

**VPS13**

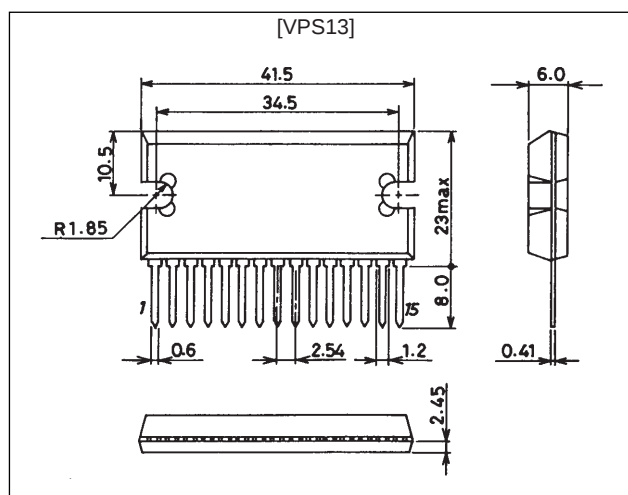
CRT Display Video Output Amplifier, High-Voltage/Wideband Amplifier

Features

- High output voltage and wide bandwidth; optimal for use in f_H (horizontal deflection frequency) = 100 kHz class monitors.
($f = 130$ MHz -3 dB at $V_{OUT} = 40$ Vp-p)
- SIP molded 15-pin package houses three amplifier channels.

Package Dimensions

unit: mm

2127A

Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		90	V
	V_{BB} max		15	V
Allowable power dissipation	P_d max	With an ideal heat sink at $T_c = 25^\circ\text{C}$	30	W
Maximum junction temperature	T_j max		150	$^\circ\text{C}$
Maximum case temperature	T_c max		100	$^\circ\text{C}$
Storage temperature	T_{stg}		-20 to $+110$	$^\circ\text{C}$

Operating Conditions at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		80	V
	V_{BB}		10	V

Electrical Characteristics at $T_a = 25^\circ\text{C}$ (for a single channel)

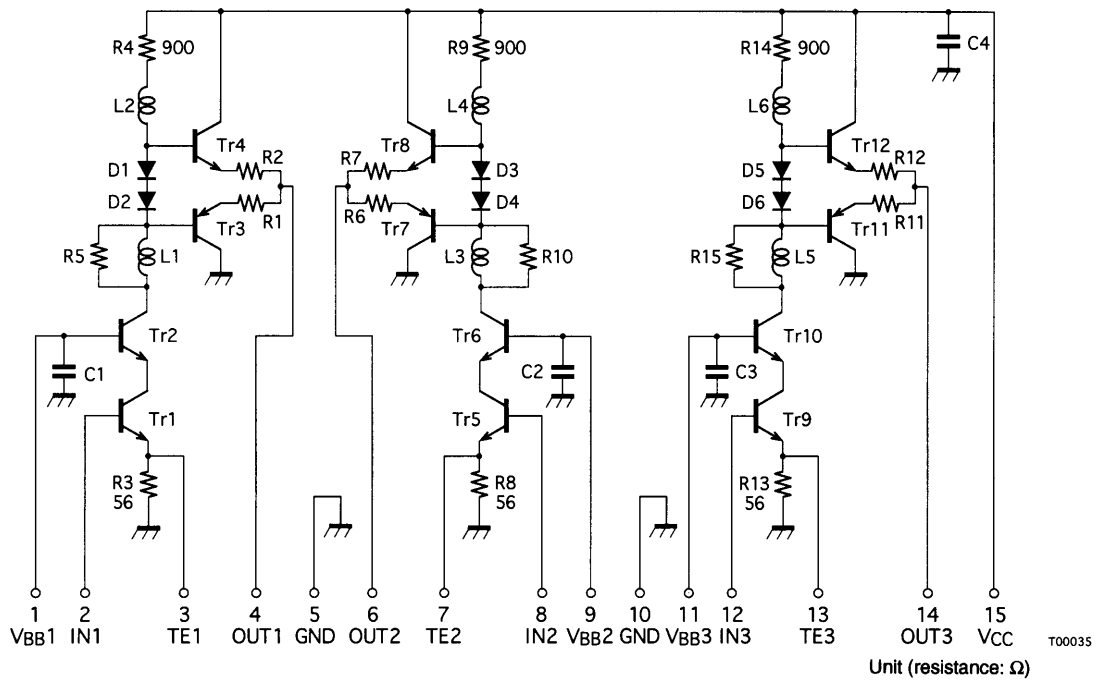
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Frequency band (-3 dB)	f_c	$V_{CC} = 80$ V, $V_{BB} = 10$ V, $C_L = 10$ pF V_{IN} (DC) = 3.2 V, V_{OUT} (p-p) = 40 V		130		MHz
Impulse response	t_r	$V_{CC} = 80$ V, $V_{BB} = 10$ V, $C_L = 10$ pF		3.5		ns
	t_f	V_{IN} (DC) = 3.2 V, V_{OUT} (p-p) = 40 V		2.9		ns
Voltage gain	VG (DC)		13	15	17	double
Current drain	$I_{CC(1)}$	$V_{CC} = 80$ V, $V_{BB} = 10$ V, V_{IN} (DC) = 2.9 V, $f = 10$ MHz clock, $C_L = 10$ pF, V_{OUT} (p-p) = 40 V		47		mA
	$I_{CC(2)}$	$V_{CC} = 80$ V, $V_{BB} = 10$ V, V_{IN} (DC) = 2.9 V, $f = 130$ MHz clock, $C_L = 10$ pF, V_{OUT} (p-p) = 40 V		85		mA

SANYO Electric Co.,Ltd. Semiconductor Bussiness Headquarters

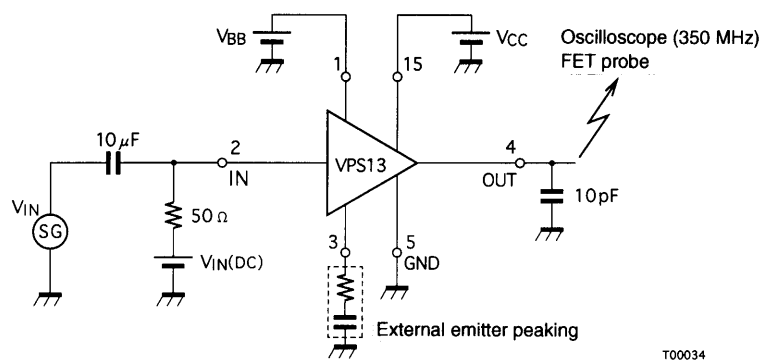
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110 JAPAN

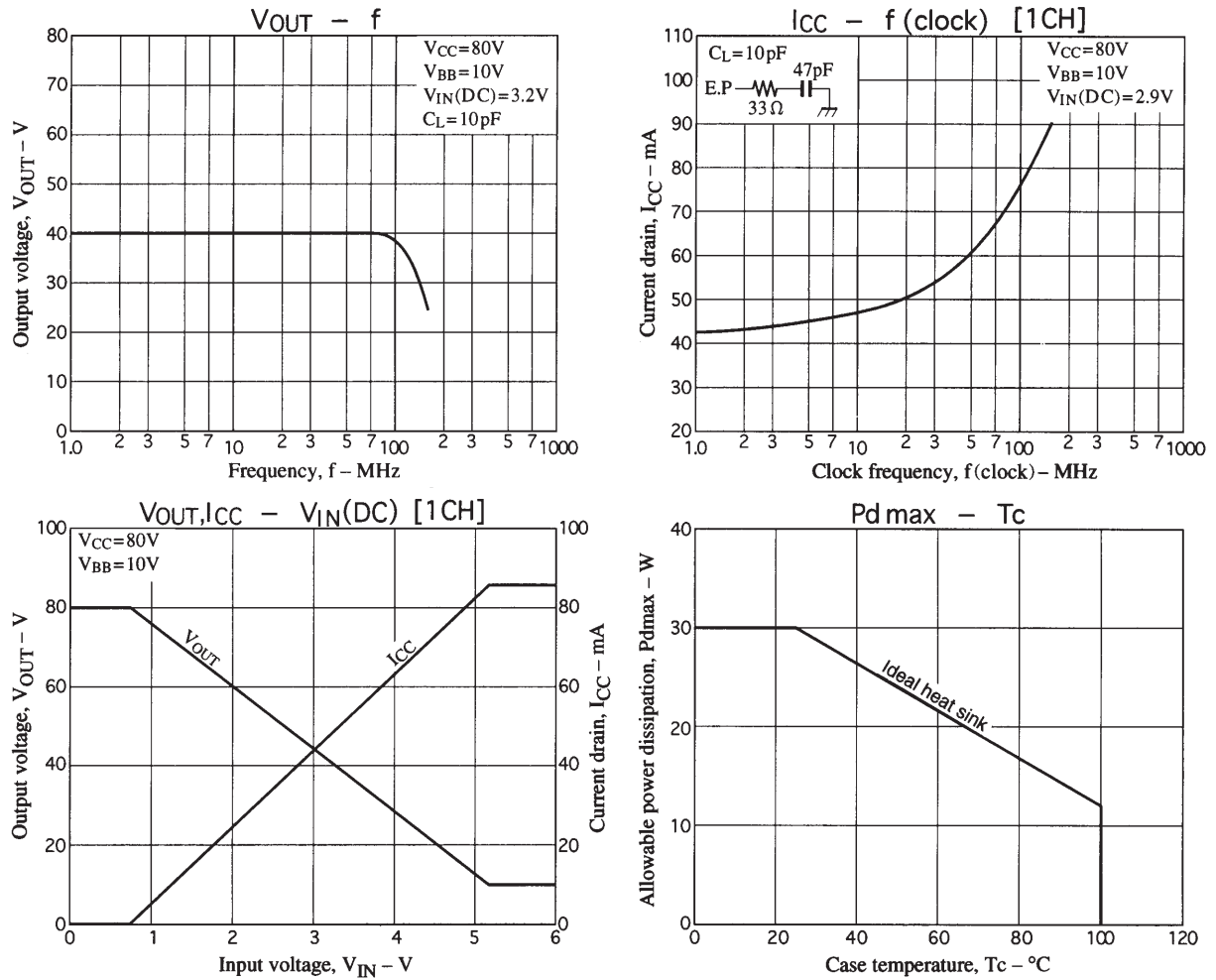
83097HA (OT)/03096HA (OT) No. 5548-1/4

Internal Equivalent Circuit



Test Circuit (for a single channel)





Thermal Design

Since the VPS13 includes three channels as shown in the circuit diagram on page 2, we first consider a single channel. The chip temperature of each transistor under actual operating conditions is determined using the following formula.

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

$\theta_{j-c}(T_{ri})$: Thermal resistance of an individual transistor

$P_c(T_{ri})$: Collector loss for an individual transistor

ΔT_c : Case temperature rise

T_a : Ambient temperature

The $\theta_{j-c}(T_{ri})$ for each chip is: $\theta_{j-c}(Tr1) = 35^{\circ}C/W$

$$\theta_{j-c}(Tr2) \text{ to } (Tr4) = 30^{\circ}C/W \dots\dots\dots(2)$$

Although the loss for each transistor in a video pack varies with frequency and is not uniform, if we assume the maximum operating frequency, $f = 130 \text{ MHz}$ (clock), then the chip with the largest loss will be transistor 3 ($Tr3$) of the emitter-follower stage. From the P_d - f (clock) figure we see that loss will be 22% of the total loss for a single channel:

$$P_c(\text{emitter-follower stage})_{(f=130 \text{ MHz})} = P_d(1ch)_{(f=130 \text{ MHz})} \times 0.22 \text{ [W]} \quad (3)$$

Here, we must select a heat sink with a capacity θ_h such that the T_j of these transistors does not exceed $150^{\circ}C$. Equation (4) below gives the relationship between θ_h and ΔT_c .

$$\Delta T_c = P_d(\text{Total}) \times \theta_h \dots\dots\dots(4)$$

The required θ_h is calculated using this equation and equation (1).

VPS13 Thermal Design Example

Conditions: Using an $f_H = 100$ kHz class monitor, $f_V = 130$ MHz (clock)

$$V_{CC} = 80 \text{ V}, V_{BB} = 10 \text{ V}, V_{OUT} = 40 \text{ Vp-p} (C_L = 10 \text{ pF})$$

Here we consider the case where this class of monitor is operated up to $T_a = 60^\circ\text{C}$ at a maximum clock frequency of $f = 130$ MHz.

As mentioned previously, the chip with the largest loss is transistor 3 (Tr3) of the emitter-follower stage. Determining that value gives:

$$P_c (\text{emitter-follower stage}) = 6.8 \times 0.22 \approx 1.5 \text{ [W]} \dots\dots\dots(5)$$

Now, determine ΔT_j by substituting the value for θ_{j-c} in equation (5).

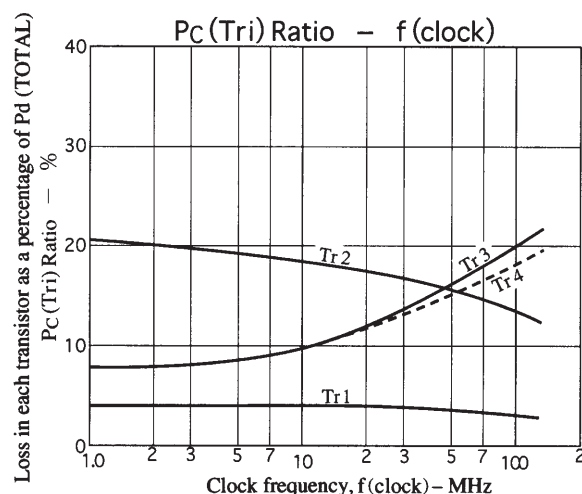
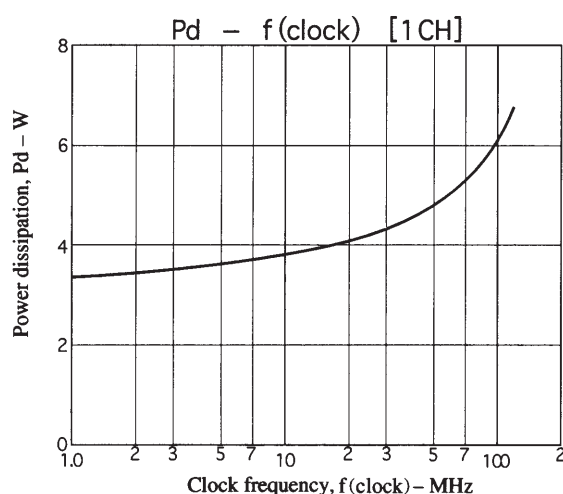
$$\Delta T_j = 1.5 \times 30 = 45 \text{ } [^\circ\text{C}]$$

Here, $\Delta T_j < 50^\circ\text{C}$, and we need only consider cases where $T_c < 100^\circ\text{C}$. Therefore, we must design a θ_h for the heat sink such that the $T_c < 100^\circ\text{C}$ condition holds when three channels are operating at maximum levels, i.e., $P_d(\text{TOTAL}) = P_d(\text{one channel}) \times 3$.

ΔT_c will be $100 - 60 = 40^\circ\text{C}$, and therefore:

$$\theta_h = \Delta T_c \div P_d (\text{TOTAL}) = 40 \div (6.8 \times 3) = 2.0, \text{ i.e. } \theta_h = 2.0^\circ\text{C/W}$$

In actual practice, the ambient temperature and operating conditions will allow a heat sink smaller than that indicated by this calculation to be used. Therefore, design optimization taking the actual conditions and the above data into account is also required.



V_{CC} (V)	V_{BB} (V)	V_{OUT} (V)	V_O (center)
80	10	40	45

- No products described or contained herein are intended for use in surgical implants, life-support systems, aerospace equipment, nuclear power control systems, vehicles, disaster/crime-prevention equipment and the like, the failure of which may directly or indirectly cause injury, death or property loss.
- Anyone purchasing any products described or contained herein for an above-mentioned use shall:
 - ① Accept full responsibility and indemnify and defend SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors and all their officers and employees, jointly and severally, against any and all claims and litigation and all damages, cost and expenses associated with such use:
 - ② Not impose any responsibility for any fault or negligence which may be cited in any such claim or litigation on SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors or any of their officers and employees jointly or severally.
- Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

This catalog provides information as of August, 1997. Specifications and information herein are subject to change without notice.