



STK392-020

Convergence Correction Circuit Three Channels in a Single Package (Maximum Output Current: 6 A)

Overview

The STK392-020 is a hybrid IC for video projector convergence correction. Since this IC integrates three output amplifier circuits in a single package, the six convergence correction output circuits, i.e., the vertical and horizontal directions for each CRT of the RGB can be formed from only two ICs.

Applications

Video projectors (both standard and high definition)

Features

- Three output amplifier circuits integrated in a single 22-pin package
- High absolute maximum supply voltage ($V_{CC \text{ max}} = \pm 44 \text{ V}$)
- Low thermal resistance ($\theta_{j-c} = 2.1 \text{ }^\circ\text{C/W}$)
- High thermal stability ($T_C \text{ max} = 125^\circ\text{C}$)
- Isolated early stage and output stage power supplies
- Output stage power supply switching supports high efficiency designs.

Specifications

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

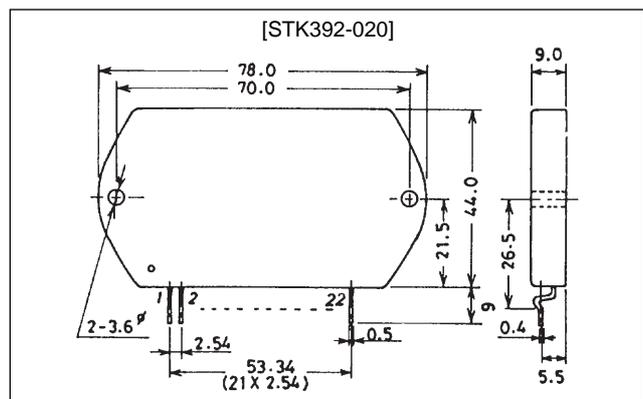
Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC \text{ max}}$		± 44	V
Maximum collector current	I_C	Tr8, 10, 18, 20, 28, 30	+6.0	A
Thermal resistance	θ_{j-c}	Tr8, 10, 18, 20, 28, 30 (per transistor)	2.1	$^\circ\text{C/W}$
Junction temperature	T_j		150	$^\circ\text{C}$
Operating substrate temperature	T_c		125	$^\circ\text{C}$
Storage temperature	T_{stg}		-30 to +125	$^\circ\text{C}$

- The input system, power supply system and output system pins are isolated in the pin arrangement, thus reducing the influence of the pattern layout on the characteristics and easing design.
- Since constant current circuits are used in the pre-driver stage, operation is stable with respect to the power supply switching.
- The Sanyo convergence correction circuit product lineup (the STK392-000 series) handles a wide range of end-product classes. Therefore, the same PCB can be used for end products from popularly-priced units to top-of-the-line models.

Package Dimensions

unit: mm

4086A



■ Any and all SANYO products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your SANYO representative nearest you before using any SANYO products described or contained herein in such applications.

■ SANYO assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO products described or contained herein.

SANYO Electric Co., Ltd. Semiconductor Business Headquarters

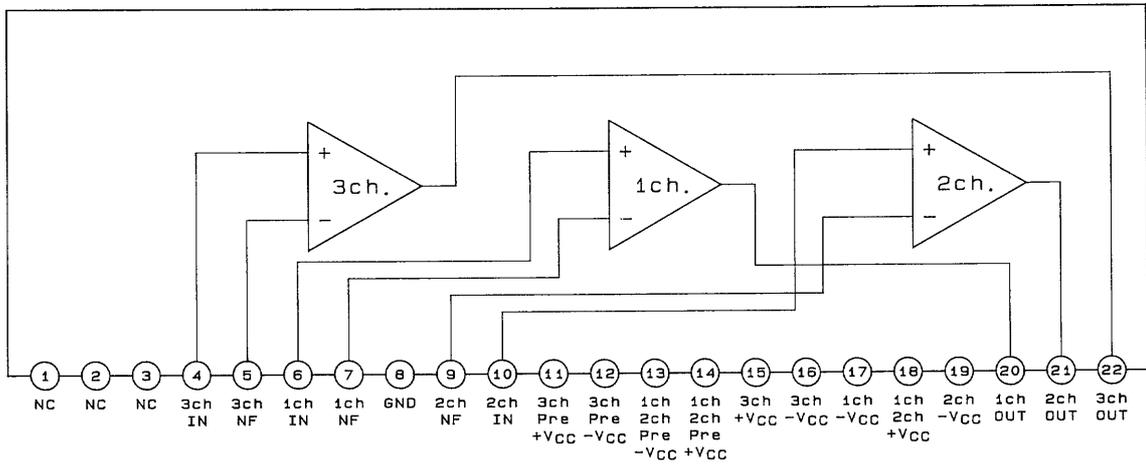
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

STK392-020

Operating Characteristics at $T_a = 25^\circ\text{C}$, $R_g = 50\ \Omega$

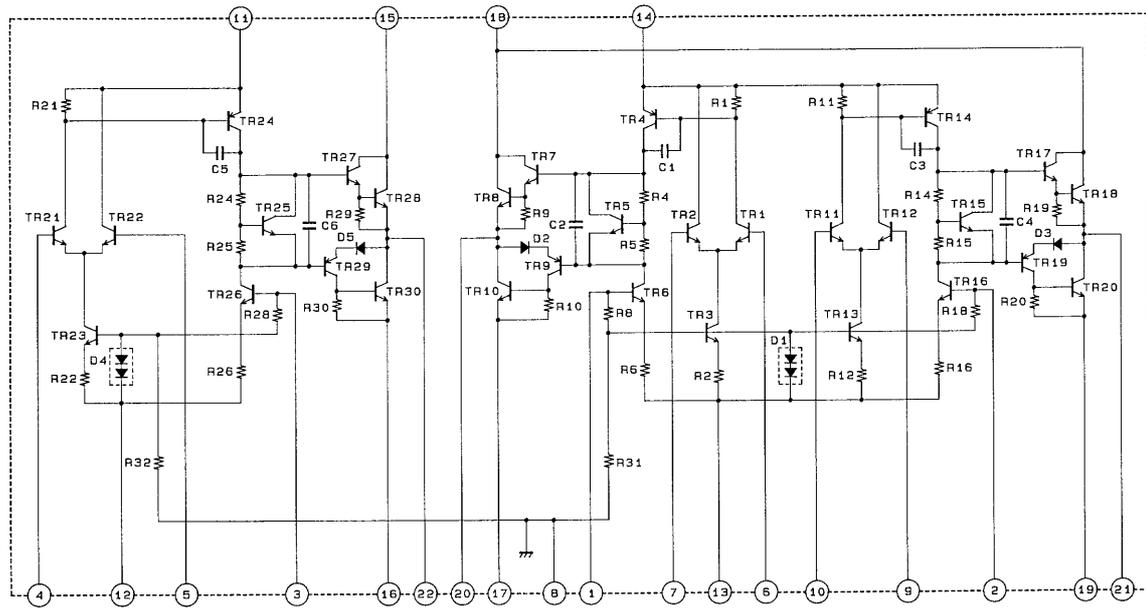
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output noise voltage	V_{NO}	$V_{CC} = \pm 35\ \text{V}$			0.2	mVrms
Quiescent current	I_{CCO}	$V_{CC} = \pm 35\ \text{V}$	30	90	150	mA
Neutral voltage	V_N	$V_{CC} = \pm 35\ \text{V}$	-50	0	+50	mV
Output delay time	t_D	$V_{CC} = \pm 35\ \text{V}$, $f = 15.75\ \text{kHz}$; Triangle wave input, $V_{OUT} = 1.5\ \text{V}_{p-p}$			1.0	μs

Equivalent Circuit Block Diagram



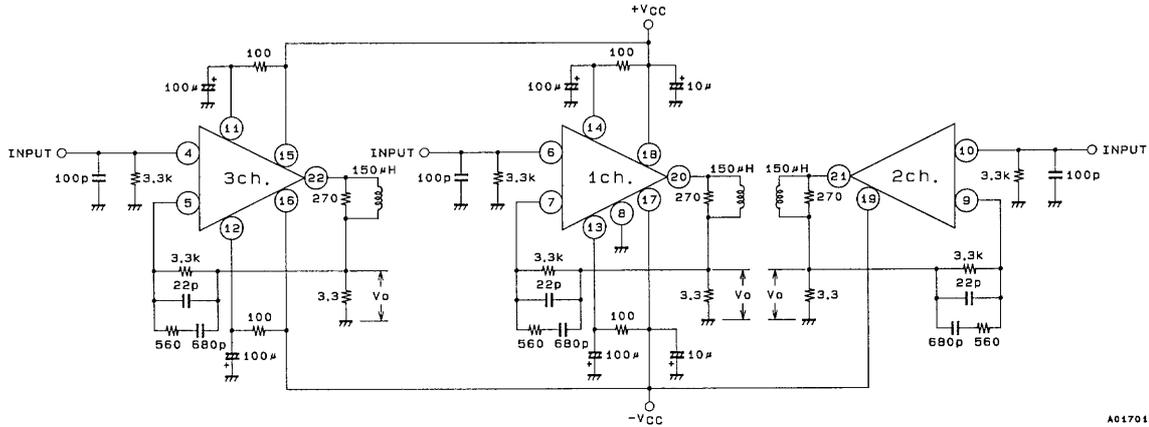
A01699

Internal Equivalent Circuit



A01700

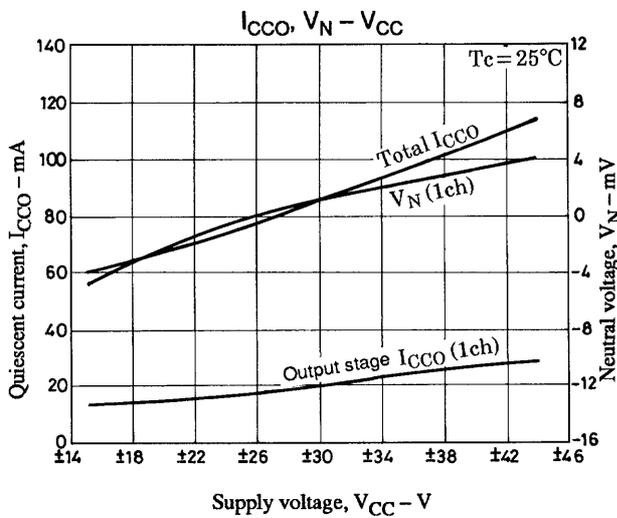
Test Circuit



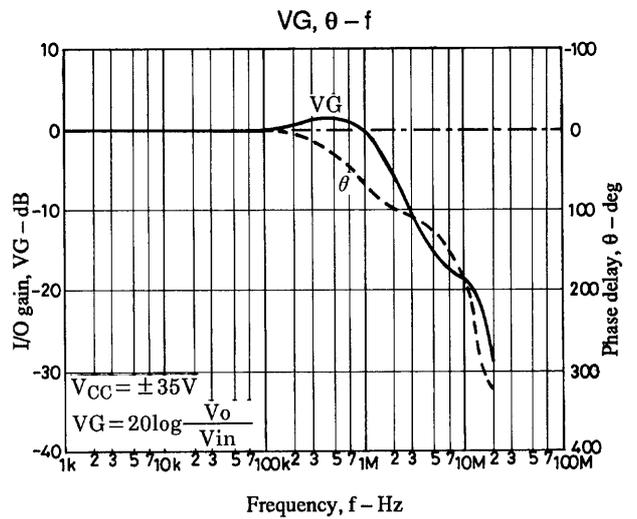
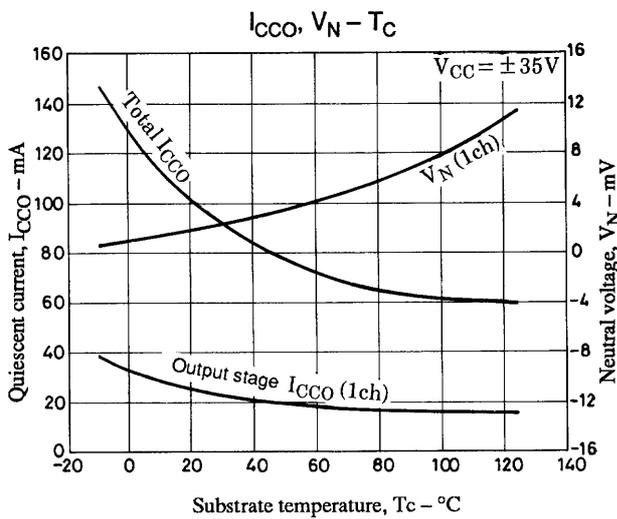
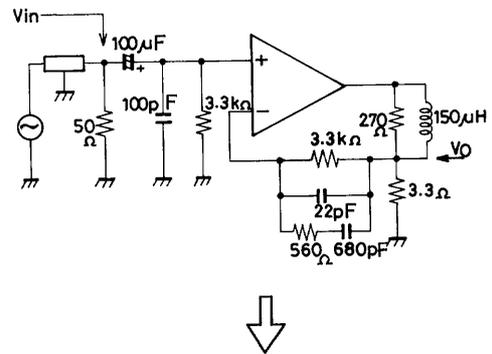
A61704

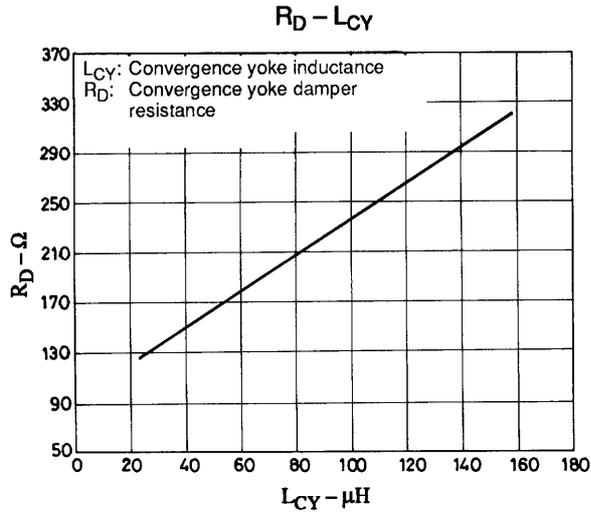
V_O: Connect to VTVM when measuring V_{NO}
 Connect to a DC volt meter when measuring V_N
 Connect to the oscilloscope when measuring t_D

Unit (resistance: Ω, capacitance: F)

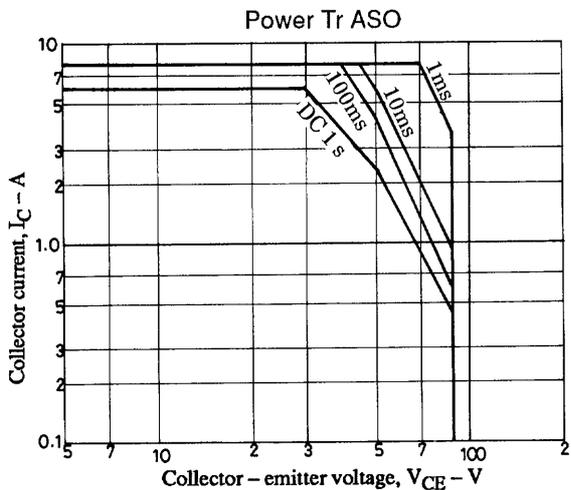
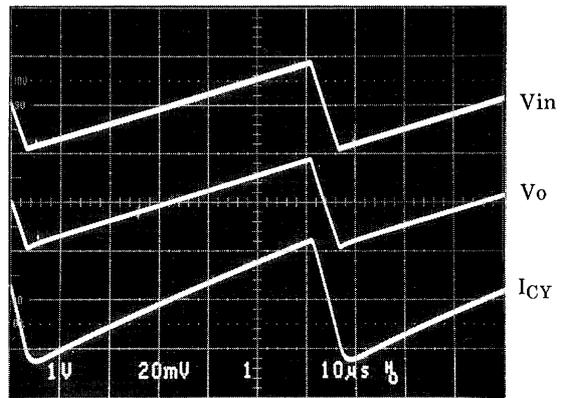
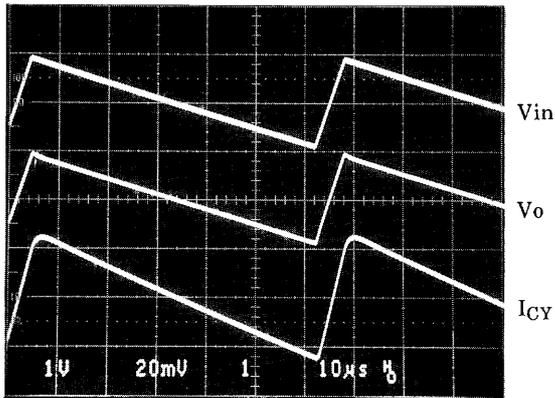
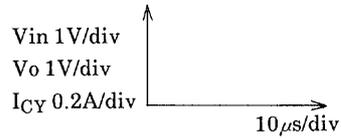
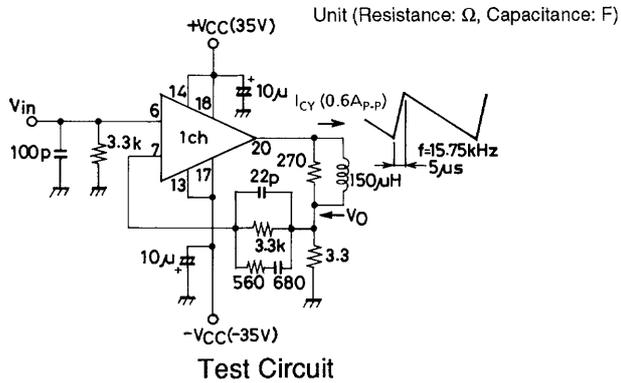


Test Circuit





Operating Waveforms



Thermal Design

1. Tj max, Tc max, and θj-c

Tj max, Tc max, and θj-c are stipulated in the maximum ratings as required parameters for thermal design.

- Tj max (junction temperature)

Tj max is a parameter that is due to the physical structure of the internal devices. Since devices will be degraded or destroyed if Tj exceeds this value, the design must not allow this value to be exceeded.

- Tc max (operating substrate temperature)

Tc max is a parameter that arises from the internal devices, the materials used, and the circuit design. It is determined based on comprehensive considerations, including reliability. Devices are not guaranteed if they are operated with Tc exceeding this value.

- θj-c (thermal resistance)

θj-c differs for each device in the design, and is stipulated in the maximum ratings since it is required to calculate Tj for the major devices in the design.

Note that Tj and Tc are independent parameters that depend on the operating conditions, and the thermal design must fulfill the maximum ratings of both these parameters.

2. Approaches to Thermal Design

Let Pd be the IC case internal operating power dissipation, and Pc be the power dissipation per power transistor. The required heat sink thermal resistance (θc-a) for this case internal power dissipation (Pd) can be derived as follows:

Condition 1: Taking Ta to be the end product guaranteed ambient temperature, the IC case temperature Tc must not exceed 125°C.

$$Pd \times \theta_{c-a} + Ta < 125^\circ\text{C} \text{ (Tc max)} \dots\dots\dots \textcircled{1}$$

Condition 2: The power transistor junction temperature must not exceed 150°C.

$$Pd \times \theta_{c-a} + Pc \times \theta_{j-c} + Ta < 150^\circ\text{C} \text{ (Tj max)} \dots\dots\dots \textcircled{2}$$

Where θj-c is the thermal resistance per power transistor.

The thermal design must fulfill these above conditions.

3. Design Procedure

The figure at right shows a model of the STK392-020 channel 1 circuit. Taking the Pd's of each channel to be Pd1 (channel 1), Pd2 (channel 2) and Pd3 (channel 3), the total Pd max can be determined as:

$$Pd \text{ max} = Pd1 \text{ max} + Pd2 \text{ max} + Pd3 \text{ max}$$

That is, condition ① gives:

$$\theta_{c-a} < \frac{Tc \text{ max} - Ta \text{ max}}{Pd \text{ max}} \dots\dots\dots \textcircled{3}$$

which allows the required heat sink thermal resistance to be derived. (Here, Tc max is taken to be 125°C.)

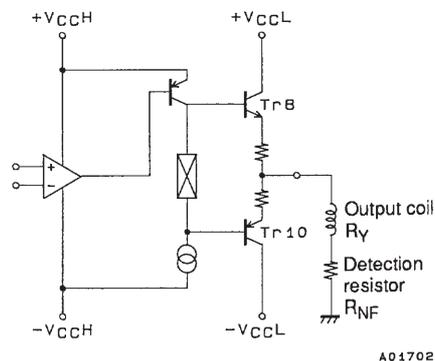
Also, taking the power dissipation per power transistor for each channel to be Pc, the transistor junction temperature Tj will be:

$$Tj = Pd \text{ max} \times \theta_{c-a} + Ta + Pc + \theta_{j-c} \dots\dots\dots \textcircled{4}$$

and this can be used to confirm that Tj does not exceed Tj max (150°C).

At this point, if Tj exceeds 150°C in the design, Tc must be lowered by lowering the heat sink thermal resistance θc-a so that Tj does not exceed 150°C.

STK392-020 Circuit Model (channel 1)



4. Thermal Design Example

Take the following to be the worst operating conditions for the STK392-020.

$$V_{CCH} = \pm 35 \text{ V}$$

$$V_{CCL} = \pm 25 \text{ V}$$

Output coil, $L_Y = 150 \mu\text{H}$, $R_Y = 0 \Omega$

Current detection resistor $R_{NF} = 3.3 \Omega$

$I_{p-o} \text{ max} = 0.4 \text{ A}$ ($I_{p-p} = 0.8 \text{ A}$), Sawtooth waveform input

$I_o(\text{DC}) \text{ max} = 0.4 \text{ A}$ DC input

All three channels operating under the same conditions

$T_a \text{ max} = 60^\circ\text{C}$ (unit internal temperature)

From figures 1 and 2, it can be seen that the Pd1 for channel 1 is:

(a) For a sawtooth wave input: Pd1 max = 4.8 W (AC)

(b) For a DC input: Pd1 max = 9.5 W (DC)

This shows that Pd1 max AC < Pd1 max DC, i.e. that Pd1 is larger for a DC input.

Also, considering Pc for the output transistors gives:

(a) For a sawtooth wave (AC) input: $P_c = 1/2 \text{ Pd1}$

(b) For a DC input: $P_c = \text{Pd1}$ (Since the power concentrates in the transistor on one side.)

Therefore, the DC input Pc for the output transistors is larger.

Accordingly, the remainder of the thermal design is based on the DC input case.

Here we ignore the power dissipation in the early stages.

When: Pd1 max = Pd2 max = Pd3 max = 9.5 W, then the Pd max (total for three channels) will be:

$$Pd \text{ max} = Pd1 \text{ max} \times 3 = 28.5 \text{ W}$$

$$\theta_{c-a} = \frac{T_c \text{ max} - T_a}{Pd \text{ max}} = \frac{125 - 60}{28.5} = 2.28^\circ\text{C/W}$$

This means that if a 2 mm thick Al plate (with an unfinished surface) is used as the heat sink, then figure 3 shows that the following area S is required.

$$S = 625 \text{ cm}^2 (25 \times 25 \text{ cm})$$

Also, from formula ④, we see that the power transistor junction temperature Tj at this time will be:

$$\begin{aligned} T_j &= Pd \text{ max} \times \theta_{c-a} + T_a + P_c \text{ max} \times \theta_{j-c} \\ &= 28.5 \times 2.28 + 60 + 9.5 \times 2.1 \\ &= 145^\circ\text{C} \end{aligned}$$

This is a 5°C derating from the required 150°C Tj max.

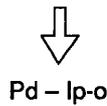
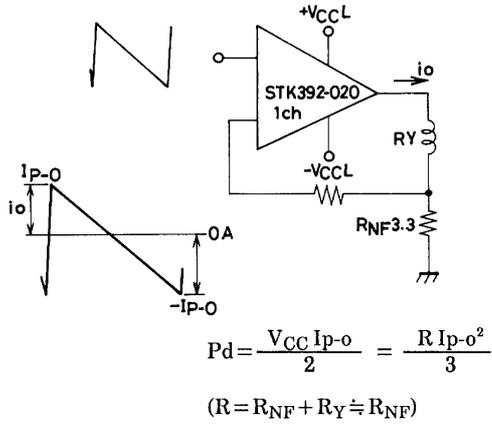
(Addendum) To be precise, the power dissipated in the early stage circuits (transistor, resistors, etc.) should also be taken into consideration.

Figure 1: Sawtooth wave input (AC) I_{p-o} – Pd1

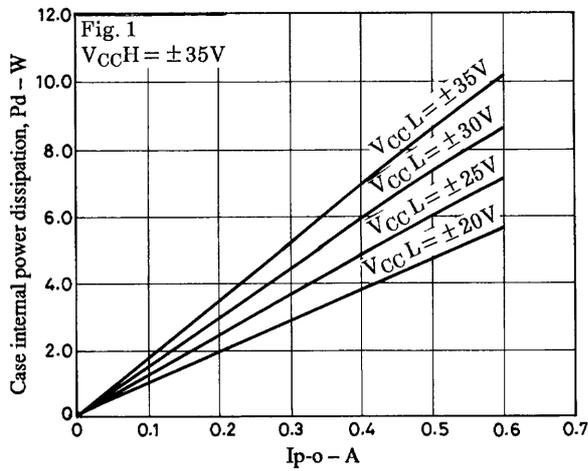
Figure 2: DC input $I_o(\text{DC})$ – Pd1

Figure 3: Aluminum plate thermal resistance characteristics

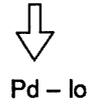
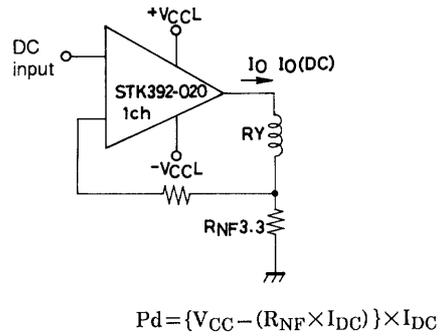
Sawtooth wave input



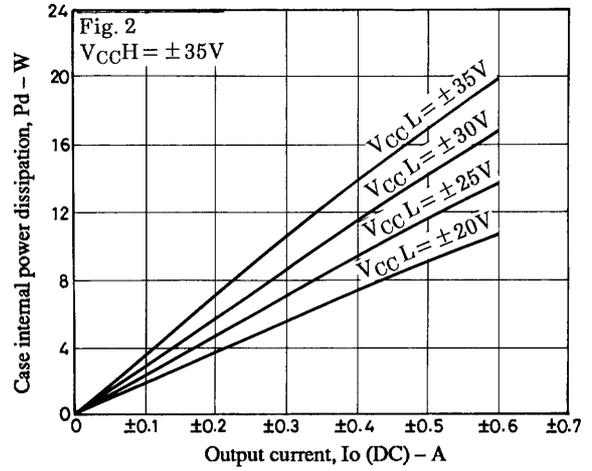
Pd - Ip-o



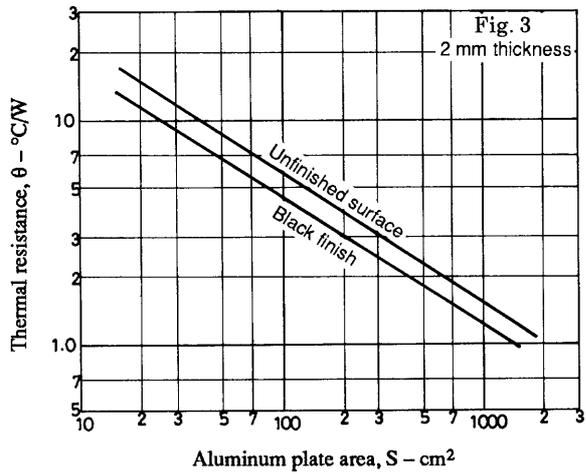
DC input



Pd - Io



Aluminum plate thermal resistance



- Specifications of any and all SANYO products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.
- SANYO Electric Co., Ltd. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all SANYO products (including technical data, services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of SANYO Electric Co., Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO product that you intend to use.
- 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 December, 1998. Specifications and information herein are subject to change without notice.