DATA SHEET

NEC

BIPOLAR ANALOG INTEGRATED CIRCUITS

μPC8106T, μPC8109T

2.0 GHz UPCONVERTER ICs FOR CELLULAR AND CORDLESS TELEPHONES

The μPC8106T and μPC8109T are silicon monolithic integrated circuits designed as upconverter series for the transmission stage of cellular and cordless telephones. Due to operation on 3 V and mini-mold package, these ICs contribute to produce low power consumption and physically small systems.

The μPC8106T and μPC8109T are manufactured using NEC's NESAT™III silicon bipolar process (f_T = 20 GHz). This process uses a silicon nitride passivation film and gold electrodes. These materials protect the chip's surface, prevent corrosion and feature the low current and high-frequency characteristics transistors. Thus, these ICs have excellent reliability and electrical performance.

FEATURES

- Recommended operating frequency : f_{RFout} = 0.4 to 2.0 GHz, f_{IFin} = 100 to 400 MHz
- Supply voltage : 2.7 to 5.5 V
- High-density surface mounting possible : 6-pin mini-mold package
- Low power consumption : 9 mA (μPC8106T), 5 mA (μPC8109T)
- Suppressed carrier leakage : Double balanced mixer
- Power-saving function

APPLICATIONS

- PHS, PDC, DECT : μPC8106T
- Analog cellular telephone, CT2 : μPC8109T

ORDERING INFORMATION

PART NUMBER	MARKINGS	PRODUCT TYPE	PACKAGE	ARRANGEMENT
μPC8106T-E3	C2D	High IP_3	6-pin mini-mold	Embossed tape 8 mm wide. Pins 1, 2 and 3 facing the perforations. 3 000 units/reel.
μPC8109T-E3	C2G	Low power consumption		

Note To order evaluation samples please contact local NEC sales office (Order number: μPC8106T or μPC8109T).

Caution: Electro-static sensitive devices

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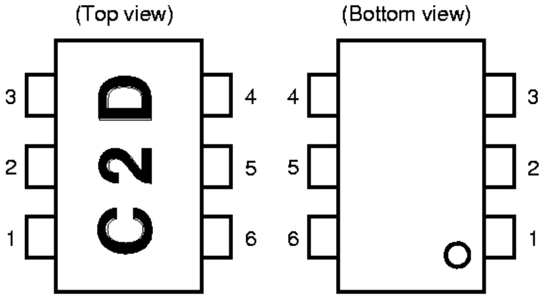
PIN CONNECTIONS



Marking is an example of μPC8106T.

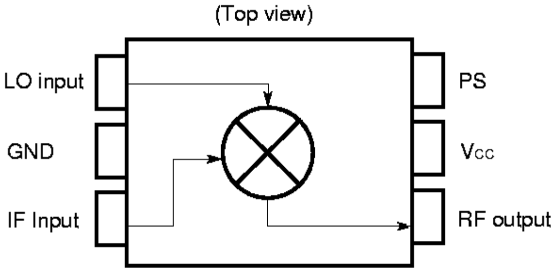
PIN NO.	FUNCTION (for both models)
1	IF input
2	GND
3	LO input
4	PS (Power save)
5	V_{CC}
6	RF output

SERIES PRODUCTS ($T_A = +25$ °C, $V_{CC} = V_{P/S} = V_{RFout} = 3.0$ V, $Z_L = Z_S = 50\ \Omega$)

TYPE	PRODUCT NAME	V_{CC} (V)	I_{CC} (mA)	CG1 (dB)	CG2 (dB)	$P_{O(sat)}1$ (dBm)	$P_{O(sat)}2$ (dBm)	OIP_31 (dBm)	OIP_32 (dBm)
High IP_3	μPC8106T	2.7 to 5.5	9	10	7	−2	−4	+5.5	+2.0
Low power consumption	μPC8109T	2.7 to 5.5	5	7	5	−6	−8	+1.5	−1.0

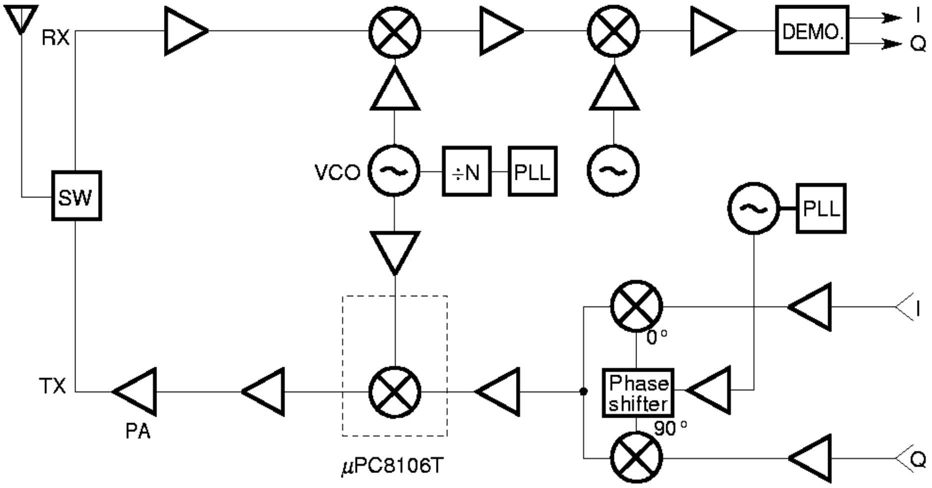
Caution The above table lists the typical performance of each model. See ELECTRICAL CHARACTERISTICS for the test conditions.

BLOCK DIAGRAM (for the μPC8106T and μPC8109T)

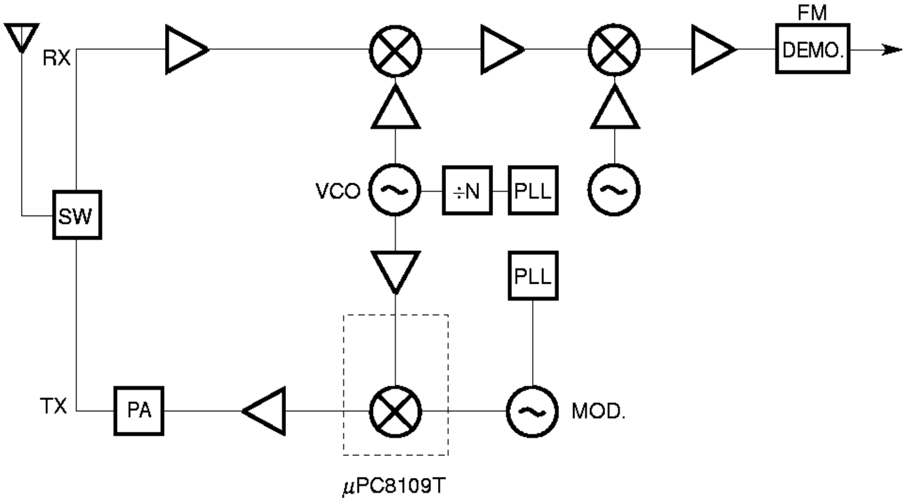


SYSTEM APPLICATION EXAMPLES (SCHEMATICS OF IC LOCATION IN THE SYSTEMS)

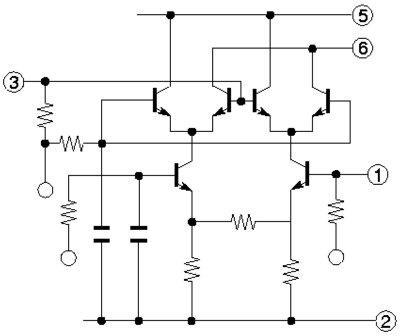
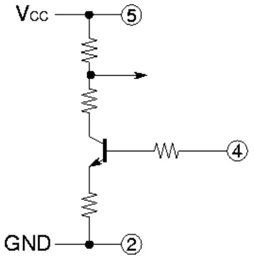
PHS, DECT



Analog cellular telephone



PIN FUNCTIONS (for the μPC8106T and μPC8109T)

PIN No.	PIN NAME	APPLIED VOLTAGE (V)	PIN VOLTAGE (V)	FUNCTION AND EXPLANATION	EQUIVALENT CIRCUIT
1	IF$_{\text{input}}$	—	1.3	This pin is IF input to double balanced mixer (DBM). The input is designed as high impedance. The circuit contributes to suppress spurious signal. Also this symmetrical circuit can keep specified performance insensitive to process-condition distribution. For above reason, double balanced mixer is adopted.	
2	GND	0	—	GND pin. Ground pattern on the board should be formed as wide as possible. Track Length should be kept as short as possible to minimize ground impedance.	
3	LO$_{\text{input}}$	—	2.4	Local input pin. Recommendable input level is –10 to 0 dBm.	
5	V$_{CC}$	2.7 to 5.5	—	Supply voltage pin.	
6	RF$_{\text{output}}$	Same bias as V$_{CC}$ through external inductor	—	This pin is RF output from DBM. This pin is designed as open collector. Due to the high impedance output, this pin should be externally equipped with LC matching circuit to next stage.	
4	PS	V$_{CC}$/GND	—	Power save control pin. Bias controls operation as follows. Pin bias: V$_{CC}$ – Control: Operation Pin bias: GND – Control: Power Save	

Note Each pin voltage is measured with V$_{CC}$ = V$_{P/S}$ = V$_{RFout}$ = 3.0 V.

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	CONDITIONS	RATING	UNIT
Supply Voltage	V_{CC}	T_A = +25 °C, Pin 5 and 6	6.0	V
PS pin Input Voltage	$V_{P/S}$	T_A = +25 °C	6.0	V
Power Dissipation of Package	P_D	Mounted on double-sided copper-clad 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	NOTE
Supply Voltage	V_{CC}	2.7	3.0	5.5	V	The same voltage should be supplied to pin 5 and 6
Operating Temperature	$T_{A(opt)}$	–40	+25	+85	°C	
Local Input Level	P_{LOin}	–10	–5	0	dBm	Z_S = 50 Ω (without matching)
RF Output Frequency	f_{RFout}	0.4	–	2.0	GHz	With external matching circuit
IF Input Frequency	f_{IFin}	100	–	400	MHz	

ELECTRICAL CHARACTERISTICS

(T_A = +25 °C, V_{CC} = V_{RFout} = 3.0 V, f_{IFin} = 240 MHz, P_{LOin} = –5 dBm, and $V_{P/S} \geq 2.7$ V unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	μPC8106T			μPC8109T			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Circuit Current	I_{CC}	No signal	4.5	9	13.5	2.5	5	8.0	mA
Circuit Current in Power-save Mode	I_{CC}(P/S)	$V_{P/S}$ = 0 V	–	–	10	–	–	10	μA
Conversion Gain 1	CG1	f_{RFout} = 0.9 GHz, P_{IFin} = –30 dBm	7	10	13	4	7	10	dB
Conversion Gain 2	CG2	f_{RFout} = 1.9 GHz, P_{IFin} = –30 dBm	4	7	10	2	5	8	dB
Maximum RF Output Power 1	$P_{O(sat)}1$	f_{RFout} = 0.9 GHz, P_{IFin} = 0 dBm	–4	–2	–	–7.5	–5.5	–	dBm
Maximum RF Output Power 2	$P_{O(sat)}2$	f_{RFout} = 1.9 GHz, P_{IFin} = 0 dBm	–6.5	–4	–	–10	–7.5	–	dBm

OTHER CHARACTERISTICS, FOR REFERENCE PURPOSES ONLY

(T_A = +25 °C, $V_{CC} = V_{RFout}$ = 3.0 V, P_{LOin} = –5 dBm, and $V_{P/S} \geq$ 2.7 V unless otherwise mentioned)

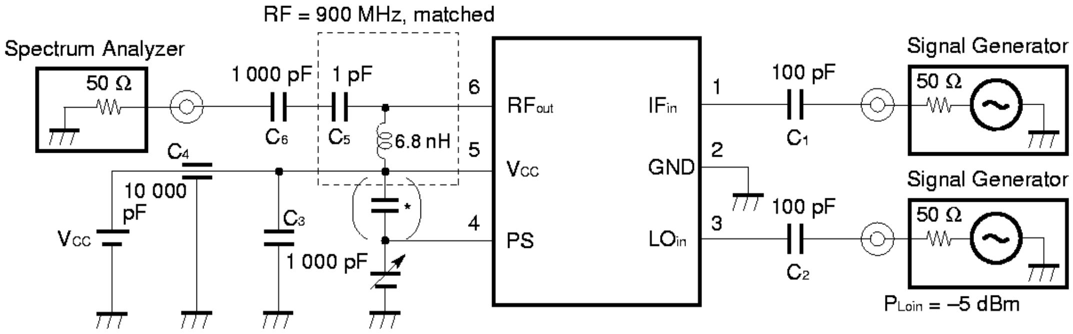
PARAMETER		SYMBOL	CONDITIONS		DATA		UNIT
					μPC8106T	μPC8109T	
Output Third-Order Distortion Intercept Point		OIP$_3$1	f_{IFin1} = 240.0 MHz	f_{RFout} = 0.9 GHz	+5.5	+1.5	dBm
		OIP$_3$2	f_{IFin2} = 240.4 MHz	f_{RFout} = 1.9 GHz	+2.0	–1.0	
Third-Order Intermodulation Distortion 1		IM$_3$1	f_{IFin1} = 240.0 MHz f_{IFin2} = 240.4 MHz P_{IFin} = –20 dBm	f_{RFout} = 0.9 GHz	–31	–29	dBc
Third-Order Intermodulation Distortion 2		IM$_3$2		f_{RFout} = 1.9 GHz	–30	–28	dBc
SSB Noise Figure		SSBNF	f_{RFout} = 0.9 GHz, f_{IFin} = 240 MHz		8.5	8.5	dB
Power Save Responce Time	Rise time	$T_{PS(rise)}$	$V_{P/S}$: GND → V_{CC}		2.0	2.0	μs
	Fall time	$T_{PS(rise)}$	$V_{P/S}$: V_{CC} → GND		2.0	2.0	μs

APPLICATION CIRCUIT EXAMPLE CHARACTERSISTICS FOR REFERENCE PURPOSE ONLY

(T_A = +25 °C, $V_{CC} = V_{P/S} = V_{RFout}$ = 3.0 V, f_{IF} = 130 MHz, f_{LOin} = 1630 MHz, P_{LOin} = –5 dBm)

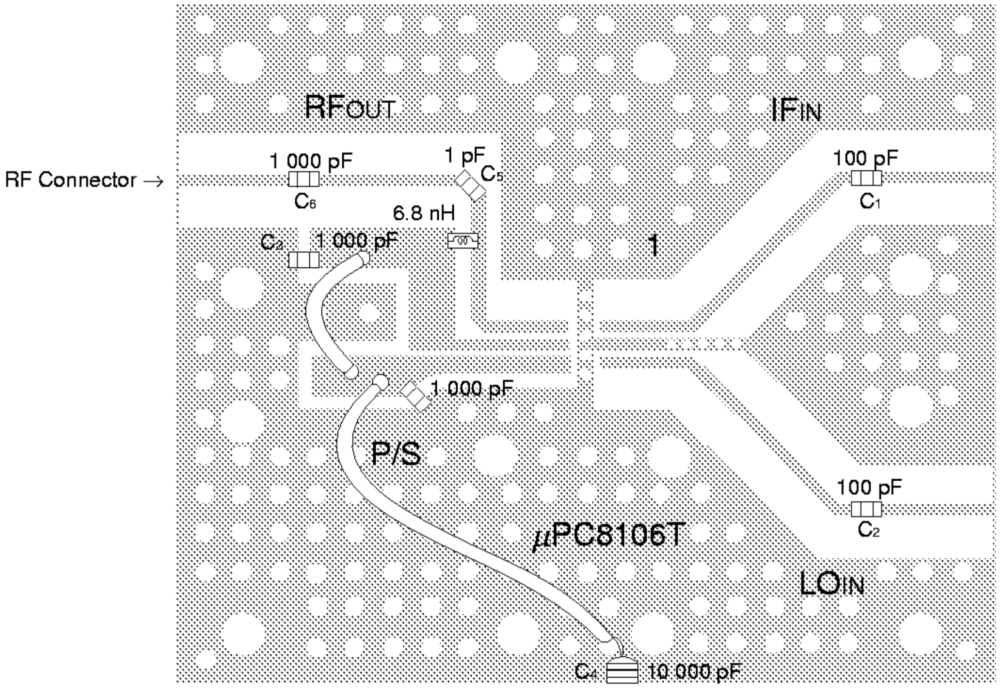
PARAMETER	SYMBOL	CONDITIONS	DATA	UNIT
			μPC8106T	
Conversion Gain 3	CG3	f_{RFout} = 1.5 GHz, with application circuit example	7	dB
Maximum RF Output Power 3	$P_{O(sat)}$3	f_{RFout} = 1.5 GHz, with application circuit example	–3.5	dBm

TEST CIRCUIT 1 (RF = 900 MHz, for the μPC8106T and μPC8109T)



* In case of unstable operation, please connect capacitor 100 pF between 4 pin and 5 pin and adjust the matching circuit.

EXAMPLE OF TEST CIRCUIT 1 ASSEMBLED ON EVALUATION BOARD



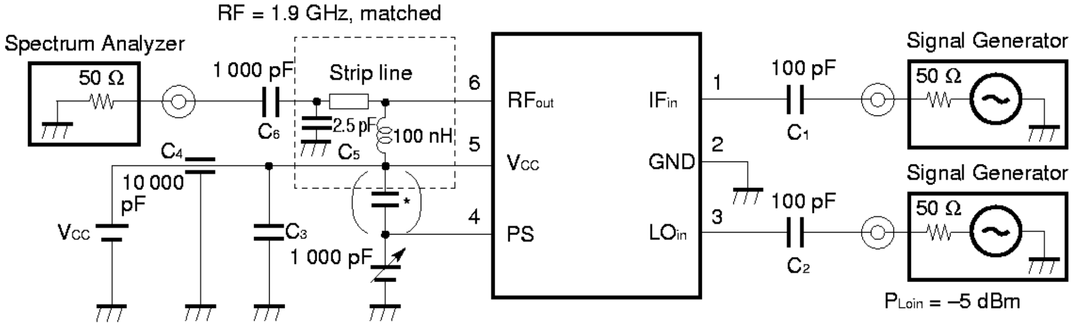
Note on the components

6.8 nH: LQP31A6N8J04 (Murata Mfg. Co., Ltd.)

Notes on the board

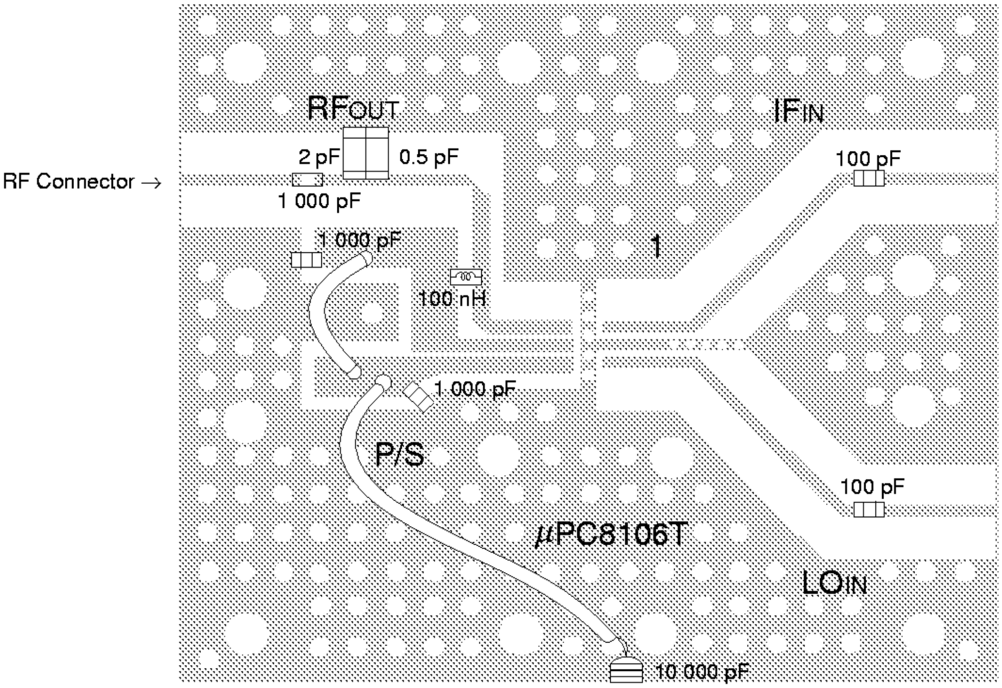
1. 35 × 42 × 0.4 mm polyimide board, 35 μm double-sided copper clad
2. Ground pattern on rear of the board
3. Solder plated patterns
4. ○ ○ ◯ : Through holes
5. C6 is for RF short on the board pattern

TEST CIRCUIT 2 (RF = 1.9 GHz, for the μPC8106T and μPC8109T)



* In case of unstable operation, please connect capacitor 100 pF between 4 pin and 5 pin and adjust the matching circuit.

EXAMPLE OF TEST CIRCUIT 2 ASSEMBLED ON EVALUATION BOARD



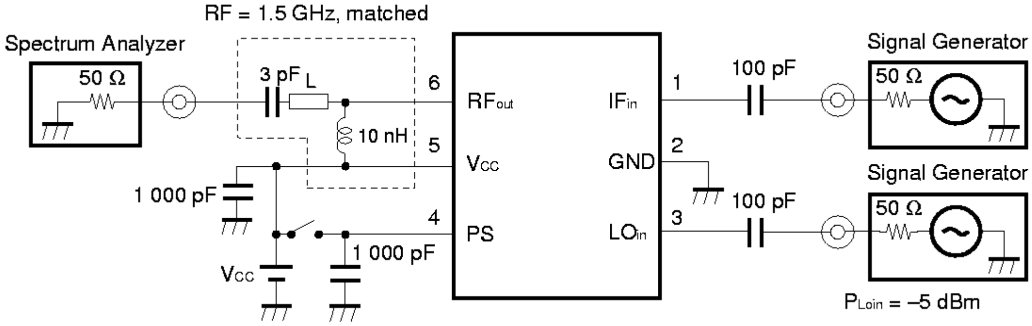
Note on the components

100 nH: LQN1AR10J(K)04 (Murata Mfg. Co., Ltd.)

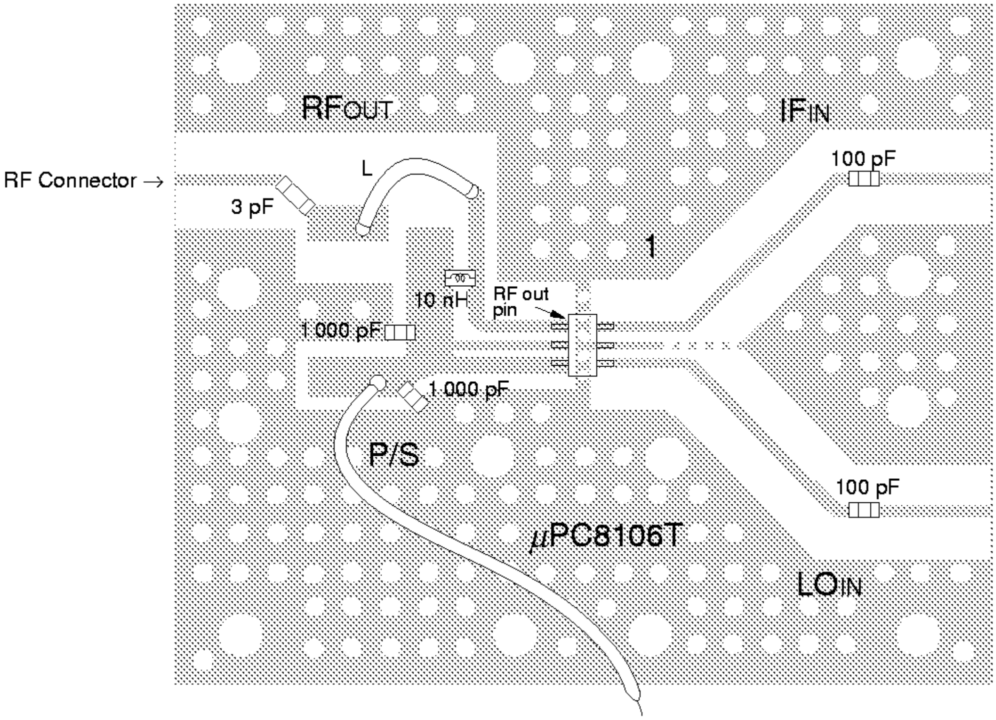
Notes on the board

1. 35 × 42 × 0.4 mm polyimide board, 35 μm double-sided copper clad
2. Ground pattern on rear of the board
3. Solder plated patterns
4. ○◯◯ : Through holes

APPLICATION CIRCUIT EXAMPLE (RF = 1.5 GHz, for the μPC8106T and μPC8109T)



EXAMPLE OF APPLICATION CIRCUIT ASSEMBLED ON EVALUATION BOARD



Note on the components

10 nH: LQN2A10NM (Murata Mfg. Co., Ltd.)

Notes on the board

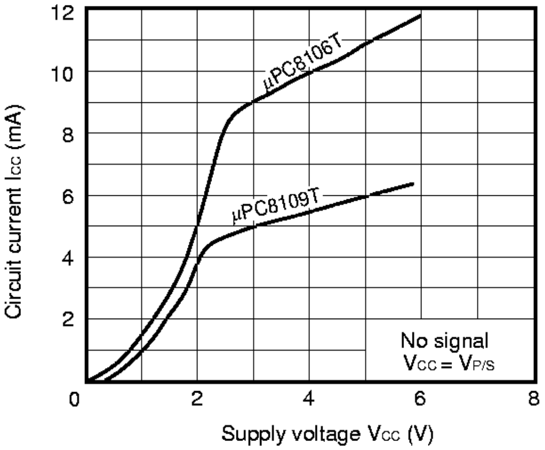
1. 35 × 42 × 0.4 mm polyimide board, 35 μm double-sided copper clad
2. Ground pattern on rear of the board
3. Solder plated patterns
4. ○○◯ : Through holes

NOTICE

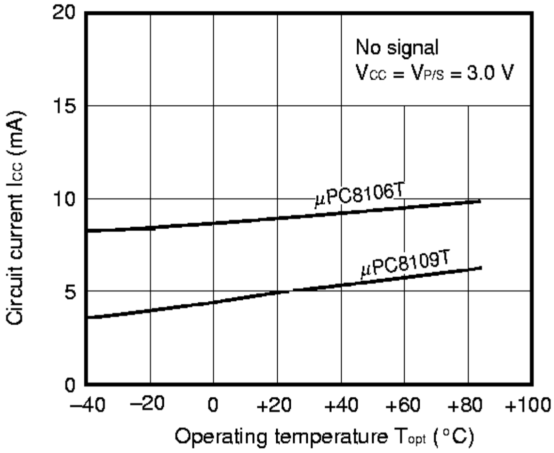
The test circuits and board pattern on data sheet are for performance evaluation use only. (They are not recommended circuits.) In the case of actual design-in, matching circuit should be determined using S parameter of desired frequency in accordance to actual mounting pattern.

CHARACTERISTIC CURVES (T_A = +25 °C, $V_{CC} = V_{RFout}$) with TEST CIRCUIT 1 or 2, according to the operating frequency, unless otherwise specified

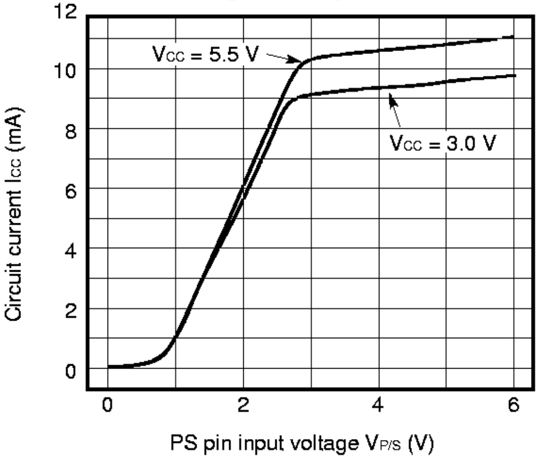
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



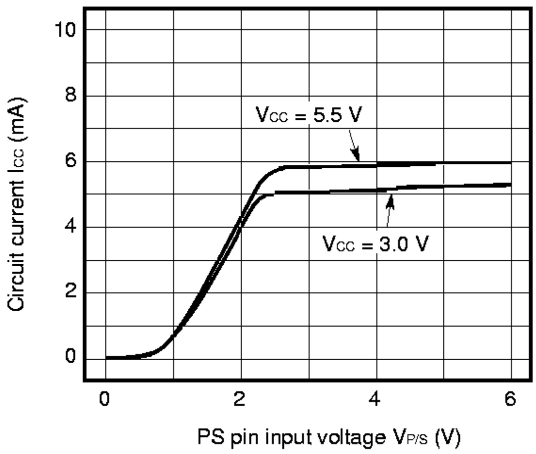
CIRCUIT CURRENT vs. OPERATING TEMPERATURE



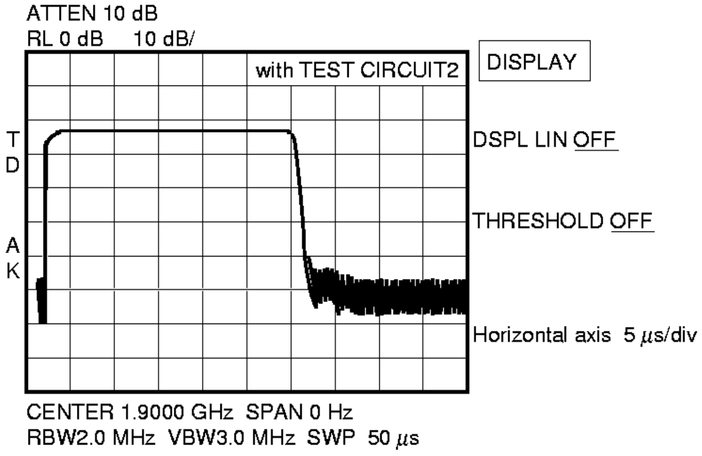
CIRCUIT CURRENT vs. PS PIN INPUT VOLTAGE (μPC8106T)



CIRCUIT CURRENT vs. PS PIN INPUT VOLTAGE (μPC8109T)



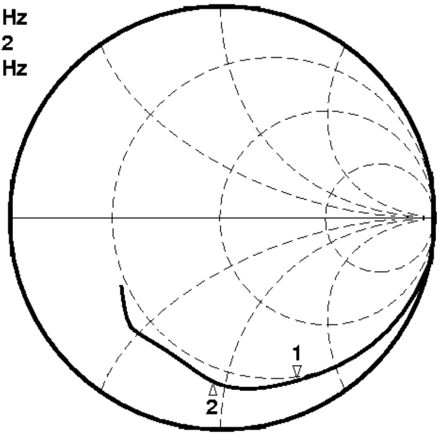
μPC8106T PS PIN CONTROL RESPONCE TIME



S PARAMETERS FOR EACH PORT ($V_{CC} = V_{P/S} = V_{RFout} = 3.0$ V) - μPC8106T, μPC8109T in common - (The parameters are monitored at DUT pins.)

LO port
2 : 12.050 Ω –45.695 Ω 2.1780 pF
1 : 13.961 Ω –76.156 Ω 1.8332 pF

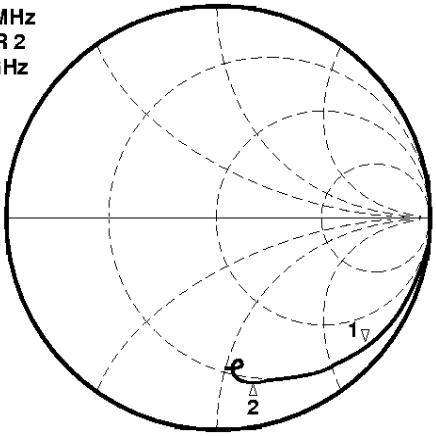
MARKER 1
1.14 GHz
MARKER 2
1.66 GHz



START 0.3 MHz STOP 3 000 MHz

RF port (no matching)
2 : 13.845 Ω –77.34 Ω 1.0850 pF
1 : 20.633 Ω –144.74 Ω 1.2218 pF

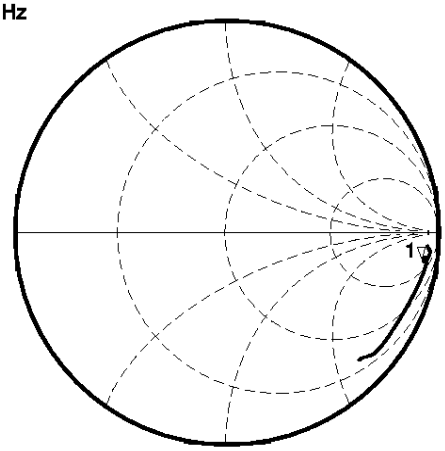
MARKER 1
900 MHz
MARKER 2
1.9 GHz



START 500 MHz STOP 2 300 MHz

IF port
1 : 154.64 Ω –494.41 Ω 1.2876 pF

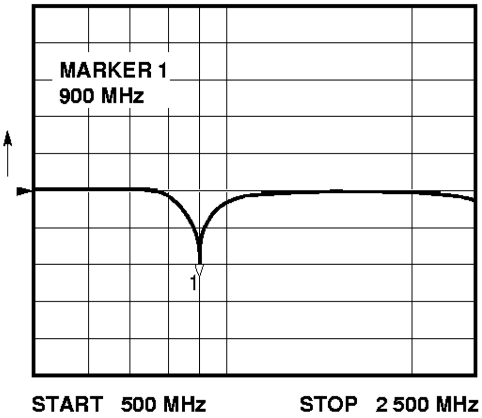
MARKER 1
250 MHz



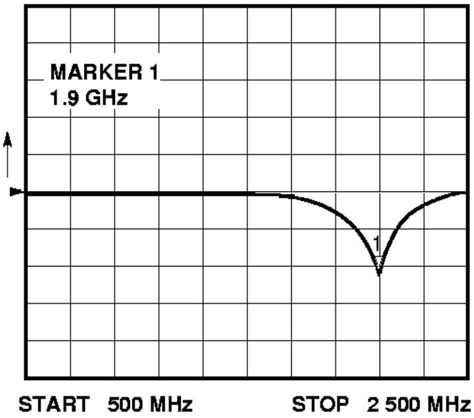
START 50 MHz STOP 1 000 MHz

S PARAMETERS FOR MATCHED RF OUTPUT ($V_{CC} = V_{P/S} = V_{RFout}$ = 3.0 V) - with TEST CIRCUITS 1 and 2 (μPC8106T, μPC8109T in common) - (S_{22} data are monitored at RF connector on board.)

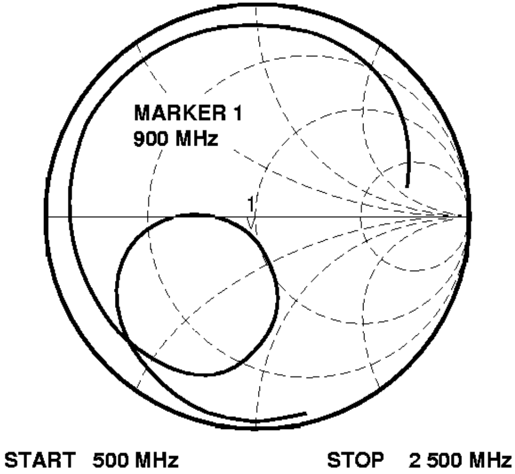
S_{22}: 900 MHz (LC-matched) in test circuit 1
S_{22} log MAG 10 dB/REF 0dB 1: –22.09 dB



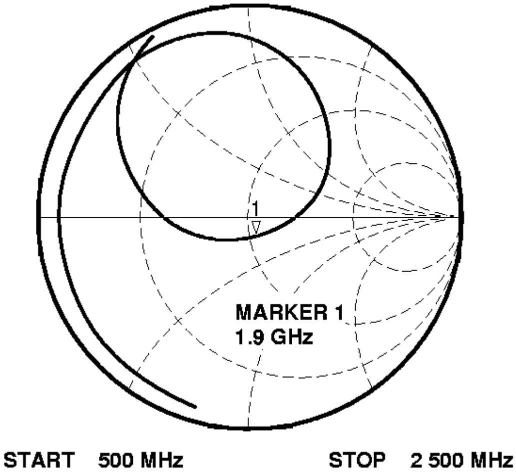
S_{22}: 1.9 GHz (matched) in test circuit 2
S_{22} log MAG 10 dB/REF 0dB 1: –22.362 dB



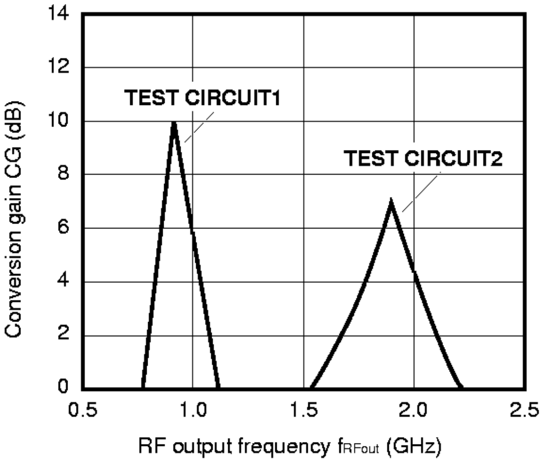
S_{22} 1 : 45.508 Ω –6.7324 Ω 26.257 pF



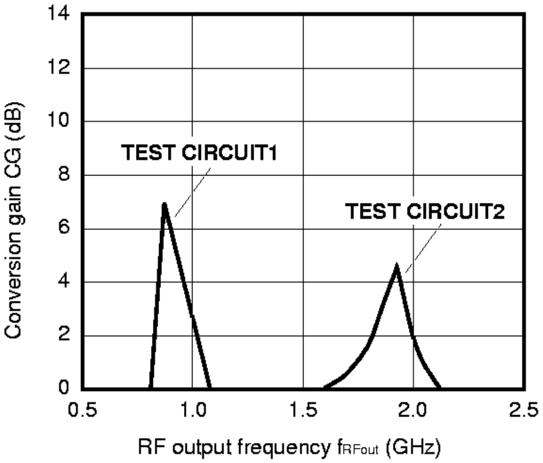
S_{22} 1 : 51.861 Ω –7.5156 Ω 11.146 pF



CONVERSION GAIN vs. RF OUTPUT FREQUENCY IN MATCHED TEST CIRCUIT (μPC8106T)

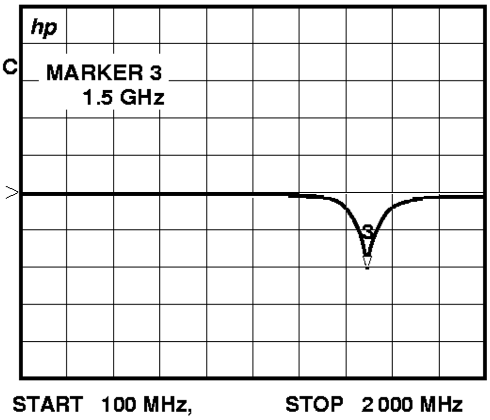


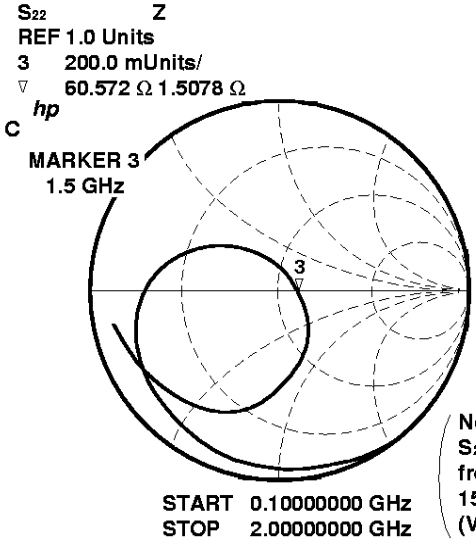
CONVERSION GAIN vs. RF OUTPUT FREQUENCY IN MATCHED TEST CIRCUIT (μPC8109T)



S PARAMETERS FOR MATCHED RF OUTPUT ($V_{CC} = V_{P/S} = V_{RFout} = 3.0$ V) - with application circuit example - (S_{22} data are monitored at RF connector on board.)

S_{22} : 1.5 GHz (LC-matched) in application circuit example
S_{22} log MAG 10 dB/REF 0 dB 3: –22.231 dB



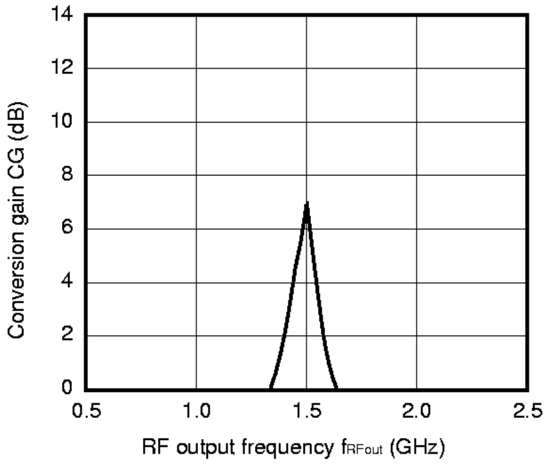


Notice
S_{22} of RF out pin of DUT

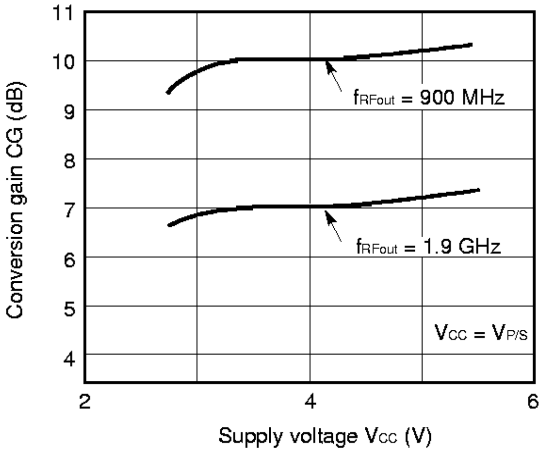
freq.	MAG	ANG
1500 MHz	.773	–66.9

($V_{CC} = V_{P/S} = V_{RFout} = 3.0$ V)

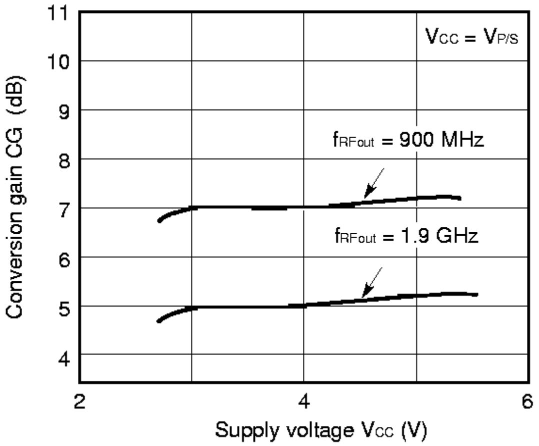
μPC8106T CONVERSION GAIN vs.
RF OUTPUT FREQUENCY ON MATCHED
EVALUATION BOARD



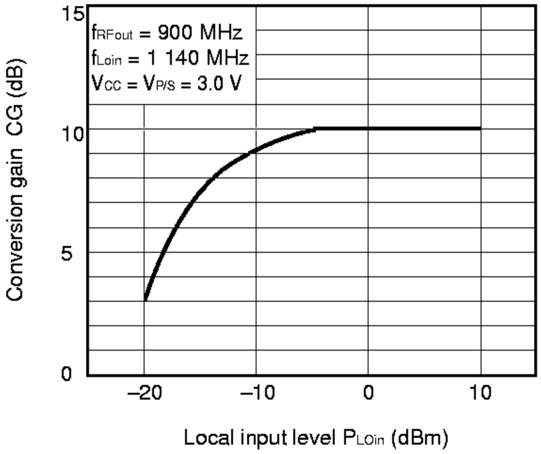
CONVERSION GAIN vs. SUPPLY VOLTAGE (μPC8106T)



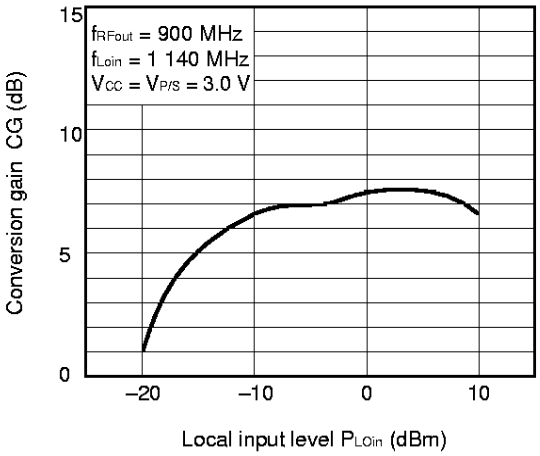
CONVERSION GAIN vs. SUPPLY VOLTAGE (μPC8109T)



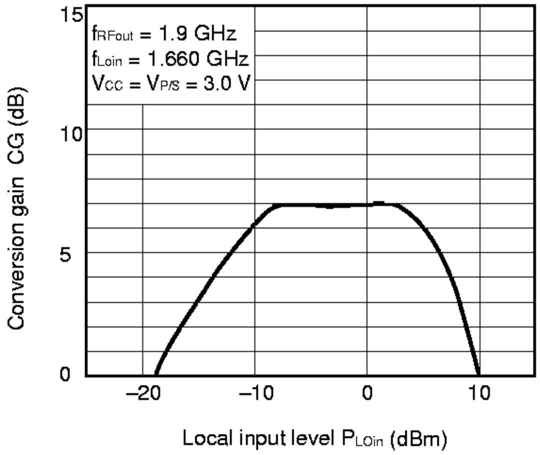
CONVERSION GAIN vs. LOCAL INPUT LEVEL AT RF 900 MHz (μPC8106T)



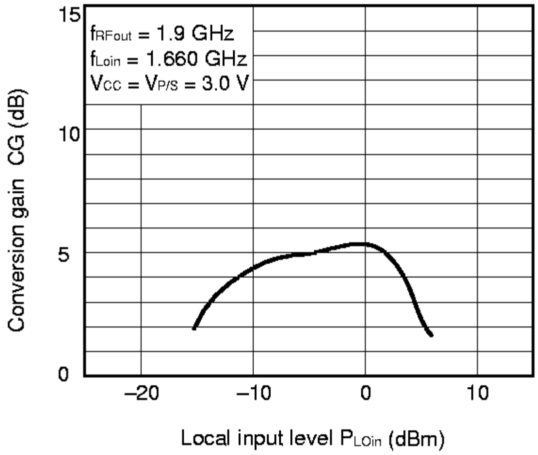
CONVERSION GAIN vs. LOCAL INPUT LEVEL AT RF 900 MHz (μPC8109T)



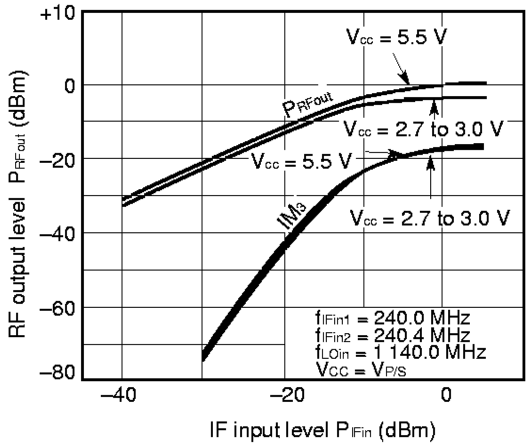
CONVERSION GAIN vs. LOCAL INPUT LEVEL AT RF 1.9 GHz (μPC8106T)



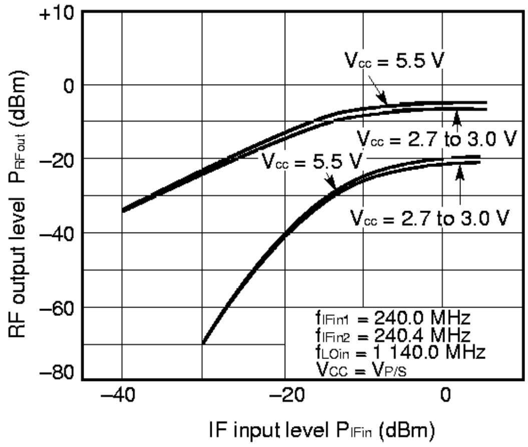
CONVERSION GAIN vs. LOCAL INPUT LEVEL AT RF 1.9 GHz (μPC8109T)



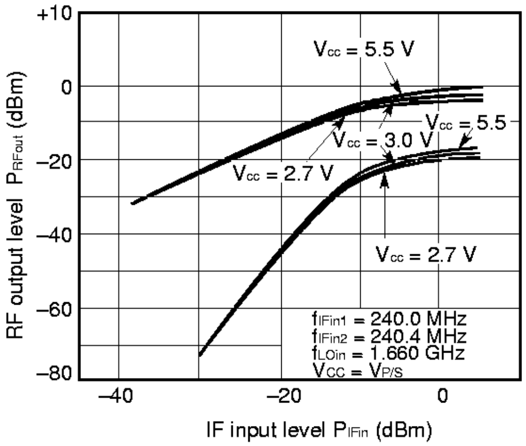
IM3 AND RF OUTPUT LEVEL vs. IF INPUT LEVEL AT RF 900 MHz (μPC8106T)



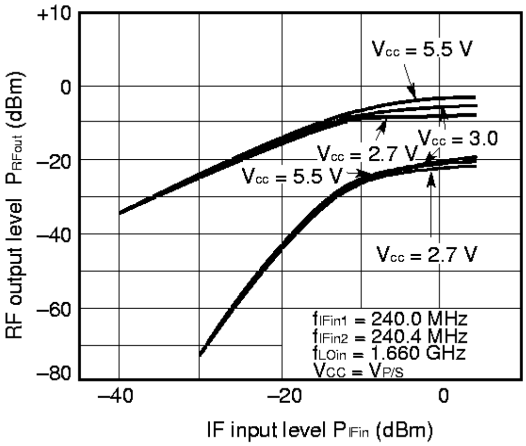
IM3 AND RF OUTPUT LEVEL vs. IF INPUT LEVEL AT RF 900 MHz (μPC8109T)



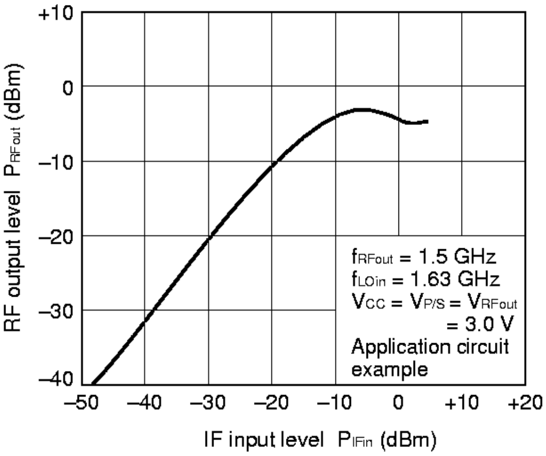
IM3 AND RF OUTPUT LEVEL vs. IF INPUT LEVEL AT RF 1.9 GHz (μPC8106T)



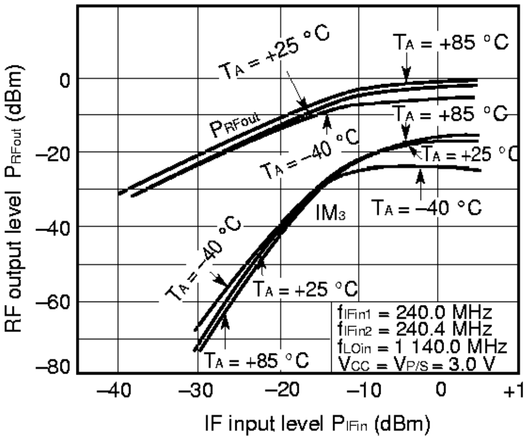
IM3 AND RF OUTPUT LEVEL vs. IF INPUT LEVEL AT RF 1.9 GHz (μPC8109T)



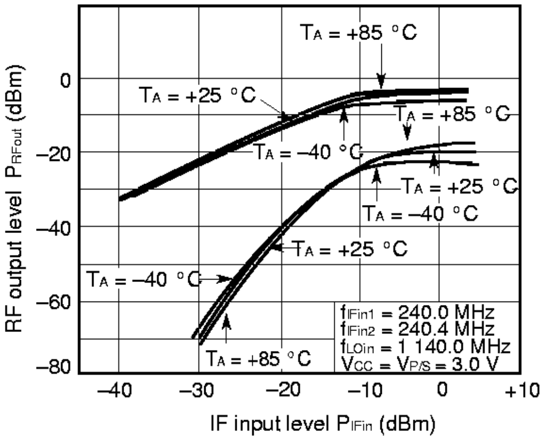
μPC8106T RF OUTPUT LEVEL vs. IF INPUT LEVEL AT RF 1.5 GHz



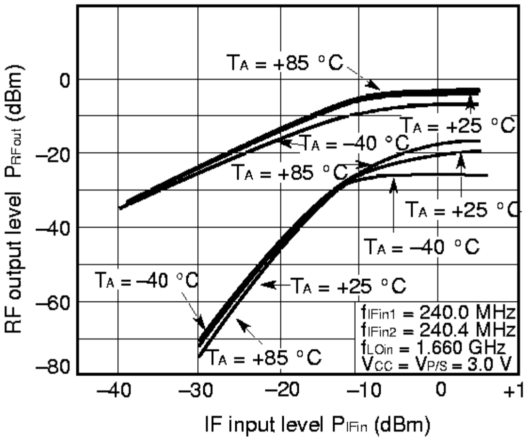
IM$_3$ AND RF OUTPUT LEVEL vs. IF INPUT LEVEL AT RF 900 MHz (μPC8106T)



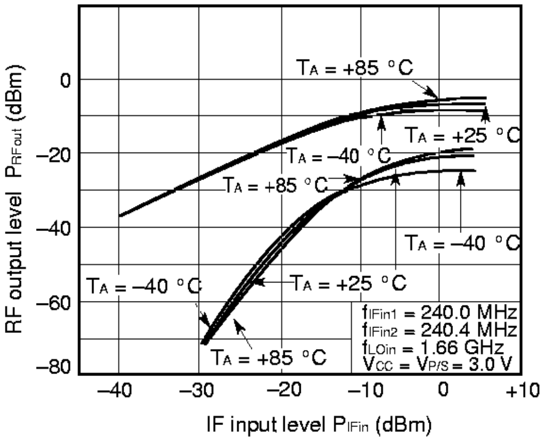
IM$_3$ AND RF OUTPUT LEVEL vs. IF INPUT LEVEL AT RF 900 MHz (μPC8109T)



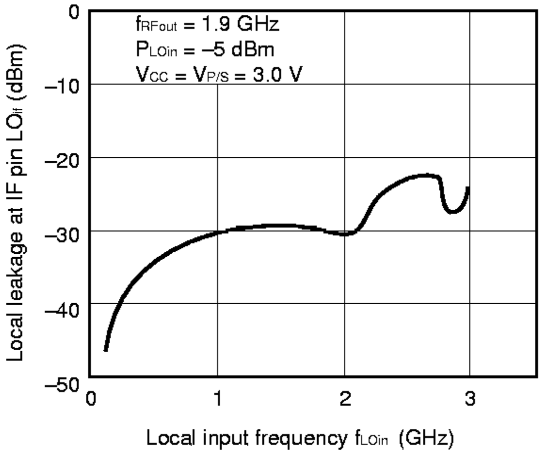
IM$_3$ AND RF OUTPUT LEVEL vs. IF INPUT LEVEL AT RF 1.9 GHz (μPC8106T)



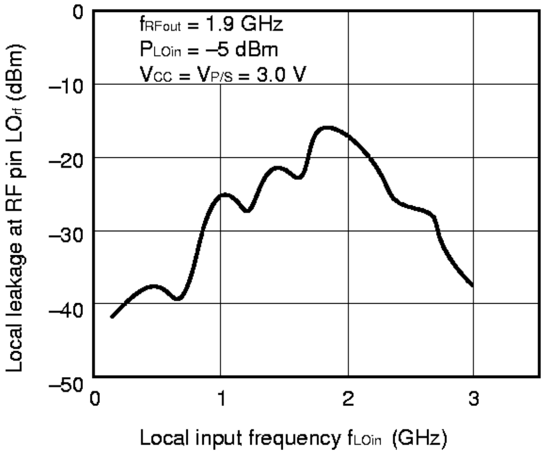
IM$_3$ AND RF OUTPUT LEVEL vs. IF INPUT LEVEL AT RF 1.9 GHz (μPC8109T)



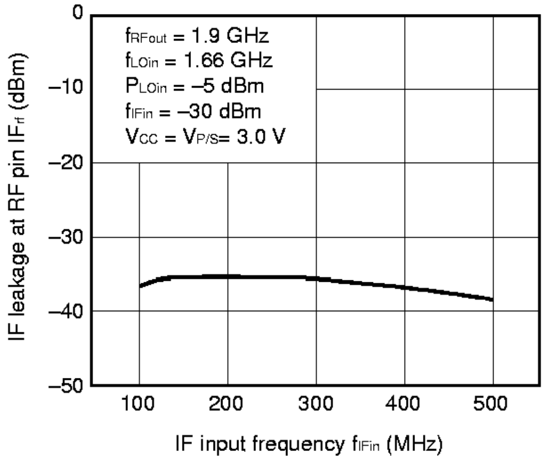
LOCAL LEAKAGE AT IF PIN vs. LOCAL INPUT FREQUENCY AT RF 1.9 GHz (μPC8106T)



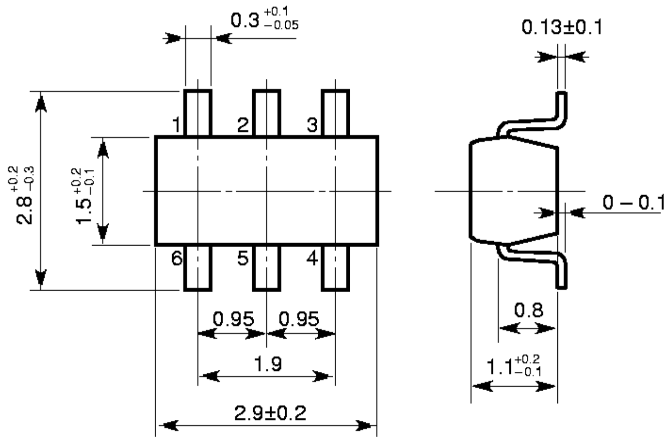
LOCAL LEAKAGE AT RF PIN vs. LOCAL INPUT FREQUENCY AT RF 1.9 GHz (μPC8106T)



IF LEAKAGE AT RF PIN vs. IF INPUT FREQUENCY AT RF 1.9 GHz (μPC8106T)



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



NOTES ON CORRECT USE

(1) Observe precutions for handling because of electrostatic sensitive devices.
(2) Form a ground pattern wide as possible to minimize ground impedance (to prevent undesired oscillation).
(3) Keep the wiring length of the ground pins as short as possible.
(4) Connect a bypass capacitor to the V_{CC} pin.
(5) Connect a matching circuit to the RF output pin.

RECOMMENDED SOLDERING CONDITIONS

The conditions listed below shall be satisfied when soldering this product.

Consult your NEC sales representative when using any other soldering process, or when soldering is done under different conditions.

μPC8106T, μPC8109T

SOLDERING PROCESS	SOLDERING CONDITIONS	SYMBOL
Infrared ray reflow	Peak package surface temperature: 235 °C Reflow time : 30 seconds or less (at 210 °C or more) Number of reflow processes : 3 Exposure limit[Note] : None	IR35-00-3
VPS	Peak package surface temperature: 215 °C Reflow time : 40 seconds or less (at 200 °C or more) Number of reflow processes : 3 Exposure limit[Note] : None	VP15-00-3
Wave soldering	Solder temperature : 260 °C Flow time : 10 seconds or less Number of flow processes : 1 Exposure limit[Note] : None	WS60-00-1
Partial heating method	Solder temperature : 300 °C or less Flow time : 3 seconds or less Exposure limit[Note] : None	

Note Exposure limit before soldering after dry-pack package is opened.
Storage conditions: Temperature of 25 °C and maximum relative humidity of 65%

Caution Do not apply more than a single process at once, except for "Partial heating method".

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NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.

Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

Anti-radioactive design is not implemented in this product.

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