

The amplifier can source the load

General, including power amplifier unit, because it is meant to be a constant voltage drive the speakers to the speaker to give a shape similar to the voltage input low output impedance.

Needed to determine the source of the power amplifier output voltage in this case lies with the type you know.

Output current not constant from one of the characteristics vary depending on the load side — speaker power, an important source of information to determine the output current in the load side and Iemasu.

Given the information from the corresponding part of the load there, if only the output stage non-feedback amplifier, and NFB have the capacity to pump current in the output stage is only Anbu, and a lack of ability of private signal is distorted away, it will leak or external.

Skills and background is important in any event the output stage, using what the output device, and what to do with the output stage to the sound through out the difference without a difference in the characteristics of the speaker load resistance to be a major factor in determining the quality of Pawaanbu is ok.

EL34 triode connected and ultra-

This machine is the representation of the EL34 one interpretation of the.

Inscription in the presence of numerous spheres, a typical output tube is the most current 賞用 EL34 using the super triode connection (over the following three results for short) was a desire from the start of .

Ball and standing on a long history of vacuum tubes, however, circuits and pretension, there is no reason take the balance, we look back, EL34 for use in the best possible way, and Kimashi to expand continuously the version of the results three super- or.

If I was carelessly using EL34, three results may be super-version 1 had ended.

Had the EL34 or forcibly twist one's arm means, and we should have been a completely different direction.

I got humbled by EL34 serving, super-ripe 3 results gradually, through the action of the EL34 I think we could reach the area.

3 results over the meaning of V is the fifth version of the super-3 binding, also played a desire V sign.

Super V 3 results

3 results are based on version 4.2 Super V Super 3 results shown in Figure 1, placed between the inverting amplifier output stage and the first stage, as shown in Figure 2 is a circuit Puretoforowa output tube.

[Figure 1] Version 4 over 3 [Figure 2] forming the basic circuit of three super-V results [\(PDF\)](#) [\(PDF\)](#)

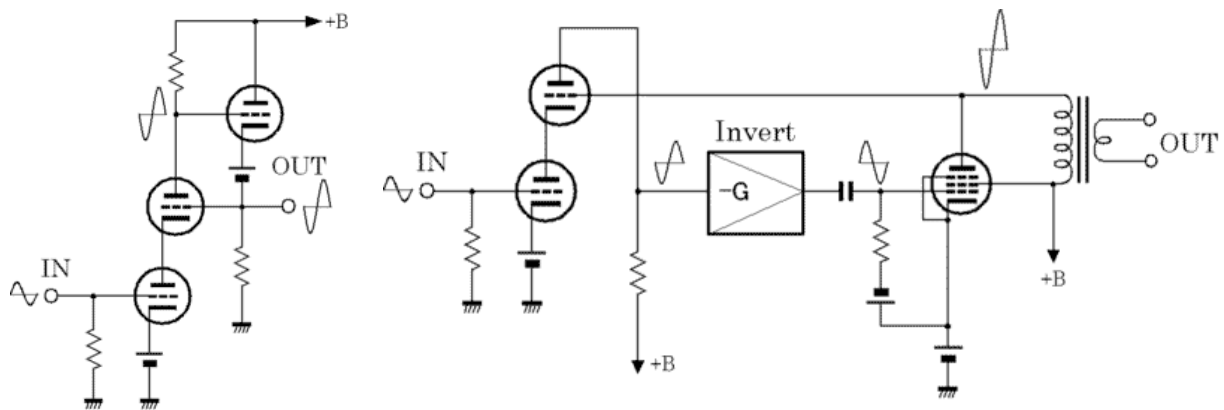
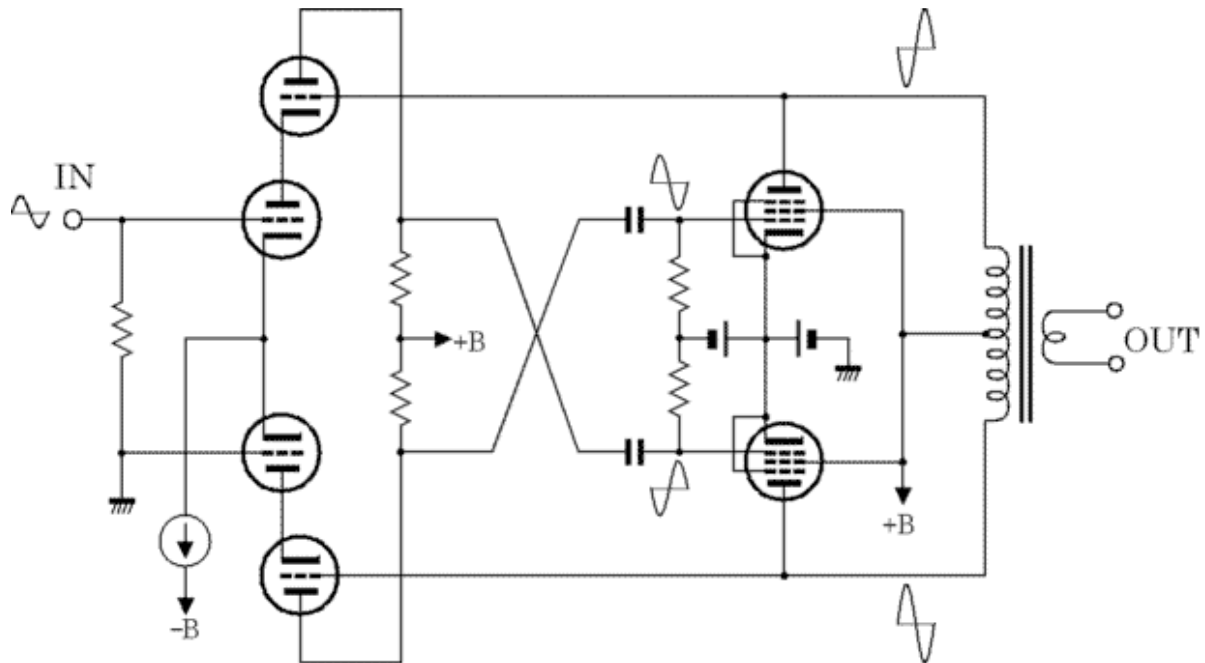


Figure 3 is a push-pull circuit, giving results for three cross-over tube and down into the output signal after the phase inversion method and V, called ultra-three results VX.

[Figure 3] Ultra VX 3 results [\(PDF\)](#)



Class B operation, unless you use a special circuit, the DC voltage to fluctuate in response to changing output tube plate output 免Rezu, will be transmitted to the first stage of this variation by the feedback loop, DC vertical output tube plate voltage fluctuation is canceled because the first-stage differential circuits equally common.

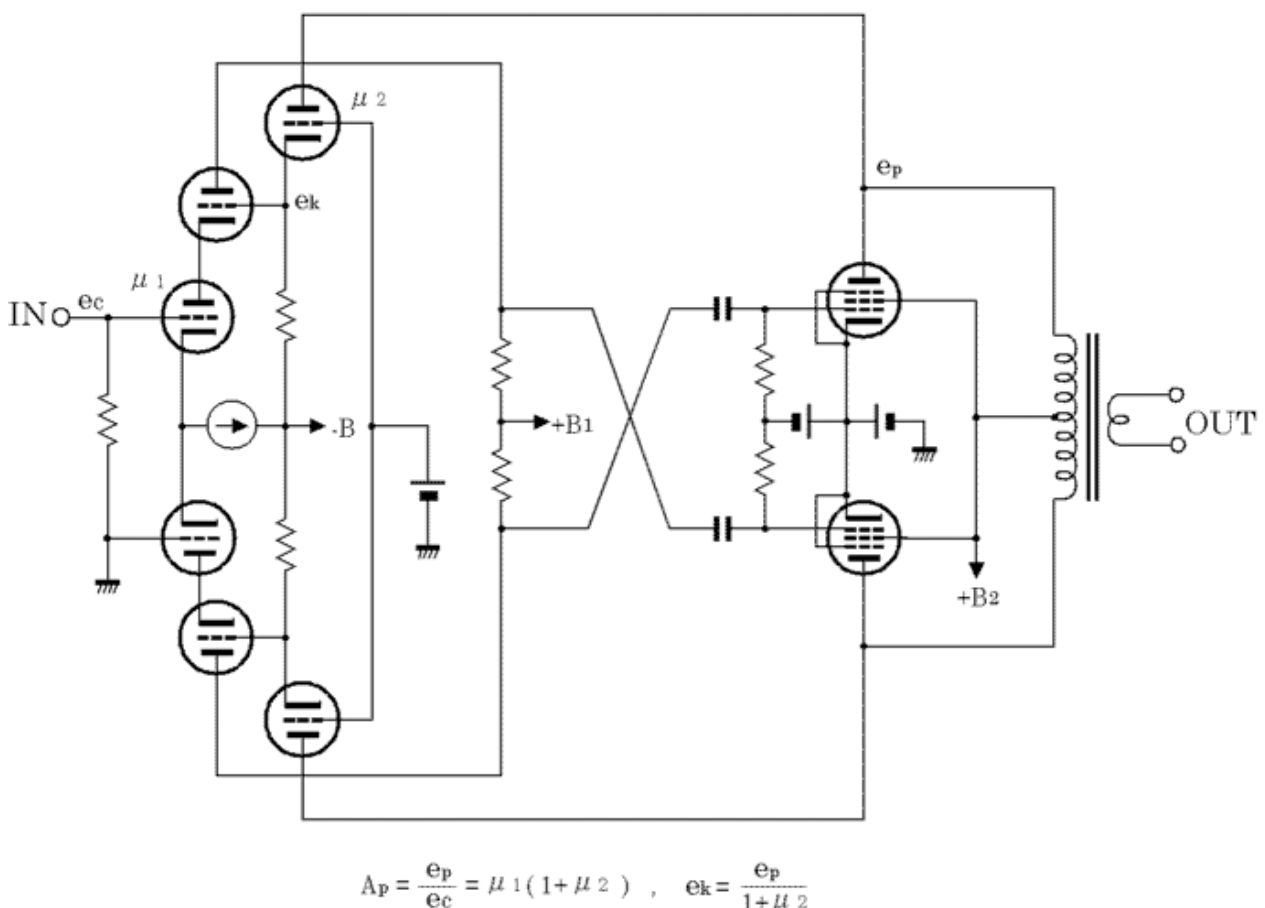
Paradoxically, once you amplify DC voltage fluctuation temporarily, changed significantly in the first stage of the DC plate voltage, to produce long-period coupling capacitor charging and discharging, the voltage of the output tube grid by which the first crossover distortion and to produce change, or it can reverse excessive current.

If you are having over the previous three results of these problems just over 3 V binding without the emergence of three B binding to adopt a super-class push-pull circuit was impossible.

Remains the basic circuit, however, must be higher than the supply voltage of the output tube plate voltage of the first stage, in order to maximize the effective use of the output tube's plate voltage up to 2 times higher than the output tube In the first stage amplifier tube voltage required, without prefix amplification also is required to unrealistically high values of μ the first-stage tube.

Therefore, we incorporated the technique of version 3 over here three results, added to the feedback triode tube between the output tube plate and the first stage shown in Figure 4.

[Figure 4] VX breaks over three results [\(PDF\)](#)



Voltage amplification up to the plate of the output tube input p A is, μ_1 each of the voltage gain of the tube and the feedback tube first stage, and that μ_2 , $A_p = \mu_1 (1 + \mu_2)$ Nearby, a ball of μ moderate used.

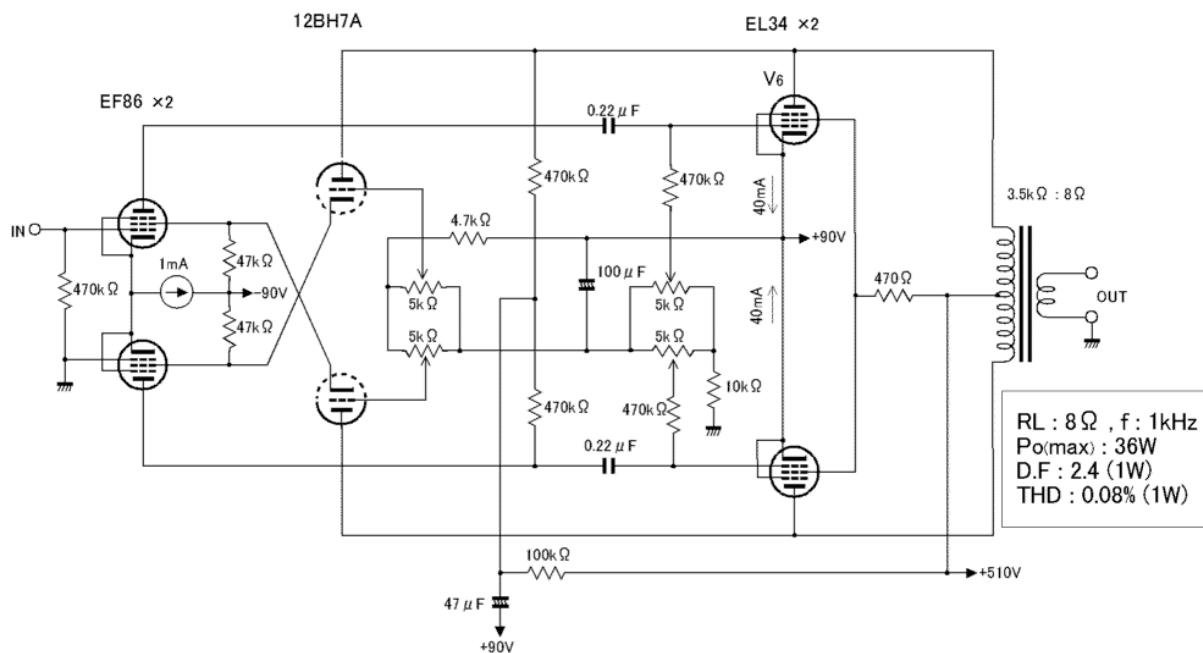
In addition, the signal voltage S word power tube return k e, the voltage signal plate output

tube e_p you, $e_k = e_p / (1 + \mu_2)$ the operating voltage of the first stage because it is often low, the above The problem can be solved in one fell swoop between.

But since e_k is also the voltage feedback ratio has declined, as well as properties become worse and not increase the open.

Figure 5 shows the experimental circuit.

[5] results over three experimental circuit VX [\(PDF\)](#)



To simplify the circuit, have been replaced by the power triode Sukodo circuit of the first stage 5, is essentially the same as in Figure 4.

To raise the gain of the first stage, increasing the load resistance and a high g_m tube replaced but you try, there was no marked improvement in performance.

3 results of Figure 2 over again so that you will return to V, putting the output stage and driver stage between the first stage, we decided to drive the output stage at the same time earn strong gain.

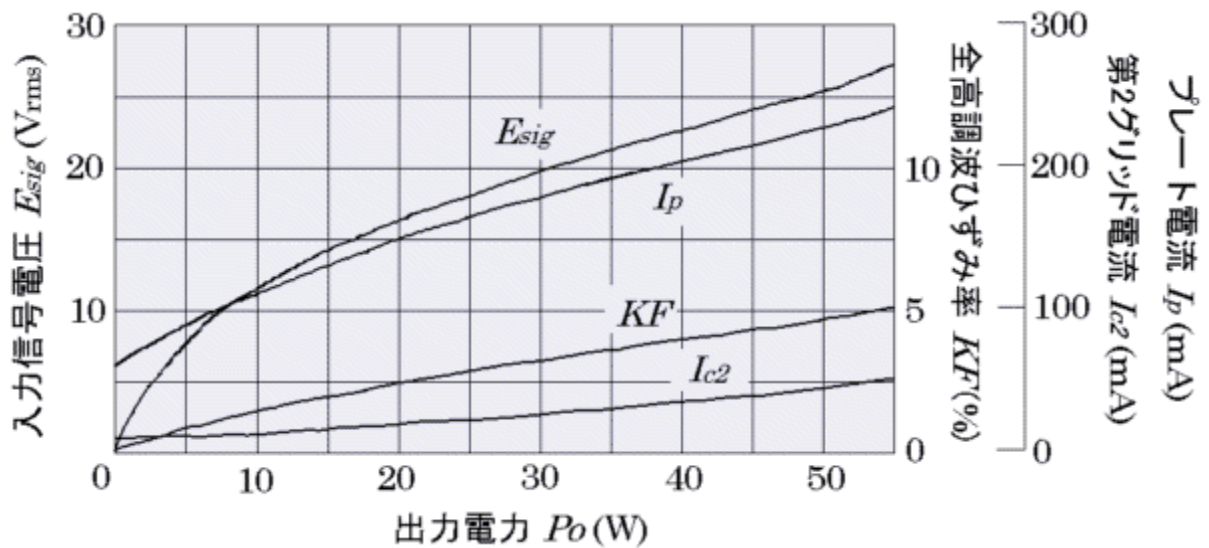
But caring is now an operational single-stage differential circuit and the driver can push you, you can be of direct benefit.

EL34 is above all what B is demonstrated by using specialty grade push-pull operation.

Unit amplifier circuits

Circuit this unit now through the process shown in Figure 6 above.

[Figure 6] circuits of this unit [\(PDF\)](#)



Unreasonably small grid resistance and the second power-ups common aim, life is shortened to the red-hot ball during the second high-power grid, it eventually comes out power, 1k Ω is a safety precaution.

The second grid resistance is common, V 6, V seems to be effective in arranging Pusshupurubaransu 7, when the second grid grounded AC condenser will increase in strain rate.

If you do not connect the grounding grid and the second at all, but micro wave oscillation was seen near the maximum output Osshiro.

Cause the grid to grid from the first second thought the idea of repatriation is done through a high Q capacitor electrode, the second grid was grounded capacitors of small capacity, was able to eliminate the oscillation waveform or.

Ringling out in the output waveform for square wave input to put a high cut, there will not be input to the amplifier's frequency response above the limit.

The first stage differential current source circuit for V 3 6AU6 as with all tube signal system built.

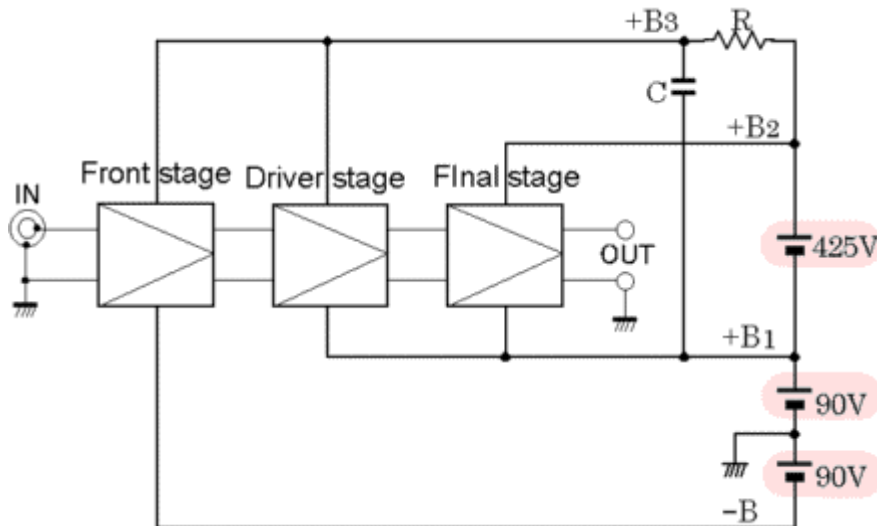
Power supply circuit unit

Tango MS-450D used a power transformer.

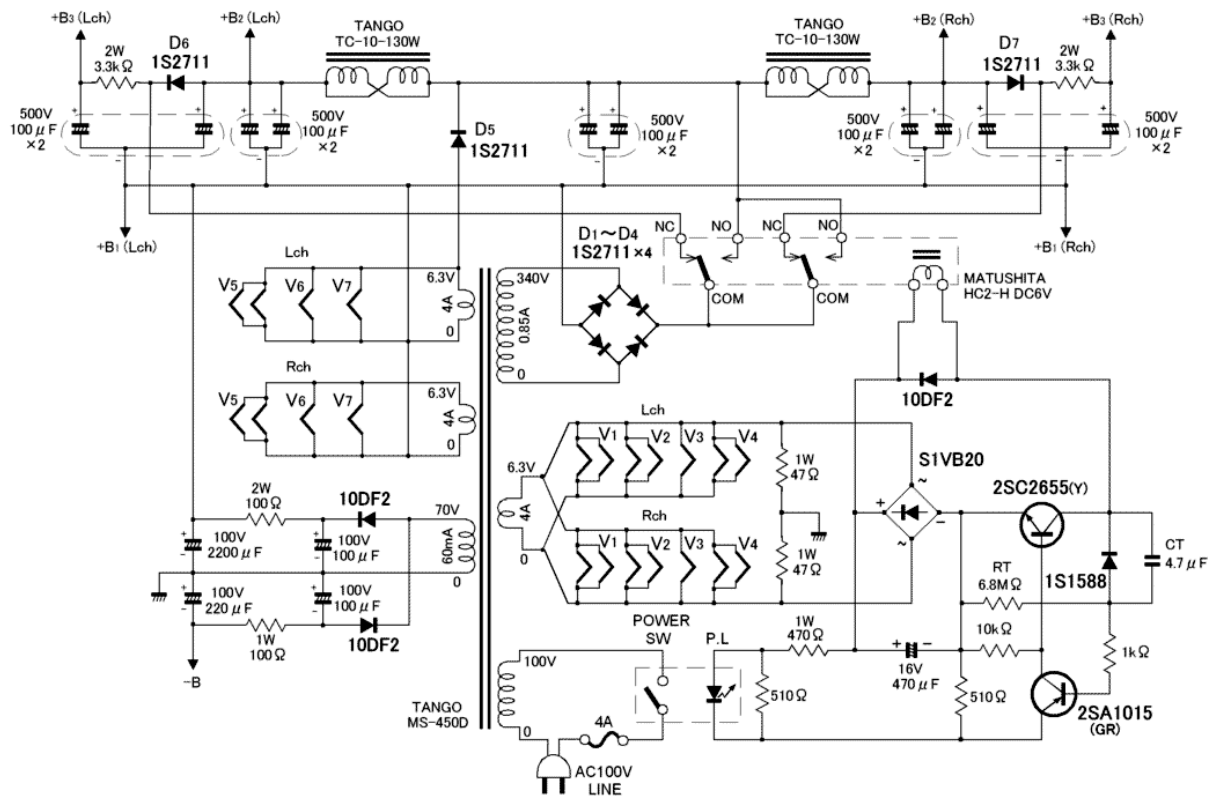
Supply relative to ground potential, ground floor, making two three-layer structure of the ground floor.

The basic structure in Figure 8 shows the actual circuit in Figure 9.

[Figure 8] Power Configuration ([PDF](#))



[9] power supply circuit ([PDF](#))



B1-B is a hit, V and 3 V at constant current circuit of the cathode of the four negative supply, is relatively insensitive to voltage fluctuations.

1 + B 1 ground floor, so the results into three loops over the potential supply and ground support to lift the second floor, there is noise.

In addition to dividing + B 1, V 4, V 6, V 7 bias voltage is used.

So + B 1, and the bias voltage dividing resistor, -B, only the current flows through.

1-B and + B is a AC70V, +90 V and -90V power supply for each rectified with.

1 + B smooth, especially for large capacitor 2200 μ F, have been completely removed ripple minutes.

2 + B 2 is the floor of the power output stage to supply power to the main current of the output tube is rapidly changing because only passes through this level, the higher this power choke coil L, R is divided into two lines to enhanced the separation channel.

+ B 3 is the first stage and driver stage power supply, + B has been obtained through a decoupling from the two.

Heating circuit, the two of winding a heater with three of the power transformer, L, R for each EL34 and V 5 12BH7A used in considering the voltage cathode + B seat heater voltage of a Mashita.

The one remaining winding a heater, timer relay circuit feeding the ball to the other later and reduced the midpoint to ground ham split resistance.

So as not to hurt over the current power output tube, place the standby time of about 30 seconds timer relay, + B for the two to launch.

Coupling capacitors charge up the middle of the output tube, especially for the positive swing towards the first output tube grid voltage, a circuit with a twist coupling capacitor is fully charged to stand during the period have been.

NC relay contacts so that Naka Hari side stand, + B is charged with three coupling capacitor voltage is hanging.

At this time, + B 3 + B to the voltage applied to the two diodes D 6, D 7 is prevented.

In addition, the current begins to flow in the V plate for 4, + B to prevent reverse polarity electrolytic capacitor charging voltage is lowered to 2, D to rectify the power output tube heater 2 5 + B You add a low voltage.

Timer relay circuit was made with the transistor to operate at supply voltages and heating. Standby time before turning on the power relay is T, C T, R T can be adjusted from time constant of approximately $T_{(sec)} = C T (\mu F) \cdot R T (M\Omega)$ and.

LED pilot lamp incorporated into this circuit, to raise the luminance for switching to the operation in the standby mode.

Parts

Tango XE-60-3.5 output transformer was used.

Also according to the power transformer, which is slightly more expensive product in order, the last number of H used the same color stick Taibu.

Tubes can be easily obtained from any popular breed, there is room for a selection of good things.

The ball looked 12AU7 in less mechanical hum and vibration resistance external guidance, at present reliable 6189W 12AU7 tube is used.

Assembly uses EL34 pairs.

— power meter Philips chose to trust and good shape.

GE 12BH7A is familiar brand.

Power rating of the resistor that I be more than twice the power, load resistance plate differential circuit so overheated and become unbalanced extreme current plates and lack coordination, twice even if you assume the worst The rated power should become more susceptible to induced shape is large, it is painful component placement.

No other appreciable parts used. Parts list [in Table 1](#) shows.

	Name	Quantity	Where to buy
Tube	PHILIPS EL34 Pair	2	Ken Audio
	SYLVANIA 6189W	4	
	GE 12BH7A	4	Ken Audio
	RCA 6AU6	2	
Diode	1S2711 Toshiba	7	Otekku
	Nihon Inter Electronics 10DF2	3	Otekku
	1S1588 Toshiaba	1	E Commerce Department
	Shindengen S1VB20	1	Alpine Radio Parts
Transistor	Toshiba 2SC2655 Y	1	Otekku
	SA1015 GR Toshiba	1	Otekku
Power transformer	Tango MS-450D H	1	Ken Audio
Output transformer	Tango XE-60-3.5	2	Ken Audio
Choke coil	Tango TC-10-130W	2	Ken Audio
Relay	Matsushita HC2-H - DC6V	1	Alpine Radio Parts
LED (red) with switch	Miyama DS-850	1	Alpine Radio Parts
Hughes	4A	1	Alpine Radio Parts
Fuse holder	Sato Parts	1	Alpine Radio Parts
Vacuum tube socket	Mold US CINCH	4	
	Mold MT9P CINCH	8	
	Mold MT7P CINCH	2	
RCA jack		2	Sound Parts
Output Terminal		4	Sound Parts
Lug plate	1L6P	2	Alpine Radio Parts
	1L2P	3	Alpine Radio Parts
Board	ICB-96G Sunhayato	1	Alpine Radio Parts

Wire rod	LCOFC # 20	As needed	Sanei radio
	LCOFC # 18	As needed	anei radio
	PCOCC # 28 shield	As needed	Sanei radio
AC cord	2m with plug 15A 125V	1	Alpine Radio Parts
Bush Code	SATO Parts BU-2	1	Alpine Radio Parts
Screw plate	ISO 3 × 10	38	Yuu Rin home improvement
Chassis	Lily of the valley temple SL-400	1	Ken Audio
Chassis leg	With adapter	4	Sanei radio

	Name	Quantity	Where to buy	
Condenser	ELNA 500V 100 μ F × 2	5	Wakamatsu trade	
	ELNA 100V 2200 μ F	1	Wakamatsu trade	
	ELNA 100V 220 μ F	1	Wakamatsu trade	
	ELNA 100V 100 μ F	2	Wakamatsu trade	
	ELNA 100V 47 μ F	2	Wakamatsu trade	
	ELNA 50V 100 μ F	2	Wakamatsu trade	
	Rubicon 16V 1000 μ F	1	Alpine Radio Parts	
	ERO MKP1845 630V 0.22 μ F	4	Wakamatsu trade	
	NTK Deppumaika 500V 1000pF	2	Wakamatsu trade	
	NTK Deppumaika 500V 20pF	2	Wakamatsu trade	
	Siemens MKH 100V 4.7 μ F	1	Alpine Radio Parts	
Metal Oxide Film resistor	5W 1k Ω	2	Alpine Radio Parts	
	3W 10k Ω	2	Alpine Radio Parts	
	2W 15k Ω	4	Alpine Radio Parts	
	2W 3.3k Ω	2	Alpine Radio Parts	
	2W 100 Ω	1	Alpine Radio Parts	
	2W 1 Ω	4	Alpine Radio Parts	
	1W 220k Ω	4	Alpine Radio Parts	
	1W 47k Ω	4	Alpine Radio Parts	
	1W 10k Ω	2	Alpine Radio Parts	
	1W 4.7k Ω	2	Alpine Radio Parts	
	1W 470 Ω	1	Alpine Radio Parts	
	1W 100 Ω	1	Alpine Radio Parts	
	1W 47 Ω	2	Alpine Radio Parts	
	Carbon film resistor	1/4W 6.8M Ω	1	Alpine Radio Parts
		1/4W 470k Ω	6	Alpine Radio Parts
1/4W 36k Ω		6	Alpine Radio Parts	
1/4W 27k Ω		27	Alpine Radio Parts	
1/4W 10k Ω		3	Alpine Radio Parts	
1/4W 1k Ω		1	Alpine Radio Parts	
1/4W 510 Ω		2	Alpine Radio Parts	
Trimmer resistor	RJC 06PK 1k Ω	2	Alpine Radio Parts	
	RJC 06PK 5k Ω	8	Alpine Radio Parts	

Processing of the chassis

This unit is over 3 V in order to reach results in the form of a, V I tried to design new and unique tone and character patterns.

Why transformer arranged in 45 ° full width of the chassis to tilt, because the heat shield between the tube and block capacitor.

And placing a central power transformer, output transformer and choke coil placed to spread its wings from side to side, the source Burotsukukondensa[√]Temashita the pace of the device was behind the five triangles.

The output tubes are placed in well-ventilated place across, according to the flow and other spheres of wiring and to avoid any interference between one thousand, right angle parallel to come in tired to watch more figurative terms away, and placed a gentle curve to the line connecting the centers of the visual sphere, respectively.

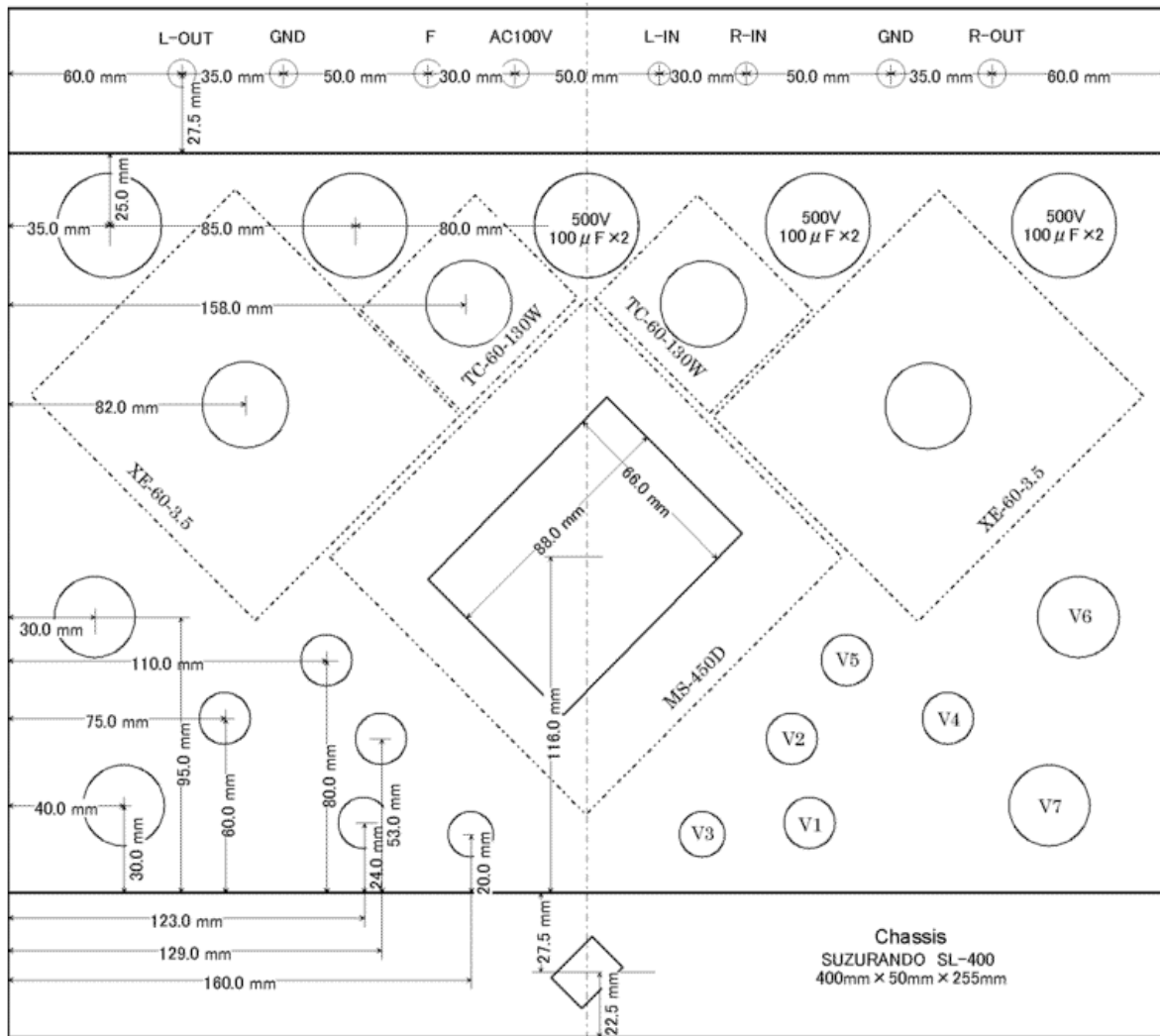
45 along the entire image of the power switch is also mounted around Kemashita.

She used to dish design Sha, lily of the valley temple SL-400 is not attached to the bottom plate, the rigidity lost weight during the lift, resulting in a diagonal direction of twist.

The rubber feet are they recessed mounting location for the apparent lack of stability, with the approach outside the mounting position, the radio switched to champagne gold Sanei leg.

Shows the alignment of chassis components in Figure 10.

[Figure 10] alignment of chassis components ([PDF](#))



During processing, so scratch painting chassis superfluous, cover the entire machine Sukungushito, paste the location plotted on graph paper punch, hit a center punch the hole location, it to rely on a hole.

If fine sandpaper after the first (or # 1000), painted surface lightly with vandalism, power—Supureratsu closest to the color of the original painting (such as Nippeaibori) 2 - Kuni Usuki by blowing across the three holes concealed metal part of the opening.

To further soothe the texture with a blow to the whole of matte — Kuriyaratsu power.

You can paint the screw heads to come to the top of the chassis.

Flat surface to preserve a sense of the chassis, I used the plate screws, the screw holes and tapered seat glove for later 利Kanai hole position fixes, requiring precise machining.

After all, even put the obsession that the technical layman, and ended up a mismatch slightly to do, and through the screw to expand by filing a hole in the bracket of the socket tube, from the appearance back to Remai teach Amateur built has become a unique technique used.

Wiring

When working inside out, paste on both sides of the test loop the rubber sheet to protect the head of the transformer.

Also, when you flip over, 20kg weight and chassis to prevent damage to the transformer, so the corner is near, do want to rely on carefully thick rubber sheet.

Ballack set stages, ball placement, orientation of the socket, but I decided to use the lug plate, turning Arekore tinkering later, the chassis is slightly messy Narimashi to add a relay due to the power circuit and or.

Vertical condenser and low power, the relay drive circuit board is put.

90V high-voltage Burotsukukondensa case because the voltage difference between the chassis, to avoid damaging the insulating sleeve, and - be careful not to inadvertently mistaken for ground terminal.

Wire tube heaters and a large output current, and cathode of the output tube is required to use low-impedance wires AWG18, AWG20 used the others.

To make a loop as web wired, I pull the ham to pick up the magnetic field lines out of the power transformer, one root so that it's tree (ground power), the stem (L, R of the two) out, The radial wires to the branch from the trunk.

Tube connecting the shield wire and pin jack first stage is to pass close to the power transformer, so pick up a ham L, R東Nemashita spiral tube.

To the chassis ground is one of the places Pinjiyakku.

Coupling capacitor to avoid interference with the surroundings, are attached to the chassis in the groove.

After wiring, properly and get rid of scrap wire and solder to the cut but will remain in the chassis, which is use something like a rice cake wrapped around a double-sided tape stick the tip of the bird and the gap or block Kkukondensa sleeve, the push would be useful without a scrap of windings in power transformer.

How to adjust

When the unit is also about the complexity, just turn it into a reckless gamble.

Much smaller extent by sight at a glance, the problems that may occur, is expected to go 常道 to check on the work of thorough measures.

If the unit can adjust the output stage alone, DC alone distortion would be a minimum balance, can also be done in one tester.

As a tentative step, in turn 差Sanai ball first, and check the operation of each power relay, semi-fixed resistors for adjusting the bias voltage $V_{R2} \sim V_{R5}$ turning off the voltage bias toward a deeper $R_i, R_1 V$ constant current circuit to leave the minimum.

Ch next piece of output for each tube to insert the V_{R4}, V_{R5} Sword of the voltage across the 1Ω resistor in the power of the output tube 35mV (Force Sword current 35mA) to adjust.

Ch also pointing to the next piece of the ball the whole page for each V_{R1} and $V_5 190V$ and cathode voltage, V_{R2}, V_{R3} in the plate voltage equal to V in both Yunitsuto 5.

This V_{R2}, V_{R3} adjustment is made only one $V_R, R V$ should be left to the other position by turning off the original.

If you can not adjust the imbalance is large and $V-1$ exchange.

Even after an adjustment of the street, watching more than one hour, make sure that you are stable.

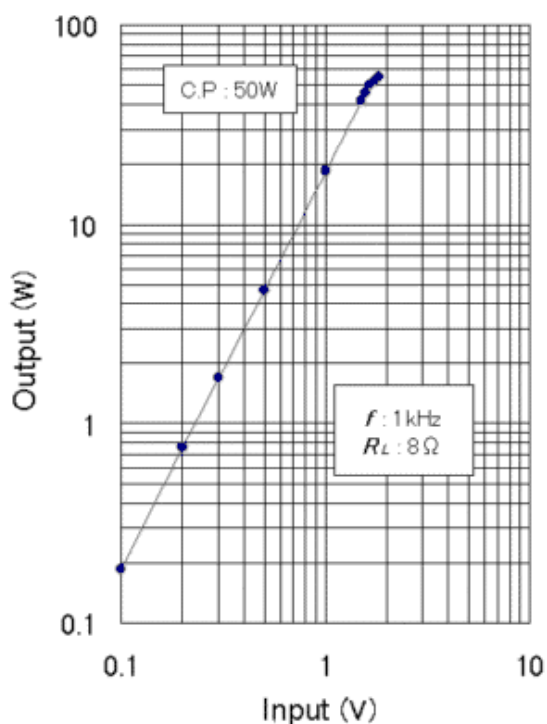
Characteristics and quality

As I mentioned above sound characteristics do not know whether the circuit is not working properly until you see the property safe.

Data is essential to take on the characteristics of self-analysis of manufacturing technology, can not understand what the truth is what must be the producer himself.

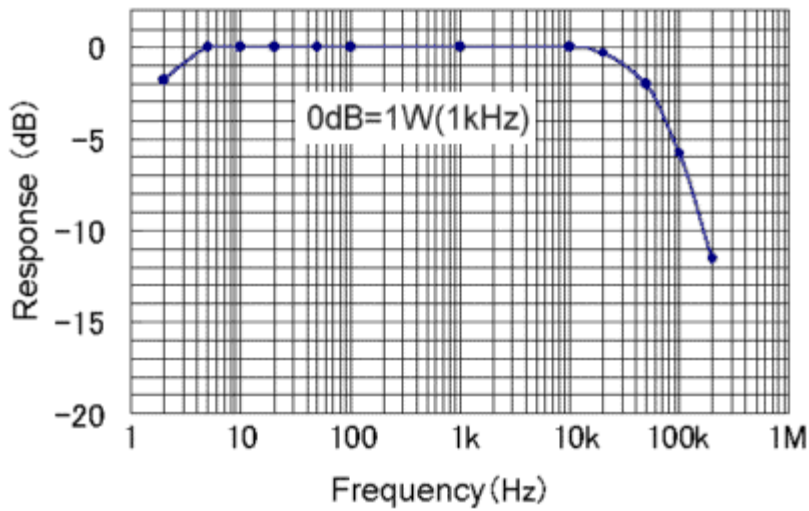
Figure 11 shows the input and output characteristics.

[11] output characteristics ([PDF](#))



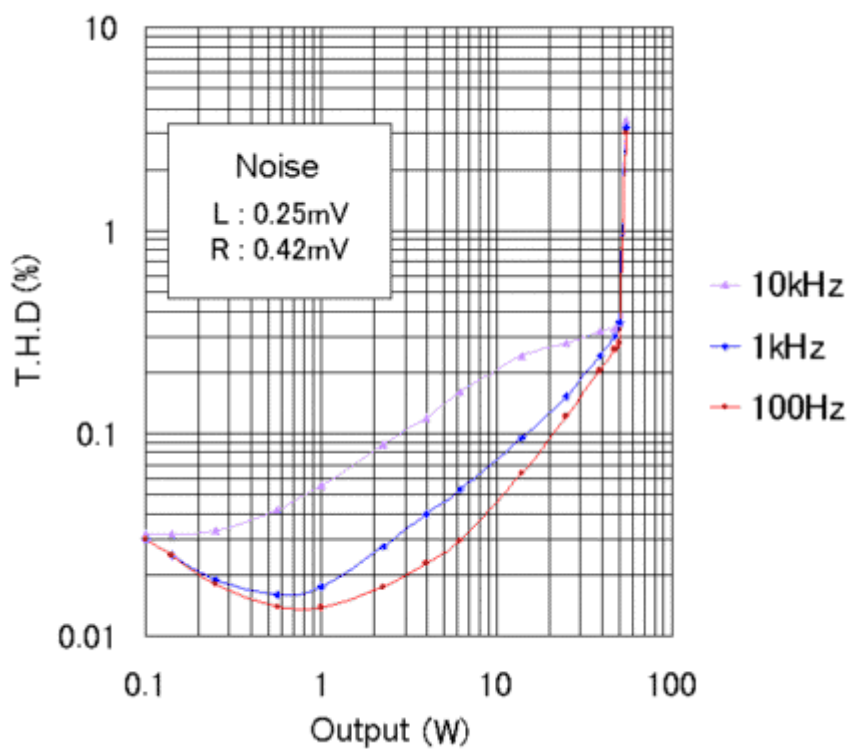
Input sensitivity at 1.7V 概略clipping point etc.
The input of the output was 50W butterfly.

Figure 12 shows the frequency response.



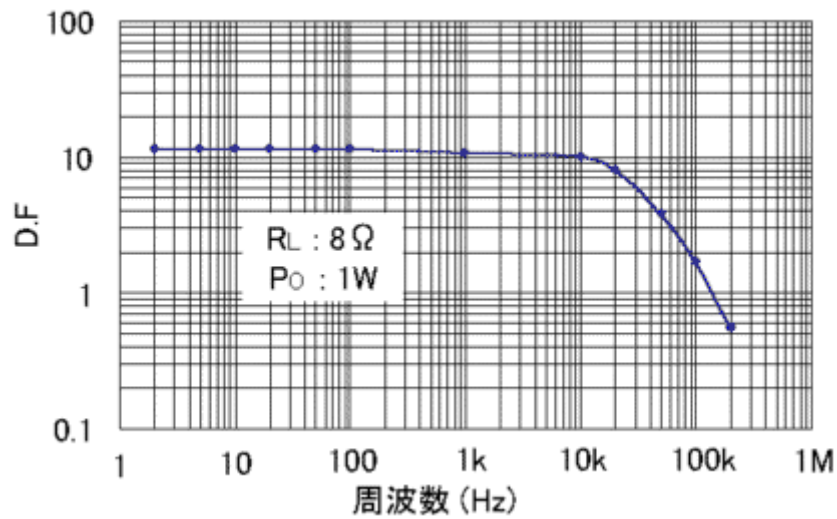
Despite the ambitious design characteristics of the high frequencies were not surprisingly decent. Low frequency limit for the property taken to 2Hz.

The distortion characteristics of noise in Figure 13.



Lch data is less residual noise. The residual noise is 0.25mV in Lch, Rch is not 0.42mV. Hum noise is the main component of the heater, DC and can be ignited 0.1mV below the present level is sufficient for practical use. Increased with increasing strain rate and frequency outputs will include many high-order harmonics distortion waveform is a complex shape changes.

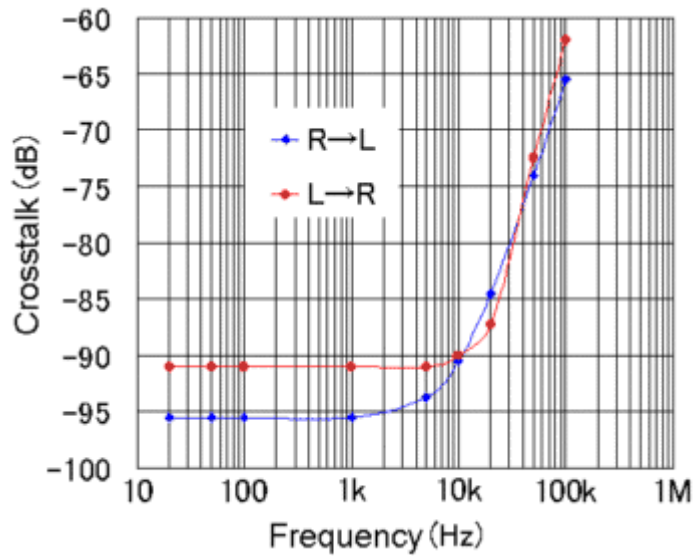
Figure 14 shows the characteristics of damping factor.



1kHz to lower frequency prior to the above, the open-loop characteristics can be inferred from this curve.

3 results for super-triode amplifier feedback element NFB itself, reflects a habit of driving all the characteristics of low impedance output transformer.

Figure 15 shows the crosstalk characteristics.

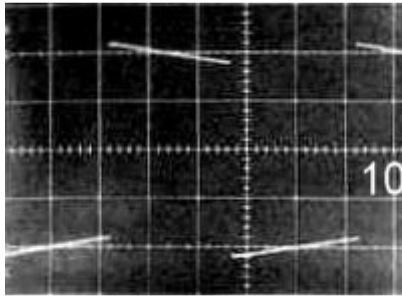


Residual noise level below the low-frequency power output stage L, R and he has a separate effect.

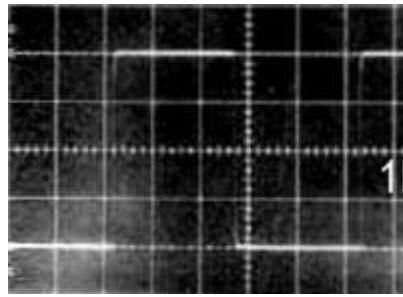
Effect of 3-layer common impedance of the power supply is unlikely.

Photo 5 shows the waveforms of the square wave output - 7. 8Ω load resistance, output voltage swing for the observed 4Vp-p.

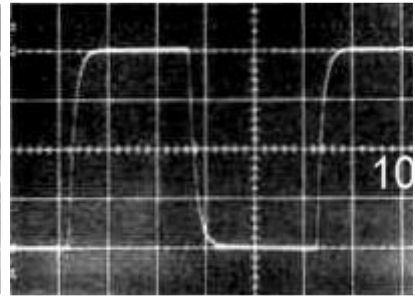
[5 Photos] 100Hz



[6 Photos] 1kHz

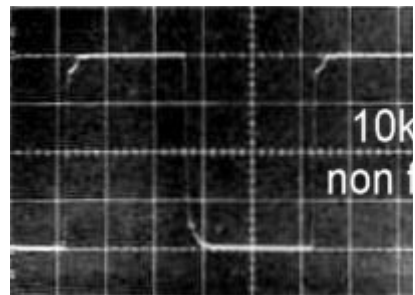


[7 Photos] 10kHz



[8 Photos] 10kHz input without filter

7 is a photograph of the input waveform when there is a high cut.
 High cut pictures are put eight input waveform, the rise is seen sluggish.



The sound quality is not felt the weight of three results were very low in the past, yet has not lost strength, the carefree relaxed, not tired of listening to sounds.
 Characteristics that stretched well down low, and far better bass sound, and for this further and 弓|Ki立Tta EL34 seems sound.

The result has been three EL34 ultra-sound only one side of the current gain.
 How good play sound in EL34, the ideal is to achieve a high level of performance even if the image EL34 amp, this unit and I think it was pretty approach.