	No.3523A	VPH05
	Wideband Video Output Module (Video Pack) High Definition Television, Projector Video Output Amplifier	

## Overview

A single-package product designed specifically for use as the video output stage in ultrahigh-resolution color CRT displays.

## Features

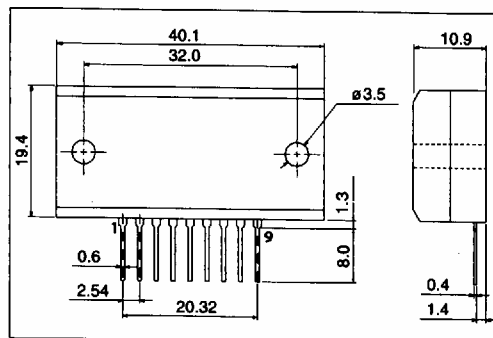
- High output voltage and wide bandwidth; best suited for HDTV.  
[  $f_C(-3dB)$  (at  $V_{OUT}=100V_{p-p}$ ) : 50MHz ]
- High performance because of adoption of FBET and LSBT structure transistor chips.

## Specifications

## Package Dimensions

unit : mm

2060



### Absolute Maximum Ratings at Ta=25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum Supply Voltage	$V_{CC}$ max		230	V
	$V_{BB}$ max		20	V
Allowable Power Dissipation	$P_D$ max		3.5	W
		$T_c=25^\circ C$	20	W
Junction Temperature	$T_j$ max		150	$^\circ C$
Operating Ambient Temperature	$T_{opr}$		85	$^\circ C$
Storage Temperature	$T_{stg}$		-20 ~ +110	$^\circ C$

### Recommended Operating Conditions at Ta=25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended Supply Voltage	$V_{CC}$ max	$V_{OUT} \sim 100V_{p-p}$	170	V
	$V_{BB}$ max	$V_{IN}(DC)=3.4V$	12	V
	$V_{CC}$ max	$V_{OUT} \sim 120V_{p-p}$	200	V
	$V_{BB}$ max	$V_{IN}(DC)=4.0V$	12	V

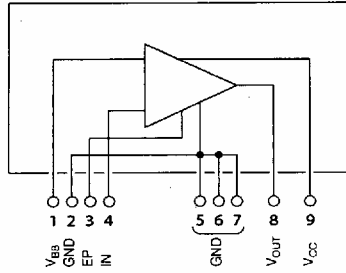
### Electrical Characteristics at Ta=25°C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Frequency Band	$f_C(-3dB)$	$V_{OUT}=100V_{p-p}$		50		MHz
		$V_{OUT}=120V_{p-p}$		45		MHz
Voltage Gain	$V_G(DC)$		26	29	32	times
Supply Current	$I_{CC1}$	$f=10MHz$ clock, $C_L=10pF$		60		mA
	$I_{CC2}$	$f=50MHz$ clock, $C_L=10pF$		100		mA
	$I_{CC3}$	$f=10MHz$ clock, $C_L=10pF$		76		mA
	$I_{CC4}$	$f=30MHz$ clock, $C_L=10pF$		96		mA

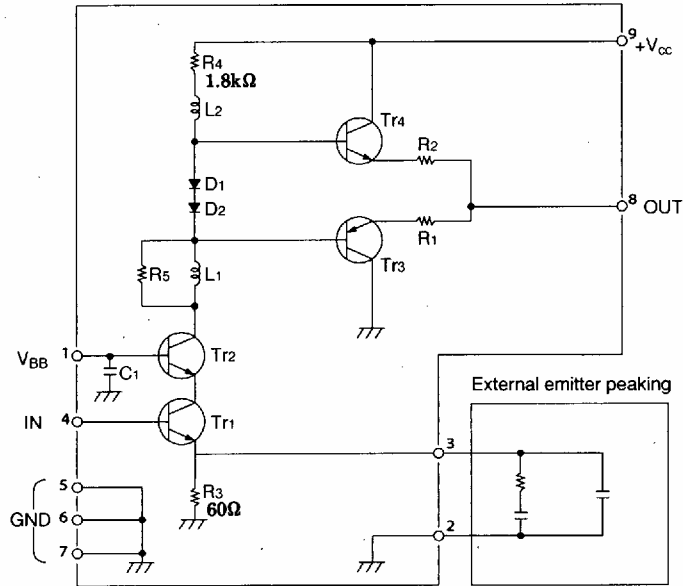
Note : With optimum peaking

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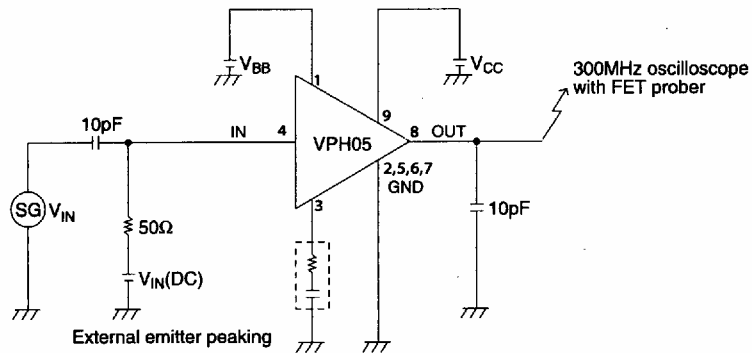
## Electrical Connection



## Internal Circuit

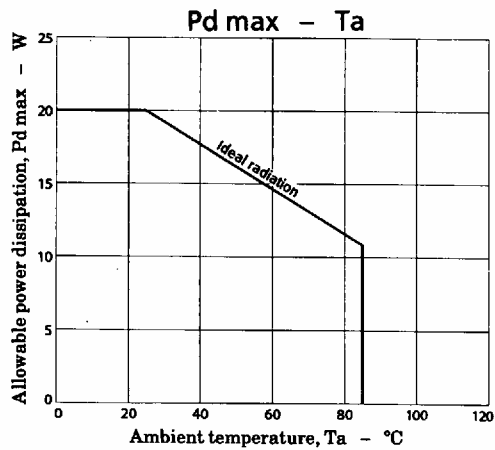
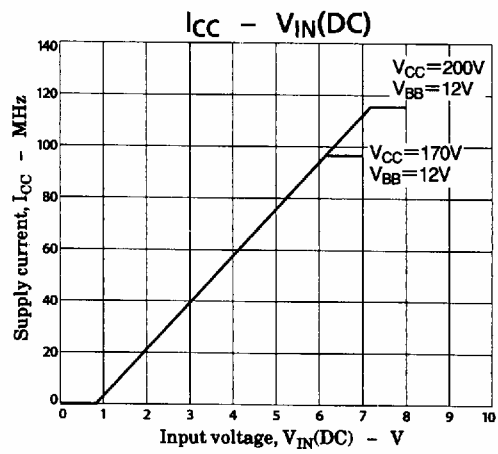
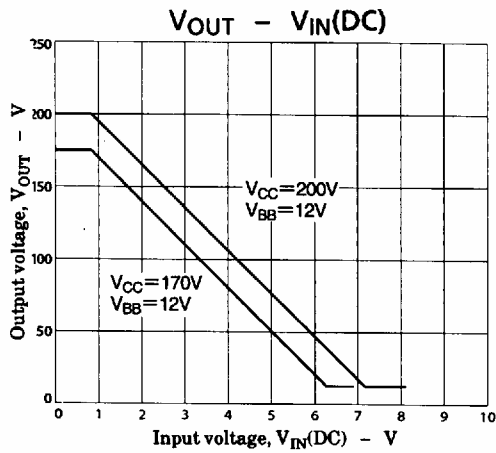
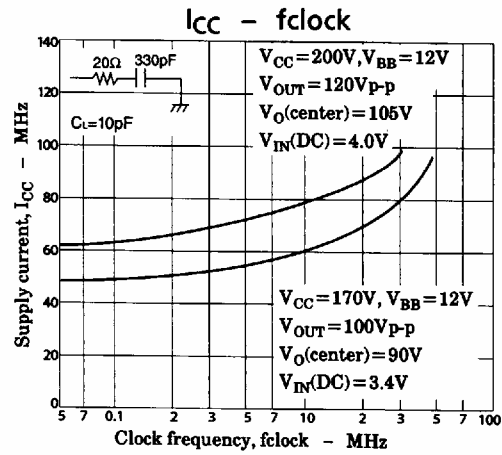
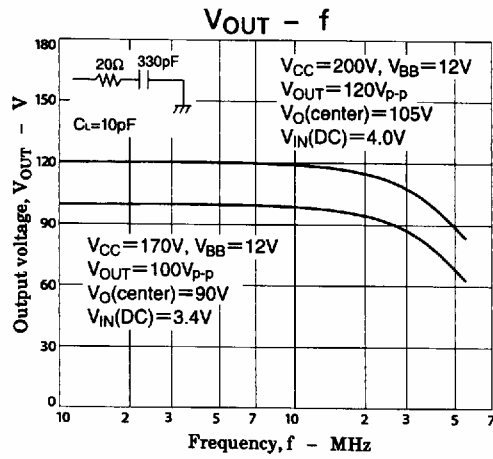


## Test Circuit



## Precautions

1. Pins should not be short-circuited while power is applied.
2. See the thermal characteristics in "Heatsink Design" when designing a heatsink.
3. The recommended mounting torque is 39 to 58 N·cm (typical : 49 N·cm)



## Heatsink Design

The data and example of heatsink design will be shown as follows.

The transistor junction temperature should be kept below 150°C. To achieve this, a heatsink should be designed to keep the case temperature below 85°C as a standard.

The temperature and the loss of the transistor chips depend on the operating frequency, and their values differ one another. Thermal calculations should be carried out for the largest-loss transistor at the maximum operating frequency of 30MHz (clock). The largest-loss transistor is Tr2 in the internal circuit schematic. It shares about 24% of the total loss shown in the Fig.1. Each transistor's  $T_j$  is calculated by next equation.

$$T_j(\text{Tri}) = \theta_{j-c}(\text{Tri}) \times P_C(\text{Tri}) + \Delta T_c + T_a(^{\circ}\text{C}) \dots\dots\dots(1)$$

$\theta_{j-c}(\text{Tri})$  : Junction-to-case thermal resistance of each chip.

$P_C(\text{Tri})$  : Collector loss of each transistor.

$\Delta T_c$  : Case temperature rise.

$T_a$  : Ambient temperature inside a set.

Each transistor's  $\theta_{j-c}(\text{Tri})$  is,

$$\theta_{j-c}(\text{Tr1}) = 30^{\circ}\text{C}/\text{W} \dots\dots\dots(2)$$

$$\theta_{j-c}(\text{Tr2 to Tr4}) = 20^{\circ}\text{C}/\text{W} \dots\dots\dots(3)$$

From the equations (1) and (2) we get  $P_C(\text{Tr2})$  at 30MHz,

$$P_C(\text{Tri})_{30\text{MHz}} = P_D(\text{total})_{30\text{MHz}} \times 0.24 \dots\dots\dots(4)$$

There is a relation shown below between  $\theta_h$  (thermal resistance of a heatsink) and  $\Delta T_c$ ,

$$\Delta T_c = P_D(\text{total}) \times \theta_h \dots\dots\dots(5)$$

You can calculate required  $\theta_h$  by the equations (1) and (5).

### Heatsink design example

Application conditions :  $f_H = 32\text{kHz}$  (HDTV),  $f(\text{video}) = 30\text{MHz}$  (clock)

$V_{CC} = 170\text{V}$ ,  $V_{BB} = 12\text{V}$ ,  $V_{OUT} = 100\text{V}_{p-p}$ , ( $C_1 = 10\text{pF}$ )

$T_a \leq 60^{\circ}\text{C}$

When a monitor is operated at the maximum frequency of 30MHz, the recommended  $\theta_h$  is,

$$\theta_h = 1.8^{\circ}\text{C}/\text{W}$$

If it is possible to keep  $T_a$  less than 40°C,  $\theta_h$  would be shrunk into,

$$\theta_h = 3.3^{\circ}\text{C}/\text{W}$$

#### (How to calculate $\theta_h$ )

As mentioned above, the largest-loss transistor is Tr2, and the value is obtained from Figs. 1 and 2 and the equation (4) ;

$$P_C(\text{Tr2}) = 13.6 \times 0.24 = 3.26\text{W} \dots\dots\dots(6)$$

Substituting the value of the equation (6) in the equation (1) and defining  $T_j < 150^{\circ}\text{C}$ ,  $\Delta T_c$  is,

$$150 > T_j = 20 \times 3.26 + \Delta T_c + 60$$

$$\therefore \Delta T_c < 25(^{\circ}\text{C})$$

Thus the case temperature rise,  $\Delta T_c$ , should be less than 25°C. To achieve this,  $\theta_h$  of the heatsink is obtained from the equation (5),

$$\theta_h < \Delta T_c \div P_D(\text{total}) = 25 \div 13.6 \approx 1.8$$

$$\therefore \theta_h = 1.8^{\circ}\text{C}/\text{W}$$

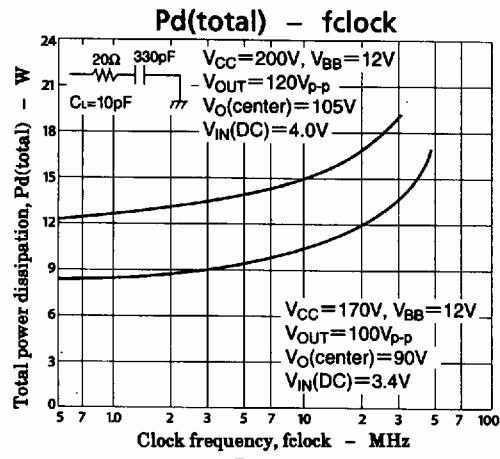


Fig.1

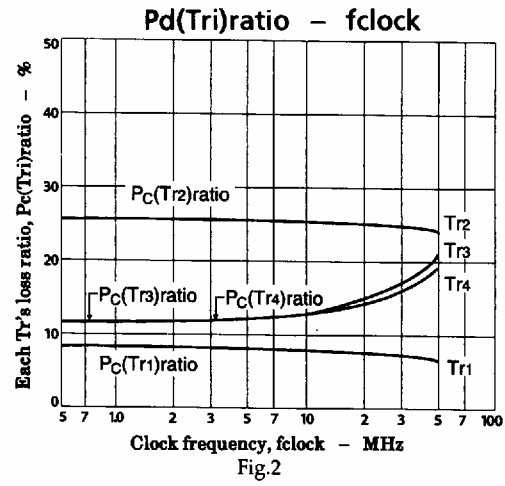


Fig.2