APPLICATION MANUAL

Single Video Amplifier
TK15404M

CONTENTS

MEETING YOUR NEEDS
TOKO, Inc.

Single Video Amplifier
TK15404M

1. DESCRIPTION

Operating from a single +5V supply, the TK15404 is a single-channel video driver IC that takes a standard video signal as the analog input and provides a buffered analog output for driving a 150Ω load (series 75Ω resistor and 75Ω cable load). The standard video input signal ($1V_{P\text{-}P}$) is typically amplified 6dB using external components to produce a $2V_{P\text{-}P}$ signal into an AC-coupled 150Ω load. During standby (Pin 1 grounded), the TK15404 consumes only 120μW of power. Nominal power dissipation (no input) is typically 32mW.

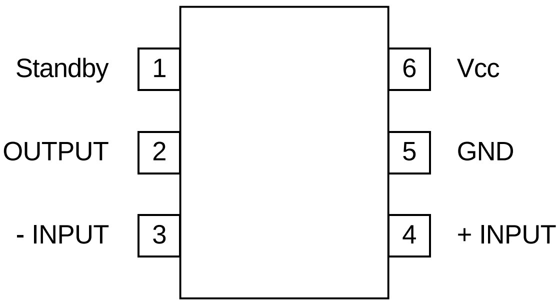
2. FEATURES

- Gain Set by External Components (6dB typ.)
- Internal 75Ω Driver
- Active High ON/OFF Control with Internal Pull-up
- Low Standby Current (typ. $I_{CCS} \leq 25\mu A$)
- Single +5V Power Supply Operation
- Very Small SOT23-6 Package

3. APPLICATIONS

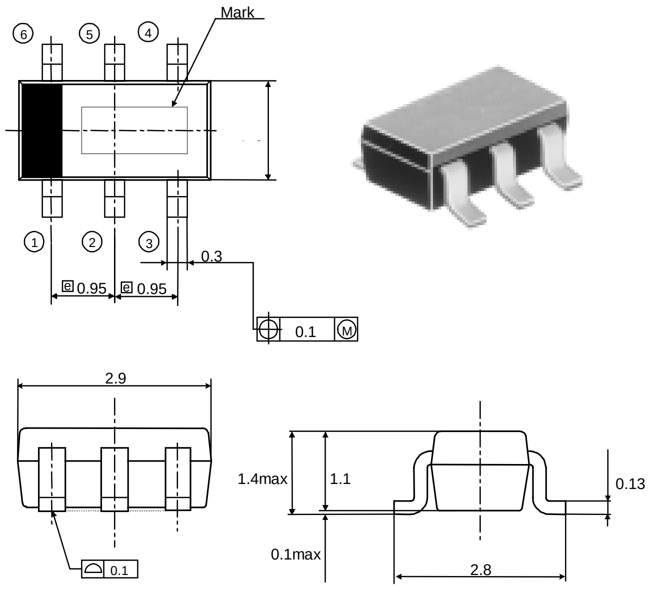
- Video Equipment
- Digital Cameras
- CCD Cameras
- TV Monitors
- Video Tape Recorders
- LCD Projectors

4. PIN CONFIGURATION



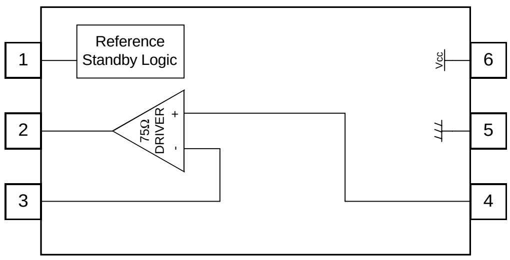
5. PACKAGE OUTLINE

- SOT23-6



* Package size value is typical

6. BLOCK DIAGRAM



7. ABSOLUTE MAXIMUM RATINGS

T_a=25°C

Parameter	Symbol	Rating	Units	Conditions
Supply Voltage	V_{CC}	6.0	V	
Power Dissipation	P_D	150	mW	Note
Storage Temperature Range	T_{stg}	-55 ~ +150	°C	
Operating Temperature Range	T_{OP}	-25 ~ +75	°C	
Input Frequency	f_{MAX}	~ 100	MHz	

Note: P_D must be decreased at the rate of 1.2mW/°C for operation above 25°C.

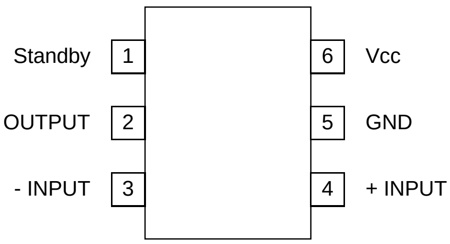
8. ELECTRICAL CHARACTERISTICS

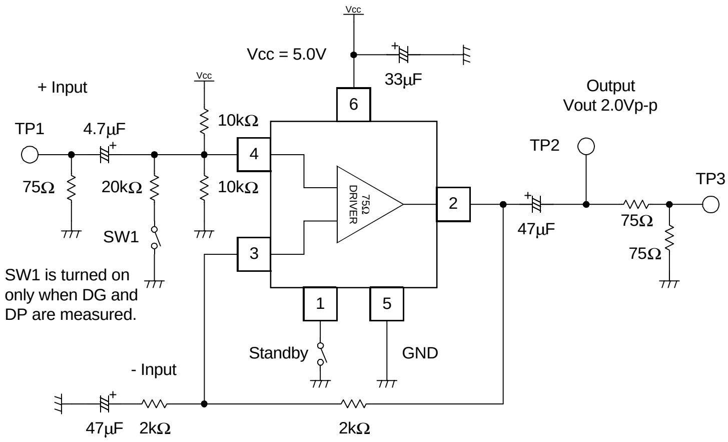
V_{CC}=5.0V, T_a=25°C, V_{IN}=1.0V_{P-P}, R_L=150Ω

Parameter	Symbol	Value			Units	Conditions
		MIN	TYP	MAX		
Operating Voltage Range	V_{OP}	4.5	5.0	5.5	V	
Supply Current	I_{CC}		6.3	8.5	mA	No Input
Standby Supply Current	I_{CCS}		24.0	50.0	µA	Pin 1 Grounded
Standby Terminal Current	I_{OS}		24.0	50.0	µA	Pin 1 Standby mode
Threshold Voltage (High to Low)	V_{THL}			0.3	V	Pin 1 Operating to Standby mode
Threshold Voltage (Low to High)	V_{TLH}	1.8			V	Pin 1 Standby to Operating mode
Voltage Gain	G_V	5.7	6.0	6.3	dB	fin=1.0MHz (Note)
Frequency Response	fr		0.0		dB	fin=1.0MHz / 5.0MHz
			-0.6		dB	fin=1.0MHz/10MHz
Total Harmonic Distortion	THD		0.2	1.0	%	fin=1.0kHz
Maximum Output Voltage	$V_{OUT(MAX)}$	1.0	1.2		Vrms	THD=10% point
Signal to Noise Ratio	S/N		-70		dB	Pedestal signal
Differential Gain	DG	-3.0		+3.0	%	Staircase wave input
Differential Phase	DP	-3.0		+3.0	deg	Staircase wave Input
Open Circuit Voltage Gain	G_{VO}		40		dB	
Frequency Bandwidth	BW		20		MHz	
Slew Rate	SR		70		V/µS	
Input Capacitance	C_{IN}		9		pF	
Input Resistance	R_{IN}		1.6		MΩ	

Note: Set by external components.

9. TEST CIRCUIT

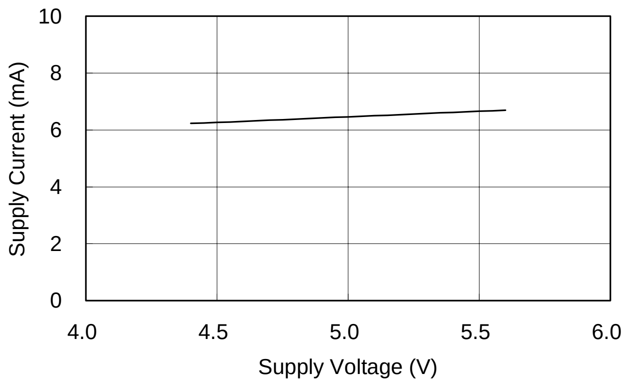




10. TYPICAL CHARACTERISTICS

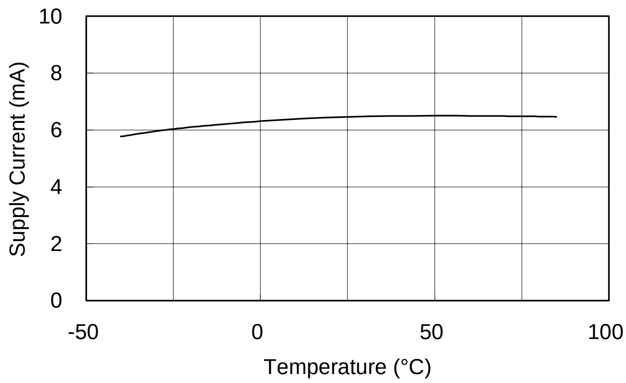
■ Supply Current vs. Supply Voltage

Ta=25°C, No Input



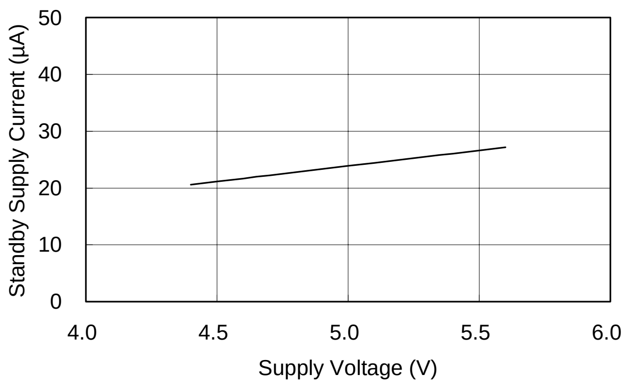
■ Supply Current vs. Temperature

V_{CC}=5.0V, No Input



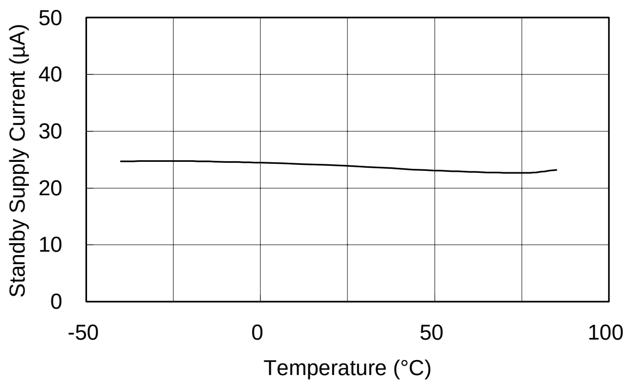
■ Standby Supply Current vs. Supply Voltage

Ta=25°C, Pin 1 GND



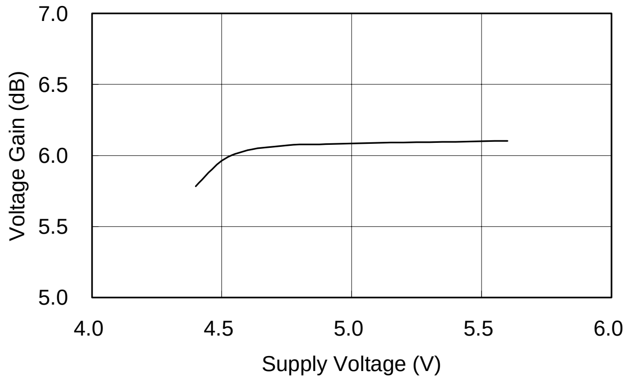
■ Standby Supply Current vs. Temperature

V_{CC}=5.0V, Pin 1 GND



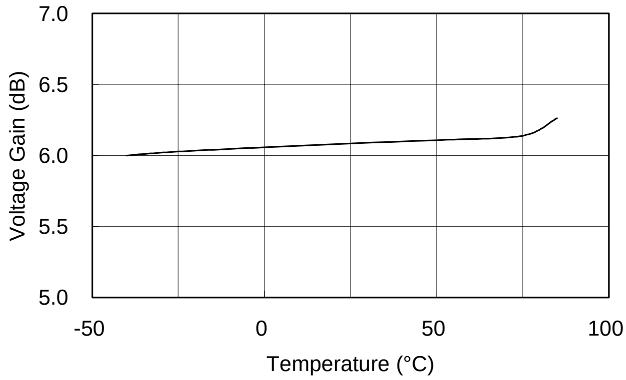
■ Voltage Gain vs. Supply Voltage

Ta=25°C, fin=1.0MHz, Vin=1.0V_{P-P}



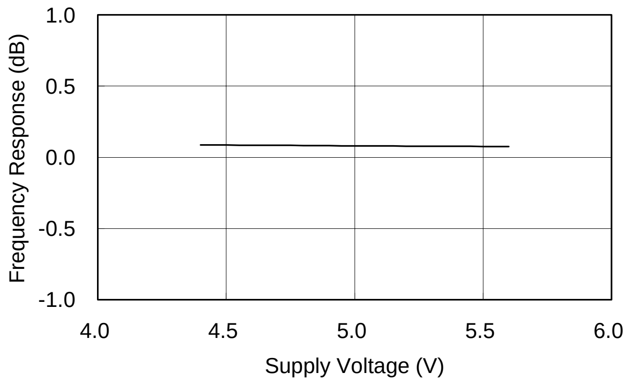
■ Voltage Gain vs. Temperature

V_{CC}=5.0V, fin=1.0MHz, Vin=1.0V_{P-P}



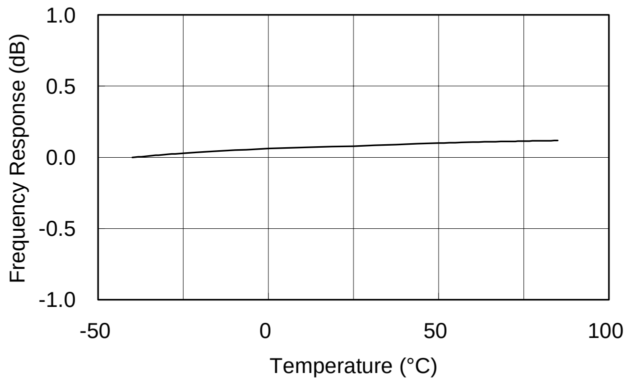
■ Frequency Response vs. Supply Voltage

Ta=25°C, fin=1MHz / 5MHz, Vin=1.0V_{P-P}



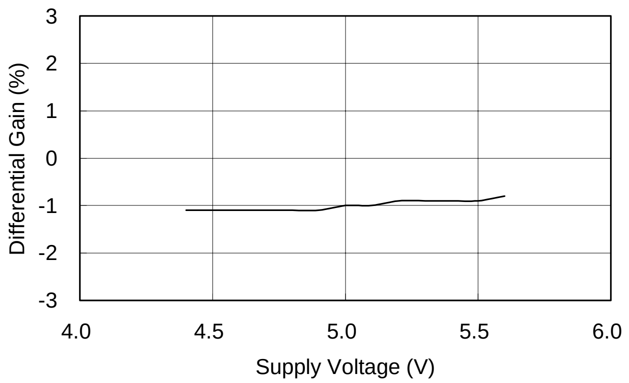
■ Frequency Response vs. Temperature

V_{CC}=5.0V, fin=1MHz / 5MHz, Vin=1.0V_{P-P}



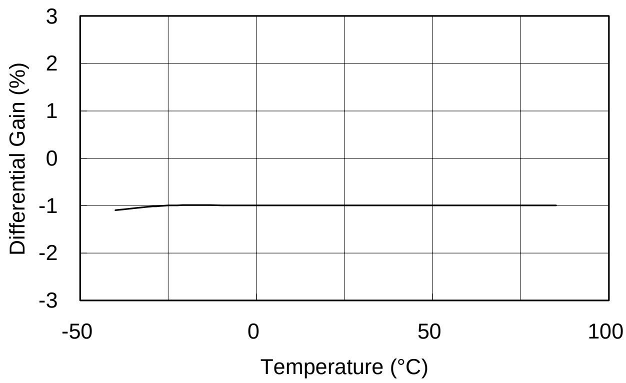
■ Differential Gain vs. Supply Voltage

Ta=25°C, Vin=1.0V_{P-P}

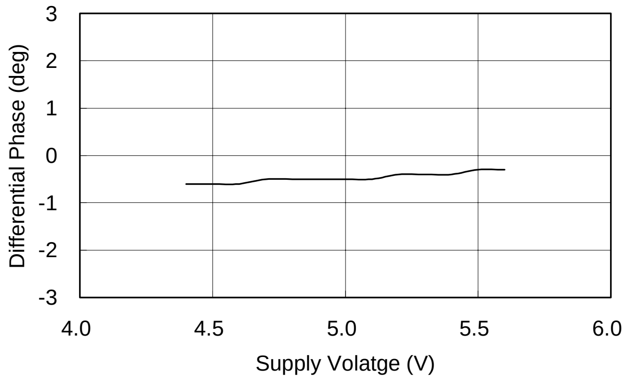


■ Differential Gain vs. Temperature

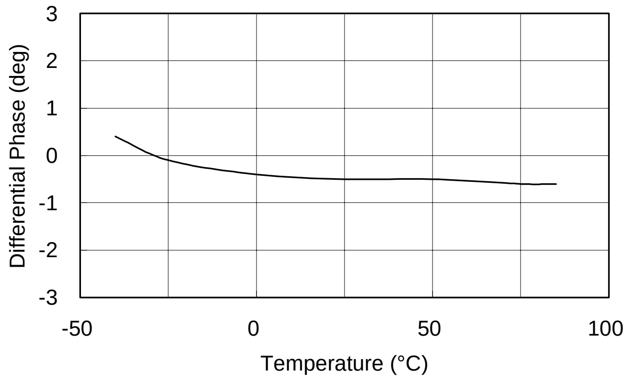
V_{CC}=5.0V, Vin=1.0V_{P-P}



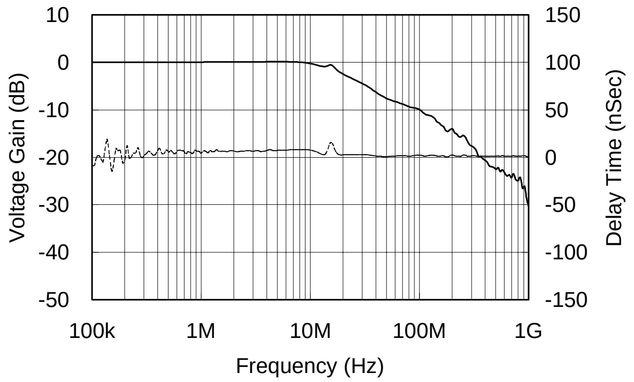
■ Differential Phase vs. Supply Voltage
Ta=25°C, Vin=1.0V_{P-P}



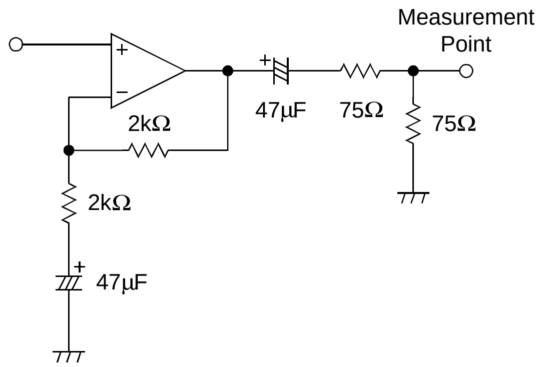
■ Differential Phase vs. Temperature
V_{CC}=5.0V, Vin=1.0V_{P-P}



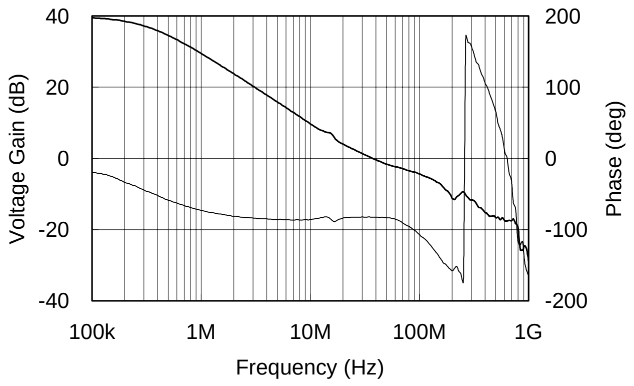
■ Voltage Gain vs. Input Frequency
Ta=25°C, Vin=1.0V_{P-P}



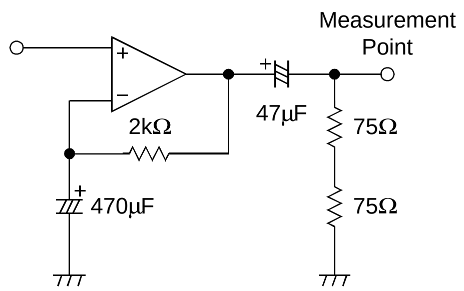
■ Voltage Gain Measurement Circuit



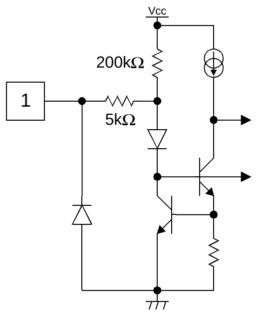
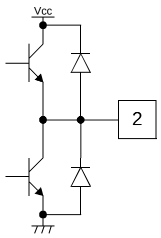
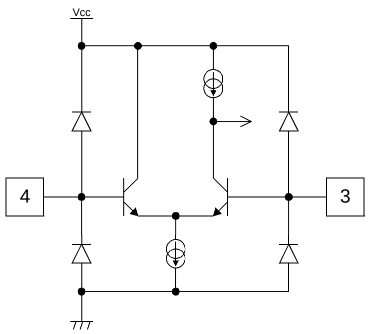
■ Open Circuit Voltage Gain vs. Input Frequency
V_{CC}=5.0V, Vin=1.0V_{P-P}



■ Open Circuit Voltage Gain Measurement Circuit



11. PIN DESCRIPTION

Pin No.	Pin Description	Internal Equivalent Circuit	Description
1	STANDBY		Standby Logic Terminal. The device is in the standby mode when Pin 1 is connected to a Low level. The device is in the operating mode when Pin 1 is connected to a High level or Open.
2	OUTPUT		Output Terminal. The output is available to drive a 75Ω + 75Ω load.
3 4	-INPUT +INPUT		Pin 3: Inverting Signal Input Terminal. Pin 4: Non-Inverting Signal Input Terminal.
5	GND	-	GND Terminal.
6	V_{CC}	-	Power Supply Terminal.

12. APPLICATIONS INFORMATION

Unless otherwise shown in the description, the examples are explained with the application of a ± power supply.

12-1. About Amplitude Restrictions

In certain applications, the output voltage is limited by the input voltage.
This is explained in the outline below using the internal equivalent circuit shown in Figure 1.

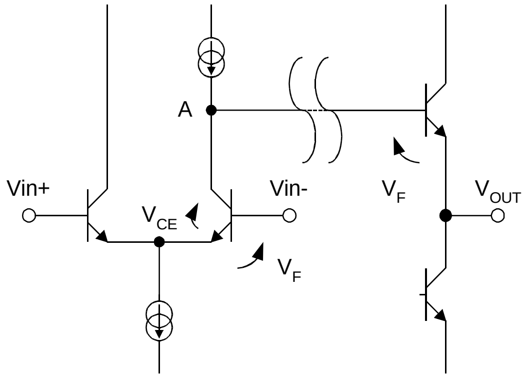


Figure 1: The internal equivalent circuit

From Figure 1, if the voltage VA at A point is shown from the input side and the output side respectively, the expression is as follows.

$$V_A \geq V_{in} - V_F + V_{CE} \qquad (1)$$

$$V_A = V_{out} + V_F \qquad (2)$$

Thus

$$V_{out} - V_{in} + 2V_F \geq V_{CE} \qquad (3)$$

Substitution of V_F=0.7V into (3) gives

$$V_{out} - V_{in} + 1.4V \geq V_{CE} \qquad (4)$$

Depending on the relationship between Vout and Vin, it may become impossible to secure the Saturation voltage VCE (about 0.3V) of the inverting input transistor; as a result, the linearity of the input and output voltage will collapse.
An example of this application is shown in Figure 2 with the preventive measures explained below.

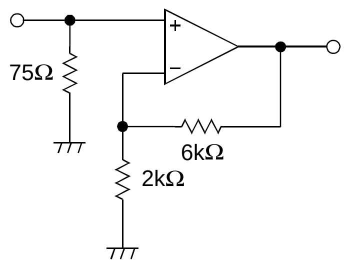


Figure 2: Application Example

In Figure 2, if -0.5V (the minimum value of input amplitude) is given to the input, the output voltage will be set to -2.0V. Substitution of Vin and Vout into (4) gives

$$V_{out} - V_{in} + 1.4V = -0.1V \leq V_{CE}(0.3V) \qquad (5)$$

This shows that the transistor of the inverting input is operating in the saturation region; for this reason, it becomes impossible to keep linearity of the input-to-output voltage. As shown in Figure 3, there is a method of providing V_{REF} as a preventive measure.
It is possible to raise the output voltage by setting up V_{REF} appropriately, and avoid amplitude restrictions.

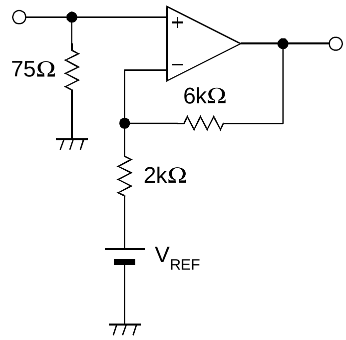


Figure 3: Example of preventive measures

If the input voltage and V_{REF} are assumed to be -0.5V, the output voltage also becomes -0.5V.
This result is substituted into expression (4)

$$V_{out} - V_{in} + 1.4V = 1.4V \geq V_{CE}(0.3V) \qquad (6)$$

As a result, the saturation voltage of the inverting input transistor is secured, and the amplitude limitation can be avoided.
However, it is necessary to pay attention to the dynamic range, especially when using this IC with a low voltage power supply. This method may be used to control the output bias voltage.

12-2. Use as a Buffer Amplifier

The gain of this operational amplifier IC can be changed with the external parts.
When this IC is used as a feedback-type buffer amplifier and an oscillation phenomenon arises, insert a feedback resistor of approximately 2kΩ.

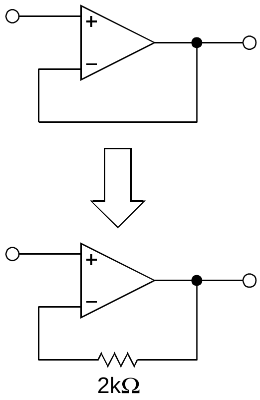


Figure 4: Example of use as a buffer amplifier

Usually, a feedback amplifier oscillates for the following reason: the internal impedance of the output terminal and the internal capacitance of the input terminal constitute a low pass filter. Phase delay occurs with a low pass filter and oscillation results.
By adding a feedback resistor to the output impedance, the cutoff frequency of the low pass filter becomes low. For this reason, the amount of feedback at the oscillation frequency is set to 0dB or less, and the oscillation stops.

13. NOTES

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■ None of ozone depleting substances (ODS) under the Montreal Protocol is used in manufacturing process of us.

14. OFFICES

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