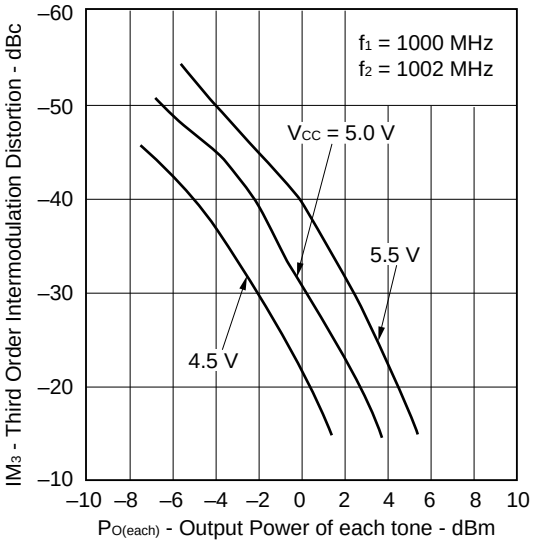
OUTPUT POWER vs. INPUT POWER



SATURATED OUTPUT POWER vs. FREQUENCY

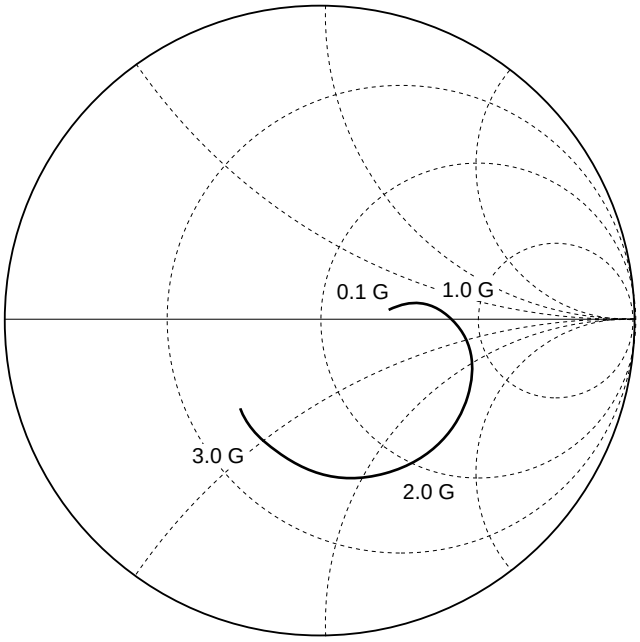


THIRD ORDER INTERMODULATION DISTORTION vs. OUTPUT POWER OF EACH TONE

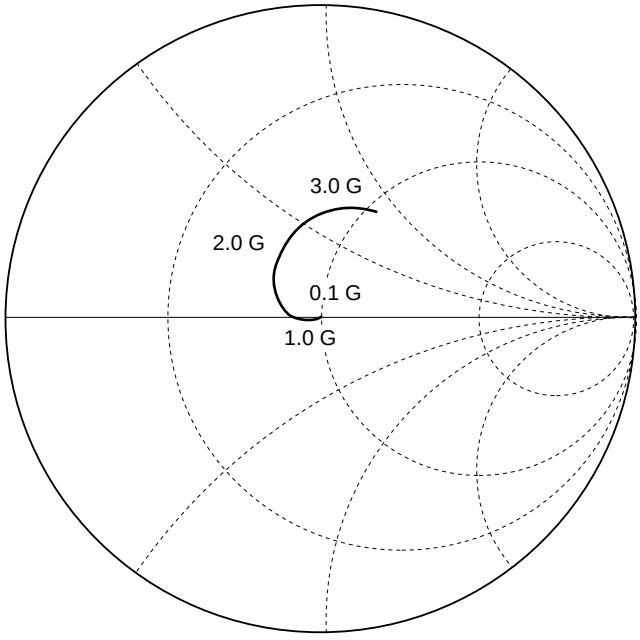


S PARAMETERS (V_{CC} = 5.0 V)

S_{11}-FREQUENCY



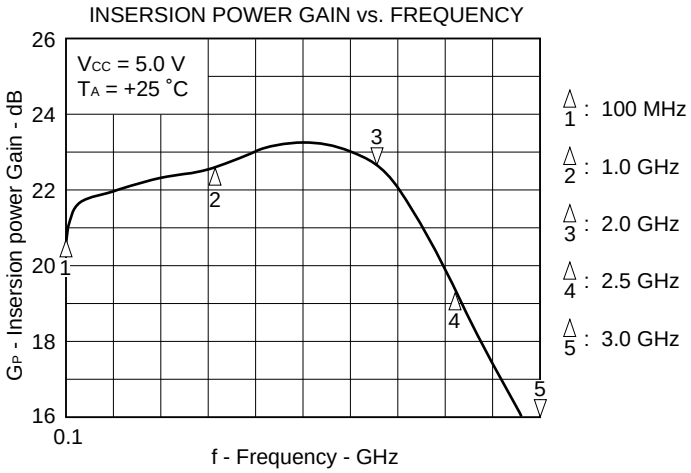
S_{22}-FREQUENCY

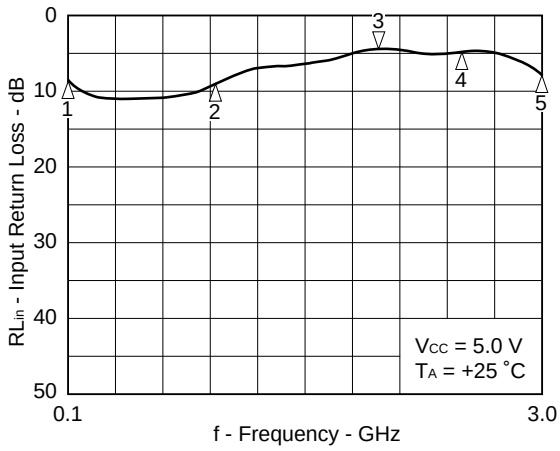


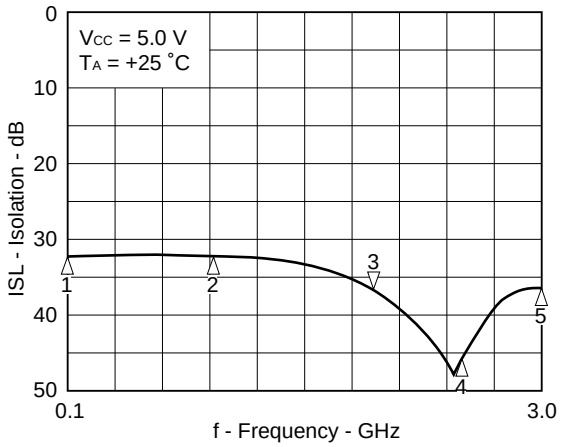
– CHARACTERISTIC CURVES WITH ACTUAL APPLICATION COMPONENT EXAMPLE –

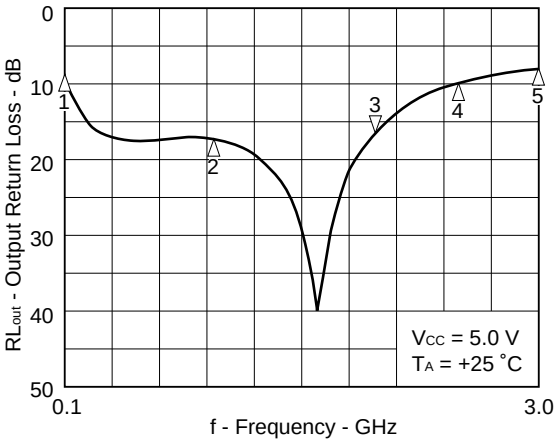
Specifications of sample chip inductor

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

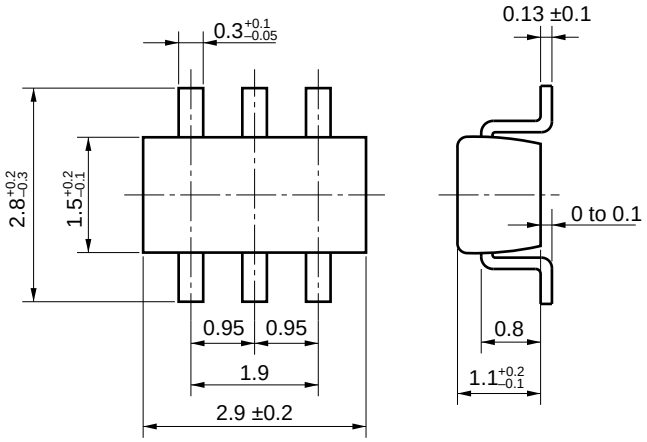








DIMENSIONS OF 6-PIN MINI-MOLD PACKAGE (Unit: mm)



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 V_{CC} pin.

(4) The inductor must be attached between V_{CC} 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.

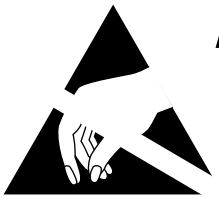
μPC2776T

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: within10 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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