APPLICATION MANUAL

Dual Video Amplifier
TK15420M / D

CONTENTS

MEETING YOUR NEEDS
TOKO, Inc.

Dual Video Amplifier
TK15420M / D

1. DESCRIPTION

The TK15420 is a dual channel video line driver IC capable of operating over a very wide supply range (V_{CC}/V_{EE} = ±2.0V to ±6.0V). It is an operational amplifier type video line driver with the adjustable voltage gain set by external resistors.

The TK15420 is available in the SOP-8 surface mount package and the DIP-8 package.

2. FEATURES

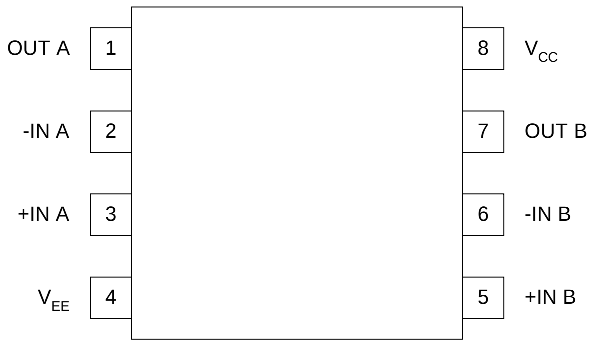
- Adjustable Voltage Gain
- Internal 2-Channel 75Ω Driver
- Operating Voltage Range (V_{CC}/V_{EE} = ±2.0V to ±6.0V)

3. APPLICATIONS

- Video Equipment
- Digital Cameras
- CCD Cameras
- TV Monitors
- Video Tape Recorders
- LCD Projectors
- DVD Player/RW
- Video Board

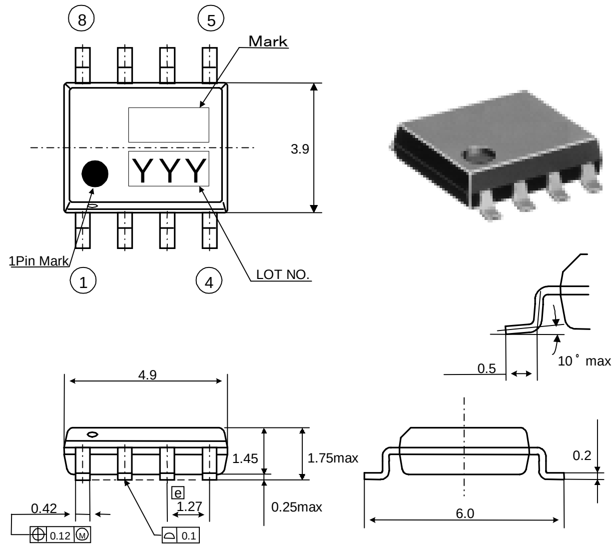
4. PIN CONFIGURATION

Top View



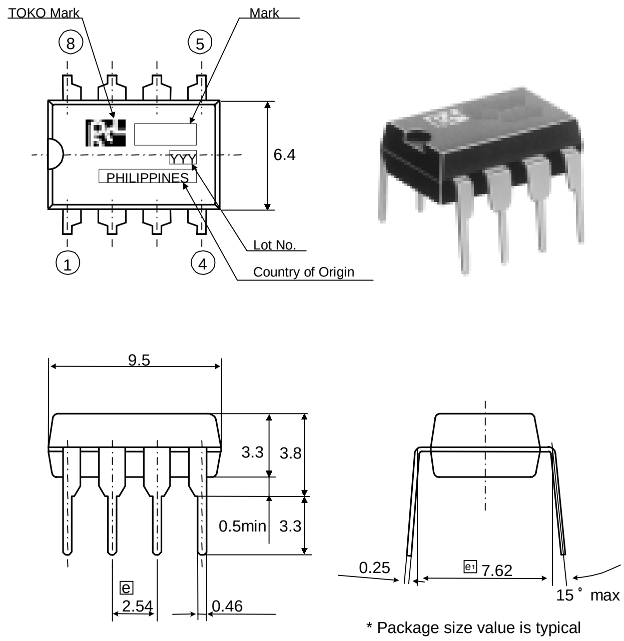
5. PACKAGE OUTLINE

■ SOP-8



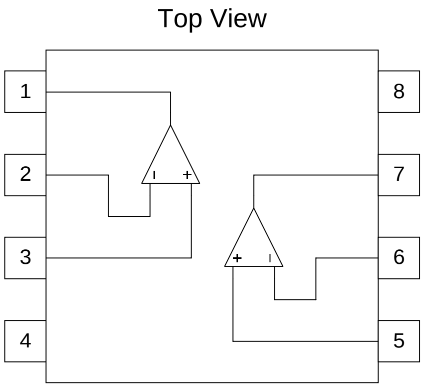
* Package size value is typical

■ DIP-8



* 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}	14.0	V	
Power Dissipation	P_D	400	mW	SOP-8, Note 1
		800		DIP-8, Note 2
Storage Temperature Range	T_{stg}	-55 ~ +150	°C	
Operating Temperature Range	T_{OP}	-25 ~ +85	°C	
Input Frequency	f_{MAX}	~ 20	MHz	

Note 1: P_D must be decreased at the rate of 3.2mW/°C for operation above 25°C.
Note 2: P_D must be decreased at the rate of 6.4mW/°C for operation above 25°C.

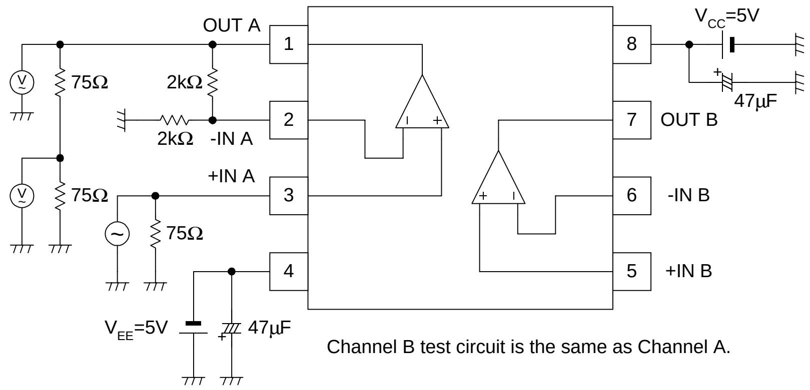
8. ELECTRICAL CHARACTERISTICS

V_{CC}/V_{EE} = ±5.0V, T_a=25°C

Parameter	Symbol	Value			Units	Conditions
		MIN	TYP	MAX		
Operating Voltage Range	V_{OP}	4.0	10.0	12.0	V	Single Supply
Supply Current	I_{CC}		16.9	23.0	mA	No Signal
Input Bias Current	I_{IB}		5.0	15.0	µA	Input Terminal
Voltage Gain	G_V	5.6	5.9	6.2	dB	fin=1MHz, Vin=1V_{P-P}
Frequency Response	fr		-0.5		dB	fin=1MHz / 10MHz
Maximum Output Voltage Swing	$V_{OUT(MAX)}$	5.0	5.7		V	DC voltage
Differential Gain	DG	-3.0	0.3	+3.0	%	Vin=1V_{P-P}, Staircase
Differential Phase	DP	-3.0	0.4	+3.0	deg	Vin=1V_{P-P}, Staircase
Cross Talk	CT	-50.0	-63.4		dB	fin=4.43MHz, Vin=1V_{P-P}
Supply Voltage Rejection Ratio	SVRR		48.6		dB	ΔV=0.4V_{P-P}, fin=100kHz
Input Capacitance	C_{IN}		1.4		pF	SOP-8
			2.3			DIP-8
Input Impedance	Z_{IN}		5.0		MΩ	

Note: When using this IC with two power supplies, the turn-on power sequence is: V_{EE}, then V_{CC}.

9. TEST CIRCUIT

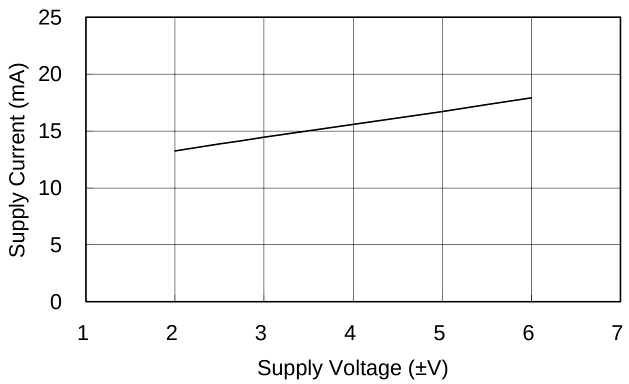


Channel B test circuit is the same as Channel A.

10. TYPICAL CHARACTERISTICS

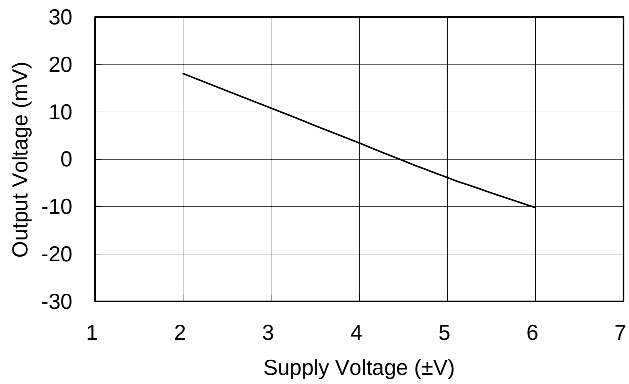
■ Supply Current vs. Supply Voltage

Ta=25°C, No Input



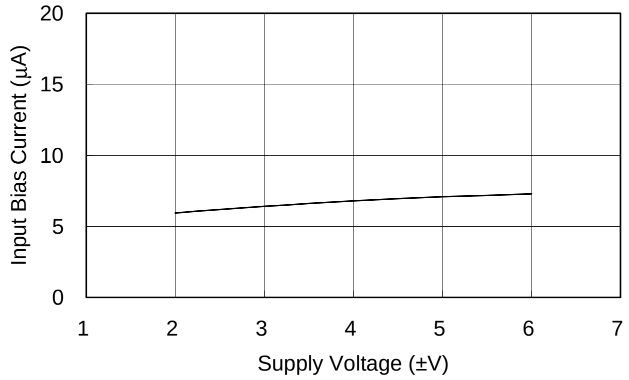
■ Output Voltage vs. Supply Voltage

Ta=25°C, No Input



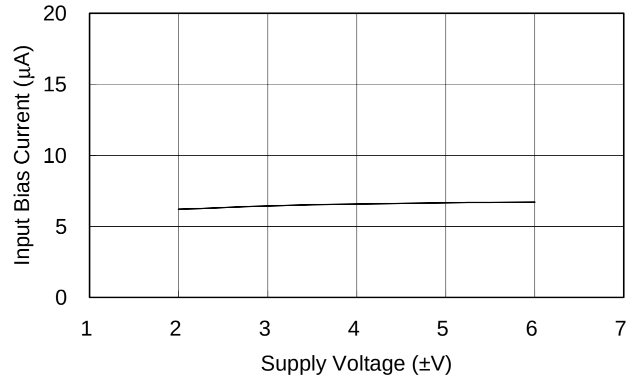
■ +Input Bias Current vs. Supply Voltage

Ta=25°C, No Input

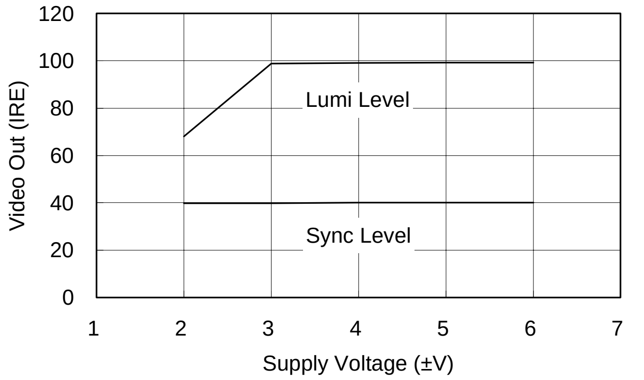


■ -Input Bias Current vs. Supply Voltage

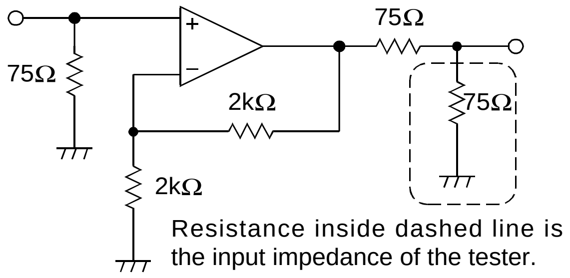
Ta=25°C, No Input



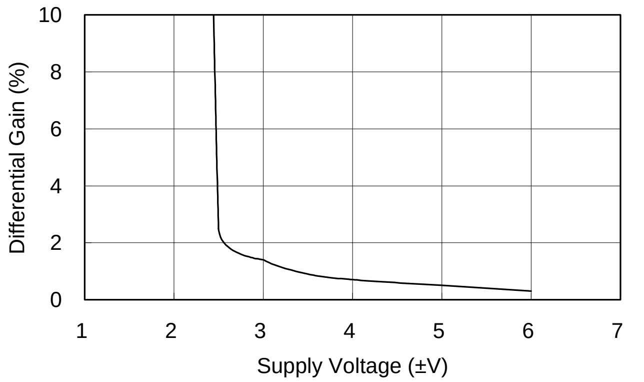
■ Video Out vs. Supply Voltage (Center Bias)
Ta=25°C, Video Signal



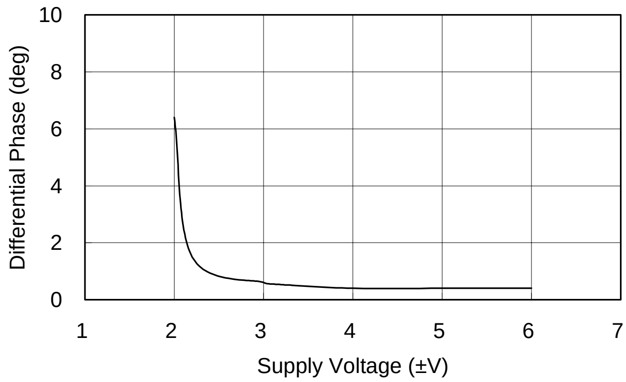
■ Measurement Circuit at the Center Bias



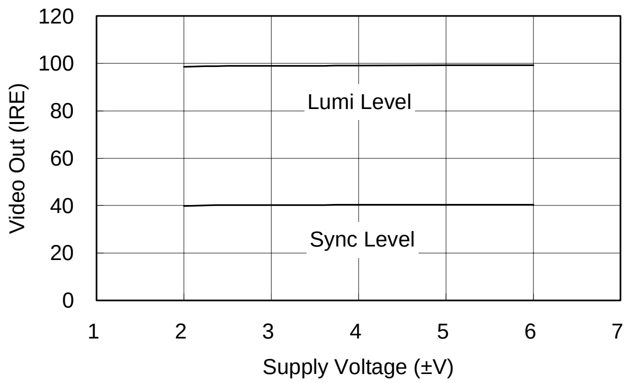
■ Differential Gain vs. Supply Voltage (Center Bias)
Ta=25°C, Vin=1V_{P-P}, Staircase Wave



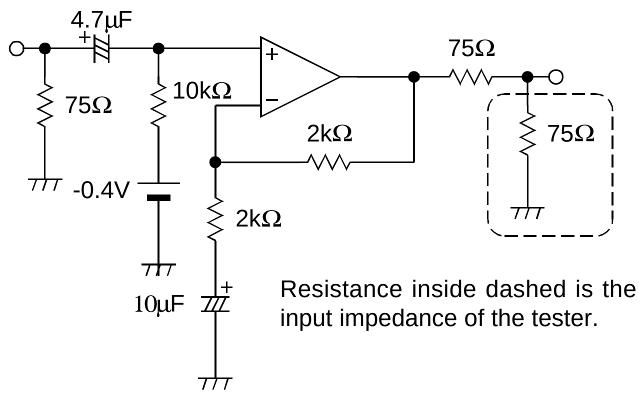
■ Differential Phase vs. Supply Voltage (Center Bias)
Ta=25°C, Vin=1V_{P-P}, Staircase Wave



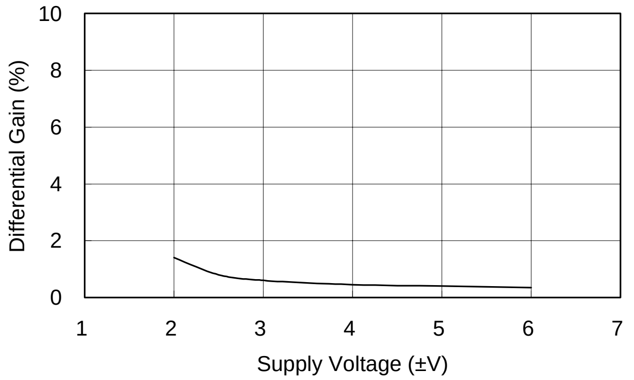
■ Video Out vs. Supply Voltage (Optimal Bias)
Ta=25°C, Video Signal



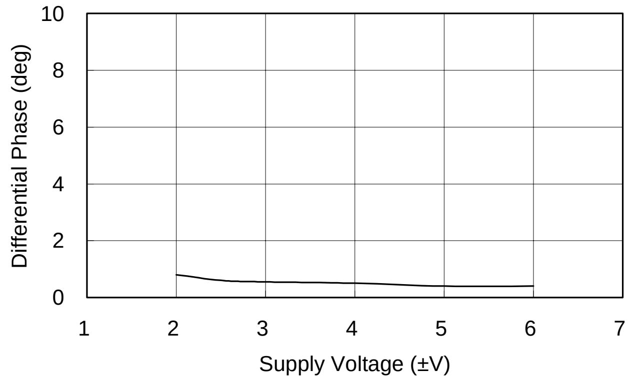
■ Measurement Circuit at the Optimal Bias



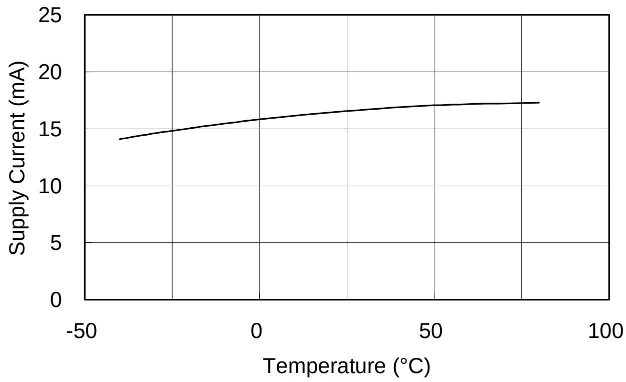
■ Differential Gain vs. Supply Voltage (Optimal Bias)
Ta=25°C, Vin=1V_{P-P}, Staircase Wave



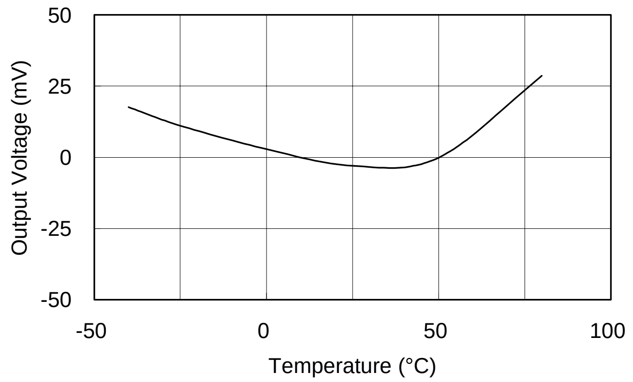
■ Differential Phase vs. Supply Voltage (Optimal Bias)
Ta=25°C, Vin=1V_{P-P}, Staircase Wave



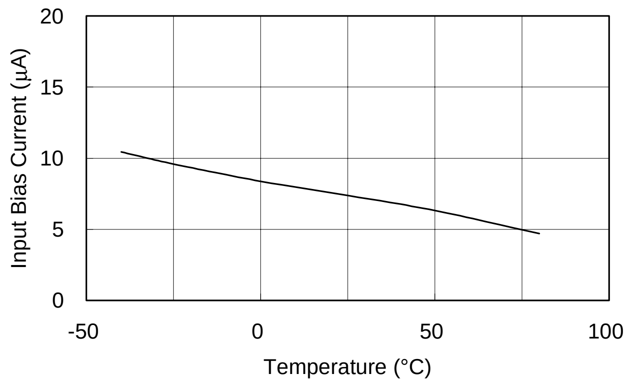
■ Supply Current vs. Temperature
V_{CC}/V_{EE} = ±5.0V, No Input



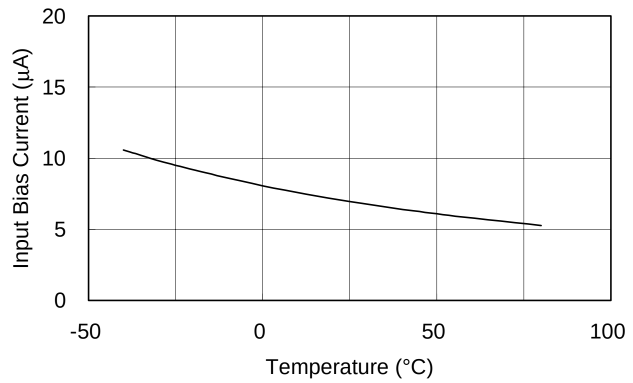
■ Output Voltage vs. Temperature
V_{CC}/V_{EE} = ±5.0V, No Input



■ +Input Bias Current vs. Temperature
V_{CC}/V_{EE} = ±5.0V, No Input

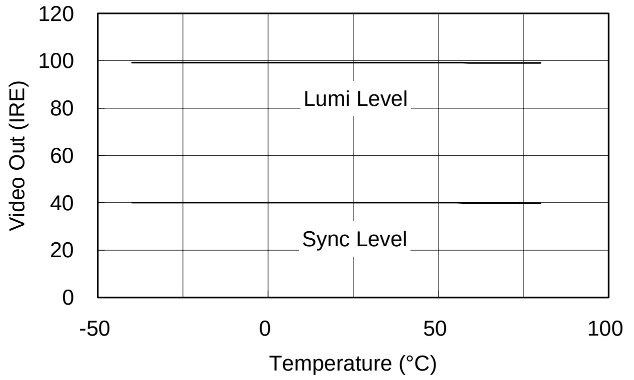


■ -Input Bias Current vs. Temperature
V_{CC}/V_{EE} = ±5.0V, No Input

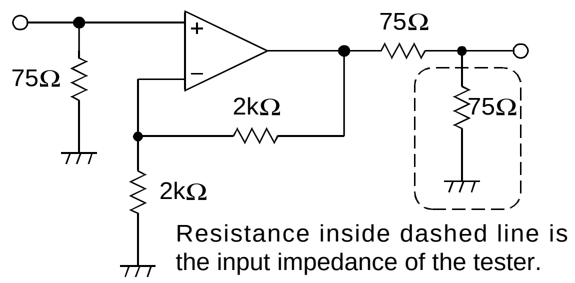


■ Video Out vs. Temperature

V_{CC}/V_{EE} = ±5.0V, Vin=1V_{P-P}, Video Signal

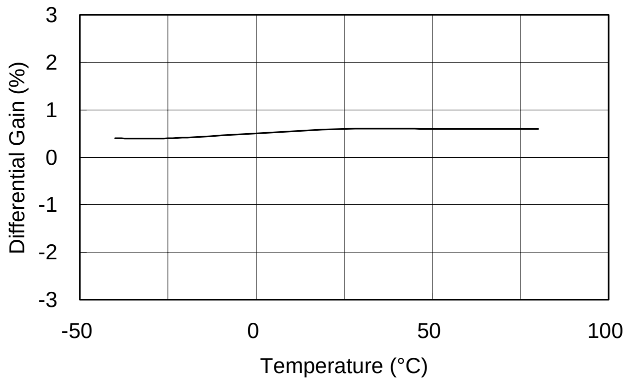


■ Temperature Characteristic Measurement Circuit



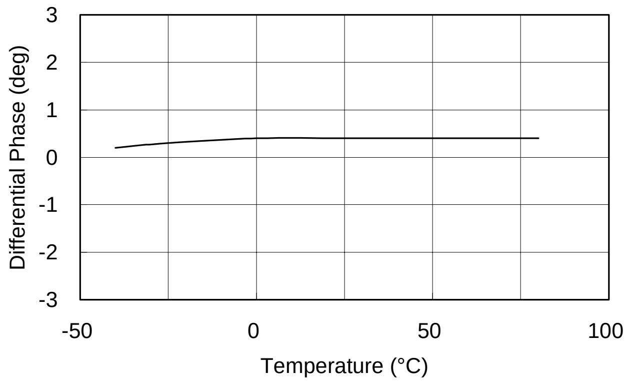
■ Differential Gain vs. Temperature (Center Bias)

V_{CC}/V_{EE} = ±5.0V, Vin=1V_{P-P}, Staircase Wave



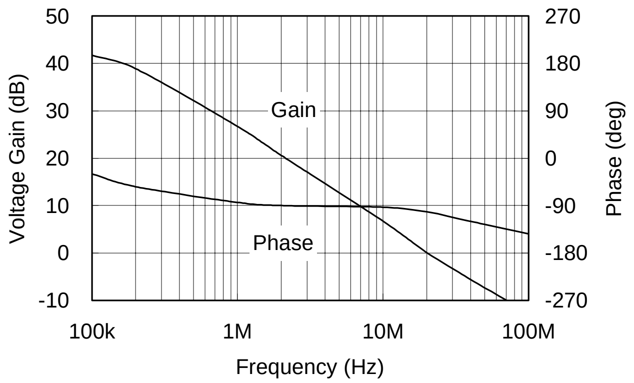
■ Differential Phase vs. Temperature (Center Bias)

V_{CC}/V_{EE} = ±5.0V, Vin=1V_{P-P}, Staircase Wave

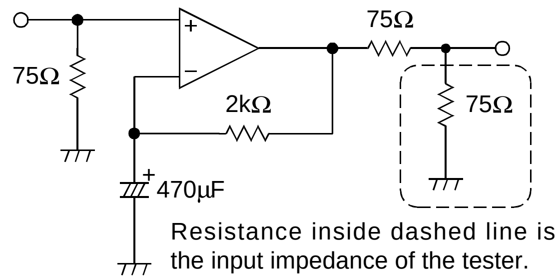


■ Open Loop Gain vs. Frequency

V_{CC}/V_{EE} = ±5.0V, Vin=1V_{P-P}, Video Signal

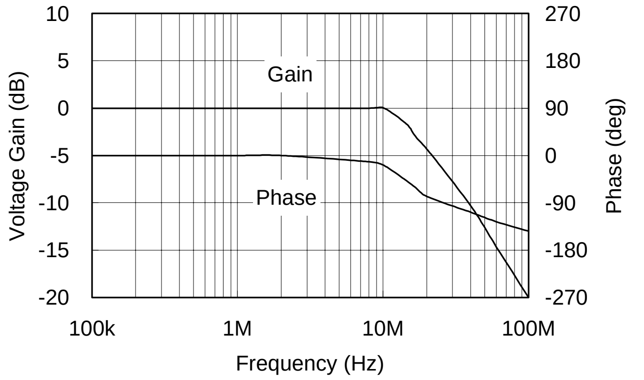


■ Open Loop Characteristic Measurement Circuit

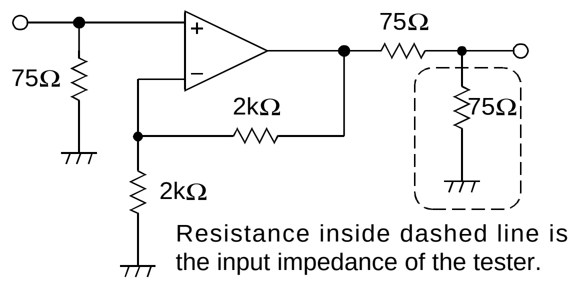


■ 6dB Amplifier Gain vs. Frequency

V_{CC}/V_{EE} = ±5.0V, Ta=25°C, Vin=1V_{P-P}

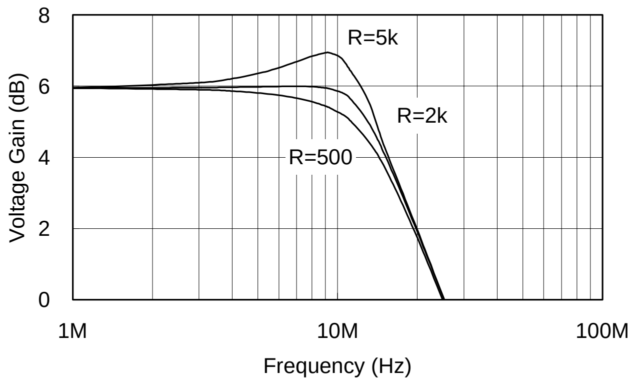


■ 6dB Amplifier Measurement Circuit

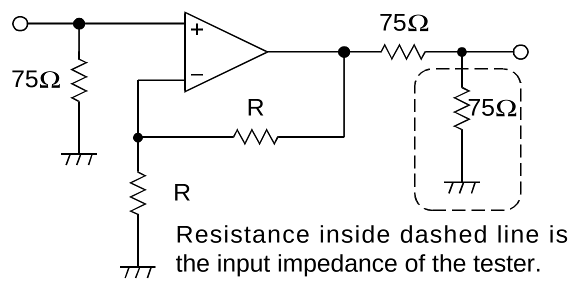


■ Voltage Gain vs. Frequency

V_{CC}/V_{EE} = ±5.0V, Ta=25°C, Vin=1V_{P-P}

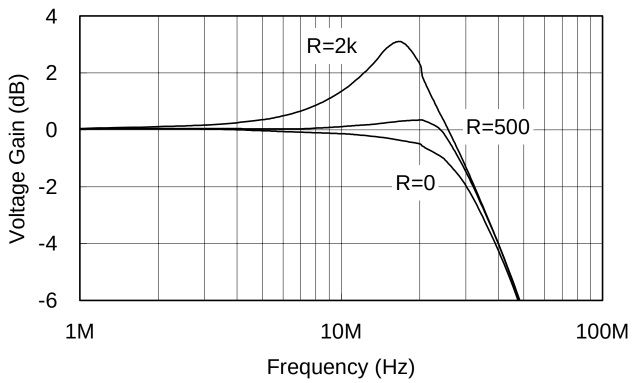


■ Voltage Gain Measurement Circuit

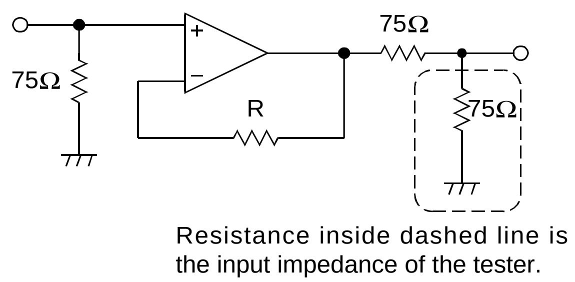


■ Buffer Amplifier Voltage Gain vs. Frequency

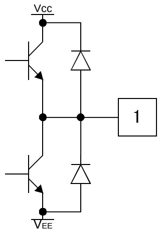
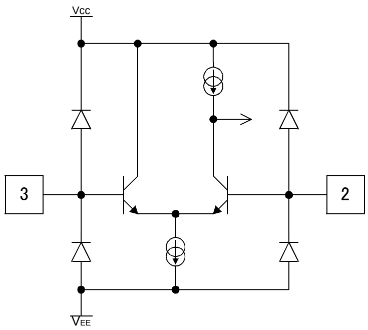
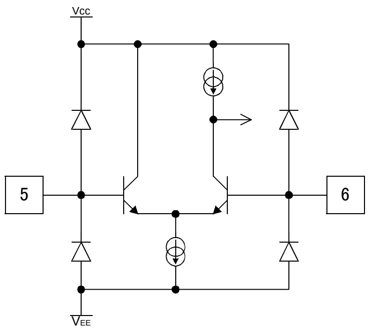
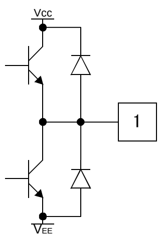
V_{CC}/V_{EE} = ±5.0V, Ta=25°C, Vin=1V_{P-P}



■ Buffer Amplifier Measurement Circuit



11. PIN DESCRIPTION

Pin No.	Pin Description	Internal Equivalent Circuit	Description
1	OUTPUT A		Output Terminal.
2 3	-INPUT A +INPUT A		Pin 2: Inverting Signal Input Terminal. Pin 3: Non-Inverting Signal Input Terminal. This circuit is a differential amplifier structure using NPN transistors.
4	V_{EE}	-	Negative Power Supply Terminal.
5 6	+INPUT B -INPUT B		Pin 5: Non-Inverting Signal Input Terminal. Pin 6: Inverting Signal Input Terminal. This circuit is a differential amplifier structure using NPN transistors.
7	OUTPUT B		Output Terminal.
8	V_{CC}	-	Positive 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.

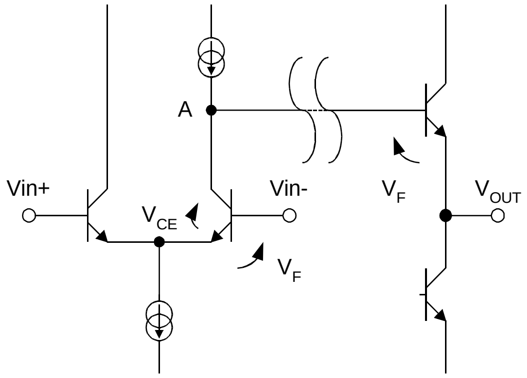


Figure 1: The internal equivalent circuit

From Figure1, 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.

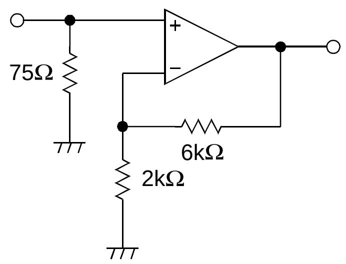


Figure 2: Application Example

In Figure2, 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.

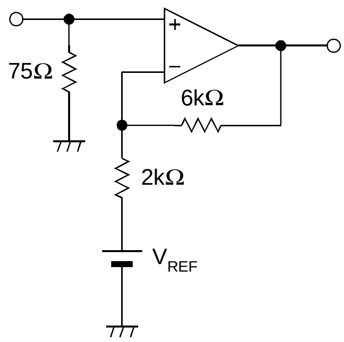


Figure 3: Example of preventive measures

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.

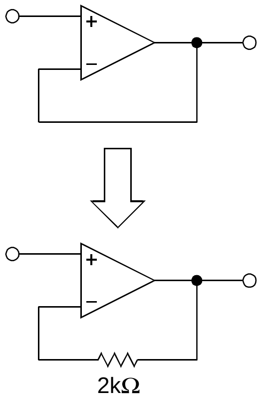


Figure 4: Example of use as a buffer amplifier

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

■ Please be sure that you carefully discuss your planned purchase with our office if you intend to use the products in this application manual under conditions where particularly extreme standards of reliability are required, or if you intend to use products for applications other than those listed in this application manual.

- Power drive products for automobile, ship or aircraft transport systems; steering and navigation systems, emergency signal communications systems, and any system other than those mentioned above which include electronic sensors, measuring, or display devices, and which could cause major damage to life, limb or property if misused or failure to function.
- Medical devices for measuring blood pressure, pulse, etc., treatment units such as coronary pacemakers and heat treatment units, and devices such as artificial organs and artificial limb systems which augment physiological functions.
- Electrical instruments, equipment or systems used in disaster or crime prevention.

■ Semiconductors, by nature, may fail or malfunction in spite of our devotion to improve product quality and reliability. We urge you to take every possible precaution against physical injuries, fire or other damages which may cause failure of our semiconductor products by taking appropriate measures, including a reasonable safety margin, malfunction preventive practices and fire-proofing when designing your products.

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

14. OFFICES

If you need more information on this product and other TOKO products, please contact us.

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