

# BIPOLAR ANALOG INTEGRATED CIRCUIT

# $\mu$ PC1694GR

### GENERAL PURPOSE HIGH FREQUENCY WIDEBAND IC FOR FREQUENCY DOWN-CONVERTER

#### DESCRIPTION

The  $\mu$ PC1694GR is Silicon monolithic IC for down-converter that is capable of operating up to 1 GHz.

This IC consists of double balanced mixer (DBM), local oscillator and IF amplifier. Furthermore, combination with the  $\mu$ PC1663G (high-speed video amp) enables it to be applied to a FM demodulation circuit such as DBS tuner.

The package is 14-pin SOP suitable for surface mounting.

#### FEATURES

- Satisfactory 1% cross-modulation distortion characteristics:  $CM = 103 \text{ dB}\mu @ f_{des} = 200 \text{ MHz}$
- Wide band operation:  $f \leq 1 \text{ GHz}$
- Easy to connect with varactor diode due to balanced amplifier oscillator
- Single-end push-pull IF amplifier suppresses fluctuation in output impedance
- Supply voltage: 5 V
- Packaged in 14-pin SOP suitable for smaller mounting area

#### ★ APPLICATIONS

- Tuners for TV and VCR

#### ★ ORDERING INFORMATION

Part Number	Package	Supplying Form
$\mu$ PC1694GR-E1	14-pin plastic SOP (225 mil)	Embossed tape 16 mm wide. Pin 1 indicates pull-out direction of tape.

**Remark** To order evaluation samples, please contact your local NEC office.

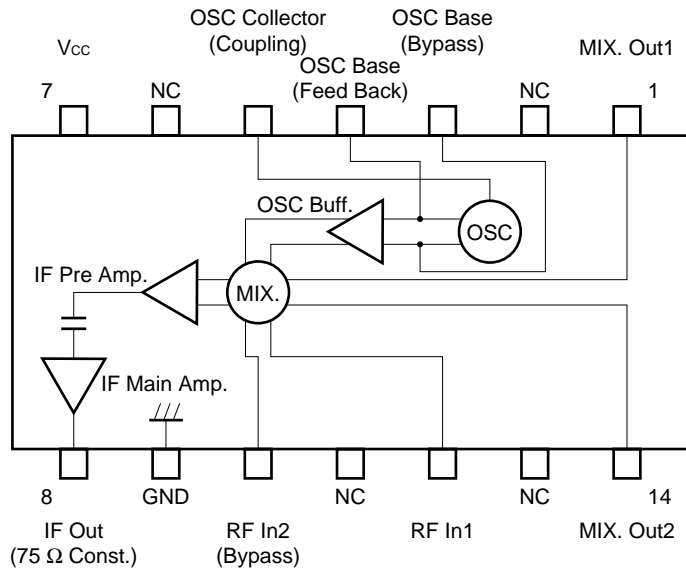
(Part number for sample order:  $\mu$ PC1694GR)

**Caution** Electro-static sensitive devices

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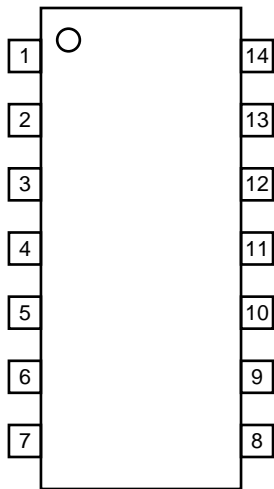
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

INTERNAL BLOCK DIAGRAM



PIN CONFIGURATION

(Top View)



1. MIX output 1
2. GND (Non Connection)
3. OSC base (bypass)
4. OSC base (feedback)
5. OSC collector (coupling)  
(MIX/IF Amp. switch)
6. GND (Non Connection)
7. Vcc
8. IF output (75 Ω)
9. GND
10. RF input 2 (bypass)
11. GND (Non Connection)
12. RF input 1
13. GND (Non Connection)
14. MIX output 2

★ ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = +25°C)

Parameter	Symbol	Conditions	Rating	Unit
Supply Voltage	V <sub>cc</sub>		6.0	V
Power Dissipation	P <sub>d</sub>	T <sub>A</sub> = +85°C <b>Note</b>	325	mW
Operating Ambient Temperature	T <sub>A</sub>		-40 to +85	°C
Storage Temperature	T <sub>stg</sub>		-65 to +150	°C

**Note** Mounted on 50 × 50 × 1.6-mm epoxy glass PWB, with copper patterning on both sides.

★ RECOMMENDED OPERATING RANGE

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V <sub>CC</sub>	4.5	5.0	5.5	V
Operating Ambient Temperature	T <sub>A</sub>	-40	+25	+85	°C

ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = +25°C, V<sub>CC</sub> = 5 V)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current 1	I <sub>CC1</sub>	No input signal <b>Note 1</b>	32	40	48	mA
Mixer Output Voltage	V <sub>MIX</sub>	1-14 pin voltage, No input signal <b>Note 1</b>	-30	0	+30	mV
Conversion Gain 1	CG1	f <sub>RF</sub> = 55 to 470 MHz, f <sub>IF</sub> = 50 MHz P <sub>RF</sub> = -40 dBm RF Input Terminal: Non Tuned <b>Note 2</b>	14	18	21	dB
Conversion Gain 2	CG2	f <sub>RF</sub> = 470 to 890 MHz, f <sub>IF</sub> = 50 MHz P <sub>RF</sub> = -40 dBm RF Input Terminal: Non Tuned <b>Note 3</b>	14	18	21	dB
Noise Figure 1	NF1	f <sub>RF</sub> = 55 to 470 MHz, f <sub>IF</sub> = 50 MHz RF Input Terminal: Non Tuned <b>Note 2</b>	—	12.5	15.0	dB
Noise Figure 2	NF2	f <sub>RF</sub> = 470 to 890 MHz, f <sub>IF</sub> = 50 MHz RF Input Terminal: Non Tuned <b>Note 3</b>	—	13.5	16.0	dB
Output Power 1	P <sub>O(sat)1</sub>	f <sub>RF</sub> = 470 MHz, f <sub>IF</sub> = 50 MHz, P <sub>RF</sub> = 0 dBm <b>Note 2</b>	+8	+10	—	dBm
Output Power 2	P <sub>O(sat)2</sub>	f <sub>RF</sub> = 890 MHz, f <sub>IF</sub> = 50 MHz, P <sub>RF</sub> = 0 dBm <b>Note 3</b>	+8	+10	—	dBm
Circuit Current 2 (U/IF)	I <sub>CC2</sub>	No input signal <b>Note 1</b>	32	40	48	mA
Power Gain (U/IF)	G <sub>P</sub>	f <sub>in</sub> = 50 MHz, P <sub>in</sub> = -40 dBm <b>Note 2</b>	17	21	24	dB
Noise Figure 3 (U/IF)	NF3	f <sub>in</sub> = 50 MHz <b>Note 2</b>	—	12.0	15.0	dB

- Notes 1. By test circuit 1
- 2. By test circuit 2
- 3. By test circuit 3

**STANDARD CHARACTERISTICS (FOR REFERENCE) (T<sub>A</sub> = +25°C, V<sub>CC</sub> = 5 V)**

Parameter	Symbol	Test Conditions	Reference Value	Unit
Conversion Gain 3	CG3	f <sub>RF</sub> = 55 MHz, f <sub>IF</sub> = 50 MHz, P <sub>RF</sub> = -40 dBm RF Input Terminal: Tuned <b>Note 1</b>	24.5	dB
Conversion Gain 4	CG4	f <sub>RF</sub> = 200 MHz, f <sub>IF</sub> = 50 MHz, P <sub>RF</sub> = -40 dBm RF Input Terminal: Tuned <b>Note 1</b>	24.5	dB
Conversion Gain 5	CG5	f <sub>RF</sub> = 470 MHz, f <sub>IF</sub> = 50 MHz, P <sub>RF</sub> = -40 dBm RF Input Terminal: Tuned <b>Note 1</b>	23.0	dB
Conversion Gain 6	CG6	f <sub>RF</sub> = 890 MHz, f <sub>IF</sub> = 50 MHz, P <sub>RF</sub> = -40 dBm RF Input Terminal: Tuned <b>Note 2</b>	20.0	dB
1% Cross-modulation Distortion 1	CM1	f <sub>RF</sub> = 55 to 470 MHz, f <sub>IF</sub> = 50 MHz <b>Note 1, 3</b>	103	dBμ
1% Cross-modulation Distortion 2	CM2	f <sub>RF</sub> = 470 to 890 MHz, f <sub>IF</sub> = 50 MHz <b>Note 2, 3</b>	100	dBμ
1% Cross-modulation Distortion 3 (U/IF)	CM3	f <sub>RF</sub> = 50 MHz <b>Note 1, 4</b>	103	dBμ
Oscillation Frequency Stability 1	f <sub>stb1</sub>	V <sub>CC</sub> ± 10%, f <sub>osc</sub> = 100 to 520 MHz <b>Note 1</b>	±100	kHz
Oscillation Frequency Stability 2	f <sub>stb2</sub>	V <sub>CC</sub> ± 10%, f <sub>osc</sub> = 520 to 940 MHz <b>Note 2</b>	±200	
Oscillation Stop (Start) Voltage 1	V <sub>osc1</sub>	f <sub>osc</sub> = 100 to 520 MHz <b>Note 1</b>	2.5	V
Oscillation Stop (Start) Voltage 2	V <sub>osc2</sub>	f <sub>osc</sub> = 520 to 940 MHz <b>Note 2</b>	3.0	

**Notes 1.** By test circuit 2

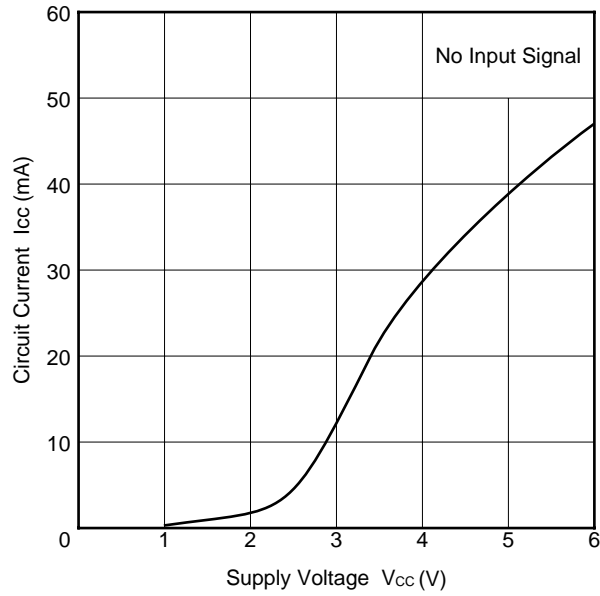
**2.** By test circuit 3

**3.** f<sub>undes</sub> = f<sub>RF</sub> ± 12 MHz, P<sub>RF</sub> = -31 dBm, f<sub>IF</sub> = 50 MHz, AM: 100 kHz, 30%Mod., S/I Ratio = 46 dBc, Output 75 Ω Open

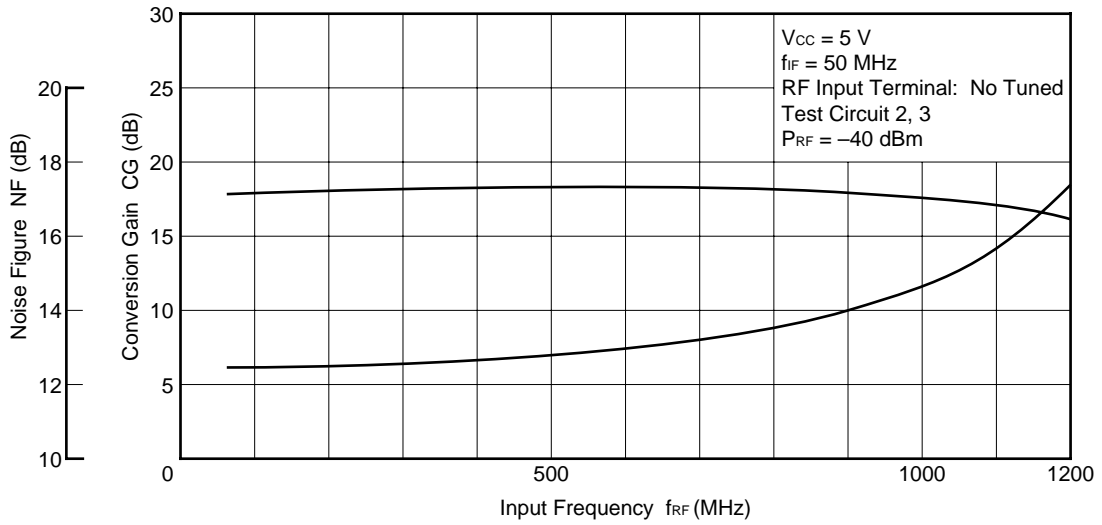
**4.** f<sub>in</sub> = 50 MHz, f<sub>undes</sub> = 62 MHz, P<sub>in</sub> = -31 dBm, AM: 100 kHz, 30% Mod., S/I Ratio = 46 dBc, Output 75 Ω Open

TYPICAL CHARACTERISTICS ( $T_A = +25^\circ\text{C}$ )

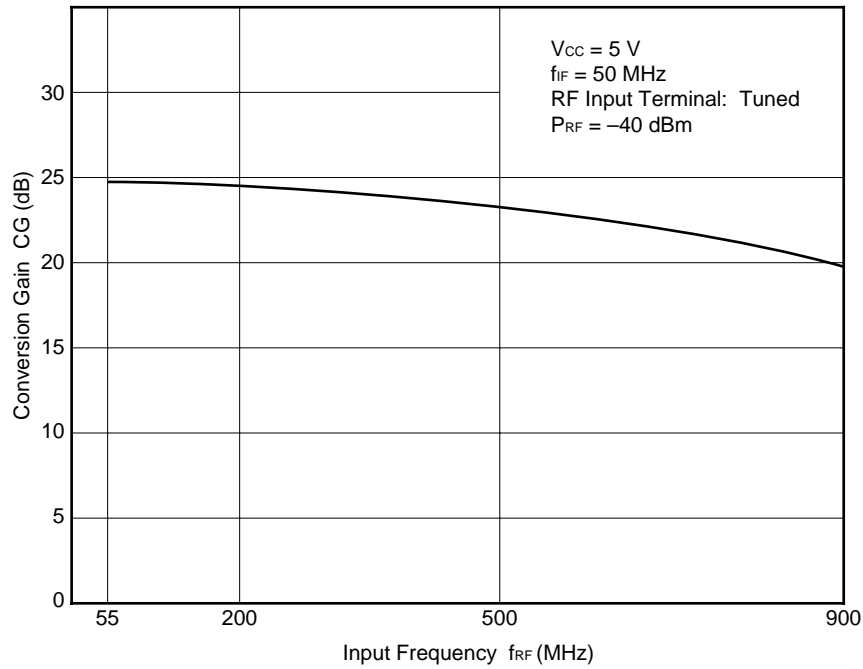
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



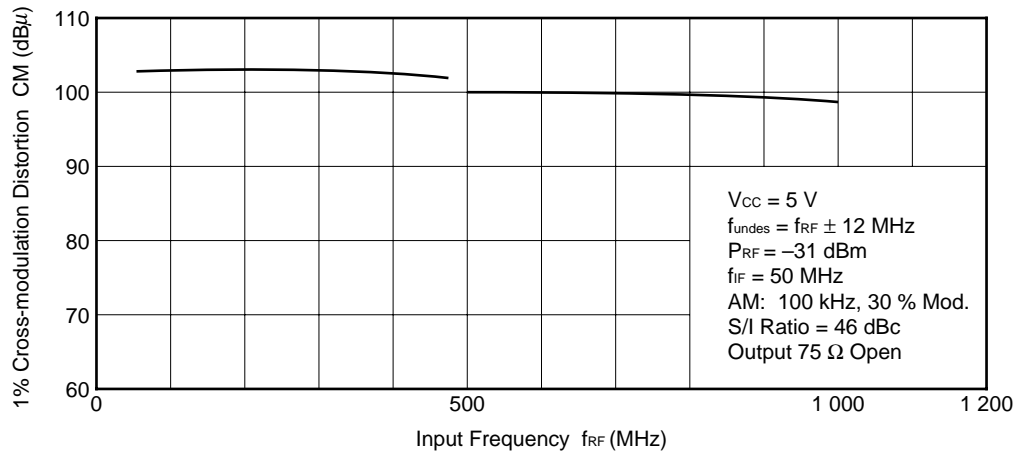
NOISE FIGURE AND CONVERSION GAIN vs. INPUT FREQUENCY



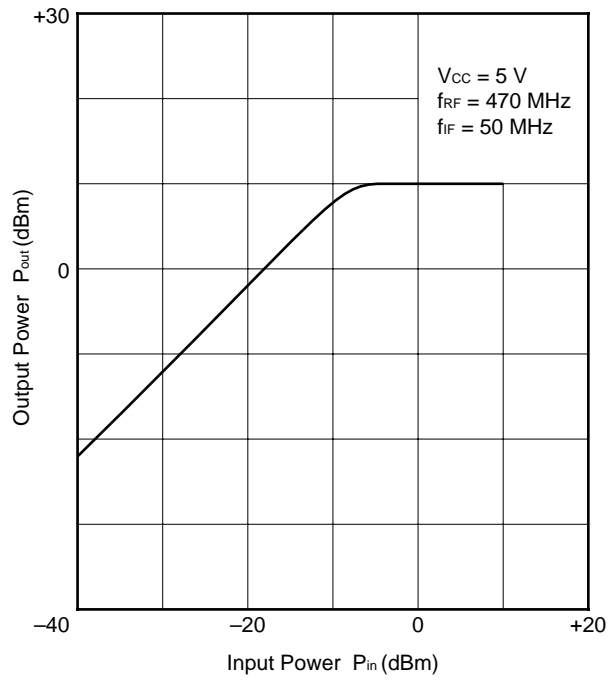
CONVERSION GAIN vs. INPUT FREQUENCY



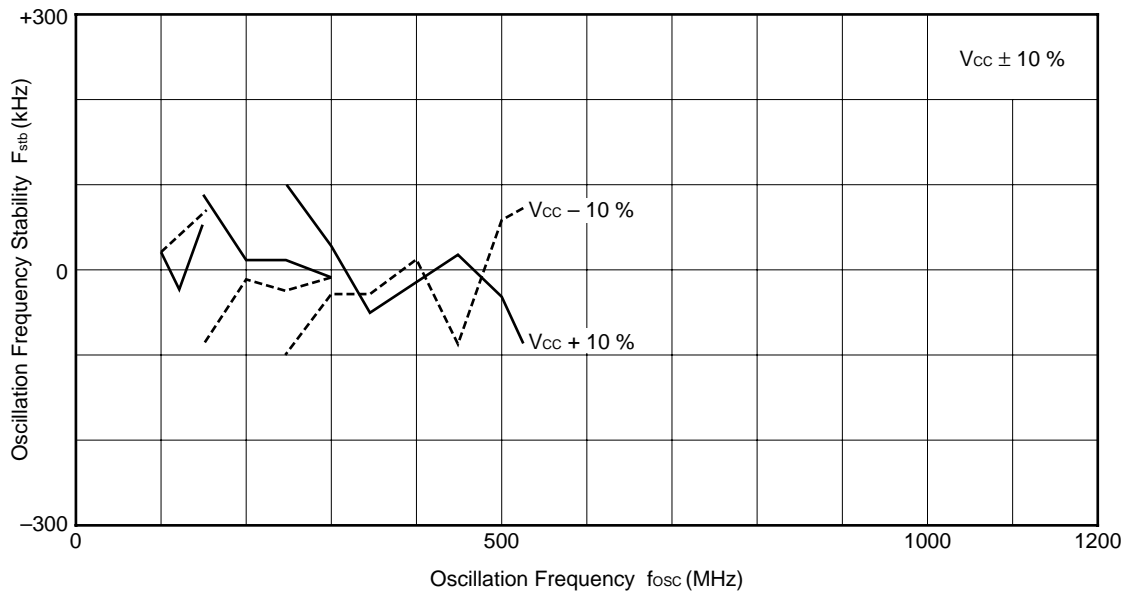
1% CROSS-MODULATION DISTORTION vs. INPUT FREQUENCY



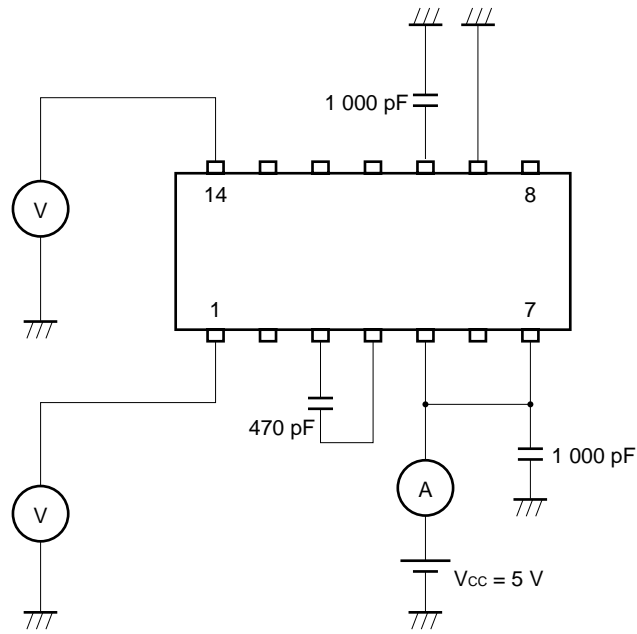
OUTPUT POWER vs. INPUT POWER



OSC-FREQUENCY STABILITY vs. OSCILLATION FREQUENCY



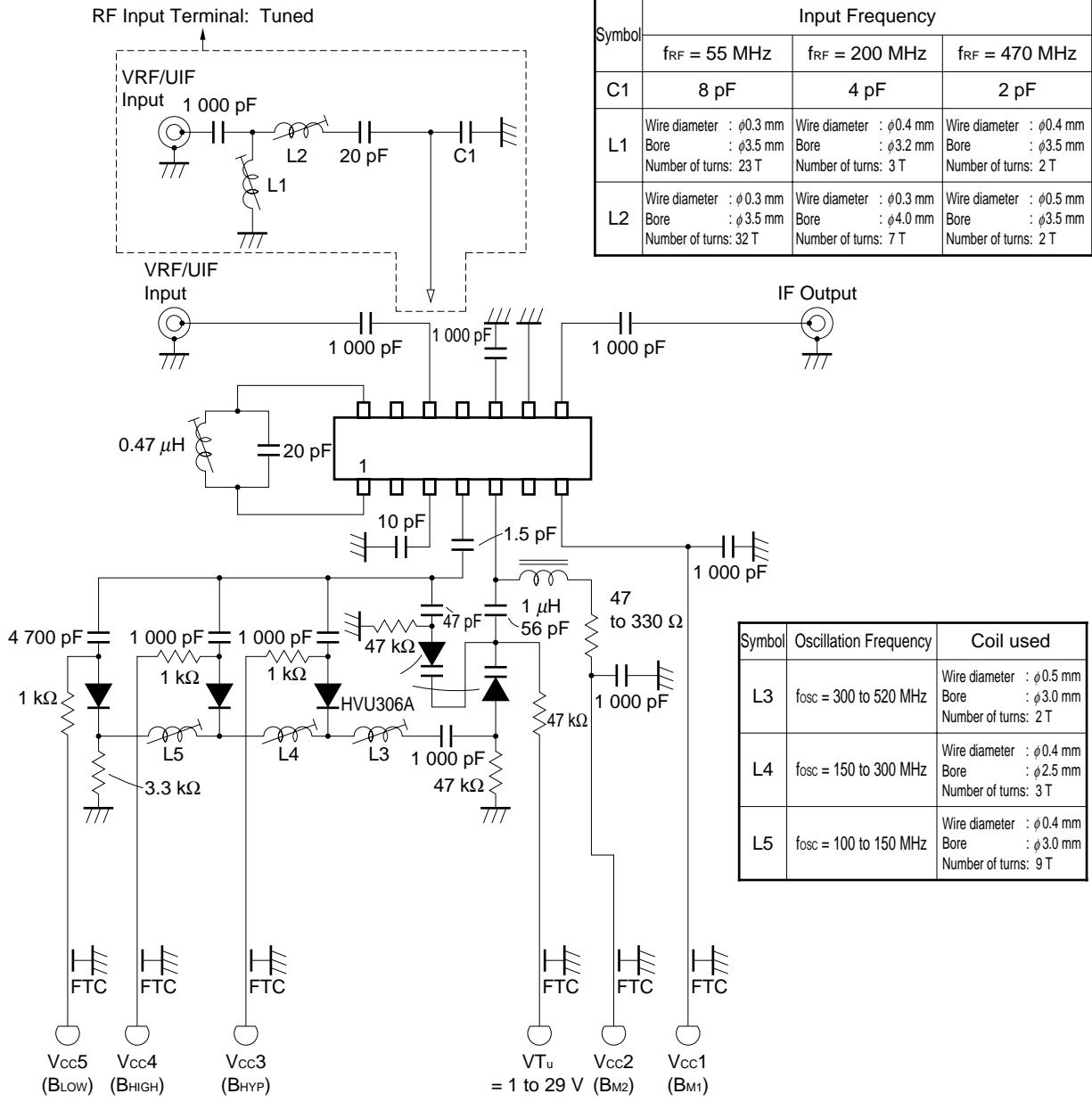
TEST CIRCUIT 1



When measuring circuit current with U/IF Amp, leave pin 5 open.

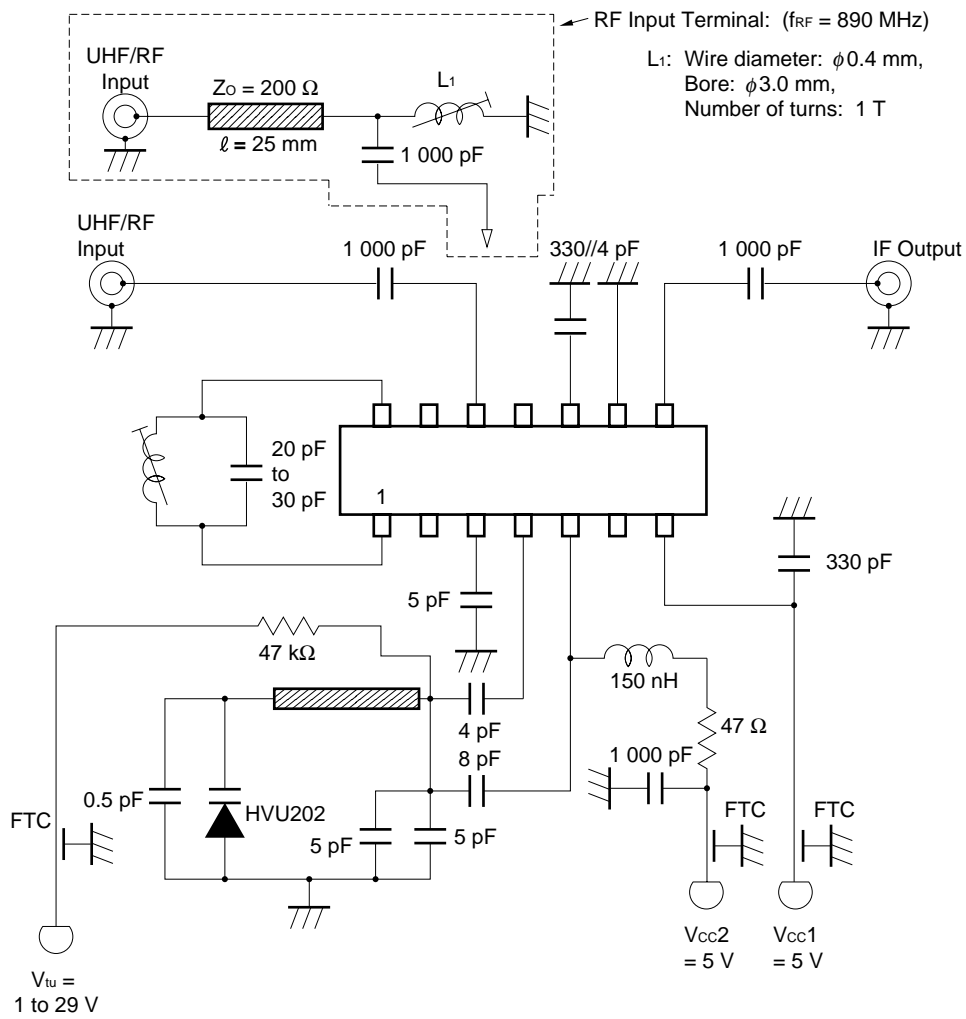


TEST CIRCUIT 2



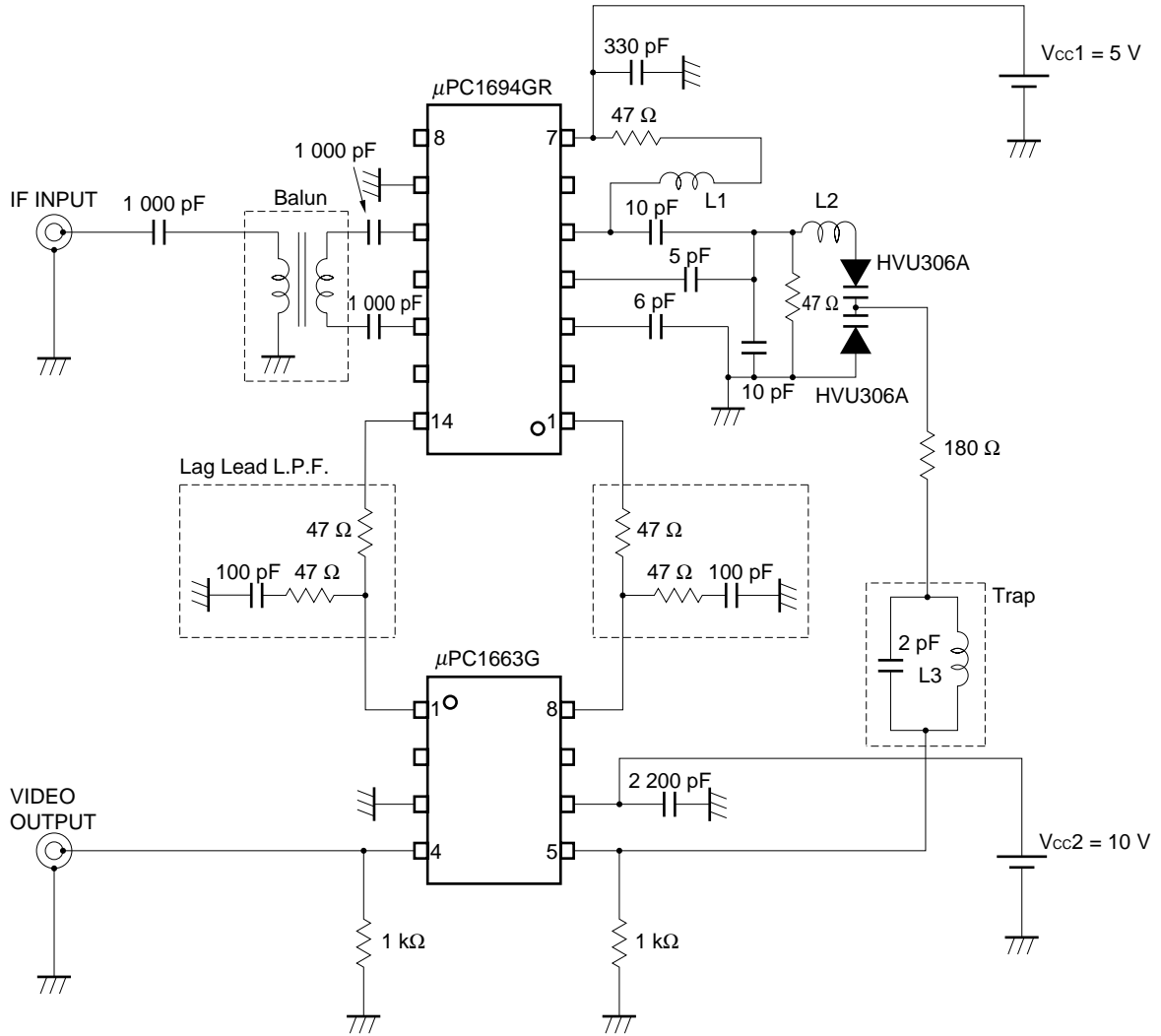
	Vcc1 (BM1)	Vcc2 (BM2)	Vcc3 (BHYP)	Vcc4 (BHIGH)	Vcc5 (BLOW)
VLOW	5 V	5 V	OPEN	OPEN	5 V
VHIGH	5 V	5 V	OPEN	5 V	OPEN
VHYPER	5 V	5 V	5 V	OPEN	OPEN
U/IF	5 V	OPEN	OPEN	OPEN	OPEN

TEST CIRCUIT 3



APPLICATION CIRCUIT EXAMPLE 1

For FM demodulator (Example using  $\mu$ PC1694GR and  $\mu$ PC1663G)



- L1: Wire diameter:  $\phi$ 0.3 mm, Bore:  $\phi$ 1.5 mm, Number of turns: 13 T
- L2: Wire diameter:  $\phi$ 0.4 mm, Bore:  $\phi$ 3.5 mm, Number of turns: 2 T
- L3: Wire diameter:  $\phi$ 0.3 mm, Bore:  $\phi$ 1.8 mm, Number of turns: 7 T
- Balun: TDK WBT5,5P5-C10129E

APPLICATION CIRCUIT EXAMPLE 2

For TV/VCR TUNER

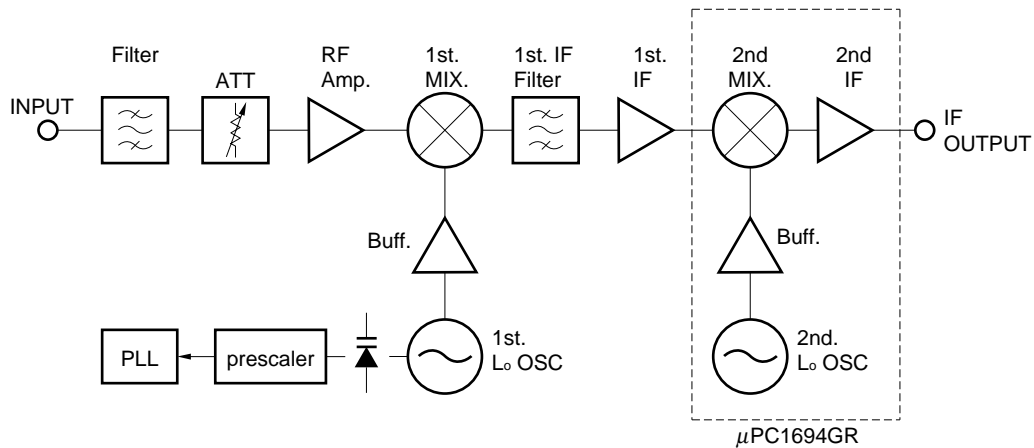
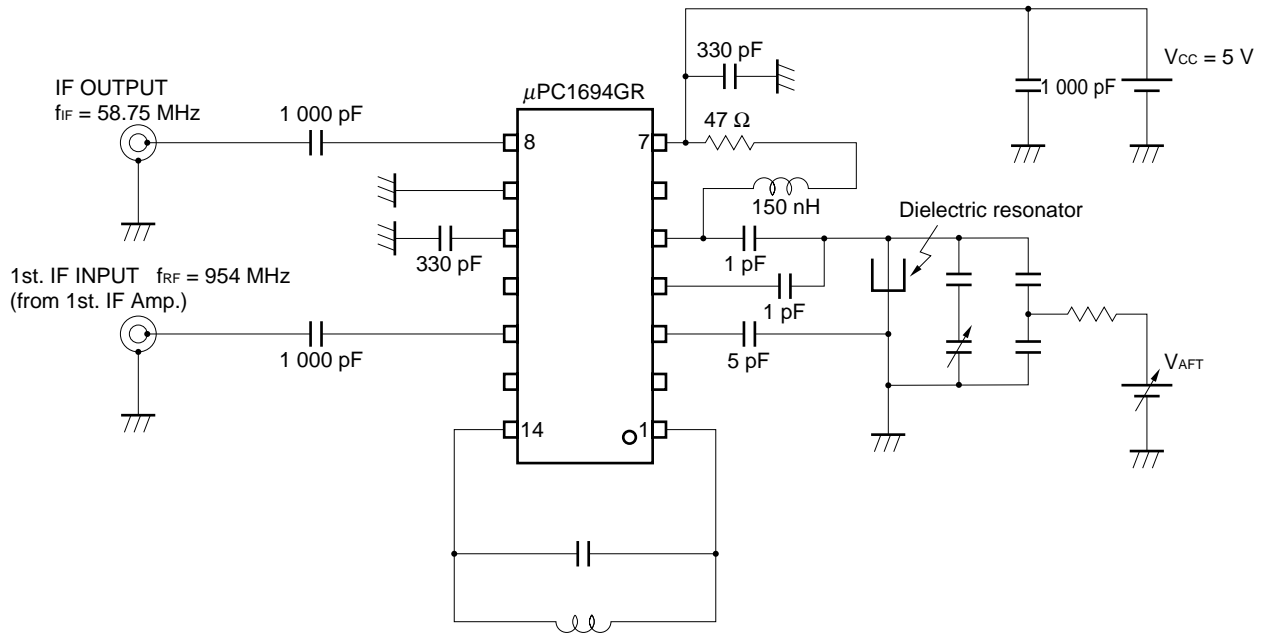
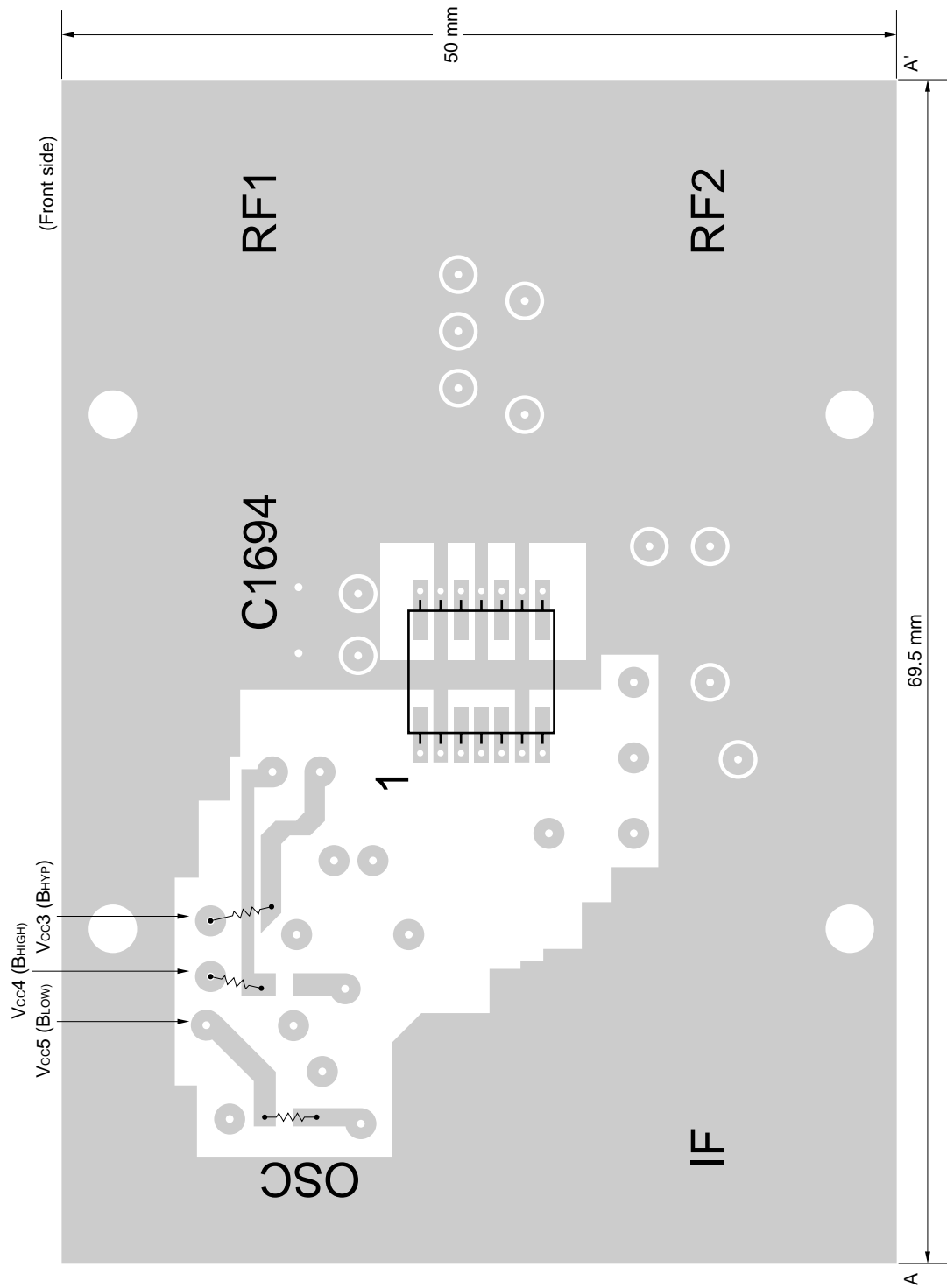
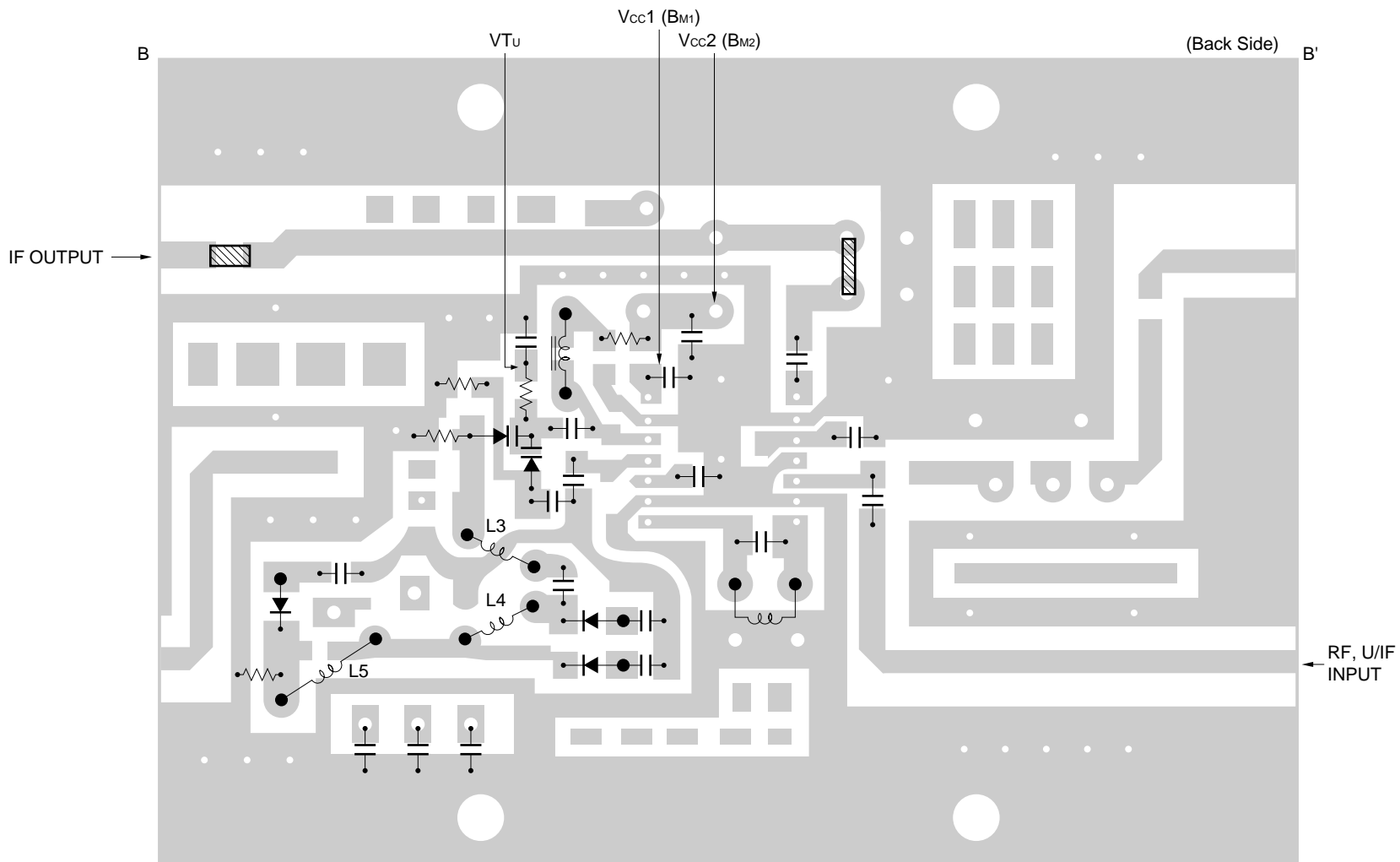


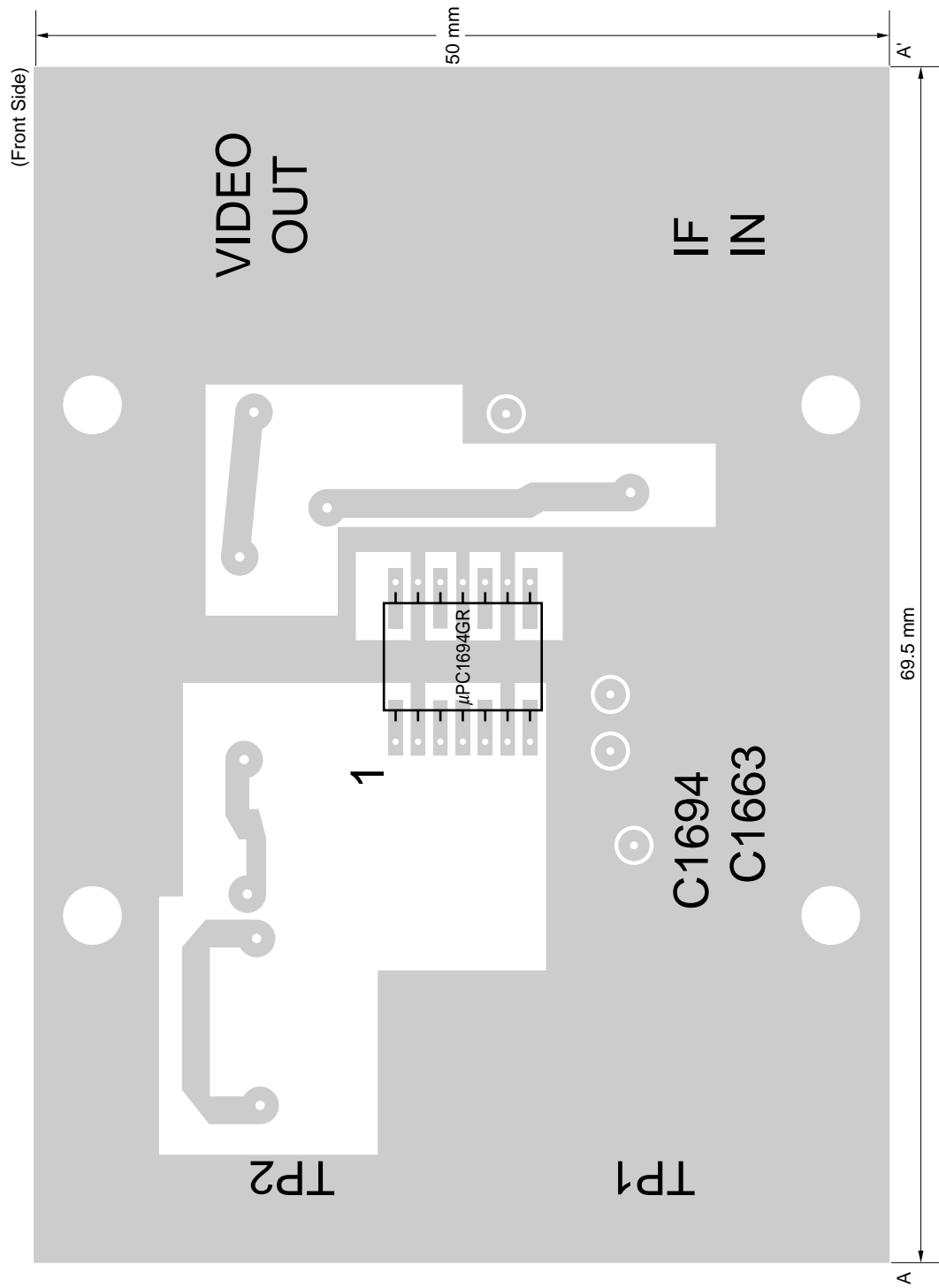
ILLUSTRATION OF THE APPLICATION CIRCUIT EXAMPLE 2 ASSEMBLED ON EVALUATION BOARD

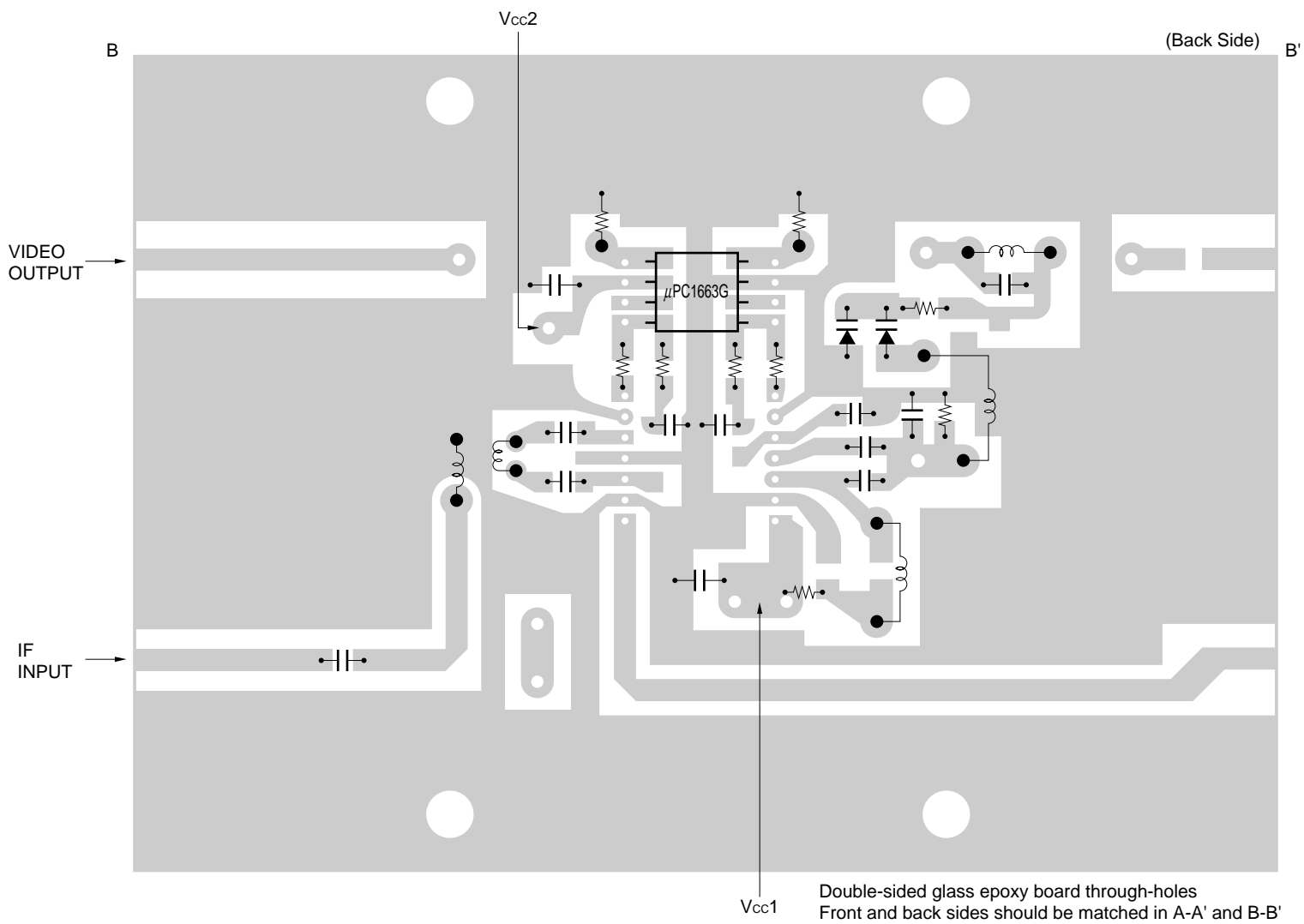




Double-sided glass epoxy board through-holes  
 Front and back sides should be matched in A-A' and B-B'  
 ▨: short-circuited strip.

ILLUSTRATION OF THE APPLICATION CIRCUIT EXAMPLE 1 ASSEMBLED ON EVALUATION BOARD

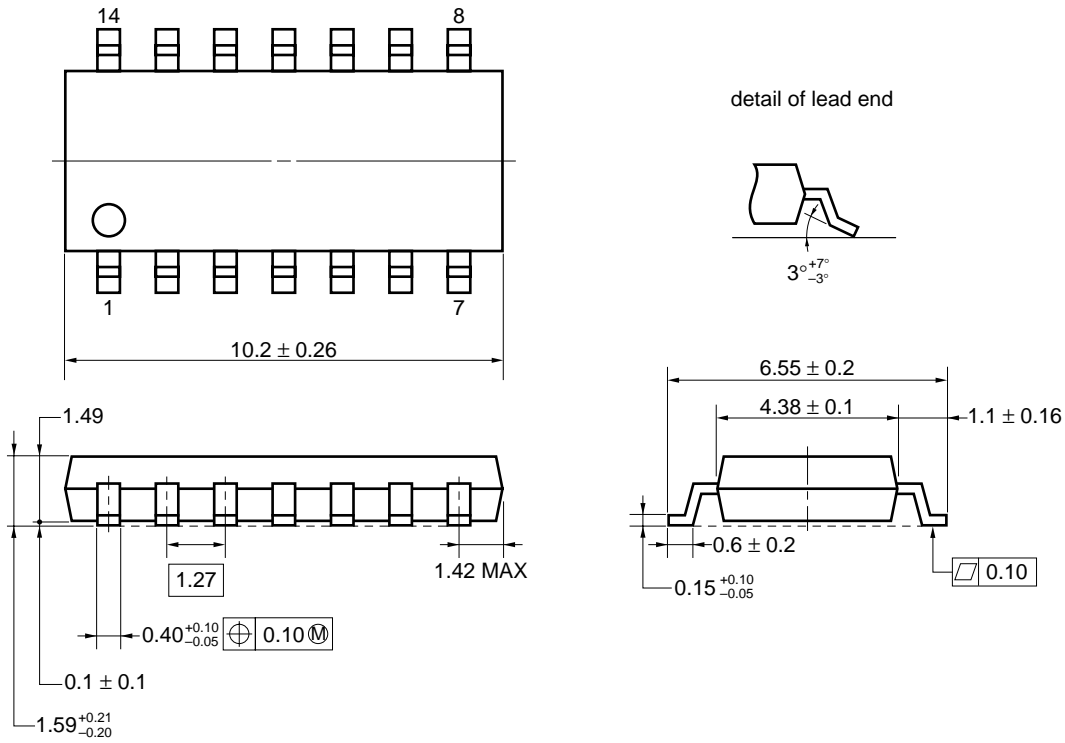






★ PACKAGE DIMENSION

14 PIN PLASTIC SOP (225 mil)



**NOTE** Each lead centerline is located within 0.10 mm of its true position (T.P.) at maximum material condition.

**NOTE ON CORRECT USE**

- (1) Since this IC uses high frequency process, care is required against the excessive input of static electricity, etc.
- (2) Use the shortest possible wiring for the GND pin.
- (3) Use the widest possible earth pattern to avoid increase of ground impedance (because it may cause abnormal oscillation).
- (4) Insert a bypass capacitor for the Vcc pin (example: 1 000 pF, 2 200 pF, etc.)
- (5) Abnormal oscillation may occur depending on the values of the choke coil and floating capacitance. Therefore, insert a resistor between the power supply and choke coil. (See the application circuit example.)

**RECOMMENDED SOLDERING CONDITIONS**

This product should be soldered under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your NEC sales representative.

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared Reflow	Package peak temperature: 235 °C or below Time: 30 seconds or less (at 210 °C) Count: 3, Exposure limit: None <sup>Note</sup>	IR35-00-3
VPS	Package peak temperature: 215 °C or below Time: 40 seconds or less (at 200 °C) Count: 3, Exposure limit: None <sup>Note</sup>	VP15-00-3
Wave Soldering	Soldering bath temperature: 260 °C or below Time: 10 seconds or less Count: 1, Exposure limit: None <sup>Note</sup>	WS60-00-1
Partial Heating	Pin temperature: 300 °C Time: 3 seconds or less (per side of device) Exposure limit: None <sup>Note</sup>	—

**Note** After opening the dry pack, keep it in a place below 25 °C and 65 % RH for the allowable storage period.

**Caution Do not use different soldering methods together (except for partial heating).**

For details of recommended soldering conditions for surface mounting, refer to information document SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E).

[MEMO]

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