NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC1694GR

GENERAL PURPOSE HIGH FREQUENCY WIDEBAND IC FOR FREQUENCY DOWN-CONVERTER

DESCRIPTION

The μPC1694GR 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 μPC1663G (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 dBμ @ f_{des} = 200 MHz
- Wide band operation: f ≤ 1 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
μPC1694GR-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: μPC1694GR)

Caution Electro-static sensitive devices

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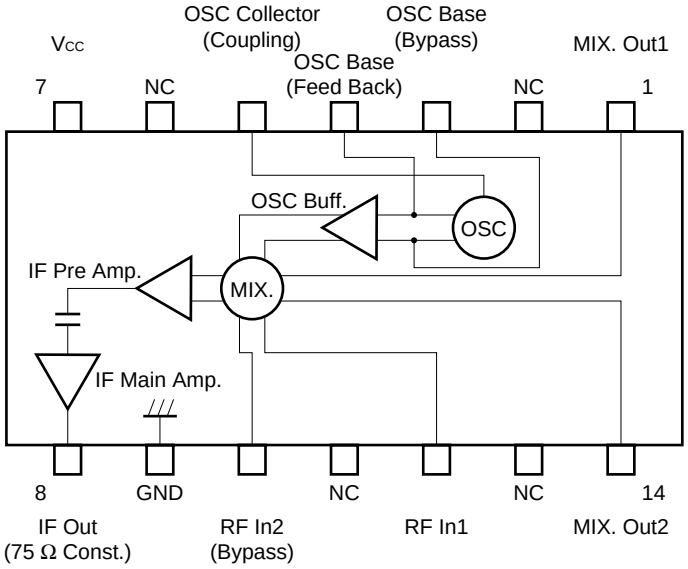
Printed in Japan

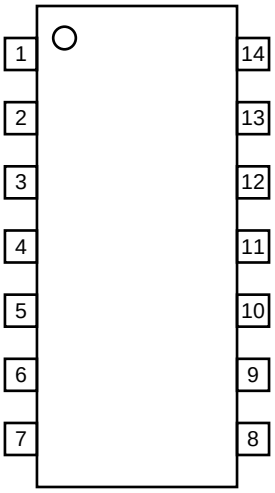
The mark ★ shows major revised points.

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. V_{CC}
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_A = +25°C)

Parameter	Symbol	Conditions	Rating	Unit
Supply Voltage	V_{CC}		6.0	V
Power Dissipation	P_D	T_A = +85°C **Note**	325	mW
Operating Ambient Temperature	T_A		–40 to +85	°C
Storage Temperature	T_{stg}		–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_{CC}	4.5	5.0	5.5	V
Operating Ambient Temperature	T_A	–40	+25	+85	°C

ELECTRICAL CHARACTERISTICS (T_A = +25°C, V_{CC} = 5 V)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current 1	I_{CC1}	No input signal **Note 1**	32	40	48	mA
Mixer Output Voltage	V_{MIX}	1-14 pin voltage, No input signal **Note 1**	–30	0	+30	mV
Conversion Gain 1	CG1	f_{RF} = 55 to 470 MHz, f_{IF} = 50 MHz P_{RF} = –40 dBm RF Input Terminal: Non Tuned **Note 2**	14	18	21	dB
Conversion Gain 2	CG2	f_{RF} = 470 to 890 MHz, f_{IF} = 50 MHz P_{RF} = –40 dBm RF Input Terminal: Non Tuned **Note 3**	14	18	21	dB
Noise Figure 1	NF1	f_{RF} = 55 to 470 MHz, f_{IF} = 50 MHz RF Input Terminal: Non Tuned **Note 2**	—	12.5	15.0	dB
Noise Figure 2	NF2	f_{RF} = 470 to 890 MHz, f_{IF} = 50 MHz RF Input Terminal: Non Tuned **Note 3**	—	13.5	16.0	dB
Output Power 1	$P_{O(sat)}1$	f_{RF} = 470 MHz, f_{IF} = 50 MHz, P_{RF} = 0 dBm **Note 2**	+8	+10	—	dBm
Output Power 2	$P_{O(sat)}2$	f_{RF} = 890 MHz, f_{IF} = 50 MHz, P_{RF} = 0 dBm **Note 3**	+8	+10	—	dBm
Circuit Current 2 (U/IF)	I_{CC2}	No input signal **Note 1**	32	40	48	mA
Power Gain (U/IF)	G_P	f_{in} = 50 MHz, P_{in} = –40 dBm **Note 2**	17	21	24	dB
Noise Figure 3 (U/IF)	NF3	f_{in} = 50 MHz **Note 2**	—	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_A = +25°C, V_{CC} = 5 V)

Parameter	Symbol	Test Conditions	Reference Value	Unit
Conversion Gain 3	CG3	f_{RF} = 55 MHz, f_{IF} = 50 MHz, P_{RF} = –40 dBm RF Input Terminal: Tuned **Note 1**	24.5	dB
Conversion Gain 4	CG4	f_{RF} = 200 MHz, f_{IF} = 50 MHz, P_{RF} = –40 dBm RF Input Terminal: Tuned **Note 1**	24.5	dB
Conversion Gain 5	CG5	f_{RF} = 470 MHz, f_{IF} = 50 MHz, P_{RF} = –40 dBm RF Input Terminal: Tuned **Note 1**	23.0	dB
Conversion Gain 6	CG6	f_{RF} = 890 MHz, f_{IF} = 50 MHz, P_{RF} = –40 dBm RF Input Terminal: Tuned **Note 2**	20.0	dB
1% Cross-modulation Distortion 1	CM1	f_{RF} = 55 to 470 MHz, f_{IF} = 50 MHz **Note 1, 3**	103	dBμ
1% Cross-modulation Distortion 2	CM2	f_{RF} = 470 to 890 MHz, f_{IF} = 50 MHz **Note 2, 3**	100	dBμ
1% Cross-modulation Distortion 3 (U/IF)	CM3	f_{RF} = 50 MHz **Note 1, 4**	103	dBμ
Oscillation Frequency Stability 1	$f_{stb}1$	V_{CC} ± 10%, f_{OSC} = 100 to 520 MHz **Note 1**	±100	kHz
Oscillation Frequency Stability 2	$f_{stb}2$	V_{CC} ± 10%, f_{OSC} = 520 to 940 MHz **Note 2**	±200	
Oscillation Stop (Start) Voltage 1	$V_{OSC}1$	f_{OSC} = 100 to 520 MHz **Note 1**	2.5	V
Oscillation Stop (Start) Voltage 2	$V_{OSC}2$	f_{OSC} = 520 to 940 MHz **Note 2**	3.0	

Notes 1. By test circuit 2

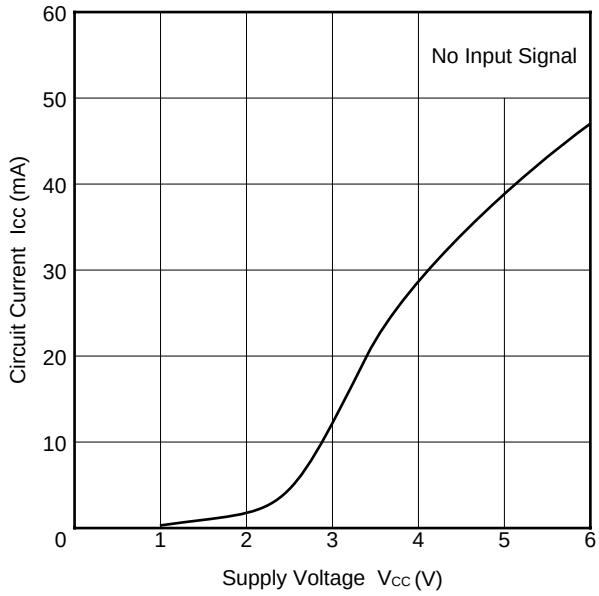
2. By test circuit 3

3. f_{undes} = f_{RF} ± 12 MHz, P_{RF} = –31 dBm, f_{IF} = 50 MHz, AM: 100 kHz, 30%Mod., S/I Ratio = 46 dBc, Output 75 Ω Open

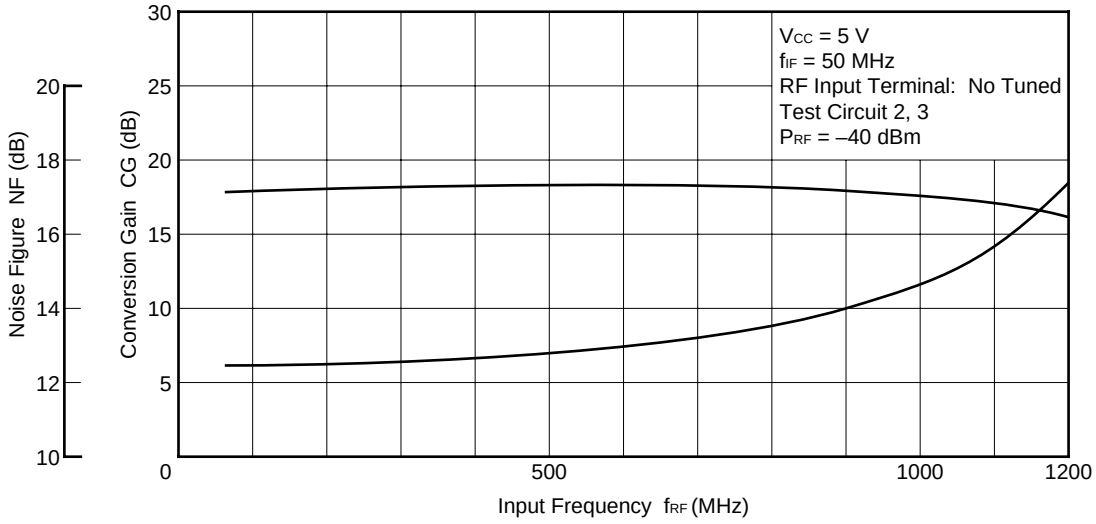
4. f_{in} = 50 MHz, f_{undes} = 62 MHz, P_{in} = –31 dBm, AM: 100 kHz, 30% Mod., S/I Ratio = 46 dBc, Output 75 Ω Open

TYPICAL CHARACTERISTICS (T_A = +25°C)

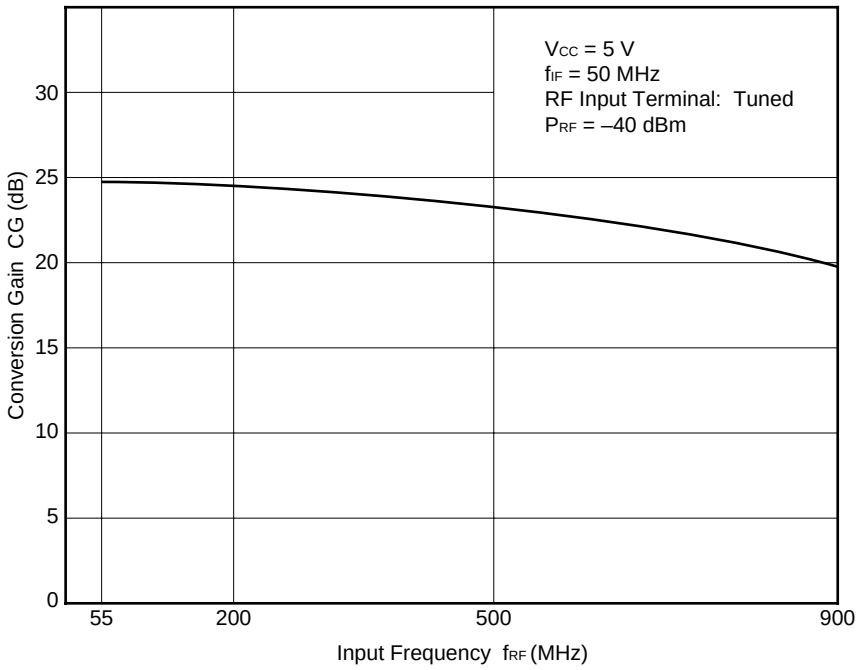
CIRCUIT CURRNT vs. SUPPLY VOLTAGE



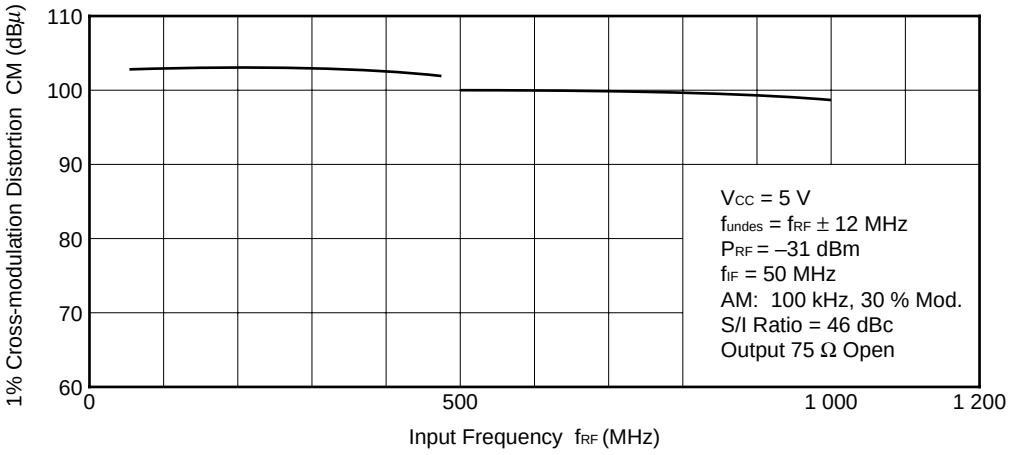
NOISE FIGURE AND CONVERSION GAIN vs. INPUT FREQUENCY



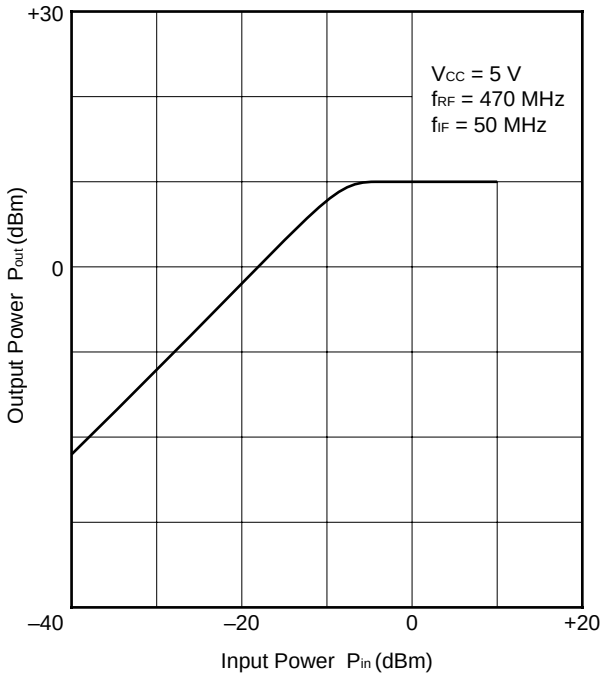
CONVERSION GAIN vs. INPUT FREQUENCY



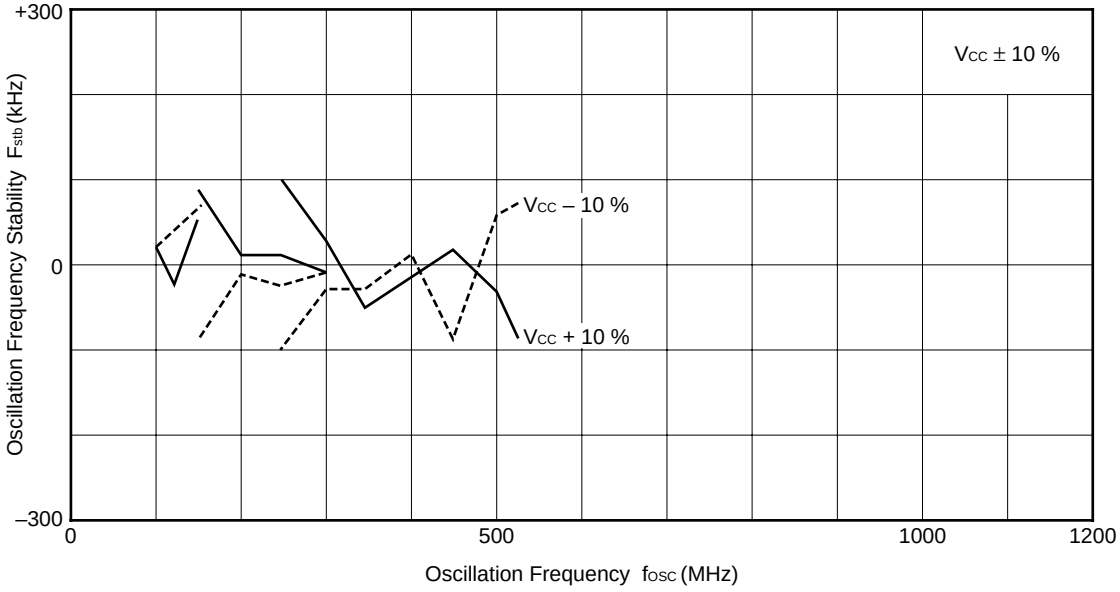
1% CROSS-MODULATION DISTORTION vs. INPUT FREQUENCY



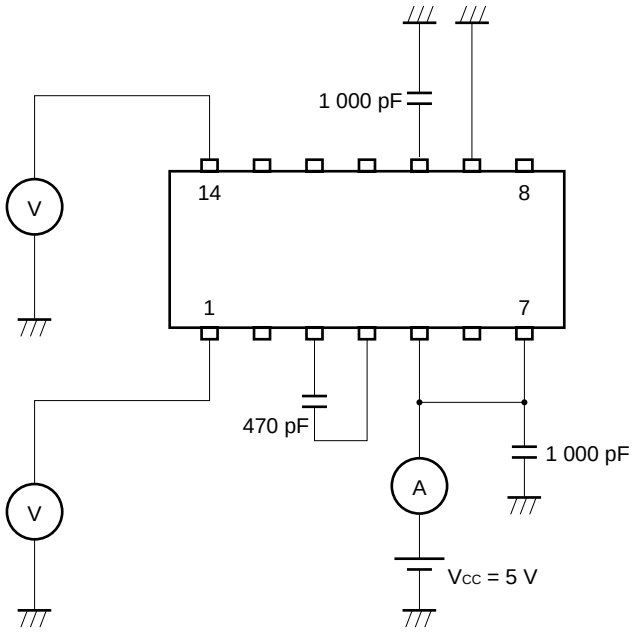
OUTPUT POWER vs. INPUT POWER



OSC-FREQUENCY STABILITY vs. OSCILLATION FREQUENCY

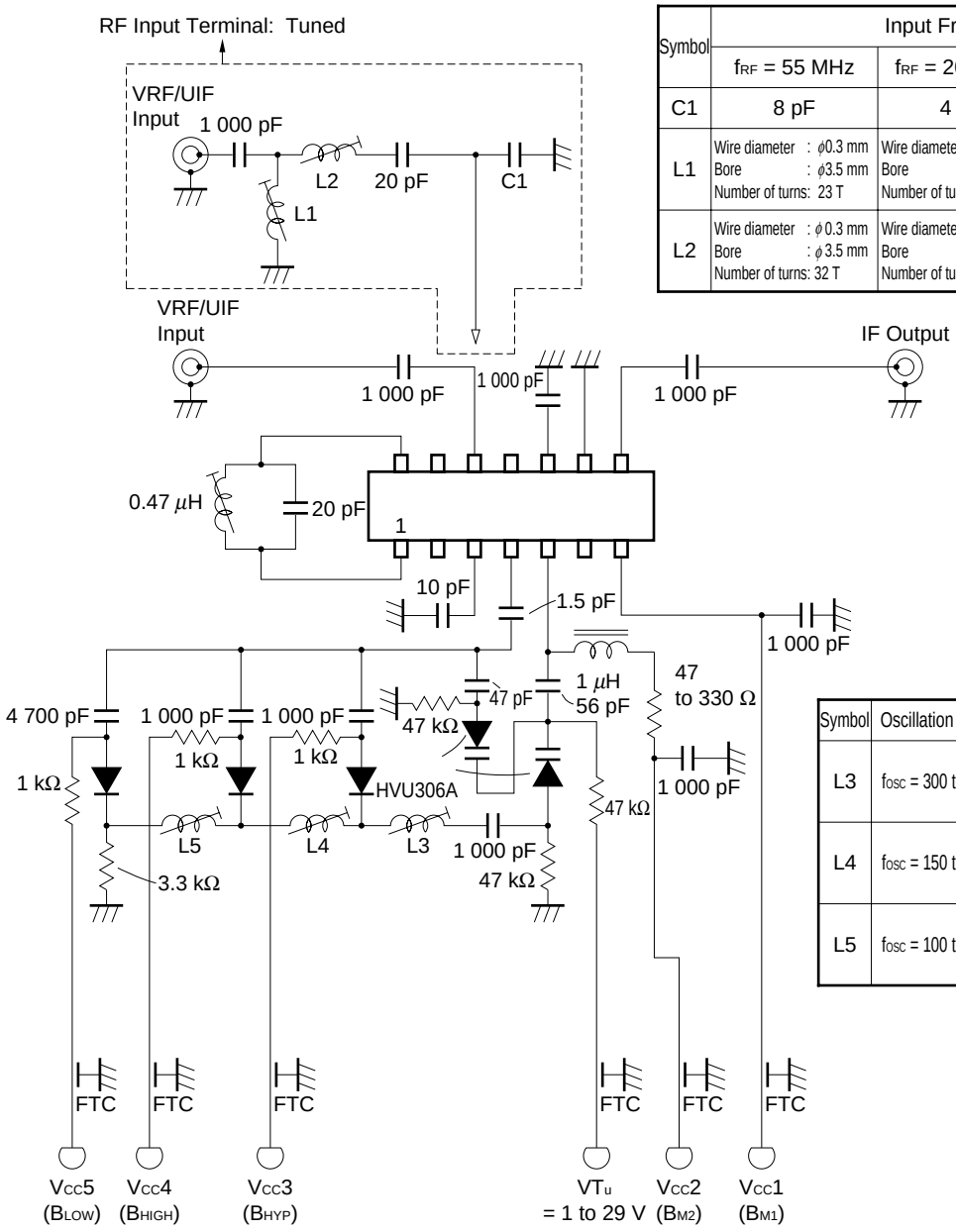


TEST CIRCUIT 1



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

TEST CIRCUIT 2

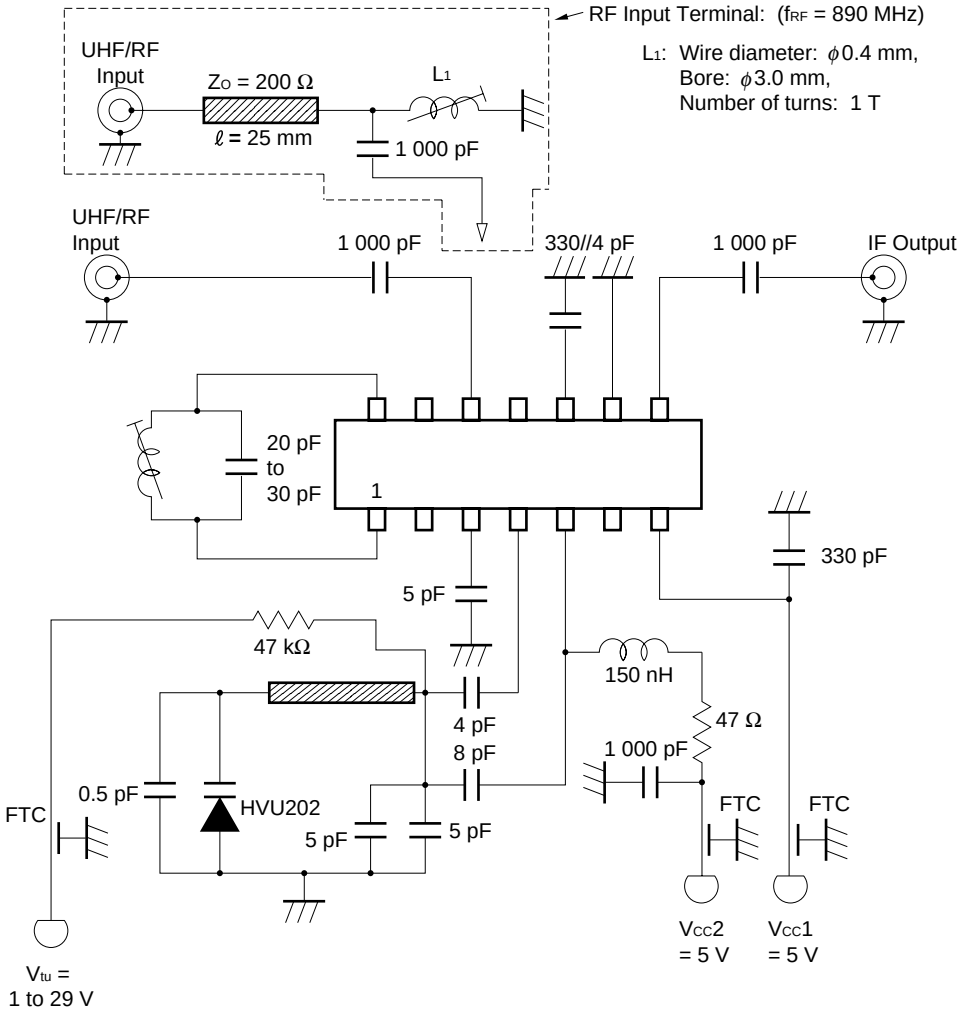


Symbol	Input Frequency		
	f_{RF} = 55 MHz	f_{RF} = 200 MHz	f_{RF} = 470 MHz
C1	8 pF	4 pF	2 pF
L1	Wire diameter : φ0.3 mm Bore : φ3.5 mm Number of turns: 23 T	Wire diameter : φ0.4 mm Bore : φ3.2 mm Number of turns: 3 T	Wire diameter : φ0.4 mm Bore : φ3.5 mm Number of turns: 2 T
L2	Wire diameter : φ0.3 mm Bore : φ3.5 mm Number of turns: 32 T	Wire diameter : φ0.3 mm Bore : φ4.0 mm Number of turns: 7 T	Wire diameter : φ0.5 mm Bore : φ3.5 mm Number of turns: 2 T

Symbol	Oscillation Frequency	Coil used
L3	f_{OSC} = 300 to 520 MHz	Wire diameter : φ0.5 mm Bore : φ3.0 mm Number of turns: 2 T
L4	f_{OSC} = 150 to 300 MHz	Wire diameter : φ0.4 mm Bore : φ2.5 mm Number of turns: 3 T
L5	f_{OSC} = 100 to 150 MHz	Wire diameter : φ0.4 mm Bore : φ3.0 mm Number of turns: 9 T

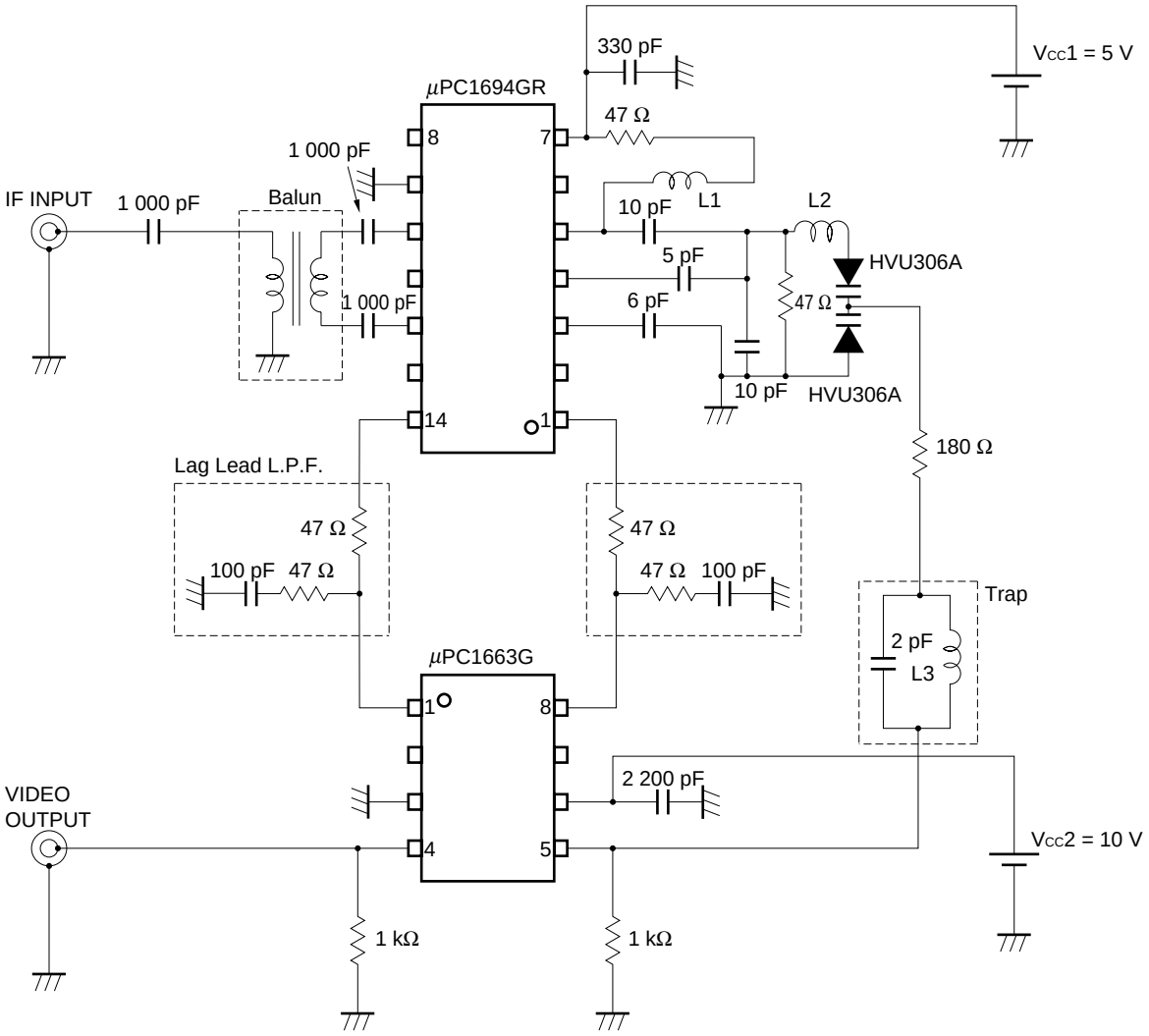
	$V_{CC}1$ (B_{M1})	$V_{CC}2$ (B_{M2})	$V_{CC}3$ (B_{HYP})	$V_{CC}4$ (B_{HIGH})	$V_{CC}5$ (B_{LOW})
V_{LOW}	5 V	5 V	OPEN	OPEN	5 V
V_{HIGH}	5 V	5 V	OPEN	5 V	OPEN
V_{HYPER}	5 V	5 V	5 V	OPEN	OPEN
U/IF	5 V	OPEN	OPEN	OPEN	OPEN

TEST CIRCUIT 3



APPLICATION CIRCUIT EXAMPLE 1

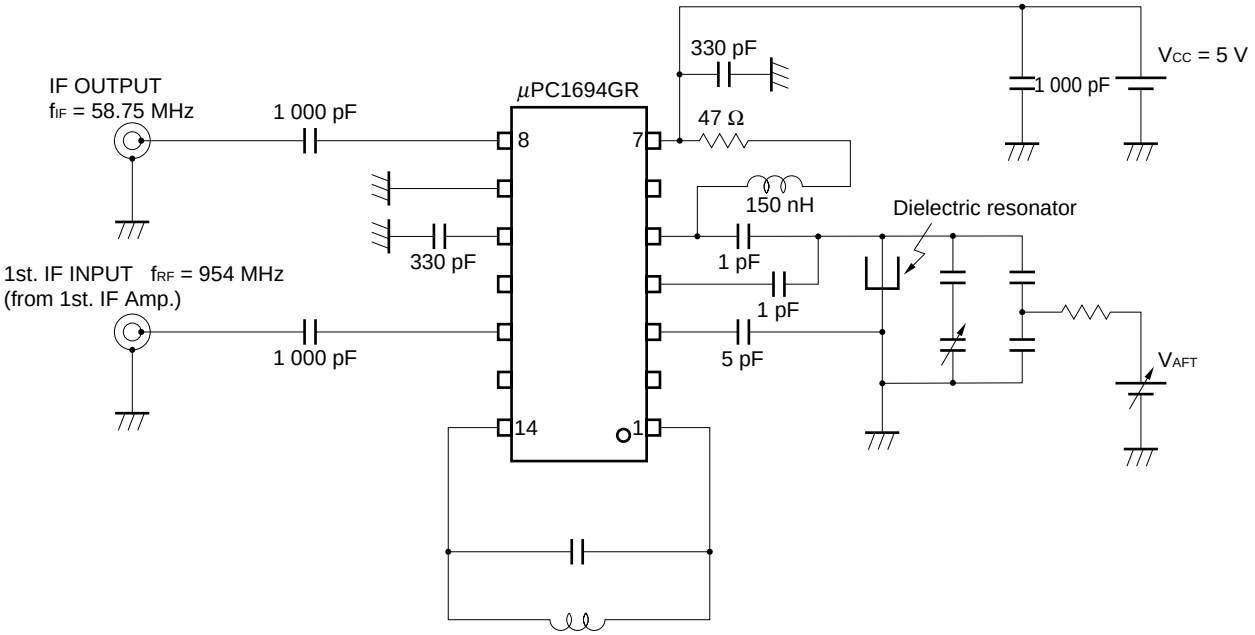
For FM demodulator (Example using μPC1694GR and μPC1663G)



L1: Wire diameter: ϕ0.3 mm, Bore: ϕ1.5 mm, Number of turns: 13 T
L2: Wire diameter: ϕ0.4 mm, Bore: ϕ3.5 mm, Number of turns: 2 T
L3: Wire diameter: ϕ0.3 mm, Bore: ϕ1.8 mm, Number of turns: 7 T
Balun: TDK WBT5,5P5-C10129E

APPLICATION CIRCUIT EXAMPLE 2

For TV/VCR TUNER



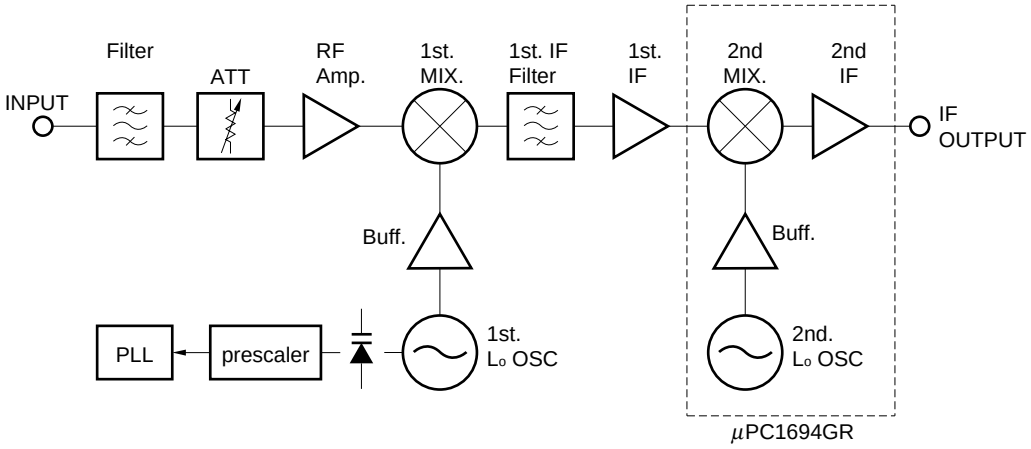
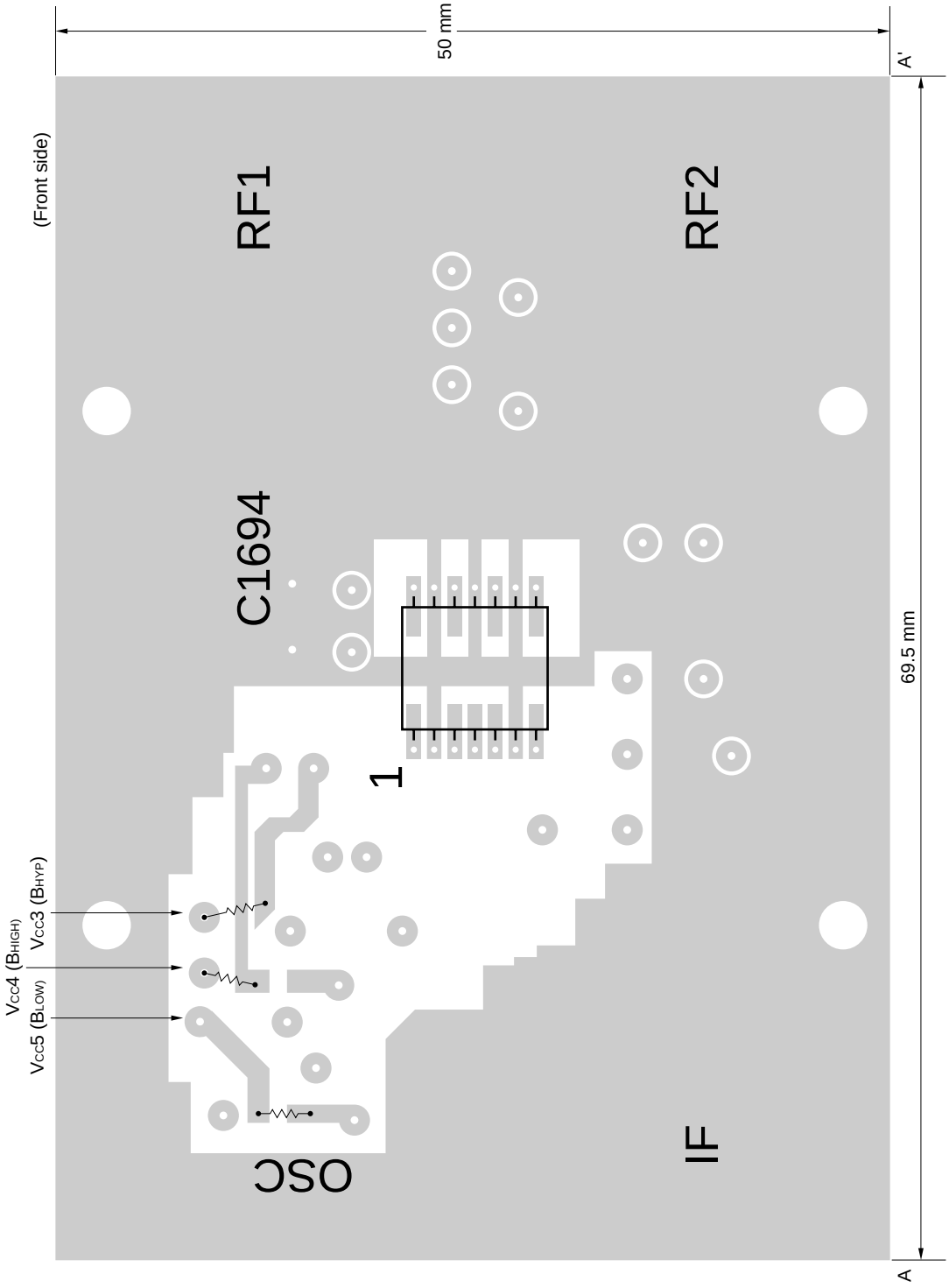
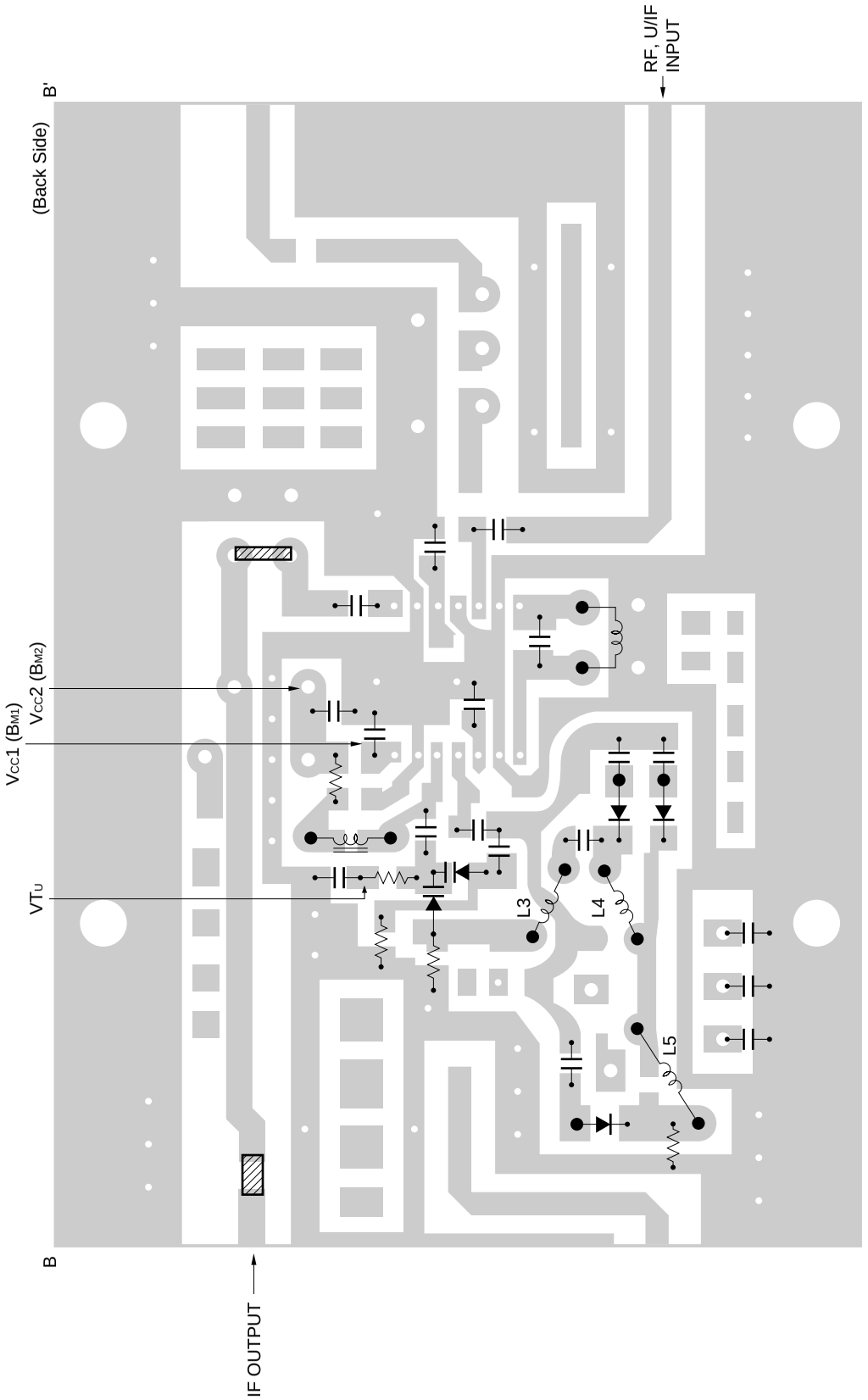


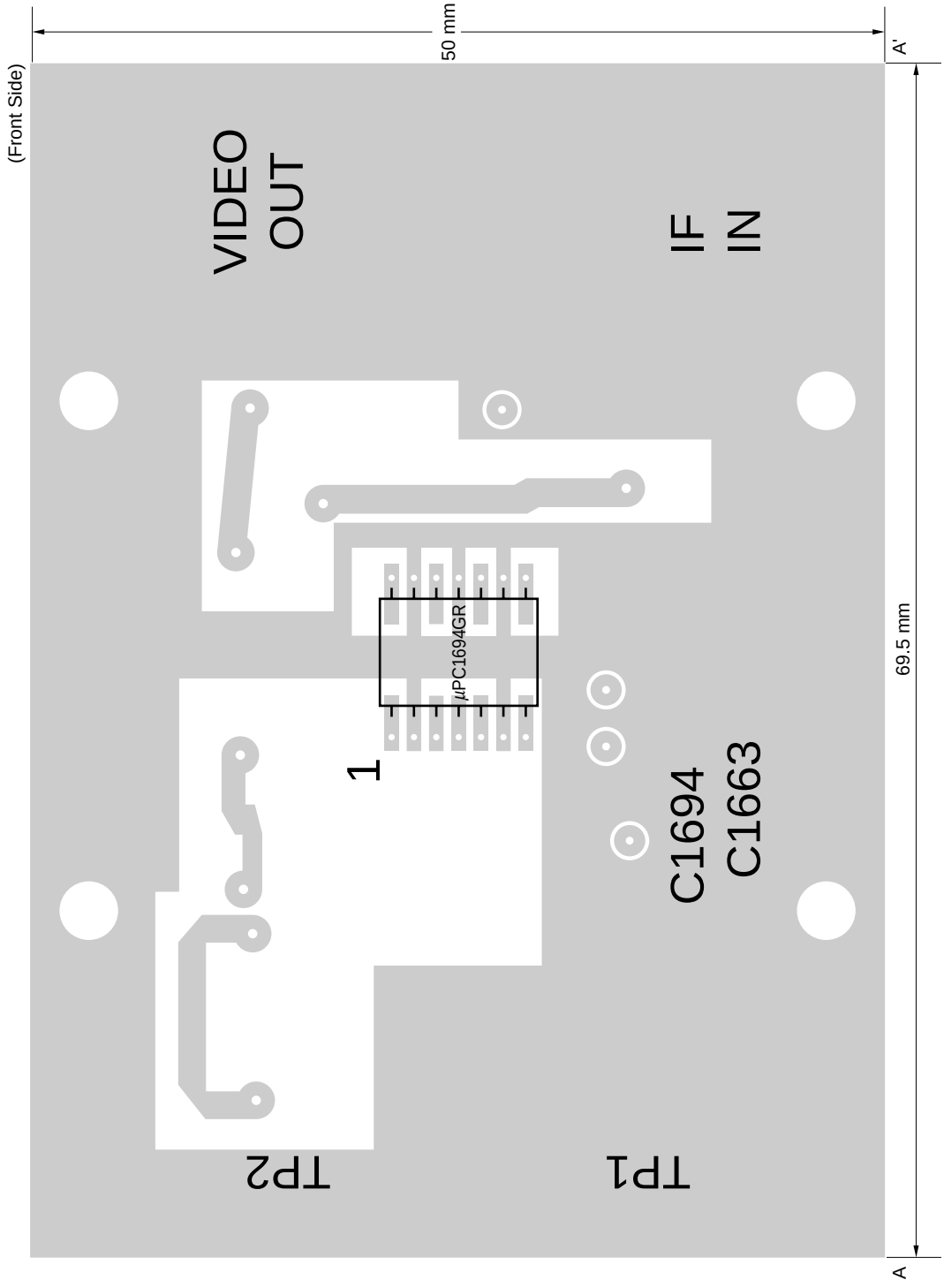
ILLUSTRATION OF THE APPLICATION CIRCUIT EXAMPLE 2 ASSEMBLED ON EVALUATION BOARD

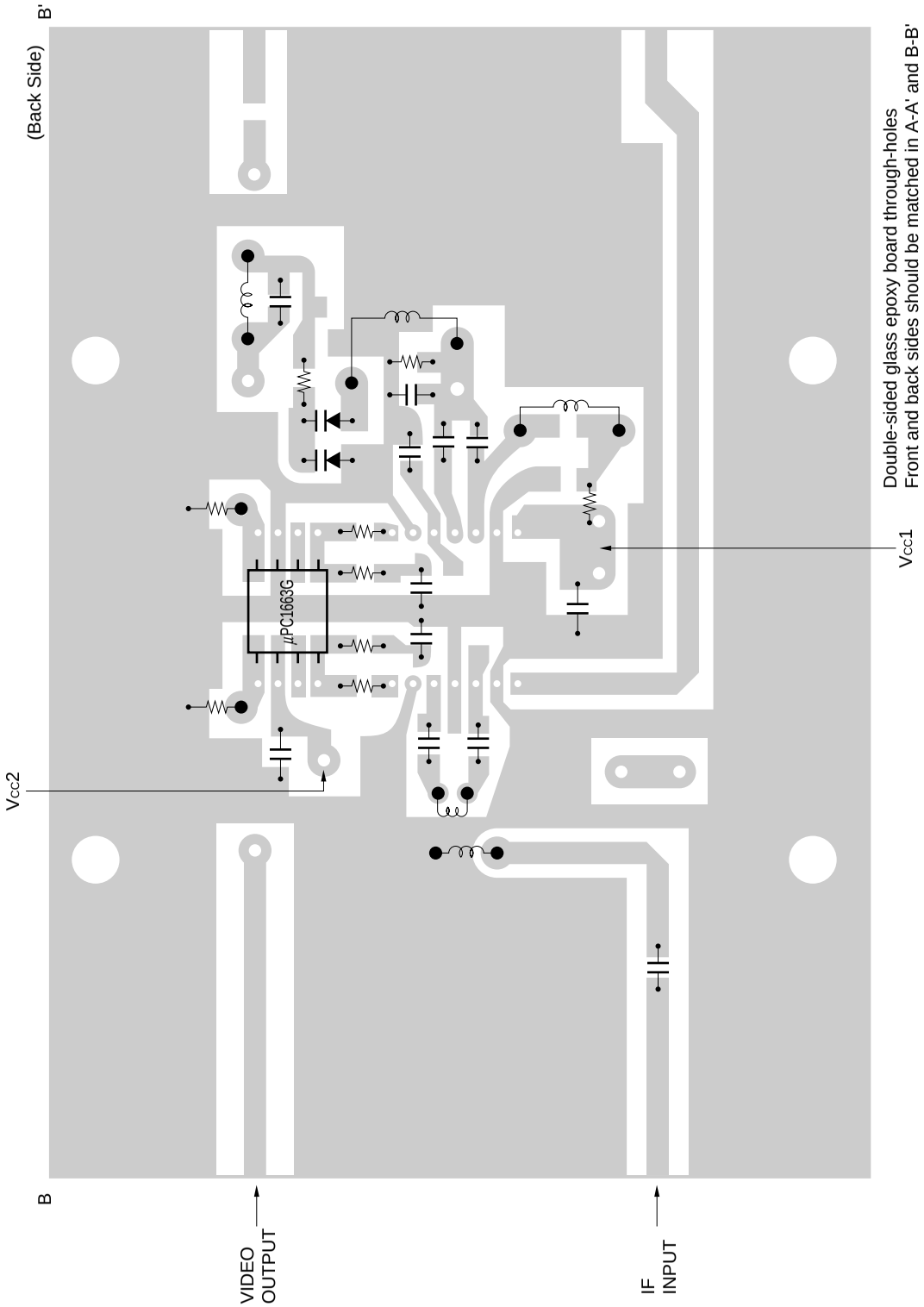




Double-sided glass epoxy board through-holes
Front and back sides should be matched in A-A' and B-B'
▨: short-circuited strip.

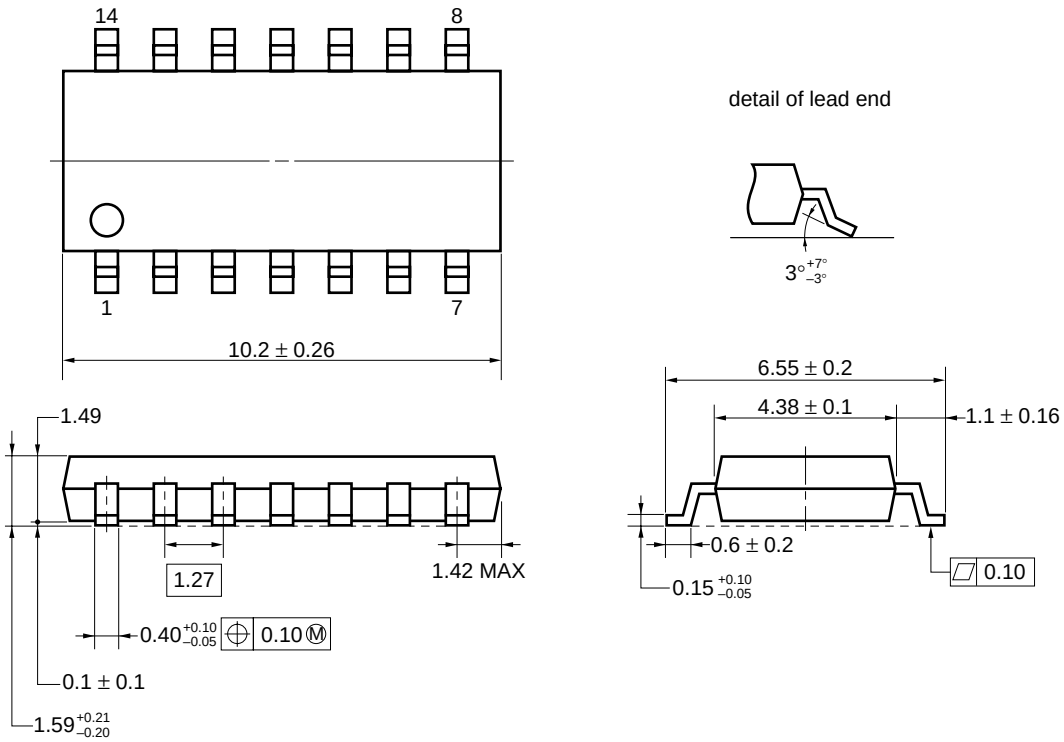
ILLUSTRATION OF THE APPLICATION CIRCUIT EXAMPLE 1 ASSEMBLED ON EVALUATION BOARD




B'
(Back Side)
Double-sided glass epoxy board through-holes
Front and back sides should be matched in A-A' and B-B'
Vcc1
μPC1663G
Vcc2
B
VIDEO
OUTPUT
IF
INPUT

★ 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 V_{CC} 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[Note]	IR35-00-3
VPS	Package peak temperature: 215 °C or below Time: 40 seconds or less (at 200 °C) Count: 3, Exposure limit: None[Note]	VP15-00-3
Wave Soldering	Soldering bath temperature: 260 °C or below Time: 10 seconds or less Count: 1, Exposure limit: None[Note]	WS60-00-1
Partial Heating	Pin temperature: 300 °C Time: 3 seconds or less (per side of device) Exposure limit: None[Note]	–

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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  - 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)
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