

BIPOLAR ANALOG INTEGRATED CIRCUIT $\mu PC3232TB$

5 V, SILICON GERMANIUM MMIC MEDIUM OUTPUT POWER AMPLIFIER

DESCRIPTION

The μ PC3232TB is a silicon germanium (SiGe) monolithic integrated circuit designed as IF amplifier for DBS tuners. This IC is manufactured using our 50 GHz f_{max} UHS2 (<u>U</u>Itra <u>High Speed</u> Process) SiGe bipolar process.

FEATURES

•	Low current	:	Icc = 26.0 mA TYP.
•	Medium output power	:	Po (sat) = +15.5 dBm TYP. @ f = 1.0 GHz
		:	Po (sat) = +12.0 dBm TYP. @ f = 2.2 GHz
•	High linearity	:	Po (1 dB) = +11.0 dBm TYP. @ f = 1.0 GHz
		:	Po (1 dB) = +8.5 dBm TYP. @ f = 2.2 GHz
•	Power gain	:	GP = 32.8 dB MIN. @ f = 1.0 GHz
		:	GP = 33.5 dB MIN. @ f = 2.2 GHz
•	Gain flatness	:	ΔG_P = 1.0 dB TYP. @ f = 1.0 to 2.2 GHz
•	Noise figure	:	NF = 4 dB TYP. @ f = 1.0 GHz
		:	NF = 4.1 dB TYP. @ f = 2.2 GHz
•	Supply voltage	:	Vcc = 4.5 to 5.5 V
•	Port impedance	:	input/output 50 Ω

APPLICATIONS

• IF amplifiers in LNB for DBS converters etc.

ORDERING INFORMATION

Part Number	Order Number	Package	Marking	Supplying Form
μPC3232TB-E3	μPC3232TB-E3-A	6-pin super minimold (Pb-Free)	C3S	 Embossed tape 8 mm wide Pin 1, 2, 3 face the perforation side of the tape Qty 3 kpcs/reel

Remark To order evaluation samples, please contact your nearby sales office Part number for sample order: μ PC3232TB-A

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

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

PIN CONNECTIONS



PRODUCT LINE-UP OF 5 V-BIAS SILICON MMIC MEDIUM OUTPUT POWER AMPLIFIER (TA = $+25^{\circ}$ C, f = 1 GHz, Vcc = Vout = 5.0 V, Zs = ZL = 50 Ω)

Part No.	Po _(sat) (dBm)	G⊦ (dB)	NF (dB)	Icc (mA)	Package	Marking
μPC2708TB	+10.0	15.0	6.5	26	6-pin super minimold	C1D
μPC2709TB	+11.5	23.0	5.0	25		C1E
μPC2710TB	+13.5	33.0	3.5	22		C1F
μPC2776TB	+8.5	23.0	6.0	25		C2L
μPC3223TB	+12.0	23.0	4.5	19		C3J
μPC3225TB	+15.5 ^{Note}	32.5 ^{Note}	3.7 ^{Note}	24.5		C3M
μPC3226TB	+13.0	25.0	5.3	15.5		C3N
μPC3232TB	+15.5	32.8	4.0	26		C3S

Note μ PC3225TB is f = 0.95 GHz

Remark Typical performance. Please refer to ELECTRICAL CHARACTERISTICS in detail.



ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	Vcc	T _A = +25°C	6.0	V
Total Circuit Current	lcc	T _A = +25°C	45	mA
Power Dissipation	PD	T _A = +85°C Note	270	mW
Operating Ambient Temperature	TA		-40 to +85	°C
Storage Temperature	Tstg		-55 to +150	°C
Input Power	Pin	T _A = +25°C	0	dBm

Note Mounted on double-sided copper-clad 50 \times 50 \times 1.6 mm epoxy glass PWB $^{\circ}$

RECOMMENDED OPERATING RANGE

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply Voltage	Vcc		4.5	5.0	5.5	V
Operating Ambient Temperature	TA		-40	+25	+85	°C

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

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	lcc	No input signal	20	26	32	mA
Power Gain 1	G⊧1	f = 0.25 GHz, Pin = -35 dBm	29	31.5	34	dB
Power Gain 2	G⊧2	f = 1.0 GHz, Pin = -35 dBm	30	32.8	35.5	
Power Gain 3	G⊦3	f = 1.8 GHz, P _{in} = -35 dBm	31	33.8	37	
Power Gain 4	G⊧4	f = 2.2 GHz, Pin = -35 dBm	30.5	33.5	36.5	
Power Gain 5	GP5	f = 2.6 GHz, Pin = -35 dBm	29	32.2	35.5	
Power Gain 6	GP6	f = 3.0 GHz, Pin = -35 dBm	27	30.7	34	
Gain Flatness	⊿Gp	$f = 1.0$ to 2.2 GHz, $P_{in} = -35$ dBm	-	1.0	-	dB
K factor 1	K1	f = 1.0 GHz, Pin = -35 dBm	-	1.3	_	-
K factor 2	K2	f = 2.2 GHz, Pin = -35 dBm	-	1.9	_	-
Saturated Output Power 1	Po (sat) 1	f = 1.0 GHz, Pin = 0 dBm	+13	+15.5	-	dBm
Saturated Output Power 2	Po (sat) 2	f = 2.2 GHz, Pin = -5 dBm	+9.5	+12	-	
Gain 1 dB Compression Output Power 1	Po (1 dB) 1	f = 1.0 GHz	+8	+11	-	dBm
Gain 1 dB Compression Output Power 2	Po (1 dB) 2	f = 2.2 GHz	+6	+8.5	-	
Noise Figure 1	NF1	f = 1.0 GHz	-	4	4.8	dB
Noise Figure 2	NF2	f = 2.2 GHz	-	4.1	4.9	
Isolation 1	ISL1	f = 1.0 GHz, Pin = -35 dBm	36	41	_	dB
Isolation 2	ISL2	f = 2.2 GHz, Pin = -35 dBm	38	45	-	
Input Return Loss 1	RLin1	f = 1.0 GHz, Pin = -35 dBm	9.5	13	_	dB
Input Return Loss 2	RLin2	f = 2.2 GHz, P _{in} = -35 dBm	10	14.5	_	
Output Return Loss 1	RLout1	f = 1.0 GHz, Pin = -35 dBm	12	15.5	_	dB
Output Return Loss 2	RLout2	f = 2.2 GHz, Pin = -35 dBm	12	15	_	
Input 3rd Order Distortion Intercept Point 1	IIP ₃ 1	f1 = 1 000 MHz, f2 = 1 001 MHz	-	-9	_	dBm
Input 3rd Order Distortion Intercept Point 2	IIP ₃ 2	f1 = 2 200 MHz, f2 = 2 201 MHz	-	-15.5	_	
Output 3rd Order Distortion Intercept Point 1	OIP31	f1 = 1 000 MHz, f2 = 1 001 MHz	-	+23.5	-	dBm
Output 3rd Order Distortion Intercept Point 2	OIP ₃ 2	f1 = 2 200 MHz, f2 = 2 201 MHz	_	+18	_	
2nd Order Intermodulation Distortion	IM2	f1 = 1 000 MHz, f2 = 1 001 MHz, P _{out} = -5 dBm/tone	_	50	_	dBc
	2f0	f0 = 1.0 GHz. Pout = -15 dBm	_	70	_	dBc

TEST CIRCUIT



The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

	Туре	Value			
R1	Chip Resistance	560 Ω			
L1	Chip Inductor	47 nH			
L2	Chip Inductor	68 nH			
C1	Chip Capacitor	100 pF			
C2	Chip Capacitor	33 pF			
C3, C4	Chip Capacitor	1 000 pF			
C5	Chip Capacitor	39 pF			
C6	Feed-through Capacitor	1 000 pF			

COMPONENTS OF TEST CIRCUIT FOR MEASURING ELECTRICAL CHARACTERISTICS

INDUCTOR FOR THE OUTPUT PIN

The internal output transistor of this IC, to output medium power. To supply current for output transistor, connect an inductor between the Vcc pin (pin 3) and output pin (pin 1). Select inductance, as the value 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 makes output-port impedance higher to get enough gain. In this case, large inductance and Q is suitable (Refer to the following page).

CAPACITORS FOR THE Vcc, INPUT AND OUTPUT PINS

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

The bypass capacitor connected to the Vcc pin is used to minimize ground impedance of Vcc pin. So, stable bias can be supplied against Vcc fluctuation.

The coupling capacitors, connected to the input and output pins, are used to cut the DC and minimize RF serial impedance. Their capacitances 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, $C = 1/(2 \pi Rfc)$.



C6: Feed-through Capacitor

COMPONENT LIST

	Value	Size		
R1	560 Ω	1005		
L1	47 nH	1005		
L2	68 nH	1005		
C1	100 pF	1608		
C2	33 pF	1608		
C3, C4	1 000 pF	1005		
C5	39 pF	1608		
C6	1 000 pF	Feed-through Capacitor		

Notes

- 1. 19 \times 21.46 \times 0.51 mm double sided copper clad RO4003C (Rogers) board.
- 2. Back side: GND pattern
- 3. Au plated on pattern
- 4. O: Through holes
- 5. L1, L2: FDK's products

TYPICAL CHARACTERISTICS (TA = +25°C, Vcc = 5.0 V, Zs = ZL = 50 Ω , unless otherwise specified)



Remark The graphs indicate nominal characteristics.



CURCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE

OUTPUT RETURN LOSS vs. FREQUENCY







NOISE FIGURE vs. FREQUENCY 7.0 6.5 6.0 Vcc = 4.5 V5.0 V 5.5 V 3.0 2.5 2.0∟ €.0• 0.5• 1.0• 1.5• 2.0 2.5• 3.0 Frequency f (GHz)

Remark The graphs indicate nominal characteristics.

NOISE FIGURE vs. FREQUENCY





Remark The graphs indicate nominal characteristics.

S-PARAMETERS (TA = +25°C, VDD = VCC = 5.0 V, Pin = -35 dBm)

S11-FREQUENCY



S-PARAMETERS

- S-parameters and noise parameters are provided on our Web site in a format (S2P) that enables the direct import of the parameters to microwave circuit simulators without the need for keyboard inputs.
- Click here to download S-parameters.
- [RF and Microwave] ® [Device Parameters]
- · URL http://www.necel.com/microwave/en/

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 terminals must be connected together with wide ground pattern to decrease impedance difference.
- (3) The bypass capacitor should be attached to the Vcc line.
- (4) The inductor (L) must be attached between Vcc and output pins. The inductance value should be determined in accordance with desired frequency.
- (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
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	W S260
Partial Heating	Peak temperature (terminal 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).

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CEL: UPC3232TB-EVAL-A