Ordering number : EN4421

Thick Film Hybrid IC

SANYO No. 4421

STK750-010

Chopper Regulator using MOS FET with Multi-Scan Support (1 A Output Current)

Overview

These days, the variety of horizontal frequencies output from personal computers (PCs) include 15 kHz, 24 kHz, 31 kHz and even 33 kHz. These differences are dependent on the device and maker, and the market itself contains many PCs and a wide array of frequencies; in other word, the need to remain compatible is stronger then ever. As the number of video signal formats created with new-media devices becomes more diversified, the search for circuit technology capable of supporting such a wide range of scanning frequencies (multiscan support) becomes even harder.

The STK750-010 is a chopper regulator using MOS FET with multi-scan support. This IC is also designed for output voltage variable control supporting a wide range of horizontal frequencies. For these reasons, the STK750-010 helps reduce streamlined power supply designs, shorten overall development time, and reduce total costs while providing high-precision CRT display performance with the highest quality.

Applications

- Multi-scan supporting CRT displays (secondary voltage variable regulator)

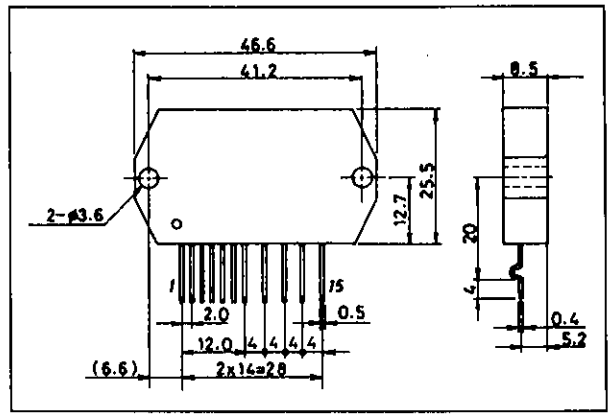
Features

- High efficiency (97%) provided by power MOS FET. Compared with bi-polar chopper regulators used until now, power dissipation is less than half while supporting compact heat sink and lighter weight design.
- Multi-scan support (output voltage variability). Supports horizontal frequency external control.
- Wider output voltage control range (50 to 130 V), compared with dropper type ICs used until now. The resonance condenser changeover circuit and the vertical dummy coil changeover circuit of horizontal deflection coil are eliminated within the horizontal autoscan circuit.
- IC operating frequency supports horizontal frequency synchronization.
- Standard chopper type eliminates need for complicated transformers and supports choke coil applications.

Package Dimensions

unit : mm

4136



Specifications

Maximum Ratings at Ta = 25°C

			unit
Maximum DC input voltage	Vin (DC) max	190	V
Maximum output current	Io max	1	A
Thermal resistance	θj-c	2.5	°C/W
Junction temperature	Tj max	150	°C
Operating substrate temperature	Tc max	105	°C
Storage temperature	Tstg	−30 to +105	°C

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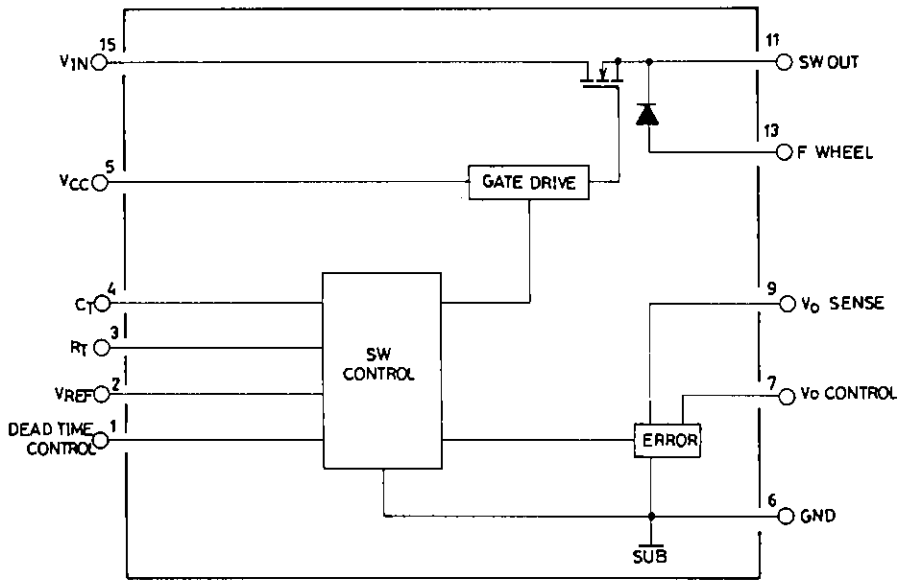
Recommended Operating Conditions at Ta = 25°C

				unit
V_{IN} voltage	Vin		165 to 175	V
V_{CC} voltage	V_{CC}		11 to 13	V
Error amplifier input voltage	Vamp	7 pin	−0.3 to V_{CC}−2	V
Timing condenser	G_T	4 pin	0.47 to 10000	nF
Timing resistor	R_T	3 pin	1.8 to 500	kΩ
Oscillation frequency	f_{OSC}		20 to 100	kHz
Maximum duty	D max		90	%

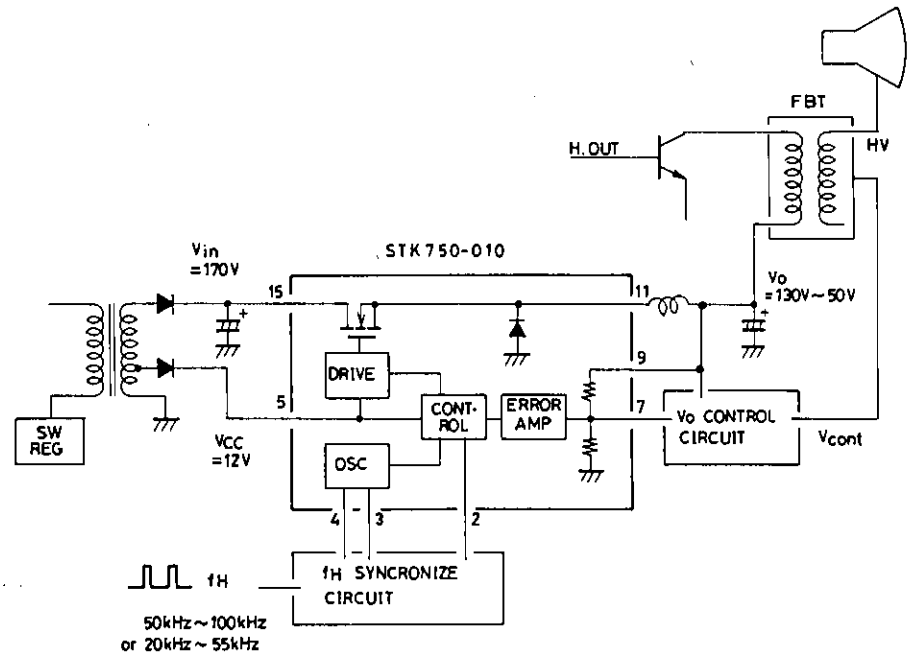
Operating Characteristics at Ta = 25°C, see specified Test Circuit, f = 50kHz

			min	typ	max	unit
Output voltage	Vo	Vin (DC) = 170V, Io = 0.5A		130±1.5		V
Input regulaton	Reg-IN	Vin (DC) = 160 to 180V, Io = 0.5A			0.05	V/V
Load regulation	Reg-L	Vin (DC) = 170V, Io = 0.2 to 1A			0.5	V/A
Efficiency	η	Vin (DC) = 170V, Io = 0.5A		97		%
Output voltage temperature coefficient	T_{CVO}	Vin (DC) = 170V, Io = 0.5A		17		mV/°C

Block Diagram

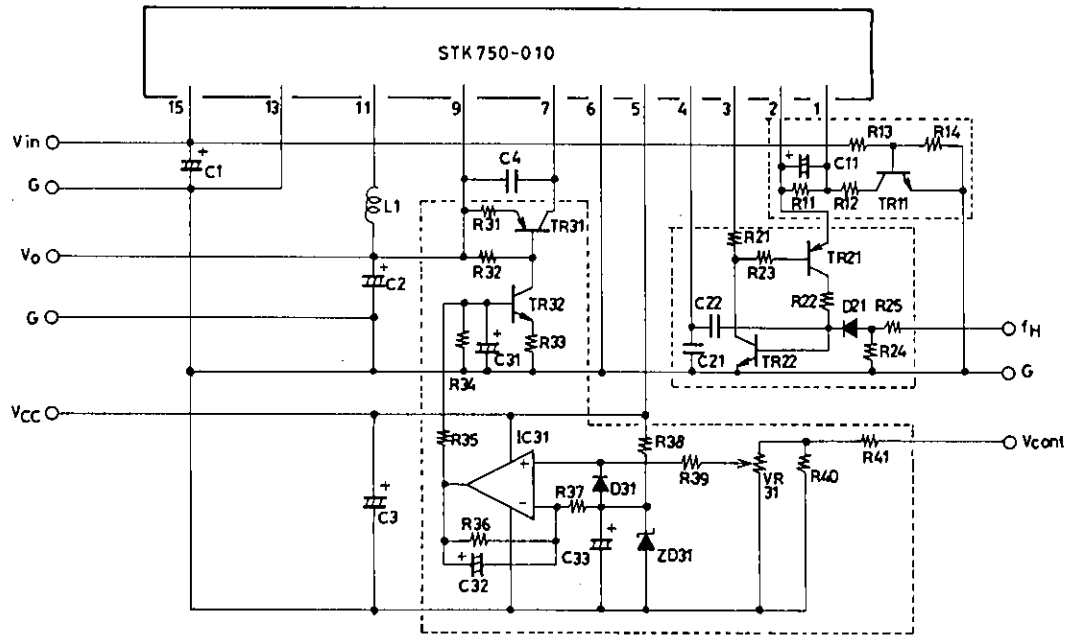


Application Circuit Block Diagram



Test Circuit

Sample circuit with f_H = 50 kHz to 100 kHz



C1	220μF / 200V	R11	130KΩ	TR11	2SC2274F	L1	4.8mH
C2	220μF / 200V	R12	8.2kΩ	TR21	2SA984F		
C3	10μF / 25V	R13	470kΩ	TR22	2SC2274F		
C4	0.047μF / 250V	R14	10kΩ	TR31	2SA1209S		
C11	22μF / 25V	R21	2.0kΩ	TR32	2SC2911S		
C21	2200pF	R22	47kΩ				
C22	4700pF	R23	30kΩ				
C31	22μF / 25V	R24	1kΩ	IC31	LA6358		
C32	10μF / 50V (N. P.)	R25	100kΩ				
C33	10μF / 25V	R31	56kΩ				
		R32	100kΩ	D21	GMA01		
		R33	3.9kΩ	D31	GMA01		
		R34	10kΩ				
		R35	1kΩ				
		R36	100kΩ	ZD31	GZA5.6X		
		R37	4.7kΩ				
		R38	4.7kΩ				
		R39	100Ω				
		R40	330kΩ				
		R41	10kΩ				
		VR31	500kΩ				

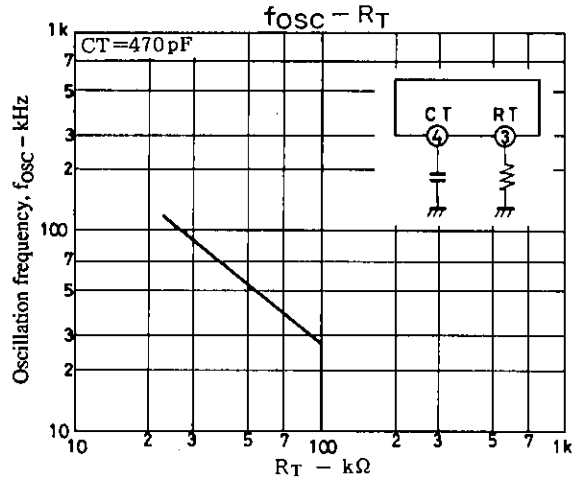
Description of Circuit Operations

1. Reference Voltage Circuit (REF REG.)
   Reference voltage outputs at 5 V with built-in oscillator and protection circuits.

2. Oscillator (OSC)
   When C and R are externally connected, self-oscillation of saw-tooth-wave forms begins. Charge current flows from the CT pin (pin 4) to the condenser and when the CT pin reaches approximately 3 V, the discharge transistor switches on and CT pin voltage drops to zero and one cycle ends. Charge current is determined by the current flowing to the external resistor connected to the RT pin (pin 3).
   Oscillation frequency is determined approximately according to the following equation:

$$f = \frac{1.2}{C_T \cdot R_T} [\text{kHz}]$$

C_T : μF
R_T : kΩ



3. Error Amplifier
   Because the power supply error amplifier is supplied directly from V_{CC}, the common mode input voltage range is between –0.3 V and V_{CC} –2 V. Figure 1 illustrates the equivalent circuit.

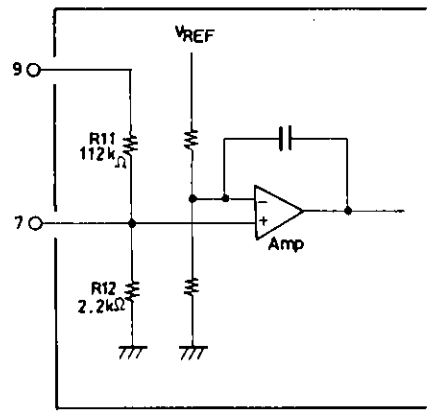


Fig. 1

When output voltage is set to Vo, approximations are determined using the following equation:

$$Vo = V_{REF'} \times \frac{R11 + R12}{R12} \qquad V_{REF'} = 2.5V$$

Supported Functions

1. Oscillation Circuit

When all devices are synchronized to the clock cycle, a circuit diagram similar to that shown in figure 2 can be synchronized.

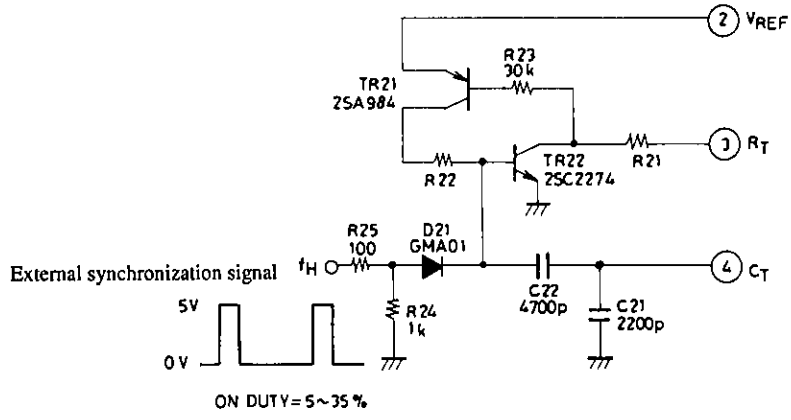


Fig. 2

Unit (resistance: Ω, capacitance: F)

Item	R21	R22	f_{OSC}	External Synchronization Support Range f_H
EX1	2.4k	39k	45kHz	48k to 100kHz
EX2	3.3k	47k	37kHz	39k to 81kHz
EX3	4.3k	68k	28kHz	29k to 65kHz
EX4	5.1k	120k	18kHz	19k to 56kHz

2. Dead-time Adjustment Circuit (DT Pin)
Soft Start Circuit

R11 and R12 are dead-time setting resistors and vary DC input voltage. By modifying the slice level of the saw-tooth wave, output maximum duty (on time) can be set. Maximum duty value should be set for approximately 90%.

If IC output pulse is operated at maximum duty when the power is turned on, a rush current flows to the output transistor. Therefore, the duty cycle should be slowly increased from 0 (this is generally referred to as a "soft start"). As shown in figure 3, configuration with the addition of a decay time constant circuit is possible using a condenser connected to the dead-time control pin (1 pin).

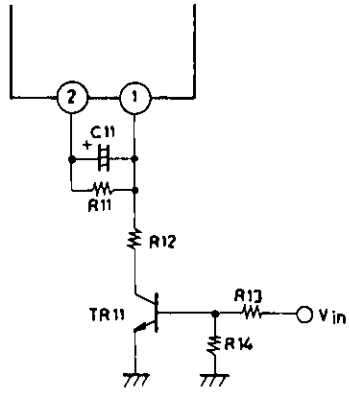
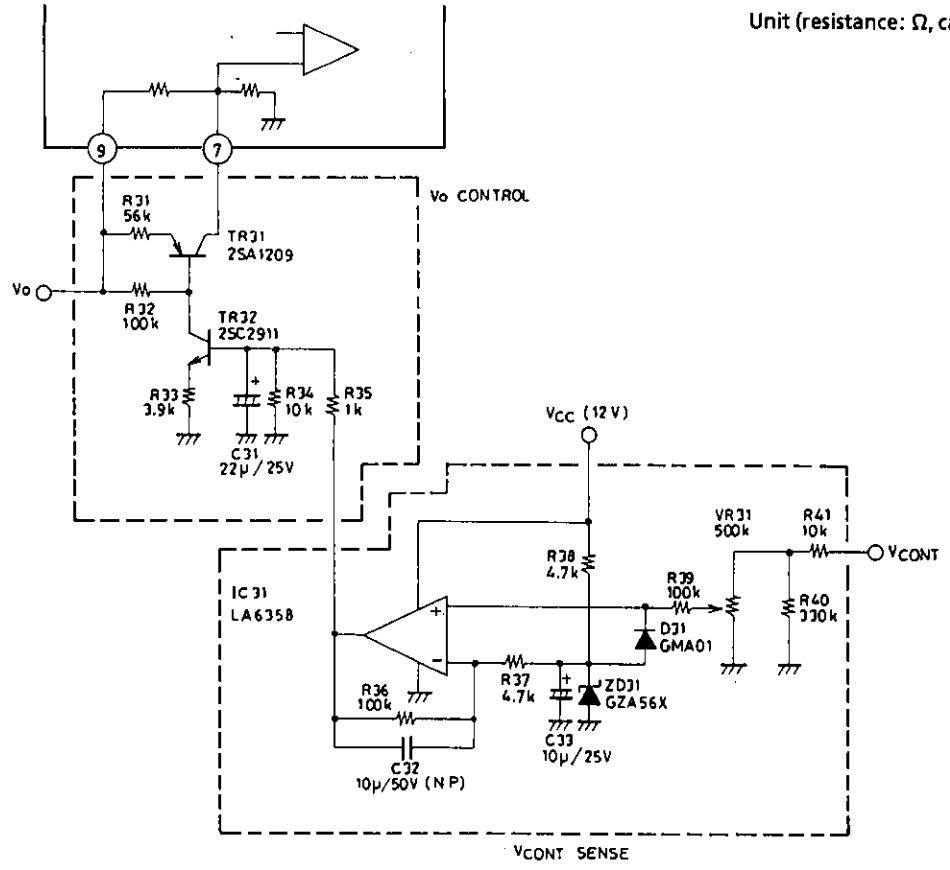


Fig. 3

3. Output Voltage Vo Control Circuit

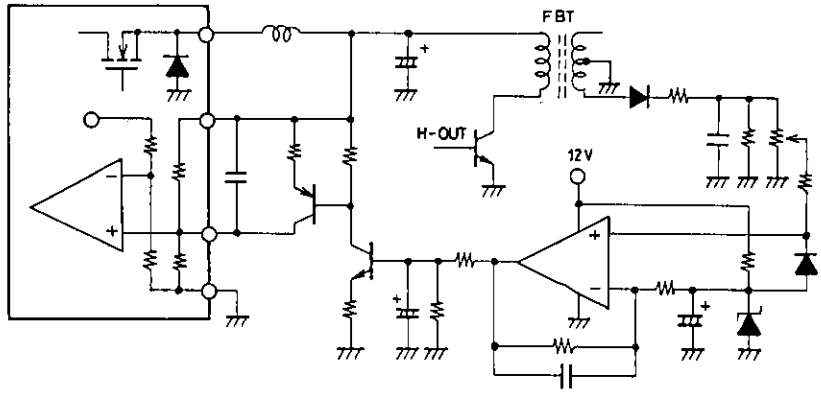
By supporting control voltage changes externally, output voltage Vo can be modified.

Unit (resistance: Ω, capacitance: F)



4. Support for Multi-Scan Applications

①



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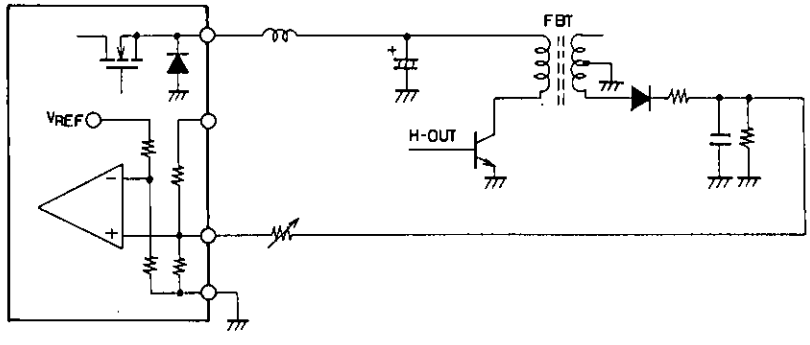
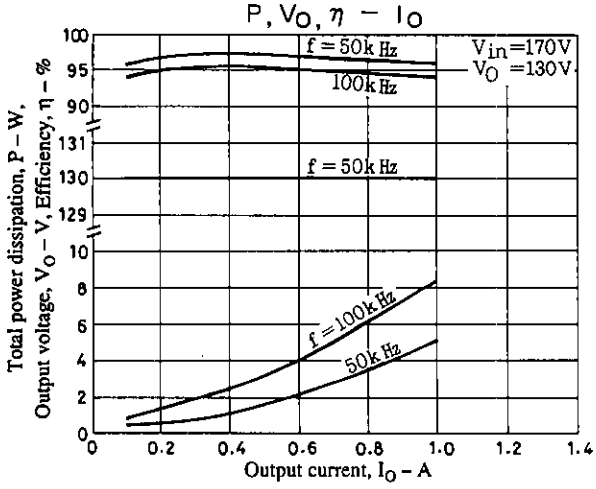
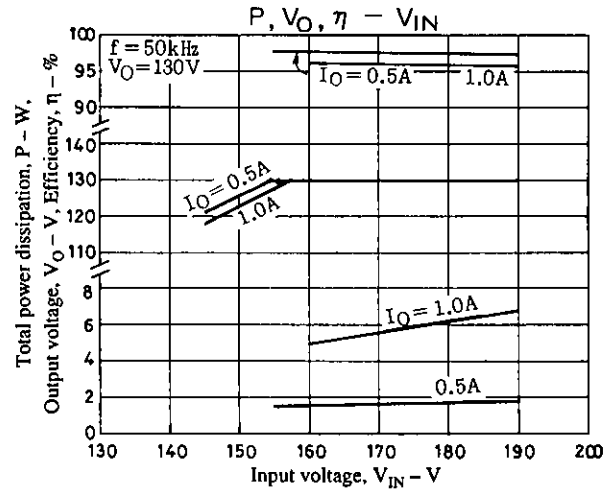
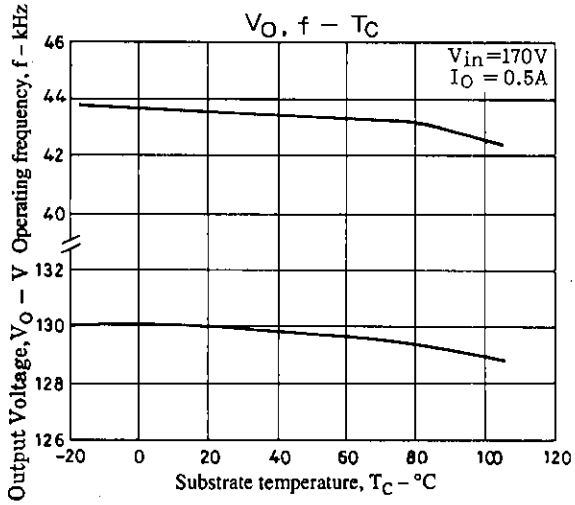
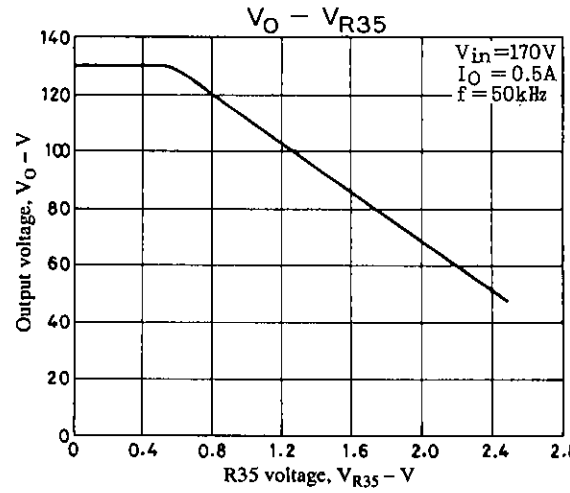
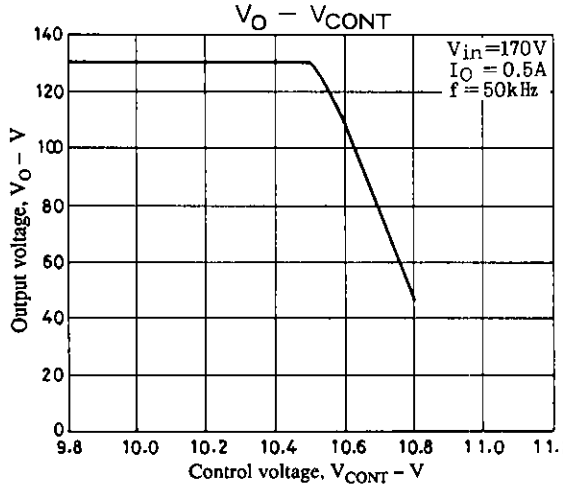



P, VO, η – IO
f = 50kHz
Vin=170V
VO =130V
100kHz
f = 50kHz
f = 100kHz
50kHz
Total power dissipation, P – W,
Output voltage, VO – V, Efficiency, η – %
Output current, IO – A


P, VO, η – VIN
f = 50kHz
VO=130V
IO=0.5A
1.0A
IO=0.5A
1.0A
IO=1.0A
0.5A
Total power dissipation, P – W,
Output voltage, VO – V, Efficiency, η – %
Input voltage, VIN – V


VO, f – TC
Vin=170V
IO = 0.5A
Output Voltage, VO – V Operating frequency, f – kHz
Substrate temperature, TC – °C


VO – VR35
Vin=170V
IO = 0.5A
f = 50kHz
Output voltage, VO – V
R35 voltage, VR35 – V


VO – VCONT
Vin=170V
IO = 0.5A
f = 50kHz
Output voltage, VO – V
Control voltage, VCONT – V

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