APPLICATION MANUAL

High-Speed Triple Video Amplifier IC
TK15452V

CONTENTS

MEETING YOUR NEEDS
TOKO, Inc.

High-Speed Triple Video Amplifier IC
TK15452V

1. DESCRIPTION

The TK15452V is a video amplifier IC capable of driving 75 Ω. There are three general-purpose amplifiers in one package.
The TK15452V, enclosed in the TSSOP-14 package, is the high-speed version of the TK15402M.

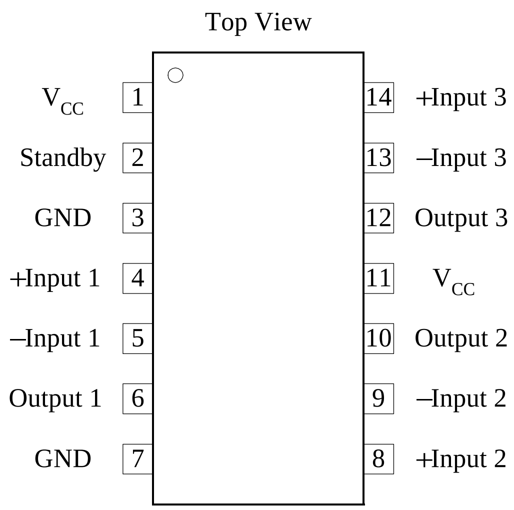
2. FEATURES

- High Frequency Operation (Flat to 30MHz)
- General-purpose Amplifier Type
- Built-in Standby Circuit
- Can Drive Two Video Loads (75Ω)
- Thin Shrink Small Outline Packaging

3. APPLICATIONS

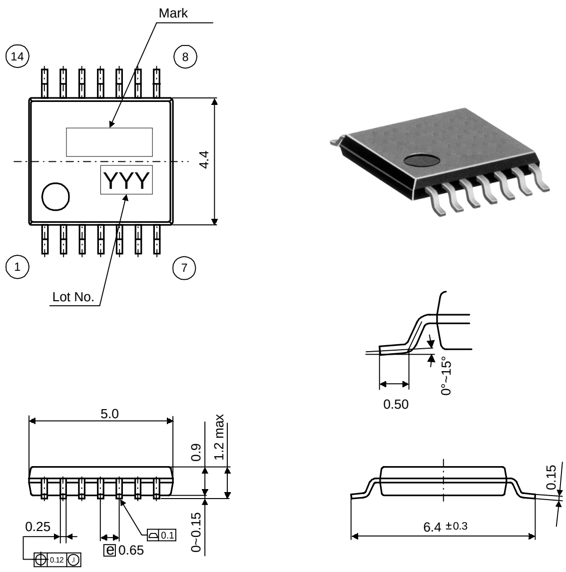
- Video and RF Signal Amplification
- 75Ω Driver

4. PIN CONFIGURATION

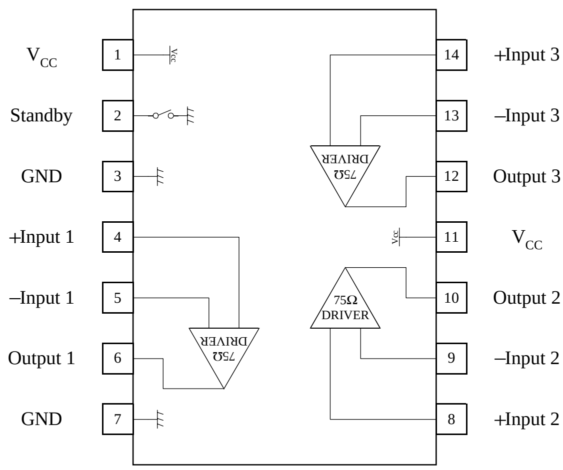


5. PACKAGE OUTLINE

■ TSSOP-14



6. BLOCK DIAGRAM



7. ABSOLUTE MAXIMUM RATINGS

T_a=25°C

Parameter	Symbol	Rating	Units	Conditions
Supply Voltage	V_{CC}	12.0	V	
Power Dissipation	P_D	1200	mW	Board Mounted *1
Storage Temperature Range	T_{stg}	-55 ~ +150	°C	
Operating Temperature Range	T_{OP}	-25 ~ +75	°C	
Maximum Operating Frequency	f_{MAX}	~ 200	MHz	
Operating Voltage Range	V_{OP}	4.0 ~ 10.0	V	*2

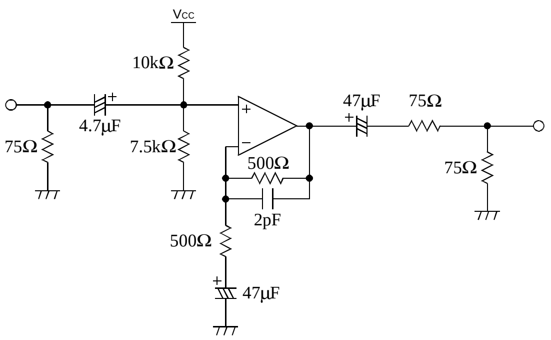
*1 P_D must be decreased at the rate of 9.6mW/°C for operation above 25°C.
*2 Maximum Operating Voltage is limited by the package power and ambient temperature.

8. ELECTRICAL CHARACTERISTICS

V_{CC}=5.0V, T_a=25°C, R_L=150Ω

Parameter	Symbol	Value			Units	Conditions
		MIN	TYP	MAX		
Supply Current	I_{CC}	–	44.2	70	mA	No Signal
Standby Supply Current	I_{CCS}	–	61.8	120	µA	Pin 2 Low
Threshold Voltage (L→H)	V_{TLH}	2.0	–	–	V	Pin 2 Standby → Operate
Threshold Voltage (H→L)	V_{THL}	–	–	0.6	V	Pin 2 Operate → Standby
Output Source Current	I_{SO}	–	50	–	mA	
Output Sink Current	I_{SI}	–	50	–	mA	
Input Bias Current	I_{IB}	–	15	45	µA	
Input Offset Voltage	V_{IO}	–	10	–	mV	
Open Circuit Voltage Gain	G_{VO}	–	48	–	dB	
Gain-Bandwidth	GB	–	180	–	MHz	
Slew rate	SR	–	220	–	V/µs	
Voltage Gain	G_V	5.35	5.85	6.35	dB	fin=1MHz
Frequency Response	fr	–	0.3	–	dB	fin=1MHz/30MHz
Differential Gain	DG	-3	0.4	3	%	Vin=1.0Vp-p, 10 Stair Case
Differential Phase	DP	-3	0.1	3	deg	Vin=1.0Vp-p, 10 Stair Case
Cross Talk1	CT1	–	-61	-40	dB	fin=4.43MHz, Vin=1.0Vp-p
Cross Talk2	CT2	–	-44	–	dB	fin=30.0MHz, Vin=1.0Vp-p
Supply Voltage Rejection Ratio	SVRR	–	-44	–	dB	ΔV_{CC}=0.4Vp-p, f=100kHz

9. TEST CIRCUIT

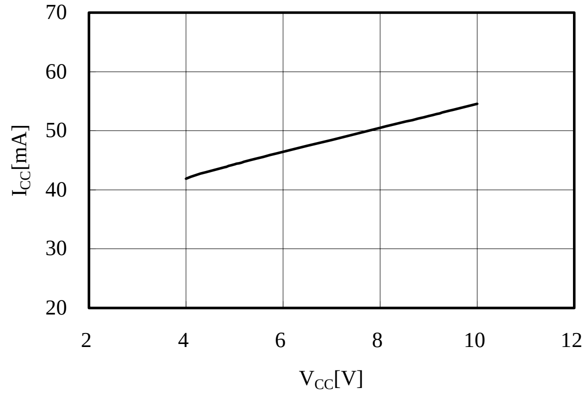


10. TYPICAL CHARACTERISTICS

10-1. Supply Voltage Characteristics

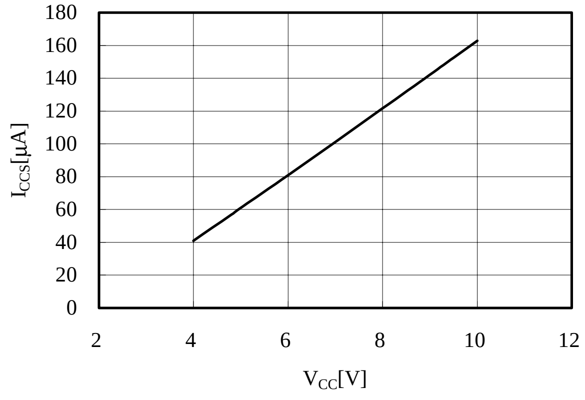
■ Supply Current vs. Supply Voltage

T_a=25°C



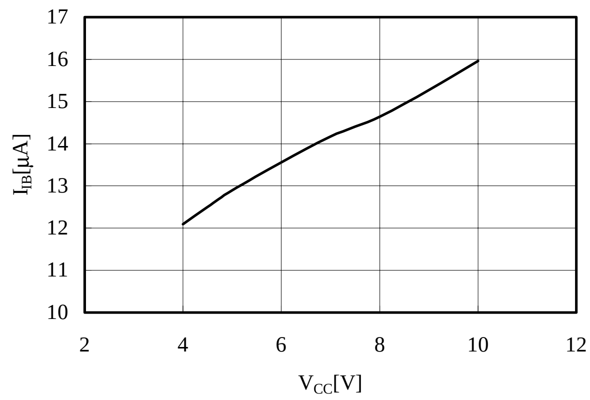
■ Standby Supply Current vs. Supply Voltage

T_a=25°C



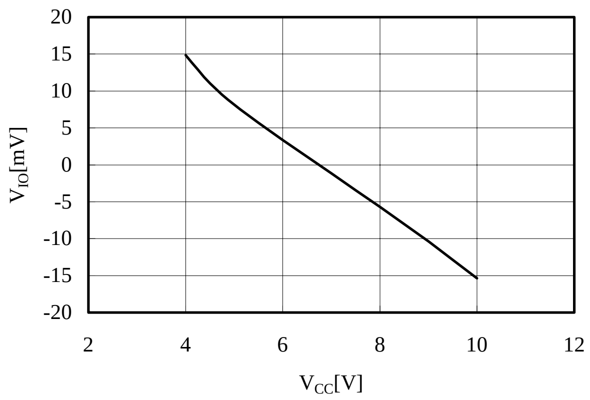
■ Input Bias Current vs. Supply Voltage

T_a=25°C



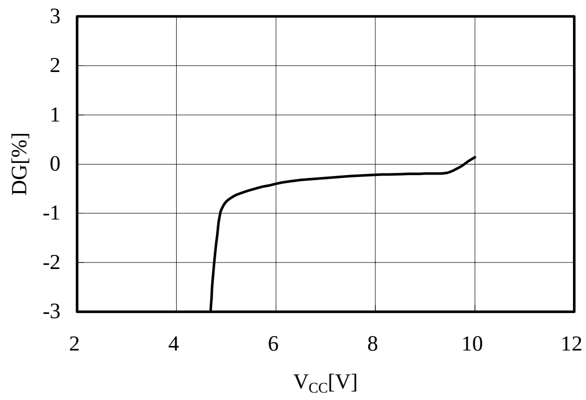
■ Input Offset Voltage vs. Supply Voltage

T_a=25°C



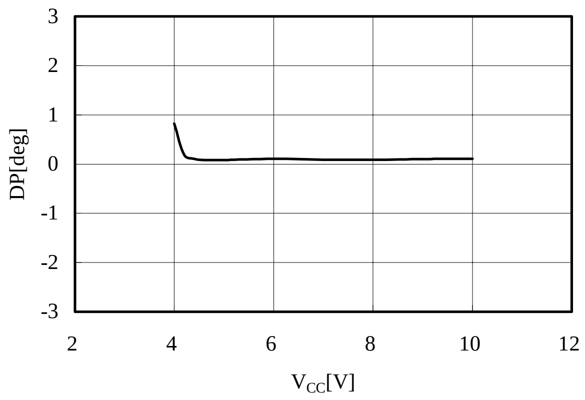
■ Differential Gain vs. Supply Voltage

T_a=25°C



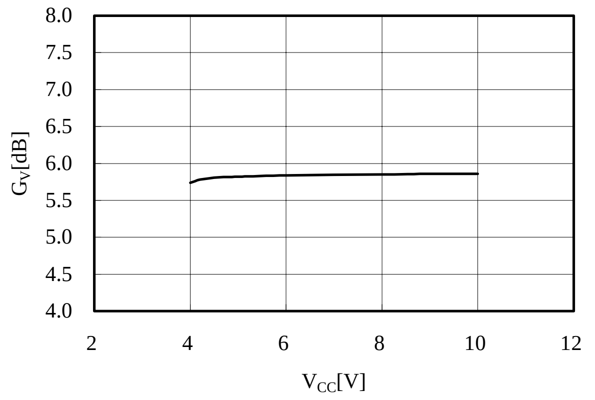
■ Differential Phase vs. Supply Voltage

T_a=25°C



■ Voltage Gain vs. Supply Voltage

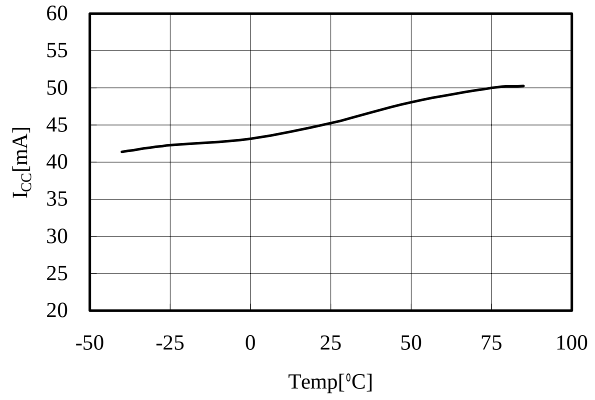
G_V=6dB, Vin=1Vp-p, fin=1MHz, T_a=25°C



10-2. Temperature Characteristics

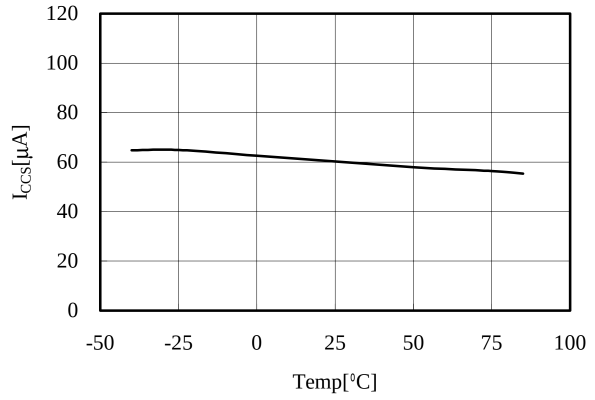
■ Supply Current vs. Temperature

V_{CC}=5.0V



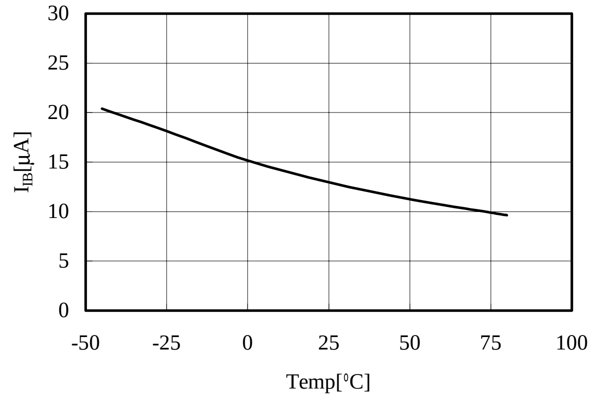
■ Standby Supply Current vs. Temperature

V_{CC}=5.0V



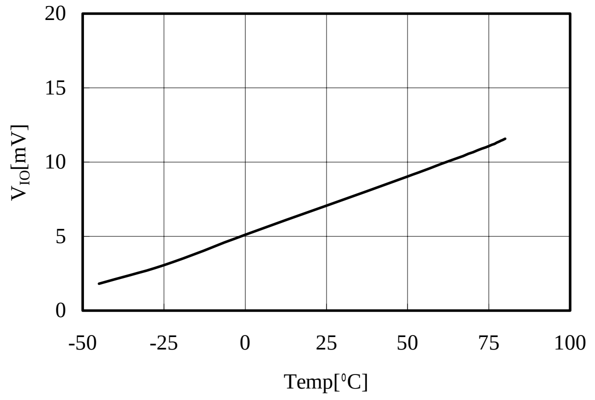
■ Input Bias Current vs. Temperature

V_{CC}=5.0V

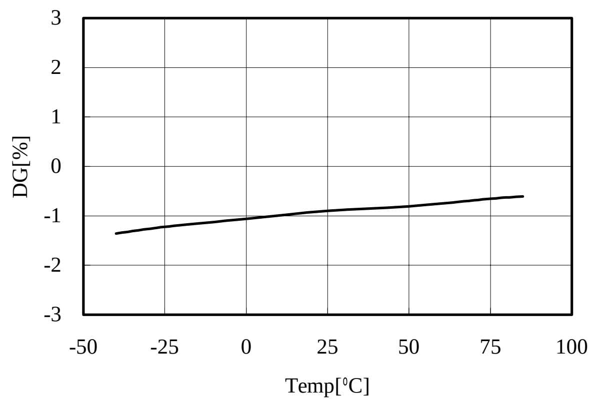


■ Input Offset Voltage vs. Temperature

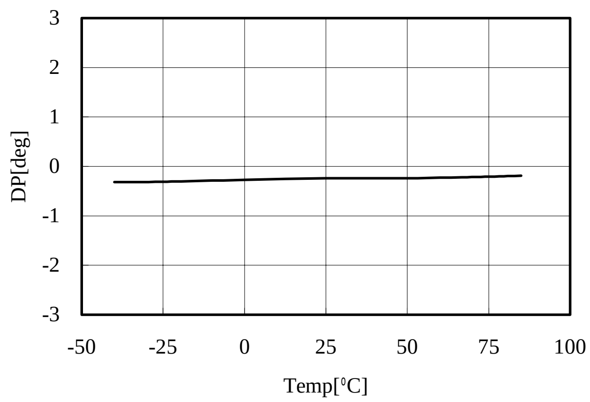
V_{CC}=5.0V



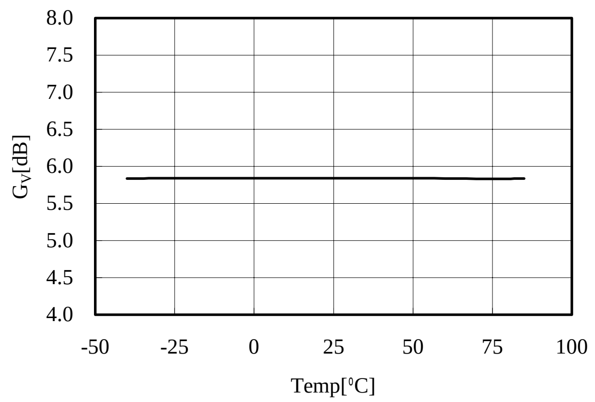
■ Differential Gain vs. Temperature
V_{CC}=5.0V



■ Differential Phase vs. Temperature
V_{CC}=5.0V

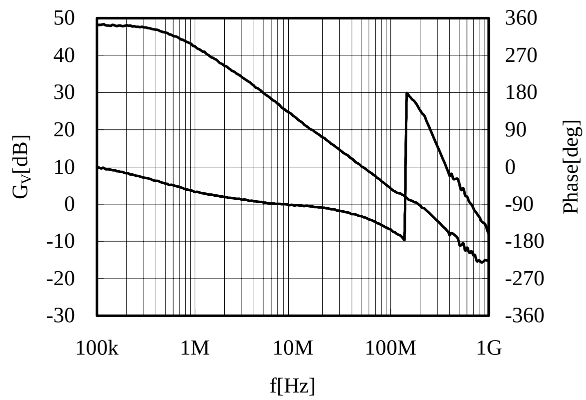


■ Voltage Gain vs. Temperature
V_{CC}=5.0V, G_V=6dB, Vin=1Vp-p, fin=1MHz

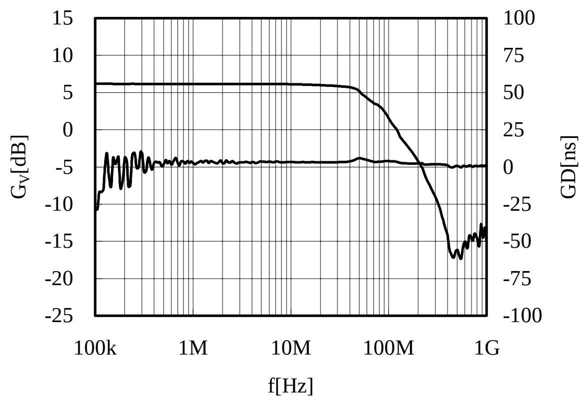


10-3. Various Main Characteristics

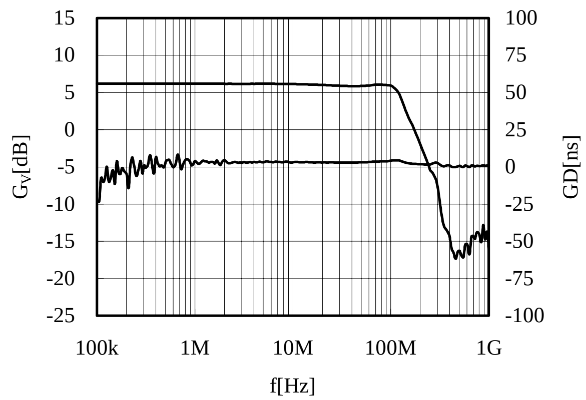
■ Open Loop Gain and Phase vs. Frequency
V_{CC}=5.0V, T_a=25°C



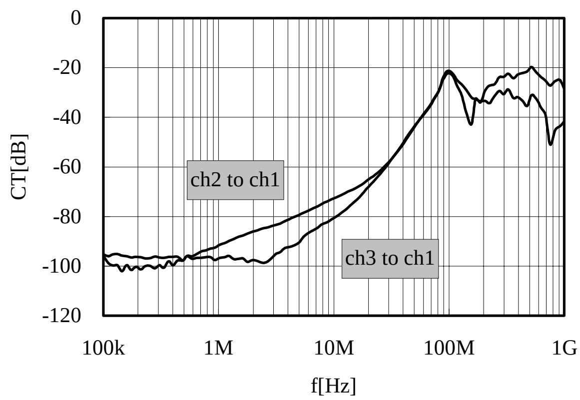
■ Closed Loop Gain and Group Delay vs. Frequency
V_{CC}=5.0V, G_V=6dB, Vin=1Vp-p, T_a=25°C



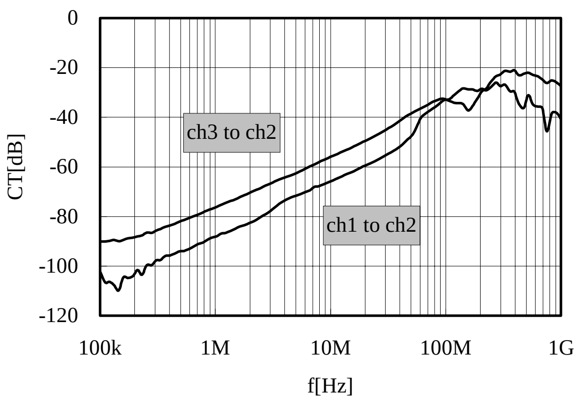
■ Closed Loop Gain and Group Delay vs. Frequency
V_{CC}=5.0V, G_V=6dB, T_a=25°C, Small Signal Input



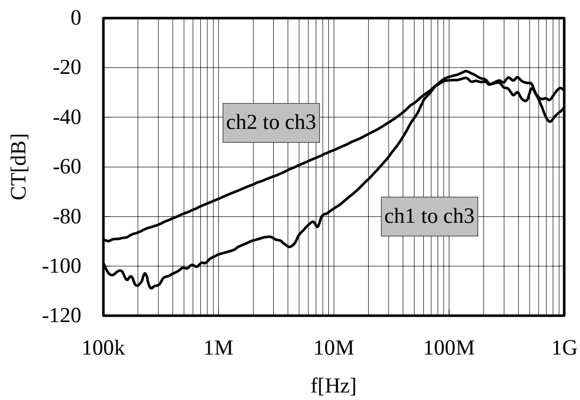
■ Cross Talk vs. Frequency (ch1 Output)
V_{CC}=5.0V, Vin=1Vp-p, T_a=25°C



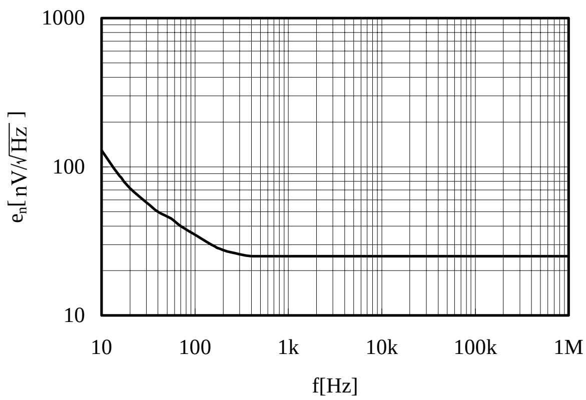
■ Cross Talk vs. Frequency (ch2 Output)
V_{CC}=5.0V, Vin=1Vp-p, T_a=25°C



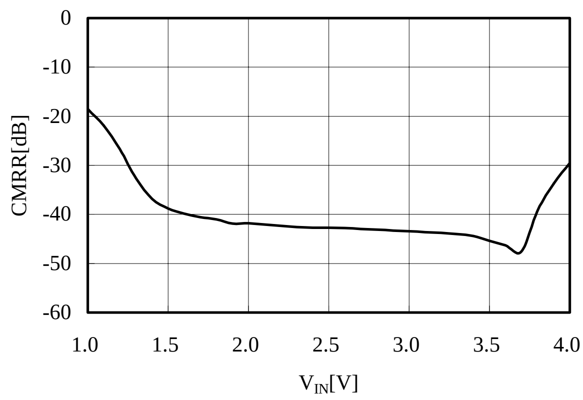
■ Cross Talk vs. Frequency (ch3 Output)
V_{CC}=5.0V, Vin=1Vp-p, T_a=25°C



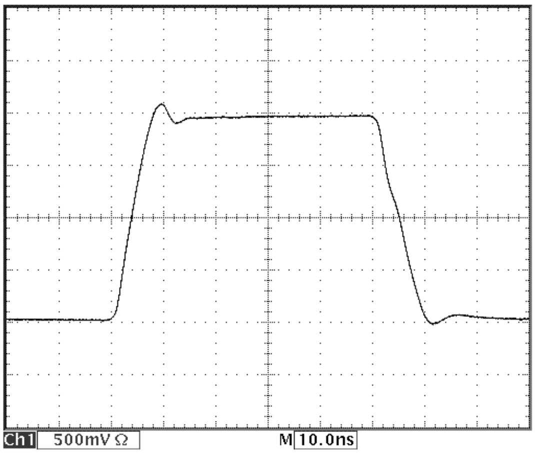
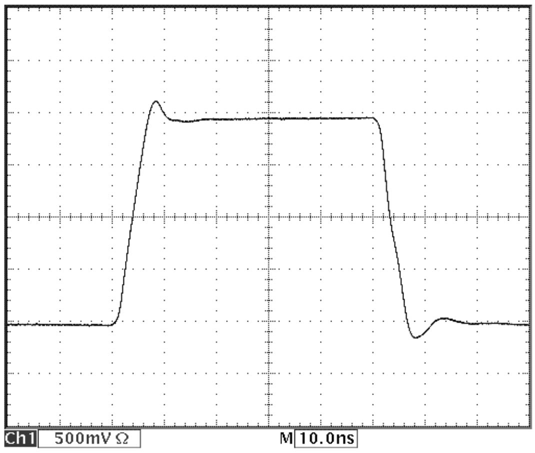
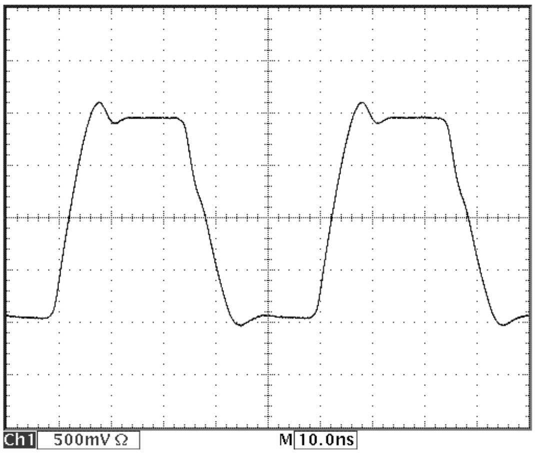
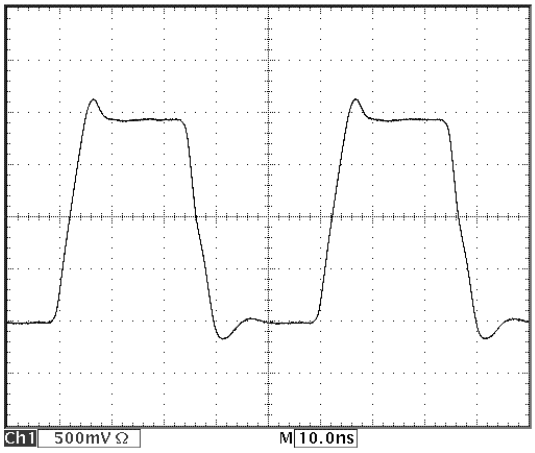
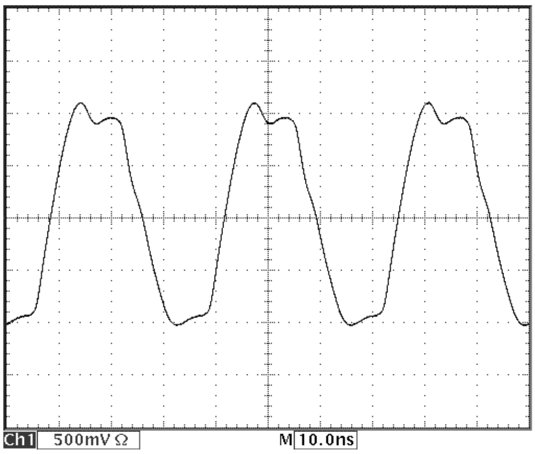
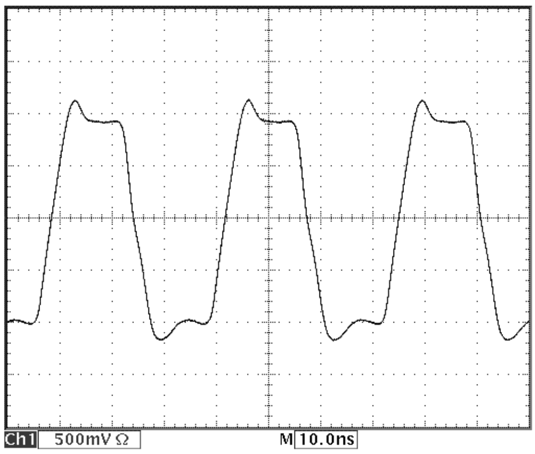
■ Input Voltage Noise vs. Frequency
V_{CC}=5.0V, T_a=25°C



■ Common Mode Rejection Ratio vs. Input Voltage
V_{CC}=5.0V, T_a=25°C



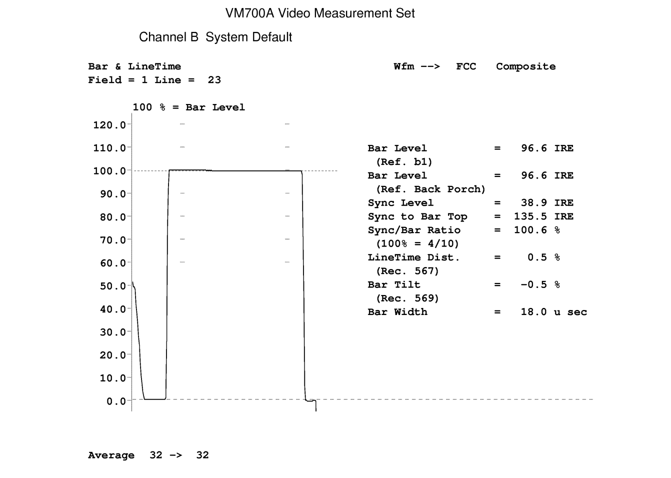
10-4. Pulse Input Characteristics

■ 10MHz Pulse Input Response V_{CC}=5.0V, Vout=2.0Vp-p, T_a=25°C	■ 10MHz Pulse Input Response V_{CC}=9.0V, Vout=2.0Vp-p, T_a=25°C
	
■ 20MHz Pulse Input Response V_{CC}=5.0V, Vout=2.0Vp-p, T_a=25°C	■ 20MHz Pulse Input Response V_{CC}=9.0V, Vout=2.0Vp-p, T_a=25°C
	
■ 30MHz Pulse Input Response V_{CC}=5.0V, Vout=2.0Vp-p, T_a=25°C	■ 30MHz Pulse Input Response V_{CC}=9.0V, Vout=2.0Vp-p, T_a=25°C
	

10-5. Video Signal Characteristics

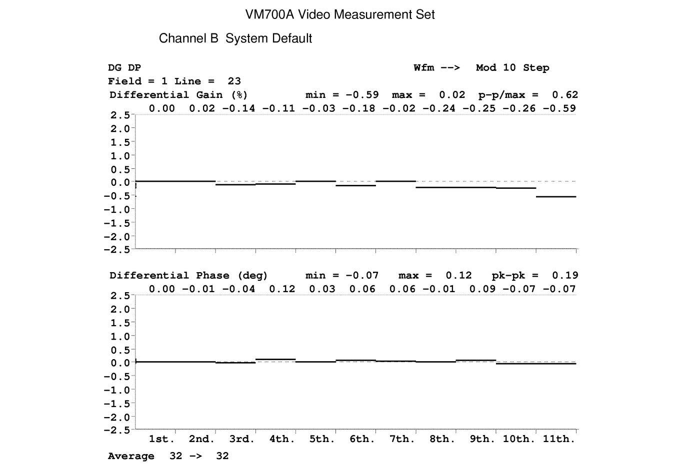
■ Bar & Line Time Characteristics

V_{CC}=5.0V, T_a=25°C, R_L=150Ω



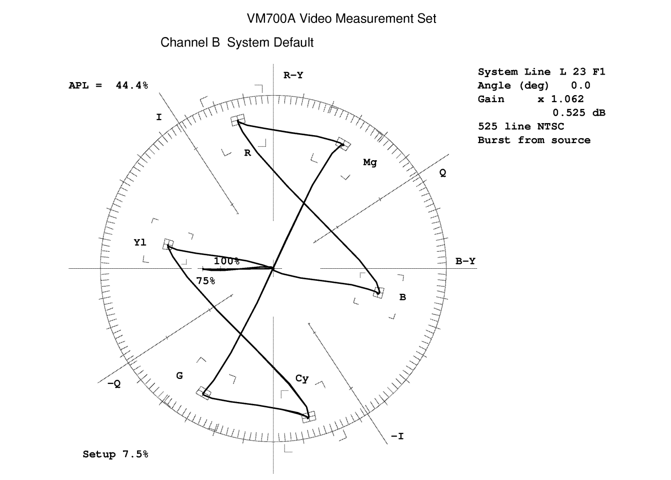
■ DG/DP Characteristics

V_{CC}=5.0V, T_a=25°C, R_L=150Ω



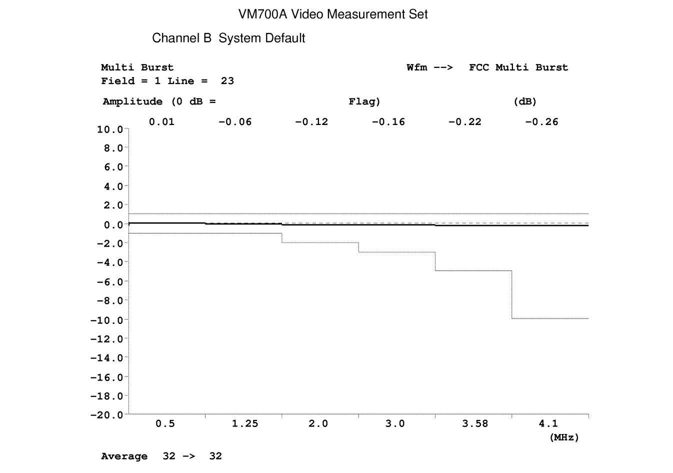
■ Color Bar Characteristic

V_{CC}=5.0V, T_a=25°C, R_L=150Ω

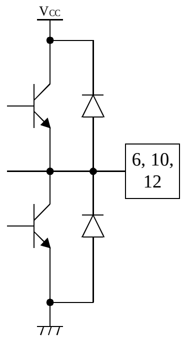
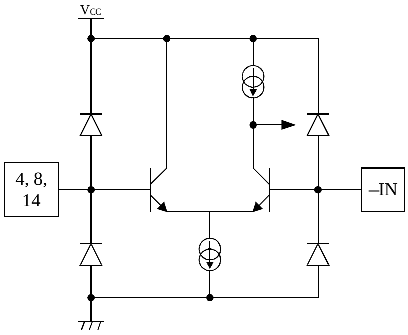
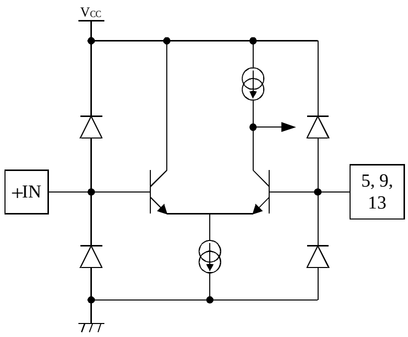
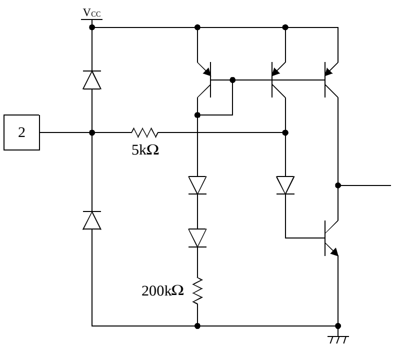


■ Multi Burst Characteristic

V_{CC}=5.0V, T_a=25°C, R_L=150Ω



11. PIN DESCRIPTION

Pin No.	Name	Internal Equivalent Circuit	Description
6 10 12	Output 1 Output 2 Output 3		Output terminal.
4 8 14	+Input 1 +Input 2 +Input 3		Non-inverting input terminal. This circuit is a differential amplifier structure using NPN transistors.
5 9 13	-Input 1 -Input 2 -Input 3		Inverting input terminal. This circuit is a differential amplifier structure using NPN transistors.
2	Standby		Standby mode switching terminal. The device is in the standby mode when Pin 2 is pulled down to a low level. The device is in the operation mode when Pin 2 is connected to a high level or open.
1, 11	V_{CC}		Supply voltage terminal.
3, 7	GND		Ground 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.

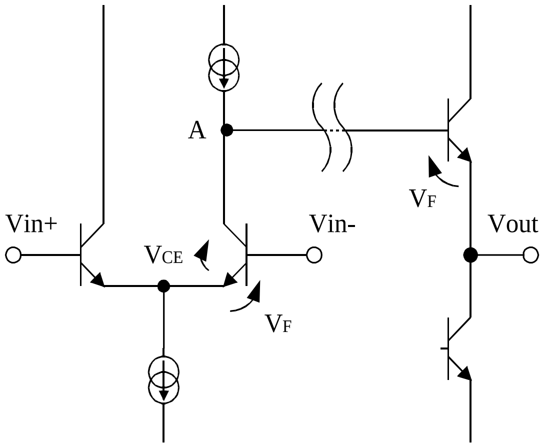


Figure 1: The internal equivalent circuit

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

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

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

Thus

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

Substitution of $V_F = 0.7V$ into (3) gives

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

Depending on the relationship between Vout and Vin, it may become impossible to secure the Saturation voltage V_{CE} (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.

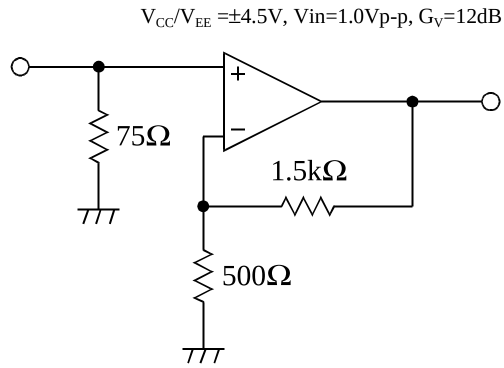


Figure 2: Application Example

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

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

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.

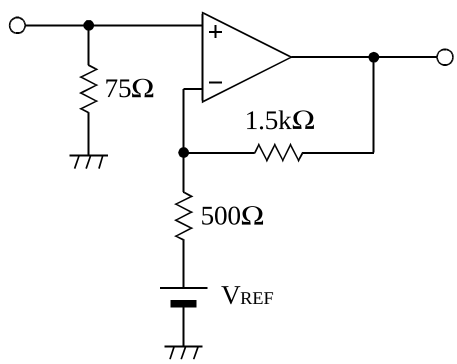


Figure 3: Example of preventive measures

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)

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

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. Two-Line Video Driver

As shown in Figure 4, this IC is a useful circuit for driving two-video lines.
Figure 5 and Figure 6 show the frequency characteristic and the DG/DP characteristics.

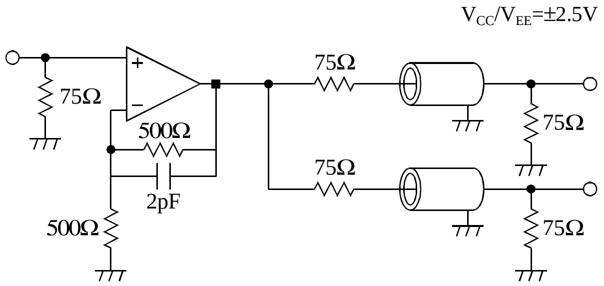


Figure 4: Two-line video driver

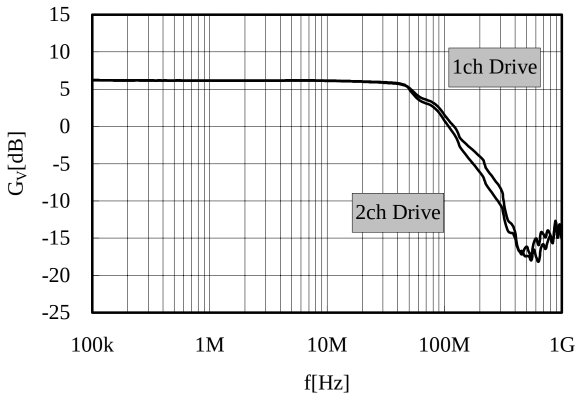


Figure 5: Frequency characteristics

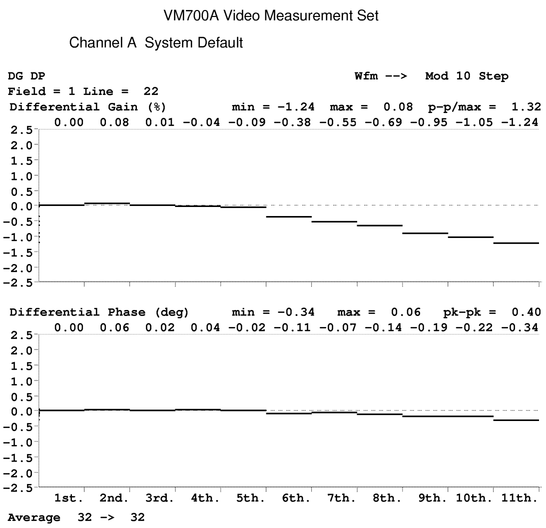


Figure 6: DG/DP characteristics

12-3. About Frequency Characteristic

If the gain is raised, the frequency characteristic falls on the balance with the open loop characteristic; this may end realizing the 30MHz flat characteristic. In this case, the frequency characteristic can be improved by a combination application shown in Figure 7.

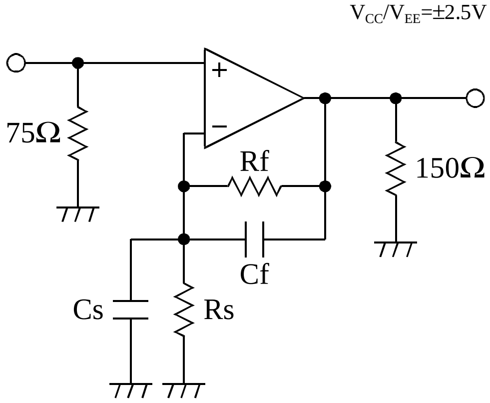


Figure 7: Example of designing a 30MHz flat circuit

The frequency characteristics shown in Figure 8 can be obtained by setting each constant according to the gain as follows.

G_V=6dB	Rf=500Ω, Rs=470Ω, Cf=2pF
G_V=9dB	Rf=470Ω, Rs=240Ω, Cs=2pF
G_V=12dB	Rf=470Ω, Rs=150Ω, Cs=10pF

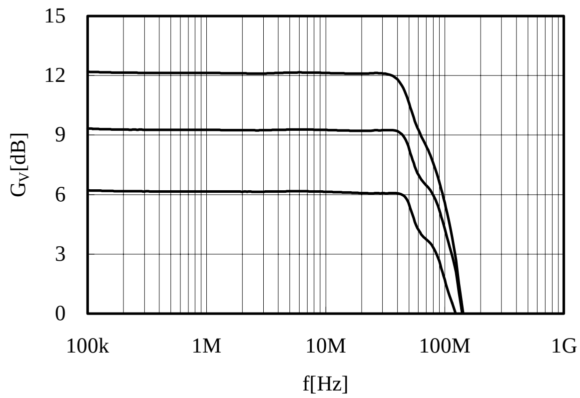


Figure 8: 30MHz flatness characteristics

12-4. Driving Capacitive Loads

If a capacitive load (C_L) is assumed in the measurement circuit of Figure 9, and the gain is measured, the resulting frequency characteristic is shown in Figure 10.

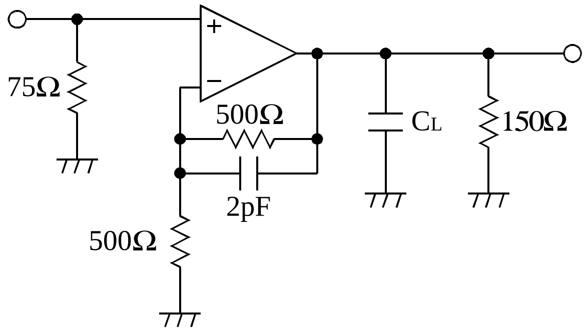


Figure 9: Measurement circuit

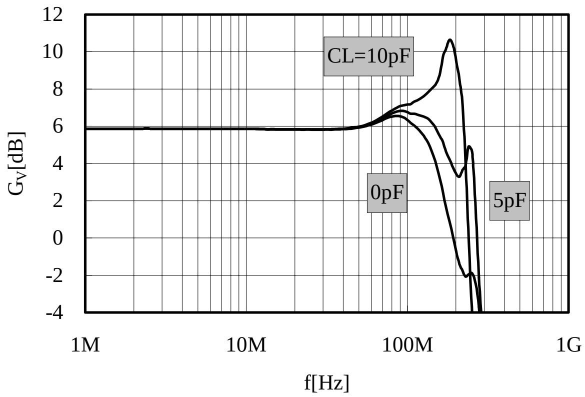


Figure 10: Frequency characteristics of capacitive load

Therefore, please note that oscillation may occur when a capacitive load is directly connected to the output terminal.

12-5. Use as a Buffer Amplifier

The gain of this operational amplifier IC can be changed with the external parts.
However, if this IC is used as a buffer amplifier (Figure 11), peaking is generated as shown in Figure 12.

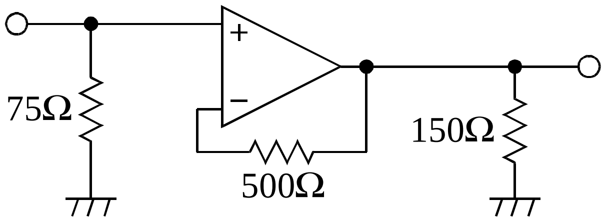


Figure 11: Example of using buffer amplifier

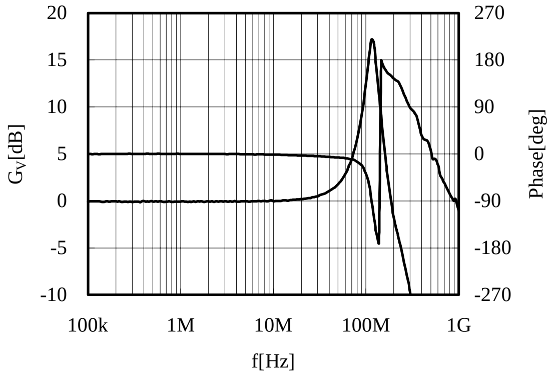


Figure 12: Frequency characteristic of buffer amplifier

There is a possibility of oscillation, so please do not use the amplifier as a buffer.

12-6. Differential Input Signal Swing

Application of this IC as a differential amplifier is also possible. One example is shown in Figure 13, with the waveforms of each terminal shown in Figure 14.

The use of a 5.0V single power supply is assumed.

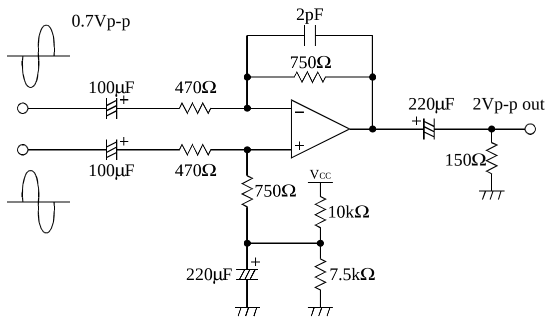


Figure 13: Differential input signal application

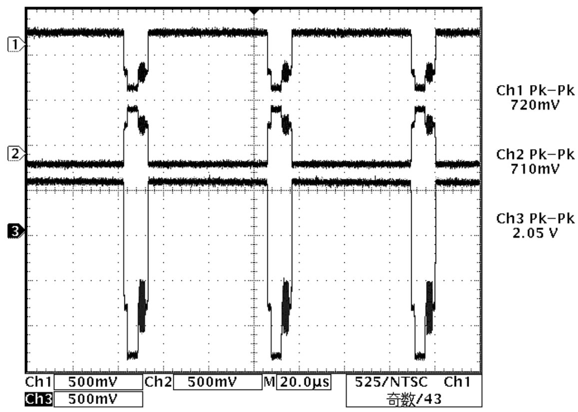


Figure 14: Waveforms of each terminal

Waveforms are non-inverting input, inverting input and output from the top.

13. NOTES

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