NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC2743GS/μPC2744GS

FREQUENCY DOWN CONVERTER FOR VHF-UHF BAND TV/VCR TUNER

DESCRIPTION

The μPC2743GS/μPC2744GS are Silicon monolithic ICs designed for TV/VCR tuner applications. These ICs consist of a double balanced mixer (DBM), local oscillator, preamplifier for prescaler operation, IF amplifier, regulator, UHF/VHF switching circuit, and so on. These one-chip ICs cover a wide frequency band from VHF to UHF bands. These ICs are packaged in 20-pin SOP (small outline package) suitable for surface mounting. So, these ICs enable to produce economical and physically small or high-density VHF-UHF tuner and reduced the tuner development time.

FEATURES

- VHF to UHF band operation.
- Low distortion (μPC2743GS), high conversion gain and low noise figure (μPC2744GS).
- Internal double balanced mixers (DBM) minimize carrier leak.
- Low oscillation frequency drift against supply voltage and temperature fluctuation due to balanced type UHF oscillator.
- Low output-impedance-fluctuation due to single-end push-pull IF amplifier.
- Supply voltage: 9 V
- Packaged in 20-pin SOP suitable for surface mounting

ORDERING INFORMATION

PART NUMBER	PACKAGE	PACKAGING STYLE
μPC2743GS μPC2744GS	20-pin plastic SOP (300 mil)	Plastic magazine case
μPC2743GS-E1 μPC2744GS-E1	20-pin plastic SOP (300 mil)	Embossed tape 24 mm wide, 2.5 k/REEL Pin 1 indicates pull-out direction of tape

Caution electro-static sensitive device

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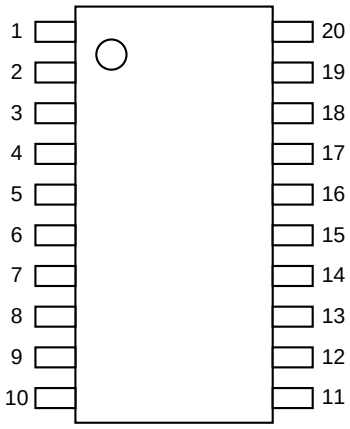
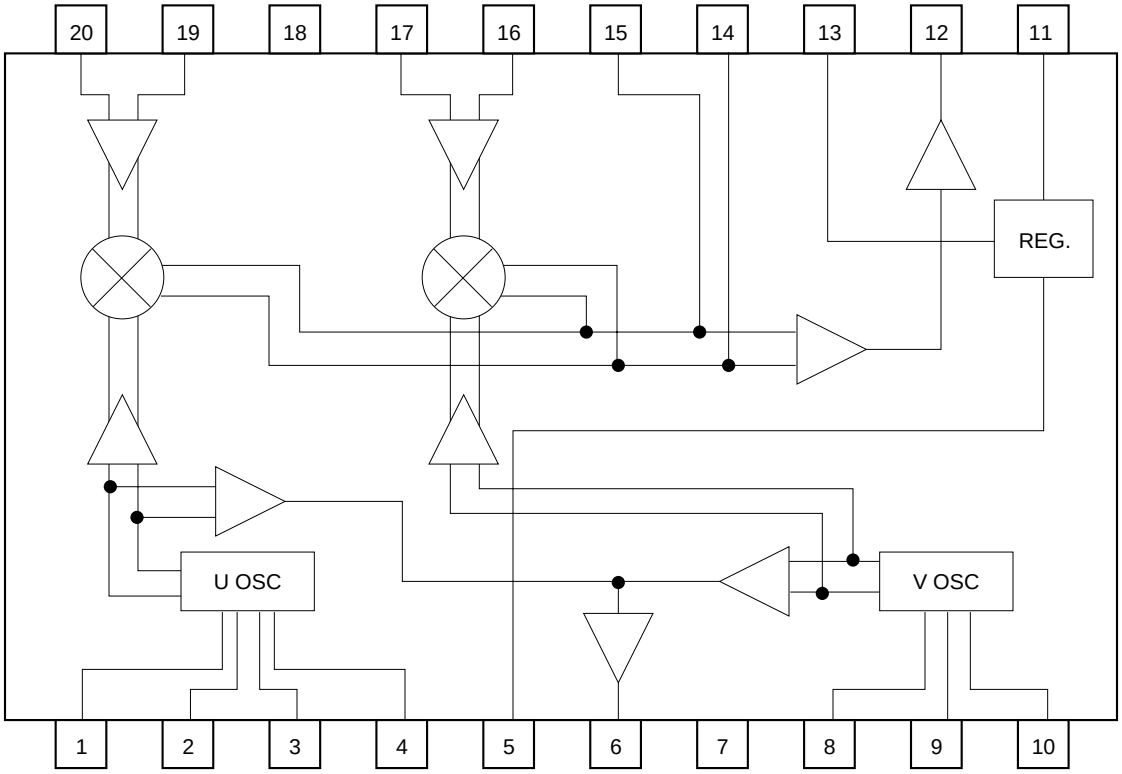
The mark ★ shows major revised points.

PIN CONFIGURATION (Top View)

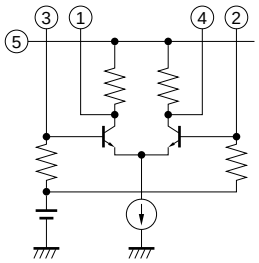
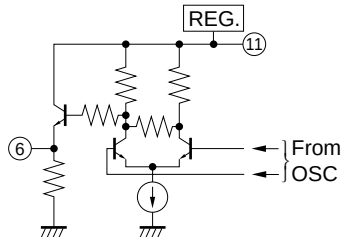
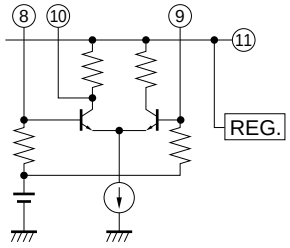


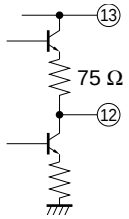
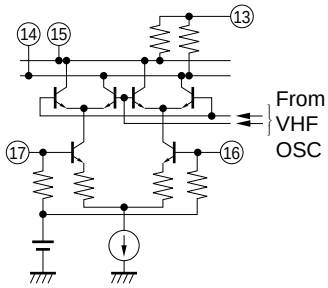
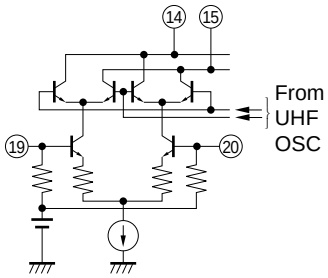
1. UOSC COLLECTOR (Tr. 1)
2. UOSC BASE (Tr. 2)
3. UOSC BASE (Tr. 1)
4. UOSC COLLECTOR (TR. 2)
5. UB
6. OSC OUTPUT
7. GND
8. VHF OSC BASE (BYPASS)
9. VHF OSC BASE
10. VHF OSC COLLECTOR
11. VB (BYPASS)
12. IF OUTPUT
13. V_{CC}
14. MIXER OUTPUT1
15. MIXER OUTPUT2
16. VHF RF INPUT1
17. VHF RF INPUT2
18. GND
19. UHF RF INPUT1
20. UHF RF INPUT2

INTERNAL BLOCK DIAGRAM



PIN EXPLANATION

Pin No.	Symbol	Pin voltage TYP. above: V mode (V) below: U mode (U)	Function and Explanation	Equivalent circuit
1	UOSC collector (Tr. 1)	— 8.3	Collector pin of UHF oscillator. Assemble LC resonator with 2 pin through capacitor ≃ 1 pF to oscillate with active feedback Loop.	
2	UOSC bace (Tr. 2)	— 4.6	Base pin of UHF oscillator with balance amplifier. Connected to LC resonator through feedback capacitor ≃ 300 pF.	
3	UOSC base (Tr. 1)	— 4.6	Base pin of UHF oscillator with balance amplifier. Connected to LC resonator through feedback capacitor ≃ 300 pF.	
4	UOSC collector (Tr. 2)	— 8.3	Collector pin of UHF oscillator with balance amplifier. Assemble LC resonator with 3 pin through capacitor ≃ 1 pF to oscillate with active feedback Loop. Double balanced oscillator with transistor 1 and transistor 2.	
5	UB	— 9.0	Switching pin for VHF or UHF operation. UHF operation = 9.0 V VHF operation = Open	
6	OSC output	4.4 4.5	UHF and VHF oscillator output pin. In case of F/S tuner application, connected PLL symthesizer IC's input pin.	
7	OSC GND	0.0 0.0	VHF and UHF oscillators' GND pin.	
8	VOSC collector		Base pin of VHF oscillator with balance amplifier. Grounded through capacitor ≃ 10 pF.	
9	VOSC base	2.5 4.9	Base pin of VHF oscillator with balance amplifier. Assemble LC resonator with 10 pin to oscillate with active feedback Loop.	
10	VOSC collector	5.1 5.8	Base pin of VHF oscillator with balance amplifier. Connected to LC resonator through feedback capacitor ≃ 3 pF.	
11	VB	5.8 5.8	Monitor pin of regulator output voltage.	

Pin No.	Symbol	Pin voltage TYP. above: V mode (V) below: U mode (U)	Function and Explanation	Equivalent circuit
12	IF output	2.6 2.6	IF output pin of VHF-UHF band functions.	
13	V_{CC}	9.0 9.0	Power supply for VHF-UHF band functions.	
14	MIX output 1	6.8 7.0	VHF and UHF MIX output pin. These pins should be equipped with tank circuit to adjust frequency.	
15	MIX output 2	6.8 7.0		
16	VRF input	3.0 3.1	VRF signal input pin from antenna.	
17	VRF input (bypass)	3.0 3.1	Bypass pin for VHF MIX input. Grounded through capacitor.	
18	MIX GND	0 0	GND pin of MIX, IF amplifier and regulator.	
19	URF input (bypass)	— 2.7	Bypass pin for UHF MIX input. Grounded through capacitor.	
20	URF input	— 2.7	URF signal input pin from antenna.	

ABSOLUTE MAXIMUM RATINGS

Supply voltage 1	V_{CC}		11.0	V
Supply voltage 2	UB		11.0	V
Power dissipation	PD	T_A = 75 °C **Note 1**	750	mW
Operating temperature range	T_A		–20 to +75	°C
Storage temperature range	T_{stg}		–55 to +150	°C

Notes 1 Mounted on a 50 × 50 × 1.6 mm double copper epoxy glass board.

RECOMMENDED OPERATING RANGE

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage 1	V_{CC}	8.0	9.0	10.0	V
Supply voltage 2	UB	8.0	9.0	10.0	V

μPC2743GS

ELECTRICAL CHARACTERISTICS (T_A = 25 °C, V_{CC} = 9 V)

PARAMETERS	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Circuit current 1 (VHF)	$I_{CC}1$	37	47	57	mA	No input signal[Note 2]
Circuit current 2 (UHF)	$I_{CC}2$	39	49	59	mA	No input signal[Note 2]
Conversion gain 1 ($VHF_{(L)}$)	CG1	16.5	20	23.5	dB	f_{RF} = 55 MHz, P_{in} = –30 dBm[Note 2]
Conversion gain 2 ($VHF_{(M)}$)	CG2	16.5	20	23.5	dB	f_{RF} = 200 MHz, P_{in} = –30 dBm[Note 2]
Conversion gain 3 ($VHF_{(H)}$)	CG3	16.5	20	23.5	dB	f_{RF} = 470 MHz, P_{in} = –30 dBm[Note 2]
Conversion gain 4 ($UHF_{(L)}$)	CG4	19.5	23	26.5	dB	f_{RF} = 470 MHz, P_{in} = –30 dBm[Note 2]
Conversion gain 5 ($UHF_{(H)}$)	CG5	19.5	23	26.5	dB	f_{RF} = 890 MHz, P_{in} = –30 dBm[Note 2]
Noise figure 1 ($VHF_{(L)}$)	NF1		13	16	dB	f_{RF} = 55 MHz[Note 2]
Noise figure 2 ($VHF_{(M)}$)	NF2		13	16	dB	f_{RF} = 200 MHz[Note 2]
Noise figure 3 ($VHF_{(H)}$)	NF3		13	16	dB	f_{RF} = 470 MHz[Note 2]
Noise figure 4 ($VHF_{(L)}$)	NF4		12	15	dB	f_{RF} = 470 MHz[Note 2]
Noise figure 5 ($VHF_{(H)}$)	NF5		12	15	dB	f_{RF} = 890 MHz[Note 2]
Maximum output power 1 ($VHF_{(L)}$)	$P_{O(SAT)}1$	+10	+13		dBm	f_{RF} = 55 MHz, P_{in} = 0 dBm[Note 2]
Maximum output power 2 ($VHF_{(M)}$)	$P_{O(SAT)}2$	+10	+13		dBm	f_{RF} = 200 MHz, P_{in} = 0 dBm[Note 2]
Maximum output power 3 ($VHF_{(H)}$)	$P_{O(SAT)}3$	+10	+13		dBm	f_{RF} = 470 MHz, P_{in} = 0 dBm[Note 2]
Maximum output power 4 ($UHF_{(L)}$)	$P_{O(SAT)}4$	+10	+13		dBm	f_{RF} = 470 MHz, P_{in} = 0 dBm[Note 2]
Maximum output power 5 ($UHF_{(H)}$)	$P_{O(SAT)}5$	+10	+13		dBm	f_{RF} = 890 MHz, P_{in} = 0 dBm[Note 2]
Oscillation output level	P_{PSC}	–20		0	dBm	**Note 3**

STANDARD CHARACTERISTICS (REFERENCE VALUES) (T_A = 25 °C, V_{CC} = 9 V)[Note 3]

PARAMETERS	SYMBOL	Value for reference	UNIT	CONDITIONS
Conversion gain 1 ($VHF_{(L)}$)	CG1	22.0	dB	f_{RF} = 55 MHz, P_{in} = –30 Bdm
Conversion gain 2 ($VHF_{(H)}$)	CG2	22.5	dB	f_{RF} = 360 MHz, P_{in} = –30 Bdm
Conversion gain 3 ($UHF_{(L)}$)	CG3	27.0	dB	f_{RF} = 400 MHz, P_{in} = –30 Bdm
Conversion gain 4 ($UHF_{(H)}$)	CG4	26.5	dB	f_{RF} = 800 MHz, P_{in} = –30 Bdm
Noise figure 1 ($VHF_{(L)}$)	NF1	12.3	dB	f_{RF} = 55 MHz
Noise figure 2 ($VHF_{(H)}$)	NF2	13.4	dB	f_{RF} = 360 MHz
Noise figure 3 ($UHF_{(L)}$)	NF3	11.0	dB	f_{RF} = 400 MHz
Noise figure 4 ($UHF_{(H)}$)	NF4	12.7	dB	f_{RF} = 800 MHz
1 % cross-modulation distortion 1 ($VHF_{(L)}$)	CM1	97	dBμ	f_{des} = 55 MHz,[Note 4]
1 % cross-modulation distortion 2 ($VHF_{(H)}$)	CM2	94	dBμ	f_{des} = 55 MHz[Note 4]
1 % cross-modulation distortion 3 ($UHF_{(L)}$)	CM3	92	dBμ	f_{des} = 55 MHz[Note 4]
1 % cross-modulation distortion 4 ($UHF_{(H)}$)	CM4	90	dBμ	f_{des} = 55 MHz[Note 4]
6 channel beat	S/I	57.5	dBc	**Note 5**
Oscillator output power 1 ($VHF_{(L)}$)	$P_{OSC}1$	–4	dBm	f_{OSC} = 100 MHz
Oscillator output power 2 ($VHF_{(H)}$)	$P_{OSC}2$	–5	dBm	f_{OSC} = 405 MHz
Oscillator output power 3 ($UHF_{(L)}$)	$P_{OSC}3$	–9	dBm	f_{OSC} = 445 MHz
Oscillator output power 4 ($UHF_{(H)}$)	$P_{OSC}4$	–13	dBm	f_{OSC} = 845 MHz

Notes 2. By measurement circuit

3. By application circuit

4. $f_{undes} = f_{des}$ + 12 MHz, P_{in} = –30 dBm, AM100 kHz 30 % modulation, DES/CM = 46 dBc, the cross-modulation values are level of undesired signals at open impedance.

5. f_P = 83.25 MHz, f_S = 87.75 MHz, P_{in} = –30 dBm each, f_{OSC} = 129 MHz

μPC2744GS

ELECTRICAL CHARACTERISTICS (T_A = 25 °C, V_{CC} = 9 V)

PARAMETERS	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Circuit current 1 (VHF)	$I_{CC}1$	37	47	57	mA	No input signal[Note 2]
Circuit current 2 (UHF)	$I_{CC}2$	39	49	59	mA	No input signal[Note 2]
Conversion gain 1 ($VHF_{(L)}$)	CG1	21.5	25	28.5	dB	f_{RF} = 55 MHz, P_{in} = –30 dBm[Note 2]
Conversion gain 2 ($VHF_{(M)}$)	CG2	21.5	25	28.5	dB	f_{RF} = 200 MHz, P_{in} = –30 dBm[Note 2]
Conversion gain 3 ($VHF_{(H)}$)	CG3	21.5	25	28.5	dB	f_{RF} = 470 MHz, P_{in} = –30 dBm[Note 2]
Conversion gain 4 ($UHF_{(L)}$)	CG4	27.5	31	34.5	dB	f_{RF} = 470 MHz, P_{in} = –30 dBm[Note 2]
Conversion gain 5 ($UHF_{(H)}$)	CG5	27.5	31	34.5	dB	f_{RF} = 890 MHz, P_{in} = –30 dBm[Note 2]
Noise figure 1 ($VHF_{(L)}$)	NF1		13	14	dB	f_{RF} = 55 MHz[Note 2]
Noise figure 2 ($VHF_{(M)}$)	NF2		13	14	dB	f_{RF} = 200 MHz[Note 2]
Noise figure 3 ($VHF_{(H)}$)	NF3		13	14	dB	f_{RF} = 470 MHz[Note 2]
Noise figure 4 ($VHF_{(L)}$)	NF4		12	13	dB	f_{RF} = 470 MHz[Note 2]
Noise figure 5 ($VHF_{(H)}$)	NF5		12	13	dB	f_{RF} = 890 MHz[Note 2]
Maximum output power 1 ($VHF_{(L)}$)	$P_{O(SAT)}1$	+10	+13		dBm	f_{RF} = 55 MHz, P_{in} = 0 dBm[Note 2]
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Maximum output power 3 ($VHF_{(H)}$)	$P_{O(SAT)}3$	+10	+13		dBm	f_{RF} = 470 MHz, P_{in} = 0 dBm[Note 2]
Maximum output power 4 ($UHF_{(L)}$)	$P_{O(SAT)}4$	+10	+13		dBm	f_{RF} = 470 MHz, P_{in} = 0 dBm[Note 2]
Maximum output power 5 ($UHF_{(H)}$)	$P_{O(SAT)}5$	+10	+13		dBm	f_{RF} = 890 MHz, P_{in} = 0 dBm[Note 2]
Oscillation output level	P_{PSC}	–20		0	dBm	**Note 3**

STANDARD CHARACTERISTICS (REFERENCE VALUES) (T_A = 25 °C, V_{CC} = 9 V)[Note 3]

PARAMETERS	SYMBOL	Value for reference	UNIT	CONDITIONS
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Conversion gain 3 ($UHF_{(L)}$)	CG3	35.5	dB	f_{RF} = 400 MHz, P_{in} = –30 Bdm
Conversion gain 4 ($UHF_{(H)}$)	CG4	35.0	dB	f_{RF} = 800 MHz, P_{in} = –30 Bdm
Noise figure 1 ($VHF_{(L)}$)	NF1	9.2	dB	f_{RF} = 55 MHz
Noise figure 2 ($VHF_{(H)}$)	NF2	9.4	dB	f_{RF} = 360 MHz
Noise figure 3 ($UHF_{(L)}$)	NF3	8.3	dB	f_{RF} = 400 MHz
Noise figure 4 ($UHF_{(H)}$)	NF4	10.0	dB	f_{RF} = 800 MHz
1 % cross-modulation distortion 1 ($VHF_{(L)}$)	CM1	92	dBμ	f_{des} = 55 MHz[Note 4]
1 % cross-modulation distortion 2 ($VHF_{(H)}$)	CM2	90	dBμ	f_{des} = 55 MHz[Note 4]
1 % cross-modulation distortion 3 ($UHF_{(L)}$)	CM3	82	dBμ	f_{des} = 55 MHz[Note 4]
1 % cross-modulation distortion 4 ($UHF_{(H)}$)	CM4	80	dBμ	f_{des} = 55 MHz[Note 4]
6 channel beat	S/I	53.5	dBc	Note 5
Oscillator output power 1 ($VHF_{(L)}$)	$P_{OSC}1$	–4	dBm	f_{OSC} = 100 MHz
Oscillator output power 2 ($VHF_{(H)}$)	$P_{OSC}2$	–5	dBm	f_{OSC} = 405 MHz
Oscillator output power 3 ($UHF_{(L)}$)	$P_{OSC}3$	–9	dBm	f_{OSC} = 445 MHz
Oscillator output power 4 ($UHF_{(H)}$)	$P_{OSC}4$	–13	dBm	f_{OSC} = 845 MHz

Notes 2. By measurement circuit

3. By application circuit

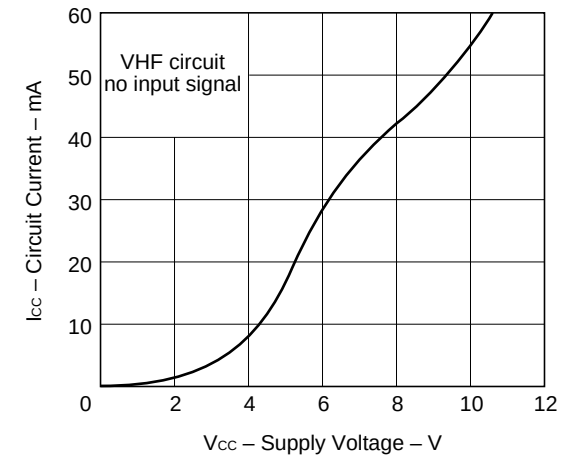
4. $f_{undes} = f_{des} + 12$ MHz, P_{in} = –30 dBm, AM100 kHz 30 % modulation, DES/CM = 46 dBc, the cross-modulation values are level of undesired signals at open impedance.

5. f_P = 83.25 MHz, f_S = 87.75 MHz, P_{in} = –30 dBm each, f_{OSC} = 129 MHz

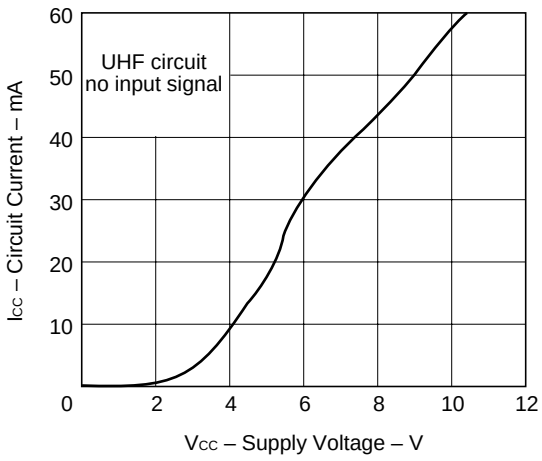
TYPICAL CHARACTERISTICS (T_A = 25 °C) – on Measurement Circuit –

μPC2743GS

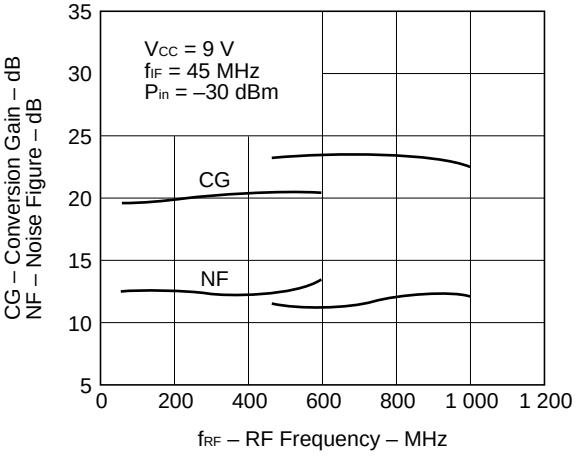
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



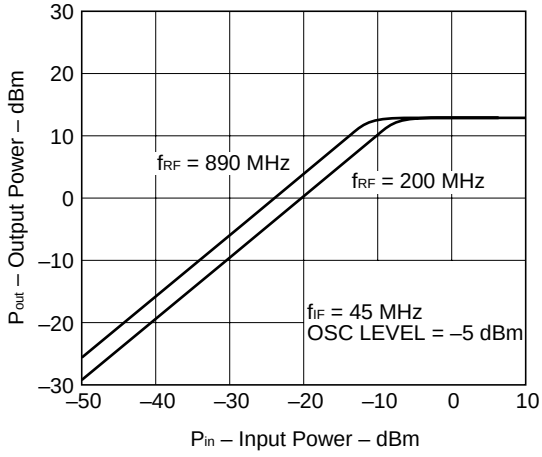
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



CONVERSION GAIN AND NOISE FIGURE vs. RF FREQUENCY



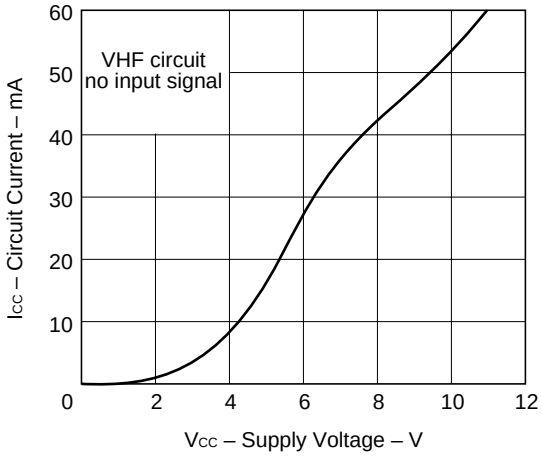
OUTPUT POWER vs. INPUT POWER



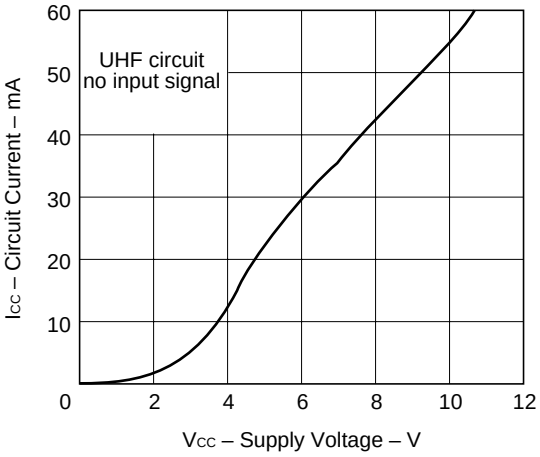
TYPICAL CHARACTERISTICS (T_A = 25 °C) – on Measurement Circuit –

μPC2744GS

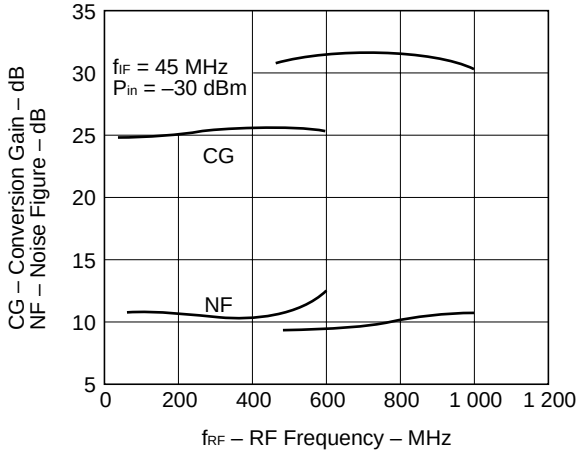
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



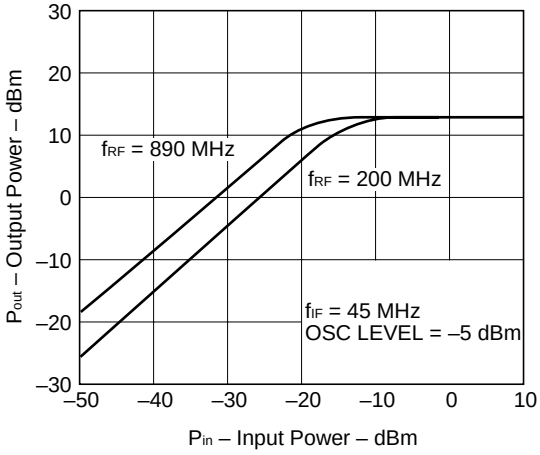
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



CONVERSION GAIN AND NOISE FIGURE vs. RF FREQUENCY

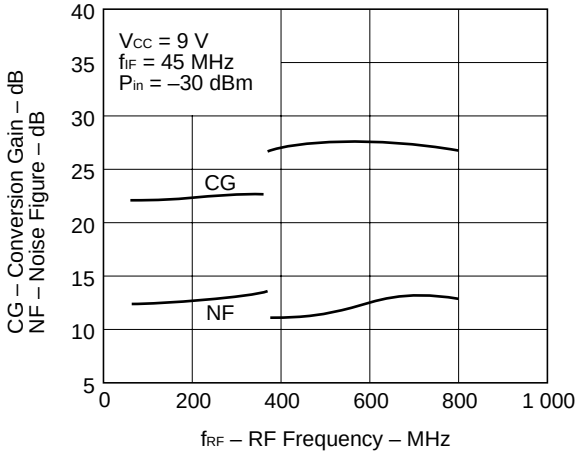


OUTPUT POWER vs. INPUT POWER

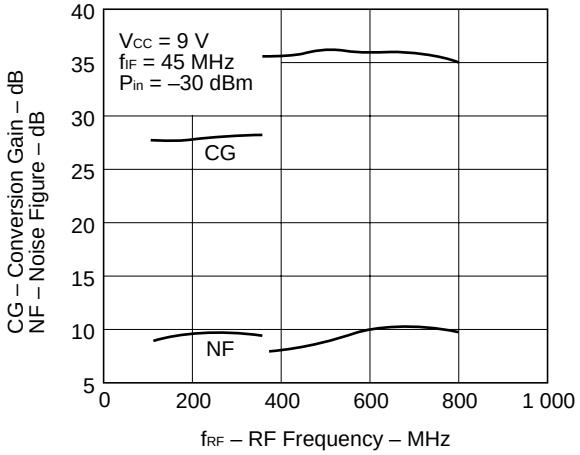


TYPICAL CHARACTERISTICS (T_A = 25 °C) – on Application Circuit –

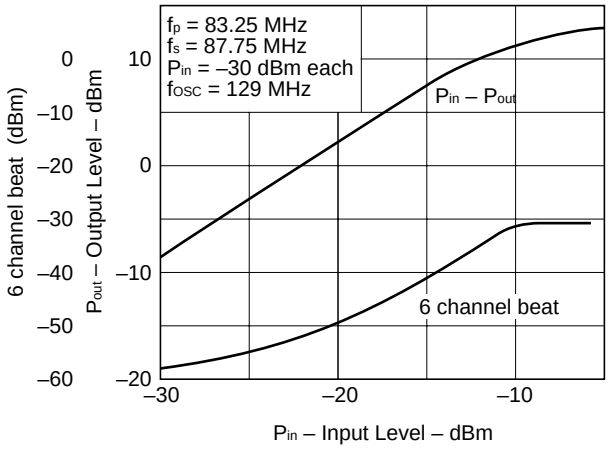
μPC2743GS CONVERSION GAIN AND NOISE FIGURE vs. RF FREQUENCY



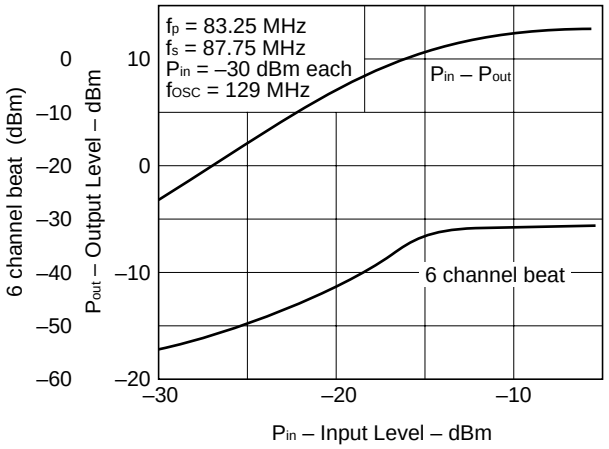
μPC2744GS CONVERSION GAIN AND NOISE FIGURE vs. RF FREQUENCY



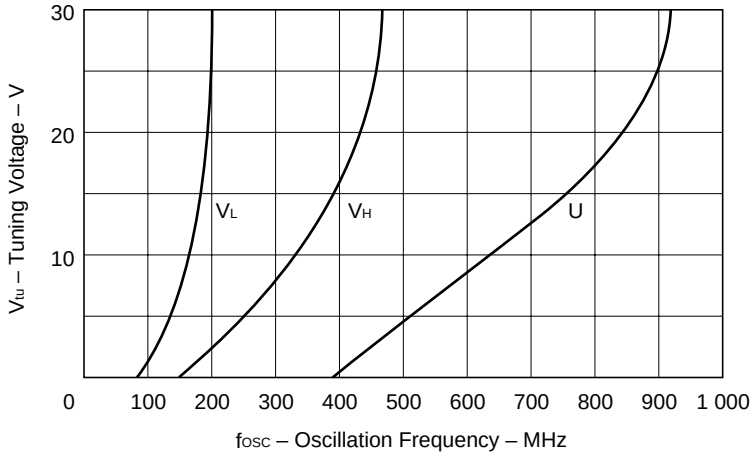
μPC2743GS 6 CHANNEL BEAT AND OUTPUT POWER vs. INPUT POWER



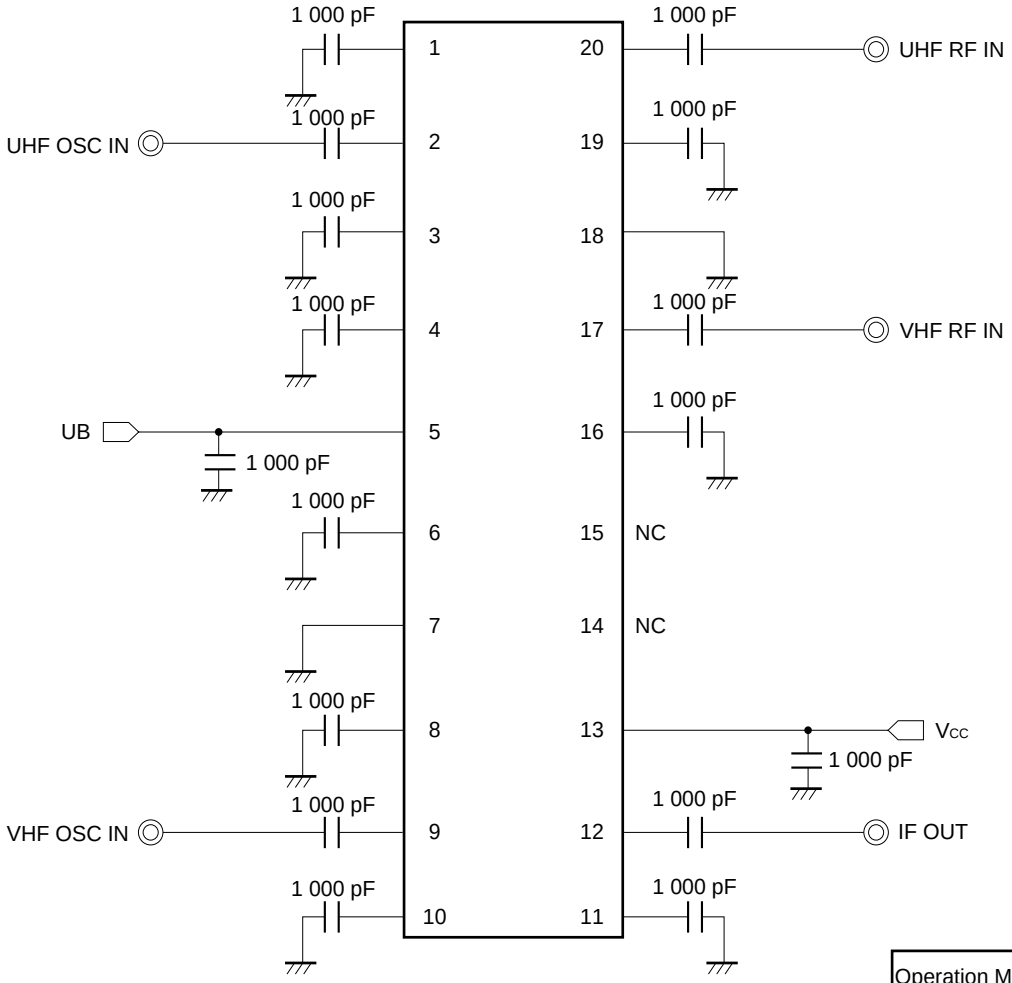
μPC2744GS 6 CHANNEL BEAT AND OUTPUT POWER vs. INPUT POWER



μPC2743/44GS OSC TUNING VOLTAGE vs. OSC FREQUENCY

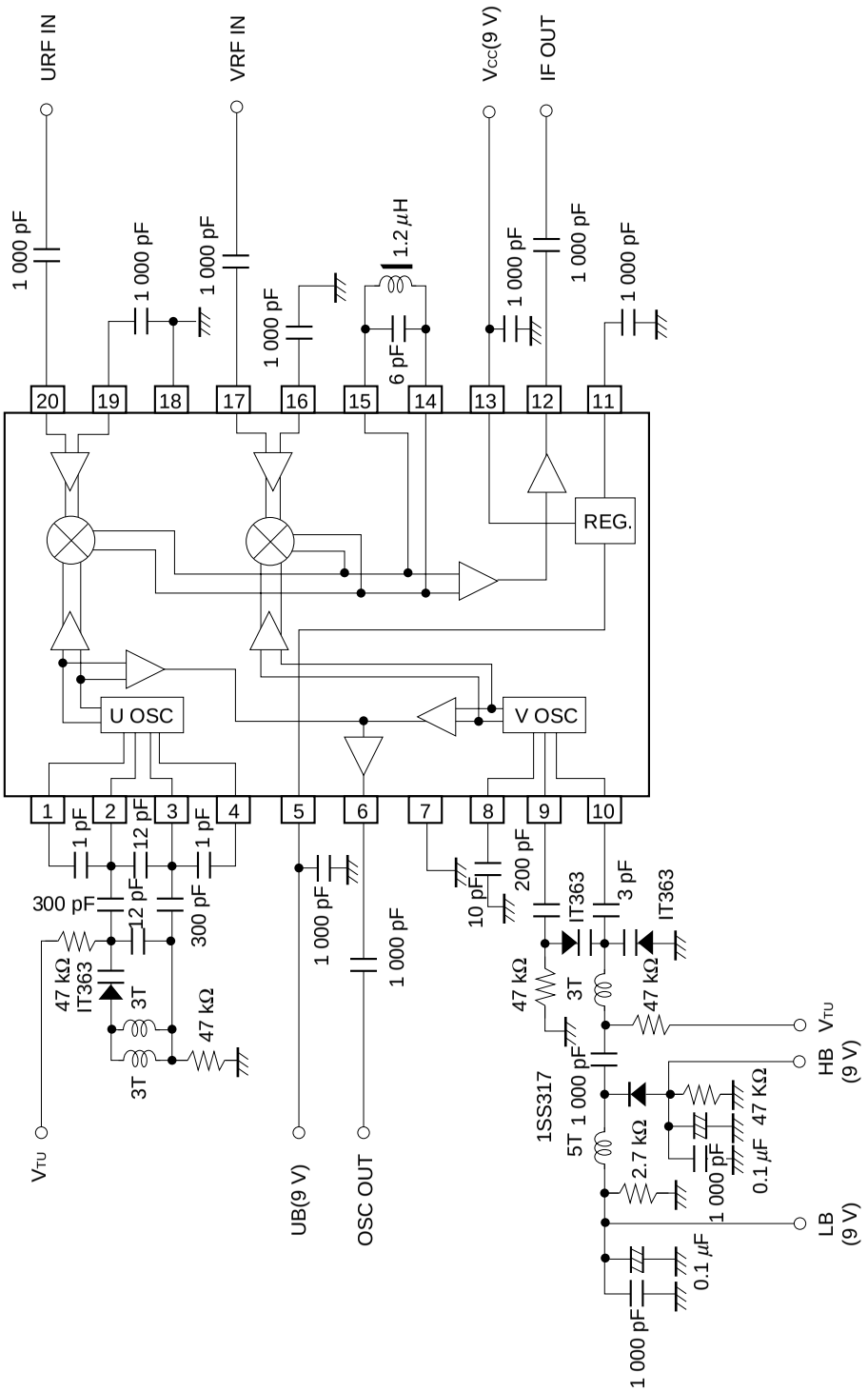


MEASUREMENT CIRCUIT



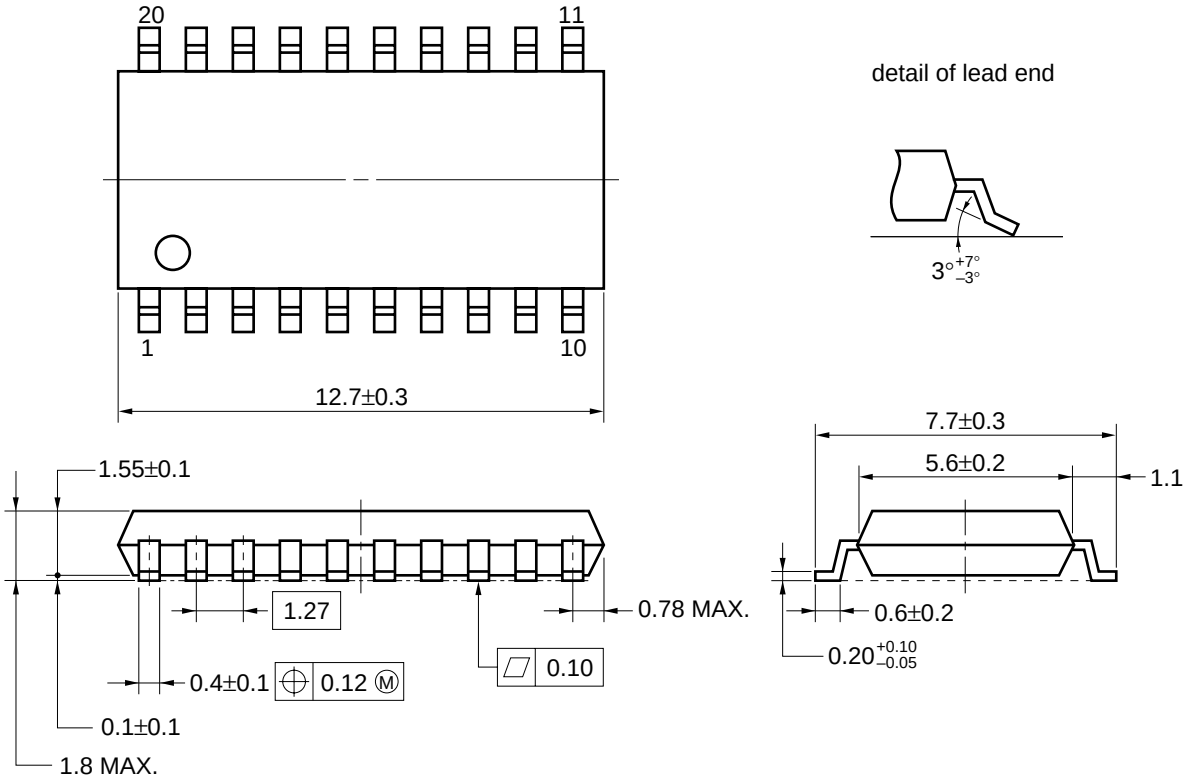
Operation Mode	V_{CC}	UB
VHF	9 V	Open
UHF	9 V	9 V

APPLICATION CIRCUIT EXAMPLE



PACKAGE DIMENSIONS

★ **20 PIN PLASTIC SOP (300 mil) (UNIT: mm)**



NOTE Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

RECOMMENDED SOLDERING CONDITIONS

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

μPC2743GS, μPC2744GS

Soldering process	Soldering conditions	Symbol
Infrared ray reflow	Peak package's surface temperature: 230 °C or below, Reflow time: 30 seconds or below (210 °C or higher), Number of reflow process: 1, Exposure limit[Note 6]: None	IR30-00
VPS	Peak package's surface temperature: 215 °C or below, Reflow time: 40 seconds or below (200 °C or higher), Number of reflow process: 1, Exposure limit[Note 6]: None	VP15-00
Wave soldering	Solder temperature: 260 °C or below, Flow time: 10 seconds or below, Number of flow process: 1, Exposure limit[Note 6]: None	WS60-00
Partial heating method	Terminal temperature: 300 °C or below, Flow time: 10 seconds or below, Exposure limit[Note 6]: None	

Notes 6 Exposure limit before soldering after dry-pack package is opened.
Storage conditions: 25 ˚C and relative humidity at 65 % or less.

Caution Apply only a single process at once, except for "Partial heating method".
For details of recommended soldering conditions for surface mounting, refer to information document SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E).

[MEMO]

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