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Data Sheet

12B, 20A, 20B, 20B-V4, 30A

Last Update: 02/18/2026 11:45:33

Description

This is a series of tubes with medium gain, with very good voltage capabilities, and very low distortion even at high signal.

Applications

		ANODE TYPE	Driver tube	Line Out	Speaker Output	OTA	Head Phone	Sakuma
	12B	Black Powdered	Yes	Yes	Yes	.	Yes	Ideal.
	20A	Mesh	Yes	Yes	.	.	.	
	20B	Black Powdered	Yes	Yes	Yes	Yes	Yes.	
	20B-V4	Black Powdered	Yes	Yes	Yes	Yes	Yes	
	30A	White Powdered	Yes	Yes				

Guarantee program for first owner.

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receipt, at the Emission Labs web site, to participate in the 5 years guarantee program.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gold Plated Grid. [\(See Notes\)](#)
- **NEW** Soft rubber suspended tube base
- Hard metal Construction [\(See Notes\)](#)
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a high quality dual box
- Tube printing with 24k gold, and red color burned into the glass
- Gold Plated, black ceramic socket

12B

This tube has gain of appr. 12x, and medium-low impedance. It can be used in almost any application, including speaker output at almost 5 Watt. Also, beautifully 12B can be used as a [SAKUMA](#) amplifier, using a 12B to drive a 12B speaker tube. This tube has sound resemblance to the vintage PX25, due to curve similarity.

20A

This is a mesh tube, with gain of appr. 20x, and medium impedance. It has a very pleasant triode sound, due to nearly total absence of odd harmonics. It's application is a driver tube for medium signal.

20B

This is a solid plate version of the 20A. It works well in all 20A circuits, but can also be biased higher as 20A. At medium voltage it is a wonderful driver tube. For lower signal it may be used at low anode voltage, like 250V. At higher anode voltage, up to 580V, 20B becomes capable of delivering very high output signal, as required for instance to drive the 845 or GM70 tube. Also at higher voltage it can deliver a few Watts output power. It can be used as driver tube or low power output tube.

20B-V4

V4 means only the heater wire has a center tap. This gives a fifth connection, so this tube needs an octal base. It is compatible to the classical 20B, but offers the advantage of the center tap on the filament. The center tap, provides a real cathode connection, for a simpler circuit, yet with better performance.

[Application Note AN-6](#) explains the meaning of the V4 Version.

30A

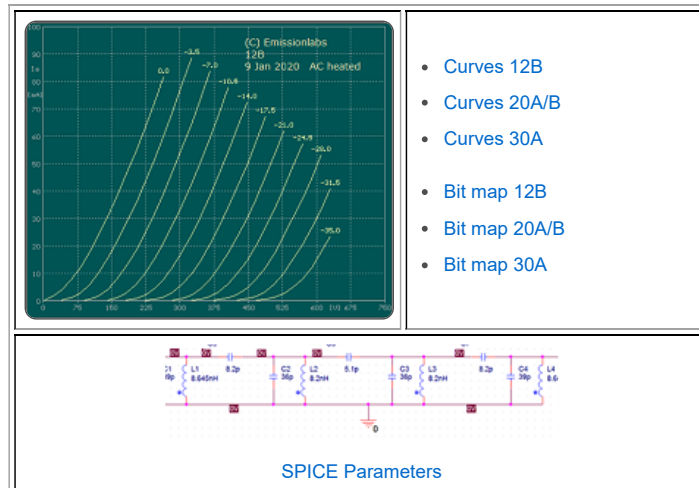
The 30A has an unloaded gain of appr. 30x. It is intended to combine the driver and pre-amplifier tube in one. This tube has exceptional low distortion, below 0,1% 2nd harmonics, and 0.01% 3rd harmonics, at FULL signal output of 60Volt RMS. [Here is a print of the simulation program, to show this](#). This program used [these 30A tube curves](#), measured with the Sofia curve tracer. At lower signal, distortion drops even further.

Filament Ratings		
	Standard tube 12B, 20A, 20B, 30A 4Pin Socket (UX4)	Cathode Tapped 20B-V4 8Pin Socket (Octal)
DC voltage recommended	= 5Volt	= 2.5 - 0 - 2.5Volt
Electronic heater modules:	Only voltage source	Only voltage source
Tolerance on filament voltage	5%	5%
Filament Current	~ 1,4Amp	~ 1,4Amp

Maximum Conditions (See Notes)	EML 12B	EML 20A	EML 20B	EML 30A
Anode Voltage	500V	490V	580V	500V
Anode Current	60mA	40mA	60mA	40mA
Continuous Anode Dissipation	25Watt	11Watt	25Watt	11Watt
Grid resistor	below 470k	below 470k	below 470k	below 470k

Factory Test Data	EML 12B	EML 20A	EML 20B	EML 30A
Anode Voltage	390V	400V	420V	400V
Anode Current	40mA	25mA	42mA	25mA
Anode Impedance (Rp)	2k9	3k7	3k	6k2
Amplification Factor	13.5	21	21	32
Transconductance	5.6 mA/V	4,2mA/V	6,9mA/V	5,2mA/V
Control Grid Voltage <i>Tested with DC heating</i>	-16V	-7.4V	-5,6V	

Control Grid Voltage <i>Tested with AC heating.</i>		-9,9V	-8,1V	
- Control Grid Voltage. <i>Actual voltage depends on individual tubes.</i> Factory test data is taken with DC heating. - Gain is unloaded gain, as will occur choke or inter stage loaded. If resistor loaded, gain will be lower.				



12B Some operating points.

This is AC heated. If DC heated, Grid voltage shifts 2.5 Volt. (See Notes)

Anode Voltage	Grid Voltage See Notes	Input	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
430V See Chart	-20.9V	4.1V RMS	831R	25mA	14.6	3k1	Choke or inter stage	LL1668-25mA	60V RMS	0,03%	Driver Stage
430V See Chart	-15V	10,7V RMS	257R	58mA	10	2k3	5k	LL1663-60mA	2,2Watt	1.4%	Output Stage
430V See Chart	-15V	10,7V RMS	257R	58mA	10.8	2k3	6k5	LL9202-50mA	2Watt	0.9%	Output Stage
500V See Chart	-21.1V	14,9V RMS	422R	50mA	10	2k4	5k	LL1663-50mA	4,1Watt	3,3%	Output Stage
500V See Chart	-21.1V	14,9V RMS	420R	50mA	10.5	2k4	6k5	LL9202-50mA	3.8Watt	2.1%	Output Stage

As a driver stage, most power tubes like 300B, need appr 60V RMS on the grid. Using 12B as a driver, only 4.1V is needed. This can be achieved with a 4x step up transformer, which gives this gain free of noise and microphonics, and supplies even a balanced input.

20A Some operating points

Anode Voltage	Grid Voltage See Notes	Input RMS	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
350V See Chart	-12.6V	3.14V	1263	10mA	20.8	5k4	Choke loaded	LL1668-10mA	60V RMS	0,17%	Driver Stage

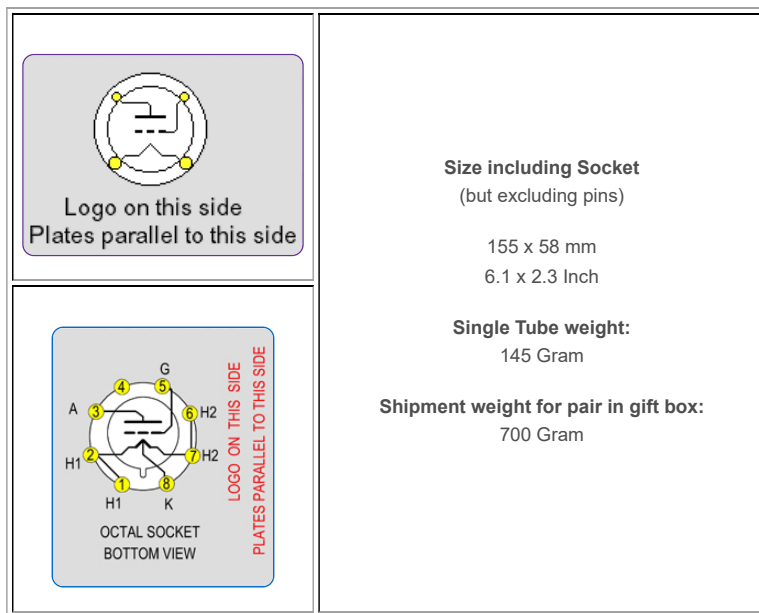
For full output signal, most power tubes like 300B, need appr 60V RMS on the grid. This is 170 Volt peak to peak, and it needs good consideration how to generate such high signal free of noise and distortion. Using 20A as a driver, only 3.14V is needed. This can be achieved with a 3x step up transformer, which gives this gain free of noise and microphonics, and supplies even a balanced input and no further drive tube is needed.

20B Some operating points

Anode Voltage	Grid Voltage See Notes	Input RMS	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
521V See Chart	-12,2V	8.5V	254R	48mA	16.4	2k9	11k	LL9202-50mA	1,8Watt	1%	Output Stage
580V See Chart	-15.7V	11.1V	368R	43mA	13.4	3k	6k5	LL9202-50mA	3,59Watt	3.7%	Output Stage
								LL2935B			Output Stage

30A Some operating points

Anode Voltage	Control Grid Voltage See Notes	Anode Current (mA)	Trans-Conduc-tance (mA)	Tube Ri (Ohm)	Gain (mu)
300	-3	10	4.6	8k	36
300	-2	15	5.3	6k6	35
300	-1	20	5.5	5k9	33
360	-5	10	4.4	8k	36
360	-3.8	15	5.1	6k9	35
360	-2.8	20	5.7	6k	34
360	-2	25	6.2	5k6	34
360	-1.1	30	6.6	5k1	34
420	-6,7	10	4.3	8k5	36
420	-5.6	15	5.0	7k	35
420	-4.6	20	5.5	6k	33
480	-8.6	10	4.1	9k3	38
480	-7.5	15	4.9	7k2	35
480	-6.5	20	5.5	6k3	35



Notes

- Hard-metals can be used in electron tubes, though these are more difficult to use, and more costly than classic nickel. This ensures reproducible tube parameters, and long term stability.
- Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)
- Plate Characteristics are made with the Sofia Digital Curve tracer.
- We are recommending the same values as Western Electric in their 1950 Data sheet.
- Some of our competitors claims to be the only one with a Center Tapped filament, but at EML we build since many years all tubes Cathode Tapped, not just this tube.
- Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
- Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves

Use as Pre Amplifier

Application info #1

For use in a separate pre amplifier, a DHT must be used with low noise in mind. Typically the wrong way for this would be to build a pre amplifier with more gain as needed, and then attenuate the **input** signal by the input volume knob accordingly.

Though people LOVE to do this, it is wrong! Such amplifiers will function dissatisfactory because of low signal to noise ratio, and also will sound sterile.

A good pre amplifier, will use an attenuating output transformer, reducing the gain of the complete product, to a number, not higher than needed. Which is 1x for a pre amplifier, or in rare cases 2x. . This will lower the output impedance of the pre amplifier with the square of the transformer attenuation which is the

essential real reason for doing so. Now, with the lower output impedance, a 600 Ohms potentiometer can be used directly at the output. Doing it like this, will drastically reduce noise as well as microphonics. Yet maintain triode sound. In this configuration, the plate signal of the output tube itself, will be 10...40 Volts, also at very low output volume setting. This prevents sterile sound. Overall Signal to Noise ratio stays very high, and microphonics are low. With such a pre amplifier, even a twisted wire pair can be used at the output, to replace shielded cable, and at very low signal the pre amplifier will be 'dead' silent, or in engineering words, have a very high Signal to Noise ratio.

20B use as OTA

Application info #2

OTA stands for One Tube Amplifier. So yes, this means a complete HiFi amplifier with only one tube. This is a concept where no pre amplifier tube and no driver tube is used. The output tube is typically 20B-V4 in such a case, and it provides almost enough gain by itself. The missing gain of appr 2...4x can be achieved by a passive gain stage, in the form of a small step input transformer from Lundahl. (We supply PCB for this, with programmable gain of 1..4x, using LL1544A). Such a passive stage costs less than a good tube stage, and provides gain at zero hum and zero noise. We much recommend this concept if only a few Watt output power is needed. Sound of the 20B-V4, as speaker driver will be 'sweet' and not dominant. Moreover, tube sound develops with the 20B also at low volume. Due to exact geometry of the anode box, there will be no audible third harmonics. So any influence will be only by second harmonics, thus achieving in a very good way, what is called triode sound.

Search the internet for this phrase: "OTA 20B One Tube Amplifier", or also click on "Professional Users" on the jacmusic website, and search that page for the phrase "20B"

12B Notes

Application info #3

For driving a 300B, it needs appr. 60V AC signal. Quite a lot, but 12B can do this nicely, and a lot higher voltage too.

It is recommended to check at the external website, jacmusic.com, for the EE-08 and EE-20 board, at the Lundahl Section. These transformer boards will supply the needed gain.

In addition, 12B seems IDEAL to build a SAKUMA amplifier. This very clever concept works almost free of distortion, as long as driver stage and output stage are identical. Enter **SAKUMA** in the search box of the jacmusic.com website. (external website)

About Noise and Distortion

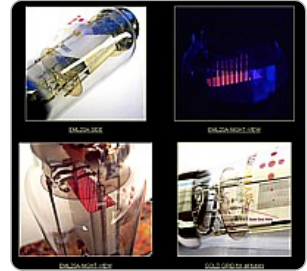
12B, 20A, 20B, 30A tubes are based on a very old principle, where high gain tubes have much wider Anode distance. This is still the ultimate way to make a very linear DHT high gain tube. Miniaturization has always been the enemy of tube linearity, specially with DHT. For this reason, the 20A/20B/30A will outdo any small size tube. We encourage you to check the tube curves of any miniature tube, like 6SN7, ECC88 or ECC82, and you will see this series presented here is much superior. However this results of larger dimension tubes is a higher working voltage. For this reason, tubes like this were not made any more after 1935, when miniaturization of tubes started to become more important. With the new production tubes we make today, miniaturization is no requirement. So for high gain tubes, we can now focus on lowest possible distortion. We build these tubes again the original way, with wide Anodes. [Check Anode picture here.](#)

These tubes belong to the lowest distortion tubes ever build. Total distortion for small signal has been measured below 0,08% at 10 Volt Eff output signal, 400V Anode. The distortion will almost not increase at higher signal. ([See Note5](#)) . Interestingly, when one DHT triode is driving another, a part of the distortion of the second tube will be eliminated by the first tube. This even harmonics cancellation appears only with triodes, and they must be similar tubes, like drive a 300B with one of the tubes of this series. Since Triodes produce very low uneven harmonics, canceling the overall distortion this way, is an amazing application of the 20B or 30B tube. ([See note 4](#))

For lowest possible mechanical noise with (any) high gain DHT pre-amp tube, use high quality tube sockets that do not pass the chassis vibrations to the tube. Chassis vibrations can come directly from

the mains transformer, or by air from the loudspeaker. The best sockets for this are probably the Yamamoto Teflon, because Teflon is a flexible material. Use tight fitting Teflon tube dampers such as the Duende Criteria. They make the best damper for the EML tubes. They can be fit very nicely on the tube top, or one on the top and one on the bottom.

Note about Blue Glow Appearance.



These tubes will often produce a blue glow on the glass. This is because of the wider Anode distance, some electrons escape after collision. The fluorescent light pattern changes with the voltage or with the signal. These light effects are normal for this type of tube. It must not be confused with gassy tubes, which produce a purple-blue cloud inside the Anodes. [D](#)



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EML1605, EML1605-V4 Data Sheet

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Description



This powerful triode is designed for amplifiers without compromise. This tube is not directly in the family of 300B tubes, but rather related to the famous PX25.

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Guarantee program for first owner.

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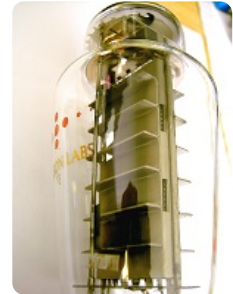
Description

The EML1605 is not directly in the family of 300B tubes, but more related to the famous Marconi PX25. The EML1605 is a medium gain tube, characterized by the more silky sound of PX25.

The 1605 is made for somewhat higher voltage, and it has almost twice the gain of a 300B tube. The PX25 is characterized by a more a silkier sound, if compared to 300B or 520B. The Marconi company had two tube for this, the PX25A which is the low gain tube, almost a 300B, and PX25 which was the medium gain tube.

The higher gain and higher impedance of the 1605 has practical reasons. In general, to get more power out of a tube, the anode dissipation has to be chosen higher. However, simply increase the anode current, is not possible, as this will reduce the grid voltage to a point where you can not apply the necessary grid signal any more. The 1605, for that reason, was designed for somewhat higher anode voltage. In this way, plate dissipation is increased while the anode current does not have to be increased. A huge advantage comes now, with the SE transformer, as it does not have to operate at excessive DC current. This (lower) DC current makes the transformer easier to build, and also the inductance of the transformer can rise. The higher impedance of the 1605 makes the higher inductance is needed anyway, so all things fall into place. In order to increase the power supply efficiency, the bias voltage of the 1605 is lower. So there will be less voltage dropped (wasted...) across the bias resistor. This lower bias voltage of course reduces the maximum signal we can apply, but since the 1605 has more gain, the total input can be lower. This makes the driver stage easier to build. So as you see, a few more things fall into place as well. All in all, the is a very nice working concept.

The high filament current of the 1605, stands for excellent emission, which on a glance can be recognized by the good linearity of the tube curves, and on the long term, tube life benefits from this very



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much also. Basically all properties and data, improves if a tube has higher filament power.

We have two versions for the heater.

~~Important~~ Normal heater (V3-Version), or Cathode Tapped heater (V4-Version).

With the Cathode Tapped tubes, we enter a new field of applications. This has not been done before with Audio tubes. When biasing a normal DHT tube, like 300B or any other, there is no cathode to connect something to. The cathode must be artificially constructed, by a resistor network, which is a small compromise. Reason is, inevitably, not just the tube's DC current, but also the complete AC signal current must pass through those resistors, which has some obvious disadvantages. Provided the heater wires are all serialized, we may tap this in the center, and voila: We have our cathode back again. Moreover this behaves like a real cathode. So the V4-tube has an Anode, a Grid, and a Cathode. The centering resistors are no longer needed. For the heater we have connections H1 and H2, and all we need, is a floating 5V connected to it. We took the opportunity, to connect H1 and H2 each with two contacts, to have lower contact resistance. So indeed, we end up with a real, 3-connection triode, and a 5V heater. Now the tube has five wire connections, and for this reason we can not use the 4 Pin UX4 base any more. We have chosen for the Octal base. It must be said, the V4 is a very special tube, which fulfills the needs of Circuit Design purists the best possible way. Depending on how you do it, you can enter new design fields. Or, it is still possible, if you change your mind, connect a V4-tube, the classic way, like any 300B or 520B-V3. In that case, disconnect the Cathode Tap, and connect the remaining 4 wires like any regular Directly Heated tube.

Here is an application note, for how to use the V4 (Cathode Tapped heater) Version.

Sound Character of the 1605 tube

When tubes are made larger and larger, such tubes often sound only good at high power. At low power, the sound becomes sterile, and the triode sound character gets lost. The 1605 is constructed to avoid this problem. It has wide, box-shaped Anodes, same as Marconi PX25, which tube is legendary for it's sweet, silky sound also at low power. This similarity gets also reflected by the tube curves of 1605, showing resemblance to PX25.

All together it can be said the sound of 1605 is in between 300B and PX25, though much higher power levels are possible.

Features

- > Double Mica tube top
- > Gold Grid (Note)
- > Soft rubber suspended tube base
- > Cathode tapped filament
- > Slow Start filaments, for best lifetime
- > 0.5 mm thick Anodes
- > 12 coolers (6 on each side of the Anode)
- > Hard metal Construction (Note)
- > Two side getters, one top getter
- > Hand blown Glass bulb
- > Anti-microphonic Anode- and grid suspension
- > These tubes are shipped in a high quality dual box
- > Tube printing with real gold (metal), red color is glass burned into the glass
- > YAMAMOTO tube sockets highly recommended.
- > Gold Plated pins, black ceramic socket, with white bottom.

EML 1605 Filament Ratings (See note 5)		
	Standard tube EML1605	Cathode Tapped EML1605-V4
Filament Voltage(AC or DC)	5.0V	5.0V with Balanced Heater. (2x 2.5V)
Electronic heater modules:	Only voltage source	Only voltage source
Tolerance on filament voltage	4%	4%
Filament Current	2,1Amp	2,1Amp

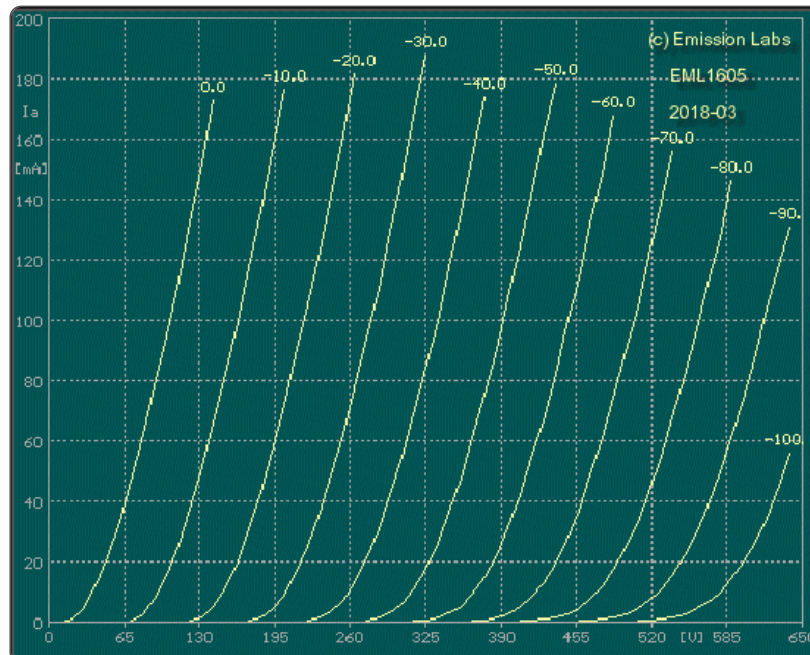
EML 1605 Maximum Conditions
See also Note4.
(Not possible simultaneously)

Anode Voltage	650Volt
Anode Current	160mA
Power Output in Class A	30Watt
Grid resistor	max. 50kOhm

Typical application
Recommended operating point
See also the notes.

With auto bias or fixed bias

Anode Voltage	580V
Anode Dissipation	64Watt
Anode Current	110mA
Control Grid Voltage	-82V
Anode Impedance (Rp)	861Ohms
Amplification Factor	7,5
Transconductance (Gm)	8.8 mA/V
Power Output in Class A	22Watt
Input Signal needed for full output Power	57Volt AC (RMS)
Load Impedance (Ra)	2700-5600 Ohm
Recommended Transformer(s)	Lundahl LL1623-120mA
Grid resistor to ground	Max. 100kOhm



EML 1605 tube curves



Recommended Lundahl transformers

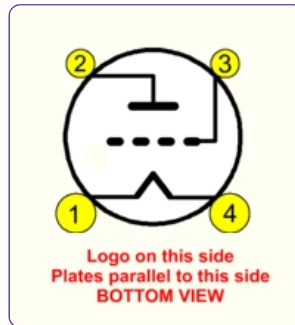
	Primary	Secondary	Auto Bias Cathode resistor	Anode Current	Anode Voltage to ground
LL1623-120mA 16Hz @1.5dB Order nr: 218-111-49	3000Ω	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω	800 Ohms	110mA	668V

EML1605 Mechanical Data

Size including Socket, but excluding pins: 200 x 68 mm
Weight of one tube: 190 Gram



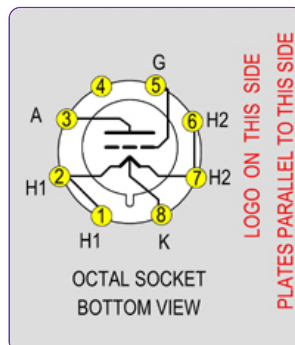
Ceramic UX4 Base



Ceramic UX4 Base



Ceramic Octal Base



Ceramic Octal Base

Notes

1. Hard-metal can be used in electron tubes, though this is more difficult to use, and more costly than classic nickel. It results in a more precise Anode distance, and does not damage in shipment. It ensures reproducible tube parameters, and long term stability. Wolfram grids allow the most precise grid wire distance, because wolfram is an extreme hard metal. Best grid geometry ensures uniformity and linearity of the tube curves.
2. Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)
3. Average Plate Characteristics: Made with the Sofia Digital Curve tracer.
4. We are recommending the same values as Western Electric in their 1950 Data sheet.

5. The Western Electric 1950 Data sheet. says 36 Watt maximum dissipation. Later data sheets say 40 Watt. Though 40 Watt is possible, this is a peak value only, and no normal working point. When you intent to get the 'maximum' out of a 300B, and operate this tube at the limits of safe operation, it is a better idea to use the 300B-XLS in such a case.
6. Some of our competitors claims to be the only one with a Center Tapped filament, but this is not true. At EML we build since many years all tubes Cathode Tapped, not just the 300B.
7. Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
8. Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves.
9. The curves for the 300B are plotted, with AC heating. This is in accordance with the historical WE data sheet.



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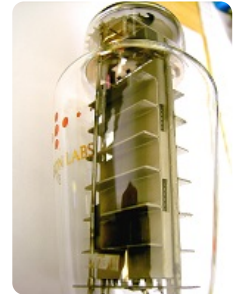
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We have two versions for the heater.

~~Important~~ Normal heater (V3-Version), or Cathode Tapped heater (V4-Version).

With the Cathode Tapped tubes, we enter a new field of applications. This has not been done before with Audio tubes. When biasing a normal DHT tube, like 300B or any other, there is no cathode to connect something to. The cathode must be artificially constructed, by a resistor network, which is a small compromise. Reason is, inevitably, not just the tube's DC current, but also the complete AC signal current must pass through those resistors, which has some obvious disadvantages. Provided the heater wires are all serialized, we may tap this in the center, and voila: We have our cathode back again. Moreover this behaves like a real cathode. So the V4-tube has an Anode, a Grid, and a Cathode. The centering resistors are no longer needed. For the heater we have connections H1 and H2, and all we need, is a floating 5V connected to it. We took the opportunity, to connect H1 and H2 each with two contacts, to have lower contact resistance. So indeed, we end up with a real, 3-connection triode, and a 5V heater. Now the tube has five wire connections, and for this reason we can not use the 4 Pin UX4 base any more. We have chosen for the Octal base. It must be said, the V4 is a very special tube, which fulfills the needs of Circuit Design purists the best possible way. Depending on how you do it, you can enter new design fields. Or, it is still possible, if you change your mind, connect a V4-tube, the classic way, like any 300B or 520B-V3. In that case, disconnect the Cathode Tap, and connect the remaining 4 wires like any regular Directly Heated tube.

Here is an application note, for how to use the V4 (Cathode Tapped heater) Version.

Sound Character of the 1605 tube

When tubes are made larger and larger, such tubes often sound only good at high power. At low power, the sound becomes sterile, and the triode sound character gets lost. The 1605 is constructed to avoid this problem. It has wide, box-shaped Anodes, same as Marconi PX25, which tube is legendary for it's sweet, silky sound also at low power. This similarity gets also reflected by the tube curves of 1605, showing resemblance to PX25.

All together it can be said the sound of 1605 is in between 300B and PX25, though much higher power levels are possible.

Features

- > Double Mica tube top
- > Gold Grid (Note)
- > Soft rubber suspended tube base
- > Cathode tapped filament
- > Slow Start filaments, for best lifetime
- > 0.5 mm thick Anodes
- > 12 coolers (6 on each side of the Anode)
- > Hard metal Construction (Note)
- > Two side getters, one top getter
- > Hand blown Glass bulb
- > Anti-microphonic Anode- and grid suspension
- > These tubes are shipped in a high quality dual box
- > Tube printing with real gold (metal), red color is glass burned into the glass
- > YAMAMOTO tube sockets highly recommended.
- > Gold Plated pins, black ceramic socket, with white bottom.

EML 1605 Filament Ratings (See note 5)		
	Standard tube EML1605	Cathode Tapped EML1605-V4
Filament Voltage(AC or DC)	5.0V	5.0V with Balanced Heater. (2x 2.5V)
Electronic heater modules:	Only voltage source	Only voltage source
Tolerance on filament voltage	4%	4%
Filament Current	2,1Amp	2,1Amp

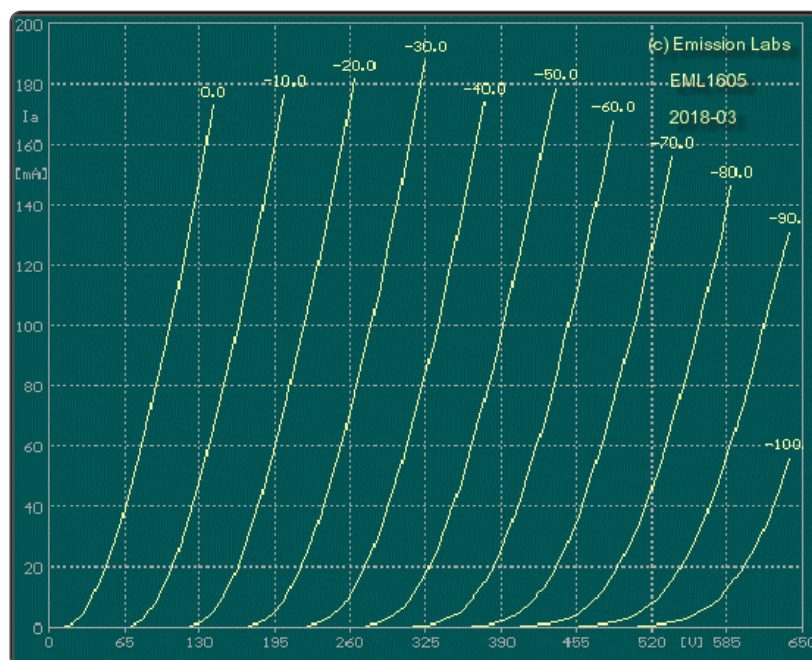
EML 1605 Maximum Conditions
See also Note4.
(Not possible simultaneously)

Anode Voltage	650Volt
Anode Current	160mA
Power Output in Class A	30Watt
Grid resistor	max. 50kOhm

Typical application
Recommended operating point
See also the notes.

With auto bias or fixed bias

Anode Voltage	580V
Anode Dissipation	64Watt
Anode Current	110mA
Control Grid Voltage	-82V
Anode Impedance (Rp)	861Ohms
Amplification Factor	7,5
Transconductance (Gm)	8.8 mA/V
Power Output in Class A	22Watt
Input Signal needed for full output Power	57Volt AC (RMS)
Load Impedance (Ra)	2700-5600 Ohm
Recommended Transformer(s)	Lundahl LL1623-120mA
Grid resistor to ground	Max. 100kOhm



EML 1605 tube curves



Recommended Lundahl transformers

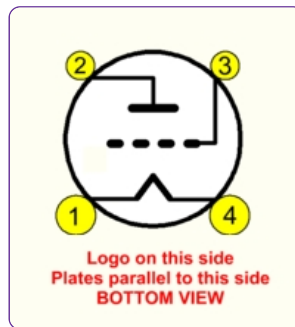
	Primary	Secondary	Auto Bias Cathode resistor	Anode Current	Anode Voltage to ground
LL1623-120mA 16Hz @1.5dB Order nr: 218-111-49	3000Ω	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω	800 Ohms	110mA	668V

EML1605 Mechanical Data

Size including Socket, but excluding pins: 200 x 68 mm
Weight of one tube: 190 Gram



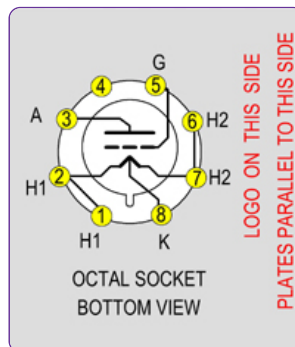
Ceramic UX4 Base



Ceramic UX4 Base



Ceramic Octal Base



Ceramic Octal Base

Notes

1. Hard-metal can be used in electron tubes, though this is more difficult to use, and more costly than classic nickel. It results in a more precise Anode distance, and does not damage in shipment. It ensures reproducible tube parameters, and long term stability. Wolfram grids allow the most precise grid wire distance, because wolfram is an extreme hard metal. Best grid geometry ensures uniformity and linearity of the tube curves.
2. Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)
3. Average Plate Characteristics: Made with the Sofia Digital Curve tracer.
4. We are recommending the same values as Western Electric in their 1950 Data sheet.

5. The Western Electric 1950 Data sheet. says 36 Watt maximum dissipation. Later data sheets say 40 Watt. Though 40 Watt is possible, this is a peak value only, and no normal working point. When you intent to get the 'maximum' out of a 300B, and operate this tube at the limits of safe operation, it is a better idea to use the 300B-XLS in such a case.
6. Some of our competitors claims to be the only one with a Center Tapped filament, but this is not true. At EML we build since many years all tubes Cathode Tapped, not just the 300B.
7. Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
8. Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves.
9. The curves for the 300B are plotted, with AC heating. This is in accordance with the historical WE data sheet.



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Data Sheet

12B, 20A, 20B, 20B-V4, 30A

Last Update: 02/18/2026 11:45:33

Description

This is a series of tubes with medium gain, with very good voltage capabilities, and very low distortion even at high signal.

Applications

		ANODE TYPE	Driver tube	Line Out	Speaker Output	OTA	Head Phone	Sakuma
	12B	Black Powdered	Yes	Yes	Yes	.	Yes	Ideal.
	20A	Mesh	Yes	Yes	.	.	.	
	20B	Black Powdered	Yes	Yes	Yes	Yes	Yes.	
	20B- V4	Black Powdered	Yes	Yes	Yes	Yes	Yes	
	30A	White Powdered	Yes	Yes				

Guarantee program for first owner.

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receipt, at the Emission Labs web site, to participate in the 5 years guarantee program.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gold Plated Grid. ([See Notes](#))
- **NEW** Soft rubber suspended tube base
- Hard metal Construction ([See Notes](#))
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a high quality dual box
- Tube printing with 24k gold, and red color burned into the glass
- Gold Plated, black ceramic socket

12B

This tube has gain of appr. 12x, and medium-low impedance. It can be used in almost any application, including speaker output at almost 5 Watt. Also, beautifully 12B can be used as a [SAKUMA](#) amplifier, using a 12B to drive a 12B speaker tube. This tube has sound resemblance to the vintage PX25, due to curve similarity.

20A

This is a mesh tube, with gain of appr. 20x, and medium impedance. It has a very pleasant triode sound, due to nearly total absence of odd harmonics. It's application is a driver tube for medium signal.

20B

This is a solid plate version of the 20A. It works well in all 20A circuits, but can also be biased higher as 20A. At medium voltage it is a wonderful driver tube. For lower signal it may be used at low anode voltage, like 250V. At higher anode voltage, up to 580V, 20B becomes capable of delivering very high output signal, as required for instance to drive the 845 or GM70 tube. Also at higher voltage it can deliver a few Watts output power. It can be used as driver tube or low power output tube.

20B-V4

V4 means only the heater wire has a center tap. This gives a fifth connection, so this tube needs an octal base. It is compatible to the classical 20B, but offers the advantage of the center tap on the filament. The center tap, provides a real cathode connection, for a simpler circuit, yet with better performance.

[Application Note AN-6](#) explains the meaning of the V4 Version.

30A

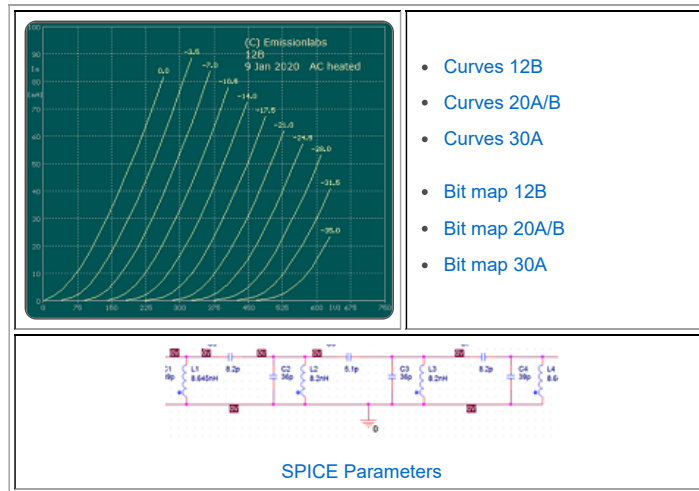
The 30A has an unloaded gain of appr. 30x. It is intended to combine the driver and pre-amplifier tube in one. This tube has exceptional low distortion, below 0,1% 2nd harmonics, and 0.01% 3rd harmonics, at FULL signal output of 60Volt RMS. [Here is a print of the simulation program, to show this](#). This program used [these 30A tube curves](#), measured with the Sofia curve tracer. At lower signal, distortion drops even further.

Filament Ratings		
	Standard tube 12B, 20A, 20B, 30A 4Pin Socket (UX4)	Cathode Tapped 20B-V4 8Pin Socket (Octal)
DC voltage recommended	= 5Volt	= 2.5 - 0 - 2.5Volt
Electronic heater modules:	Only voltage source	Only voltage source
Tolerance on filament voltage	5%	5%
Filament Current	~ 1,4Amp	~ 1,4Amp

Maximum Conditions (See Notes)	EML 12B	EML 20A	EML 20B	EML 30A
Anode Voltage	500V	490V	580V	500V
Anode Current	60mA	40mA	60mA	40mA
Continuous Anode Dissipation	25Watt	11Watt	25Watt	11Watt
Grid resistor	below 470k	below 470k	below 470k	below 470k

Factory Test Data	EML 12B	EML 20A	EML 20B	EML 30A
Anode Voltage	390V	400V	420V	400V
Anode Current	40mA	25mA	42mA	25mA
Anode Impedance (Rp)	2k9	3k7	3k	6k2
Amplification Factor	13.5	21	21	32
Transconductance	5.6 mA/V	4,2mA/V	6,9mA/V	5,2mA/V
Control Grid Voltage <i>Tested with DC heating</i>	-16V	-7.4V	-5,6V	

Control Grid Voltage <i>Tested with AC heating.</i>		-9,9V	-8,1V	
- Control Grid Voltage. <i>Actual voltage depends on individual tubes.</i> Factory test data is taken with DC heating. - Gain is unloaded gain, as will occur choke or inter stage loaded. If resistor loaded, gain will be lower.				



12B Some operating points.

This is AC heated. If DC heated, Grid voltage shifts 2.5 Volt. (See Notes)

Anode Voltage	Grid Voltage See Notes	Input	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
430V See Chart	-20.9V	4.1V RMS	831R	25mA	14.6	3k1	Choke or inter stage	LL1668-25mA	60V RMS	0,03%	Driver Stage
430V See Chart	-15V	10,7V RMS	257R	58mA	10	2k3	5k	LL1663-60mA	2,2Watt	1.4%	Output Stage
430V See Chart	-15V	10,7V RMS	257R	58mA	10.8	2k3	6k5	LL9202-50mA	2Watt	0.9%	Output Stage
500V See Chart	-21.1V	14,9V RMS	422R	50mA	10	2k4	5k	LL1663-50mA	4,1Watt	3,3%	Output Stage
500V See Chart	-21.1V	14,9V RMS	420R	50mA	10.5	2k4	6k5	LL9202-50mA	3.8Watt	2.1%	Output Stage

As a driver stage, most power tubes like 300B, need appr 60V RMS on the grid. Using 12B as a driver, only 4.1V is needed. This can be achieved with a 4x step up transformer, which gives this gain free of noise and microphonics, and supplies even a balanced input.

20A Some operating points

Anode Voltage	Grid Voltage See Notes	Input RMS	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
350V See Chart	-12.6V	3.14V	1263	10mA	20.8	5k4	Choke loaded	LL1668-10mA	60V RMS	0,17%	Driver Stage

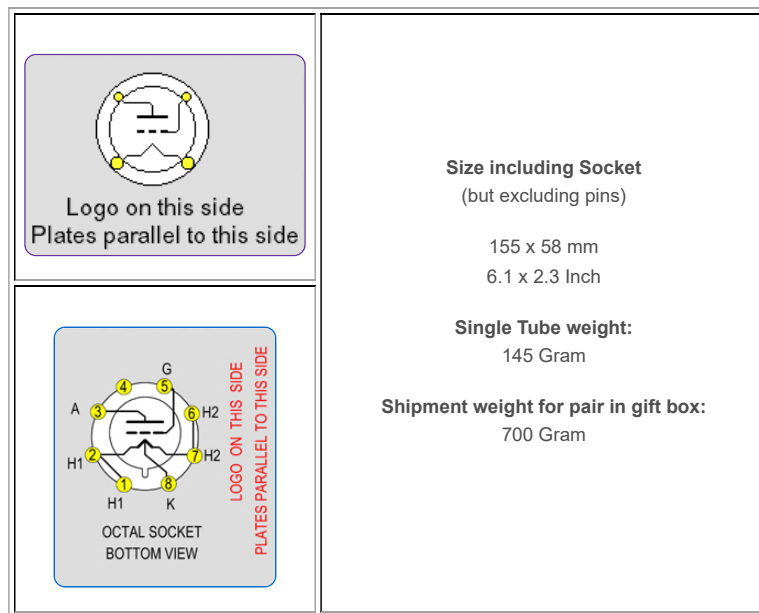
For full output signal, most power tubes like 300B, need appr 60V RMS on the grid. This is 170 Volt peak to peak, and it needs good consideration how to generate such high signal free of noise and distortion. Using 20A as a driver, only 3.14V is needed. This can be achieved with a 3x step up transformer, which gives this gain free of noise and microphonics, and supplies even a balanced input and no further drive tube is needed.

20B Some operating points

Anode Voltage	Grid Voltage See Notes	Input RMS	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
521V See Chart	-12,2V	8.5V	254R	48mA	16.4	2k9	11k	LL9202-50mA	1,8Watt	1%	Output Stage
580V See Chart	-15.7V	11.1V	368R	43mA	13.4	3k	6k5	LL9202-50mA	3,59Watt	3.7%	Output Stage
								LL2935B			Output Stage

30A Some operating points

Anode Voltage	Control Grid Voltage See Notes	Anode Current (mA)	Trans-Conduc-tance (mA)	Tube Ri (Ohm)	Gain (mu)
300	-3	10	4.6	8k	36
300	-2	15	5.3	6k6	35
300	-1	20	5.5	5k9	33
360	-5	10	4.4	8k	36
360	-3.8	15	5.1	6k9	35
360	-2.8	20	5.7	6k	34
360	-2	25	6.2	5k6	34
360	-1.1	30	6.6	5k1	34
420	-6,7	10	4.3	8k5	36
420	-5.6	15	5.0	7k	35
420	-4.6	20	5.5	6k	33
480	-8.6	10	4.1	9k3	38
480	-7.5	15	4.9	7k2	35
480	-6.5	20	5.5	6k3	35



Notes

- Hard-metals can be used in electron tubes, though these are more difficult to use, and more costly than classic nickel. This ensures reproducible tube parameters, and long term stability.
- Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)
- Plate Characteristics are made with the Sofia Digital Curve tracer.
- We are recommending the same values as Western Electric in their 1950 Data sheet.
- Some of our competitors claims to be the only one with a Center Tapped filament, but at EML we build since many years all tubes Cathode Tapped, not just this tube.
- Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
- Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves

Use as Pre Amplifier

Application info #1

For use in a separate pre amplifier, a DHT must be used with low noise in mind. Typically the wrong way for this would be to build a pre amplifier with more gain as needed, and then attenuate the **input** signal by the input volume knob accordingly.

Though people LOVE to do this, it is wrong! Such amplifiers will function dissatisfactory because of low signal to noise ratio, and also will sound sterile.

A good pre amplifier, will use an attenuating output transformer, reducing the gain of the complete product, to a number, not higher than needed. Which is 1x for a pre amplifier, or in rare cases 2x. . This will lower the output impedance of the pre amplifier with the square of the transformer attenuation which is the

essential real reason for doing so. Now, with the lower output impedance, a 600 Ohms potentiometer can be used directly at the output. Doing it like this, will drastically reduce noise as well as microphonics. Yet maintain triode sound. In this configuration, the plate signal of the output tube itself, will be 10...40 Volts, also at very low output volume setting. This prevents sterile sound. Overall Signal to Noise ratio stays very high, and microphonics are low. With such a pre amplifier, even a twisted wire pair can be used at the output, to replace shielded cable, and at very low signal the pre amplifier will be 'dead' silent, or in engineering words, have a very high Signal to Noise ratio.

20B use as OTA

Application info #2

OTA stands for One Tube Amplifier. So yes, this means a complete HiFi amplifier with only one tube. This is a concept where no pre amplifier tube and no driver tube is used. The output tube is typically 20B-V4 in such a case, and it provides almost enough gain by itself. The missing gain of appr 2...4x can be achieved by a passive gain stage, in the form of a small step input transformer from Lundahl. (We supply PCB for this, with programmable gain of 1..4x, using LL1544A). Such a passive stage costs less than a good tube stage, and provides gain at zero hum and zero noise. We much recommend this concept if only a few Watt output power is needed. Sound of the 20B-V4, as speaker driver will be 'sweet' and not dominant. Moreover, tube sound develops with the 20B also at low volume. Due to exact geometry of the anode box, there will be no audible third harmonics. So any influence will be only by second harmonics, thus achieving in a very good way, what is called triode sound.

Search the internet for this phrase: "OTA 20B One Tube Amplifier", or also click on "Professional Users" on the jacmusic website, and search that page for the phrase "20B"

12B Notes

Application info #3

For driving a 300B, it needs appr. 60V AC signal. Quite a lot, but 12B can do this nicely, and a lot higher voltage too.

It is recommended to check at the external website, jacmusic.com, for the EE-08 and EE-20 board, at the Lundahl Section. These transformer boards will supply the needed gain.

In addition, 12B seems IDEAL to build a SAKUMA amplifier. This very clever concept works almost free of distortion, as long as driver stage and output stage are identical. Enter **SAKUMA** in the search box of the jacmusic.com website. (external website)

About Noise and Distortion

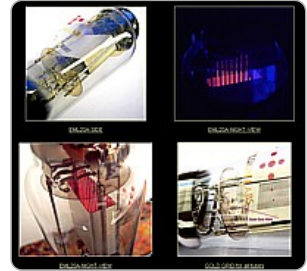
12B, 20A, 20B, 30A tubes are based on a very old principle, where high gain tubes have much wider Anode distance. This is still the ultimate way to make a very linear DHT high gain tube. Miniaturization has always been the enemy of tube linearity, specially with DHT. For this reason, the 20A/20B/30A will outdo any small size tube. We encourage you to check the tube curves of any miniature tube, like 6SN7, ECC88 or ECC82, and you will see this series presented here is much superior. However this results of larger dimension tubes is a higher working voltage. For this reason, tubes like this were not made any more after 1935, when miniaturization of tubes started to become more important. With the new production tubes we make today, miniaturization is no requirement. So for high gain tubes, we can now focus on lowest possible distortion. We build these tubes again the original way, with wide Anodes. [Check Anode picture here.](#)

These tubes belong to the lowest distortion tubes ever build. Total distortion for small signal has been measured below 0,08% at 10 Volt Eff output signal, 400V Anode. The distortion will almost not increase at higher signal. ([See Note5](#)) . Interestingly, when one DHT triode is driving another, a part of the distortion of the second tube will be eliminated by the first tube. This even harmonics cancellation appears only with triodes, and they must be similar tubes, like drive a 300B with one of the tubes of this series. Since Triodes produce very low uneven harmonics, canceling the overall distortion this way, is an amazing application of the 20B or 30B tube. ([See note 4](#))

For lowest possible mechanical noise with (any) high gain DHT pre-amp tube, use high quality tube sockets that do not pass the chassis vibrations to the tube. Chassis vibrations can come directly from

the mains transformer, or by air from the loudspeaker. The best sockets for this are probably the Yamamoto Teflon, because Teflon is a flexible material. Use tight fitting Teflon tube dampers such as the Duende Criteria. They make the best damper for the EML tubes. They can be fit very nicely on the tube top, or one on the top and one on the bottom.

Note about Blue Glow Appearance.



These tubes will often produce a blue glow on the glass. This is because of the wider Anode distance, some electrons escape after collision. The fluorescent light pattern changes with the voltage or with the signal. These light effects are normal for this type of tube. It must not be confused with gassy tubes, which produce a purple-blue cloud inside the Anodes. [D](#)



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Data Sheet

12B, 20A, 20B, 20B-V4, 30A

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Description

This is a series of tubes with medium gain, with very good voltage capabilities, and very low distortion even at high signal.

Applications

		ANODE TYPE	Driver tube	Line Out	Speaker Output	OTA	Head Phone	Sakuma
	12B	Black Powdered	Yes	Yes	Yes	.	Yes	Ideal.
	20A	Mesh	Yes	Yes	.	.	.	
	20B	Black Powdered	Yes	Yes	Yes	Yes	Yes.	
	20B- V4	Black Powdered	Yes	Yes	Yes	Yes	Yes	
	30A	White Powdered	Yes	Yes				

Guarantee program for first owner.

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receipt, at the Emission Labs web site, to participate in the 5 years guarantee program.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gold Plated Grid. ([See Notes](#))
- **NEW** Soft rubber suspended tube base
- Hard metal Construction ([See Notes](#))
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a high quality dual box
- Tube printing with 24k gold, and red color burned into the glass
- Gold Plated, black ceramic socket

12B

This tube has gain of appr. 12x, and medium-low impedance. It can be used in almost any application, including speaker output at almost 5 Watt. Also, beautifully 12B can be used as a [SAKUMA](#) amplifier, using a 12B to drive a 12B speaker tube. This tube has sound resemblance to the vintage PX25, due to curve similarity.

20A

This is a mesh tube, with gain of appr. 20x, and medium impedance. It has a very pleasant triode sound, due to nearly total absence of odd harmonics. It's application is a driver tube for medium signal.

20B

This is a solid plate version of the 20A. It works well in all 20A circuits, but can also be biased higher as 20A. At medium voltage it is a wonderful driver tube. For lower signal it may be used at low anode voltage, like 250V. At higher anode voltage, up to 580V, 20B becomes capable of delivering very high output signal, as required for instance to drive the 845 or GM70 tube. Also at higher voltage it can deliver a few Watts output power. It can be used as driver tube or low power output tube.

20B-V4

V4 means only the heater wire has a center tap. This gives a fifth connection, so this tube needs an octal base. It is compatible to the classical 20B, but offers the advantage of the center tap on the filament. The center tap, provides a real cathode connection, for a simpler circuit, yet with better performance.

[Application Note AN-6](#) explains the meaning of the V4 Version.

30A

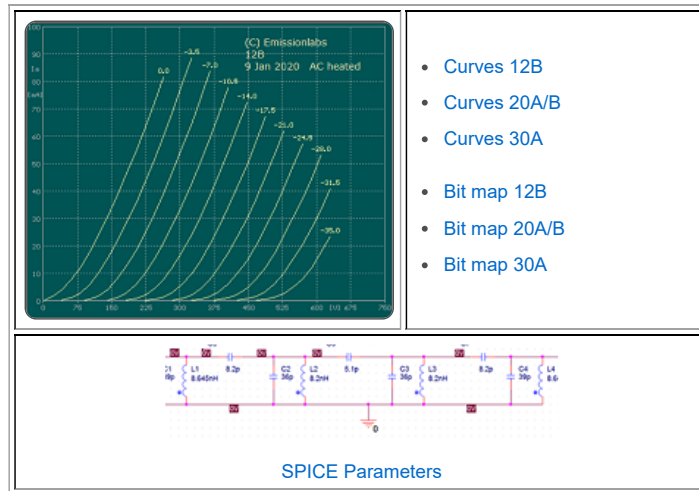
The 30A has an unloaded gain of appr. 30x. It is intended to combine the driver and pre-amplifier tube in one. This tube has exceptional low distortion, below 0,1% 2nd harmonics, and 0.01% 3rd harmonics, at FULL signal output of 60Volt RMS. [Here is a print of the simulation program, to show this](#). This program used [these 30A tube curves](#), measured with the Sofia curve tracer. At lower signal, distortion drops even further.

Filament Ratings		
	Standard tube 12B, 20A, 20B, 30A 4Pin Socket (UX4)	Cathode Tapped 20B-V4 8Pin Socket (Octal)
DC voltage recommended	= 5Volt	= 2.5 - 0 - 2.5Volt
Electronic heater modules:	Only voltage source	Only voltage source
Tolerance on filament voltage	5%	5%
Filament Current	~ 1,4Amp	~ 1,4Amp

Maximum Conditions (See Notes)	EML 12B	EML 20A	EML 20B	EML 30A
Anode Voltage	500V	490V	580V	500V
Anode Current	60mA	40mA	60mA	40mA
Continuous Anode Dissipation	25Watt	11Watt	25Watt	11Watt
Grid resistor	below 470k	below 470k	below 470k	below 470k

Factory Test Data	EML 12B	EML 20A	EML 20B	EML 30A
Anode Voltage	390V	400V	420V	400V
Anode Current	40mA	25mA	42mA	25mA
Anode Impedance (Rp)	2k9	3k7	3k	6k2
Amplification Factor	13.5	21	21	32
Transconductance	5.6 mA/V	4,2mA/V	6,9mA/V	5,2mA/V
Control Grid Voltage <i>Tested with DC heating</i>	-16V	-7.4V	-5,6V	

Control Grid Voltage <i>Tested with AC heating.</i>		-9,9V	-8,1V	
- Control Grid Voltage. <i>Actual voltage depends on individual tubes.</i> Factory test data is taken with DC heating. - Gain is unloaded gain, as will occur choke or inter stage loaded. If resistor loaded, gain will be lower.				



12B Some operating points.

This is AC heated. If DC heated, Grid voltage shifts 2.5 Volt. (See Notes)

Anode Voltage	Grid Voltage See Notes	Input	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
430V See Chart	-20.9V	4.1V RMS	831R	25mA	14.6	3k1	Choke or inter stage	LL1668-25mA	60V RMS	0,03%	Driver Stage
430V See Chart	-15V	10,7V RMS	257R	58mA	10	2k3	5k	LL1663-60mA	2,2Watt	1.4%	Output Stage
430V See Chart	-15V	10,7V RMS	257R	58mA	10.8	2k3	6k5	LL9202-50mA	2Watt	0.9%	Output Stage
500V See Chart	-21.1V	14,9V RMS	422R	50mA	10	2k4	5k	LL1663-50mA	4,1Watt	3,3%	Output Stage
500V See Chart	-21.1V	14,9V RMS	420R	50mA	10.5	2k4	6k5	LL9202-50mA	3.8Watt	2.1%	Output Stage

As a driver stage, most power tubes like 300B, need appr 60V RMS on the grid. Using 12B as a driver, only 4.1V is needed. This can be achieved with a 4x step up transformer, which gives this gain free of noise and microphonics, and supplies even a balanced input.

20A Some operating points

Anode Voltage	Grid Voltage See Notes	Input RMS	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
350V See Chart	-12.6V	3.14V	1263	10mA	20.8	5k4	Choke loaded	LL1668-10mA	60V RMS	0,17%	Driver Stage

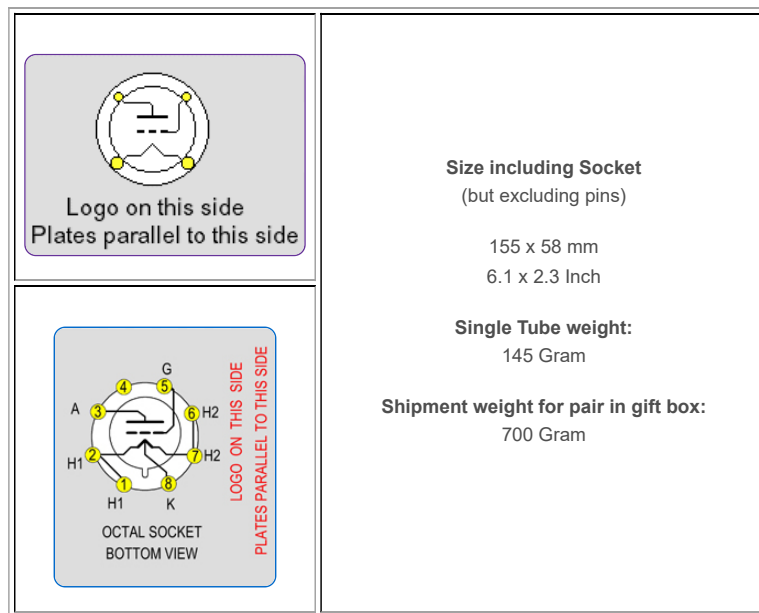
For full output signal, most power tubes like 300B, need appr 60V RMS on the grid. This is 170 Volt peak to peak, and it needs good consideration how to generate such high signal free of noise and distortion. Using 20A as a driver, only 3.14V is needed. This can be achieved with a 3x step up transformer, which gives this gain free of noise and microphonics, and supplies even a balanced input and no further drive tube is needed.

20B Some operating points

Anode Voltage	Grid Voltage See Notes	Input RMS	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
521V See Chart	-12,2V	8.5V	254R	48mA	16.4	2k9	11k	LL9202-50mA	1,8Watt	1%	Output Stage
580V See Chart	-15.7V	11.1V	368R	43mA	13.4	3k	6k5	LL9202-50mA	3,59Watt	3.7%	Output Stage
								LL2935B			Output Stage

30A Some operating points

Anode Voltage	Control Grid Voltage See Notes	Anode Current (mA)	Trans-Conduc-tance (mA)	Tube Ri (Ohm)	Gain (mu)
300	-3	10	4.6	8k	36
300	-2	15	5.3	6k6	35
300	-1	20	5.5	5k9	33
360	-5	10	4.4	8k	36
360	-3.8	15	5.1	6k9	35
360	-2.8	20	5.7	6k	34
360	-2	25	6.2	5k6	34
360	-1.1	30	6.6	5k1	34
420	-6,7	10	4.3	8k5	36
420	-5.6	15	5.0	7k	35
420	-4.6	20	5.5	6k	33
480	-8.6	10	4.1	9k3	38
480	-7.5	15	4.9	7k2	35
480	-6.5	20	5.5	6k3	35



Notes

- Hard-metals can be used in electron tubes, though these are more difficult to use, and more costly than classic nickel. This ensures reproducible tube parameters, and long term stability.
- Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)
- Plate Characteristics are made with the Sofia Digital Curve tracer.
- We are recommending the same values as Western Electric in their 1950 Data sheet.
- Some of our competitors claims to be the only one with a Center Tapped filament, but at EML we build since many years all tubes Cathode Tapped, not just this tube.
- Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
- Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves

Use as Pre Amplifier

Application info #1

For use in a separate pre amplifier, a DHT must be used with low noise in mind. Typically the wrong way for this would be to build a pre amplifier with more gain as needed, and then attenuate the **input** signal by the input volume knob accordingly.

Though people LOVE to do this, it is wrong! Such amplifiers will function dissatisfactory because of low signal to noise ratio, and also will sound sterile.

A good pre amplifier, will use an attenuating output transformer, reducing the gain of the complete product, to a number, not higher than needed. Which is 1x for a pre amplifier, or in rare cases 2x. . This will lower the output impedance of the pre amplifier with the square of the transformer attenuation which is the

essential real reason for doing so. Now, with the lower output impedance, a 600 Ohms potentiometer can be used directly at the output. Doing it like this, will drastically reduce noise as well as microphonics. Yet maintain triode sound. In this configuration, the plate signal of the output tube itself, will be 10...40 Volts, also at very low output volume setting. This prevents sterile sound. Overall Signal to Noise ratio stays very high, and microphonics are low. With such a pre amplifier, even a twisted wire pair can be used at the output, to replace shielded cable, and at very low signal the pre amplifier will be 'dead' silent, or in engineering words, have a very high Signal to Noise ratio.

20B use as OTA

Application info #2

OTA stands for One Tube Amplifier. So yes, this means a complete HiFi amplifier with only one tube. This is a concept where no pre amplifier tube and no driver tube is used. The output tube is typically 20B-V4 in such a case, and it provides almost enough gain by itself. The missing gain of appr 2...4x can be achieved by a passive gain stage, in the form of a small step input transformer from Lundahl. (We supply PCB for this, with programmable gain of 1..4x, using LL1544A). Such a passive stage costs less than a good tube stage, and provides gain at zero hum and zero noise. We much recommend this concept if only a few Watt output power is needed. Sound of the 20B-V4, as speaker driver will be 'sweet' and not dominant. Moreover, tube sound develops with the 20B also at low volume. Due to exact geometry of the anode box, there will be no audible third harmonics. So any influence will be only by second harmonics, thus achieving in a very good way, what is called triode sound.

Search the internet for this phrase: "OTA 20B One Tube Amplifier", or also click on "Professional Users" on the jacmusic website, and search that page for the phrase "20B"

12B Notes

Application info #3

For driving a 300B, it needs appr. 60V AC signal. Quite a lot, but 12B can do this nicely, and a lot higher voltage too.

It is recommended to check at the external website, jacmusic.com, for the EE-08 and EE-20 board, at the Lundahl Section. These transformer boards will supply the needed gain.

In addition, 12B seems IDEAL to build a SAKUMA amplifier. This very clever concept works almost free of distortion, as long as driver stage and output stage are identical. Enter **SAKUMA** in the search box of the jacmusic.com website. (external website)

About Noise and Distortion

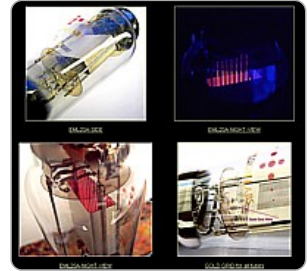
12B, 20A, 20B, 30A tubes are based on a very old principle, where high gain tubes have much wider Anode distance. This is still the ultimate way to make a very linear DHT high gain tube. Miniaturization has always been the enemy of tube linearity, specially with DHT. For this reason, the 20A/20B/30A will outdo any small size tube. We encourage you to check the tube curves of any miniature tube, like 6SN7, ECC88 or ECC82, and you will see this series presented here is much superior. However this results of larger dimension tubes is a higher working voltage. For this reason, tubes like this were not made any more after 1935, when miniaturization of tubes started to become more important. With the new production tubes we make today, miniaturization is no requirement. So for high gain tubes, we can now focus on lowest possible distortion. We build these tubes again the original way, with wide Anodes. [Check Anode picture here.](#)

These tubes belong to the lowest distortion tubes ever build. Total distortion for small signal has been measured below 0,08% at 10 Volt Eff output signal, 400V Anode. The distortion will almost not increase at higher signal. ([See Note5](#)) . Interestingly, when one DHT triode is driving another, a part of the distortion of the second tube will be eliminated by the first tube. This even harmonics cancellation appears only with triodes, and they must be similar tubes, like drive a 300B with one of the tubes of this series. Since Triodes produce very low uneven harmonics, canceling the overall distortion this way, is an amazing application of the 20B or 30B tube. ([See note 4](#))

For lowest possible mechanical noise with (any) high gain DHT pre-amp tube, use high quality tube sockets that do not pass the chassis vibrations to the tube. Chassis vibrations can come directly from

the mains transformer, or by air from the loudspeaker. The best sockets for this are probably the Yamamoto Teflon, because Teflon is a flexible material. Use tight fitting Teflon tube dampers such as the Duende Criteria. They make the best damper for the EML tubes. They can be fit very nicely on the tube top, or one on the top and one on the bottom.

Note about Blue Glow Appearance.



These tubes will often produce a blue glow on the glass. This is because of the wider Anode distance, some electrons escape after collision. The fluorescent light pattern changes with the voltage or with the signal. These light effects are normal for this type of tube. It must not be confused with gassy tubes, which produce a purple-blue cloud inside the Anodes. [D](#)



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Data Sheet

12B, 20A, 20B, 20B-V4, 30A

Last Update: 02/18/2026 11:45:33

Description

This is a series of tubes with medium gain, with very good voltage capabilities, and very low distortion even at high signal.

Applications

		ANODE TYPE	Driver tube	Line Out	Speaker Output	OTA	Head Phone	Sakuma
	12B	Black Powdered	Yes	Yes	Yes	.	Yes	Ideal.
	20A	Mesh	Yes	Yes	.	.	.	
	20B	Black Powdered	Yes	Yes	Yes	Yes	Yes.	
	20B-V4	Black Powdered	Yes	Yes	Yes	Yes	Yes	
	30A	White Powdered	Yes	Yes				

Guarantee program for first owner.

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receipt, at the Emission Labs web site, to participate in the 5 years guarantee program.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gold Plated Grid. ([See Notes](#))
- **NEW** Soft rubber suspended tube base
- Hard metal Construction ([See Notes](#))
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a high quality dual box
- Tube printing with 24k gold, and red color burned into the glass
- Gold Plated, black ceramic socket

12B

This tube has gain of appr. 12x, and medium-low impedance. It can be used in almost any application, including speaker output at almost 5 Watt. Also, beautifully 12B can be used as a [SAKUMA](#) amplifier, using a 12B to drive a 12B speaker tube. This tube has sound resemblance to the vintage PX25, due to curve similarity.

20A

This is a mesh tube, with gain of appr. 20x, and medium impedance. It has a very pleasant triode sound, due to nearly total absence of odd harmonics. It's application is a driver tube for medium signal.

20B

This is a solid plate version of the 20A. It works well in all 20A circuits, but can also be biased higher as 20A. At medium voltage it is a wonderful driver tube. For lower signal it may be used at low anode voltage, like 250V. At higher anode voltage, up to 580V, 20B becomes capable of delivering very high output signal, as required for instance to drive the 845 or GM70 tube. Also at higher voltage it can deliver a few Watts output power. It can be used as driver tube or low power output tube.

20B-V4

V4 means only the heater wire has a center tap. This gives a fifth connection, so this tube needs an octal base. It is compatible to the classical 20B, but offers the advantage of the center tap on the filament. The center tap, provides a real cathode connection, for a simpler circuit, yet with better performance.

[Application Note AN-6](#) explains the meaning of the V4 Version.

30A

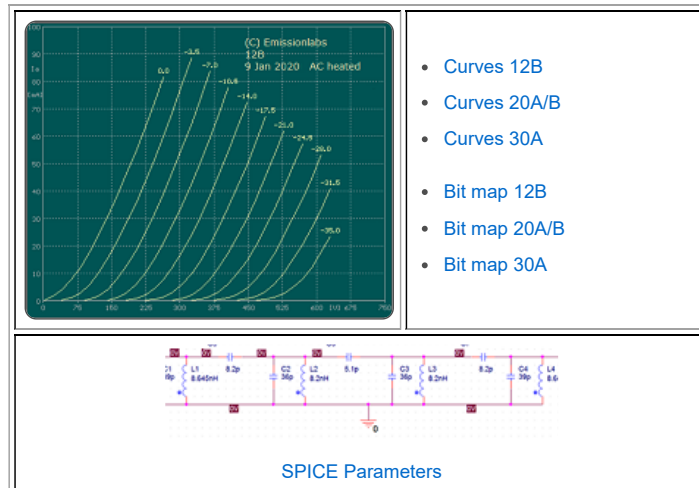
The 30A has an unloaded gain of appr. 30x. It is intended to combine the driver and pre-amplifier tube in one. This tube has exceptional low distortion, below 0,1% 2nd harmonics, and 0.01% 3rd harmonics, at FULL signal output of 60Volt RMS. [Here is a print of the simulation program, to show this](#). This program used [these 30A tube curves](#), measured with the Sofia curve tracer. At lower signal, distortion drops even further.

Filament Ratings		
	Standard tube 12B, 20A, 20B, 30A 4Pin Socket (UX4)	Cathode Tapped 20B-V4 8Pin Socket (Octal)
DC voltage recommended	= 5Volt	= 2.5 - 0 - 2.5Volt
Electronic heater modules:	Only voltage source	Only voltage source
Tolerance on filament voltage	5%	5%
Filament Current	~ 1,4Amp	~ 1,4Amp

Maximum Conditions (See Notes)	EML 12B	EML 20A	EML 20B	EML 30A
Anode Voltage	500V	490V	580V	500V
Anode Current	60mA	40mA	60mA	40mA
Continuous Anode Dissipation	25Watt	11Watt	25Watt	11Watt
Grid resistor	below 470k	below 470k	below 470k	below 470k

Factory Test Data	EML 12B	EML 20A	EML 20B	EML 30A
Anode Voltage	390V	400V	420V	400V
Anode Current	40mA	25mA	42mA	25mA
Anode Impedance (Rp)	2k9	3k7	3k	6k2
Amplification Factor	13.5	21	21	32
Transconductance	5.6 mA/V	4,2mA/V	6,9mA/V	5,2mA/V
Control Grid Voltage <i>Tested with DC heating</i>	-16V	-7.4V	-5,6V	

Control Grid Voltage <i>Tested with AC heating.</i>		-9,9V	-8,1V	
- Control Grid Voltage. <i>Actual voltage depends on individual tubes.</i> Factory test data is taken with DC heating. - Gain is unloaded gain, as will occur choke or inter stage loaded. If resistor loaded, gain will be lower.				



12B Some operating points.

This is AC heated. If DC heated, Grid voltage shifts 2.5 Volt. (See Notes)

Anode Voltage	Grid Voltage See Notes	Input	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
430V See Chart	-20.9V	4.1V RMS	831R	25mA	14.6	3k1	Choke or inter stage	LL1668-25mA	60V RMS	0,03%	Driver Stage
430V See Chart	-15V	10,7V RMS	257R	58mA	10	2k3	5k	LL1663-60mA	2,2Watt	1.4%	Output Stage
430V See Chart	-15V	10,7V RMS	257R	58mA	10.8	2k3	6k5	LL9202-50mA	2Watt	0.9%	Output Stage
500V See Chart	-21.1V	14,9V RMS	422R	50mA	10	2k4	5k	LL1663-50mA	4,1Watt	3,3%	Output Stage
500V See Chart	-21.1V	14,9V RMS	420R	50mA	10.5	2k4	6k5	LL9202-50mA	3.8Watt	2.1%	Output Stage

As a driver stage, most power tubes like 300B, need appr 60V RMS on the grid. Using 12B as a driver, only 4.1V is needed. This can be achieved with a 4x step up transformer, which gives this gain free of noise and microphonics, and supplies even a balanced input.

20A Some operating points

Anode Voltage	Grid Voltage See Notes	Input RMS	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
350V See Chart	-12.6V	3.14V	1263	10mA	20.8	5k4	Choke loaded	LL1668-10mA	60V RMS	0,17%	Driver Stage

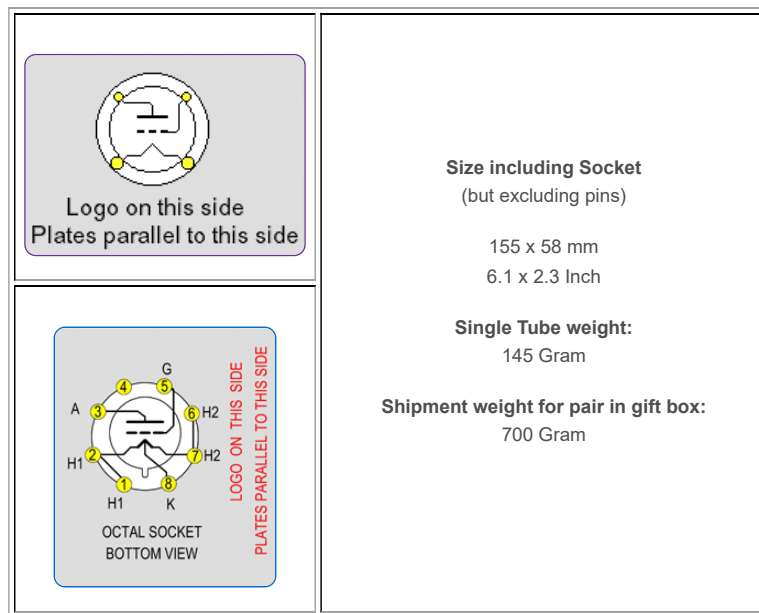
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Anode Voltage	Grid Voltage See Notes	Input RMS	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
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								LL2935B			Output Stage

30A Some operating points

Anode Voltage	Control Grid Voltage See Notes	Anode Current (mA)	Trans-Conduc-tance (mA)	Tube Ri (Ohm)	Gain (mu)
300	-3	10	4.6	8k	36
300	-2	15	5.3	6k6	35
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Notes

- Hard-metals can be used in electron tubes, though these are more difficult to use, and more costly than classic nickel. This ensures reproducible tube parameters, and long term stability.
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Use as Pre Amplifier

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For use in a separate pre amplifier, a DHT must be used with low noise in mind. Typically the wrong way for this would be to build a pre amplifier with more gain as needed, and then attenuate the **input** signal by the input volume knob accordingly.

Though people LOVE to do this, it is wrong! Such amplifiers will function dissatisfactory because of low signal to noise ratio, and also will sound sterile.

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20B use as OTA

Application info #2

OTA stands for One Tube Amplifier. So yes, this means a complete HiFi amplifier with only one tube. This is a concept where no pre amplifier tube and no driver tube is used. The output tube is typically 20B-V4 in such a case, and it provides almost enough gain by itself. The missing gain of appr 2...4x can be achieved by a passive gain stage, in the form of a small step input transformer from Lundahl. (We supply PCB for this, with programmable gain of 1..4x, using LL1544A). Such a passive stage costs less than a good tube stage, and provides gain at zero hum and zero noise. We much recommend this concept if only a few Watt output power is needed. Sound of the 20B-V4, as speaker driver will be 'sweet' and not dominant. Moreover, tube sound develops with the 20B also at low volume. Due to exact geometry of the anode box, there will be no audible third harmonics. So any influence will be only by second harmonics, thus achieving in a very good way, what is called triode sound.

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12B Notes

Application info #3

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In addition, 12B seems IDEAL to build a SAKUMA amplifier. This very clever concept works almost free of distortion, as long as driver stage and output stage are identical. Enter **SAKUMA** in the search box of the jacmusic.com website. (external website)

About Noise and Distortion

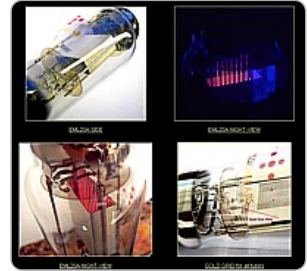
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For lowest possible mechanical noise with (any) high gain DHT pre-amp tube, use high quality tube sockets that do not pass the chassis vibrations to the tube. Chassis vibrations can come directly from

the mains transformer, or by air from the loudspeaker. The best sockets for this are probably the Yamamoto Teflon, because Teflon is a flexible material. Use tight fitting Teflon tube dampers such as the Duende Criteria. They make the best damper for the EML tubes. They can be fit very nicely on the tube top, or one on the top and one on the bottom.

Note about Blue Glow Appearance.



These tubes will often produce a blue glow on the glass. This is because of the wider Anode distance, some electrons escape after collision. The fluorescent light pattern changes with the voltage or with the signal. These light effects are normal for this type of tube. It must not be confused with gassy tubes, which produce a purple-blue cloud inside the Anodes. [D](#)



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274B Data Sheet

Last Update: 07/12/2026 12:35:52

Description

This tube is a full wave rectifier, electrically equivalent to the original Western Electric historical tube.

274A is electrically equivalent to 274B, but we stopped making 274A. The difference between 274A and 274B is only the socket. 274A has a UX4 socket, 274B has an Octal socket.

In case you need to use still 274A, it can be replaced by the [EML 80A](#). This tube, can directly replace 274A. (Historic type 80 can NOT replace the 274A)



The EML tubes feature a series connected filament for both diodes together, which has certain advantages.

This tube can supply 140mA with a normal C-L-C filter. AT these conditions, the 274B is designed to be used with a small size first capacitor of 4uF only.

At lower voltage, lower current, it is possible to use a first capacitor of 20uF.

[High Resolution](#)

[Anode Detail](#)

Guarantee program for first owner

The first owner can register the tube within 4 weeks after receipt, at the Emission Labs web site, to participate in the 5 years guarantee program, which is additional to the legal obligations of the seller.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Soft rubber suspended tube base
- Hard metal Construction ([Note1](#))
- Extra large getters
- Hand blown Glass bulb
- These tubes are shipped in a [high quality dual box](#)
- Tube printing with real gold (metal), red color is glass burned into the glass
- Gold Plated, black ceramic socket

Did you know this?

Emission Labs was the first company to re-introduce the 274 tube again, in the year 2001.

EML Rectifier tubes



[AZ4-Mesh](#)

[5U4G-Mesh](#)

[5Z3-Mesh](#)

[80-R Mesh](#)

[81-Monodiode](#)

[274A-Mesh](#)

[274B-Mesh](#)

Sound Character of the 274B

It is the most asked question, and behavior of a power supply depends a lot on the type of tube rectifier used, and the way it is used.

With 274A, 274B, the intention is to have only small current peaks through the capacitor, and mains transformer. This will result in less mechanical hum of the transformer, less electrical and magnetitic hum radiation into of the preamplifier, an improved sound compared to lower impedance rectifier tubes such as 5U4G, or even solid state rectifiers.

For ultra low ripple, it is recommended to use the Lundahl [LL1673](#) dual coil choke in low CMR configuration. In this configuration, there is virtually no field radiation from the choke. (See link to circuit diagram, at the bottom of this page).

Filament Ratings	
Filament Voltage	5 Volt (AC or DC)
Tolerance on filament voltage	5%
Filament Current	2 Ampere

Maximum ratings if transformer above 350V AC Capacitor Input	
NOT possible simultaneously Take one maximum number, you must reduce another READ all notes at the bottom of this Data sheet	
AC input voltage	550Volts
First capacitor	4uF
DC output current	150mA

Maximum ratings if transformer below 350V AC Capacitor Input	
Possible simultaneously	
DC output current	125mA
Rtr = Transformer Raa minimum value. (Add normal resistor, if your Raa too low)	Rtr= 200 Ohms
First capacitor, connected to Anodes	20uF max

Maximum ratings Choke Input	
NOT possible simultaneously Take one maximum number, you must reduce another READ all notes at the bottom of this Data sheet	
AC input voltage	660Volts
DC output current	200mA

Typical Conditions Capacitor Input, C-L-C. See also: Note 2	
DC output voltage	450Volt
Total rectified current	140mA
First capacitor, connected to Anodes	4uF

Choke	10 Henry
Second capacitor	max 20uF
For a total (C1 + C2) capacitance above 24uF, a limiting series resistor must be used, so the peak in-rush current through the choke is limited to the saturation current of the choke, or max 600mA, whatever comes first. Otherwise tube damage can result. MUST MEASURE. Can not be calculated in a reliable way. For lowest hum, this resistor is in series with the choke. So you get a C-LR-C filter. In this way 200uF is possible.	

Typical conditions Choke Input, L-C. See also: Note 2 X = Not possible			
AC input	DC 120ma	DC 160mA	DC 200mA
200	165V	145V	130V
250	230V	200V	180V
300	290V	270V	240V
350	360V	330V	300V
400	420V	400V	X
450	480V	460V	X
500	550V	X	X

274B Mechanical Data	
	Tube Size including Socket: 147 x 55 mm Connections: Filaments: 8 + 2 Anodes: 4 + 6 
Single Tube weight	125 Gram
Shipment weight	400 Gram

Some Design Notes for Tube Power Supply

- [Old Design Info- Still valid!](#)
- [Application Note AN-01](#)
- [Application Note AN-02](#)
- [More Technical Notes](#)

Notes

1. Good care should be taken when making the design of any DHT rectifier. It must be prevented to have strong current peaks, through the first capacitor, because consequently this flows through the tube anode, and transformer windings as well. The transformer will produce mechanical hum by this, most specially if there is no such thing as windings symmetry by design, or if the windings copper resistance is chosen too low. (Which two things, very unfortunately, are ignored often by today's transformer builders, who regard tubes and silicon diodes the same) Such transformers are noisy over time, and also the tube will suffer. Particularly at very high voltage, the magnetic peak load with

be too high for the transformer core, creating difficult (or impossible) to locate sources of hum. For this reason, the first capacitor (C1) should never be larger than stated in this data sheet. Read also the next note:

2. Mechanical transformer hum, and also tube current peaks are greatly reduced by a smaller capacitor value. In order to achieve the same amount of filtering, simply increase the choke value accordingly. Although it is clear, higher capacitor values come at lower cost than high value chokes, working with a smaller capacitor and larger choke, is always better. The result will be: Lower mechanical transformer hum, less electrical field radiation into the pre-amp, and significant more lifetime from the rectifier tube. This is why we recommend using largest chokes, and actually today these are not overly expensive. From Lundahl, high value chokes are achievable at the same price as HiFi capacitors, like from a Mundorf or Black gate. So we have to go back to the roots, and use high quality, large value chokes, like in the old days of radio design.
3. For best ripple suppression, increase the choke to any value you need, or even use an C-L-C-L-C circuit, as also advised in the historical RCA data sheet. So we are advising this, same as it was advised almost 100 years ago already.
4. Higher capacitor values as the data sheet maximum limit may sometimes be used, yet only at very special conditions. This can be the case, if the rectifier is used at significant lower voltage and lower current than maximum. Though we advise against it, you may see this occasionally. This is however often wrong, if not done without careful measurements, proving peak current is within range. Moreover there is no real need for this. As a rule of thumb, high voltage power supplies are work best with large size chokes, specially at high output current, whereas low voltage power supplies are more conveniently build with larger capacitors.
5. Windings symmetry is needed with HV transformers to prevent hum. A HV winding with Cathode Tap, requires most of the time FOUR separated HV windings inside the transformer, which are arranged for the end user as one winding with a Cathode Tap. It is remarkable to see, how transformer manufacturers have forgotten this today. If simply two windings are laid over each other, the inner winding has smaller copper resistance than the outer. With load being not identical this way, a small DC current results, which pre-magnetises the transformer core, and mechanical hum is the result. However we have a tube data sheet here, no transformer construction manual, so we can not explain this in more detail.
6. Each tube is numbered from the inside, with a metal [Tag](#).
7. Some of our competitors claims to be the only one with a Center Tapped filament, but at EML we build since many years all tubes Cathode Tapped. With rectifiers, the series connection makes the middle of the filaments virtually grounded, when using a heater supply winding with a grounded Cathode Tap.
8. Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.



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2A3-Mesh Data Sheet

Last Update: 09/05/2026 11:58:18

Description



The EML 2A3 mesh tube is a plug & play, direct replacement for original the RCA 2A3 tube. It features a mesh window in the Anodes. This combines the mechanical stability of Solid Plate tubes, with the properties mesh materia, which is soft, and has a resonance damping function. We think this is the most ideal combination for a low power audio tube.

[Click here for High Resolution image](#)

Guarantee program for first owner.

The first owner can register the tube at the Emission Labs website, to participate in the [5 years guarantee program](#).

Sound Character of the EML 2A3-mesh

When a tube is given mesh Anodes, something magic happens to the sound. We believe this is caused by the high damping properties of the wire mesh material. When using mesh tubes, you will experience what people call a more 'transparent' sound stage, meaning a more realistic stereo reproduction of the original sound recording. With this quality product you will enjoy the very best of what small triodes have to offer.

The EML 2A3-Meshtube is constructed for lowest microphonics. All critical parts, like filaments and grids are made of hard metal for higher reliability and reproducibility quality. The tube base is now glued on the glass with anti-vibration rubber.

Where 2A3-Mesh is not advised:

- Mesh tubes used as output tubes in a separate pre amplifier, or used in a head phone amplifier, may occasionally cause a spurious noise. Though this is rare, it is not a tube issue when it happens. Otherwise we recommend the EML solid plate tubes.

EML 2A3-Mesh Filament Ratings

Filament Voltage:	2.5Volt (AC or DC)
Electronic heater modules:	Only voltage source

Cathode Tapped Version (V4-Version)

With the Cathode Tap connected tubes, we enter a new field of applications. This has not been done before with Audio tubes. When biasing a DHT tube there is no cathode to connect something to. The cathode must be artificially constructed, by a resistor network. Since many years, all EML tubes already feature a Cathode Tapped heater, which is a way to enforce better electrical field geometry. Only, to this Cathode Tap there was never an electrical connection. So to the tube itself we had to make no changes. To the Cathode Tap of the heater, is now connected a wire, which becomes the third connection to the heater. Now the tube has five wire connections, and for this reason we can not use the 4 Pin UX4 base any more. We have chosen for the Octal base. It must be said, the V4 is a very special tube, which fulfills the needs of Circuit Design purists the best possible way. Depending on how you do it, you can enter new design fields, or you may choose to connect the Cathode Tapped tubes just the classical way. Even so, for tube testing you can ignore the Cathode Tap, and just connect the tube the regular (four pole) way. In that case, the EML1605-V4 will behave like a standard four pole tube. In the case you own Cathode Tapped tubes, but you wish to connect them like a non-Cathode Tapped tube, this is possible too. In that case just do not connect the Cathode Tap.

Here is a link to Application Note 06, describing the Cathode Tapped tubes in general. [Link here](#).

Recommended Lundhal transformers

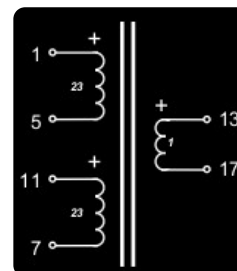
Tolerance on filament voltage: (See Notes 12) Also read our TB-05	4% 2.4 ... 2.6V at Tube pins 2.5 ... 2.7V at Socket pins
Filament Current:	2.5Ampere
Maximum Time on Stand By (Heater voltage only):	2 hours

EML 2A3-Mesh Maximum Conditions (not possible simultaneously)	
Anode Voltage	350Volt
Anode Current	70mA
Anode Dissipation Continuous	18Watt
Highest possible Grid to ground resistor, Single Ended, Auto Bias. (See Notes 8 , 11)	500kOhm
Highest possible Grid to ground resistor, Single Ended, Fixed Bias. (See Notes 8 , 11)	50kOhm

EML 2A3-Mesh Factory Test conditions	
Anode Voltage	250V
Anode Current	60mA
Control Grid Voltage	as needed for 60mA
Transconductance	tested at 60mA

Typical application Single Ended (SE) Recommended operating point All bias methods are possible	
Anode Voltage	250V
Anode Dissipation	15Watt
Anode Current	60mA
Control Grid Voltage	-45Volt
Anode Impedance (Rp)	800 Ohm
Amplification Factor	4,1
Transconductance (Gm)	5,2mA/V
Load Impedance (Ra)	2500 Ohm
Power Output @ Ra = 2500k	3.5 Watt

Typical application Push Pull (PP) Recommended operating point Auto Bias	
Anode Voltage	300V
Anode Current at zero signal (value is for one tube)	40mA
Cathode Resistor (Common Resistor for one tube)	780 Ohms
Load Impedance (Raa)	5000 Ohm
Power Output @ Raa = 5k	10 Watt



Single Ended: [LL1623-60mA](#) (Wire secondary for ALT B, C, D for : 4, 8, 16 Ohms in this order)

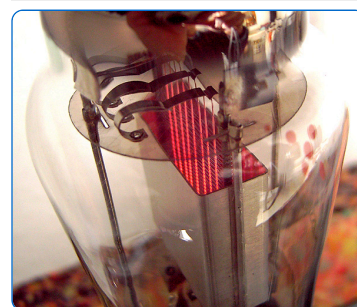
Parallel Single Ended: [LL1627-140mA](#) (Wire secondary for ALT B, C, D for : 4, 8, 16 Ohms in this order)

Push Pull [LL1620-PP](#) (Wire secondary for ALT C, D, E for : 4, 8, 16 Ohms in this order)

Push Pull [LL1620-PP-CFB](#) (with optional 25% Cathode feedback winding)

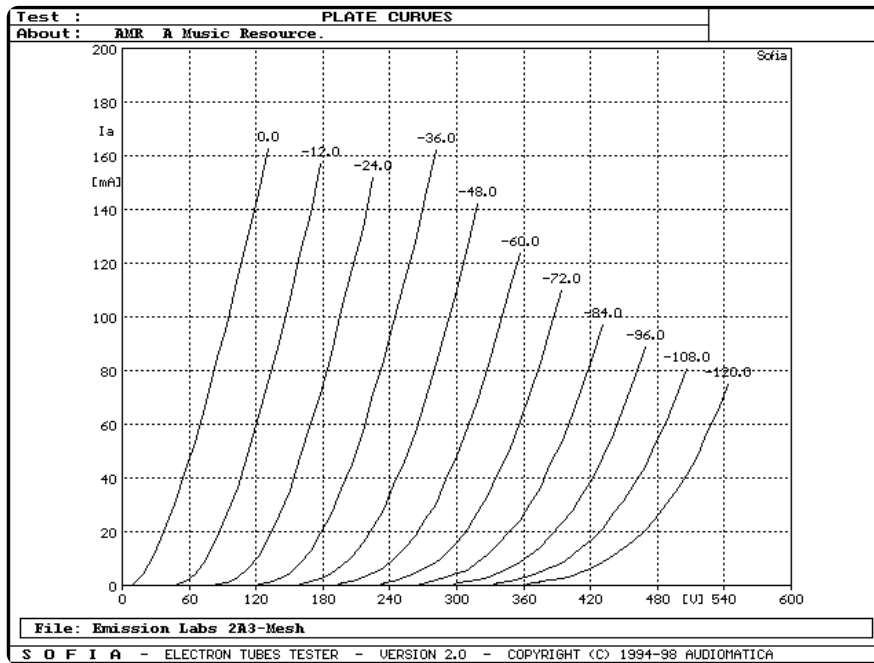
Complete list of [recommendations here](#)

Driver Tubes



20A / 20B / 30A

Use 20B-V4 to replace 1/2 of 6SN7



EML 2A3 Average Plate Characteristics. See Note 3

EM2A3 Mechanical Data

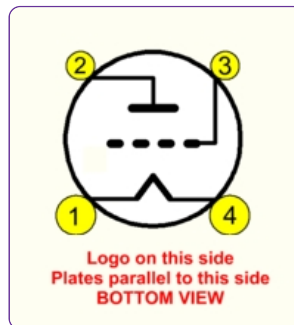
Size including Socket, but excluding pins: 147 x 60 mm

Shipment weight of one tube: 140 Gram

Shipment weight for pair in gift box: 730 Gram



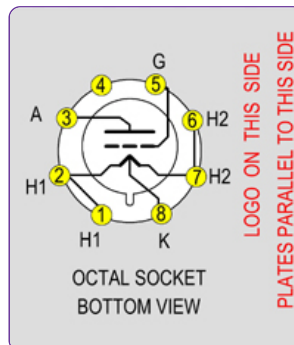
Ceramic UX4 Base



Ceramic UX4 Base



Ceramic Octal Base



Ceramic Octal Base

Features

- **NEW** Gold Plated Grid ([Note8](#))
- **NEW** Gray Wire Mesh
- **NEW** Soft rubber suspended tube base
- **NEW** Cathode Tapped filament version available (order V4-Version)
- Electrically compatible to vintage 2A3 tube by RCA.
- Hard metal Construction ([Note1](#))
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a [high quality dual box](#)
- Tube printing with real gold (metal), red color is glass burned into the glass
- Gold Plated pins, black ceramic socket. (White bottom.)

Notes

Note 1) Hard-metals like Molybdenum and Wolfram are used in EML tubes. Though these metals are more costly than classical tube nickel. At critical places, we use hard metal for better geometry. This results in best tube parameters, also after shipment. You will still find EML tubes mechanically much more stable than comparable tubes on the market.

Note 2) Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)

Note 3) Average Plate Characteristics are made with the Sofia Digital Curve tracer.

Note 6) Some competitors claim to be the only one with a Center Tapped filament, but this is not true. At EML we build since 2005 all triodes with Center Tapped filament ever since, not just the 300B. Such tubes which we offer in V4-Version have an electrical connection to the Cathode Tap. Thus offering a real cathode connection, but also none-V4 tubes have this center tap, but it is not connected to the socket.

Note 8) Gold Plated grids have a few advantages. Amongst other this will give better bias stability of the tube, some protection against accidental overload, better linearity of tube curves, and much reduced grid current.

Note 10) Some competitors offer what they call 'Mesh' tubes, which are no mesh tubes at all, but only give the optical illusion of this. [See our warning page for FAKE Mesh tubes.](#)

Note 11) These grid current values are the original RCA specifications, which EML also meets and guarantees. Though it can be observed that often significant higher values seem possible with old or new tubes, please keep well in mind, that the grid current creates a voltage across the grid resistor. This is a DC current, coming "from" the grid. So, the polarity of this voltage will off-bias the tube such that plate current will increase, above the intended value. In some bad cases, leading to thermal destruction of the tube. For this reason, manufacturers specify a maximum grid resistor, which value has to do with the quality of the whole tube, including clean materials, best vacuum, and safe thermal design. When tubes are new, grid current is usually at it's lowest. In order to operate safe, during the entire lifetime of the tube, these grid resistor values were specified by RCA. We adopted those values at EML, in order to prevent amplifier designers to build products around the (much better) EML specifications, but then historical tubes may sometimes fail in such an amplifier. Understanding this consequence, EML 2A3 may be used with 2x higher grid value resistors as RCA specified. So 1 Meg for Auto bias, and 100k for fixed bias. Grid current of factory new tubes is below 1uA. Rejection level for faulty, used tubes is above 3uA at 250V/60mA, and full warm up.

Note 12) Heater Voltage. Precise heater voltage is the #1 key to long tube life. Use of **current source modules** voids guarantee. Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime. Heater voltage is always defined at the tubes pins itself. There may be some voltage drop along the wires, and tube contacts as well. So voltage measured at the tube socket wiring should ideally be 2.5 to 2.7V.



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2A3-S Data Sheet

Last Update: 07/12/2026 12:36:04

Description



The EML2A3-S is a plug & play, direct replacement for original the RCA 2A3 tube. It will bias exactly at the original operating point.

Yet, for higher power applications, this tube can be used as well. At higher plate dissipation, it is possible to bias the tube up to 28Watt dissipation, which Single-Ended, will give 9.3 Watt RMS output.

[Large Picture](#)

Guarantee program for first owner.

The first owner can register the tube at the Emission Labs website, to participate in the [5 years guarantee program](#). Lifetime of the 2A3-S is estimated [comparable to the EML45 tube](#).

Sound Character of the EML 2A3-S

First, if used at standard 2A3 bias, this tube must be compared with the RCA single plate version.

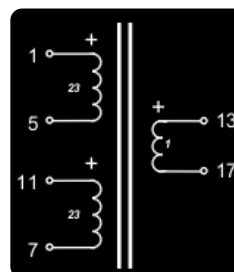
The second application is using this tube at higher dissipation. This will give higher output power, up to 9.3 Watt, and if compared with a standard application, at the SAME output power, distortion will be much lower. The robustness of the 2A3-S is remarkable, and it is excellently suited for Push-Pull design as well.

All critical parts, like filaments and grids are made of hard metal for higher reliability and reproducible quality. The tube base is now glued on the glass with anti-vibration rubber.

2A3-S Filament Ratings	
Filament Voltage	2.5Volt (AC or DC)
Tolerance on filament voltage	4%
	2.4 ... 2.6V at Tube pins
	2.5 ... 2.7V at Socket pins
See also this graph	
Filament Current	2.5Ampere

2A3-S Maximum Conditions	
Anode Voltage	400Volt

Recommended Lundhal transformers



Single Ended: [LL1623-60mA](#) (Wire secondary for ALT B, C, D for : 4, 8, 16 Ohms in this order)

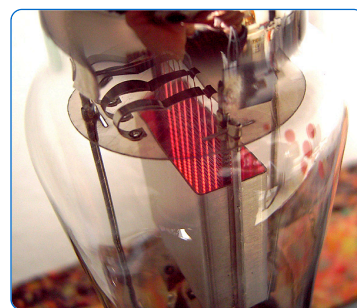
Parallel Single Ended: [LL1627-140mA](#) (Wire secondary for ALT B, C, D for : 4, 8, 16 Ohms in this order)

Push Pull [LL1620-PP](#) (Wire secondary for ALT C, D, E for : 4, 8, 16 Ohms in this order)

Push Pull [LL1620-PP-CFB](#) (with optional 25% Cathode feedback winding)

Complete list of [recommendations here](#)

Driver Tubes



[20A / 20B / 30A](#)

Use 20B-V4 to replace 1/2 of 6SN7

Anode Current	100mA
Anode Dissipation Continuous	28Watt
Anode Dissipation Peak (30minutes)	40Watt
Power Output in Class A	9.3 Watt
Highest possible Grid to ground resistor, Single Ended.	250kOhm
Highest possible Grid to ground resistor, Push-Pull.	50kOhm

2A3-S Factory Test conditions	
Anode Voltage	250V
Anode Current	60mA
Control Grid Voltage	matched
Transconductance	matched

2A3-S Typical Data (1) RCA 2A3 operating point	
Anode Voltage	250V
Anode Dissipation	15Watt
Anode Current	60mA
Control Grid Voltage	-45Volt
Anode Impedance (Rp)	800Ohms
Amplification Factor	4, 1
Transconductance (Gm)	5,2mA/V
Load Impedance (Ra)	2500 Ohm
Power Output @ Ra = 2500k	3.5 Watt

2A3-S Typical Data (2) Safe operation point for high power application	
Anode Voltage	375V
Anode Dissipation	28Watt
Anode Current	75mA
Control Grid Voltage	-Volt
Anode Impedance (Rp)	745Ohms
Amplification Factor	4, 1
Transconductance (Gm)	5,5mA/V
Load Impedance (Ra)	2250...3750 Ohm

2A3-S Mechanical Data	

 Logo on this side Plates parallel to this side	Size including Socket (but excluding pins) 175 x 60 mm 6.9 x 2.7 Inch
Tube weight	140Gram
Shipped weight for double box with one pair	770Gram

Features

- Gold Plated Grid ([Note8](#))
- Gray Wire Mesh
- Soft rubber suspended tube base
- Cathode Tapped filament version available (order V4-Version)
- Electrically compatible to vintage 2A3 tube by RCA.
- Hard metal Construction ([Note1](#))
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a [high quality dual box](#)
- Tube printing with 24k gold, and red color burned into the glass
- Gold Plated, black ceramic socket

Notes

Note 1) Hard-metals like Molybdenum and Wolfram are used in EML tubes. Though these metals are more costly than classical tube nickel. At critical places, we use hard metal for better geometry. This results in best tube parameters, also after shipment. You will still find EML tubes mechanically much more stabile than comparable tubes on the market.

Note 2) Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)

Note 3) Average Plate Characteristics are made with the Sofia Digital Curve tracer.

Note 6) Some competitors claim to be the only one with a Center Tapped filament, but this is not true. At EML we build since 2005 all triodes with Center Tapped filament ever since, not just the 300B. Such tubes which we offer in V4-Version have an electrical connection to the Cathode Tap. Thus offering a real cathode connection, but also none-V4 tubes have this center tap, but it is not connected to the socket.

Note 7) Heater Voltage: Some people experiment with lower filament voltage, to expect better lifetime. This is essentially wrong to do. If the magic was that easy, we would make the tubes like this ourselves. Under Heating can lead to early loss of emission, though new EML tubes will fully recover once the heater voltage is corrected, older tubes will recover only partially. The specified filament voltage at 0% tolerance is the one for best lifetime. The voltage we specify, is at the TUBE PINS itself. Any voltage drop by the socket contacts must be compensated for. For 2A3 tubes, some sockets have 50mV voltage drop per pin, because the heater current of 2.5 Ampere is very high. Causing a total drop of 0.1V for both pins together. So a voltage of 2.6Volts at the socket pins is needed, to make sure there is minimum 2.5 Volts at the tube pins. If operated at 2.5V at the **SOCKET** Pins, this is the lowest limit, because at the **TUBE** Pins this means only 2.4V, at the lowest end of the tolerance, thus not achieving the highest lifetime.

Note 8) Gold Plated grids have a few advantages. Amongst other this will give better bias stability of the tube, some protection against accidental overload, better linearity of tube curves, and much reduced grid current.

Note 10) Some competitors offer what they call 'Mesh' tubes, which are no mesh tubes at all, but only give the optical illusion of this. [See our warning page for FAKE Mesh tubes.](#)

Note 11) These grid current values are the original RCA specifications, which EML also meets and guarantees. Though it can be observed that often significant higher values seem possible with old or

new tubes, please keep well in mind, that the grid current creates a voltage across the grid resistor. This is a DC current, coming "from" the grid. So, the polarity of this voltage will off-bias the tube such that plate current will increase, above the intended value. In some bad cases, leading to thermal destruction of the tube. For this reason, manufacturers specify a maximum grid resistor, which value has to do with the quality of the whole tube, including clean materials, best vacuum, and safe thermal design. When tubes are new, grid current is usually at it's lowest. In order to operate safe, during the entire lifetime of the tube, these grid resistor values were specified by RCA. We adopted those values at EML, in order to prevent amplifier designers to build products around the (much better) EML specifications, but then historical tubes may sometimes fail in such an amplifier. Understanding this consequence, EML 2A3 may be used with 2x higher grid value resistors as RCA specified. So 1 Meg for Auto bias, and 100k for fixed bias. Grid current of factory new tubes is below 1uA. Rejection level for faulty, used tubes is above 3uA at 250V/60mA, and full warm up.



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300B / 300BM+ Data Sheet

Last Update: 07/12/2026 12:36:23

Description

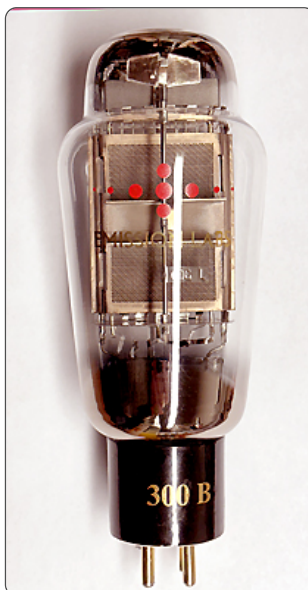


300B Solid Plate

This tube is a direct replacement for the Western Electric E300B as built until 1988. Glass height however is 15mm longer. Diameter is the same.

[High Resolution](#)

[300B Tube compare \(on Youtube\)](#)



300BM+ Mesh Plate

Product Release February 2026

This tube can be used in all 300B power amplifiers. For pre amplifiers and head phone we recommend Solid plate.

[High Resolution](#)

[Night View](#)

Guarantee program for first owner

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receipt, at the Emission Labs website, to participate in the 5 years guarantee program.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gold Plated Grid ([Note](#))
- **NEW** Soft rubber suspended tube base

Other 300B Versions

[Replacement Read me!](#)

[300B-XLM](#)

[300B-XLS](#)

[320B-XLS](#)

[520B](#)

- Hard metal Construction ([Note](#))
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a high quality dual box
- Tube printing with 24k gold, and red color burned into the glass
- Gold Plated pins, black ceramic socket, with white bottom

Sound Character of the EML 300B

It is probably the most asked question, and for this we refer to the genuine 300B, as made until 1988 by Western Electric itself, in the [Hawthorne plant](#), in USA.

The 300B tube has less interaction with the speaker system, as smaller tubes like the 45 have. This makes the overall sound less dependant on the speakers, and more dependant on the tubes itself. We see 300B often used with medium efficiency loudspeakers. Meaning, the tube often needs to work medium hard, which is indeed what the 300B is designed for. There are some more requirements too.

With low to medium efficiency speakers, relatively high output power at low distortion is required. Another requirement is, distortion should increase as little as possible, during the aging process. This requirement is often overseen, because tube owners have a high lifetime expectation anyway, even though this tube is loaded quite hard by some amplifiers. So the 300B has to build with as much as possible reserve emission. This is just what we are doing at EML. Low distortion needs emission reserve.

The low distortion of EML 300B, can optically be seen from the tube curves. This is demonstrated by the equal distance between each curve, specially where they are close to the horizontal axis, in the high voltage range. The more uniform at this difficult region, the higher the emission of the tube probably is. Compare this with other brands, and you will see the difference. We achieve this by our unique filament and grid construction, featuring a real, physical filament Cathode tap, positioned outside of the grid, but inside the glass bulb. We use gold plated grids, and a very long life cathode coating. The gold plated grid ensures constant tube data over the entire lifetime.

Sound Character of the EML 300B Mesh

Mesh tubes have a sound of it's own.

[Click here](#) for a detailed, general description.

EML 300B Filament Ratings	
Filament Voltage	= 5 Volt (AC or DC)
Electronic heater modules:	Only voltage source
Tolerance on filament voltage	-4... +5% 4.8 ... 5.25V at Tube pins 4.85 ... 5.30V at Socket pins See also this graph
Filament Current	~ 1.3 Ampere
Maximum Time on Stand By (Heater voltage only)	2 hours

EML-300B Factory Test conditions	
Anode Voltage	300V
Anode Current	60mA

EML-300B Factory Test Result at 300V, 60mA	
Grid voltage (AC heated)	-61V
Grid voltage (DC heated)	-58,5V

Transconductance	5.5 mA/V
Note: these are average values, variation is appr 5% for random tubes. Any other current will also give another transconductance	

EML-300B incoming inspection. Tested at 300V, 60mA Multiply -Grid Voltage with transduction	
New tube. AC heated.	above 315
New tube. DC heated.	above 302

EML 300B Capacitance	
Grid to Plate	15pF
Grid to Filament	8.5pF
Anode to Filament	4pF

EML 300B Factory Test conditions	
Anode Voltage	300V
Anode Dissipation	17Watt
Anode Current	56mA
Anode Impedance	700 Ohm
Amplification Factor	3,9
Transconductance	5.6 mA/V
Control Grid Voltage	matched
Transconductance	matched

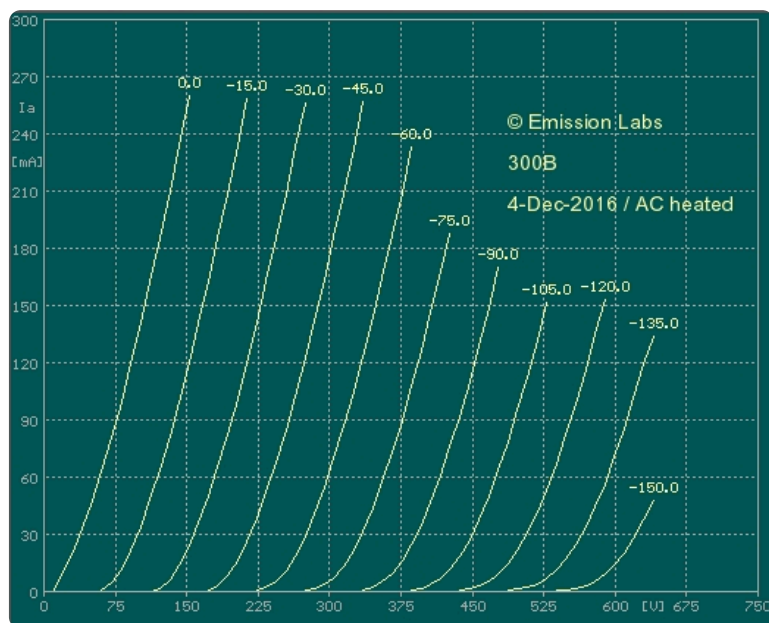
EML 300B Maximum Ratings (Not possible simultaneously)	
Maximum Anode Voltage	450V
Safe Maximum Anode Dissipation	36 Watt
Peak Anode Dissipation	40Watt
Maximum Anode Current Fixed Bias	70mA
Maximum Anode Current Auto Bias	100mA
Recommended grid Resistor	150k Auto Bias
Maximum grid resistor Auto Bias	250k Auto Bias

300B Recommended Single Ended operating points. Other choices are possible.							
Anode vs. Heater (Volt)	Grid (V) vs. Heater	Anode Current (mA)	Anode Rp (Ohm)	Load (Ohm)	Anode Dissipation (Watt)	Power Output Watt)	2nd harm. (dB)
350	-74	60	720	2000	21	10.2	21
350	-74	60	720	3000	21	8.3	26
350	-74	60	720	4000	21	7.0	30
350	-71	80	640	2200	28	9.6	26

400	-87	60	720	3500	24	10.5	26
400	-84	80	720	2500	32	12.5	25
450	-100	60	780	4000	27	12.5	26
450	-100	60	780	5500	27	10.0	30
450	-98	73	720	2000	33	16.2	21
450	-98	73	720	3000	33	13.2	25
450	-98	73	720	4500	33	10.5	30
450	-97	80	700	2000	36*	17.8	21
450	-97	80	700	3000	36*	14.6	26
450	-97	80	700	4500	36*	11.5	31

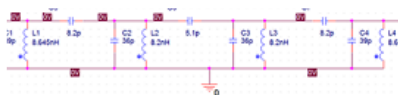
* Lifetime of 300B reduces at 36 Watt dissipation, regardless of the tube brand. For best lifetime, it is recommended to stay below 33 Watt. For highest output power and no compromise with lifetime or distortion, it recommended to choose the 300B-XLS.

Choice of output transformer impedance: For each working point, a wide range of primary impedance is possible. When using a transformer of another value, you can estimate the output power and distortion by averaging between two rows of this table. Example: 450V, 60mA. Use of Lundahl LL1679-70mA (4k5 type). This will give you appr. 11.5 Watt @ 27dB 2nd harmonics. (28dB distance of signal to 2nd harmonics.



EML 300B tube curves. See Note 3

[300B Anode Curves Print Version \(full size pdf\)](#)



[300B SPICE Parameters, made with EML tube.](#)

Some recommended Lundahl transformers

	Primary	Secondary	Auto Bias Cathode resistor	Anode Current	Anode Voltage to ground
LL1623-090mA 11Hz @1.5dB	3000Ω	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω	750 Ohms	80mA	435V

Alternative:

Use transformer Impedance Boards for LL1623 by JACMUSIC.

EE16 switches between 4 and 8Ohms at 3k.

EE18 switches between 8 and 16Ohms at 3k.

LL1664-080mA
13Hz @1.5dB

3000Ω

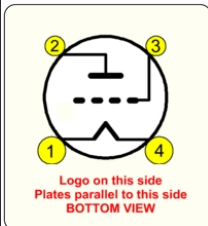
8Ω

750 Ohms

80mA

435V

Complete list of [recommendations here](#)

EML 300B Mechanical Data

Size including Socket
(but excluding pins)

148 x 65 mm

Pin 1: Heater1

Pin 4: Heater2

Pin2: Anode

Pin3: Grid

Weight of one tube:

145 Gram

Shipment weight for pair in gift box:

840 Gram

Notes

- Hard-metals can be used in electron tubes, though these are more difficult to use, and more costly than classic nickel. Hard metal Anodes have a more precise Anode distance, and do not change shape when heated, or at mechanical shock. This ensures reproducible tube parameters, and long term stability. Wolfram grids allow the most precise grid wire distance, because wolfram is an extreme hard metal. Best grid geometry ensures uniformity and linearity of the tube curves.
- Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)
- Average Plate Characteristics are made with the Sofia Digital Curve tracer.
- We are recommending the same values as Western Electric in their 1950 Data sheet.
- The Western Electric 1950 Data sheet. says 36 Watt maximum dissipation. Later data sheets say 40 Watt. Though 40 Watt is possible, this is a peak value only, and no normal working point. When you intent to get the maximum out of a 300B, and operate this tube at the limits of safe operation, it is a better idea to use the 300B-XLS in such a case.
- Some of our competitors claims to be the only one with a Center Tapped filament, but at EML we build since many years all tubes Cathode Tapped, not just this tube.
- Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
- Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves.
- The curves for the 300B are plotted, with AC heating. This is in accordance with the historical WE data sheet.



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300B-25 Mesh Data Sheet

Last Update: 09/05/2026 12:09:16

Description



The EML 300B-25 mesh is a **direct** replacement for the 2A3 tube. It features 2.5 Volt heater.

Warning: This tube can not be used in a classical 300B amplifier. For testing with a tube tester, you need to use 2A3 settings

[High Resolution](#)

Guarantee program for first owner.

The first owner can register the tube within 4 weeks after receipt, at the Emission Labs © website, to participate in the 5 years guarantee program, which is additional to the legal obligations of the seller.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

This is a 300B-Mesh tube, with the 2.5V heater of the 2A3.

Sound Character of the EML 300B-25

Users of 2A3 tubes, so far have a limited choice of tubes to use. There was only 2A3 and 2A3-Mesh. With the 300B-25 we offer an alternative tube. The idea is to get a slightly different sound, and possible a small gain in output power for any amplifier.

It is interesting to see, electrical data of the 300B tube at the operating point of 2A3 is very similar, and apart from the heater voltage, a 300B could replace the 2A3. So we have put the heater of the 2A3 tube inside a 300B, to get a 300B tube with heater specifications of the 2A3. We have called this tube 300B-25 ('25' stands for 2.5V heater).

Some customer feedback:

Hello Jac, It has been 3 weeks since I got my new Emission Labs 300B 2.5V. From the very beginning it became obvious to me how good they are. It is not surprising that after 21 days they are even better. They deliver incredibly razor sharp three-dimensional images I have never ever got from my speakers. The realism of presentation, richness and beauty of the music, harmony, emotions, the thrill of the listening - all of them are top notch. Really addictive tubes. The best of all 300B/2A3 hybrids I have ever used in my amp. I am really looking forward to mesh Anode version. P.S. If you want, you can quote my feedback on your new and very nice page.

***Placed here with the kind permission of Krzysztof Leonarcik**

TABLE

	<u>Plate Voltage</u> Volts	<u>Grid Bias</u> Volts	<u>Plate Current</u> Milliamperes	<u>Load Resistance</u> Ohms	<u>Power Output</u> Watts	<u>Second Harmonic</u> db	<u>Third Harmonic</u> db
Recommended Operating Conditions	200	— 42	30	2000	3.0	20	31
	200	— 39	40	2500	2.6	26	38
	200	— 37	50	2500	2.5	30	45
	250	— 55	30	2000	4.9	18	27
	250	— 55	30	4500	3.2	27	40
	250	— 52	40	3000	4.0	26	36
	250	— 50	50	2500	4.4	26	39
	250	— 48	60	2000	4.7	26	38
	250	— 48	60	2700	4.1	30	45
	250	— 45	80	1500	5.0	26	41
	300	— 65	40	2500	6.7	20	30
	300	— 63	50	2000	7.2	21	29
	300	— 63	50	3000	6.1	26	37
	300	— 61	60	2400	6.6	26	37
	300	— 61	60	3400	5.6	30	44
	300	— 58	80	1700	7.5	26	37
	350	— 76	50	3600	7.8	26	38

The above table shows three working points from the 1930's Western Electric 300B data sheet. The last working point shows 250V, 60mA, -45V bias. This is identical to the 2A3 tube. This means the tube will bias normally in any 2A3 auto bias circuit. Yet dynamic parameters are slightly different, which indicates sound will be slightly different as well. Due to the somewhat higher load (2A3 is loaded with 2k5 normally, vs. 2k7 required here for the 300B) the output power may be slightly increased accordingly. Also it can be seen, the 300B works in a range with the lowest distortion here, 30dB 2nd harmonics and even 45 dB 3rd, harmonics. Such good numbers can also be expected from the 300B-25.

Filament Ratings (See note 5)

Filament Voltage	2.5Volt (AC or DC)
Electronic heater modules	Only voltage source
Tolerance on filament voltage	4% 2.4 ... 2.6V at Tube pins 2.5 ... 2.7V at Socket pins See also this graph
Filament Current	2.5Ampere

All other Data

[See 300B Mesh](#)



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300B / 300BM+ Data Sheet

Last Update: 07/12/2026 12:36:23

Description

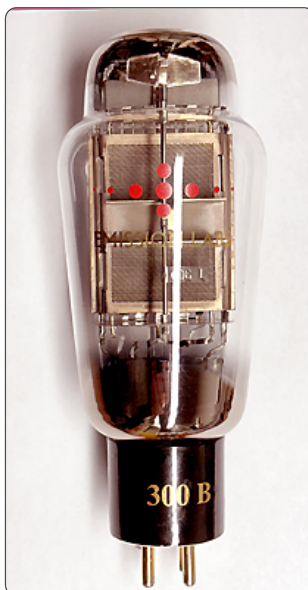


300B Solid Plate

This tube is a direct replacement for the Western Electric E300B as built until 1988. Glass height however is 15mm longer. Diameter is the same.

[High Resolution](#)

[300B Tube compare \(on Youtube\)](#)



300BM+ Mesh Plate

Product Release February 2026

This tube can be used in all 300B power amplifiers. For pre amplifiers and head phone we recommend Solid plate.

[High Resolution](#)

[Night View](#)

Guarantee program for first owner

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receipt, at the Emission Labs website, to participate in the 5 years guarantee program.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gold Plated Grid ([Note](#))
- **NEW** Soft rubber suspended tube base

Other 300B Versions

[Replacement Read me!](#)

[300B-XLM](#)

[300B-XLS](#)

[320B-XLS](#)

[520B](#)

- Hard metal Construction ([Note](#))
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a high quality dual box
- Tube printing with 24k gold, and red color burned into the glass
- Gold Plated pins, black ceramic socket, with white bottom

Sound Character of the EML 300B

It is probably the most asked question, and for this we refer to the genuine 300B, as made until 1988 by Western Electric itself, in the [Hawthorne plant](#), in USA.

The 300B tube has less interaction with the speaker system, as smaller tubes like the 45 have. This makes the overall sound less dependant on the speakers, and more dependant on the tubes itself. We see 300B often used with medium efficiency loudspeakers. Meaning, the tube often needs to work medium hard, which is indeed what the 300B is designed for. There are some more requirements too.

With low to medium efficiency speakers, relatively high output power at low distortion is required. Another requirement is, distortion should increase as little as possible, during the aging process. This requirement is often overseen, because tube owners have a high lifetime expectation anyway, even though this tube is loaded quite hard by some amplifiers. So the 300B has to build with as much as possible reserve emission. This is just what we are doing at EML. Low distortion needs emission reserve.

The low distortion of EML 300B, can optically be seen from the tube curves. This is demonstrated by the equal distance between each curve, specially where they are close to the horizontal axis, in the high voltage range. The more uniform at this difficult region, the higher the emission of the tube probably is. Compare this with other brands, and you will see the difference. We achieve this by our unique filament and grid construction, featuring a real, physical filament Cathode tap, positioned outside of the grid, but inside the glass bulb. We use gold plated grids, and a very long life cathode coating. The gold plated grid ensures constant tube data over the entire lifetime.

Sound Character of the EML 300B Mesh

Mesh tubes have a sound of it's own.

[Click here](#) for a detailed, general description.

EML 300B Filament Ratings	
Filament Voltage	= 5 Volt (AC or DC)
Electronic heater modules:	Only voltage source
Tolerance on filament voltage	-4... +5% 4.8 ... 5.25V at Tube pins 4.85 ... 5.30V at Socket pins See also this graph
Filament Current	~ 1.3 Ampere
Maximum Time on Stand By (Heater voltage only)	2 hours

EML-300B Factory Test conditions	
Anode Voltage	300V
Anode Current	60mA

EML-300B Factory Test Result at 300V, 60mA	
Grid voltage (AC heated)	-61V
Grid voltage (DC heated)	-58,5V

Transconductance	5.5 mA/V
Note: these are average values, variation is appr 5% for random tubes. Any other current will also give another transconductance	

EML-300B incoming inspection. Tested at 300V, 60mA Multiply -Grid Voltage with transconduction	
New tube. AC heated.	above 315
New tube. DC heated.	above 302

EML 300B Capacitance	
Grid to Plate	15pF
Grid to Filament	8.5pF
Anode to Filament	4pF

EML 300B Factory Test conditions	
Anode Voltage	300V
Anode Dissipation	17Watt
Anode Current	56mA
Anode Impedance	700 Ohm
Amplification Factor	3,9
Transconductance	5.6 mA/V
Control Grid Voltage	matched
Transconductance	matched

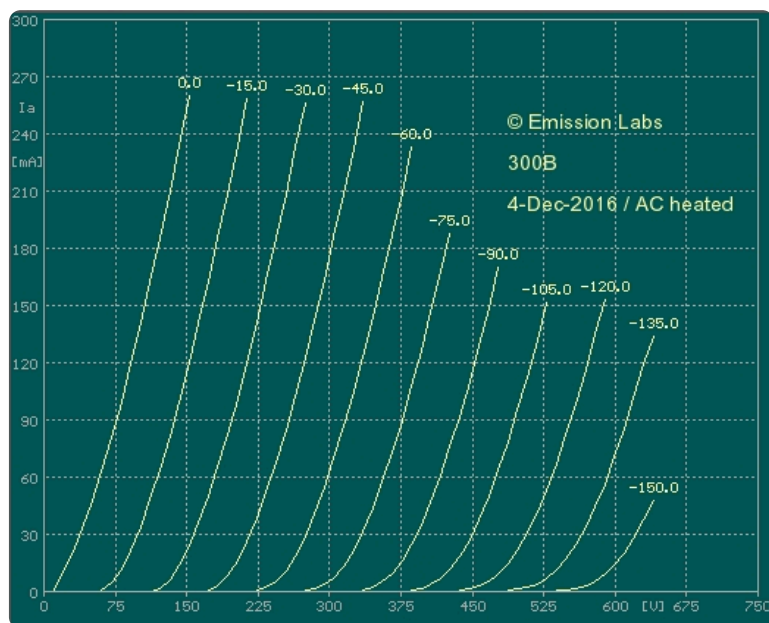
EML 300B Maximum Ratings (Not possible simultaneously)	
Maximum Anode Voltage	450V
Safe Maximum Anode Dissipation	36 Watt
Peak Anode Dissipation	40Watt
Maximum Anode Current Fixed Bias	70mA
Maximum Anode Current Auto Bias	100mA
Recommended grid Resistor	150k Auto Bias
Maximum grid resistor Auto Bias	250k Auto Bias

300B Recommended Single Ended operating points. Other choices are possible.							
Anode vs. Heater (Volt)	Grid (V) vs. Heater	Anode Current (mA)	Anode Rp (Ohm)	Load (Ohm)	Anode Dissipation (Watt)	Power Output Watt)	2nd harm. (dB)
350	-74	60	720	2000	21	10.2	21
350	-74	60	720	3000	21	8.3	26
350	-74	60	720	4000	21	7.0	30
350	-71	80	640	2200	28	9.6	26

400	-87	60	720	3500	24	10.5	26
400	-84	80	720	2500	32	12.5	25
450	-100	60	780	4000	27	12.5	26
450	-100	60	780	5500	27	10.0	30
450	-98	73	720	2000	33	16.2	21
450	-98	73	720	3000	33	13.2	25
450	-98	73	720	4500	33	10.5	30
450	-97	80	700	2000	36*	17.8	21
450	-97	80	700	3000	36*	14.6	26
450	-97	80	700	4500	36*	11.5	31

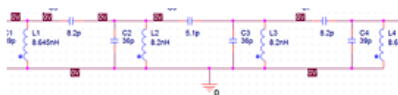
* Lifetime of 300B reduces at 36 Watt dissipation, regardless of the tube brand. For best lifetime, it is recommended to stay below 33 Watt. For highest output power and no compromise with lifetime or distortion, it recommended to choose the 300B-XLS.

Choice of output transformer impedance: For each working point, a wide range of primary impedance is possible. When using a transformer of another value, you can estimate the output power and distortion by averaging between two rows of this table. Example: 450V, 60mA. Use of Lundahl LL1679-70mA (4k5 type). This will give you appr. 11.5 Watt @ 27dB 2nd harmonics. (28dB distance of signal to 2nd harmonics.



EML 300B tube curves. See Note 3

[300B Anode Curves Print Version \(full size pdf\)](#)



[300B SPICE Parameters, made with EML tube.](#)

Some recommended Lundahl transformers

	Primary	Secondary	Auto Bias Cathode resistor	Anode Current	Anode Voltage to ground
LL1623-090mA 11Hz @1.5dB	3000Ω	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω	750 Ohms	80mA	435V

Alternative:

Use transformer Impedance Boards for LL1623 by JACMUSIC.

EE16 switches between 4 and 8Ohms at 3k.

EE18 switches between 8 and 16Ohms at 3k.

LL1664-080mA
13Hz @1.5dB

3000Ω

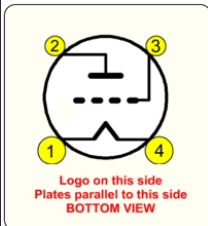
8Ω

750 Ohms

80mA

435V

Complete list of [recommendations here](#)

EML 300B Mechanical Data

Size including Socket
(but excluding pins)

148 x 65 mm

Pin 1: Heater1

Pin 4: Heater2

Pin2: Anode

Pin3: Grid

Weight of one tube:

145 Gram

Shipment weight for pair in gift box:

840 Gram

Notes

- Hard-metals can be used in electron tubes, though these are more difficult to use, and more costly than classic nickel. Hard metal Anodes have a more precise Anode distance, and do not change shape when heated, or at mechanical shock. This ensures reproducible tube parameters, and long term stability. Wolfram grids allow the most precise grid wire distance, because wolfram is an extreme hard metal. Best grid geometry ensures uniformity and linearity of the tube curves.
- Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)
- Average Plate Characteristics are made with the Sofia Digital Curve tracer.
- We are recommending the same values as Western Electric in their 1950 Data sheet.
- The Western Electric 1950 Data sheet. says 36 Watt maximum dissipation. Later data sheets say 40 Watt. Though 40 Watt is possible, this is a peak value only, and no normal working point. When you intent to get the maximum out of a 300B, and operate this tube at the limits of safe operation, it is a better idea to use the 300B-XLS in such a case.
- Some of our competitors claims to be the only one with a Center Tapped filament, but at EML we build since many years all tubes Cathode Tapped, not just this tube.
- Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
- Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves.
- The curves for the 300B are plotted, with AC heating. This is in accordance with the historical WE data sheet.



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EML 300B-XLS, 300B-XLM Data Sheet

Last Update: 07/12/2026 12:36:21

Description



This tube has the classical grid construction and the tube curves of the 300B. It has the stronger Anode construction and larger glass of the vintage 52B however. So in one tube we have combined the very best of two classical products.

[Front view](#)

[Side View](#)

Guarantee program for first owner.

The first owner can register the tube within 4 weeks after receipt, at the Emission Labs website, to participate in the 5 years guarantee program, which is additional to the legal obligations of the seller.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gold Plated Grid(Note8)
- **NEW** Soft rubber suspended tube base
- Hard metal Construction(Note1)
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a high quality dual box
- Tube printing with 24k gold, and red color burned into the glass
- YAMAMOTO tube sockets highly recommended.
- Gold Plated, black ceramic socket

Sound Character of the EML 300B-XLS

300B-XLS is an ideal choice, because good sound results from not over stressing the tube. This means the tube should not be working at the maximum electrical limits. Here we think the 300B-XLS is at its right place, taking advantage of the higher electrical reserve this tube has. The 300B-XLS will reproduce the required loudness with much more ease than the standard 300B. The result is a more transparent sound picture at low or medium volume, while at higher volume, the dynamics of the original recording will stay unaffected.

Other 300B Versions

Several other versions exist, ranging from a lower power 300B-Mesh tube, to the higher power 300B-XLS tube, or even the very high power 520B-V3 tubes. (The 520B is called like this for historical reasons, but is indeed a very large 300B. almost twice the power)

[About Replacement](#)

[300B](#)

[300B-Mesh](#)

[320B-XLS](#)

[520B](#)

Sound Character of the EML 300B-XLM

When a tube is given mesh Anodes, something magic happens to the sound. We believe this is caused by the better damping properties of the wire mesh material. A Solid Plate anode can have some ringing (bell like effect). A mesh anode will not have this effect. In most cases, when using mesh tubes, you will experience a more transparent sound stage. With mesh tubes you will enjoy the very best of what triodes have to offer. In general, we recommend to use mesh XLM at somewhat lower bias as the solid plate XLS. This is better for the tube, and it also develops it's characteristic, somewhat more silkier mesh sound.

Note: mesh means woven metal wire. Chinese factories make a tube with punched metal sheet, and for marketing purposes call this 'mesh'. Which is not so. Such a thin sheet punched Anode, will have a metallic sound, and will miss the damping properties, of the wire mesh anode.

For use in Push Pull amplifiers

300B-XLS is a very good choice, because Push Pull is hard on the tubes by definition. The 300B-XLS is made to deal with such conditions, and will allow the amplifier to play gently at low sound level, as well as reproduce higher sound level with the detail and precision you expect from a push pull amplifier. Even more suited for Push Pull is [320B-XLS](#).

Bias of the 300B-XLS / XLM

These tubes will bias in any amplifier the same way as the original WE300B. Still it can be used in two ways if you want it. These two methods are explained here.

1. It is possible to replace any 300B with this tube. Just plug it into any 300B amplifier, and the tube will set itself exactly to the original 300B working point. The EML 300B-XLS is a very strong tube, and it will develop the output power with more ease. Specially for amplifiers that let the 300B tubes work very hard, the EML 300B-XLS is the right product choose. Any amplifier that is trying to get as much as possible power out of a normal 300B, will benefit from the 300B-XLS. Improved sound and longer lifetime will be the result.
2. Another purpose is to get more power, as would be possible with standard 300B tubes. This can only be done when there is the possibility to adjust the bias of the amplifier higher. If the Anode current of the tube is set ABOVE the standard 300B specifications, the tube will now move to a part of the curves with lower Anode resistance. This is a specialty of the 300B-XLS and 300B-XLM. This will give a better damping factor of the bass loudspeakers, resulting not in more bass, but in a more natural sound. Check our customer feedback section of the website!
3. Alternatively the whole amplifier can be dedicated to only the 300B-XLS / XLM, if both anode voltage and current can be increased. A list of recommending working points is given, further down in this data sheet.

We have two versions for the heater:

Normal heater with the UX4 Socket, or Cathode Tapped heater with an octal socket for the 300B-XLS only. Tubes with the Cathode Tapped heater have an additional electrical connection, and need an octal socket for this reason. The Cathode Tap, provides a REAL electrical cathode, which simplifies schematics, improves signal to noise ratio, increases tube output power and lowers distortion. Yet, if desired afterwards, these can always be used as regular 300B-XLS, by simply not connecting the Cathode Tap.



Normal UX4 Socket



V4-Version with Octal Socket, only available for 300B-XLS

Here is a link to Application Note 06, describing the V4-Version in general.

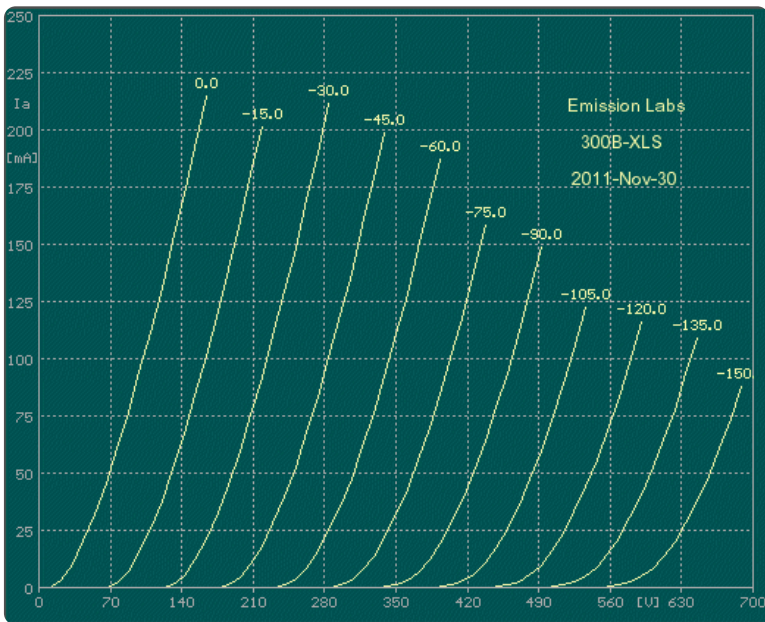
[Link to AN-06](#)

Filament Ratings (See note 5)		
	Standard tube 300B-XLS / XLM 4Pin Socket (UX4)	Cathode Tapped 300B-XLS V4 8Pin Socket (Octal)
Filament Voltage (AC or DC)	5 Volt	
Electronic heater modules:	Only Voltage Source Current source not recommended	
Tolerance on filament voltage	-4... +5% 4.8 ... 5.25V at Tube pins 4.9 ... 5.35V at Socket pins See also this graph	
Filament Current	~ 1.5Amp	

Factory Test conditions	300B-XLS	300B-XLM
Anode Voltage	495V	400V
Anode Current	100mA	75mA
Grid voltage (DC heated)	-104V	-88V
Transconductance	6.4 mA/V	6.2mA/V
Anode Current	100mA	75mA
Note: these are average values, variation is appr 5% for random tubes. Any other current will also give another transconductance		

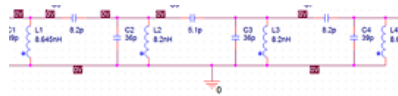
EML 300B-XLS incoming inspection. Tested at 495V, 100mA	
Multiply Grid Voltage with transconduction	
New tube	above 600

Maximum Ratings (Not possible simultaneously)		
	300B-XLS	300B-XLM
Maximum Anode Voltage	600V	600V
Maximum Anode Dissipation	55Watt	41 Watt
Peak Anode Dissipation	60Watt	60Watt
Maximum Anode Current Fixed Bias	110mA	110mA



300B-XLS / XLM have the same curves. See Note 3

These Curves as white Print Version



300B SPICE Parameters, made with EML tube.

Some recommended Lundahl transformers

	Primary	Secondary	Anode Current
LL1623-090mA 11Hz @1.5dB	3000Ω	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω	90mA
LL1623-120mA 13Hz @1.5dB	3000Ω	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω	110mA
LL2768-120mA	2700Ω	Alt.B = 8Ω Alt.C = 16Ω	110mA

Alternative:

Use transformer Impedance Boards for LL1623 by JACMUSIC.

EE16 switches between 4 and 8Ohms at 3k.

EE18 switches between 8 and 16Ohms at 3k.

LL1664-80mA 13Hz @1.5dB	3000Ω	8Ω	80mA
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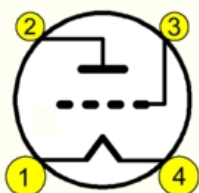
Complete list of [recommendations here](#)

300B-XLS / XLM Mechanical Data

Size including Socket (but excluding pins): 175 x 63mm

Weight of one tube: 140 Gram

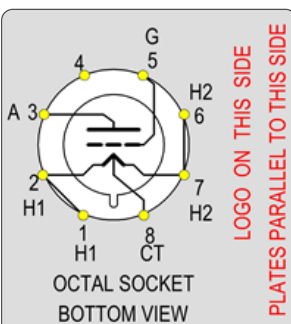
Shipment weight for pair in gift box: 750 Gram



Logo on this side
Plates parallel to this side
BOTTOM VIEW

Pin 1: Heater1
Pin 4: Heater2
Pin2: Anode
Pin3: Grid

Standard UX4 Base



Special Octal Base, V4 Version
only for 300B-XLS

Pin 1+2: Heater1
Pin 6+7: Heater2
Pin 8: Cathode Tap (Cathode)
Pin3: Anode
Pin5: Grid

Notes

1. Hard-metals can be used in electron tubes, though these are more difficult to use, and more costly than classic nickel. Hard metal Anodes have a more precise Anode distance, and do not change shape when heated, or at mechanical shock. This ensures reproducible tube parameters, and long term stability. Wolfram grids allow the most precise grid wire distance, because wolfram is an extreme hard metal. Best grid geometry ensures uniformity and linearity of the tube curves.
2. Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)
3. Average Plate Characteristics are made with the [Sofia Digital Curve tracer](#).
4. The Western Electric 1950 Data sheet. says 36 Watt maximum dissipation. Later data sheets say 40 Watt. Though 40 Watt is possible, this is a peak value only, and no normal working point. When you intent to get the 'maximum' out of a 300B, and operate this tube at the limits of safe operation, it is a much better idea to use the 300B-XLS in such a case.
5. Some of our competitors claims to be the only one with a Center Tapped filament, but at EML we build since many years all tubes Cathode Tapped, not just this tube.
6. Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
7. Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves.
8. The curves for the 300B-XLS are plotted, with DC heating. These are also valid for the 300B-XLM.
9. Heater voltage is always defined at the tubes pins itself. There may be some voltage drop along the wires, and tube contacts as well. So voltage measured at the tube socket wiring should ideally be 5.1V.



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EML 300B-XLS, 300B-XLM Data Sheet

Last Update: 07/12/2026 12:36:21

Description



This tube has the classical grid construction and the tube curves of the 300B. It has the stronger Anode construction and larger glass of the vintage 52B however. So in one tube we have combined the very best of two classical products.

[Front view](#)

[Side View](#)

Guarantee program for first owner.

The first owner can register the tube within 4 weeks after receipt, at the Emission Labs website, to participate in the 5 years guarantee program, which is additional to the legal obligations of the seller.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gold Plated Grid(Note8)
- **NEW** Soft rubber suspended tube base
- Hard metal Construction(Note1)
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a high quality dual box
- Tube printing with 24k gold, and red color burned into the glass
- YAMAMOTO tube sockets highly recommended.
- Gold Plated, black ceramic socket

Sound Character of the EML 300B-XLS

300B-XLS is an ideal choice, because good sound results from not over stressing the tube. This means the tube should not be working at the maximum electrical limits. Here we think the 300B-XLS is at its right place, taking advantage of the higher electrical reserve this tube has. The 300B-XLS will reproduce the required loudness with much more ease than the standard 300B. The result is a more transparent sound picture at low or medium volume, while at higher volume, the dynamics of the original recording will stay unaffected.

Other 300B Versions

Several other versions exist, ranging from a lower power 300B-Mesh tube, to the higher power 300B-XLS tube, or even the very high power 520B-V3 tubes. (The 520B is called like this for historical reasons, but is indeed a very large 300B. almost twice the power)

[About Replacement](#)

[300B](#)

[300B-Mesh](#)

[320B-XLS](#)

[520B](#)

Sound Character of the EML 300B-XLM

When a tube is given mesh Anodes, something magic happens to the sound. We believe this is caused by the better damping properties of the wire mesh material. A Solid Plate anode can have some ringing (bell like effect). A mesh anode will not have this effect. In most cases, when using mesh tubes, you will experience a more transparent sound stage. With mesh tubes you will enjoy the very best of what triodes have to offer. In general, we recommend to use mesh XLM at somewhat lower bias as the solid plate XLS. This is better for the tube, and it also develops it's characteristic, somewhat more silkier mesh sound.

Note: mesh means woven metal wire. Chinese factories make a tube with punched metal sheet, and for marketing purposes call this 'mesh'. Which is not so. Such a thin sheet punched Anode, will have a metallic sound, and will miss the damping properties, of the wire mesh anode.

For use in Push Pull amplifiers

300B-XLS is a very good choice, because Push Pull is hard on the tubes by definition. The 300B-XLS is made to deal with such conditions, and will allow the amplifier to play gently at low sound level, as well as reproduce higher sound level with the detail and precision you expect from a push pull amplifier. Even more suited for Push Pull is [320B-XLS](#).

Bias of the 300B-XLS / XLM

These tubes will bias in any amplifier the same way as the original WE300B. Still it can be used in two ways if you want it. These two methods are explained here.

1. It is possible to replace any 300B with this tube. Just plug it into any 300B amplifier, and the tube will set itself exactly to the original 300B working point. The EML 300B-XLS is a very strong tube, and it will develop the output power with more ease. Specially for amplifiers that let the 300B tubes work very hard, the EML 300B-XLS is the right product choose. Any amplifier that is trying to get as much as possible power out of a normal 300B, will benefit from the 300B-XLS. Improved sound and longer lifetime will be the result.
2. Another purpose is to get more power, as would be possible with standard 300B tubes. This can only be done when there is the possibility to adjust the bias of the amplifier higher. If the Anode current of the tube is set ABOVE the standard 300B specifications, the tube will now move to a part of the curves with lower Anode resistance. This is a specialty of the 300B-XLS and 300B-XLM. This will give a better damping factor of the bass loudspeakers, resulting not in more bass, but in a more natural sound. Check our customer feedback section of the website!
3. Alternatively the whole amplifier can be dedicated to only the 300B-XLS / XLM, if both anode voltage and current can be increased. A list of recommending working points is given, further down in this data sheet.

We have two versions for the heater:

Normal heater with the UX4 Socket, or Cathode Tapped heater with an octal socket for the 300B-XLS only. Tubes with the Cathode Tapped heater have an additional electrical connection, and need an octal socket for this reason. The Cathode Tap, provides a REAL electrical cathode, which simplifies schematics, improves signal to noise ratio, increases tube output power and lowers distortion. Yet, if desired afterwards, these can always be used as regular 300B-XLS, by simply not connecting the Cathode Tap.



Normal UX4 Socket



V4-Version with Octal Socket, only available for 300B-XLS

Here is a link to Application Note 06, describing the V4-Version in general.

[Link to AN-06](#)

Filament Ratings (See note 5)		
	Standard tube 300B-XLS / XLM 4Pin Socket (UX4)	Cathode Tapped 300B-XLS V4 8Pin Socket (Octal)
Filament Voltage (AC or DC)	5 Volt	
Electronic heater modules:	Only Voltage Source Current source not recommended	
Tolerance on filament voltage	-4... +5% 4.8 ... 5.25V at Tube pins 4.9 ... 5.35V at Socket pins See also this graph	
Filament Current	~ 1.5Amp	

Factory Test conditions	300B-XLS	300B-XLM
Anode Voltage	495V	400V
Anode Current	100mA	75mA
Grid voltage (DC heated)	-104V	-88V
Transconductance	6.4 mA/V	6.2mA/V
Anode Current	100mA	75mA
Note: these are average values, variation is appr 5% for random tubes. Any other current will also give another transconductance		

EML 300B-XLS incoming inspection. Tested at 495V, 100mA	
Multiply Grid Voltage with transconduction	
New tube	above 600

Maximum Ratings (Not possible simultaneously)		
	300B-XLS	300B-XLM
Maximum Anode Voltage	600V	600V
Maximum Anode Dissipation	55Watt	41 Watt
Peak Anode Dissipation	60Watt	60Watt
Maximum Anode Current Fixed Bias	110mA	110mA



Some recommended Lundahl transformers			
	Primary	Secondary	Anode Current
LL1623-090mA 11Hz @1.5dB	3000Ω	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω	90mA
LL1623-120mA 13Hz @1.5dB	3000Ω	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω	110mA
LL2768-120mA	2700Ω	Alt.B = 8Ω Alt.C = 16Ω	110mA

Alternative:

Use transformer Impedance Boards for LL1623 by JACMUSIC.

EE16 switches between 4 and 80ohms at 3k.

EE18 switches between 8 and 160ohms at 3k.

LL1664-80mA 13Hz @1.5dB	3000Ω	8Ω	80mA
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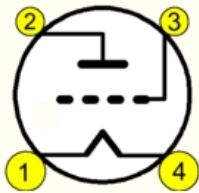
Complete list of [recommendations here](#)

300B-XLS / XLM Mechanical Data

Size including Socket (but excluding pins): 175 x 63mm

Weight of one tube: 140 Gram

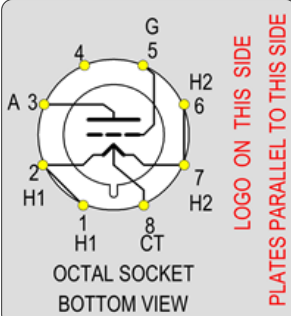
Shipment weight for pair in gift box: 750 Gram



Logo on this side
Plates parallel to this side
BOTTOM VIEW

Pin 1: Heater1
Pin 4: Heater2
Pin2: Anode
Pin3: Grid

Standard UX4 Base



Special Octal Base, V4 Version
only for 300B-XLS

Pin 1+2: Heater1
Pin 6+7: Heater2
Pin 8: Cathode Tap (Cathode)
Pin3: Anode
Pin5: Grid

Notes

1. Hard-metals can be used in electron tubes, though these are more difficult to use, and more costly than classic nickel. Hard metal Anodes have a more precise Anode distance, and do not change shape when heated, or at mechanical shock. This ensures reproducible tube parameters, and long term stability. Wolfram grids allow the most precise grid wire distance, because wolfram is an extreme hard metal. Best grid geometry ensures uniformity and linearity of the tube curves.
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5. Some of our competitors claims to be the only one with a Center Tapped filament, but at EML we build since many years all tubes Cathode Tapped, not just this tube.
6. Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
7. Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves.
8. The curves for the 300B-XLS are plotted, with DC heating. These are also valid for the 300B-XLM.
9. Heater voltage is always defined at the tubes pins itself. There may be some voltage drop along the wires, and tube contacts as well. So voltage measured at the tube socket wiring should ideally be 5.1V.



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Data Sheet

12B, 20A, 20B, 20B-V4, 30A

Last Update: 02/18/2026 11:45:33

Description

This is a series of tubes with medium gain, with very good voltage capabilities, and very low distortion even at high signal.

Applications

		ANODE TYPE	Driver tube	Line Out	Speaker Output	OTA	Head Phone	Sakuma
	12B	Black Powdered	Yes	Yes	Yes	.	Yes	Ideal.
	20A	Mesh	Yes	Yes	.	.	.	
	20B	Black Powdered	Yes	Yes	Yes	Yes	Yes.	
	20B- V4	Black Powdered	Yes	Yes	Yes	Yes	Yes	
	30A	White Powdered	Yes	Yes				

Guarantee program for first owner.

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receipt, at the Emission Labs web site, to participate in the 5 years guarantee program.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gold Plated Grid. ([See Notes](#))
- **NEW** Soft rubber suspended tube base
- Hard metal Construction ([See Notes](#))
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a high quality dual box
- Tube printing with 24k gold, and red color burned into the glass
- Gold Plated, black ceramic socket

12B

This tube has gain of appr. 12x, and medium-low impedance. It can be used in almost any application, including speaker output at almost 5 Watt. Also, beautifully 12B can be used as a [SAKUMA](#) amplifier, using a 12B to drive a 12B speaker tube. This tube has sound resemblance to the vintage PX25, due to curve similarity.

20A

This is a mesh tube, with gain of appr. 20x, and medium impedance. It has a very pleasant triode sound, due to nearly total absence of odd harmonics. It's application is a driver tube for medium signal.

20B

This is a solid plate version of the 20A. It works well in all 20A circuits, but can also be biased higher as 20A. At medium voltage it is a wonderful driver tube. For lower signal it may be used at low anode voltage, like 250V. At higher anode voltage, up to 580V, 20B becomes capable of delivering very high output signal, as required for instance to drive the 845 or GM70 tube. Also at higher voltage it can deliver a few Watts output power. It can be used as driver tube or low power output tube.

20B-V4

V4 means only the heater wire has a center tap. This gives a fifth connection, so this tube needs an octal base. It is compatible to the classical 20B, but offers the advantage of the center tap on the filament. The center tap, provides a real cathode connection, for a simpler circuit, yet with better performance.

[Application Note AN-6](#) explains the meaning of the V4 Version.

30A

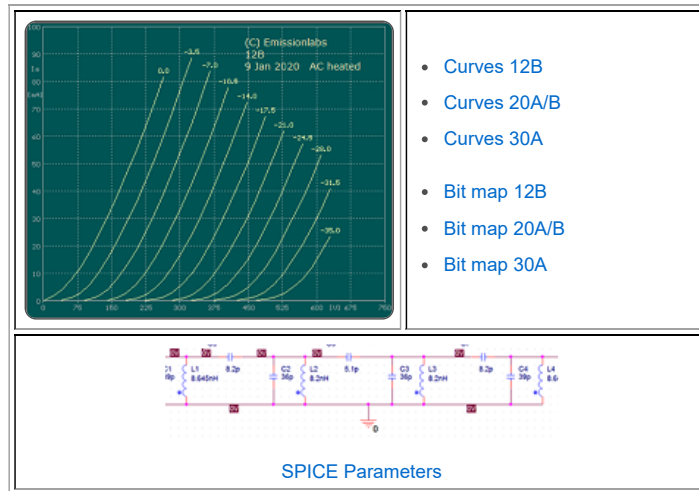
The 30A has an unloaded gain of appr. 30x. It is intended to combine the driver and pre-amplifier tube in one. This tube has exceptional low distortion, below 0,1% 2nd harmonics, and 0.01% 3rd harmonics, at FULL signal output of 60Volt RMS. [Here is a print of the simulation program, to show this](#). This program used [these 30A tube curves](#), measured with the Sofia curve tracer. At lower signal, distortion drops even further.

Filament Ratings		
	Standard tube 12B, 20A, 20B, 30A 4Pin Socket (UX4)	Cathode Tapped 20B-V4 8Pin Socket (Octal)
DC voltage recommended	= 5Volt	= 2.5 - 0 - 2.5Volt
Electronic heater modules:	Only voltage source	Only voltage source
Tolerance on filament voltage	5%	5%
Filament Current	~ 1,4Amp	~ 1,4Amp

Maximum Conditions (See Notes)	EML 12B	EML 20A	EML 20B	EML 30A
Anode Voltage	500V	490V	580V	500V
Anode Current	60mA	40mA	60mA	40mA
Continuous Anode Dissipation	25Watt	11Watt	25Watt	11Watt
Grid resistor	below 470k	below 470k	below 470k	below 470k

Factory Test Data	EML 12B	EML 20A	EML 20B	EML 30A
Anode Voltage	390V	400V	420V	400V
Anode Current	40mA	25mA	42mA	25mA
Anode Impedance (Rp)	2k9	3k7	3k	6k2
Amplification Factor	13.5	21	21	32
Transconductance	5.6 mA/V	4,2mA/V	6,9mA/V	5,2mA/V
Control Grid Voltage <i>Tested with DC heating</i>	-16V	-7.4V	-5,6V	

Control Grid Voltage <i>Tested with AC heating.</i>		-9,9V	-8,1V	
- Control Grid Voltage. <i>Actual voltage depends on individual tubes.</i> Factory test data is taken with DC heating. - Gain is unloaded gain, as will occur choke or inter stage loaded. If resistor loaded, gain will be lower.				



12B Some operating points.

This is AC heated. If DC heated, Grid voltage shifts 2.5 Volt. (See Notes)

Anode Voltage	Grid Voltage See Notes	Input	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
430V See Chart	-20.9V	4.1V RMS	831R	25mA	14.6	3k1	Choke or inter stage	LL1668-25mA	60V RMS	0,03%	Driver Stage
430V See Chart	-15V	10,7V RMS	257R	58mA	10	2k3	5k	LL1663-60mA	2,2Watt	1.4%	Output Stage
430V See Chart	-15V	10,7V RMS	257R	58mA	10.8	2k3	6k5	LL9202-50mA	2Watt	0.9%	Output Stage
500V See Chart	-21.1V	14,9V RMS	422R	50mA	10	2k4	5k	LL1663-50mA	4,1Watt	3,3%	Output Stage
500V See Chart	-21.1V	14,9V RMS	420R	50mA	10.5	2k4	6k5	LL9202-50mA	3.8Watt	2.1%	Output Stage

As a driver stage, most power tubes like 300B, need appr 60V RMS on the grid. Using 12B as a driver, only 4.1V is needed. This can be achieved with a 4x step up transformer, which gives this gain free of noise and microphonics, and supplies even a balanced input.

20A Some operating points

Anode Voltage	Grid Voltage See Notes	Input RMS	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
350V See Chart	-12.6V	3.14V	1263	10mA	20.8	5k4	Choke loaded	LL1668-10mA	60V RMS	0,17%	Driver Stage

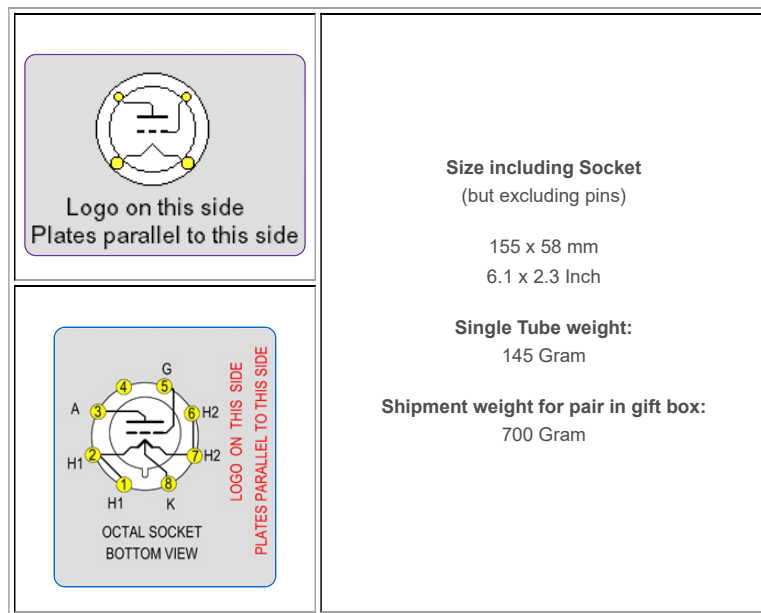
For full output signal, most power tubes like 300B, need appr 60V RMS on the grid. This is 170 Volt peak to peak, and it needs good consideration how to generate such high signal free of noise and distortion. Using 20A as a driver, only 3.14V is needed. This can be achieved with a 3x step up transformer, which gives this gain free of noise and microphonics, and supplies even a balanced input and no further drive tube is needed.

20B Some operating points

Anode Voltage	Grid Voltage See Notes	Input RMS	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Load (Ohm)	Lundahl Trans former	Output	Tube Dist. Total	Use as
521V See Chart	-12,2V	8.5V	254R	48mA	16.4	2k9	11k	LL9202-50mA	1,8Watt	1%	Output Stage
580V See Chart	-15.7V	11.1V	368R	43mA	13.4	3k	6k5	LL9202-50mA	3,59Watt	3.7%	Output Stage
								LL2935B			Output Stage

30A Some operating points

Anode Voltage	Control Grid Voltage See Notes	Anode Current (mA)	Trans-Conduc-tance (mA)	Tube Ri (Ohm)	Gain (mu)
300	-3	10	4.6	8k	36
300	-2	15	5.3	6k6	35
300	-1	20	5.5	5k9	33
360	-5	10	4.4	8k	36
360	-3.8	15	5.1	6k9	35
360	-2.8	20	5.7	6k	34
360	-2	25	6.2	5k6	34
360	-1.1	30	6.6	5k1	34
420	-6,7	10	4.3	8k5	36
420	-5.6	15	5.0	7k	35
420	-4.6	20	5.5	6k	33
480	-8.6	10	4.1	9k3	38
480	-7.5	15	4.9	7k2	35
480	-6.5	20	5.5	6k3	35



Notes

- Hard-metals can be used in electron tubes, though these are more difficult to use, and more costly than classic nickel. This ensures reproducible tube parameters, and long term stability.
- Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)
- Plate Characteristics are made with the Sofia Digital Curve tracer.
- We are recommending the same values as Western Electric in their 1950 Data sheet.
- Some of our competitors claims to be the only one with a Center Tapped filament, but at EML we build since many years all tubes Cathode Tapped, not just this tube.
- Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
- Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves

Use as Pre Amplifier

Application info #1

For use in a separate pre amplifier, a DHT must be used with low noise in mind. Typically the wrong way for this would be to build a pre amplifier with more gain as needed, and then attenuate the **input** signal by the input volume knob accordingly.

Though people LOVE to do this, it is wrong! Such amplifiers will function dissatisfactory because of low signal to noise ratio, and also will sound sterile.

A good pre amplifier, will use an attenuating output transformer, reducing the gain of the complete product, to a number, not higher than needed. Which is 1x for a pre amplifier, or in rare cases 2x. . This will lower the output impedance of the pre amplifier with the square of the transformer attenuation which is the

essential real reason for doing so. Now, with the lower output impedance, a 600 Ohms potentiometer can be used directly at the output. Doing it like this, will drastically reduce noise as well as microphonics. Yet maintain triode sound. In this configuration, the plate signal of the output tube itself, will be 10...40 Volts, also at very low output volume setting. This prevents sterile sound. Overall Signal to Noise ratio stays very high, and microphonics are low. With such a pre amplifier, even a twisted wire pair can be used at the output, to replace shielded cable, and at very low signal the pre amplifier will be 'dead' silent, or in engineering words, have a very high Signal to Noise ratio.

20B use as OTA

Application info #2

OTA stands for One Tube Amplifier. So yes, this means a complete HiFi amplifier with only one tube. This is a concept where no pre amplifier tube and no driver tube is used. The output tube is typically 20B-V4 in such a case, and it provides almost enough gain by itself. The missing gain of appr 2...4x can be achieved by a passive gain stage, in the form of a small step input transformer from Lundahl. (We supply PCB for this, with programmable gain of 1..4x, using LL1544A). Such a passive stage costs less than a good tube stage, and provides gain at zero hum and zero noise. We much recommend this concept if only a few Watt output power is needed. Sound of the 20B-V4, as speaker driver will be 'sweet' and not dominant. Moreover, tube sound develops with the 20B also at low volume. Due to exact geometry of the anode box, there will be no audible third harmonics. So any influence will be only by second harmonics, thus achieving in a very good way, what is called triode sound.

Search the internet for this phrase: "OTA 20B One Tube Amplifier", or also click on "Professional Users" on the jacmusic website, and search that page for the phrase "20B"

12B Notes

Application info #3

For driving a 300B, it needs appr. 60V AC signal. Quite a lot, but 12B can do this nicely, and a lot higher voltage too.

It is recommended to check at the external website, jacmusic.com, for the EE-08 and EE-20 board, at the Lundahl Section. These transformer boards will supply the needed gain.

In addition, 12B seems IDEAL to build a SAKUMA amplifier. This very clever concept works almost free of distortion, as long as driver stage and output stage are identical. Enter **SAKUMA** in the search box of the jacmusic.com website. (external website)

About Noise and Distortion

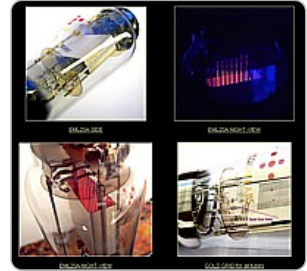
12B, 20A, 20B, 30A tubes are based on a very old principle, where high gain tubes have much wider Anode distance. This is still the ultimate way to make a very linear DHT high gain tube. Miniaturization has always been the enemy of tube linearity, specially with DHT. For this reason, the 20A/20B/30A will outdo any small size tube. We encourage you to check the tube curves of any miniature tube, like 6SN7, ECC88 or ECC82, and you will see this series presented here is much superior. However this results of larger dimension tubes is a higher working voltage. For this reason, tubes like this were not made any more after 1935, when miniaturization of tubes started to become more important. With the new production tubes we make today, miniaturization is no requirement. So for high gain tubes, we can now focus on lowest possible distortion. We build these tubes again the original way, with wide Anodes. [Check Anode picture here.](#)

These tubes belong to the lowest distortion tubes ever build. Total distortion for small signal has been measured below 0,08% at 10 Volt Eff output signal, 400V Anode. The distortion will almost not increase at higher signal. ([See Note5](#)) . Interestingly, when one DHT triode is driving another, a part of the distortion of the second tube will be eliminated by the first tube. This even harmonics cancellation appears only with triodes, and they must be similar tubes, like drive a 300B with one of the tubes of this series. Since Triodes produce very low uneven harmonics, canceling the overall distortion this way, is an amazing application of the 20B or 30B tube. ([See note 4](#))

For lowest possible mechanical noise with (any) high gain DHT pre-amp tube, use high quality tube sockets that do not pass the chassis vibrations to the tube. Chassis vibrations can come directly from

the mains transformer, or by air from the loudspeaker. The best sockets for this are probably the Yamamoto Teflon, because Teflon is a flexible material. Use tight fitting Teflon tube dampers such as the Duende Criteria. They make the best damper for the EML tubes. They can be fit very nicely on the tube top, or one on the top and one on the bottom.

Note about Blue Glow Appearance.



These tubes will often produce a blue glow on the glass. This is because of the wider Anode distance, some electrons escape after collision. The fluorescent light pattern changes with the voltage or with the signal. These light effects are normal for this type of tube. It must not be confused with gassy tubes, which produce a purple-blue cloud inside the Anodes. [D](#)



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EML 320B-XLS Data Sheet

Replaces also 842 tube

Last Update: 01/11/2026 09:34:10

Description



This tube is the same as 300B-XLS, apart from the heater current, which is higher. For this reason we point out only the differences, and for all other information we refer to the [300B-XLS data sheet](#).

[Front view](#)

[Side View](#)

The intention of 320B-XLS vs 300B-XLS

With tubes, when increasing the heater power, the tube gets more suited for harder conditions. For this reason we recommend the 320B in situations where 300B-XLS would be used near the end of it's possibilities. Such as biased close to maximum, and for Push-Pull amplifiers. Though Push Pull can be made with any 300B, it is known to be harder on the tubes than a Single Ended design.

Sound Character of the EML 320B-XLS

Generally the even higher heater power of the 320B-XLS will give the tube a fraction more impulsiveness if used at high output power. So for designers who want to get the upmost in terms of output power, but are reluctant to stress the 300B-XLS very hard, 320B-XLS is the choice.

For use in Push Pull amplifiers, this tube is also a natural choice, because this type of amplifier is hard on the tubes by definition. The 320B-XLS is made to deal with such conditions, and will allow the amplifier to play gently at low sound level, as well as reproduce higher sound level with the detail and precision you expect from a push pull amplifier.

EML 320B-XLS filament Ratings

Heater Voltage (AC or DC)	5 Volt
Electronic heater modules:	Only voltage source
Tolerance on heater voltage	5%
heater Current	~ 1.7 Ampere

EML-320B-XLS Factory Test conditions

Anode Voltage	495V
Anode Current	110mA

Other 300B Versions

Several other versions exist, ranging from a lower power 300B-Mesh tube, to the higher power 320B-XLS tube, or even the very high power 520B-V3 tubes. (The 520B is called like this for historical reasons, but is indeed a very large 300B. almost twice the power).

[300B](#)

[300B-Mesh](#)

[300B-XLS](#)

[520B](#)

EML-320B-XLS Factory Test Result at 495V, 110mA

Grid voltage (DC heated)	-104V
Transconductance	6.7 mA/V

Note: these are average values, variation is appr 5% for random tubes. Any other current will also give another transconductance

**EML-320B-XLS incoming inspection. Tested at 495V,
110mA**

Multiply -Grid Voltage with transconduction

New tube	minimum 655
----------	-------------

EML 320B-XLS Maximum Conditions
(Voltage and current not possible simultaneously - not
a recommended operating point)

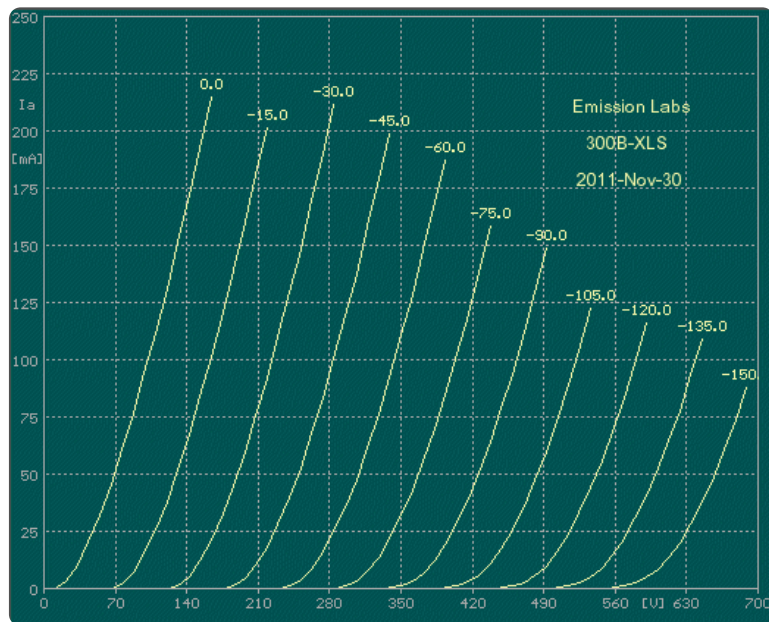
Anode Voltage	550Volt
Anode Current	160mA
Power Output in Class A	22Watt
Peak Anode Dissipation	65 Watt, one minute
Highest possible Grid to ground resistor, Single Ended.	150kOhm
Highest possible Grid to ground resistor, Push-Pull.	50kOhm

320B-XLS Recommended Single Ended operating points (This is just a selection, other choices are possible)

Anode Voltage (Against Heater)	Control Grid Voltage (Against Heater)	Anode Current (ma)	Anode Rp (Ohm)	Load (Ohm)	Anode Dissipation (Watt)	Power Output (Watt)	2nd harm. (dB)
450	-97	80	700	2000	36	18	22
450	-97	80	700	3000	36	15	26
450	-97	80	700	4500	36	12	31
475	-97	90	670	1900	43	21	23
475	-97	90	670	2800	43	17	27
475	-97	90	670	4200	43	14	32
500	-98	110	630	1800	55	27	23
500	-98	110	630	2700	55	22	27
500	-98	110	630	4000	55	17	32

Choice of output transformer impedance: For each working point, a wide range of primary impedance is possible. When using a transformer of another value, you can

estimate the output power and distortion by averaging between two rows of this table.
 Example: 500V, 110mA. Use of Lundahl LL1623-120mA (3k type). This will give you
 appr. 20 Watt @ 28dB 2nd harmonics. (28dB distance of signal to 2nd harmonics.



Curves of 320B-XLS apply

[Anode Curves Print Version \(full size pdf\)](#)



[Download these curves as PTE file](#)

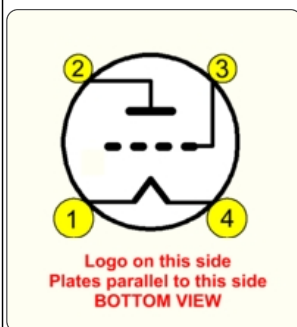
[What is a PTE file?](#)

Some recommended Lundahl transformers

	Primary	Secondary	Anode Current
LL1623-090mA 11Hz @1.5dB	3000Ω	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω	90mA
LL1623-120mA 13Hz @1.5dB	3000Ω	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω	120mA
Alternative: Use transformer Impedance Boards for LL1623 by JACMUSIC. EE16 switches between 4 and 8Ohms at 3k. EE18 switches between 8 and 16Ohms at 3k.			
LL1664-80mA 13Hz @1.5dB	3000Ω	8Ω	80mA
Complete list of recommendations here			

320B-XLS Mechanical Data

Size including Socket (but excluding pins): 175 x 63mm
Weight of one tube: 140 Gram
Shipment weight for pair in gift box: 750 Gram



Standard UX4 Base

Pin 1: Heater1
Pin 4: Heater2
Pin2: Anode
Pin3: Grid



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EML45 Data Sheet

Last Update: 07/12/2026 12:36:39



45 years after the last American tubes of 'Type 45' were made, EML was the first company, to take this tube back in production again, in the year 2001. The EML has 4 four original V-shaped filaments like found in vintage 45 tubes. (See note4) This tube has fully original specifications of the American RCA Type. All critical parts are made of hard metal for higher reliability and reproducible quality.

[High Resolution](#)

Guarantee program for first owner.

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receipt, at the Emission Labs website, to participate in the 5 years guarantee program.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Gold Grid

We have added a gold grid to all EML tubes, some time ago, also to the 45. Very few NOS tubes have this. You can see the gold color of the grid wire when you look into the tube in the sunlight. The gold grid will give better bias stability, and you will may see the EML tubes bias perfectly right out of the box, and no bias change during burn in. Also read the next table 'features'. As an overall total result, the standard 45 is a no compromise replacement for the original RCA 45. Check also the 45-mesh data sheet.

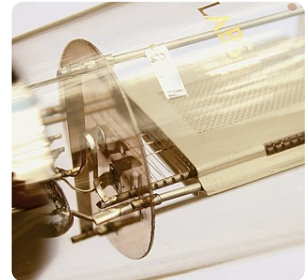
Features

- Nano Ampere range grid current, vs NOS tubes which can have sometimes 2uA.
- Cathode Tapped filament
- 30% lower distortion compared to any other 45. [Read here.](#)
- Hard metal Construction (Note1)
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a [high quality dual box](#)
- Tube printing with real gold (metal), red color is glass burned into the glass
- YAMAMOTO tube sockets highly recommended.
- Gold Plated pins, black ceramic socket. (White bottom.)

Sound Character of the EML 45

We are often asked to describe the sound of our 45 tubes. If you are looking for real triode sound, the 45 tube is very interesting. It is important that tubes and speakers fit together well. So low power tubes

All 45 Versions



Several other versions exist. We have a solid plate version, the 45M (mesh) version, and the new 45B, which can be used to achieve higher output power. Additionally we sometimes build a limited series of globe glass 45 or 45M tubes.

[45 \(Solid\)](#)

[45M \(Mesh\)](#)

[45B](#)

[Globe](#)

Lifetime of the 45



We have this amazing lifetime report by a customer from Canada, who build a pair of 45 into an amplifier with hour counter on it.

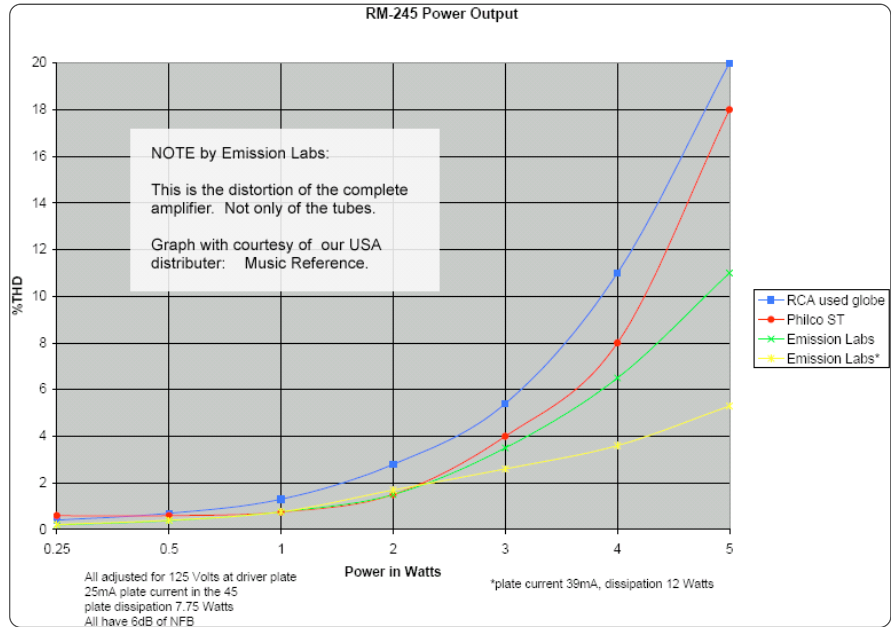
[Read more...](#)

Very Nice Article

sound best at high efficiency speakers, and vice versa. Best sound of the 45 is developed at the very sweet first Watt. The 45 will reward you with best sound when you are using high efficiency speaker systems, starting at 96..99dB. At the same time, here comes a drawback for the amplifier and the tubes as well. Such speaker systems of 100dB and above will make smallest imperfections audible, and the amplifier must produce as little hum and noise as can be. This is difficult. When you are thinking of 108db horn systems this stresses the design limits of tubes and amplifiers a lot. A quick way to test the noise level of your amplifier-tube combination is, to measure the AC signal out of the amplifier with the inputs muted, but the speaker connected. Anything below 3 millivolt at 8 Ohms is a good achievement, and such an amplifier below 1 millivolt can be called a fine piece of work. If an amplifier will produce low hum with many different tubes, this is definitely a better design, than such an amplifier that is critical on the tubes. Of course, here the tubes play a major role too. At EML we have greatly reduced hum and distortion of all tubes, by a new filament construction. This was done by a real, physical filament Cathode Tap, that is positioned outside of the Anodes, but inside the glass bulb. The result was, we reduced the hum level of the EML45 even below that of many good NOS tubes.

~~Updated~~ We have two versions for the heater: Normal heater, or Cathode Tapped heater. Here is a link to Application Note 06, describing the Cathode Tapped tubes in general. [Link here](#).

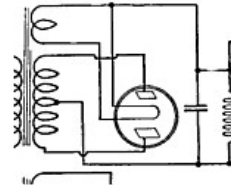
Distortion of the EML45, versus Power Output



Distortion of the EML tubes is probably the lowest you can have. Here is a link to detailed test results, made for us by Roger Modjeski from RAM LABs, USA. From this you can see, the EML 45 is having the best results, most specially at higher signal level. For equal loudness, the human ear needs higher power at lower frequencies, and this is present in all music in a natural way. The result is though, bass tones of amplifiers have the highest electrical signal level, so bass distortion appears always first. This will change the sound character, making the bass less 'dry'. At medium volume you don't hear this as distortion. What you do hear is, the overall sound picture gets less precise, less natural, and it makes your ears tired from listening sooner. This is a very important mechanism to understand. The EML45 tubes give a strong contribution here, by reproducing the bass sound with smallest distortion a 45 tube can do.

EML 45 Filament Ratings

Filament Voltage	2.5Volt (AC or DC)
Electronic heater modules:	Only voltage source
Tolerance on filament voltage	5%
Filament Current	~ 1.5Ampere
Maximum Time on Stand By (Heater voltage only)	2 hours



Written it 1929, but nothing has changed ever since.

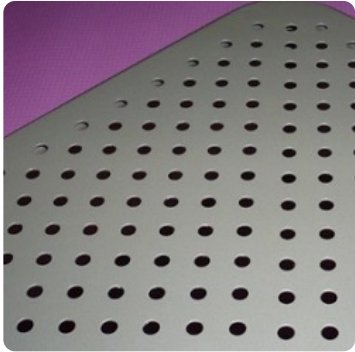
[Full article](#)

Did you know?



Emission Labs was the first company to re-introduce the 45 tube again, in 2001

Warning for FAKE mesh



[Full article](#)

EML 45 Maximum Conditions	
Anode Voltage	300Volt
Anode Current	45mA
Continuous Anode Dissipation	11Watt
Power Output in Class A	2.5 Watt
Grid resistor, highest possible value (Important: Note5)	500k Ohm

EML 45 Factory Test conditions	
Anode Voltage to Cathode	250V
Anode Current	34mA
Grid Voltage	at above conditions
Transconductance	at above conditions

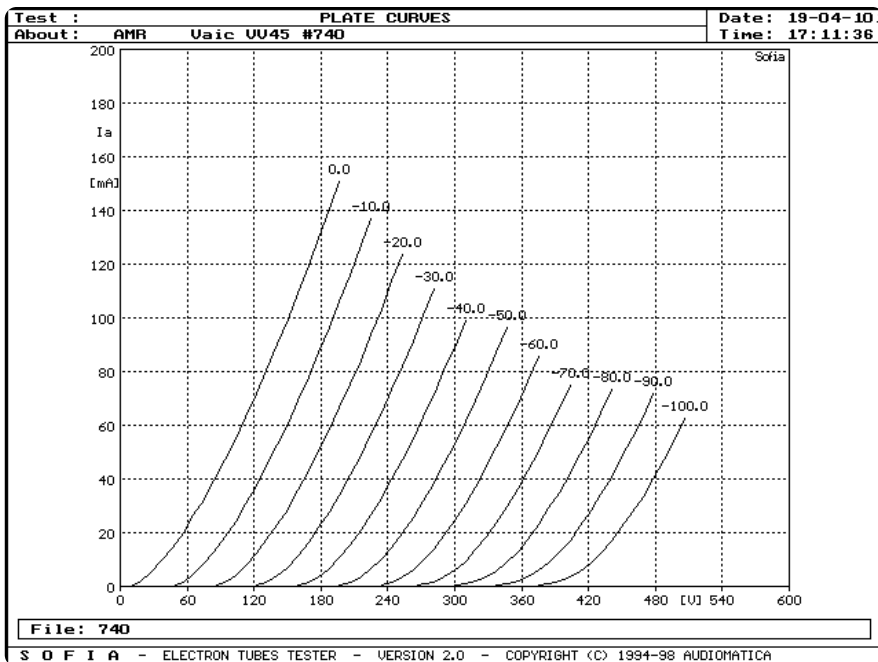
EML 45 Typical Data	Single Ended CLASS A1 AUTO BIAS	
Anode Voltage to Cathode	250V	275V
Anode Voltage to Ground	300V	331V
Anode Current	34mA	36mA
Anode Dissipation	6.8Watt	7.9 Watt
Cathode resistor	1470 Ohm	1550 Ohm
Cathode Resistor voltage	50Volt	56Volt
Anode Impedance (Rp)	1750 Ohm	1670 Ohm
Load Resistance (Ra)	3900 Ohm	4600 Ohm
Amplification Factor	3.5	3.5
Transconductance (Gm)	2mA/V	2.1mA/V
Power Output in Class A	1.6 Watt	2 Watt
Total Distortion	5%	5%

EML 45 Typical Data (2)	PUSH PULL CLASS A1 AUTO BIAS	
Anode Voltage to Cathode	250V	275V
Anode Current 2) 3)	68mA	72mA
Anode Dissipation 1) 3)	6.8Watt	7.9 Watt
Cathode Resistor 2)	735 Ohms	775 Ohms
Bias voltage	50Volt	56Volt
Load Resistance (Ra)	4200 Ohm	3900 Ohm
Power Output in Class A 2)	4.6Watt	5.5 Watt
Total Distortion	-40dB	-40dB

- 1) Values for one tube
 2) Values for both tubes together
 3) Values are for zero Signal in this table, but will rise at higher signal. Avoid overdrive which exceeds maximum Anode dissipation of 11 Watt per tube.

EML 45 Typical Data (3)	PUSH PULL CLASS AB1 AUTO BIAS	
Anode Voltage to Cathode	275V	300V
Anode Current 2) 3)	67mA	64.5mA
Anode Dissipation 1) 3)	7.3Watt	7.6Watt
Anode Dissipation 1) 4)	8.4Watt	8.2Watt
Cathode Resistor 2)	850 Ohms	1000 Ohms
Bias voltage 3)	57Volt	64.5Volt
Bias voltage 4)	69,7Volt	72Volt
Load Resistance (Ra)	4000 Ohm	5000 Ohm
Power Output in Class A 2)	6Watt	7.4 Watt
Total Distortion	-34dB	-40dB
1) Values for one tube 2) Values for both tubes together 3) Value are for zero Signal. 4) Values are at maximum Signal.		

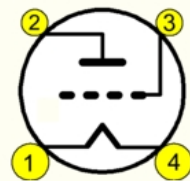
EML 45 Typical Data (4)	PUSH PULL CLASS AB2 AUTO BIAS	
Anode Voltage to Cathode	275V	275V
Anode Current. 2) 3)	72mA	72mA
Anode Current. 2) 4)	90mA	97.4mA
Anode Dissipation. 1) 3)	7.9Watt	7.9Watt
Anode Dissipation. 1) 4)	9.2Watt	9.7Watt
Input Signal, RMS. 1) 4)	37.5V	39.2V
Input Signal current. 1) 4)	7.5mA	5.3mA
Cathode Resistor. 2)	775 Ohms	775 Ohms
Bias Resistor voltage. 3)	56Volt	56Volt
Bias Resistor voltage. 4)	69.5V	75.5V
Load Resistance (Ra)	5810 Ohm	5420 Ohm
Power Output in Class A 2)	12.7 Watt	13.2 Watt
Total Distortion 5)	-26dB	-26dB
1) Values for one tube 2) Values for both tubes together 3) Value are for zero Signal. 4) Values are at maximum Signal. 5) class AB2 means the tube is grid current driven. This requires a very low impedance driver stage. (See table for grid AC requirements)		



Recommended Singe Ended transformers

	Primary	Output	Remark
LL1663-040 <i>Lundahl</i>	5000Ω	8Ω	Budget transformer. No housing, and only one output impedance.
LL1682-050 <i>Lundahl</i>	5000Ω	5Ω	Budget transformer. No housing, and only one output impedance.
LL2752-060 <i>Lundahl</i>	4600Ω	Alt.C =8Ω Alt.D =16Ω	This transformer can be rewired for 8 or 16 Ohms (no taps). The primary is ideal for 275V use.

EML 45 Mechanical Data



Logo on this side
Plates parallel to this side
BOTTOM VIEW

Size including Socket
(but excluding pins)

145 x 58 mm

Weight of one tube:

140 Gram

Shipment weight for
pair in gift box: 700 Gram

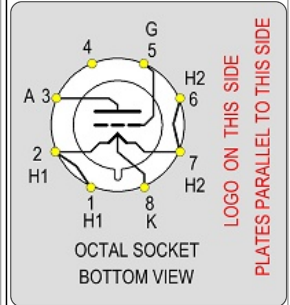
Pin 1: Heater1

Pin 4: Heater2

Pin2: Anode

Pin3: Grid

Ceramic UX4 Base

		Size including Socket (but excluding pins) 147 x 60 mm Weight per tube: 140 Gram Pin 1+2: Heater1 Pin 6+7: Heater2 Pin 8: Cathode Tap (Cathode) Pin3: Anode Pin5: Grid Pin4: Not on tube base
Ceramic Octal Base, V4 Version		

Note 1) Hard-metal filaments prevent filament breakage with DHT Tubes. This material has a higher melting point than classic nickel wires. Wolfram grids allow the most precise grid wire distance, because wolfram is an extreme hard metal. This ensures better grid precision, which gives uniformity and better linearity at the low end of the tube curves

Note 2) Individual Test data: Control Grid Voltage, Anode current, Transconductance and Filament Current is the test certificate that is on the outside of the box. Each tube is numbered, inside the bulb with a [metal Tag](#)

Note 3) Tube Curves: Made on the The Sofia Curve tracer, with courtesy of AMR, Wisconsin, USA.

Note 4) The V shaped filaments will give different electrical fields inside the tube, as compared to parallel filaments. For keeping the original character of this tube, we choose for V-shaped filaments.

Note 5) EML45 first generation (from before 2004) have a maximum grid resistor value of 100k. For tubes after 2004 we have this specification: Auto Bias: 500k. Adjustable bias 100k. As a rule of thumb, the coupling capacitor value is calculated as: $C[\mu F] = 47/R[k\Omega]$. So in this formula, the value of R is in k Ω , and the result is then in μF . Example: A grid resistor of 470k would need a coupling capacitor of $47/470 = 1\mu F$.

Note 6) In a class AB2 amplifier, the tubes are operated mildly into positive Control Grid Voltage, and output power as published here should not tried to be exceeded. The 2nd Harmonics resulting from this, are cancelled by virtue of the Push Pull circuit. A sufficient low impedance driver stage is needed for class AB2. This can be achieved with a step down inter stage transformer, as recommended by the RCA receiving tube manual 1934, Page 93.

Note 7) A quick way to test the hum level of a amplifier, is to measure the AC signal the speaker terminals, with the inputs muted, but the speaker connected. Anything below 3 millivolt at 8 Ohms is a good achievement, and such an amplifier below 1 millivolt can be called a fine piece of work. If an amplifier will produce low hum with many different tubes, this is definitely a better design, than such an amplifier that is critical on the tubes.



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EML 45B

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Description



Features

- The 45B tube is designed to build amplifiers with fully original 45 tube sound, but the 45B is able to do so at more than twice the output power. However to achieve this, the amplifier needs to be modified, or new designed.
- Without modification, the 45B can be used in every normal 45 amplifier just as well.

High Resolution

About the 45 tube, 45B tube, and how to use it.

The 45B tube resulted from the many conversations I had with my friend Roger Modjeski, who unfortunately passed away in 2020. Roger spend his entire life and career on designing classical tube amplifiers, combining high output power with long tube life.

[How to use the 45B instead of the 45.](#)

Guarantee program for first owner.

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receipt, at the Emission Labs website, to participate in the 5 years guarantee program.

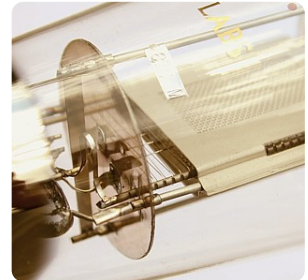
[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

EML 45B Filament Ratings

Filament Voltage	= 2.5Volt (AC or DC)
Electronic heater modules:	Only voltage source
Tolerance on filament voltage	5%
Filament Current	~ 1.5Ampere
Maximum Time on Stand By (Heater voltage only)	2 hours

All 45 Versions



Several other versions exist. We have a solid plate version, the 45M (mesh) version, and the new 45B, which can be used to achieve higher output power. Additionally we sometimes build a limited series of globe glass 45 or 45M tubes.

45 (Solid)

45M (Mesh)

45B

Globe

Lifetime of the 45



We have this amazing lifetime report by a customer from Canada, who build a pair of 45 into an amplifier with hour counter on it.

[Read more...](#)

Very Nice Article

EML 45B Capacitance

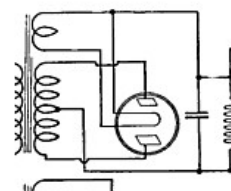
Grid to Plate	7pF
Grid to Filament	4pF
Plate to Filament	3pF

EML 45B Maximum Conditions

Plate Voltage	420Volt
Plate Current	53mA
Minimum Plate Dissipation	8.5Watt
Continuous Plate Dissipation	22Watt
Power Output in Class A	5.2Watt
Grid resistor	500k Ohm

EML 45B Factory Test conditions

Plate Voltage	275V
Plate Current	36mA



Written it 1929, but nothing has changed ever since.

[Full article](#)

Did you know?

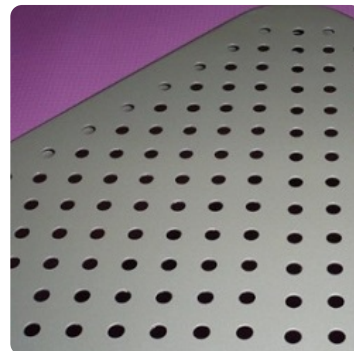


Emission Labs was the first company to re-introduce the 45 tube again, in 2001

45B Recommended Single Ended operating points. Bias Method: Auto Bias.

Line	Vb	Ua	Rk	Ug	Ia	Ra	Transformer examples	P Tube	P Out	Damp. factor	2nd harm. (%)	Tube
						Ω	See also note 2, 3, 4, 5					
1	331V	275V	1555Ω	-56V	36mA	4k6	LL1663-40mA. 8Ω	9.9W	2W	3.5	4.5%	45, 45M, 45B Classic RCA circuit
2	331V	275V	613Ω	-46V	75mA	5k5	LL1620-080 4-8-16Ω	20.8W	2W	6.4	0,72%	45B Note2 Graph
3	466V	384	2000Ω	-82V	41mA	9k2	LL1679-055 8-16Ω	15.8W	3.1W	4.6	3.5%	45B only. Note6
4	466V	384	2000Ω	-82V	41mA	6k5	LL9202-050 4-8-16Ω	15.8W	4W	3.2	4.9%	45B only. Note7
5	495V	408V	1800Ω	-87V	48mA	9k2	LL1679-055 8-16Ω	19.7W	3.6W	5.1	3.4%	45B only. Note6
6	495V	408V	1800Ω	-87V	48mA	6k5	LL9202-050 4-8-16Ω	19.7W	4.5W	3.6	4.4%	45B only.

Warning for FAKE mesh

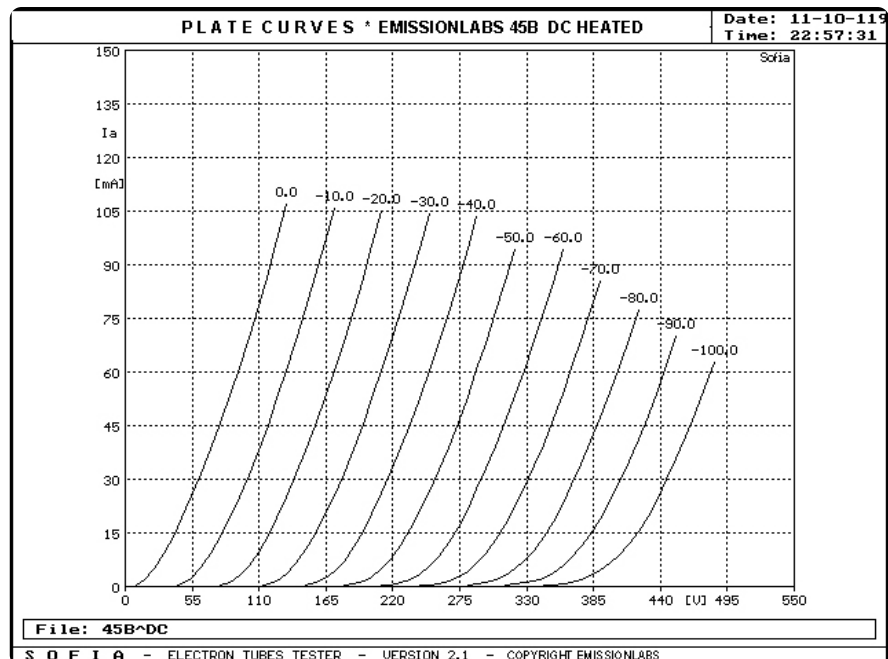
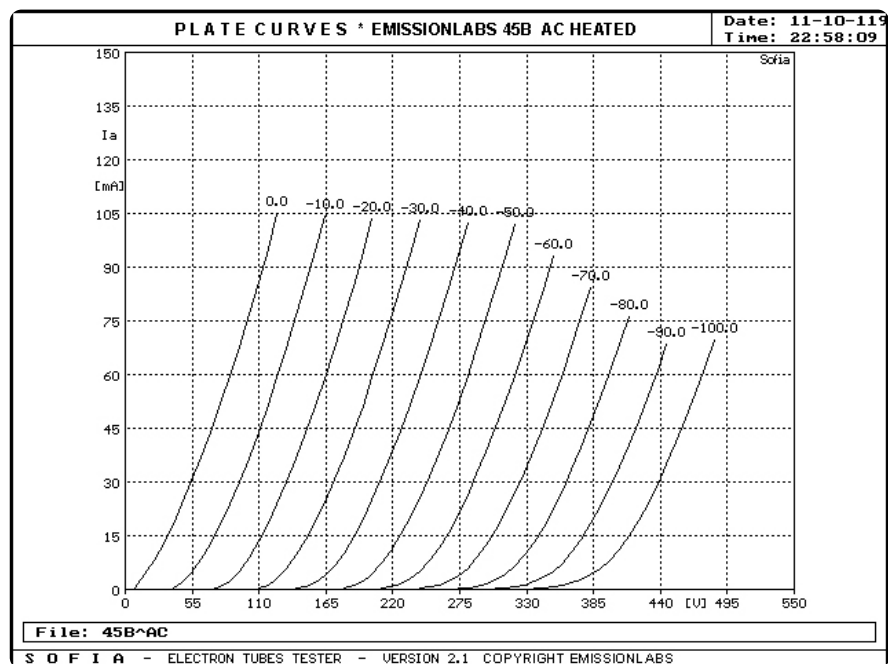


[Full article](#)

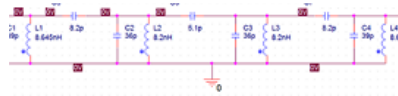
													Note7
7	495V	408V	1800Ω	-87V	48mA	5k	LL1663-050 8Ω.	19.7W	5.2W	2.7	5.6%	45B only. Note8	
8	495V	408V	1800Ω	-87V	48mA	5k	LL1663-050 8Ω.	19.7W	4.5W	2.7	3%	45B only. Note9	

A final note about distortion: Note10 .

Credit: We want to honour our late friend Roger Modjeski, from the company RAM-LABS / Music Reference USA, for doing many detailed measurements on the 45B tube. He showed, the published maximum distortion and maximum output power in this data sheet was achieved easily. Even so, the 45B seemed capable of doing more as published here. Thank you very much Roger. You will be remembered!

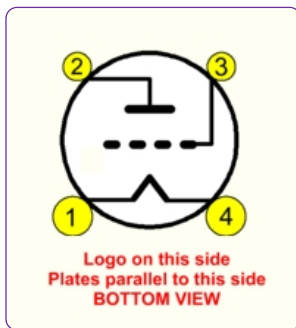


SPICE Parameters for circuit simulation



[SPICE Parameters overview](#)

EML 45B Mechanical Data



Ceramic UX4 Base

Size including Socket
(but excluding pins)

145 x 58 mm

Weight of one tube:

140 Gram

Pin 1: Heater1

Pin 4: Heater2

Pin3: Anode (Plate)

Pin3: Grid

Notes

- Note1) With tubes, miniaturization and linearity do not go together well. This is explained by electrical fields having specific behavior which does not follow the miniaturization exactly. With the EML45, the plate is larger than the historical 45, which large size contributes to lower distortion. This is documented by an external company, and they report 30% lower distortion compared to historical 45. [Read here](#).
- Note2) Almost no distortion, and exceptional high damping factor. Ultimate circuit for back loaded horns, which need little power, but highest damping factor, to prevent muddy sound. Damping Factor is R_a/R_p . Here 6k/933. [Proof of calculations here](#).
- Note4) Distortion drops considerably at lower signal. A distortion compare between two operating points should be made at the same output power.
- Note5) Transformer DC loss NOT included in Supply voltage. So depending on the chosen transformer, the Supply voltage needs to be chosen slightly higher, to compensate for the DC loss across the transformer.
- Note6) This working point gives superior results for all parameters, being: Output power, distortion and damping factor.
- Note7) This working point gives damping factor and distortion similar to the RCA circuits. Yet at higher output power.
- Note8) This working point is optimized for highest output power, at the compromise of damping factor. Distortion may seem high at 5.2 Watt, but this reduces drastically at lower output signal of 4.5 Watt. For this see Note 10.
- Note9) This is the same working point as above, and it demonstrates an amazing 30.4dB low distortion, yet at 4.5 Watt still. However damping factor is not very high. This would be a meaningful application for loudspeaker systems using an active bass, so damping factor plays no important role.

- Note10) As you see from the examples, there is no "best" working point. It is confusing if you were looking for that. You need to choose one, which suits your own needs best. Keep in mind, distortion is specified at full power for the working points, but it drops exponential at lower power. A triode amplifier with 5% distortion at full power is considered very good, as distortion drops drastically at half of maximum power.



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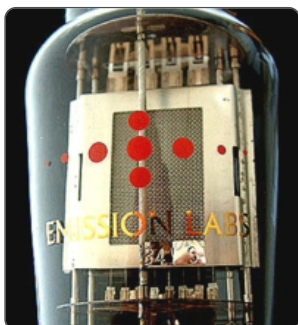


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EML45 'Mesh' Information Only For Data sheet, use EML45

Last Update: 07/12/2026 12:36:31



The 45 mesh and 45 Solid Plate differ at a few subtle points, which are described here in detail.

For general information, we refer to the data sheet of the 45 'Solid Plate'.

History of the 45

For keeping the original sound character of this tube, we have chosen for V-shaped filaments.

The 2A3 can be called the big brother of the 45, designed by RCA. The 2A3 and 45 differ not only in size, but also the 45 has a V-Shape of its filaments, whereas the 2A3 does not have this. The V-shaped filaments will give a different electrical field inside the tube. Though the influence of this on the sound is not large, it is still characteristic for the 45 tube.

The wire mesh we use, is very soft, in order to achieve the mechanical damping properties. It would be too soft to make the entire anode of mesh wire, but we have solved this problem by using a mesh window. The window size is larger than the filaments, and the solid part of the anode, serves now the cooling, while keeping the anode distance constant. An anode of wire mesh only, would expand due to heat, and then change its distance, and by this the electrical bias.

What is a wire mesh?

In the English dictionary, 'mesh wire' is described as woven metal wire. Some sellers fool the buyer with a many tiny punched holes in the Anode. They are calling this 'mesh'. A difference which you can see only under magnification. Read here for a [warning information](#).

Mesh window, reasons behind it

The frame of the wire mesh window, is also internally covered with mesh, in order to prevent a sudden change of anode distance inside the Anodes, at the position where the wire mesh window ends. Like this, we can use the wire mesh window, and keep the electrical properties of the 45 unchanged. Also, this construction makes the tube shock proof to a great extent, and the typical shipment damage problems as with historical mesh wire tubes, will not occur with EML. This construction gives not only a pleasant sounding tube, it appeared later, this stands also for exceptional long lifetime. We have reason to believe, it is outdoing the lifetime of NOS tubes by a multiple factor. (Read the article on the right side of this page)

Sound character

Please also read the data sheet of the regular 45, as this information applies for the 45 mesh version as well.

Influence of mesh on the sound

Mesh wire has a very high mechanical damping factor due to friction, if the wire crossings are not mechanically connected to each other. This friction avoids resonance effects. It is even used as

Other 45 Versions

Several other versions exist. We have a Solid Plate version, the 45M (mesh) version, and the new 45B, which can be used to achieve higher output power. Additionally we sometimes build a limited series of globe glass 45 or 45M tubes.

[45 \(Solid\)](#)

[45B](#)

[Globe](#)

Lifespan of the 45



We have this amazing lifetime report by a customer from Canada, who built a 45 amplifier, with an hours counter.

[Full article](#)

Warning for FAKE mesh



damping system in instruments. In the factory we can investigate the loose anodes. If you knock on such a Solid Plate anode, there will be a bell sound, because nickel is a very hard metal. If you knock on a mesh anode, there will be no ringing, as the damping function of the wire mesh will do it's job. This is insofar the only mechanical proof we have found for the difference in sound.

In addition, there are two elements which are present, of which we assume, they influence sound as well. The surface of the wire mesh is raw, so anode

distance is varies with some 7% percent, depending if you look at a wire, or at a crossing. Thousands of those areas are in parallel, and the result is the composite anode as such. Moreover a small percentage of the electrons escape initially through the holes, and returning to the anode at the outside. This is causing a small blue fluorescent effect, and also their electrical path is obviously somewhat different.

The sound difference

We are often asked about this. During hearing tests, an improved sound is confirmed by many listeners worldwide, most of all when using high quality loudspeaker systems, such as horn systems, or head phones. When a tube is given mesh Anodes, something magic happens to the sound. A more transparent sound stage appears in many cases, meaning a more realistic stereo reproduction of the original sound recording. With mesh tubes you will enjoy the very best of what small triodes have to offer.

Higher anode dissipation of the 45 mesh

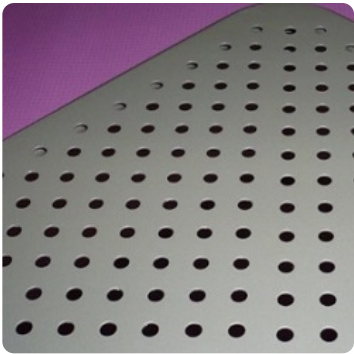
Though this was not a specific design intention, we have found that the wire mesh version can handle a slightly higher maximum anode dissipation than the standard 45.

EML 45 MESH Maximum Conditions. (Allowed continiously)	
Anode Voltage	300Volt
Anode Current	45mA
Maximum Dissipation for new types after 2006.	13,5 Watt (Note4)
Maximum Dissipation for older types from 2006 or before	11 Watt (Note4)
Power Output in Class A	3.5 Watt
Grid resistor, highest possible value (Important: Note5)	500k Ohm

EML 45 MESH Typical Data Single Ended			
Anode Voltage	250V	275V	300V
Anode Current	34mA	36mA	39mA
Maximum Dissipation	8.5Watt	9.9 Watt	11.7Watt (only possible with mesh tube, or with the new 45B)
Control Grid Voltage	50Volt	56Volt	58,6Volt
Anode Impedance (Rp)	1750 Ohm	1670 Ohm	1600 Ohm
Amplification Factor	3.5	3.5	3.5
Transconductance (Gm)	2mA/V	2.1mA/V	2.2mA/V
Power Output in Class A	1.6 Watt	2 Watt	2.5 Watt
Load Impedance (Ra)	3900 Ohm	4600Ohm	5000-5600 Ohm

Recommended Singe Ended transformers

	Primary	Output	Remark
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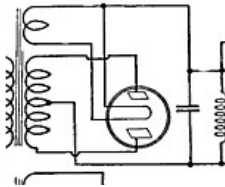
[Full article](#)

Did you know?



Emission Labs was the first company to re-introduce the 45 tube again, in 2001

Very Nice Article



Written it 1929, but nothing has changed ever since.

[Full article](#)

FC12S <i>ISO Japan</i>	5000Ω	8Ω, 16Ω	This transformer includes already a (beautiful) housing, and easy to use tapped connections.
LL1663-040 <i>Lundahl</i>	5000Ω	8Ω	Budget transformer. No housing, and only one output impedance.
LL1682-050 <i>Lundahl</i>	5000Ω	5Ω	Budget transformer. No housing, and only one output impedance.
LL2752-060 <i>Lundahl</i>	4600Ω	Alt.C =8Ω Alt.D =16Ω	This transformer can be rewired for 8 or 16 Ohms (no taps). The primary is ideal for 275V use.

Note 4) Historical 45 tubes have a maximum dissipation of 11 Watt, which means the maximum voltage and maximum current can not be applied at the same time. Our new type, (shipped since Q3-2006) has 13,5 Watt maximum dissipation, meaning maximum voltage and maximum current can be applied at the same time.

Note 5) EML45 first generation (from before 2004) and all tubes from before the year 2000, which have the designation on the socket: 'VV45', have a maximum grid resistor value of 100k. Exceeding this value may cause difficulties with tube bias.

Note 6) In a class AB2 amplifier, the tubes are operated mildly into positive Control Control Grid Voltage. Output power as published not tried be exceeded, though this may appear possible, it will damage the grid of historical tubes. The 2nd Harmonics resulting from this, are cancelled by virtue of the Push Pull circuit. A sufficient low impedance driver stage is needed for class AB2. This can be achieved with a step down inter stage transformer, as recommended by the RCA receiving tube manual 1934, Page 93. Please look at the standard '45' data sheet for some examples of Push Pull working points



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Type 50 Data Sheet

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Description



Introduced in 1928 by RCA, the historical 50 tube, was one of the first higher power triodes for Audio Applications. The curves of this tube are extremely nice, and so distortion will be very low, even at high signal. For that reason, it was originally recommended to use transformer coupling, which method is the safest for high output power circuits. Although the EML50 is much higher quality than the original 50 tubes, and the EML can safely be used capacitor coupled, you can stay closer to the original circuits and design ideas, by using transformer coupling. (Some circuits with the LL1660 will be added to a later version of this data sheet)

[High Resolution](#)

Operation and operating points are identical to the historical 50, but it is also possible to use the EML at higher Anode dissipation, up to maximum 28 Watt continuous.

The quality of modern transformer cores is significantly higher than in the first days of tube production, and step-up coupling transformers can be found with perfect full HiFi properties. We recommend the Lundahl LL1660 Series here. These have a passive gain of 2.5 and seem the ideal combination with this tube.

Guarantee program for first owner.

The first owner can register the tube within 4 weeks after receival, at the Emission Labs ® website, to participate in the 5 years guarantee program, which is additional to the legal obligations of the seller.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gold Plated Grid
- Hard metal Construction (Note1)
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a [high quality dual box](#)
- Tube printing with real gold (metal), red color is glass burned into the glass
- Gold Plated pins, black ceramic socket. (White bottom.)

Sound Character of the EML 50



Article from 1928 about the introduction of the 50 tube.

[Pdf Article](#)

Specially intended for use with the historical type 50, the type 81 mono diode was introduced at that time. At EML we did the same thing, we introduced the 50 and the 81 together. In order to make a rectifier circuit, the classical way, just parallel the heaters of the 81 mono diode, and the result is a double diode, which is more powerful than a tube like 5U4G.



According to Ing. Alesa Vaic, who was the first re-introduce the 300B in 1994 (under the Vaic Valve brand), DHT tube families, are soundwise characterized by their heater voltage. This explains the popularity of the European 4Volt tubes, like AD1, PX4, PX25, RE604, but also 2.5V tubes like 45 and 2A3 have their own fans. The 50 (and also the 81 mono diode) with it's 7.5V heater are a family of it's own for this reason.



The EML50 is made with a boxed anode, which makes the tube larger than the RCA tube, and we get less distortion in return for that. This can already be seen by looking at the curves, which are simply excellent. Though there is a resemblance with 300B, the 50 is different. The 50 feels best at higher voltage and higher impedance. The of such tubes is softer, silkier, less dominant as a low gain tube

like 300B.

Something which influences the sound very much, is the option of the EML50, to exceed the Anode voltage of the RCA, which is possible because of the boxed anode of EML (vs the tiny construction of RCA).



Here is a [fantastic report](#) about a 50 Amplifier, placed here with the friendly permission of Raymond Woerdman from Holland. It is in Dutch, perhaps you can find a way to translate it online.

EML 50 Filament Ratings	
Filament Voltage	7.5Volt (AC or DC)
Electronic heater modules:	Only voltage source
Tolerance on filament voltage	5%
Filament Current	1.25Ampere
Maximum Time on Stand By (Heater voltage only)	2 hours

EML 50 Maximum Conditions not possible simultaneously	
Anode Voltage	500Volt
Continuous Anode Dissipation	28Watt
Peak Anode Dissipation (Not continuous)	35Watt
Anode Current	120mA
Grid resistor with Auto Bias	250k Ohm (note4)
Grid resistor with Fixed Bias	50k Ohm (note4)

EML 50 Factory Test conditions	
Anode Voltage	400V
Anode Current	55mA

EML 50 Typical Data *1

Anode Voltage	350V	400V	450V
Anode Current	45mA	55mA	55mA
Anode Dissipation	15.8Watt	22Watt	24.8 Watt
Control Grid Voltage	63Volt	70Volt	84Volt
Anode Impedance (Rp)	1900 Ohm	1800 Ohm	1800 Ohm
Amplification Factor	3.8	3.8	3.5
Transconductance (Gm)	2mA/V	2.1mA/V	2.1mA/V
Load Impedance (Ra)	4100 Ohm	3670 Ohm	4350 Ohm
Power Output in Class A	2.4 Watt	3.4 Watt	4.6 Watt
h2 Distortion at full signal	3,4%	3,62%	4.1%
h3 Distortion at full signal	0.8%	0,87%	1.04%
Reference	here	here	here

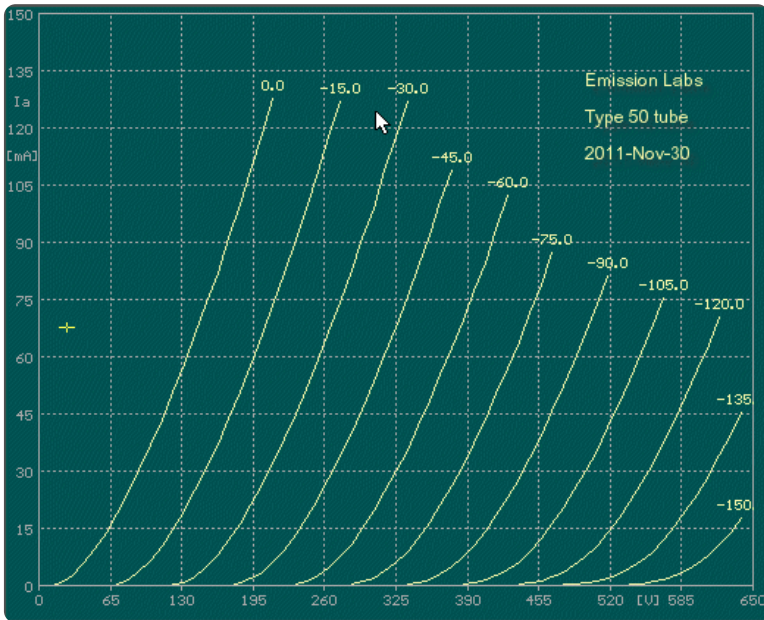
***1 These working points are identical to the historical data sheet.**

Note: We have calculated distortion of the EML50, at the power level of the RCA data sheet. The simulation shows, these are well chosen working points, considering the relatively low working voltage. The EML50 has somewhat higher efficiency, and appr. 15% more output power will be achieved.

EML 50 Typical Data, not possible with historic tubes *2

Anode Voltage	485V	485V	
Anode Current	57mA	57mA	
Anode Dissipation	28 Watt	28 Watt	
Control Grid Voltage	89.5Volt	89,5Volt	
Anode Impedance (Rp)	1400 Ohm	1400 Ohm	
Amplification Factor	3.7	3.7	
Transconductance (Gm)	2.7mA/V	2.7mA/V	
Power Output in Class A	6.7 Watt	5,7 Watt	
Load Impedance (Ra)	5000 Ohm	7000 Ohm	
h2 Distortion at full signal	.4.5%	2.78%	
h3 Distortion at full signal	1.2%	0,65%	
Lundahl SE Output Transformer	LL1623-60mA	LL9202-60mA	
Reference	here	here	

*1 These working points take advantage of the higher capabilities of the EML50 vs historical RCA tubes. The column with 5k load impedance is similar with the RCA use. The second column is focussed on lower distortion, which comes at slightly lower output power.



[Print Version](#)

EML 50 Mechanical Data	
 Logo on this side Plates parallel to this side	Size including Socket (but excluding pins) 145 x 58 mm
Single Tube weight	145 Gram
Shipment weight for pair in gift box	700 Gram

Notes

1. Hard-metal can be used in electron tubes, though this is more difficult to use, and more costly than classic nickel. It results in a more precise Anode distance, and does not damage in shipment. It ensures reproducible tube parameters, and long term stability. Wolfram grids allow the most precise grid wire distance, because wolfram is an extreme hard metal. Best grid geometry ensures uniformity and linearity of the tube curves.
2. Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)
3. Average Plate Characteristics are made with the Sofia Digital Curve tracer.
4. Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
5. Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves.



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5U4G Mesh Data Sheet

5Z3 Mesh Data Sheet

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Description



This data sheet applies for the 5Z3-Mesh and 5U4G-Mesh, which are electrically identical, apart from the sockets. 5U4G-Mesh uses an Octal Socket socket, of which only five pins are used (and one of those is electrically not connected). 5Z3-Mesh uses a four Pin UX4 socket.

These are direct replacements for the historical 5U4G or 5Z3. They can not replace 5U4GA or 5U4GB which are different tubes. [See Note 4](#)

Note that the Emission Labs® tube is somewhat larger size than the historical tubes. Check below at mechanical data, for details. Like most NOS rectifiers, also the EML rectifiers are Slow-Start tubes, protecting the power supply and the whole amplifier to some degree. The delay time for first function is 2 seconds, and the delay for full current is 7 seconds.

For ultra low ripple, it is recommended to use the [Lundahl LL1673 dual coil choke in low CMR configuration](#). In this configuration, there is virtually no field radiation from the choke. (See link to circuit diagram, at the bottom of this page).

[Tube Picture High Resolution](#)

Guarantee program for first owner.

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receipt, at the Emission Labs® website, to participate in the 5 years guarantee program.

[Our Guarantee conditions](#)

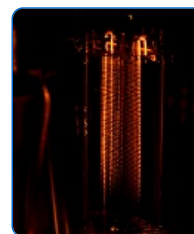
[Register here for the 5years guarantee](#)

Features

- In 2011, we have included inside the tube glass a special element to stabilize the heater voltage. See also the pictures on the right. ([or here](#)) These elements at higher current, will increase their resistance, and help protect the heater against accidental over voltage.
- Slow Start (2...7 seconds)
- Filaments are series connected, for best symmetry of the two diodes inside.
- Extra large getters.
- Each tube is numbered, inside the bulb with a metal Tag.
- Extra large getters, flashing the complete tube bottom.
- These tubes are shipped in a high quality box.
- Tube printing with real gold (metal), red color is burned into the glass.
- In 2011, we have started to ship 5U4G-mesh with the new ceramic socket, with five pins. From Yamamoto, the Octal 8/5p Teflon socket is recommended. This is an octal socket, but has five pin holes only. It is specially used for this rectifier. When working with Octal sockets, you will find the

About the EML 5U4G

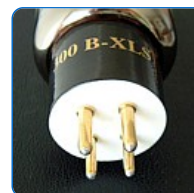
Emission Labs® was the first company to introduce a mesh version the 5U4G in the year 2006. Also, we were the first company to reintroduce the 5Z4 in 2007.



Starting May 2011, we have included inside the tube glass a special element to stabilize the heater current. Please click on the next picture:



These red glowing metal strips, are in series with the filament. These have a current depending resistance. By this, it will help to keep the filament current constant, despite some variation of heater voltage, caused by mains voltage changes. This adds to the life time of the tube.

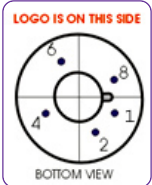


5Z3-Mesh
UX4 Base

Yamamoto an amazing top class product. For this rectifier you can take the special octal version with five holes only. Like this you can never put in a non-rectifier tube by mistake. You can also use normal octal sockets of course.

Filament Ratings	
Filament Voltage	5 Volt (AC or DC)
Tolerance on filament voltage	5%
Filament Current	3 Ampere

Maximum ratings NOT possible simultaneously	
AC transformer voltage	550Volts
AC transformer copper resistance (Raa)	Not below 170 Ohms for curves 1...6 Not below 230 Ohms for curves 7...8
DC output current of circuit	225mA Capacitor loaded 265mA Choke loaded
First capacitor, connected to Anodes	40uF
AC Peak Current (repeatedly)	800mA
Transient Peak Current (only once)	4A

Mechanical Data	
 5U4G-Mesh Bottom view	Tube Size including Socket: 165 x 60 mm Connections: Filaments: 8 + 2 Anodes: 4 + 6
 5Z3-Mesh	Tube Size including Socket: 165 x 60 mm
Tube weight	130 Gram
Shipped weight for one tube	400 Gram



UX4 Socket
(by Yamamoto)



5U4G-Mesh
Octal Base



5-Hole Octal Socket
(by Yamamoto)

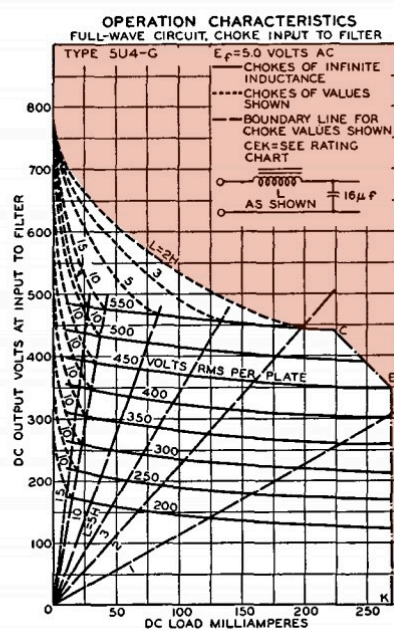
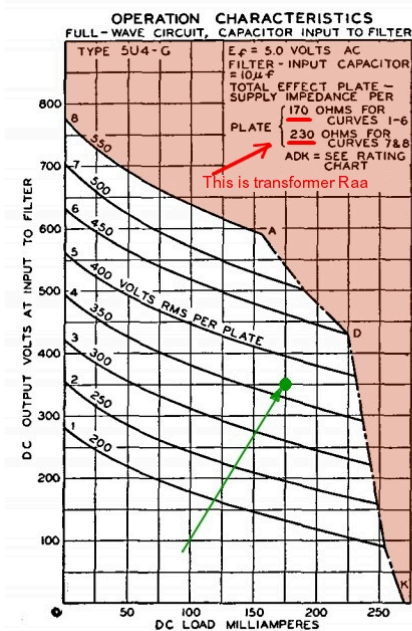


PART II

DESIGNING RECTIFIER CIRCUITS

Typical application

- > See: [CIRCUIT DIAGRAM](#)
- > See: [Note 2](#)



Left Chart for following Capacitor loaded tube, with these values: **Right Chart for following Choke loaded tube, with these values:**

- >Capacitor input filter. Value chosen 10uF here
- >Transformer DC Resistance 170 Ohms for curves 1...6
- > Transformer DC Resistance 230 Ohms for curves 7...8
- >Choke input filter
- >Transformer DC Resistance= Uncritical
- >Capacitor value 16uf here.

About these Charts:

These charts are graphical design tools, saving the trouble of calculations.

Both charts show some degree of derating, meaning you can not have maximum current and maximum voltage at the same time. As the choke loaded circuit is not so hard on the tubes, you will see derating is less at very high current. So the maximum of 265mA can be used up to 350V DC output. This is definitely not possible with a capacitor loaded circuit. Though capacitor loaded circuits perform good at low to medium current, like at 100mA you can get 600V, where choke loaded will only do 470...540V depending on the choke inductance. This is only from the view of convenient use. From the view of good tube life and smallest hum field radiation, choke loaded is preferred, unless you work at very low current, like below 75mA.

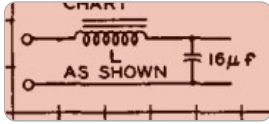
From the right choke loaded chart it can be seen, the maximum current of 265 can be used to generate 350Volt DC, whereas the capacitor loaded circuit at 350V can only so 230mA. Yet when generating 480VDC, the limit is 150mA only of choke loaded, or 200mA capacitor loaded. It pays off to check, if you can fulfil the needs with a choke loaded circuit, and if yes, this would be the better circuit to take. So both circuits can do 480V at 150mA, and choke loaded will sure do this at less disturbance to sensitive circuits near by.

How to use these Charts:

- >Choose the required DC Voltage on the Vertical axis
- >Choose the requires Output current on the Horizontal axis
- >You have to be in the white Zone. Otherwise 5U4G can not be used. (or use two in parallel)
- >Take closest curves 1...8 for the transformer AC voltage, or estimate one curve in between.
- >Note, the curves on the right chart have a smaller angle. (they are more horizontal). Meaning output voltage depends not much on actual DC current.
- >Note, this is official RCA information from the RCA tube manual 1954. You can download the 1954 and other manuals from 4tubes.com.

These graphs are from the historical RCA data sheets. When designing new circuits yourself, be aware a tube rectifier is more difficult to use than a silicon diode. Very roughly, the electrical model of a tube rectifier is like an ideal diode, with a resistor in series. You need to limit the peak value at any circumstance to prevent defects, and keep it as low as possible for best lifetime. Since peak current is difficult to measure, a more practical way is use graphs such as the one on the left here. All in the end, you will notice you need more than a quick glance on the data. You will always end up with some sort of de-rating. Such as: At maximum voltage, you can not draw maximum current. At maximum current, you can not use the maximum first capacitor. Maximum tube life will not go together with maximum load conditions, etc. Mistakes come from now knowing how these compromises must be made, or copy circuits from the internet, made by others the same way.

Choke loaded circuit.



The best for the tube, and for low hum field radiation, is a choke loaded circuit. In simple wordings, a capacitor loaded circuit is lower cost, but will put more stress on the tube, and also some stress on the first capacitor, which will degenerate by this over the years. A choke loaded circuit will put the stress mainly to the choke,

which is a device with no wear out, and the tube and capacitor are spared a lot.

Technically there is more to it. A choke loaded circuit will force almost DC current through the diodes. Moreover, a choke loaded circuit acts as a 'DC transformer', so the DC current which is generated, it higher as the AC current used! To make it even better, a choke loaded circuit has a better load regulation as capacitor loaded. So at higher current, voltage drops less as with a capacitor loaded circuit. This may all sound unbelievable, but it works like this: The inductance of the choke is a constant current user, or constant current supply, either way, depending if the transformer is charging the circuit, or if the circuit is discharging itself into the load. When the inductance is large enough, the DC current change very little within one AC cycle. So a signal almost like DC will flow trough the choke, and for that reason through the entire circuit. This includes the rectifier diodes, and even the transformer windings. The engine storage buffer for this is the choke itself, which will generate the required voltage, to keep the DC current flowing. Like this, the whole circuit carries DC current. The function on the second capacitor is to prove an L-C filter to reduce residual hum, but AC current peaks of the capacitor are small. Much to the contrary of an C-L-C circuit, which has a very heavy pulsed charge current into the first capacitor. This current with C-L-C circuit can radiate a magnetic field, saturate the mains transformer at it's peaks, and also wear out the rectifier diodes much faster. The much more gentle L-C circuit. can load a mains transformer up to 100% of it's specified ratings, whereas C-L-C circuits can load a transformer only up to 66% (or the transformer will produce audible hum + magnetic hum field)

We much recommend you to have a look at the original RCA data sheets, winch content is too extended to quote it here, however this is the one and only reference for designs with a long tube life. Designs with mistakes in it, will initially work. So the fact it 'works' does not prove you will get long lifetime.

After all, the disadvantage of a choke loaded circuit is the cost and dimensions of the choke. So many times, you will see HiFi companies saving money on it.

Please note it can not be the intention here, to explain how to design a good circuit. However we try to tell some things here, that we know are sometimes not looked at very well. Also we encourage you to read the original old data sheets. from RCA, General Electric and Sylvania, and Telefunken. You can download these and a lot more s from 4tubes.com. So look there for datasheets, and the famous RCA handbook

Some important things to remember (unsorted)

1. **Fuse Protection.** To protect the rectifier, a slow fuse must be used. If choke loaded, the fuse must be from the output of the DC voltage, to the rest of the circuit. If capacitor loaded, the fuse must be to the transformer Cathode Tap. (So where there is a wire to the transformer Cathode Tap, inside this wire must be a fuse inserted)
2. **The ideal application of ANY rectifier tube, all brands, is Choke Loaded.** A choke loaded rectifier circuits will give better performance in many ways, however it's function is often misunderstood, and for this reason not often used. However we recommend a choke loaded circuits with first priority always.

Advantages of a choke loaded rectifier circuit, vs. capacitor loaded are following:

- >Transformer HV winding can be used up to specified maximum output power, instead of 66% de rated value for capacitor load. This is so for all transformers, any brand. Otherwise heavy mechanical hum may appear. In other words: A 100 Watt transformer winding may be loaded only with 66 Watt of capacitor loaded, or 100 Watt if choke loaded. Choke loaded circuits are almost a resistive load for the transformer, whereas capacitor loaded circuits cause impulsive load (with rattling noise).
- >Longest lifetime of the rectifier

- >Less AC field radiation from the wiring
- >Very lower internal resistance of the output voltage, when above 1/3 of maximum output current. This will make the DC voltage independent of the current drawn, within 10%. Capacitor loaded rectifier circuits provide no load regulation, and drop the output voltage rapidly at higher current.
- >No need to deal with transformer windings resistance

3. If Capacitor loaded, you must have a minimum required copper resistance of the transformer winding. This old design rule, is still obligatory for any 5U4G, EML or other brand. If capacitor loaded, the first capacitor must be chosen at or below the maximum value in this data sheet. At EML we adapted to the same values from old data sheets. So there will be no doubt about those values. The minimum resistance is specified for the complete winding. (So not measured from the Cathode Tap). In case you use a transformer with too low copper resistance, you need to add one series resistors in each HV winding connection of the transformer. Then, with those two resistors in series, you re-measure the transformer winding, and the result must be as follows:

Raa, value, for Curves 1...6: minimum 170 Ohms

Raa, value, for Curves 7...8: minimum 230 Ohms.

If you ignore this design rule, tube damage will result. Also in many 'professional' amplifiers, this design rule is not used by designers who do not read the historical data sheets Tube damage can result as a white spark inside the tube at switch on, filament material can chip off, or the tube life will be much reduced. With most amplifiers, the transformer winding is directly connected to the tube socket, and no protective series resistors are used. In most cases, the transformer resistance can be conveniently measured by a specialist, directly at the tube socket, when the rectifier tube is removed first.

4. Never operate the tube in the red area of the graph, above.

Note the graph has a white and a red (pink) area. Operation in the red area is strictly forbidden. Going to the limits is possible, but maximum tube life will not result from this. The '70%' limit for long-life operation applies also here.

When studying the graph, you will see a dotted line, on the right upper side. It looks like a corner of the graph is cut off here. This cut off piece will be larger when the first capacitor is larger. So now, it is specified for a first capacitor of 10uF in this graph. The best way to prevent problems, is not the maximum value capacitors, and use simply a bit higher transformer voltage and larger chokes to get the required result. This will not give less efficiency of the rectifier circuit ! It will however make any type of rectifier tube last longer. Even the opposite effect can be seen, when people over-rate the first capacitor in an attempt to get lowest possible hum. In several cases, over-rating the capacitor will even increase the total hum of the amplifier. Elementary design rules say, you stabilize a high voltage with a large choke, and low voltage with a large capacitor. With maximum value capacitors, the capacitor charge pulses get extremely high, causing hum field radiation into the pre-amplifier wiring and tubes. These charge pulses have a kind of 'bad sounding' wave shape, and smallest hum field radiation from this, can become audible if strayed into the pre-amp circuit anywhere. Two design notes for this are at the end of this data sheet. When designing your own circuit, you should really read those notes.

Notes

- Note 2) To prevent large charge current peaks, the first capacitor (C1) should NOT be larger than 40uF. If the input capacitor is too large, this will result in heavy AC charge current through this capacitor. This is not good for the rectifier tube, and also not for the capacitor lifetime. The AC capacitor current peaks may cause hum radiation into the preamplifier. With the given C-L-C values in table, the rectifier circuit will work best. For filtering, with oversized components, you will have best results by increasing the choke. Do not oversize capacitor C1, this may increase hum. You can choose the choke large as you want. This will have better results with high voltage rectification.
- >Note 3) Rectifier tubes may under no circumstance carry larger current peaks as what they are designed for. The current peaks are mainly a function of: power supply DC load, first capacitor and transformer copper resistance. The copper resistance for 5U4G and 5Z3 may not be smaller than 170 Ohms. This is very important to check, and too low copper resistance may damage the rectifier, no matter what brand or construction. Use a small series resistor if the copper resistance of the used transformer is too low. If you scroll further down this data sheet., there is a link to a table with historical information about this, for several rectifier types, not only 5U4G.
- >Note 4) There is common misunderstanding that 5U4G and 5U4GB is electrically the same. 5U4GB is a version, with lower internal resistance and higher peak current is allowed. The GB version is not the same tube as the G Version. Replacing 5U4G with 5U4GB may result in higher rectified voltage, so should never be done. Replacing 5U4GB with 5U4G may result in lower rectified voltage, and may result in damage of the 5U4G rectifier.

- >Note 5) For those who do computer simulations, the Anode current of 5U4G can be found by Child-Langmuir's Law. This results in the formula $I_p = K \cdot V_p^{1.5}$. You can enter this in programs and draw a Anode curve. The number K is the Diode Perveance, the value is in Amps per Volt, that tells nicely what that means. That you have to find experimental with new tubes. It was found for new 5U4G as 0.000777



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5U4G Mesh Data Sheet

5Z3 Mesh Data Sheet

Last Update: 01/20/2026 05:59:56

Description



This data sheet applies for the 5Z3-Mesh and 5U4G-Mesh, which are electrically identical, apart from the sockets. 5U4G-Mesh uses an Octal Socket socket, of which only five pins are used (and one of those is electrically not connected). 5Z3-Mesh uses a four Pin UX4 socket.

These are direct replacements for the historical 5U4G or 5Z3. They can not replace 5U4GA or 5U4GB which are different tubes. [See Note 4](#)

Note that the Emission Labs® tube is somewhat larger size than the historical tubes. Check below at mechanical data, for details. Like most NOS rectifiers, also the EML rectifiers are Slow-Start tubes, protecting the power supply and the whole amplifier to some degree. The delay time for first function is 2 seconds, and the delay for full current is 7 seconds.

For ultra low ripple, it is recommended to use the [Lundahl LL1673 dual coil choke in low CMR configuration](#). In this configuration, there is virtually no field radiation from the choke. (See link to circuit diagram, at the bottom of this page).

[Tube Picture High Resolution](#)

Guarantee program for first owner.

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receipt, at the Emission Labs® website, to participate in the 5 years guarantee program.

[Our Guarantee conditions](#)

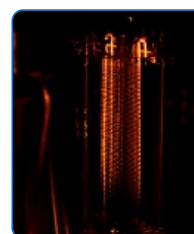
[Register here for the 5years guarantee](#)

Features

- In 2011, we have included inside the tube glass a special element to stabilize the heater voltage. See also the pictures on the right. ([or here](#)) These elements at higher current, will increase their resistance, and help protect the heater against accidental over voltage.
- Slow Start (2...7 seconds)
- Filaments are series connected, for best symmetry of the two diodes inside.
- Extra large getters.
- Each tube is numbered, inside the bulb with a metal Tag.
- Extra large getters, flashing the complete tube bottom.
- These tubes are shipped in a high quality box.
- Tube printing with real gold (metal), red color is burned into the glass.
- In 2011, we have started to ship 5U4G-mesh with the new ceramic socket, with five pins. From Yamamoto, the Octal 8/5p Teflon socket is recommended. This is an octal socket, but has five pin holes only. It is specially used for this rectifier. When working with Octal sockets, you will find the

About the EML 5U4G

Emission Labs® was the first company to introduce a mesh version the 5U4G in the year 2006. Also, we were the first company to reintroduce the 5Z4 in 2007.



Starting May 2011, we have included inside the tube glass a special element to stabilize the heater current. Please click on the next picture:



These red glowing metal strips, are in series with the filament. These have a current depending resistance. By this, it will help to keep the filament current constant, despite some variation of heater voltage, caused by mains voltage changes. This adds to the life time of the tube.

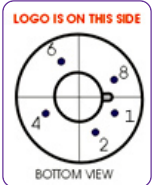


5Z3-Mesh
UX4 Base

Yamamoto an amazing top class product. For this rectifier you can take the special octal version with five holes only. Like this you can never put in a non-rectifier tube by mistake. You can also use normal octal sockets of course.

Filament Ratings	
Filament Voltage	5 Volt (AC or DC)
Tolerance on filament voltage	5%
Filament Current	3 Ampere

Maximum ratings NOT possible simultaneously	
AC transformer voltage	550Volts
AC transformer copper resistance (Raa)	Not below 170 Ohms for curves 1...6 Not below 230 Ohms for curves 7...8
DC output current of circuit	225mA Capacitor loaded 265mA Choke loaded
First capacitor, connected to Anodes	40uF
AC Peak Current (repeatedly)	800mA
Transient Peak Current (only once)	4A

Mechanical Data	
 5U4G-Mesh Bottom view	Tube Size including Socket: 165 x 60 mm Connections: Filaments: 8 + 2 Anodes: 4 + 6
 5Z3-Mesh	Tube Size including Socket: 165 x 60 mm
Tube weight	130 Gram
Shipped weight for one tube	400 Gram



UX4 Socket
(by Yamamoto)



5U4G-Mesh
Octal Base



5-Hole Octal Socket
(by Yamamoto)

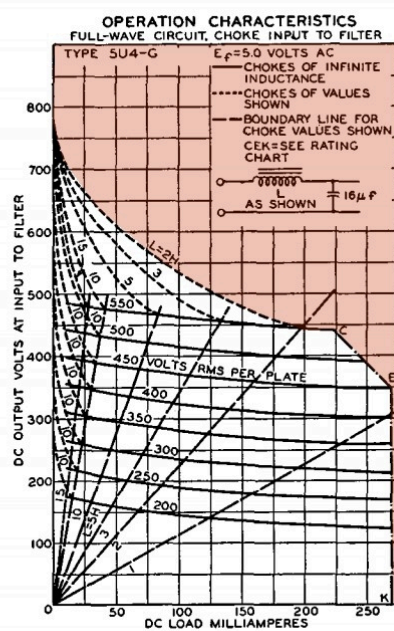
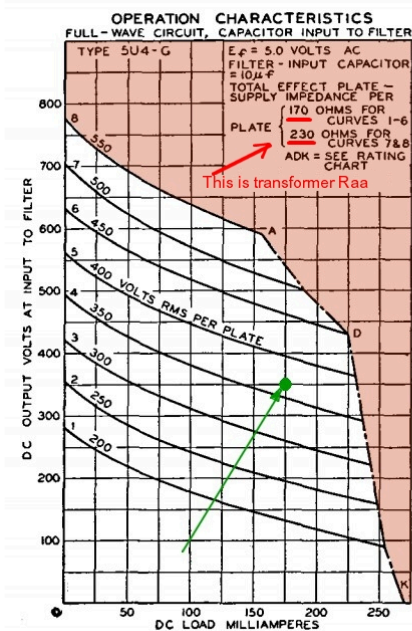


PART II

DESIGNING RECTIFIER CIRCUITS

Typical application

- > See: [CIRCUIT DIAGRAM](#)
- > See: [Note 2](#)



Left Chart for following Capacitor loaded tube, with these values: **Right Chart for following Choke loaded tube, with these values:**

- >Capacitor input filter. Value chosen 10uF here
- >Transformer DC Resistance 170 Ohms for curves 1...6
- > Transformer DC Resistance 230 Ohms for curves 7...8
- >Choke input filter
- >Transformer DC Resistance= Uncritical
- >Capacitor value 16uf here.

About these Charts:

These charts are graphical design tools, saving the trouble of calculations.

Both charts show some degree of derating, meaning you can not have maximum current and maximum voltage at the same time. As the choke loaded circuit is not so hard on the tubes, you will see derating is less at very high current. So the maximum of 265mA can be used up to 350V DC output. This is definitely not possible with a capacitor loaded circuit. Though capacitor loaded circuits perform good at low to medium current, like at 100mA you can get 600V, where choke loaded will only do 470...540V depending on the choke inductance. This is only from the view of convenient use. From the view of good tube life and smallest hum field radiation, choke loaded is preferred, unless you work at very low current, like below 75mA.

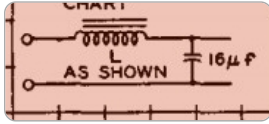
From the right choke loaded chart it can be seen, the maximum current of 265 can be used to generate 350Volt DC, whereas the capacitor loaded circuit at 350V can only so 230mA. Yet when generating 480VDC, the limit is 150mA only of choke loaded, or 200mA capacitor loaded. It pays off to check, if you can fulfil the needs with a choke loaded circuit, and if yes, this would be the better circuit to take. So both circuits can do 480V at 150mA, and choke loaded will sure do this at less disturbance to sensitive circuits near by.

How to use these Charts:

- >Choose the required DC Voltage on the Vertical axis
- >Choose the requires Output current on the Horizontal axis
- >You have to be in the white Zone. Otherwise 5U4G can not be used. (or use two in parallel)
- >Take closest curves 1...8 for the transformer AC voltage, or estimate one curve in between.
- >Note, the curves on the right chart have a smaller angle. (they are more horizontal). Meaning output voltage depends not much on actual DC current.
- >Note, this is official RCA information from the RCA tube manual 1954. You can download the 1954 and other manuals from 4tubes.com.

These graphs are from the historical RCA data sheets. When designing new circuits yourself, be aware a tube rectifier is more difficult to use than a silicon diode. Very roughly, the electrical model of a tube rectifier is like an ideal diode, with a resistor in series. You need to limit the peak value at any circumstance to prevent defects, and keep it as low as possible for best lifetime. Since peak current is difficult to measure, a more practical way is use graphs such as the one on the left here. All in the end, you will notice you need more than a quick glance on the data. You will always end up with some sort of de-rating. Such as: At maximum voltage, you can not draw maximum current. At maximum current, you can not use the maximum first capacitor. Maximum tube life will not go together with maximum load conditions, etc. Mistakes come from now knowing how these compromises must be made, or copy circuits from the internet, made by others the same way.

Choke loaded circuit.



The best for the tube, and for low hum field radiation, is a choke loaded circuit. In simple wordings, a capacitor loaded circuit is lower cost, but will put more stress on the tube, and also some stress on the first capacitor, which will degenerate by this over the years. A choke loaded circuit will put the stress mainly to the choke,

which is a device with no wear out, and the tube and capacitor are spared a lot.

Technically there is more to it. A choke loaded circuit will force almost DC current through the diodes. Moreover, a choke loaded circuit acts as a 'DC transformer', so the DC current which is generated, it higher as the AC current used! To make it even better, a choke loaded circuit has a better load regulation as capacitor loaded. So at higher current, voltage drops less as with a capacitor loaded circuit. This may all sound unbelievable, but it works like this: The inductance of the choke is a constant current user, or constant current supply, either way, depending if the transformer is charging the circuit, or if the circuit is discharging itself into the load. When the inductance is large enough, the DC current change very little within one AC cycle. So a signal almost like DC will flow through the choke, and for that reason through the entire circuit. This includes the rectifier diodes, and even the transformer windings. The engine storage buffer for this is the choke itself, which will generate the required voltage, to keep the DC current flowing. Like this, the whole circuit carries DC current. The function on the second capacitor is to prove an L-C filter to reduce residual hum, but AC current peaks of the capacitor are small. Much to the contrary of an C-L-C circuit, which has a very heavy pulsed charge current into the first capacitor. This current with C-L-C circuit can radiate a magnetic field, saturate the mains transformer at it's peaks, and also wear out the rectifier diodes much faster. The much more gentle L-C circuit. can load a mains transformer up to 100% of it's specified ratings, whereas C-L-C circuits can load a transformer only up to 66% (or the transformer will produce audible hum + magnetic hum field)

We much recommend you to have a look at the original RCA data sheets, winch content is too extended to quote it here, however this is the one and only reference for designs with a long tube life. Designs with mistakes in it, will initially work. So the fact it 'works' does not prove you will get long lifetime.

After all, the disadvantage of a choke loaded circuit is the cost and dimensions of the choke. So many times, you will see HiFi companies saving money on it.

Please note it can not be the intention here, to explain how to design a good circuit. However we try to tell some things here, that we know are sometimes not looked at very well. Also we encourage you to read the original old data sheets. from RCA, General Electric and Sylvania, and Telefunken. You can download these and a lot more s from 4tubes.com. So look there for datasheets, and the famous RCA handbook

Some important things to remember (unsorted)

1. **Fuse Protection.** To protect the rectifier, a slow fuse must be used. If choke loaded, the fuse must be from the output of the DC voltage, to the rest of the circuit. If capacitor loaded, the fuse must be to the transformer Cathode Tap. (So where there is a wire to the transformer Cathode Tap, inside this wire must be a fuse inserted)
2. **The ideal application of ANY rectifier tube, all brands, is Choke Loaded.** A choke loaded rectifier circuits will give better performance in many ways, however it's function is often misunderstood, and for this reason not often used. However we recommend a choke loaded circuits with first priority always.

Advantages of a choke loaded rectifier circuit, vs. capacitor loaded are following:

- >Transformer HV winding can be used up to specified maximum output power, instead of 66% de rated value for capacitor load. This is so for all transformers, any brand. Otherwise heavy mechanical hum may appear. In other words: A 100 Watt transformer winding may be loaded only with 66 Watt of capacitor loaded, or 100 Watt if choke loaded. Choke loaded circuits are almost a resistive load for the transformer, whereas capacitor loaded circuits cause impulsive load (with rattling noise).
- >Longest lifetime of the rectifier

- >Less AC field radiation from the wiring
- >Very lower internal resistance of the output voltage, when above 1/3 of maximum output current. This will make the DC voltage independent of the current drawn, within 10%. Capacitor loaded rectifier circuits provide no load regulation, and drop the output voltage rapidly at higher current.
- >No need to deal with transformer windings resistance

3. If Capacitor loaded, you must have a minimum required copper resistance of the transformer winding. This old design rule, is still obligatory for any 5U4G, EML or other brand. If capacitor loaded, the first capacitor must be chosen at or below the maximum value in this data sheet. At EML we adapted to the same values from old data sheets. So there will be no doubt about those values. The minimum resistance is specified for the complete winding. (So not measured from the Cathode Tap). In case you use a transformer with too low copper resistance, you need to add one series resistors in each HV winding connection of the transformer. Then, with those two resistors in series, you re-measure the transformer winding, and the result must be as follows:

Raa, value, for Curves 1...6: minimum 170 Ohms

Raa, value, for Curves 7...8: minimum 230 Ohms.

If you ignore this design rule, tube damage will result. Also in many 'professional' amplifiers, this design rule is not used by designers who do not read the historical data sheets Tube damage can result as a white spark inside the tube at switch on, filament material can chip off, or the tube life will be much reduced. With most amplifiers, the transformer winding is directly connected to the tube socket, and no protective series resistors are used. In most cases, the transformer resistance can be conveniently measured by a specialist, directly at the tube socket, when the rectifier tube is removed first.

4. Never operate the tube in the red area of the graph, above.

Note the graph has a white and a red (pink) area. Operation in the red area is strictly forbidden. Going to the limits is possible, but maximum tube life will not result from this. The '70%' limit for long-life operation applies also here.

When studying the graph, you will see a dotted line, on the right upper side. It looks like a corner of the graph is cut off here. This cut off piece will be larger when the first capacitor is larger. So now, it is specified for a first capacitor of 10uF in this graph. The best way to prevent problems, is not the maximum value capacitors, and use simply a bit higher transformer voltage and larger chokes to get the required result. This will not give less efficiency of the rectifier circuit ! It will however make any type of rectifier tube last longer. Even the opposite effect can be seen, when people over-rate the first capacitor in an attempt to get lowest possible hum. In several cases, over-rating the capacitor will even increase the total hum of the amplifier. Elementary design rules say, you stabilize a high voltage with a large choke, and low voltage with a large capacitor. With maximum value capacitors, the capacitor charge pulses get extremely high, causing hum field radiation into the pre-amplifier wiring and tubes. These charge pulses have a kind of 'bad sounding' wave shape, and smallest hum field radiation from this, can become audible if strayed into the pre-amp circuit anywhere. Two design notes for this are at the end of this data sheet. When designing your own circuit, you should really read those notes.

Notes

- Note 2) To prevent large charge current peaks, the first capacitor (C1) should NOT be larger than 40uF. If the input capacitor is too large, this will result in heavy AC charge current through this capacitor. This is not good for the rectifier tube, and also not for the capacitor lifetime. The AC capacitor current peaks may cause hum radiation into the preamplifier. With the given C-L-C values in table, the rectifier circuit will work best. For filtering, with oversized components, you will have best results by increasing the choke. Do not oversize capacitor C1, this may increase hum. You can choose the choke large as you want. This will have better results with high voltage rectification.
- >Note 3) Rectifier tubes may under no circumstance carry larger current peaks as what they are designed for. The current peaks are mainly a function of: power supply DC load, first capacitor and transformer copper resistance. The copper resistance for 5U4G and 5Z3 may not be smaller than 170 Ohms. This is very important to check, and too low copper resistance may damage the rectifier, no matter what brand or construction. Use a small series resistor if the copper resistance of the used transformer is too low. If you scroll further down this data sheet., there is a link to a table with historical information about this, for several rectifier types, not only 5U4G.
- >Note 4) There is common misunderstanding that 5U4G and 5U4GB is electrically the same. 5U4GB is a version, with lower internal resistance and higher peak current is allowed. The GB version is not the same tube as the G Version. Replacing 5U4G with 5U4GB may result in higher rectified voltage, so should never be done. Replacing 5U4GB with 5U4G may result in lower rectified voltage, and may result in damage of the 5U4G rectifier.

- >Note 5) For those who do computer simulations, the Anode current of 5U4G can be found by Child-Langmuir's Law. This results in the formula $I_p = K \cdot V_p^{1.5}$. You can enter this in programs and draw a Anode curve. The number K is the Diode Perveance, the value is in Amps per Volt, that tells nicely what that means. That you have to find experimental with new tubes. It was found for new 5U4G as 0.000777



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EML80A Mesh Data Sheet

Last Update: 07/12/2026 12:37:02

Description



This tube has the designation "80A", indicating it is a special version of the "80" tube.

The difference is two:

1. The A-Version has the tube socket mounted 180° rotated, compared to all other EML tubes. Like this they fit nicely into Yamamoto amplifiers, which have the rectifier socket mounted rotated. By this little cosmetic change, the logo is at the front in Yamamoto amplifiers.
2. The 80A is dual tested, at Type 80 specifications, and at 274A specifications.

More about this, in the description below here.

[High Resolution](#)

Description

The 80 rectifier was a standard rectifier in American Radios. These radios worked typically at 250V DC. To avoid the use of a power supply choke, they used relatively high first capacitors. Due to this low voltage, the "Type 80" was relatively low cost, and it became very popular.

The 274A rectifier has also a 2 Ampere heater and UX4 socket. It was however intended for higher voltage applications, which was achieved by a better tube socket, and more isolation distance with the mica parts and the tube stem. The drawback of the much higher voltage, is a smaller maximum value of the first capacitor.

The Emission Labs 80A can fulfill both requirements: The high voltage if the type 80 tube, using a small capacitor, and the lower voltage of the 274A tube, using a large capacitor.

With rectifier design in general, to achieve ultra low ripple, it is recommended to use the Lundahl LL1673 [dual coil choke](#) in what is called: "CMR" configuration. A large choke needs no high first capacitor, can take a higher second capacitor much better, and there will be virtually no hum field radiation from the choke itself. (See link to circuit diagram, at the bottom of this page).

Guarantee program for first owner.

The first owner can register the tube within 4 weeks after receipt, at the Emission Labs website, to participate in the 5 years guarantee program, which is additional to the legal obligations of the seller.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

Did you know this?

Emission Labs was the first company to use soft rubber to attach the tube base. Now many other companies copied this. Thanks for the credit :)

EML Rectifier tubes



[AZ4-Mesh](#)

[5U4G-Mesh](#)

[5Z3-Mesh](#)

[80A-Mesh](#)

[81-Monodiode](#)

[274A-Mesh](#)

[274B-Mesh](#)

- Hard metal filaments ([See Note1](#)), series connected.
- Each tube is numbered, inside the bulb with a metal Tag
- Hand blown, Globe shaped glass
- Extra large getters.
- These tubes are shipped in a high quality dual box or single box for rectifiers.
- Tube printing with real gold (metal), red color is burned into the glass.
- Gold Plated pins, black ceramic UX4 socket. (White bottom). Ideal for the YAMAMOTO tube sockets.

Typical application notes below here, applies for 80 and the 274 tube.

- [See: CIRCUIT DIAGRAM](#)
- [See: Note 2](#)

Sound Character of the 80 Rectifier

It is the most asked question, and behavior of a power supply depends a lot on the type of tube rectifier used, and the way it is used.

The 80 rectifier was intended for small radios, where it cooperated with output tubes like the 45 Triode and 47 pentode. Radio receivers usually operate at 250V DC. This voltage was easy to achieve, and enough for amplifier tubes. However for a triode as output tube, 250V was a compromise in terms of output power. Otherwise the whole radio had to be designed for higher voltage, which was more expensive. Yet for higher power output, a higher working voltage of 275V was used, as found in more expensive radios and audio amplifiers. The 80 tube was designed for both applications, and still today the ideal choice for small HiFi amplifiers, or pre amplifiers. It can be regarded as a smaller version of the 5U4G, but the 80 has higher plate impedance, which is of advantage for low hum circuit design.

The maximum capacitor value for the 80 tube was limited at 20uF. The 80 rectifier is quite robust, because the relation of maximum capacitor value compared to the heater current is better than with 5U4G. For this reason, collectors often find the original 80 rectifier still working in old radios.

Overall it can be said, the 80A rectifier is a very reliable tube, and comfortable for the electronics designer, due to it's relatively high possible first capacitor. Other than 5U4G, this tube is characterized by higher dynamic resistance, thus reducing power supply hum, and radiation of hum into other parts of the circuit. Also for head phone amplifiers, it makes this tube a very good choice.

Filament Ratings	
Filament Voltage	5 Volt (AC or DC)
Tolerance on filament voltage	5%
Filament Current	2 Ampere

Maximum ratings if transformer below 350V AC For use as type 80 tube

Max limits are possible simultaneously

	AC in	DC out
Capacitor Input	350	125mA
Transformer Raa minimum value. (Add normal resistor, if your Raa too low)		
		200 Ohms

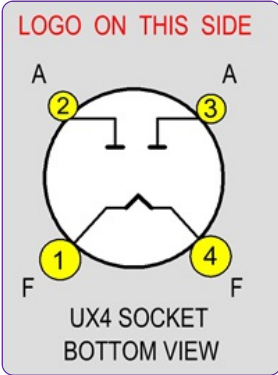
Maximum ratings if transformer above 350V AC For use as 274A tube

Max limits NOT possible simultaneously

Take one maximum number, you must de rate another
READ all notes at the bottom of this Data sheet

DC output current	160mA
-------------------	-------

Choke Input	550Volts
Capacitor Input	450Volts
First capacitor, connected to Anodes	4uF

80A Mechanical Data	
	Size including Socket (but excluding pins) 140 x 58 mm 5.5 x 2.3 Inch
Tube weight:	130 Gram
Shipped weight for a single boxed tube:	400 Gram

Notes

1. Good care should be taken when making the design of any DHT rectifier. Strong current peaks must be prevented through the first capacitor, because consequently this flows through the tube anode, and transformer windings as well. The transformer will produce mechanical hum, if there is no mechanical windings symmetry. (such as one layer simply wound over the other). Also hum can occur, when the copper resistance is chosen too low. Such errors will make the transformer noisy, and it is not good for the tube also. For this reason, the first capacitor (C1) should never be larger than stated in this data sheet.
2. Power supply hum is greatly reduced by a smaller capacitor value. In order to achieve the same amount of filtering, simply increase the choke value accordingly. Although it is clear, larger capacitors come at lower cost than larger chokes, working with a small capacitor and large choke, is always better. The result will be: Lower mechanical transformer hum, less electrical field radiation into the pre-amp, and more lifetime from the rectifier tube. From Lundahl, high value chokes are achievable at the same price as HiFi capacitors, like from a Mundorf or Black gate. Going back to the roots, we use high quality, large value chokes, as it was normal in the old days of radio design, when the type 80 tube was invented by RCA.
3. For best ripple suppression, increase the choke to any value you need, or even use an C-L-C-L-C circuit, as also advised in the historical RCA data sheet. We advise this, same as it was advised 100 years ago.
4. Higher capacitor values as the data sheet maximum limit, MAY sometimes be used, but only at very special conditions. This can be the case, if the rectifier is used at significant lower voltage and lower current than maximum. Though we advise against it, you may see this occasionally. This is however wrong, if not done without a measurement, proving peak current is within range. Moreover there is no real need for this. As a rule of thumb, high voltage power supplies work better larger chokes, whereas low voltage power supplies work better with larger capacitors.
5. Mechanical windings symmetry is needed with HV transformers to avoid hum. A HV winding with Cathode Tap, requires most of the time FOUR separated HV windings inside the transformer, which are arranged for the end user as one winding with a Cathode Tap. It is remarkable to see, how transformer manufacturers have forgotten this today. If simply two windings are laid over each other, the inner winding has smaller copper resistance than the outer. With load being not identical this way, a small DC current results, which pre-magnetises the transformer core, and mechanical hum is the result. However we write a tube data sheet here, not a transformer construction manual, so we can not explain this in more detail.



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81 Mono Diode Data Sheet

Last Update: 06/13/2024 07:08:09

Description

The 81 was historically intended for use with the Type 50 tube. The 81 is a classical mono diode for relatively high voltage, such as found with large directly heated triodes. Normally two 81 tubes are used for full wave rectification. The heaters of two tubes should be put in parallel, thus the equivalent of a normal dual diode will result. In this configuration It can produce conveniently an output voltage of 500....700 Volt, at maximum 170mA. Other than dual diodes such as 5U4G, a pair of 81 can be used at maximum voltage and maximum current at the same time.

Note, it takes two 81 monodiodes to build a rectifier circuit, which is actually more powerful than a 5U4G circuit.



High Resolution

The EML tubes feature a series connected filament for both diodes together, which has certain advantages.

This tube can supply 140mA with a normal C-L-C filter. The 274A and 274B are designed for Audio purposes, and best use is with a small size first capacitor.

The EML 274 is also specially suited for applications with relatively high DC voltage. The new ceramic sockets we use since 2011, are make this possible.

Guarantee program for first owner

The first owner can register the tube within 4 weeks after receipt, at the Emission Labs © website, to participate in the 5 years guarantee program, which is additional to the legal obligations of the seller.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- **NEW** Soft rubber suspended tube base
- Hard metal Construction ([Note1](#))
- Extra large getters
- Hand blown Glass bulb
- These tubes are shipped in a [high quality dual box](#)
- Tube printing with real gold (metal), red color is glass burned into the glass
- YAMAMOTO tube sockets highly recommended.
- Gold Plated, black ceramic socket

Did you know?

Did you know? Emission Labs® was the first company to re-introduce the 81 tube again, in the year 20212.

EML Rectifier tubes



[AZ4-Mesh](#)

[5U4G-Mesh](#)

[5Z3-Mesh](#)

[80-Mesh](#)

[81-Monodiode](#)

[274A-Mesh](#)

[274B-Mesh](#)

Sound Character of the 81

We try to answer this question if possible. The 50 triode will give it's best performance at a relative high voltage. The 81 diode has a larger anode distance as usual. This makes the impedance higher, and the characteristic of this tube softer. The 81 diode is the most genuine tube to use together with the 50 triode, since it was originally designed for this use. Also constrictionwise the 81 looks a lot like the 50 itself. When using this tube, the whole amplifier comes with 7.5 Volts heaters, which have a nicer glow appearance then the 5V heaters.

To a construct usual dual rectifier, the heaters of two diodes are connected in parallel.

For very small amplifiers, such as head phones, it is possible to use just one monodiode.

For ultra low ripple, it is recommended to use the Lundahl [LL1673](#) dual coil choke in low CMR configuration. In this configuration, there is virtually no field radiation from the choke. (See link to circuit diagram, at the bottom of this page).

Filament Ratings for one diode	
Filament Voltage	= 7.5 Volt (See Note1)
Filament Current	~ 1.25 Ampere (See Note1)

Maximum ratings for a PAIR of diodes	
IMPORTANT: Please read the notes at the bottom of this data sheet	
AC input voltage	700Volts
DC output current, for a PAIR of tubes	170mA
Copper Resistance of transformer minimum value. Add normal resistor if copper resistance is too low. (so if you have 120 Ohms, you need to add 80 ohms or more)	200 Ohms
First capacitor, connected to Anodes	4uF max

Full Wave Rectification with a pair of 81 tubes.		
Capacitor loaded (4uF)		
Some examples from these curves on the right:		
Transformer Voltage	DC Output Voltage	DC Output Current
500-0-500V	580V=	40mA=
500-0-500V	520V=	90mA=
500-0-500V	443V=	170mA=
450-0-450V	510V=	40mA=
450-0-450V	460V=	90mA=
450-0-450V	382V=	170mA=

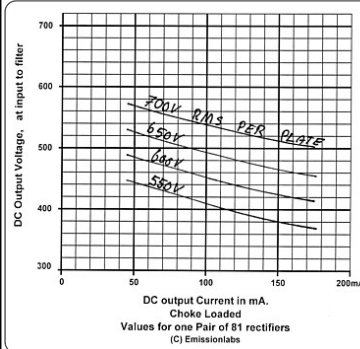
DC output Current in mA.
Capacitor Loaded
Values for one Pair of 81 rectifiers
(C) Emissionlabs

Full Wave Rectification with a pair of 81 tubes.

Choke loaded, for instance with Lundahl LL1673-10Henry

Some examples from these curves on the right:

Transformer Voltage	DC Output Voltage	DC Output Current
600-0-600V	490V=	40mA=
600-0-600V	460V=	90mA=
600-0-600V	440V=	170mA=
550-0-550V	450V=	40mA=
550-0-550V	418V=	90mA=
550-0-550V	371V=	170mA=



Note, with a choke input, the load regulation is much better, it is approximately twice as good as capacitor loaded.

81 Mechanical Data



Tube Size including Socket:
140 x 58 mm



Tube weight	130 Gram
Shipped weight for double box with one pair	400 Gram

Some Design Notes for Tube Power Supply

- [Old Design Info- Still valid!](#)
- [Application Note AN-01](#)
- [Application Note AN-02](#)
- [More Technical Notes](#)

Notes

1. Good care should be taken when making the design of any DHT rectifier. It must be prevented to have strong current peaks, through the first capacitor, because consequently this flows through the tube anode, and transformer windings as well. The transformer will produce mechanical hum by this, most specially if windings symmetry fails. Also the tube will suffer. For this reason, the first capacitor (C1) should never be larger than stated in this data sheet. The mechanical transformer hum, and also tube current peaks are greatly reduced by smaller capacitor values, and use higher choke values instead. Although higher capacitor values come at lower cost, using lower capacitors and higher chokes values instead, is always more satisfactory in the end. The result will be: Lower transformer hum, less electrical field radiation into the pre-amp, and more lifetime from the rectifier tube. This is why we recommend using largest chokes. From Lundahl, high value chokes are achievable at the same price as HiFi capacitors, like from a Mundorf or Black gate. So we have to

go back to the roots, and use high quality, large value chokes, like in the old days of radio design. For best ripple suppression, increase the choke to any value you need, or even use an C-L-C-L-C circuit, as also advised in the historical RCA data sheet.

2. As a rule of thumb, high voltage power supplies are work best with large size chokes, specially at high output current, whereas low voltage power supplies are more conveniently build with larger capacitors



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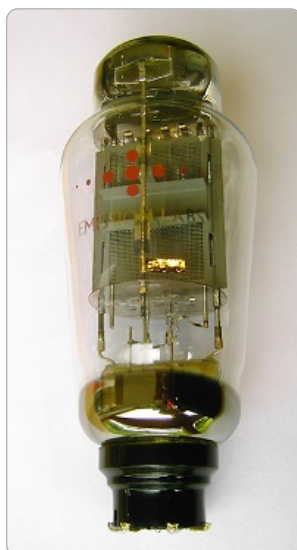
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EML AD1/350 Mesh with classic 8-pin socket EML AD1/350 Mesh with UX4 socket

Last Update: 07/12/2026 12:35:33

Description



AD1/350 was the Telefunken designation for their higher quality version of AD1, capable to replace any AD1, at classic 250V working point, but also it may be operated up to 350V, in order to bring the tube in a range with better efficiency and **additional** output power resulting from it, yet without increasing dissipation. This higher working point, with historic versions, it will initially work, but the tubes may develop grid current unexpectedly.

EML AD1/350 however is fully free of grid current at any operation point, also at high use hours as well.

Though it is electrically not identical, any existing 2A3 circuit diagram can be used, provided there is the 4 Volt heater voltage available.

We have a version with the vintage 8pin Side socket, and with the 4Pin UX4 base.

[8Pin High Resolution](#)

[4Pin High Resolution](#)

Guarantee program for first owner.

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receipt, at the Emission Labs® website, to participate in the 5 years guarantee program.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gray Wire Mesh Anodes, mounted on a hard metal frame for best stability.
- Gold plates, Wolfram Grid
- Soft rubber suspended tube base
- Cathode Tapped filament
- Slow Start filaments, for best lifetime
- Anode voltage maximum 350V
- Can be used continuously at maximum Anode dissipation
- Hard metal Construction ([See Notes](#))
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension

About AD1

AD1, the queen of European DHT triodes, is an audio tube, intended for large radios and cinema amplifiers. It was introduced just before the second world war, and during the war 'big' radios and cinemas were no item. Already during the war, military small pentodes were made. Then after the war, the high need for new made radios ended the production of the AD1, before it had really started. The market required high quantities of small size, low cost tubes. It is not known how many AD1 were made, but estimated is 250.000 pieces. Also the AD1 socket type (P8) got obsolete, because it can only be connected to 'wired' tubes, and not to the after-war tubes which typically had their pins through the glass. This socket is however amongst the best ever made. It pulls the tube inside the socket, and it closes the chassis part like a lid, so not dust can get in. You need no tube retainers, the tube pins are extremely well self cleaning, and the chassis part can be accessed for cleaning with a cloth. It is a true high-end socket, and several military sockets were inspired on this technology later.

- These tubes are shipped in a high quality dual box
- Tube printing with real gold (metal), red color is glass burned into the glass

Tube Sockets for AD1



The original P8 'side contact' socket was a Philips development. This socket had an interesting property, it pulls the tube inside the socket by itself. To make this work well, tube base dimensions, socket dimensions and shape of the socket springs has to be exact. We have to mention that new production Chinese sockets are not so ideal, and shape of those can be bad. At EML, to

build the AD1, we use Vintage tube bases from the 1930's, of which we have some old stock. For the amplifier chassis, we recommend **NOS** tubes sockets, as we sell for a low price.

Sound Character of the AD1

The higher heater voltage of 4 Volts, is also the source of another sound. This effect is only so with directly heated tubes. The AD1 sounds less dominant, more silky than 2A3. It can be said that all 4Volts DHT from the 1930's 1940's have very high collector's value, much higher than 2.5 Volts tubes have ever achieved.

Let me quote **Rainer zur Linde**, who wrote several books in German language about historical tubes. Translated here in English: **'AD1 is the highlight of European DHT triodes, and also marks the end of the period of DHT tubes manufacturing'**. Perhaps there is no better way to describe this tube.

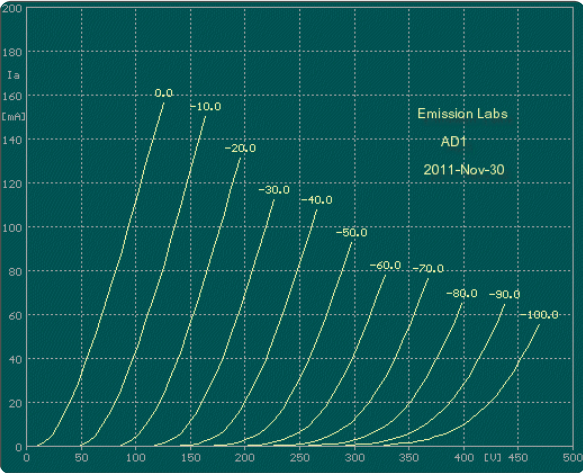
Filament Ratings (See note 5)	
Filament Voltage	4.0 Volt (AC or DC)
Electronic heater modules:	Only voltage source
Tolerance on filament voltage	+5% / -2.5% (see notes)
Filament Current	1,5 Ampere

Maximum Conditions (Max voltage and max current not possible simultaneously)	
Anode Voltage	350Volt
Anode Current	60mA
Anode Dissipation Fixed Bias (Continuously)	15 Watt
Anode Dissipation Auto bias (Continuously)	18 Watt
Highest possible Grid to ground resistor, Single Ended, Auto Bias.	500kOhm
Highest possible Grid to ground resistor, Single Ended, Fixed Bias.	50kOhm

Typical Tube Parameters measured @ Ua= 250V, Ia= 60mA	
Anode Impedance (Rp)	670 Ohms
Amplification Factor	4
Transconductance (Gm)	6 mA/V

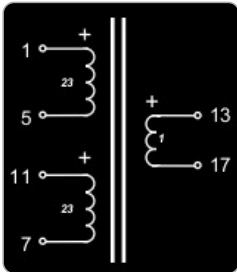
Recommended operating points Class A (Single Ended) Auto Bias, with Cathode resistor

Anode Voltage (to Cathode)	250V	300V	350V
Supply voltage (to Ground)	295V	360V	423V
Anode Current	60mA	50mA	43mA
Anode Dissipation	15Watt	15Watt	15Watt
Cathode Resistor (Rk)	750R	1k2	1679R
Control Grid Voltage	-45Volt	-60Volt	-73Volt
Load Impedance (Ra)	2k5	4k2	6k3
Recommended Lundahl Transformers	LL1623- 060mA	LL1679- 70mA	LL1620- 060mA
Power Output	4,5 Watt	5,3 Watt	5,8 Watt
These operating points are recommended in: 'Elektronenroehren, 2. Band, by H.BARKHAUSEN, 1928. This is one of the finest tube electronics books that I know, and several chapters are dedicated to the wonderful AD1 tube.			



EML AD1-Mesh Anode Curves

[Download these curves as PTE file - What is that?](#)

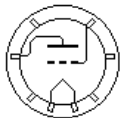


Some recommended Lundahl transformers for classical working points. Possible with 2A3 and AD1.

Click [here](#) for complete list of recommendations.

	Primary	Secondary
Single Ended. LL1623-60mA . 11Hz @1.5dB	Ra= 3000	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω
Single Ended LL1664-60mA 13Hz @1.5dB	Ra= 3000	8Ω Only

Parallel Singe Ended LL1623-120mA	Ra= 1600	Alt.C = 4Ω Alt.D = 8Ω Alt.E = 16Ω
Push Pull LL1620-PP	Raa= 6000	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω
Push Pull LL1679	Raa= 4500	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω
Push Pull LL1620-PP-CFB (with optional 25% Cathode feedback winding)	Raa= 6000	Alt.B = 4Ω Alt.C = 8Ω Alt.D = 16Ω

Mechanical Data	
EML Logo is on this side  bottom view	Size including Socket: 65 x 150mm
 EML Logo is on this side bottom view	Size including Socket: (but excluding pins) 147 x 60 mm Weight of one tube: 140 Gram Pin 1: Heater1 Pin 4: Heater2 Pin2: Anode Pin3: Grid
Single Tube weight	110 Gram
Shipment weight for pair in gift box	600 Gram

Notes

Note1) Gold Plated grids is a difficult to use technology, which reduces grid current to a minimum. Philips and Tungsram historical AD1 tubes suffer often from grid current and/or gas problems which may occur after the first 500hours of use. To the contrary, EML tubes have superb stability of the tube bias, and grid current much below 1uA.

Note2) Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that comes with each individual Tube. Each tube is numbered, inside the bulb with a metal [Tag](#)

Note3) Serial filaments is a technology, found in all later types Emission Labs® tubes. We use a Cathode Tapped filament wire for this. The Cathode Tap is physically located on the mica Anode the bottom of the tube. By this we connect two filament wires are in series, and the connection point is the Cathode Tap. Since this Cathode Tap can not be connected to the outside of the tube, we call it a virtual

Cathode Tap, but actually it really exists inside the tube, and ensures a perfect balancing of the emission of each individual filament wire. By this method we reduce tube hum to the lowest possible level.

Note4) Best Heater voltage is precisely 4V on the tube pins. Tube pins is not the same as socket pins, because 1.5A is a high current, and there are two contacts in the path. We recommend appr 0.1 V additional for this on the socket, to compensate for voltage drop across the contacts. So 4.1V on the socket, equals 4V on the tube itself. It is possible to exceed the heater voltage with +5%, with no change to lifetime or functioning. However working below specified heater voltage can impair tube function. If so, initially the tube seems to have no problem with it. However after some 100...500 hours, bias current may begin to reduce. If this took place, the following will help. With normal anode voltage on the circuit, normal operation, just correct the heater voltage to 4.3V on the socket, and the tube begins to recover after a few minutes. After some hours burn in like this, the tube is good again, and voltage can be reduced to normal, and the tube will be in good condition just like before.



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AZ4 Mesh Data Sheet

Last Update: 07/12/2026 12:35:43

Description



historically, AZ4 was parts of a new generation rectifier tubes, following up the famous RGN Series of Telefunken, intended for applications the AZ1 by Philips, could not do. AZ4 is in between 274B and 5U4G.

The smaller AZ1 was the mostly used rectifier tube in Europe, and electrical identical to RGN1064. The more powerful AZ4 is on par with stronger tubes like RGN2004.

AZ4 is an ideal candidate for HiFi applications. It can easily supply a stereo amplifier using a pair of AD1 or 2A3, as done for instance in the [Yamamoto A06-03](#) amplifier.

The base of this tube is an original old Bakelite base, that we remove from NOS tubes.

[High Resolution](#)

Guarantee program for first owner.

The first owner can register the tube within 4 weeks after receival, at the Emission Labs ® website, to participate in the 5 years guarantee program, which is additional to the legal obligations of the seller.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Soft rubber suspended tube base
- Hard metal Construction ([Note1](#))
- Extra large getters
- Hand blown Glass bulb
- These tubes are shipped in a [high quality single box](#)
- Tube printing with real gold (metal), red color is glass burned into the glass
- For AZ4, we apply original bake lite NOS Tube base from 1950
- YAMAMOTO tube sockets or NOS Sockets recommended. New made Chinese sockets are troublesome and not recommended.

Filament Ratings AZ4

Filament Voltage

4 Volt (AC or DC)

Did you know?

Emission Labs; was the first company to re-introduce the AZ4 mesh in the year 2005.

Tolerance on filament voltage	5%
Filament Current	Appr 2.3 Ampere

Maximum ratings NOT possible simultaneously IMPORTANT: Please read the notes at the bottom of this data sheet	
AC input voltage	300Volts
DC output current	200 mA
Minimum Copper Resistance of transformer winding Raa. Add two normal resistors in series, if copper resistance is below 2x 60 Ohms.	2x 60 Ohms
Maximum First capacitor, connected to Anodes	60uF max

AZ4 Mechanical Data	
 Logo is on this side	Size of Glass Bulb 125 x 58 mm
Tube weight:	130 Gram
Shipped weight for a single boxed tube:	400 Gram

Previous Type	Later Type	Max Transformer AC	Max Capacitor	Heater Current	Max DC output
RGN1064	AZ1	2x 300V	60uF	1.1A	100mA
RGN1054	AZ3	2x 350V	12uF	2A	120mA
RGN2004	AZ4	2x 300V	60uF	2.3A	200mA
RGN4004	AZ50	2x 500V	64uF	3A	250mA

SOME DESIGN NOTES FOR POWER SUPPLIES

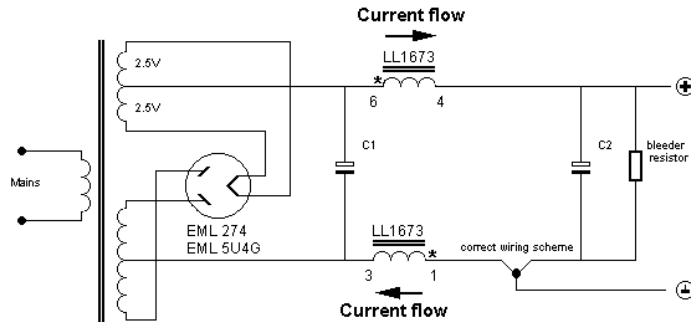
Design note-1

Design note-2

BLEEDER RESISTOR: will discharge the capacitor when the circuit is switched off. Make sure the resistor will discharge the capacitors to less than 40 Volts in maximum one minute. Verify the results! Depending on the capacitor value you may end up with a larger power resistor than expected.

Keep one inch distance from the capacitor, to prevent heating up the capacitor.

The suggested wiring scheme will make sure you have no ground loop error. So the black dot is one soldering point, to which ONLY these THREE wires are connected as you can see in this scheme. No other wires may be connected to it. When the black dot is in fact a chassis connection, it means the "ground" connection is already made, and only the choke and C2 are connected to it.



Note: This scheme for improved Ripple rejection works only with dual chokes like Lundahl 1673 or similar part numbers. The chokes must be wound on one core. Please check the right polarity of the connections. Use pin connections of the choke as in this circuit diagram.

Like this, effectively the choke will have the specified value as in the datasheet. For instance, the LL1673/10Henry will be split in two halves of 5Henry. It will perform as 10Henry still.

Jac-Music Copyright 2001

Note 1) Good care should be taken when making the design of any DHT rectifier. It must be prevented to have strong current peaks, through the first capacitor, because consequently this flows through the tube anode, and transformer windings as well. The transformer will produce mechanical hum by this, most specially if windings symmetry fails. Also the tube will suffer. For this reason, the first capacitor (C1) should never be larger than stated in this data sheet. The mechanical transformer hum, and also tube current peaks are greatly reduced by smaller capacitor values, and use higher choke values instead. Although higher capacitor values come at lower cost, using lower capacitors and higher chokes values instead, is always more satisfactory in the end. The result will be: Lower transformer hum, less electrical field radiation into the pre-amp, and more lifetime from the rectifier tube. This is why we recommend using largest chokes. From Lundahl, high value chokes are achievable at the same price as HiFi capacitors, like from a Mundorf or Black gate. So we have to go back to the roots, and use high quality, large value chokes, like in the old days of radio design. For best ripple suppression, increase the choke to any value you need, or even use an C-L-C-L-C circuit, as also advised in the historical RCA data sheet.

Note 2) As a rule of thumb, high voltage power supplies are work best with large size chokes, specially at high output current, whereas low voltage power supplies are more conveniently build with larger capacitors.

Note 3) Windings symmetry is needed with HV transformers to prevent hum. A HV winding with Cathode Tap, requires FOUR separated HV windings inside the transformer, which are arranged for the end user as TWO windings which are in series. It is remarkable to see, this is widely unknown today by many transformer manufacturers. Also this is more expensive. So often, they build tube rectifier windings only from two internal windings, and not FOUR windings as needed for tube rectifiers. However we have a tube data sheet here, no transformer construction manual, so we can not explain this in full detail.



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PX25 Data Sheet. Tube for UX4 socket

Last Update: 07/12/2026 12:35:44

Description



The PX25 is one of the all time classic audio output triodes. Designed in England in 1932, it was the first tube, designed for larger output power.

High Resolution

Night Picture

Guarantee program for first owner.

The first owner can register the tube within 4 weeks after receipt, at the Emission Labs website, to participate in the 5 years guarantee program, which is additional to the legal obligations of the seller.

Our Guarantee conditions

Register here for the 5years guarantee

Features

- Gold Plated Grid (Note8)
- Soft rubber suspended tube base
- Hard metal Construction (Note1)
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a high quality dual box
- Tube printing with 24k gold, and red color burned into the glass
- Gold Plated, black ceramic socket.

The Character of the EML PX25

The PX25 is one of the all time classic audio output triodes. Designed in England in 1932, it was the first tube, designed for larger output power. In the old Marconi Numbering System, P stands for 4V heater, and X stands for Power Tube. In Japan, 4Volt heater tubes have always been more preferred for their

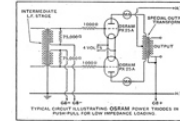
OF TECHNICAL IMPORTANCE

FOR GREATER UNDISTORTED
POWER OUTPUT
AT MODERATE
VOLTAGES

Osram
valves
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ENGLAND
Solely by All Radio Dealers

NEW

POWER TRIODES
TYPE
PX25A DA30



TYPICAL CIRCUIT FOR OPERATING OSRAM POWER TRIODES IN
PUSH-PULL FOR LOW IMPEDANCE LOADING

CHARACTERISTICS	TYPE PX25A	TYPE DA30
Filament Voltage	4.0	4.0
Filament Current	2.5 amp	2.5 amp
Anode Voltage	400 max	500 max
Angle Factor	1.8	1.5
Impedance	800 ohms	900 ohms
Mutual Conductance	1.7 mm ² /v	2.00 mm ² /v
Load Resistance for "Low Loading" push-pull (Anode to Anode)	5,000 ohms	1,000 ohms
Price each:	35/-	30/-

WRITE FOR NEW OSRAM VALVE GUIDE

"Low Impedance Loading" is a method of using a pair of Output Valves in a push-pull circuit to obtain a considerable increase in undistorted power, without resort to high H.T. voltage or the necessity for positive grid drive.

The success of the system depends on the characteristics of the valves and on the design of transformers employed. Full particulars are available on application.

OSRAM PX25A is a Power Triode designed for use in pairs where a maximum A.T. voltage of 400 is available. The rated dissipation of the PX25A type is 25 watts.

OSRAM DA30 is a Power Triode for use in amplifiers where a greater output is required and where a maximum A.T. voltage of 500 is obtainable. The rated dissipation of the DA30 type is 30 watts.

OSRAM VALVES - DESIGNED TO ASSIST THE DESIGNER

Solely by The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

Old Advert from 1930

sound. Moreover, PX25 is a tube with higher gain, it is around 9x unloaded, which is more than twice as much as 300B. This makes driver circuit easier, and PX25 needs less than 30V RMS signal on the grid, for full output signal. The higher gain of PX25 was achieved by Marconi, by increasing the plate distance. We did the same, and the larger side holes, makes also [the glow picture nice looking](#).

Test data of the PX25.

Just a short note, there is PX25 and PX25A. Though only this letter "A" added, these are completely different tubes, and can not replace each other. All data is fully different. PX25A is like a lower power 300B with 4V heater, but PX25 is a higher impedance tube, with wider anode distance. Be careful buying historical tubes, to be used in the same amplifier, it must be PX25 and not PX25A.

Also, Osram specifies the PX25 at 400V, 62.5mA. We do not understand why some vendors of replica PX25 are using 325V as a test voltage, and then write test results which the OSRAM tube has at 400V. This is strange and curious, because such a tube does not replicate original OSRAM data.

Designing with PX25

One of the greatest circuit designers, was D.T.N. Williamson, who based his amazing work initially on the PX25, using 6J5 tubes a driver. Though PX25 was his favorite tube, it was very hard to obtain for him, as it was in production not very long, and already NOS when he started with PX25. Williamson, who worked at MO Valve and Ferranti, noticed PX25 has remarkable similarity with a Triode strapped KT66, and he used this in the late 1940's an alternative to PX25. He published these findings in some issues of WIRELESS WORLD magazine.

This inspiration of Williamson, who used KT66 Triode strapped, as a replacement for PX25, we want to pass this on! There are so many Triode Mode KT66 circuits around, which can be easily modified into PX25 DHT circuits.

Sound of the PX25

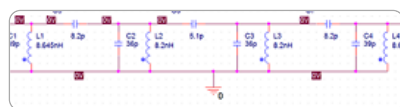
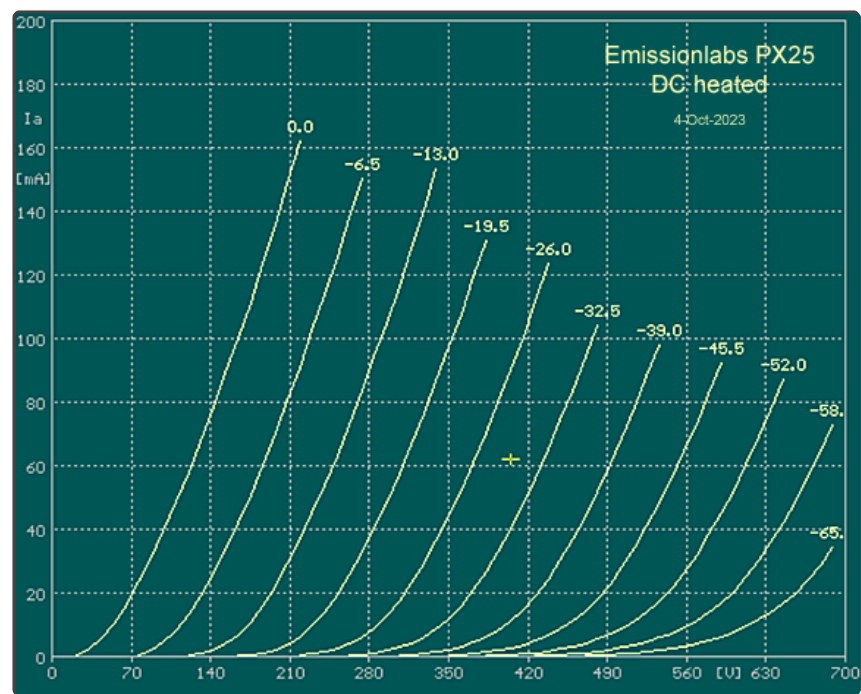
We need to understand the design principle of the PX25 tube. This is a tube with much larger plate distance as usual. We just adopted this from the vintage designs. The larger distance will catch your eye immediately, when looking inside the bulb. Not only will this make the glow picture nicer. Also the higher anode distance results in higher gain, and higher plate impedance. Which is what PX25 sound is about. Generally speaking such tubes have a more silkier sound, and a tendency to develop best efficiency at somewhat higher plate voltage. As with all higher gain tubes, there is a higher influence of the tube itself, to the final sound. For the same reason, a good quality transformer is needed, and a good quality PX25 tube is needed, with original specifications. When these factors come together, sound becomes as intended by it's designers, now almost 100 years ago.

As a transformer, we recommend Lundahl or similar quality.

Moreover, many of the greatest sounding DHT tubes were from the 4Volts series. Such tubes are PX25, AD1, RE134, PX4, RS241 or RE604, were always appreciated for their characteristic, more gentle sound.

EML PX25 Filament Ratings	
Filament Voltage Important: See notes at page bottom	= 4 Volt (AC or DC)
Electronic heater modules (See Note)	Only voltage source
Tolerance on filament voltage	4%
Filament Current	2 Ampere

EML PX25 Maximum Conditions	
Not possible simultaneously	
Anode Voltage	500Volt
Anode Current	90mA



SPICE Parameters

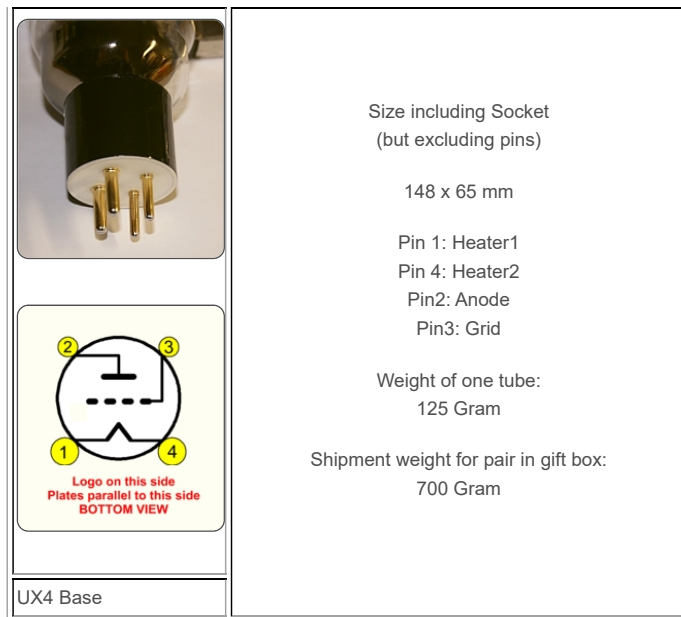
EML PX25 tube curves.

See also Note4

Some recommended Lundahl transformers

	Primary Ohms	Secondary Ohms
LL1679-70mA	4k5	4-8-16
LL1664-080	3k	8

EML PX25 Mechanical Data



Notes

1. Hard-metal can be used in electron tubes, though this is more difficult to use, and more costly than classic nickel. It results in a more precise Anode distance, and does not damage in shipment. It ensures reproducible tube parameters, and long term stability. Wolfram grids allow the most precise grid wire distance, because wolfram is an extreme hard metal. Best grid geometry ensures uniformity and linearity of the tube curves.
2. Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves.
3. Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)
4. Average Plate Characteristics are made with the Sofia Digital Curve tracer. The curves for the PX25 are plotted, with DC heating. DC heated curves have a shift of the grid voltage of 1/2 the heater voltage vs AC heated. After curve tracing, DC heated curves can be recognized quickly, by the $U_g=0V$ curve not starting at Zero Volt plate voltage. Here, with this tube at appr. +20V plate.
5. **Heater Voltage.** Precise heater voltage is the #1 key to long tube life.

Use of **current source modules** voids guarantee.

Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.

Heater voltage is always defined at the tubes pins itself. There may be some voltage drop along the wires, and tube contacts as well. So voltage measured at the tube socket wiring should ideally be 4.1V.

Original Data Sheets of Osram and Mazda, are mostly referring to DC heating.

6. [Link to wikipedia for Williamson Amplifier](#)



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PX4 Data Sheet

Last Update: 07/12/2026 12:35:46

Description



The EML PX4 mesh tube is upwards compatible to the 15 Watt Version of the historic PX4 by OSRAM and MARCONI. The EML PX4 has higher heater current, and also higher maximum power ratings.

The PX4 is a well balanced design by Osram and Marconi. It works best at the recommended operating points. The higher dissipation as possible for the EML is only for extra lifetime and more safety.

[High Resolution](#)

Guarantee program for first owner.

The first owner can register the tube within 4 weeks after receipt, at the Emission Labs website, to participate in the 5 years guarantee program, which is additional to the legal obligations of the seller.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gold Plated Grid
- Soft rubber suspended tube base
- Hard metal Construction (Note1)
- Extra large getters
- Hand blown Glass bulb
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a high quality dual box
- Tube printing with 24k gold, and red color burned into the glass
- Gold Plated, black ceramic socket

Description

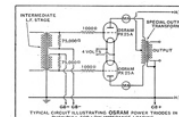
We quote from the [OSRAM data sheet](#): 'The PX4 is a Directly Heated Power Triode for the output stage of receivers and amplifiers, where a considerable output power is required with a maximum anode (to Grid) Voltage of 300 Volts. For this purpose the tube has exceptionally good characteristics, and is particularly suitable for operating moving coil speakers at large volume without distortion'

OF TECHNICAL IMPORTANCE

FOR GREATER UNDISTORTED
POWER OUTPUT
AT MODERATE
VOLTAGES

Osram
valves
MADE IN
ENGLAND
Solely by All Radio Dealers

NEW
POWER TRIODES
TYPE
PX25A **DA30**



CHARACTERISTICS	TYPE PX25A	TYPE DA30
Filament Voltage	4.0	4.0
Filament Current	2.5 amp	2.5 amp
Anode Voltage	400 max.	500 max.
Angle Factor	1.0	1.0
Impedance	800 ohms	800 ohms
Max. Power Output	15 watts	15 watts
Max. Anode Current	1.0 amp	1.0 amp
Max. Anode Dissipation	1.0 watt	1.0 watt
Max. Grid Dissipation	0.5 watt	0.5 watt
Max. Cathode Dissipation	0.5 watt	0.5 watt
Price each	35/-	30/-

OSRAM VALVES - DESIGNED TO ASSIST THE DESIGNER
John of The General Electric Co., Ltd., Marconi House, Kingsway, London, W.C.2.

Old Advert from 1930

Application

In accordance with the historical datasheets, EML PX4 is most suitable for applications for medium output power.

There is some resemblance with the 2A3 or AD1 tube, which can also operate nicely at 250V 60mA, same as the PX4. Yet PX4 is a tube with somewhat higher impedance character, positioned somewhere in between 45 and 2A3. This makes it a very good tube for high efficiency loudspeakers, similar to what OSRAM wrote already, now almost 100 years ago.

Filament / Heater

The EML PX4 uses a heater current of 1.6 Ampere, vs. only 1 Ampere for the historical tubes. The EML heaters are specially constructed to have lowest possible hum, which is lower than historical tubes. For best results we recommend DC heating. This becomes increasingly important if a tube is used for very high efficiency loudspeakers. Please note, for all directly heated tubes, the best DC heater schematic is using the same as for AC, and apply DC voltage to it, instead of AC.

Anode dissipation

Very early types had 12 Watt Anode dissipation. Later types were upwards compatible, and had 15 Watt dissipation. These can be recognized by the working points of 15 Watt in the datasheet such as 300V 50mA and 250V / 60mA. These 12 Watt tubes and 15 Watt tubes have essentially the same tube curves, but of course you will see other recommended bias resistors in old data sheets, to achieve 12 Watt or 15 Watt dissipation.

Correct Bias

The EML PX4 is intended to be upwards compatible with original Osram / Marconi tubes, with the only difference being the higher heater current of the EML. By OSRAM, the PX4 was designed for low to medium Anode voltage, and indeed the tube works best with the Anode voltages as specified in the data sheet. As the Anode voltage is relatively low, it is recommended to use a classical auto bias circuit, as this keeps the cost and construction effort low. Unlike the historical tubes, the EML tubes have some hidden reserve as you can see from the Peak Anode Dissipation of 17 Watt. This makes it possible to bias the tube in idle at maximum 15 Watt indeed, whereas under peak signal level, the dissipation may shift up for a short time to the peak level 17 Watt.

On the other hand, you can take any PX4 amplifier designed for OSRAM tubes, and replace those by EML PX4, and bias will be the same, but care should be taken, the amplifier can deliver the higher heater current of the EML.

EML PX4 Filament Ratings	
Filament Voltage Important: See notes at page bottom	= 4 Volt (AC or DC)
Electronic heater modules:	Only voltage source
Tolerance on filament voltage	5%
Filament Current	1.6 Ampere

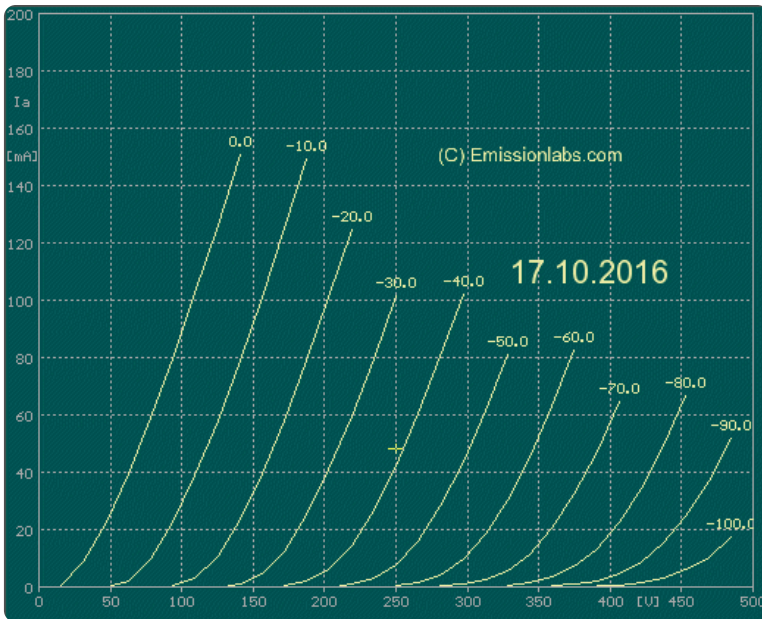
EML PX4 Maximum Conditions	
Not possible simultaneously	
Anode Voltage, Working point	400Volt
Anode Current	80mA
Peak Anode Dissipation	25Watt
Anode Dissipation Continuous	18Watt

Highest possible Grid to ground resistor, Single Ended.	250k Ohm Original OSRAM 500k Ohm possible for EML
Highest possible Grid to ground resistor, Push-Pull.	50kOhm

EML PX4 Test conditions	
Anode Voltage	250V
Anode Current	48mA

EML PX4 Test Result Average values *	
Grid Voltage, AC Heated	-35.1V
Grid Voltage, DC Heated	-33.1V
* For testing, the grid voltage has to be adjusted, until plate current is 48mA. Then, measure tube data.	

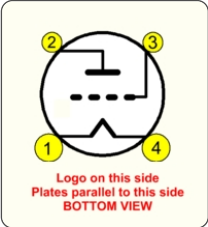
EML PX4 Operating Single Ended, Class A		
Supply Voltage	350V	350V
Anode Voltage	300V	250V
Anode Current	50mA	60mA
Bias Resistor	1k	600R
Load Resistor (Ra)	3k5	3k
Output Power	4.5Watt	3Watt
Distortion	4.3%	2,8%
Input Signal	36.5V rms	26V rms
Gain (Mu)	4.6	4.5
Transconductance (Gm)	5.3mA/V	5.6mA/V
Anode Impedance (Rp)	875R	800R
Possible Lundahl transformers	LL1620-060 3k3 to 4/8/16 Ohms	LL1664-060 3k to 8Ohms



EML PX4 tube curves, DC heated.

Curves with Sofia Curve tracer

[S-PARAMETERS here](#)

EML PX4 Mechanical Data	
	Size including Socket (but excluding pins)
 Logo on this side Plates parallel to this side BOTTOM VIEW	Pin 1: Heater1 Pin 4: Heater2 Pin2: Anode Pin3: Grid Weight of one tube: 145 Gram Shipment weight for pair in gift box: 840 Gram
UX4 Base	

Notes

1. Hard-metal can be used in electron tubes, though this is more difficult to use, and more costly than classic nickel. It results in a more precise Anode distance, and does not damage in shipment. It ensures reproducible tube parameters, and long term stability. Wolfram grids allow the most precise grid wire distance, because wolfram is an extreme hard metal. Best grid geometry ensures uniformity and linearity of the tube curves.
2. Individual Test data, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#)
3. Average Plate Characteristics are made with the Sofia Digital Curve tracer.

4. Some of our competitors claims to be the only one with a Center Tapped filament, but at EML we build since many years all tubes Cathode Tapped, not just this tube.
5. Do not experiment with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
6. Gold Plated grids have a few advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves.
7. Heater voltage is always defined at the tubes pins itself. There may be some voltage drop along the wires, and tube contacts as well. So voltage measured at the tube socket wiring should ideally be 0.1V higher.



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RGN2504 Data Sheet

Last Update: 01/04/2024 16:28:09



This tube feature a series connected filament for both diodes together, which has certain advantages.

This tube can supply 200mA with a C-L-C filter.

[High Resolution](#)

Guarantee program for first owner.

At EML we have the normal guarantee. In addition to that, the first owner can register the tube within 4 weeks after receival, at the Emission Labs website, to participate in the 5 years guarantee program.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Extra large getters
- Hand blown Glass bulb
- These tubes are shipped in a [high quality dual box](#)
- Tube printing with real gold (metal), red color is glass burned into the glass
- Gold Plated pins, white ceramic socket.

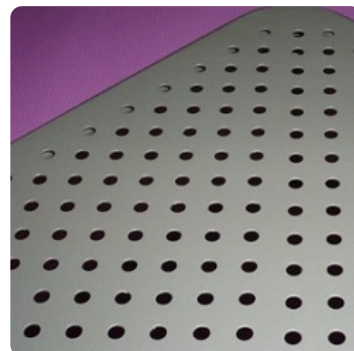
RGN2504 Filament Ratings

Filament Voltage	4Volt (AC or DC)
Tolerance on filament voltage	-3.5...4.2V
Filament Current	2.6.Ampere

RGN2504 Maximum Conditions

AC input (*2)	2x 300V	2x 400V	2x 500V
DC output	200mA	150mA	120mA
First Capacitor	60uF	50uF	50uF
Transformer minimum DC resistance (*1)	2x 70R	2x 100R	2x 120R

Warning for FAKE mesh



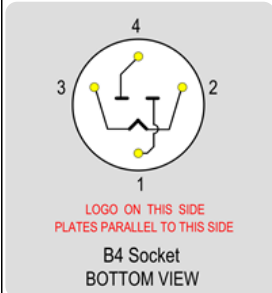
[Full article](#)

*1) This is minimum value. If transformer DC resistance is too low, a series resistors must be used.

*2) For each other transformer voltage, **maximum** allowed DC output current is calculated as follows:

$$I \text{ (in mA)} = 60000 / \text{Transformer AC voltage}$$

RGN2504 Mechanical Data



Size including Socket
(but excluding pins)

145 x 58 mm

Weight of one tube: 140 Gram

Shipment weight for pair in gift
box: 350 Gram

Pin 1: Anode1

Pin 4: Anode2

Pin2: Filament

Pin3: Filament



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Data Sheet RS 242

Last Update: 07/12/2026 12:35:48

Description



RS 242 was designed by **Telefunken** as a space saving transmitter tube for portable applications, and for amateur radio. It's good sound, made it a popular audio tube amongst Japanese collectors. The combination of gain=17, and $R_p=5k$, and exceptional linearity of the tube curves, allows interesting audio applications.

The EML RS 242 is a replacement for the famous Telefunken RS 242. All dynamic parameters are identical. Heater current of the EML tube was chosen higher. ([See also notes](#)).

Tube microphonics is generally increased by the glass surface, and it decreased by the weight of the glass per square centimeter. This is why we have chosen for this very small glass bottle, made of thicker glass. ([See notes](#))

Socket: RS 242 has the European B4 Socket.

[High Resolution picture of RS242](#)

Nothing was officially published by Telefunken, because RS242 was a second world war military product. After the war, any military production in Germany was not allowed, and RS242 was not produced any more. It went under, without documentation. All what remains today, is a little data sheet which was with the tubes, at packaging. It gives only data for use as a transmitter tube, and specific tube curves for use as transmitter tube. And of course what we have, is NOS tubes. From those we extracted all data, and tube curves, as needed for audio. We have to credit the Japanese Audio Scene, for discovering the excellent audio properties of RS242. Something Telefunken never intended. From the tube curves, we extracted the dynamic parameters, and they were identical as on that small TFK sheet, with the tubes. From such mint quality NOS tubes, we took the tube curves, and build our RS242 to fit exactly to those curves. Those curves are so nicely linear, considering the gain of this tube is still a factor 17. I think we can say RS242 was a masterpiece of design, by Telefunken. Though we found the higher heater current we choose at EML works out positive on all tube properties.

For modern design simulation, we also supply the S-parameters.

Guarantee program for first owner.

The first owner can register the tube within 4 weeks after receival, at the Emission Labs website, to participate in the 5 years guarantee program, which is additional to the legal obligations of the seller.

[Our Guarantee conditions](#)

[Register here for the 5years guarantee](#)

Features

- Gold Plated Grid ([See Notes](#))
- *New* Soft rubber suspended tube base
- Hard metal Construction ([See Notes](#))

Empty

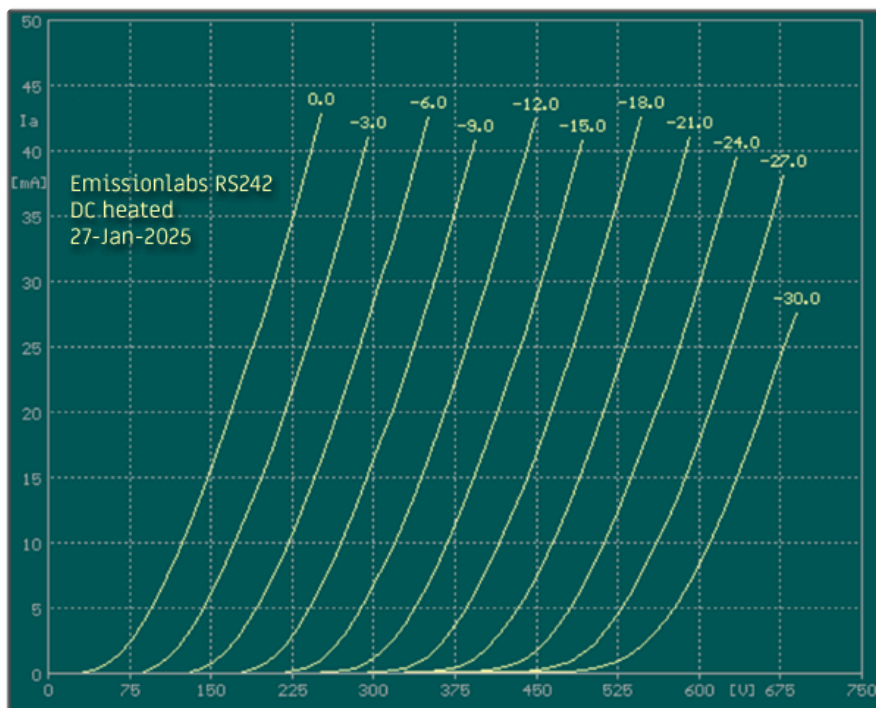
- Extra large getters
- Heavy glass bottle
- Anti-microphonic Anode- and grid suspension
- These tubes are shipped in a [high quality dual box](#)
- Tube printing with 24k gold, and red color burned into the glass
- Machined, solid tube base pins for highest contact precision.
- Gold Plated, ceramic socket

EML RS 242 Filament Ratings	
Filament Voltage Important: See notes at page bottom	3.8...4.1 Volt DC
Electronic heater modules:	Only voltage source
Filament Current	0.9 Ampere

EML RS 242 Maximum Conditions (not possible simultaneously)	
Anode Voltage	500Volt
Anode Current	70mA
Anode Dissipation Continuous	17Watt
Highest possible Grid to ground resistor, Single Ended.	250kOhm
Highest possible Grid to ground resistor, Push-Pull.	50kOhm

EML RS 242 Factory Test condition	
Anode Voltage	400V
Anode Current	30mA

EML RS 242 Average Resulting Data	
Control Grid Voltage (V)	-10.9
Transconductance (mA/V)	4.6
Amplification Factor	17
Anode Impedance	4k7



EML RS 242. DC heated tube curves. See Notes

These curves are made with the Sofia Curve tracer.

Curves Extrapolation

S-PARAMETERS

Applications of RS242

Many Transmitter triodes are good audio amplifiers as well. You will find this for instance directly in the data sheet of the 845 tube, where it is specified in Class C (Radio Transmitter) and in Class A (Single Ended Audio). However, transmitter tubes require often a very high plate voltage, in order to get acceptable Efficiency in Class A or AB. Sure such a tube can be used like this, and users do it, but there are compromises when the voltage is reduced, to what is normal inside HiFi amplifiers.

RS242 however, was intended for portable operation. So for this reason it works at lower power, and lower voltage. This makes it ideal as a driver tube, pre-amp output tube, or pre amplifier tube.

As a driver tube, distortion becomes exceptionally low, even at very high signal. This is remarkable at such high gain. Signal needed, to drive a 300B tube is relatively high, it is 60 Volts RMS, or 170 Volt peak-peak. For best results, a plate choke is recommended. This allows a much lower plate voltage, and reduces distortion at the same time.

Some Applications

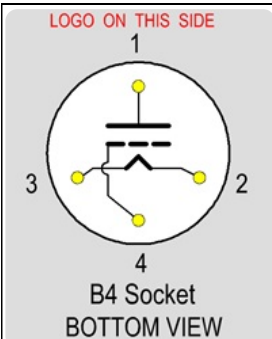
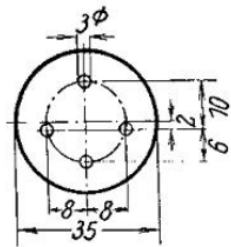
1) RS 242 as driver tube. (DC heated)

Anode Voltage	Grid Voltage	Input	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Lundahl Transformer	Output	Tube Dist. Total
350V See Chart	-10.9V	3.5V RMS	545R	20mA	16.3	4k	LL1668-25mA	60V RMS	0,03%

2) RS 242 as pre amplifier output tube. (DC heated)

Anode Voltage	Grid Voltage	Input	Cathode resistor for Auto Bias	Anode Current (mA)	Circuit Gain	Tube Ri (Ohm)	Lundahl Transformer	Output
350V See Chart	-11.2V	1V RMS	622R	18mA	16.3	4k	LL1689-18mA ALT-Q	1.8V RMS
Input Signal 1V Output Signal 1.8V Tube distortion in this circuit: 0.05% Output resistance: 75 Ohms Low microphonics circuit								

RS 242 Mechanical Data



Size including Socket
(but excluding pins)
105 x 43 mm

Weight of one tube: 140 Gram

Shipment weight for pair in gift
box: 350 Gram

Pin 1: Anode1

Pin 2: Filament

Pin3: Filament

Pin4: Grid

Notes

- Hard-metals** can be used in electron tubes, though these are more difficult to use, and more costly than classic nickel. This results in less distribution of the tube parameters, and better long term stability. Wolfram grids allow the most precise grid wire distance, because wolfram is an extreme hard metal. Best grid geometry ensures uniformity and linearity of the tube curves. Gold plating of the grids has several advantages, such as increased bias stability, some protection against accidental overload, and better linearity of tube curves.
- Heater Current** of original RS242 was chosen by Telefunken company as low as they could get it, to make the batteries of portable equipment last longer. Today, this is no requirement any more, and we chose a higher heater current. This will increase lifetime very much, and eliminates risk of heater breakage in shipment.
- Heater Voltage** is always defined at the tubes pins itself. There may be some voltage drop along the socket contacts. So voltage measured at the tube socket wiring should ideally be 4.1V.
- Do not experiment** with lower filament voltage, to expect better lifetime. We already specify filament voltage for the best lifetime.
- Plate Characteristics** are made with the Sofia Digital Curve tracer. The curves with AC heating are 100% compatible with Telefunken, we made those for the compare. For HiFi use, we publish and recommend DC heating always.
- Individual Test data**, such as: Matching Data, Grid Current, Vacuum, Filament Current, etc., are on the Certificate that is on the outside of the tube box. Each tube is numbered from the inside, with a metal [Tag](#).
- Acoustic Microphonics** and "sensitivity to tap noise" should not be confused with each other. We can reduce the acoustic microphonics considerably by reducing the glass surface, but this will make no difference for "tap noise" effects. Even so, tapping on a working tube, ALWAYS leads to early wear out of the tube filaments. This will start, or accelerate crystallization, which may lead to heater breakage at a much later moment. Also it may cause chipping of the cathode coating. We always say, just never tap on a working tube, because it can and probably will reduce tube life time. This applies for all Directly Heater Tubes, independent of brand or construction,

