PRELIMINARY DATA SHEET

NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC8172TK

SMALL PACKAGE FREQUENCY UP-CONVERTER IC

DESCRIPTION

The μPC8172TK is a silicon monolithic integrated circuit designed as frequency up-converter for cellular telephone transmitter stage.

This TK suffix IC which is smaller package than conventional TB suffix IC contribute to reduce your system size.

This IC is manufactured using our 30 GHz f_{max} UHS0 (Ultra High Speed Process) silicon bipolar process.

FEATURES

- High output frequency : f_{RFout} = 0.8 to 2.5 GHz
- Circuit current : I_{CC} = 9.0 mA TYP.
- High-density surface mounting : 6-pin lead-less minimold package
- Supply voltage : V_{CC} = 2.7 to 3.3 V

APPLICAIONS

- PCS1900M
- 2.4 GHz band transmitter/receiver system (wireless LAN etc.)
- RF module etc.

ORDERING INFORMATION

Part Number	Package	Marking	Supplying Form
μ PC8172TK-E2	6-pin lead-less minimold (1511)	6A	• Embossed tape 8 mm wide • Pin 1, 6 face the perforation side of the tape • Qty 5 kpcs/reel

Remark To order evaluation samples, contact your nearby sales office.
Part number for sample order: μPC8172TK

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

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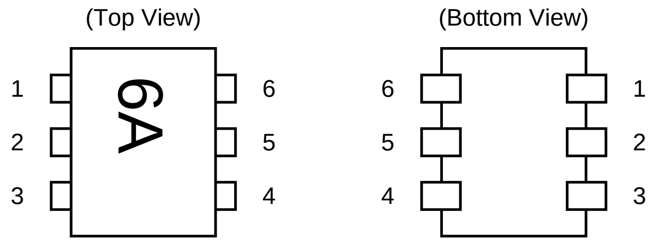
PIN CONNECTIONS



Pin No.	Pin Name
1	IFinput
2	GND
3	LOinput
4	PS
5	V_{CC}
6	RFoutput

Caution Pin arrangement differs from the conventional 6-pin super mini-mold type (μPC8172TB).

PRODUCT LINE-UP

Part No.	Package	I_{CC} (mA)	f_{RFout} (GHz)	CG (dB)		
				@RF0.9 (GHz) Note	@RF1.9 (GHz)	@RF2.4 (GHz)
μPC8172TK	6-pin lead-less minimold	9.0	0.8 to 2.5	9.5	8.5	8.0
μPC8106TB	6-pin super minimold (1511)	9.0	0.4 to 2.0	9.0	7.0	–
μPC8109TB		5.0	0.4 to 2.0	6.0	4.0	–
μPC8163TB		16.5	0.8 to 2.0	9.0	5.5	–
μPC8172TB		9.0	0.8 to 2.5	9.5	8.5	8.0
μPC8187TB		15.0	0.8 to 2.5	11.0	11.0	10.0

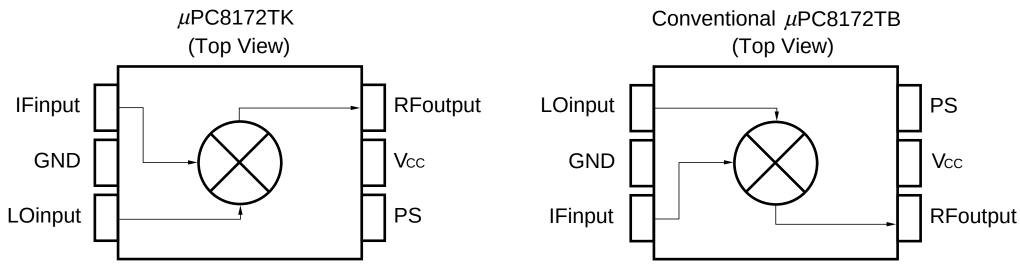
Part No.	$P_{O (sat)}$ (dBm)			OIP_3 (dBm)		
	@RF0.9 (GHz) Note	@RF1.9 (GHz)	@RF2.4 (GHz)	@RF0.9 (GHz) Note	@RF1.9 (GHz)	@RF2.4 (GHz)
μPC8172TK	+0.5	0	–0.5	+7.5	+6.0	+4.0
μPC8106TB	–2.0	–4.0	–	+5.5	+2.0	–
μPC8109TB	–5.5	–7.5	–	+1.5	–1.0	–
μPC8163TB	+0.5	–2.0	–	+9.5	+6.0	–
μPC8172TB	+0.5	0	–0.5	+7.5	+6.0	+4.0
μPC8187TB	+4.0	+2.5	+1.0	+10.0	+10.0	+8.5

Note f_{RFout} = 0.83 GHz@ μPC8163TB, μPC8187TB

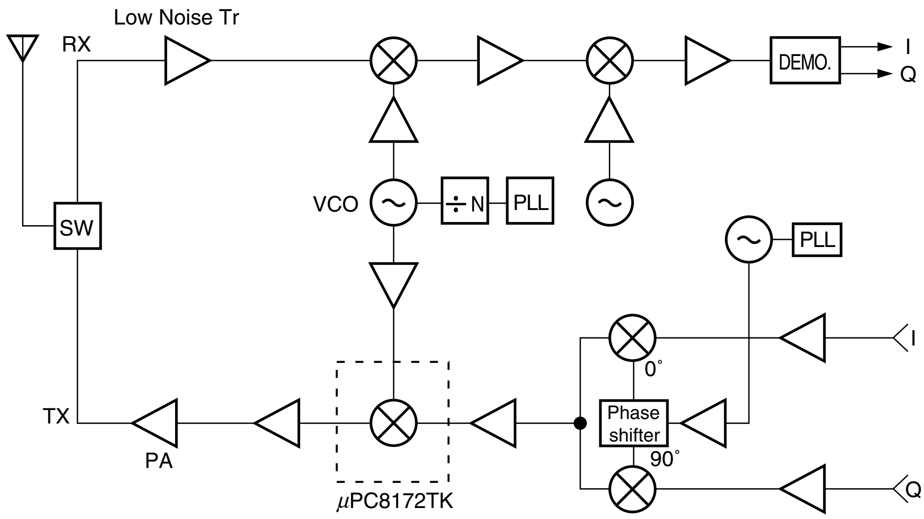
Remarks 1. Typical performance. Please refer to **ELECTRICAL CHARACTERISTICS** in detail.

2. To know the associated product, please refer to each latest data sheet.

BLOCK DIAGRAM

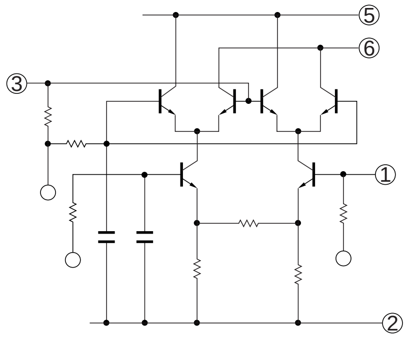
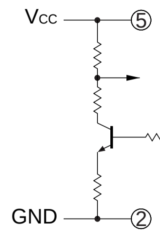


SYSTEM APPLICATION EXAMPLE



Caution To know the associated products, please refer to each latest data sheet.

PIN EXPLANATION

<table>
<tr><th>Pin No.</th><th>Pin Name</th><th>Applied Voltage (V)</th><th>Pin Voltage (V) Note</th><th>Function and Applications</th><th>Internal Equivalent Circuit</th></tr>
<tr><td>1</td><td>IFinput</td><td>–</td><td>1.3</td><td>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.</td><td rowspan="5">
</td></tr>
<tr><td>2</td><td>GND</td><td>GND</td><td>–</td><td>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.</td></tr>
<tr><td>3</td><td>LOinput</td><td>–</td><td>2.4</td><td>Local input pin.
Recommendable input level is –10 to 0 dBm.</td></tr>
<tr><td>5</td><td>V_{CC}</td><td>2.7 to 3.3</td><td>–</td><td>Supply voltage pin.</td></tr>
<tr><td>6</td><td>RFoutput</td><td>Same bias as V_{CC} through external inductor</td><td>–</td><td>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.</td></tr>
<tr><td>4</td><td>PS</td><td>V_{CC}/GND</td><td>–</td><td>Power save control pin.
Bias controls operation as follows.
<table><tr><th>Pin bias</th><th>Control</th></tr><tr><td>V_{CC}</td><td>Operation</td></tr><tr><td>GND</td><td>Power Save</td></tr></table></td><td>
</td></tr>
</table>

Note Each pin voltage is measured with $V_{CC} = V_{PS} = V_{RFout} = 3.0$ V

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Test Conditions	Ratings	Unit
Supply Voltage	V_{CC}	T_A = +25°C	3.6	V
PS pin input Voltage	V_{PS}	T_A = +25°C	3.6	V
Power Dissipation of Package	P_D	T_A = +85°C **Note**	203	mW
Operating Ambient Temperature	T_A		–40 to +85	°C
Storage Temperature	T_{stg}		–55 to +150	°C
Input Power	P_{in}		+10	dBm

Note Mounted on double-side copper-clad 50 × 50 × 1.6 mm epoxy glass PWB

RECOMMENDED OPERATING RANGE

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Remarks
Supply Voltage	V_{CC}	2.7	3.0	3.3	V	Same voltage should be applied to pin 5 and pin 6.
Operating Ambient Temperature	T_A	–40	+25	+85	°C	
Local Input Level	P_{LOin}	–10	–5	0	dBm	Z_S = 50 Ω (without matching)
RF Output Frequency	f_{RFout}	0.8	–	2.5	GHz	With external matching circuit
IF Input Frequency	f_{IFin}	50	–	600	MHz	

ELECTRICAL CHARACTERISTICS (T_A = +25°C, V_{CC} = V_{RFout} = 3.0 V, f_{IFin} = 240 MHz, P_{LOin} = –5 dBm, and V_{PS} ≥ 2.7 V, unless otherwise specified)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
Circuit Current	I_{CC}	No signal		5.5	9.0	13	mA
Circuit Current In Power Save Mode	$I_{CC (PS)}$	V_{PS} = 0 V		–	–	2.0	μA
Conversion Gain	CG1	f_{RFout} = 0.9 GHz Note1	P_{IFin} = –30 dBm, f_{IFin} = 240 MHz	6.5	9.5	12.5	dB
	CG2	f_{RFout} = 1.9 GHz Note2		5.5	8.5	11.5	dB
	CG3	f_{RFout} = 2.4 GHz Note2		5.0	8.0	11.0	dB
Saturated RF output Power	$P_{O (sat)}$ 1	f_{RFout} = 0.9 GHz Note1	P_{IFin} = 0 dBm, f_{IFin} = 240 MHz	–2.5	+0.5	–	dBm
	$P_{O (sat)}$ 2	f_{RFout} = 1.9 GHz Note2		–3.5	0	–	dBm
	$P_{O (sat)}$ 3	f_{RFout} = 2.4 GHz Note2		–4.0	–0.5	–	dBm

Notes 1. $f_{RFout} < f_{LOin}$ @ f_{RFout} = 0.9 GHz

2. $f_{LOin} < f_{RFout}$ @ f_{RFout} = 1.9 GHz/2.4 GHz

OTHER CHARACTERISTICS, FOR REFERENCE PURPOSES ONLY

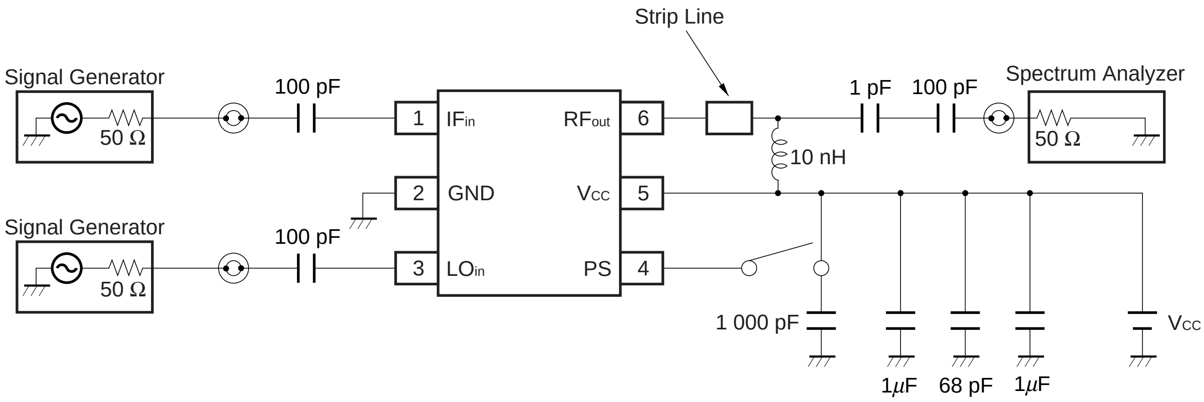
(T_A = +25°C, V_{CC} = V_{RFout} = 3.0 V, P_{LOin} = –5 dBm, and $V_{PS} \geq$ 2.7 V, unless otherwise specified)

Parameter		Symbol	Test Conditions		Data	Unit
Out 3rd Order Distortion Intercept Point		$OIP_3$1	f_{RFout} = 0.9 GHz Note1	$f_{IFin}1$ = 240 MHz $f_{IFin}2$ = 241 MHz	+7.5	dBm
		$OIP_3$2	f_{RFout} = 1.9 GHz Note2		+6.0	dBm
		$OIP_3$3	f_{RFout} = 2.4 GHz Note2		+4.0	dBm
Input 3rd Order Distortion Intercept Point		$IIP_3$1	f_{RFout} = 0.9 GHz Note1	$f_{IFin}1$ = 240 MHz $f_{IFin}2$ = 241 MHz	–2.0	dBm
		$IIP_3$2	f_{RFout} = 1.9 GHz Note2		–2.5	dBm
		$IIP_3$3	f_{RFout} = 2.4 GHz Note2		–4.0	dBm
SSB Noize Figure		SSB·NF1	f_{RFout} = 0.9 GHz, f_{IFin} = 240 MHz		9.5	dB
		SSB·NF2	f_{RFout} = 1.9 GHz, f_{IFin} = 240 MHz		10.4	dB
		SSB·NF3	f_{RFout} = 2.4 GHz, f_{IFin} = 240 MHz		10.6	dB
Power Save Response Time	Rise time	$T_{PS\ (rise)}$	V_{PS} : GND → V_{CC}		1.0	μs
	Fall time	$T_{PS\ (fall)}$	V_{PS} : V_{CC} → GND		1.5	μs

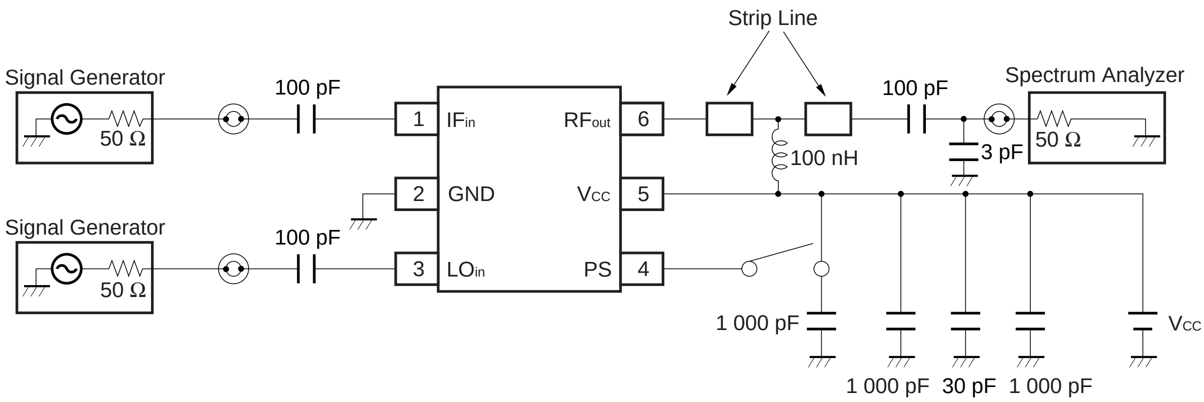
Notes 1. $f_{RFout} < f_{LOin}$ @ f_{RFout} = 0.9 GHz

2. $f_{LOin} < f_{RFout}$ @ f_{RFout} = 1.9 GHz/2.4 GHz

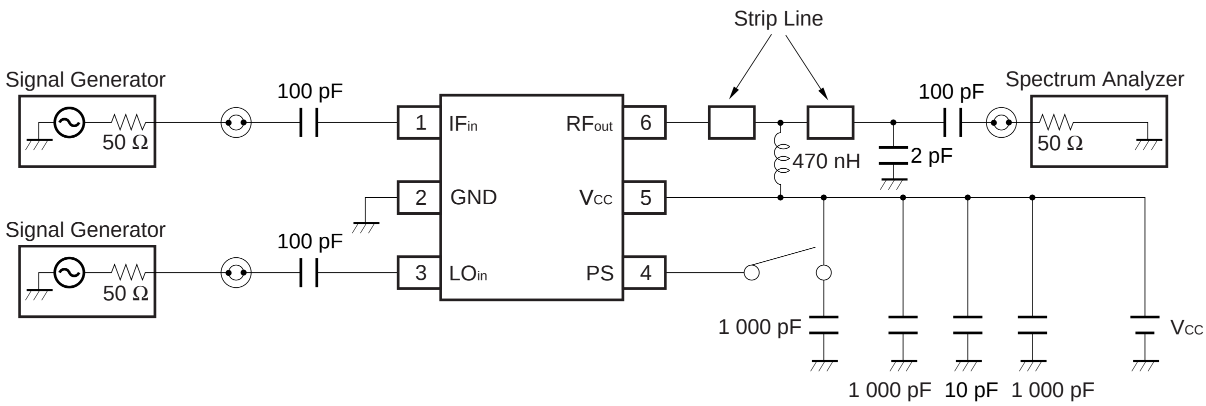
TEST CIRCUIT 1 (f_{RFout} = 0.9 GHz)



TEST CIRCUIT 2 (f_{RFout} = 1.9 GHz)

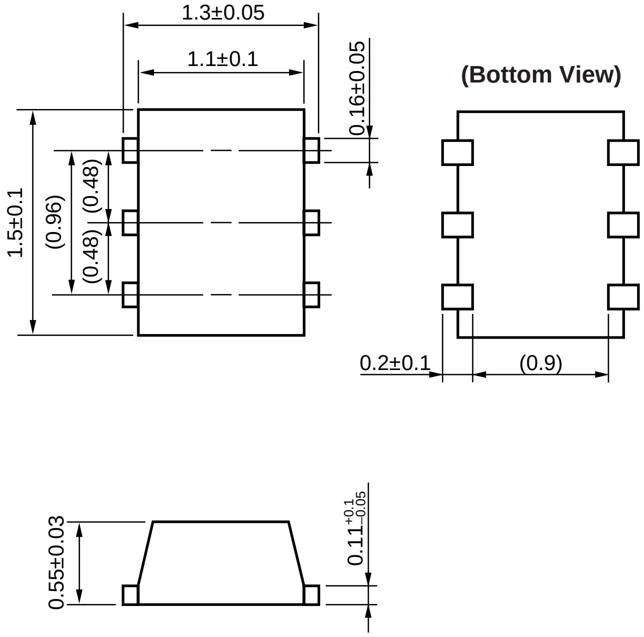


TEST CIRCUIT 3 (f_{RFout} = 2.4 GHz)



PACKAGE DIMENSIONS

6-PIN LEAD-LESS MINIMOLD (1511) (UNIT: mm)



Remark ( ) : Reference value

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).
(3) Connect a bypass capacitor (example : 1 000 pF) to the V_{CC} pin.
(4) Connect a matching circuit to the RF output pin.
(5) 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).

▶**For further information, please contact**

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