
Telefon AB L M Ericsson,
established in 1876,
is parent company to a globe
encircling chain of affiliates.
Today the L M Ericsson Group
is represented in some 75 countries
and enjoys a front-ranking position
not only in telecommunication
but throughout the broad spectrum
of the entire teletechnics industry.
Ericsson LM
longlife tubes

LM Ericsson

longlife tubes

bring you benefits derived from more than 20 years experience in meeting and anticipating the demands of industrial and telecommunication electronics.

contents

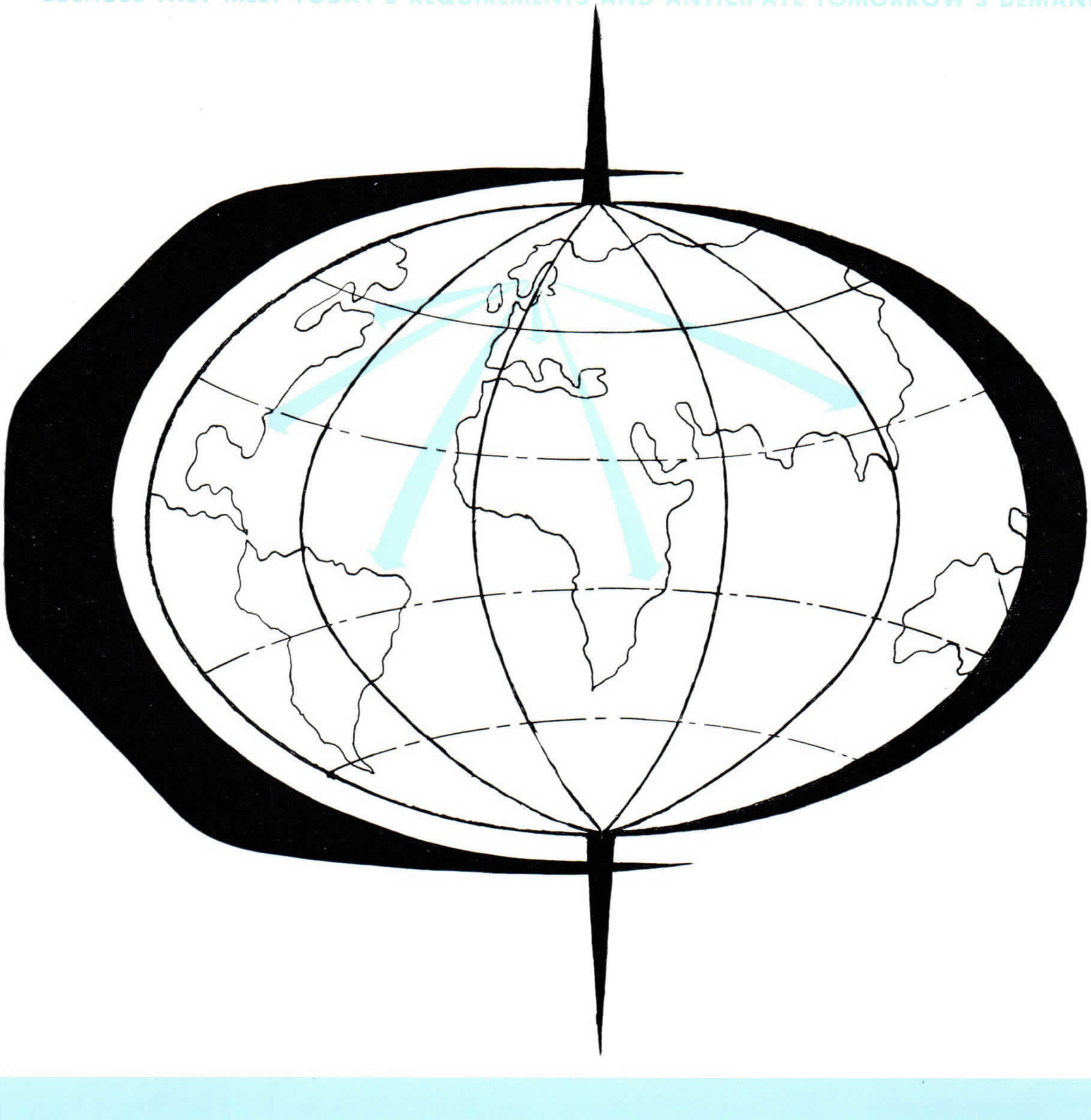
Ericsson LM

LM ERICSSON

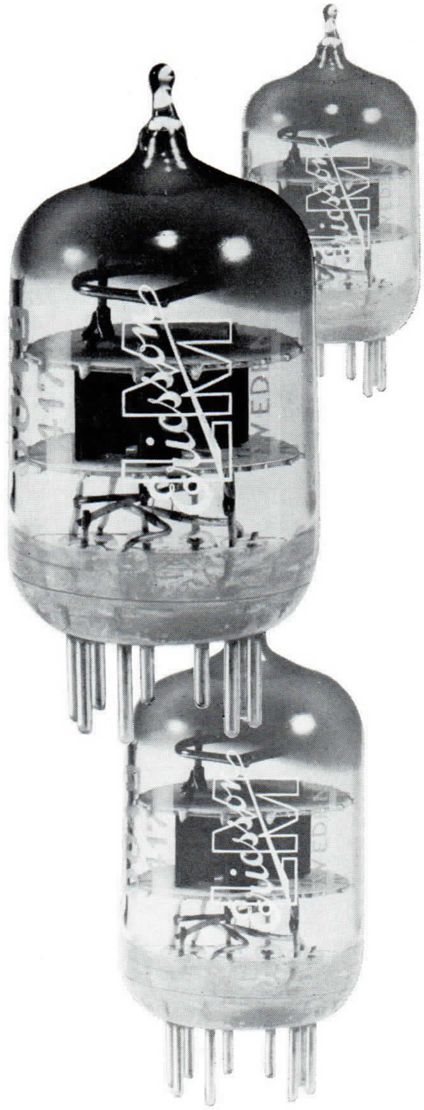
longlife tubes

ARE IN USE ALL OVER THE WORLD

BECAUSE THEY MEET TODAY'S REQUIREMENTS AND ANTICIPATE TOMORROW'S DEMANDS



YOU GET THESE FEATURES WITH LM ERICSSON LONGLIFE TUBES



Long service life

LOWER MAINTENANCE COSTS

Field experience and results of life tests prove that life expectancy is more than 50,000 hours.

Low failure rate

DEPENDABLE OPERATION

Extensive records of the field operation of large numbers of tubes of different types show an approximate failure rate of only .15 % per 1000 hours.

Stable characteristics

TROUBLE-FREE SERVICE

A batch of 5591/403B tubes was followed through 25,000 hours of operation. The original spread in characteristics remained unchanged throughout the entire period. The variation in the mean value stayed within ± 3 %.

Low interface resistance

NO "SLEEPING SICKNESS"

All LM Ericsson longlife tubes are constructed with cathodes of special material and processed in such a way that the development of cathode interface impedance is restricted.

Shock and vibration resistance

LONG TUBE LIFE IN MOBILE EQUIPMENT TOO

LM Ericsson's special endurance test vibrates tubes in three directions at 2.5 g's for 96 hours. LM Ericsson longlife tubes withstand shocks of up to 500 g's.

Individual tube warranty

YOU BUY WITH CONFIDENCE

All LM Ericsson longlife tubes are covered by an *individual* service life warranty. For most tubes this *individual* service life warranty is 10,000 hours.

LM Ericsson longlife tubes meet your requirements — maintain high quality service throughout tough sustained usage.

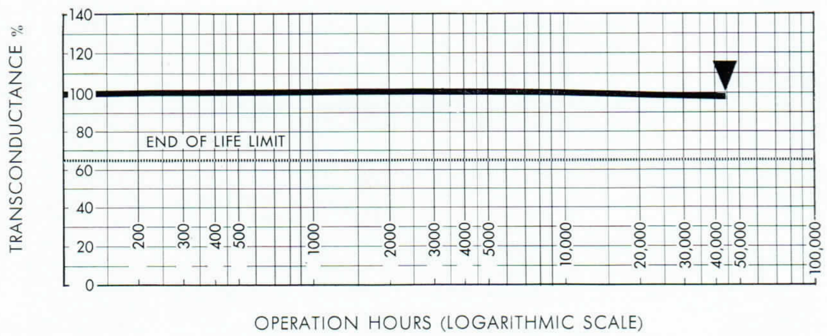
THE SUPERIOR LIFETIME

that extra plus

These life-curves show the results of tests conducted over a six year period. Quality improvements developed during these six years guarantee that today's tubes will perform as well *or better.*

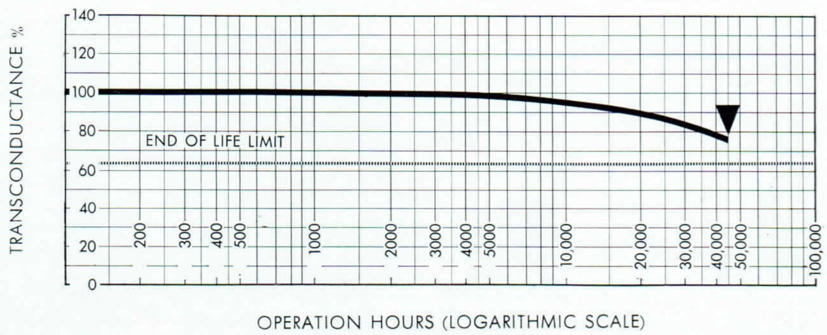
Representative Life Charts *mean values at normal operating conditions*

1



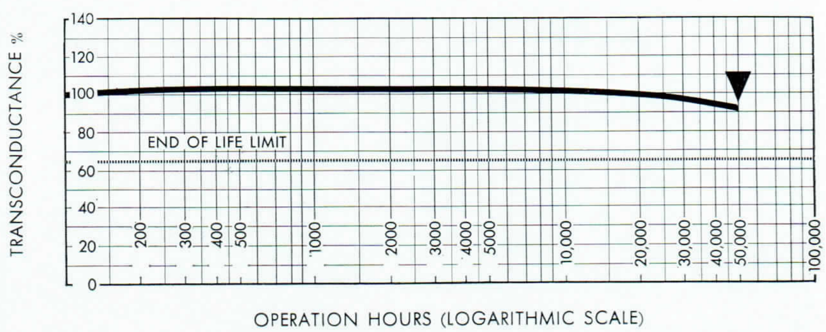
Applicable to 6928/6AQ5L
Latest Check Point
45,000 hours

2



Applicable to 5847/404A
Latest Check Point
45,000 hours

3

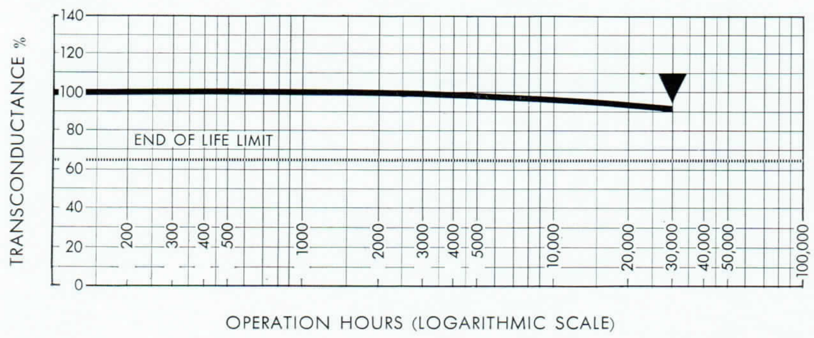


Applicable to 5590/401A, 5591/403B, 6028/408A
Latest Check Point
50,000 hours

that extra plus

These life-curves show the results of tests conducted over a six year period. Quality improvements developed during these six years guarantee that today's tubes will perform as well *or better.*

Representative Life Charts *mean values at normal operating conditions*



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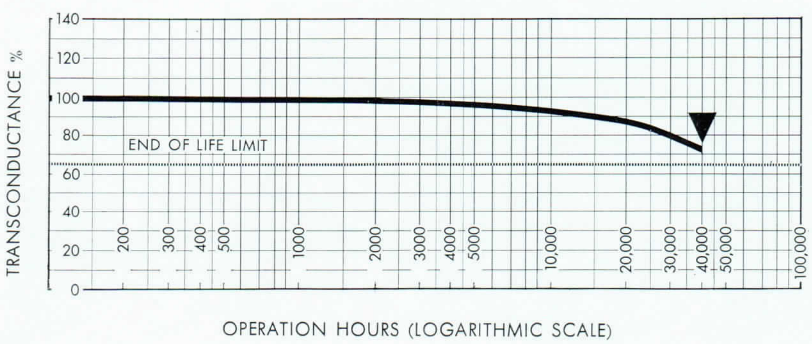
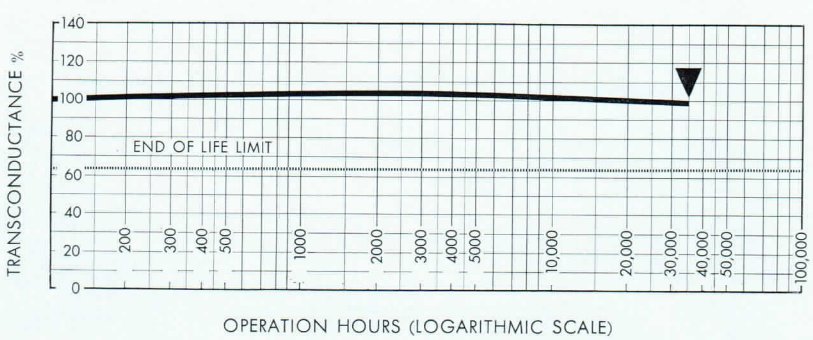
Applicable to 6761
Latest Check Point
30,000 hours*



5

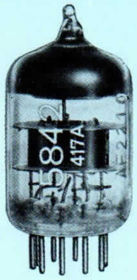
Applicable to 2C51/396A and 407A. Latest Check Point
40,000 hours

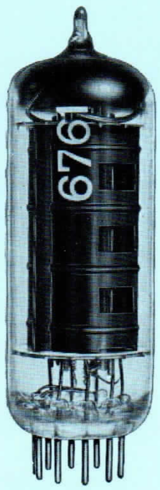


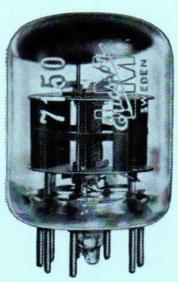
6

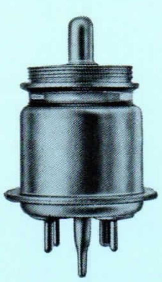
Applicable to 6927/6J6L
Latest Check Point
35,000 hours*

* *Test records discontinued*









that extra plus

The curve below shows the results of a life test on tube type 5591/403B. It is of special interest to equipment designers and those who use large quantities of tubes.

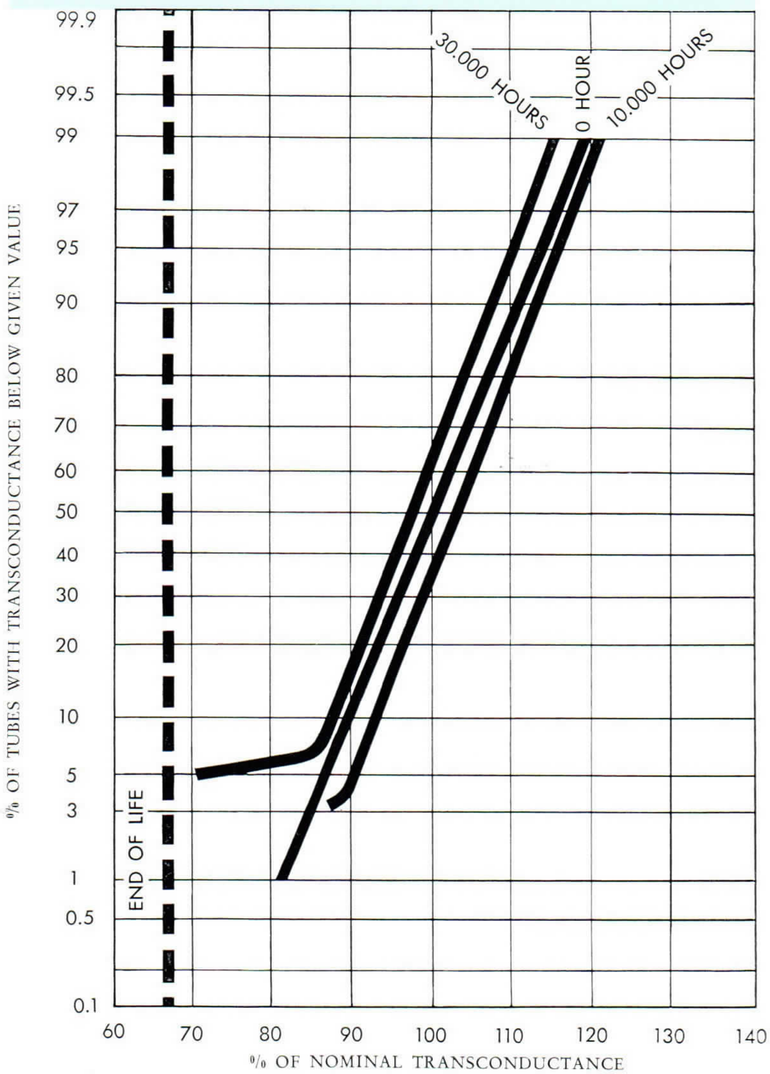
The *data spread* at zero hours is small. It remains practically unchanged not only at 10,000 hours but also after 30,000 hours of service.

Only 4 % of the tubes in the test batch failed during the test — *less than .15 % failures per 1000 hours of operation.*

The linear appearance of the curves indicates the *ideal (Gaussian) data spread* within the group. This type of data spread is extremely valuable where larger numbers of tubes are to be used, as in telephone line amplifiers connected in cascade, where the resulting amplification should remain at the original level even after the exchange of one or all of the tube batches.

Spread in characteristics during lifetime

TUBE TYPE 5591/403B



HOW TO SECURE MAXIMUM LIFETIME

Long term life and high reliability of electron tubes primarily depend on tube design and construction. LM Ericsson have extended every effort to provide their tubes with the best conceivable requisites for extraordinarily long useful life together with stable data and minimum failure rate.

The life test charts on page A3—A5 show that LM Ericsson tubes maintain stable data under normal operating conditions throughout more than 50,000 hours of operation.

Unfavorable operating conditions, however, can substantially shorten tube life — and in certain cases tubes are quickly damaged. You who seek maximum lifetime and reliability will find the following suggestions of interest.

HEATER VOLTAGE

Heater power at rated voltage brings the cathode to optimum temperature for maximum tube life and data stability. For this reason it is vital that heater voltage deviate as little as possible from average rated values listed in LM Ericsson data sheets.

Excessive heater voltage raises cathode temperature. This can evaporate cathode material which is redeposited on other tube elements. As a result lifetime is shortened, emission deteriorates, grid emission occurs and insulation breaks down.

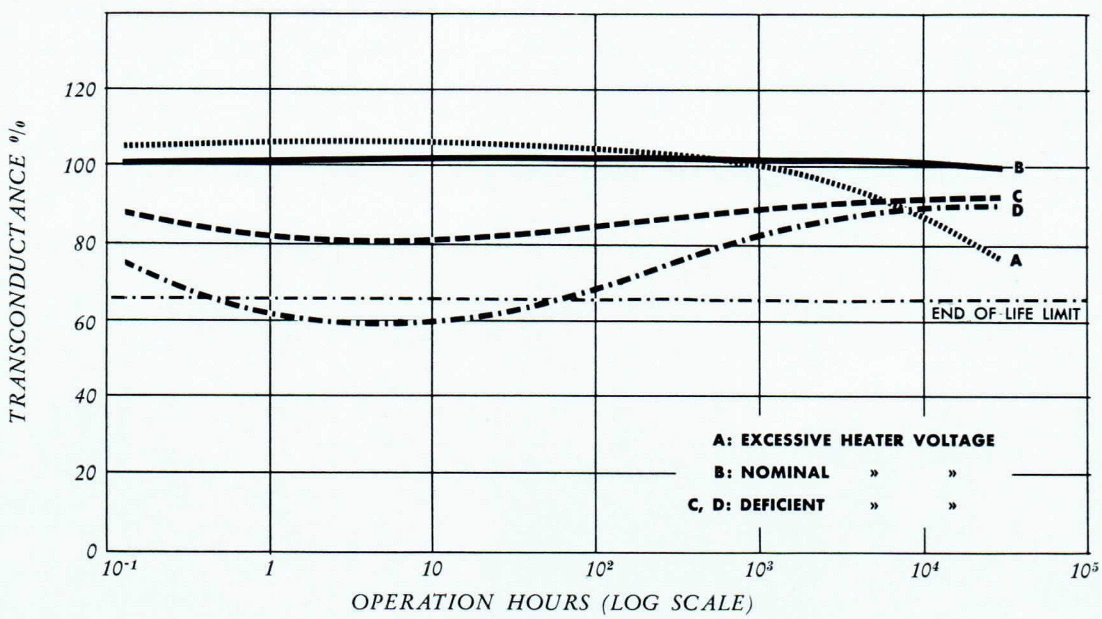
Deficient heater voltage can quickly cause reduction of emission and cause data to fall below minimum values for satisfactory operation during the initial operating period. Usually however, if cathode temperature is not too low, emission gradually recovers.

Specified heater voltage tolerances in LM Ericsson data sheets are within ± 5 % of rated value. Tube life will be enchanced and reliability improved by keeping heater voltage within 1 or 2 % of rated value. Operation at values within tolerances listed in data sheets is a pre-requisite for our lifetime warranty. If wider variations are impossible to avoid, heater voltages should be chosen so that the minimum operational value does not fall below 95 % of the average rating listed in data sheets. The following chart showing typical curves of transconductance as a function of operating time at different heater voltages illustrates clearly the effect of heater voltage variations.

Edition 1

It can be seen that heater overvoltage substantially reduces lifetime while deficient heater voltage leads to unsatisfactory operation during a relatively long initial operating period.

As shown in curves C and D, behaviour from tube to tube varies considerably even when operating at equally deficient voltages.



Operation with two or more *heaters connected in series* is not recommended. Deviation in heater current characteristics from tube to tube causes some tubes to consume too much power and others too little. Dissimilar warm-up times can also cause series connected tubes to be exposed to damaging overloads. These premonitions do not, of course, apply to tubes especially designed for operation in series.

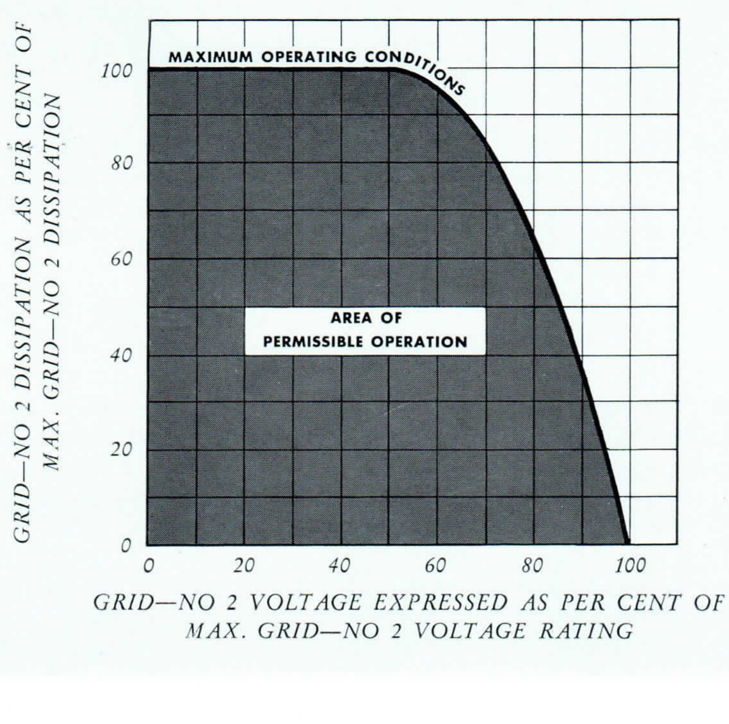
MAXIMUM RATINGS

The absolute maximum ratings listed in our data sheets are not to be exceeded under any operating conditions. They are conservatively chosen to guarantee reliable operation and long tube life. Tube performance will not immediately deteriorate if these values are surpassed within reason, but as a rule long life capability will be considerably shortened.

The *bulb temperature* of a tube depends on electrode dissipation, ambient temperature and the capacity of the surrounding to absorb heat. Excessive bulb temperature can release gas which causes cathode poisoning. Too high temperatures at the base of the tube can cause electrolysis of the glass between tube pins which leads to air leakage. It is therefore vital that bulb temperature at hottest point remains below maximum permissible values under all operating conditions.

Excessive *screen grid dissipation* can bring thin grid wires, which have poor thermal conductivity, to red heat, thus deforming the grid and releasing gas which can cause cathode poisoning. Special attention is required where screen grids operate at high peak currents and voltages, during pulse operation for example. For reliable operation it is vital that screen grid dissipation does not reach excessive momentary values. Both peak dissipation and average dissipation should therefore be carefully checked.

Maximum permissable screen grid dissipation depends on screen grid voltage. The chart below illustrates this relationship. The curve shows that full rated dissipation is permissible for voltages up to 50 % of maximum rated screen grid voltage. When higher voltages occur dissipation must be reduced to values within the area described by the curve.



HOW TO SECURE MAXIMUM LIFETIME

When a *positive control grid* voltage is applied, part of the cathode current is diverted to the control grid. Resultant grid dissipation causes an additional temperature rise in grid wires which normally operate at very high temperatures due to the proximity of the cathode. Thin grid wires have poor thermal conductivity. Thus even moderate grid dissipation can damage the grid and in certain cases melt individual grid wires.

Grid-to-cathode distance is minute, particularly in frame grid tubes. Even at moderate *negative control grid voltage* the strength of the field between grid and cathode is high. Field concentration occuring around the thin grid wires enters into this relationship too. Even momentary excesses above the listed maximum ratings can cause arc-over which damages the cathode.

TUBE SHIELDS

The use of tube shields usually raises temperature at certain points on the tube envelope, thus negatively affecting tube operation. Necessary shielding should therefore be accomplished some other way, rather than enclosing tubes in shields. By the use of tight fitting shields, which make direct contact with the tubes, heat dissipation is markedly improved, but the distribution of temperature over the entire tube envelope is uneven, since glass conducts heat poorly.

Generally speaking, the top and base of the tube are warmer when shields are used. This can reduce getter activity, increase gas pressure in the tube and cause electrolysis of glass in base and bulb which in turn causes leakage risks. Moreover, sharp edges on tube shields can score the glass which leads to the building up of cracks.

If tube shields must be used, make certain that heat dissipation from the tube is as effective as possible. Similarily, checks should be made that bulb temperature does not exceed permissible values at any point when operating under thermally unfavorable conditions. To reduce temperature it is sometimes necessary to use forced air cooling or, alternatively, reduce tube input power.

TUBE SOCKETS

A poor fit between tube pins and socket contacts can set up mechanical stresses in the base which result in cracked glass. The pin position tolerance areas are to be found on page D5. Satisfactory tube sockets should be dimensioned in compliance herewith. When a tube pin is inserted, the socket contact shall be capable of free movement corresponding to the pin position tolerances plus those tolerances which apply to the socket itself.

Since socket springs are movable, they should be held in the proper position with a soldering plug while leads are soldered to them. Leads should be sufficiently flexible so as not to hinder contact movements.

Before plugging the tube into the socket, align the pins with a pin straightener.

HOW TO TEST LONGLIFE TUBES

PRE-HEATING

Before measuring electrical characteristics the tube should be preheated through a 10 minute operation period. Pre-heating and measuring should be done under identical operating conditions. During the pre-heating period thermal equilibrium is reached and characteristics are stabilized. Moreover, defects which are dependent on temperature — gas or leakage currents for example — are more easily detected.

TESTING CONDITIONS

For nearly all types of tubes, both typical operating conditions and data limits for new tubes are listed in data sheets. It is therefore best that tubes first be tested under listed conditions. This is always desirable in case of complaints. When measuring under other conditions, care must be taken that applicable maximum ratings are not exceeded.

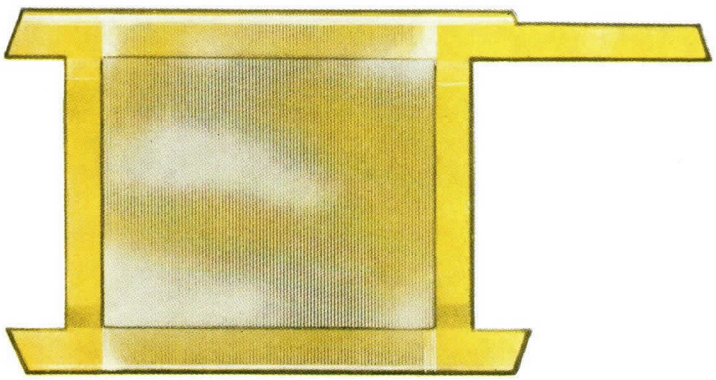
CATHODE ACTIVITY TEST

Measurement of changes in tube characteristics when heater voltage is decreased to 90 % of rated value is sometimes performed to gain an indication of the condition of cathode emission and the remaining tube life. Such measurement is not generally suited to LM Ericsson long life tubes since they are designed to operate with low cathode temperatures at rated heater voltage. If a cathode activity test is to be conducted it should be undertaken at heater voltages ranging from 105 % to 95 % of the rated value.

TUBE TESTERS

If a commercial tube tester is used, a type which supplies direct current to all electrodes except the heater is recommended. Dynamic testing — measuring with unfiltered full- or half-wave rectified voltages — is not recommended. Such measurement often gives misleading results since values read are not referred to a definite working point but are averaged from a large portion of the measured tube characteristic. Moreover, grids in particular are exposed to overload from measurement pulses — in spite of the fact that average dissipation does not exceed maximum permissible values.

THE FRAME GRID



Today more information must be sent via coaxial cable and radio link. This job demands tubes that can better amplify broader frequency bands.
Only tubes that offer a higher transconductance and lower capacitances can meet this demand. And only by using smaller and smaller grid wire diameters can such tubes be produced.

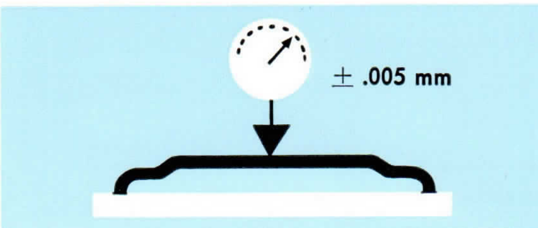
In LM Ericsson's Wide Band Tubes the grid wire diameter has been reduced to .0065 mm.

In conventional grid construction, grid wire of sufficiently large diameter to support itself must be used; accuracy of grid dimension is obtained by stretching on a mandrel; and grid-to-cathode dimension depends on tolerances of holes in top and bottom mica rod supports. Today's exacting grid-to-cathode spacing tolerance cannot be met by these methods.

Accurate dimension control is of the utmost importance for the data and longlife characteristics of the finished tube.

LM Ericsson's frame grid construction methods maintain a consistent precision in dimension control, far superior to the various types of ordinary grid construction, and much better than the more simple type of frame grid construction, in which a number of hoops are welded together thus building up a lattice work of the frame type.

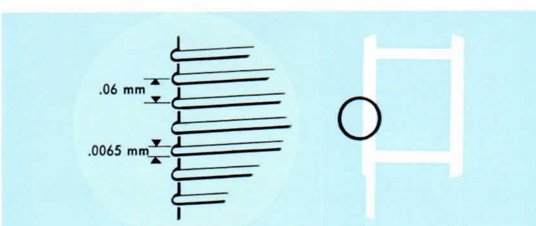
THE FRAME GRID



Let us follow the various steps taken in the production of LM Ericsson frame grids:

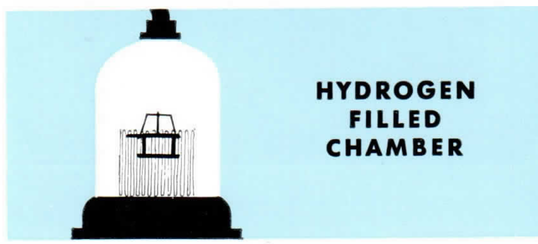
The grid frames are punched out of pure molybdenum plate. The finished grid is composed of two identical halves. The strong frames provide excellent heat dissipation, and make possible an exceptionally sturdy vibration-free construction.

After punching the frames are bent to the proper profile. Then after burring they are hand ground to a tolerance of ± .005 mm. The combined tolerance for the two halves after joining is ± .01 mm.



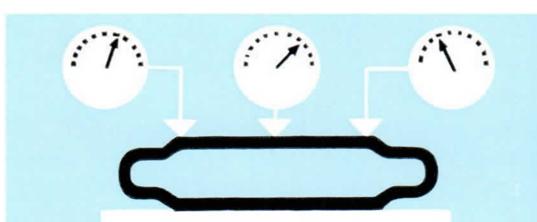
In a grid winding machine especially constructed for frame grid production, the grid wire is wound over the joined frame halves. The grid wire is of gold plated tungsten — diameter only .0065 mm. Gold plating diminishes grid emission and improves conductivity at higher frequencies. The exceptionally fine grid wire not only achieves good characteristics over a broad frequency band; it also gives uniform cathode emission over the cathode casing thus prolonging operating time and cutting down noise. The ends of the grid wire are fastened to the frame's cross bar with a special cement which when heated disappears without leaving a trace.

The wound grid is hung in a hydrogen filled chamber where a suitable number of fine gold threads are draped over the frame. The grid is heated until the gold melts. As heat is applied heavier gases are driven out of the grid and replaced with hydrogen which is more easily removed later when the tube is highly evacuated.

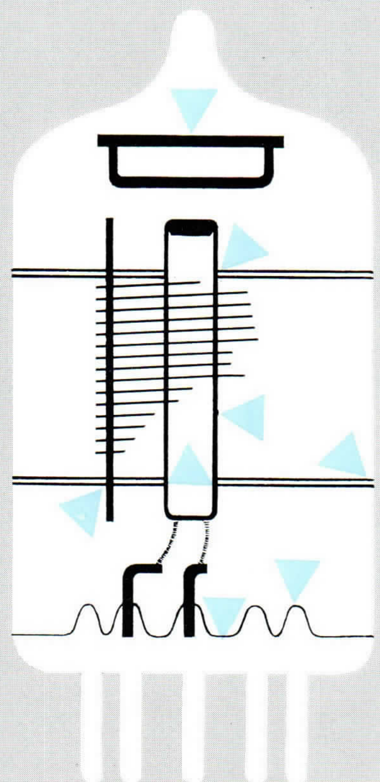


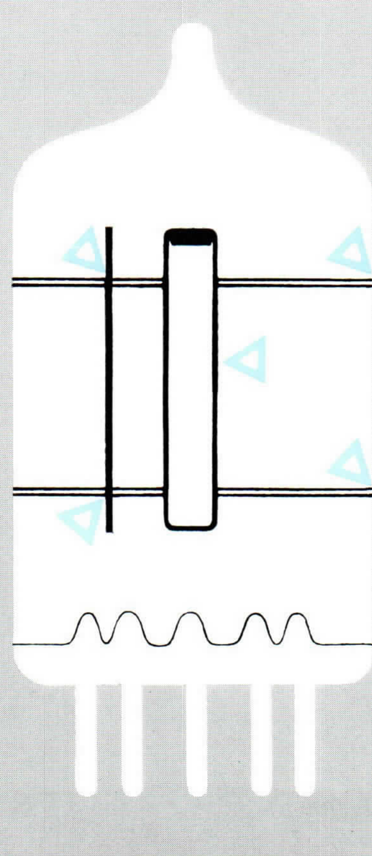
The grids are then paired with finished cathodes at a distance of .01 mm. A consistent grid-cathode distance is maintained in every tube, producing a nearly ideal data spread.

Rigid support of the fine wires reduces mechanical resonance. Frame grids have a resonance frequency of about 15 kilocycles; conventional grids' resonance frequency is only about 2 kilocycles. Because the different turns have different resonance frequencies the "tuning fork effect" is eliminated.

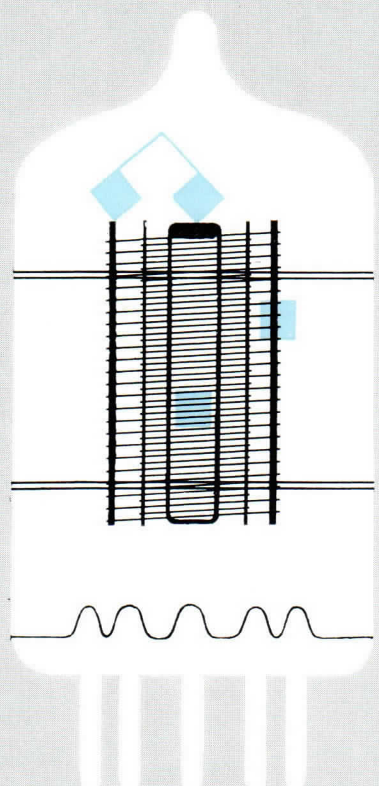


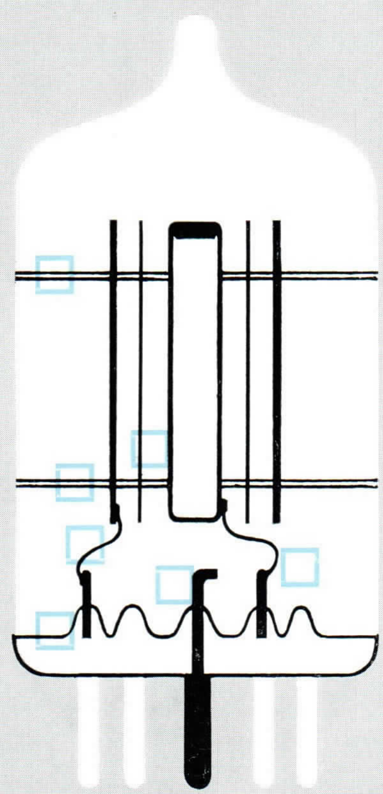
Ericsson LM





Ericsson LM





FACTS YOU SHOULD KNOW

about LM Ericssons

LONGLIFE TUBES

STABLE CHARACTERISTICS — TIGHT TOLERANCES

Gold plated grid wire

diminishes grid emission and stabilizes contact potential.

Microscopic grid wires

closely spaced assure exceptionally uniform current density in the cathode sleeve. As a result plate current cutoff control is improved and lifetime prolonged.

Pairing grids and cathodes

for each of these particular tube types which have critical data values maintains consistent grid-to-cathode spacing, a pre-requisite for uniform data characteristics.

50 hour run-in period

at normal operating conditions.

FREEDOM FROM CATHODE INTERFACE RESISTANCE

Pure nickel

cathode sleeves in LM Ericssons longlife tubes contain a mere .01 % magnesium and .01 % silicon. Ordinary cathodes contain 10 times as much. The low silicon content guarantees freedom from measurable interface resistance even after 30,000 hours' operation — and also if the tube is used under cutoff conditions. The low magnesium content reduces risk of vaporized metal causing insulation failure on the mica spacers and between the electrodes.

MECHANICAL STABILITY

Pre-stressed glass stems

are frequently spot checked to insure careful effective control of stress patterns.

Mica spacers and electrodes

are painstakingly fitted. Careful continuous quality control of the mica itself assures an effective fit throughout sustained usage.

Wet-blasted electrodes

provide clean contact surfaces, long-lasting dependable welded connections.

MAXIMUM LIFETIME

Cathode temperature ratings

chosen to assure maximum operating lifetime.

Low cathode current density

contributes to dependability and stability of cathode emission.

Oversized getters

operate when tube is in use, assure dependable high vaccum, long reliable operation.

Improved insulation

inside tube's stem reduces insulation breakdown risk between electrodes.

Prolonged activation

and aging, expensive but necessary, assures uniform unchanging data characteristics.

MINIMUM FAILURE RATE

Mechanical stability

of extraordinarily high quality is provided by processes and controls described in detail under another heading.

50 hour run-in period

at normal operating conditions sharply reduces failure risk, since failure rate is highest during the first 24 hours of operation.

LOW MICROPHONICS — LOW NOISE

Grid rod support ends

are left unnotched, avoiding sawing of the mica spacers due to thermal displacement. Original fit remains permanently snug.

Mica spacers

of unsurpassed quality meet rigid size and hardness tolerances. The tube's resistance to vibration and its excellent microphonic characteristics will therefore be practically unchanged throughout its entire lifetime.

A more even current density

over the cathode sleeve is assured by thin, closely spaced grid wires. This also contributes to lower noise.

Frame grid tubes

are tested individually for microphonics.

QUALITY CONTROL
Special tests

In addition to normal production and design tests, L M Ericsson's miniaturized longlife tubes undergo the following special tests which check both quality and reliability.

MICROSCOPIC INSPECTION
Welds, glass structure and parts pass exacting microscopic examination both before and after sealing.

STABILITY
Transconductance and plate current are measured for two hours partly at full and partly at 90 % of rated heater voltage. Test results are an excellent indication of operational stability.

LIFE TEST
Life tests extending well beyond 10,000 hours for most tube types are performed under normal operating conditions. Results obtained to date are shown on pages A3—A5.

VIBRATION FATIGUE
All tube types undergo vibration tests. Tubes are subjected to multi-directional vibration stresses at 25 c/s and an acceleration of 2.5 g for approx. 100 hours. Some types are tested at fixed bias; some with cathode bias.

VIBRATION OUTPUT
Output voltage obtained across a specified load resistance at various frequencies and an acceleration of 2.5 g is continuously checked on every type of tube.

HEATER TEST
135 volts DC are applied between cathode and heater (+ heater). Heater voltage is simultaneously set at 120 % of rated value. Heater voltage is interrupted 2000 times during the test.

GLASS STRAIN TEST
Tube pins are forced over deflection cones. Tubes and cones are completely submerged in boiling water for 15 seconds; then immediately plunged into cold water.
In another test, tube pins forced over deflection cones are left that way for 72 hours.
Strains in the base are continually checked by a polariscope.

MICROPHONY
With the exception of output tubes, all types are tested for microphony.

INSULATION TEST
Insulation between the grid and other electrodes is tested in all tubes. With -100 volts applied to the grid, insulation resistance must exceed 100 megohms.

Edition 1

A

THE SUPERIOR LIFETIME that extra plus

TO KEEP PACE with rapidly developing industrial electronics, remote control systems, computers, automation electronics, and communications system and for greater dependability, LM Ericsson created their famous longlife tubes. They meet your requirements by virtue of long years of painstaking research and development.

2C51

TWIN TRIODE

396 A

Twin triode with separate cathodes suitable for use in amplifier, mixer, oscillator and multivibrator circuits. Useful frequency range extends from low frequencies to about 800 Mc.

COLD CAPACITANCES (without external shield)

Input, Each Section*	2.2	μμF
Output, Section 1*	1.0	μμF
Output, Section 2*	1.0	μμF
Plate to Grid, Each Section*	1.3	μμF
Plate to Plate, nominal	.05	μμF
Plate to Plate, maximum	.1	μμF

ABSOLUTE MAXIMUM RATINGS (each section)

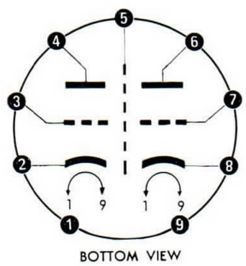
Plate Voltage	330	volts
Grid Voltage, positive value	+ 5	volts
Grid Voltage, negative value	— 50	volts
Cathode Current	20	ma
Plate Dissipation	1.6	watts
Heater — Cathode Voltage	100	volts
Bulb Temperature, at hottest point	160	°C
Grid Circuit Resistance		
with fixed bias	1	Mohm
with cathode bias	2	Mohms

* Measured with internal shield and heater connected to cathode of section. Elements of other section grounded.

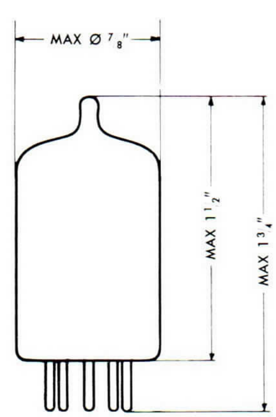
MECHANICAL DATA

Base: Small Button Noval 9-pin, RETMA E9-1
Bulb: EIA T 6½
Mounting Position: Any

PIN NO	CONNECTED TO
1.	Heater
2.	Cathode of Section 1
3.	Grid of Section 1
4.	Plate of Section 1
5.	Shield
6.	Plate of Section 2
7.	Grid of Section 2
8.	Cathode of Section 2
9.	Heater



BOTTOM VIEW



2C51
396 A — TWIN TRIODE

TYPICAL OPERATION. CLASS A1. (each section)

Heater Voltage	6.3	6.3	volts
Heater Current	.3	.3	amp
Plate Supply Voltage	130	150	volts
Cathode Bias Resistor	200	240	ohms
Plate Current	7.6	8.2	ma
Transconductance	5400	5500	μmhos
Amplification Factor	35	35	
Plate Resistance	6500	6400	ohms
Grid Voltage for Plate Current = 10 μa	— 6	— 7	volts
Equivalent Noise Resistance	500	500	ohms
Input Conductance at 100 Mc	130	130	μmhos

TYPICAL OPERATION. CLASS AB1

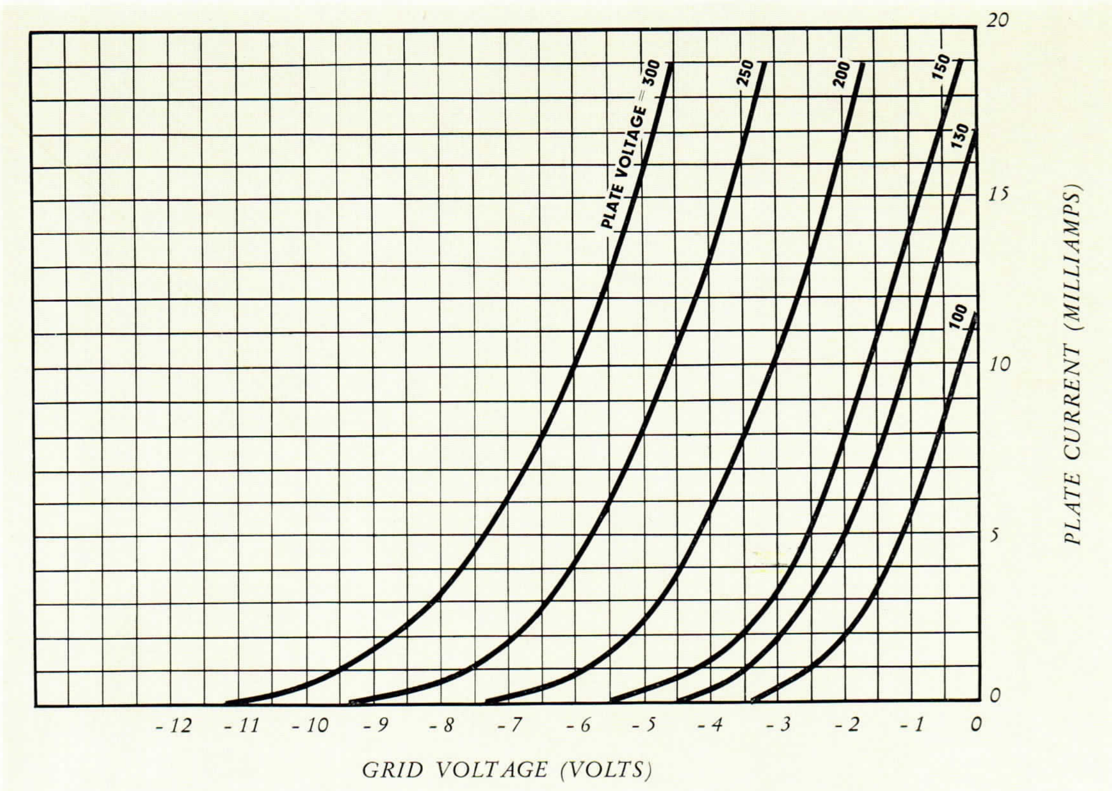
Plate Supply Voltage	300	volts
Cathode Bias Resistor	800	ohms
RMS AF Grid to Grid Voltage	14	volts
Zero Signal Plate Current, Each Section	4.9	ma
Max. Signal Plate Current, Each Section	6.3	ma
Load Impedance, Plate to Plate	40,000	ohms
Total Harmonic Distortion	10	%
Max. Signal Power Output	1.0	watt

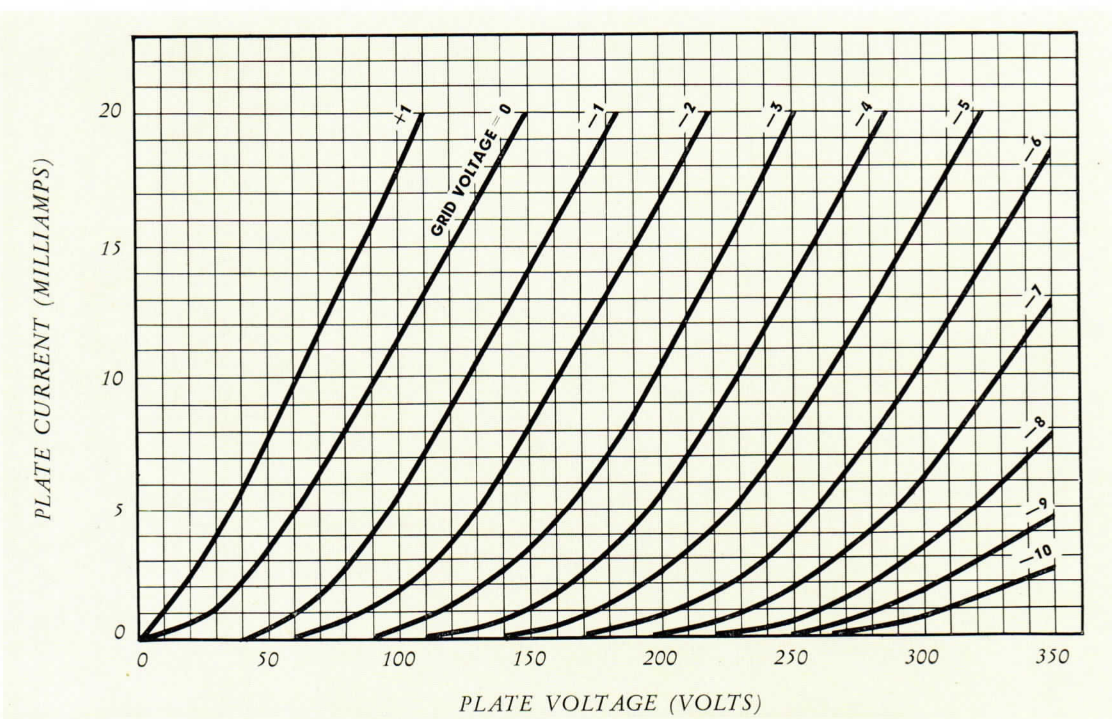
OPERATION RANGE VALUES (each section)

Heater Voltage		6.3		volts
Plate Supply Voltage		130		volts
Cathode Bias Resistor		200		ohms
	MIN	AVE	MAX	
Heater Current	280	300	320	ma
Plate Current	5.2	7.6	10.0	ma
Transconductance	4200	5400	6600	μmhos
Transconductance, End of Life Point	3600			μmhos
I_{hk} at E_{hk} = ± 100 volts			20	μa
Grid Current			— .05	μa
Cutoff Plate Current at E_{c1} = — 10 volts			75	μa
Vibration Output Measured at 2.5 g and 25 cps with both sections in parallel E_f = 6.3 v, E_b = 150 v, E_{c1} = — 3 v, r_p = 2000 ohms.		5		mv

Edition 1

AVERAGE CHARACTERISTICS

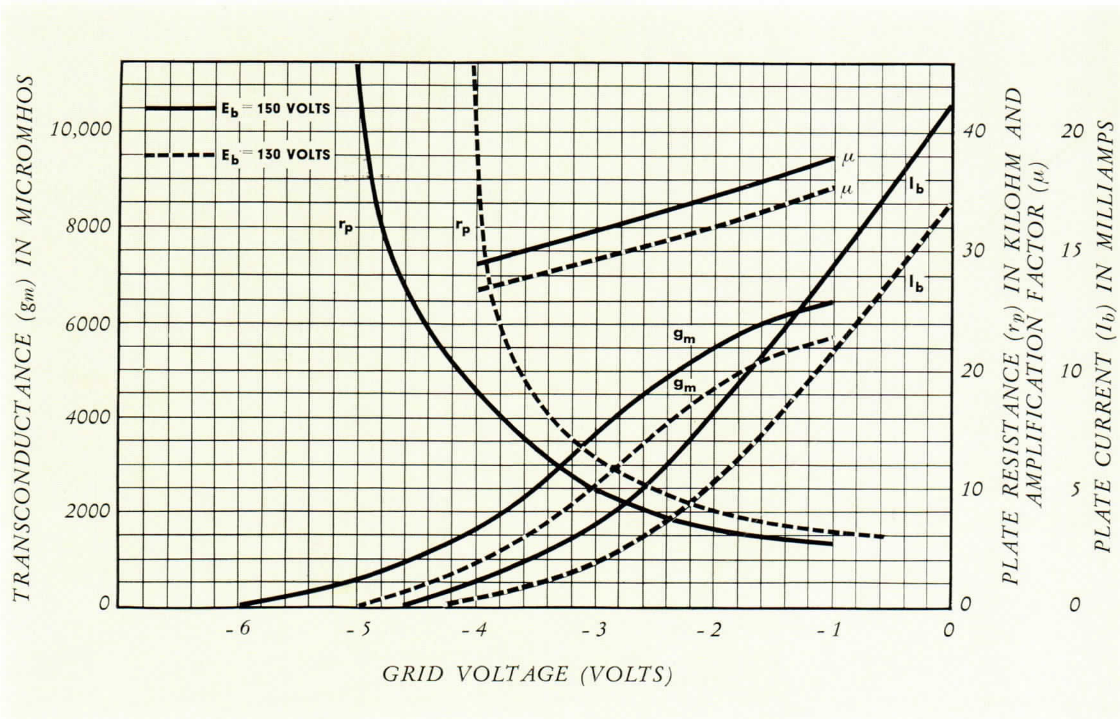


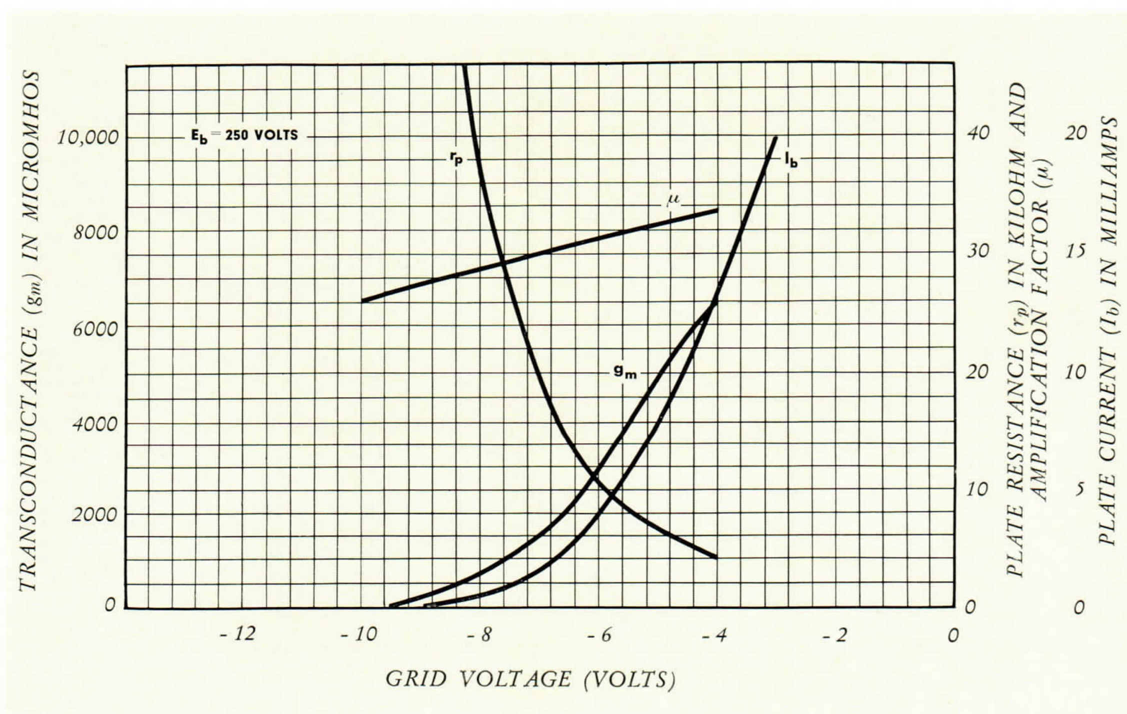


2C51 TWIN TRIODE

396 A

AVERAGE CHARACTERISTICS





TWIN TRIODE 407A

Twin triode with separate cathodes suitable for use in amplifier, mixer, oscillator and multivibrator circuits. Useful frequency range extends from low frequencies to about 800 Mc.

COLD CAPACITANCES (without external shield)

Input, Each Section*	2.2	μμF
Output, Section 1*	1.0	μμF
Output, Section 2*	1.0	μμF
Plate to Grid, Each Section*	1.3	μμF
Plate to Plate, nominal	.05	μμF
Plate to Plate, maximum	.1	μμF

ABSOLUTE MAXIMUM RATINGS (each section)

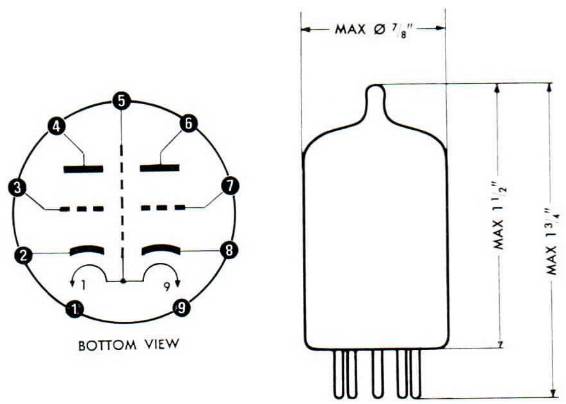
Plate Voltage	330	volts
Grid Voltage, positive value	+ 5	volts
Grid Voltage, negative value	— 50	volts
Cathode Current	20	ma
Plate Dissipation	1.6	watts
Heater — Cathode Voltage	130	volts
Bulb Temperature, at hottest point	160	°C
Grid Circuit Resistance		
with fixed bias	1	Mohm
with cathode bias	2	Mohms

* Measured with internal shield and heater connected to cathode of section. Elements of other section grounded.

MECHANICAL DATA

Base: Small Button Noval 9-pin, RETMA E9-1
Bulb: EIA T 6½
Mounting Position: Any

PIN NO	CONNECTED TO
1.	Heater
2.	Cathode of Section 1
3.	Grid of Section 1
4.	Plate of Section 1
5.	Shield and Heater Tap
6.	Plate of Section 2
7.	Grid of Section 2
8.	Cathode of Section 2
9.	Heater



Edition 1

407A TWIN TRIODE

Ericsson LM

TYPICAL OPERATION. CLASS A1. (each section)

Heater Voltage (Pins 1 & 9 to Pin 5)	20.0	20.0	volts
Heater Current	.1	.1	amp
Heater Voltage (Pin 1 to Pin 9)	40.0	40.0	volts
Heater Current	.05	.05	amp
Plate Supply Voltage	130	150	volts
Cathode Bias Resistor	200	240	ohms
Plate Current	7.6	8.2	ma
Transconductance	5400	5500	μmhos
Amplification Factor	35	35	
Plate Resistance	6500	6400	ohms
Grid Voltage for Plate Current = 10 μa	— 6	— 7	volts
Equivalent Noise Resistance	500	500	ohms
Input Conductance at 100 Mc	130	130	μmhos

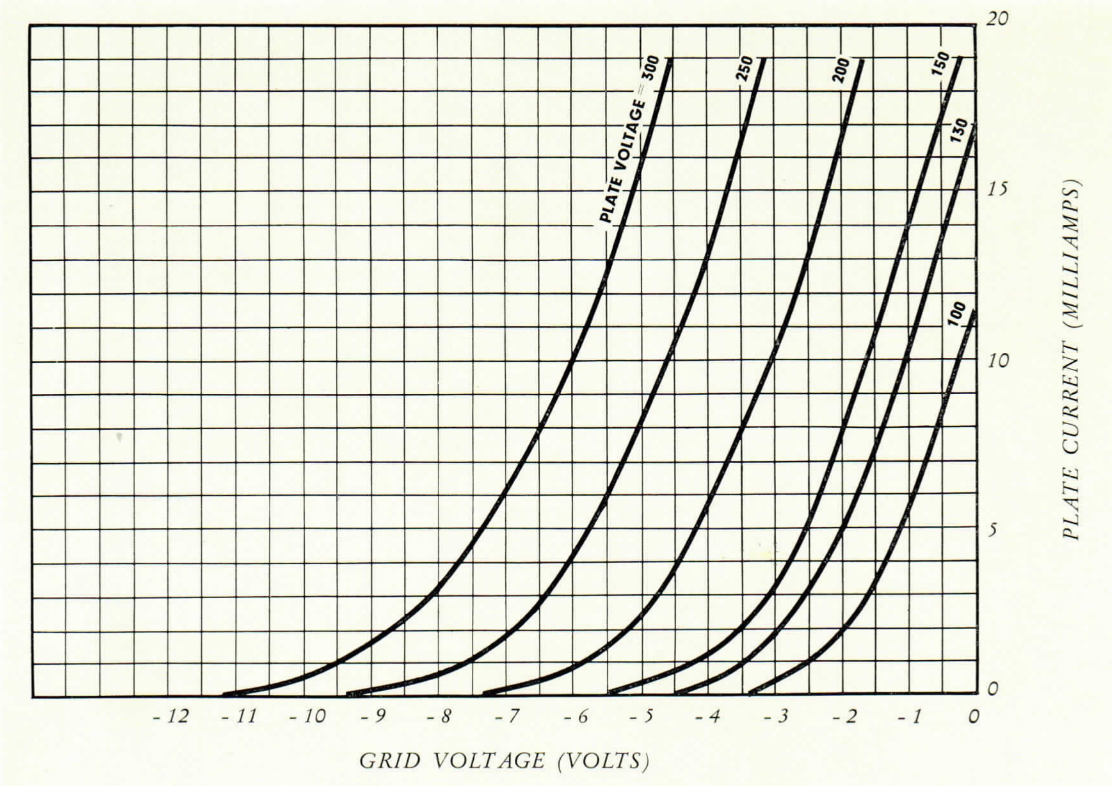
TYPICAL OPERATION. CLASS AB1

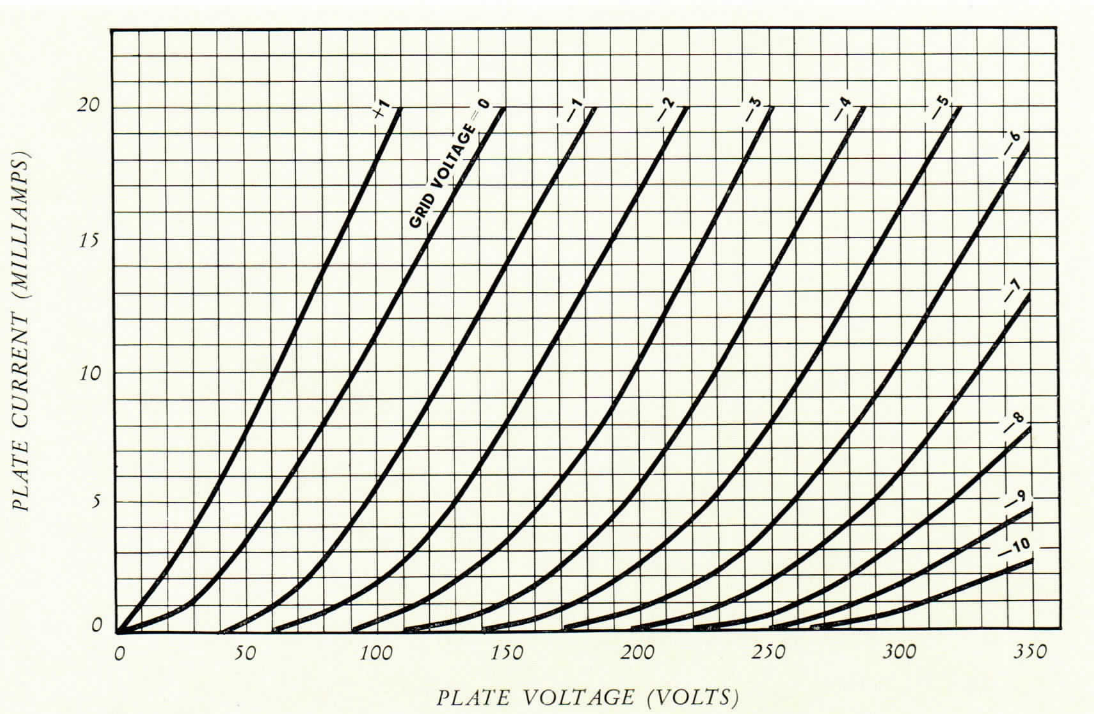
Plate Supply Voltage	300	volts
Cathode Bias Resistor	800	ohms
RMS AF Grid to Grid Voltage	14	volts
Zero Signal Plate Current, Each Section	4.9	ma
Max. Signal Plate Current, Each Section	6.3	ma
Load Impedance, Plate to Plate	40,000	ohms
Total Harmonic Distortion	10	%
Max. Signal Power Output	1.0	watt

OPERATION RANGE VALUES (each section)

	MIN	AVE	MAX	
Heater Voltage		20.0		volts
Plate Supply Voltage		150		volts
Cathode Bias Resistor		240		ohms
Heater Current	90	100	110	ma
Plate Current	5.9	8.2	10.0	ma
Transconductance	4500	5500	6500	μmhos
Transconductance, End of Life Point	3700			μmhos
I_{hk} at $E_{hk} = \pm 100$ volts			20	μa
Grid Current			–.05	μa
Cutoff Plate Current at $E_{c1} = -10$ volts			75	μa
Vibration Output Measured at 2.5 g and 25 cps with both sections in parallel. $E_f = 40.0$ v, $E_b = 150$ v, $E_{c1} = -3$ v, $r_p = 2000$ ohms.		5		mv

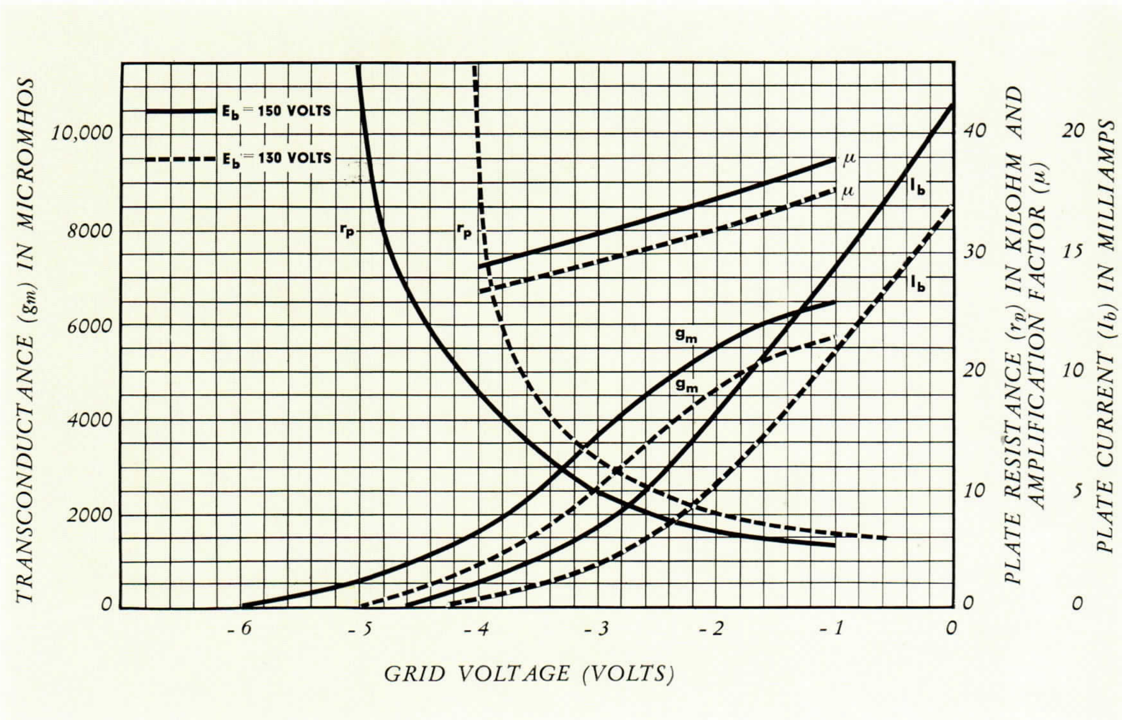
AVERAGE CHARACTERISTICS

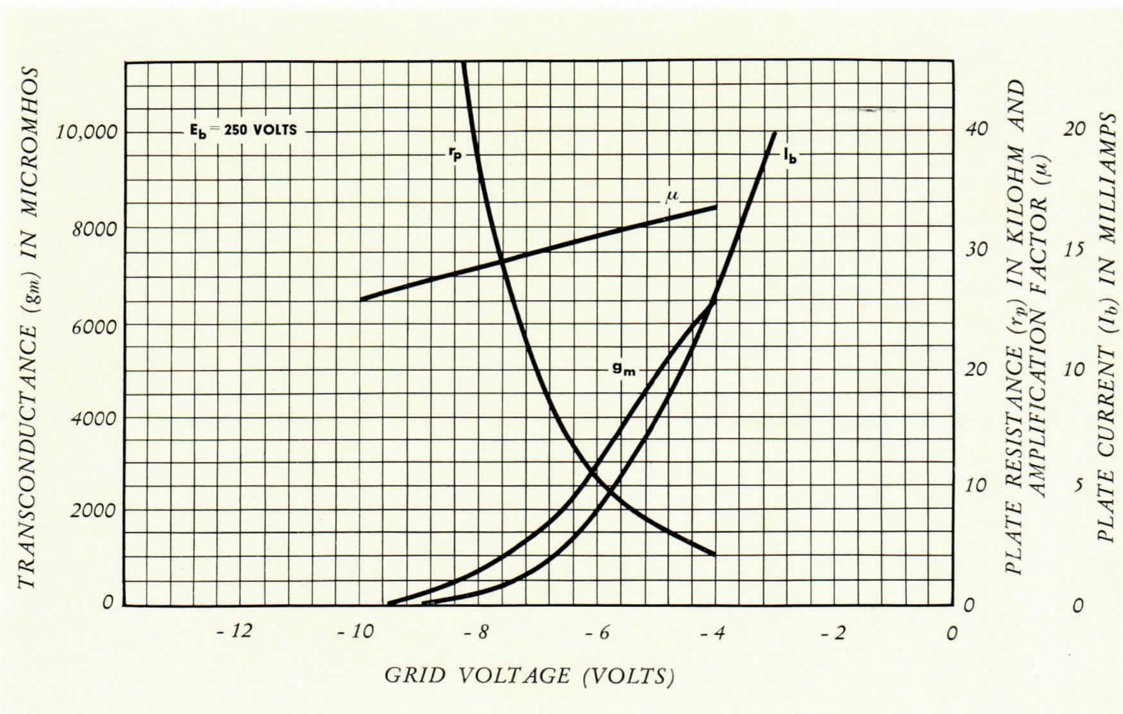




407A TWIN TRIODE

AVERAGE CHARACTERISTICS





MICROWAVE TRIODE 416B

Planar triode for use as microwave amplifier, mixer and oscillator at frequencies of about 4000 Mc. High transconductance gives the tube a superior figure of merit. Exceptionally low noise factor makes it particularly suitable as a pre-amplifier at very high frequencies ranging from 200 Mc to 4000 Mc.
The frame grid, which is similar in principle to that described in Section A, has a lateral wire diameter of only .0065 mm.

CAPACITANCES

Grid to Plate, cold tube	1.5	μμF
Grid to Shell*, cold tube	10	μμF
Grid to Shell*, $E_f = 6.1$ v, $E_b = 0$ v	9	μμF
Plate to Shell*, cold tube	.02	μμF
Cathode to Shell, cold tube	45	μμF

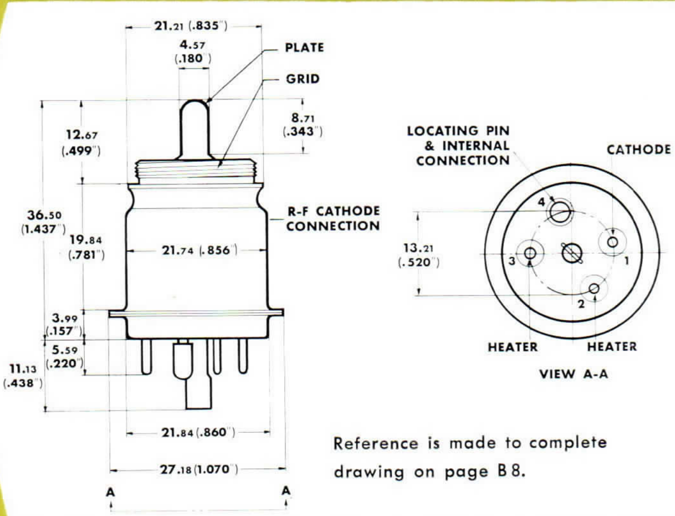
* Cathode connected to Shell through "cathode to shell" capacitance.

ABSOLUTE MAXIMUM RATINGS

Plate Voltage	270	volts
Grid Voltage, positive value	+ 1.5	volts
Grid Voltage, negative value	— 15	volts
Plate Current	33	ma
Grid Current	15	ma
Plate Dissipation	7.5	watts
Heater — Cathode Voltage	45	volts
Plate Seal Temperature	150	°C
Grid Seal Temperature	100	°C

MECHANICAL DATA

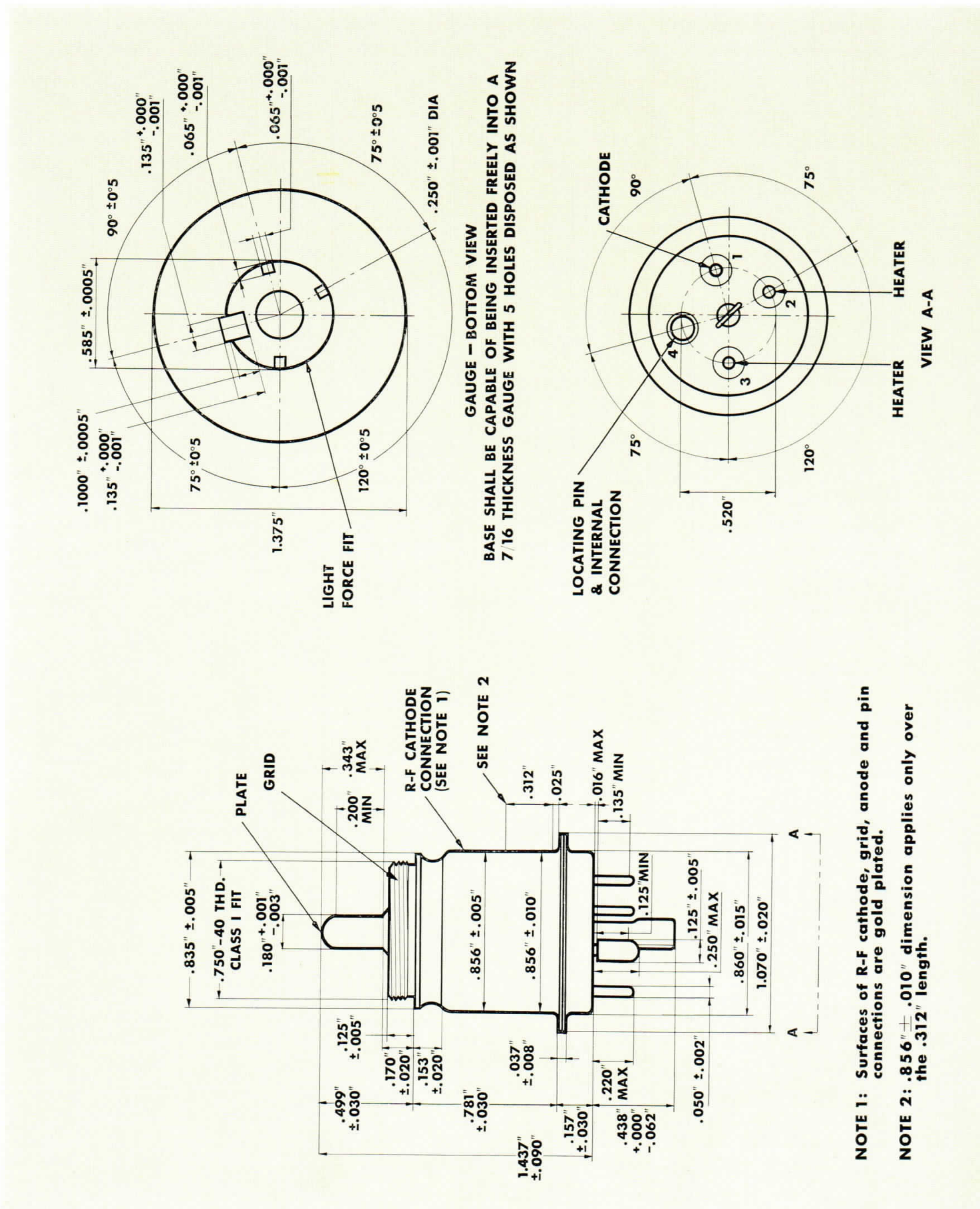
Base: See drawing
Dimensions: See drawing
Mounting Position: Any
Socket: KS 14134



Reference is made to complete drawing on page B 8.

416B MICROWAVE TRIODE

MECHANICAL DATA



NOTE 1: Surfaces of R-F cathode, grid, anode and pin connections are gold plated.

NOTE 2: .856" ± .010" dimension applies only over the .312" length.

MICROWAVE TRIODE 416B

ELECTRICAL DATA

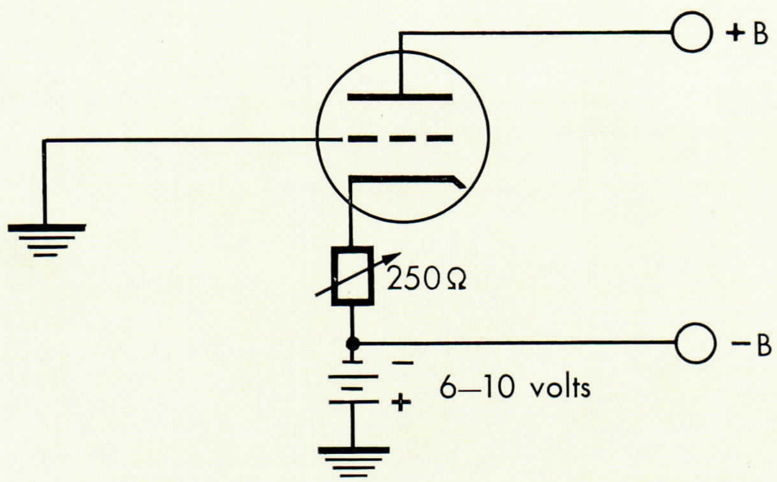
Heater Voltage	6.3	volts
Heater Current	1.18	amps
Amplification Factor	300	
Transconductance at Plate Current = 30 ma	50,000	μmhos
Noise Figure at 500 Mc	below 6	db

TYPICAL OPERATION

	MIN	AVE	
Heater Voltage		6.1	volts
Heater Current		1.15	amps
Plate Voltage		200	volts
Bias Circuit — see Diagram			
Frequency		4200	Mc
Gain:	MIN	AVE	
High Level (500 mw Output)	3	6	db
Low Level (50 mw Output)	8	10	db
Band Width (3 dB down)		100	Mc

SPECIAL DATA

RECOMMENDED GRID BIAS



416B MICROWAVE TRIODE

HEATER VOLTAGE

The bogie value of heater voltage is 6.3 volts. For optimum tube life, however, the heater voltage should be kept as close as possible to 6.1 volts and should not under any condition fall below 6.0 or exceed 6.6 volts.

TUBE TEMPERATURE

Sufficient conduction and convection cooling must be provided to limit the grid and plate temperatures under all operating conditions to:

Grid Terminal	max. 100° C
Anode Terminal	max. 150° C

When using the 416B in a closed cavity it is recommended that cooling air be admitted through the tube cavity to the anode terminal. Normal temperature ranges are:

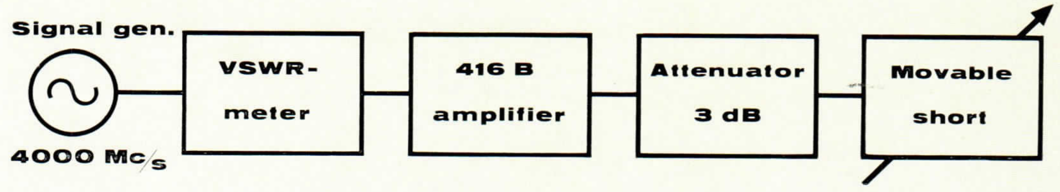
Tube Shell	55 ± 10° C
Grid Terminal	35 ± 10° C
Anode Terminal	85 ± 10° C

TESTING

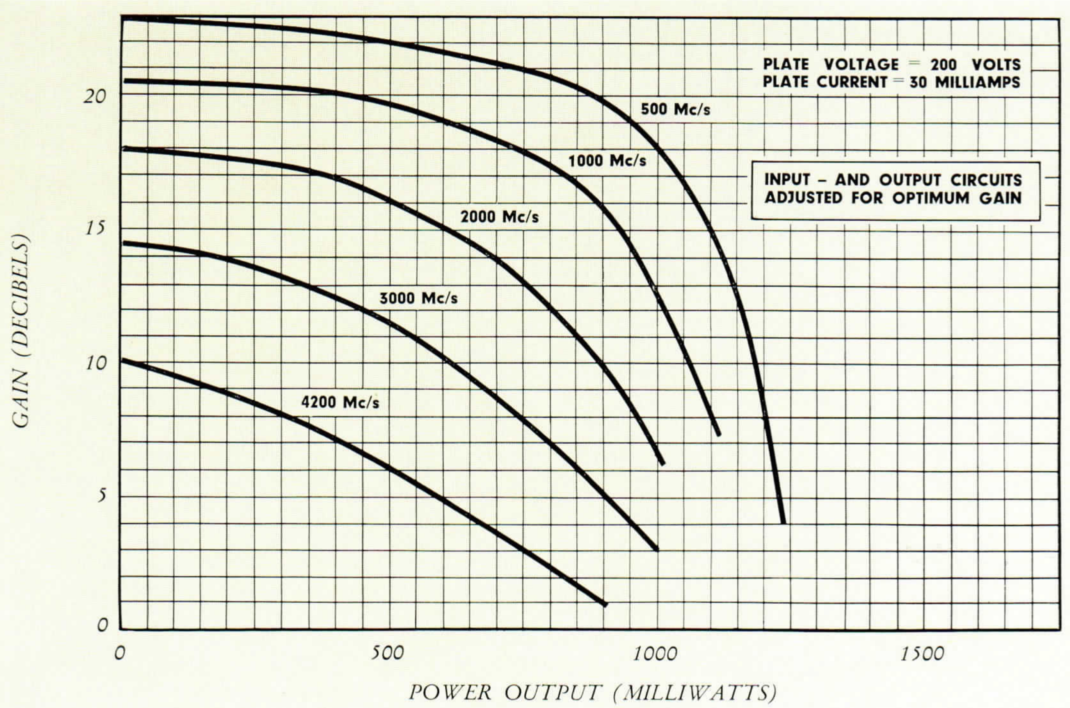
Owing to the fact that the 416B will start to oscillate at a plate current of 2 ma in test circuits, where high unbypassed resistances can not be used, it is strongly recommended that the tube be tested by inserting it into a properly designed cavity with forced air cooling.

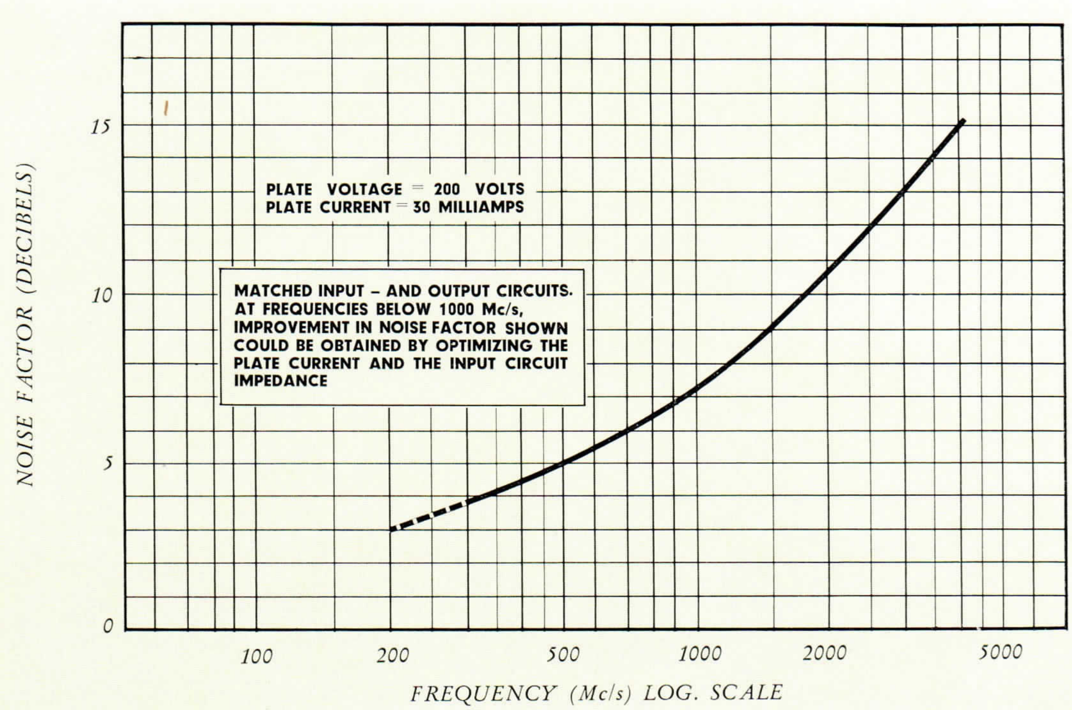
INPUT IMPEDANCE

416B has an extremely high amplification factor. This means for example that the isolation is high between the input and output circuit which is an important feature when several RF-amplification stages are used in cascade. In the application shown the maximum input standing wave ratio was measured when the position of a movable short in the output line was varied through all phases. It was found that the maximum voltage standing wave ratio can be expected not to exceed 1.60.



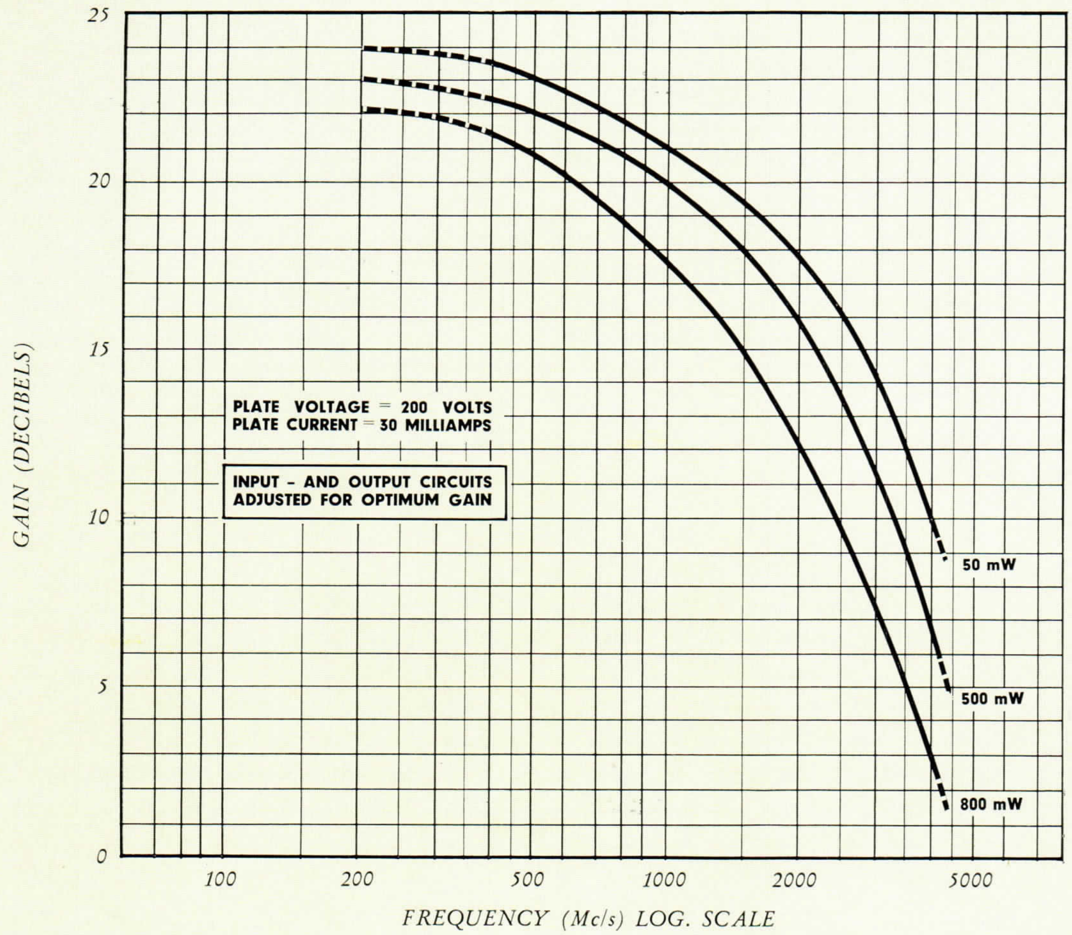
AVERAGE CHARACTERISTICS





416B MICROWAVE TRIODE

AVERAGE CHARACTERISTICS



SINGLE TRIODE **5842** / *417 A*

The 5842/417A is specially designed for use at intermediate frequencies where, owing to the absence of negative feed-back, use can be made of triodes, which have the advantage of causing less noise. The frame grid, described in Section A, has a lateral wire diameter of only .0065 mm.

COLD CAPACITANCES (no external shield unless specified)

Grounded Grid		
Plate to Cathode and Heater	max. .55	μμF
Input (Cathode to Grid and Heater)	9.0	μμF
Output (Plate to Grid and Heater)	1.8	μμF
Output. External shield connected to grid pins	2.6	μμF
Grounded Cathode		
Plate to Grid	1.7	μμF
Input (Grid to Cathode and Heater)	5.5	μμF
Output (Plate to Cathode and Heater)	.4	μμF

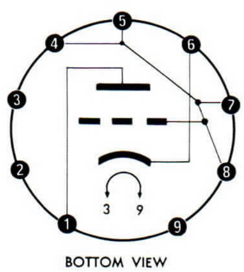
ABSOLUTE MAXIMUM RATINGS

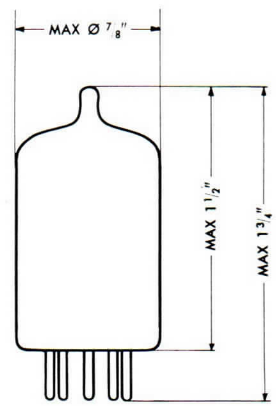
Plate Voltage	200	volts
Grid Voltage, positive value	+ 0	volt
Grid Voltage, negative value	— 25	volts
Cathode Current	38	ma
Plate Dissipation	4.5	watts
Heater — Cathode Voltage	55	volts
Bulb Temperature, at hottest point	160	°C
Grid Circuit Resistance		
with fixed bias	.05	Mohm
with cathode bias	.1	Mohm

MECHANICAL DATA

Base: Small Button Noval 9-pin, RETMA E9-1
Bulb: EIA T 6½
Mounting Position: Any

PIN NO.	CONNECTED TO
1.	Plate
2.	No Connection
3.	Heater
4.	Grid
5.	Grid
6.	Cathode
7.	Grid
8.	Grid
9.	Heater





5842

417 A

SINGLE TRIODE

TYPICAL OPERATION. CLASS A_1

Heater Voltage	6.3	6.3	volts
Heater Current	.3	.3	amp
Plate Supply Voltage	130	150	volts
Grid Supply Voltage	+ 9	—	volts
Cathode Bias Resistor	360	60	ohms
Plate Current	27	25	ma
Transconductance	27,000	25,000	μmhos
Amplification Factor	44	43	
Plate Resistance approx.	1600	1700	ohms
Grid Voltage for Plate Current = 10 μa	— 5	— 5	volts
Equivalent Noise Resistance	100	100	ohms

FIGURE OF MERIT

	Tube Cold	*Typical operation**
At IF without external shield $\frac{g_m}{\sqrt{C_{in} \cdot C_{out}}}$	6.2	3.2

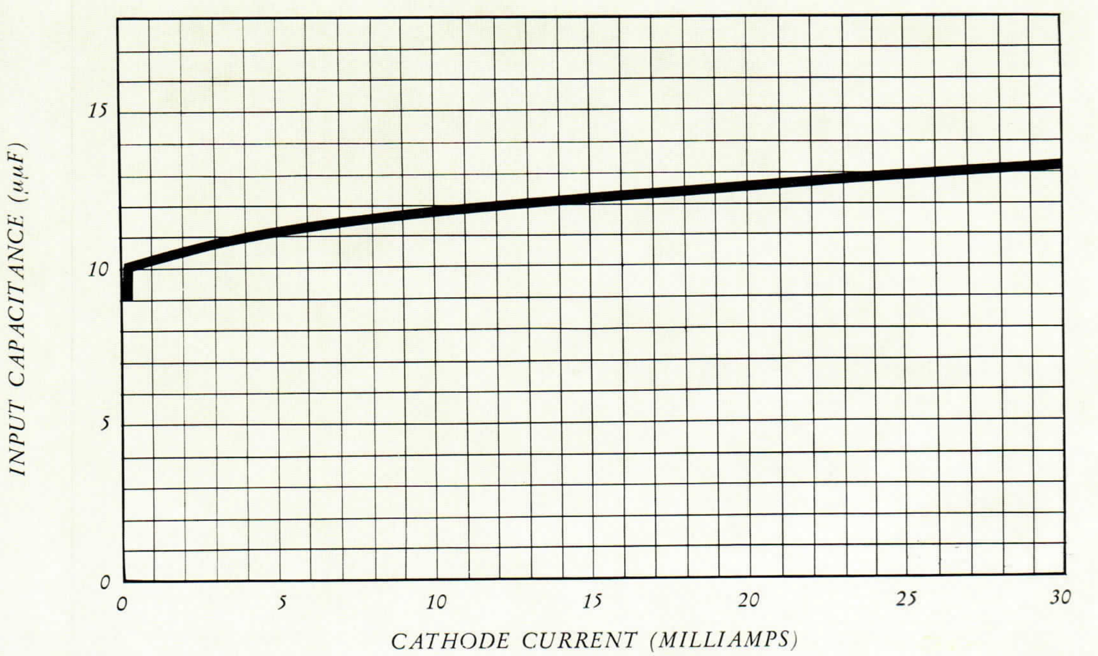
* 3 μμF has been added for input circuit and 2 μμF for output circuit in order to get total circuit capacitances under typical operating conditions.

OPERATION RANGE VALUES

Heater Voltage		6.3		volts
Plate Supply Voltage		150		volts
Cathode Bias Resistor		60		ohms
	MIN	AVE	MAX	
Heater Current	280	300	320	ma
Plate Current	20	25	30	ma
Transconductance	20,000	25,000	30,000	μmhos
Transconductance, End of Life Point	16,000			μmhos
I_{hk} at $E_{hk} = \pm 100$ volts			20	μa
Grid Current			-.5	μa
Cutoff Plate Current at E_{c1} = — 10 volts			100	μa
Vibration Output			100	mv
Measured at 2.5 g and 25 cps. $E_f = 6.3$ v, $E_b = 150$ v, $E_{c1} = -2$ v, $r_p = 2000$ ohms.				

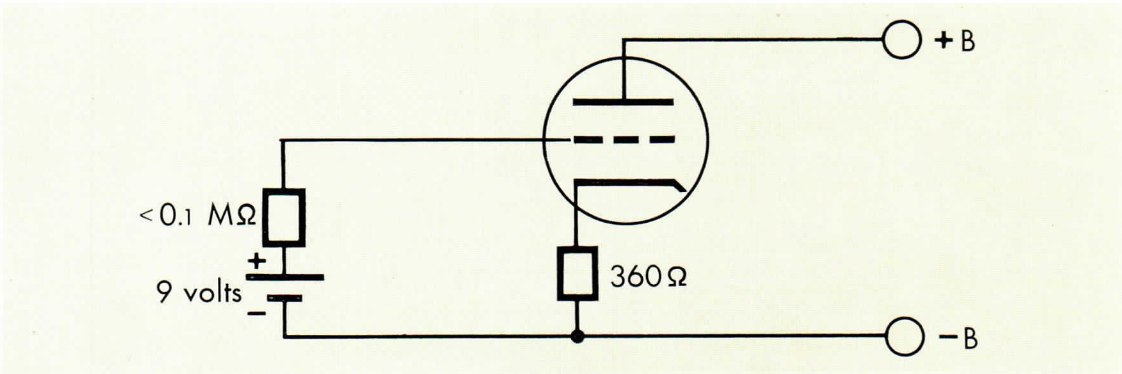
Edition 1

SPECIAL DATA



CAPACITANCES IN OPERATION:

Space-charge effects in electron current flow cause an increase in tube capacitances. Input capacitance as a function of cathode current is shown above. For best value of figure of merit external shield should be excluded.



BIAS CONSIDERATIONS:

The operating characteristics of high transconductance tubes are sensitive to variations in manufacture. Because of this the use of a 360 ohm cathode resistor, in conjunction with a DC control grid return to a + 9.0 volt supply, is recommended. This circuit is shown below.

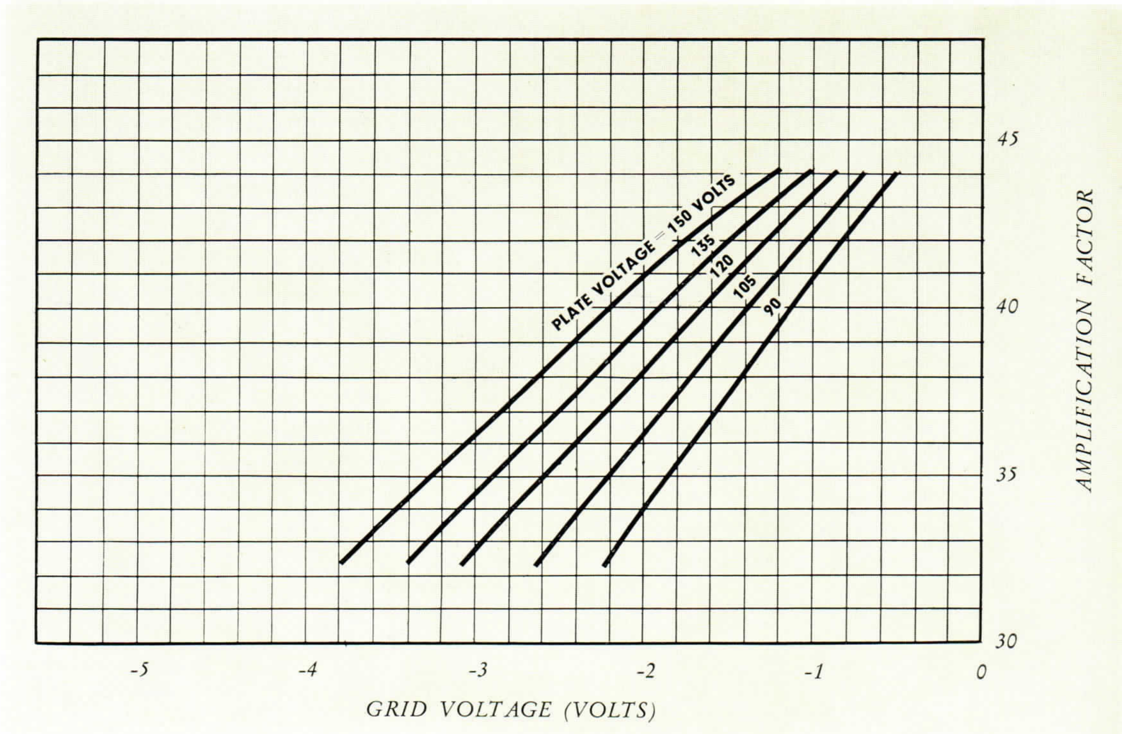
To prevent burning out grid wires by removal of plate voltage when the + 9.0 volt bias is still applied, a limiting resistor of 10,000 ohms in series with the bias supply is suggested. Where the use of such a resistor is not practical, care should be taken to see that the grid bias is not applied before the plate voltage.

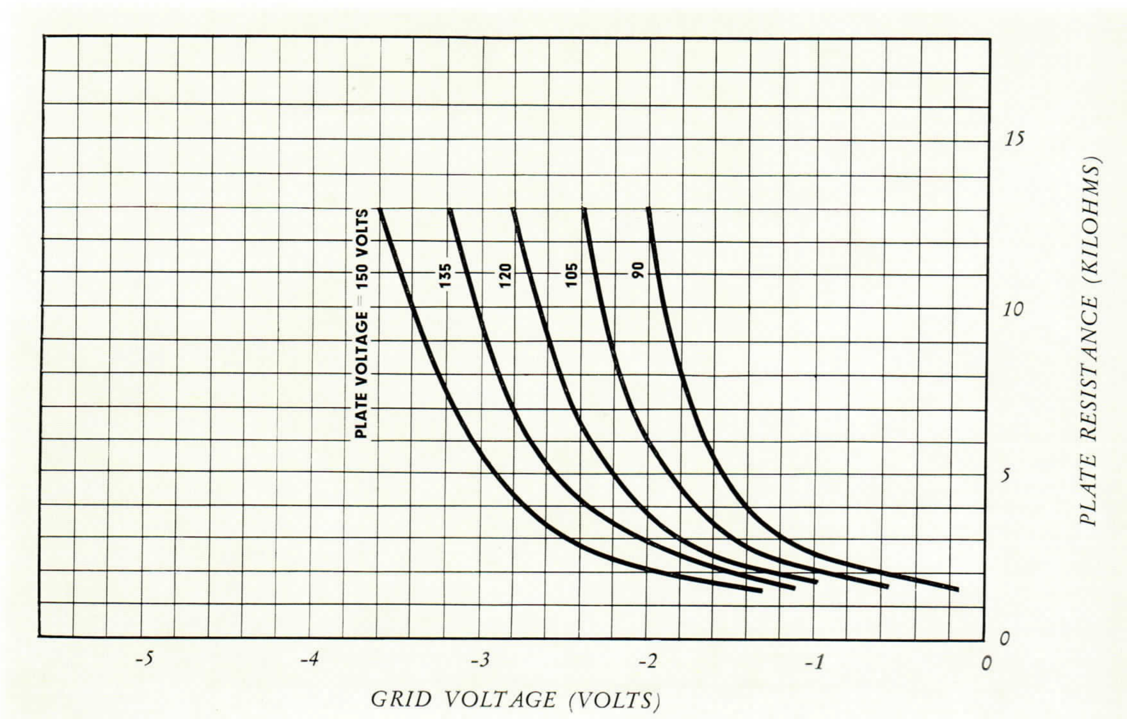
5842

417 A

SINGLE TRIODE

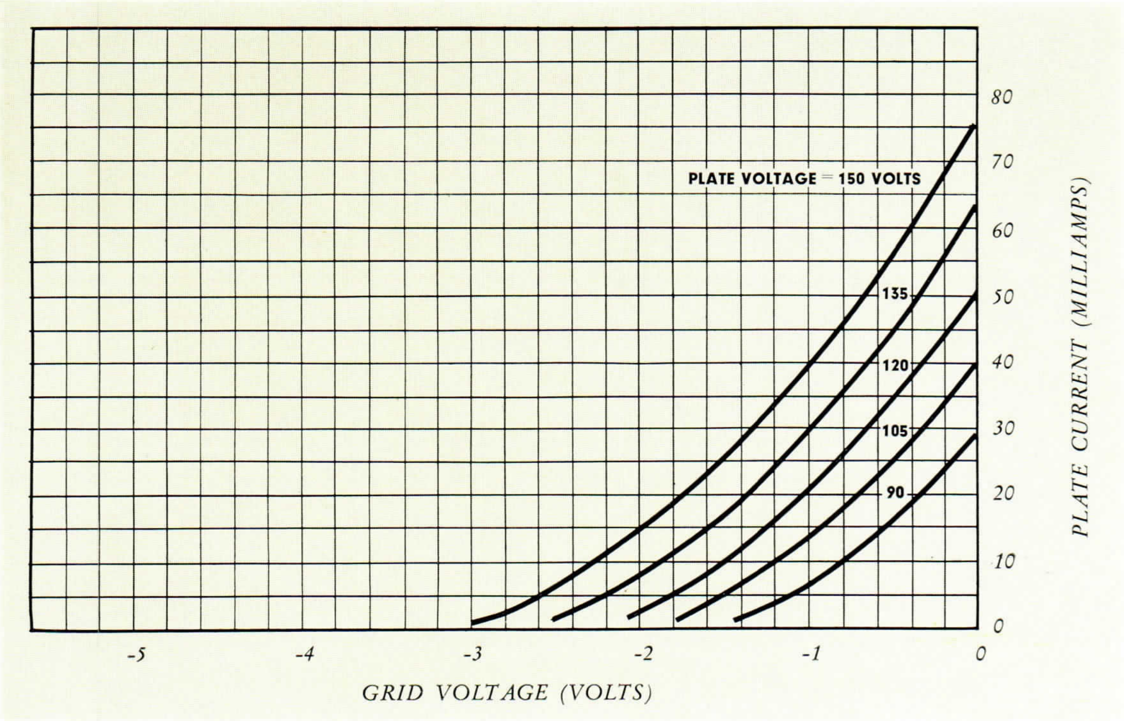
AVERAGE CHARACTERISTICS

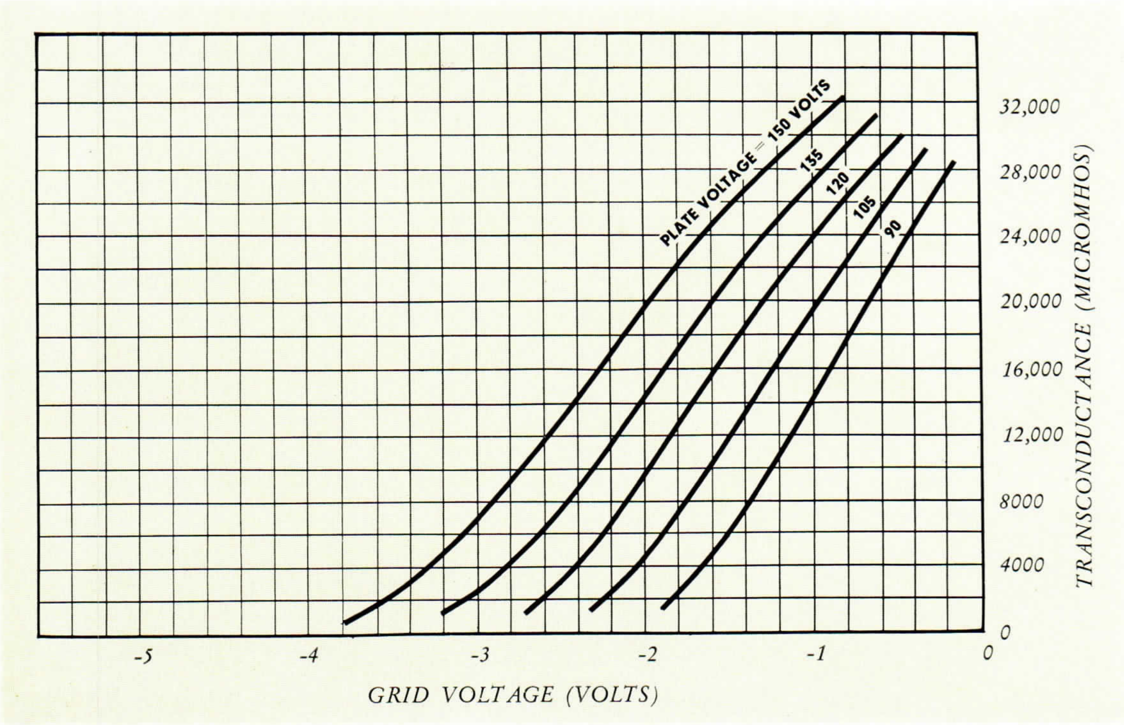




SINGLE TRIODE **5842** 417 A

AVERAGE CHARACTERISTICS





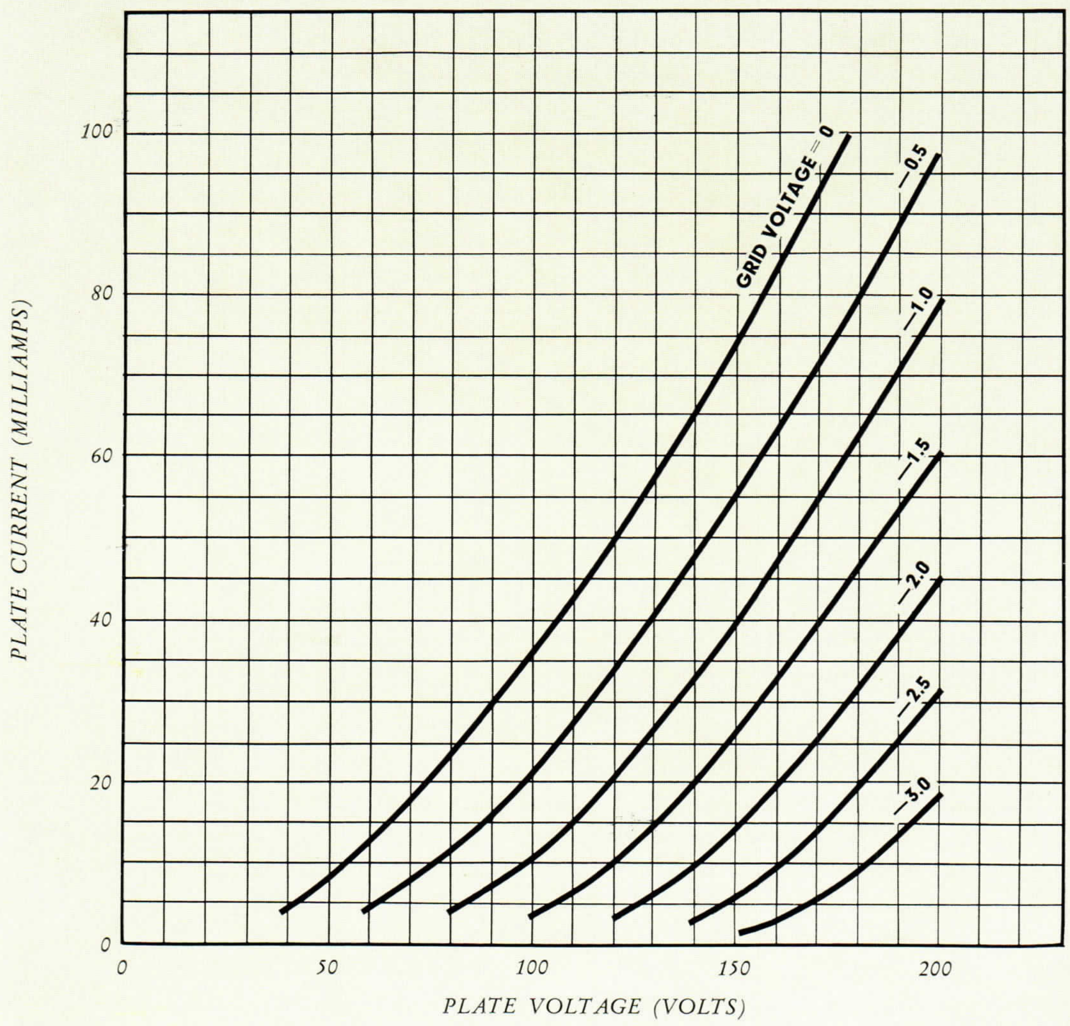
5842

417 A

SINGLE TRIODE

Ericsson LM

AVERAGE CHARACTERISTICS



TWIN TRIODE 6927

6J6L

Twin triode with common cathode for use as high frequency amplifier, oscillator or mixer. With the grids in push-pull and plates connected in parallel the tube may be used as a mixer at frequencies as high as 600 Mc.

COLD CAPACITANCES (without external shield)

Input, Each Section	2.0	μμF
Output, Section 1	.45	μμF
Output, Section 2	.40	μμF
Plate to Grid, Each Section	1.5	μμF

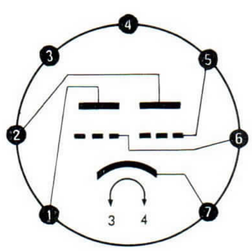
ABSOLUTE MAXIMUM RATINGS (each section)

Plate Voltage	220	volts
Grid Voltage, positive value	+ 5	volts
Cathode Current	17	ma
Plate Dissipation	1.4	watts
Heater — Cathode Voltage	100	volts
Bulb Temperature, at hottest point	160	°C
Grid Circuit Resistance, Cathode Bias	.5	Mohm

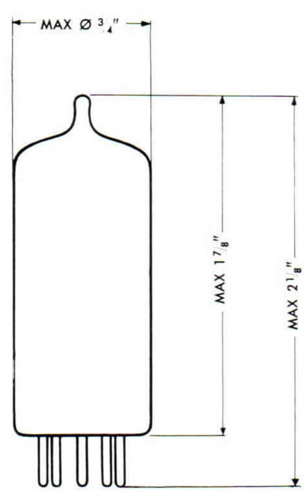
MECHANICAL DATA

Base: Small Button Miniature 7-pin, RETMA E7-1
Bulb: EIA T 5½
Mounting Position: Any

PIN NO.	CONNECTED TO
1.	Plate of Section 2
2.	Plate of Section 1
3.	Heater
4.	Heater
5.	Grid of Section 1
6.	Grid of Section 2
7.	Cathode



BOTTOM VIEW



6927 TWIN TRIODE

6J6L

TYPICAL OPERATION. CLASS A1. (each section)

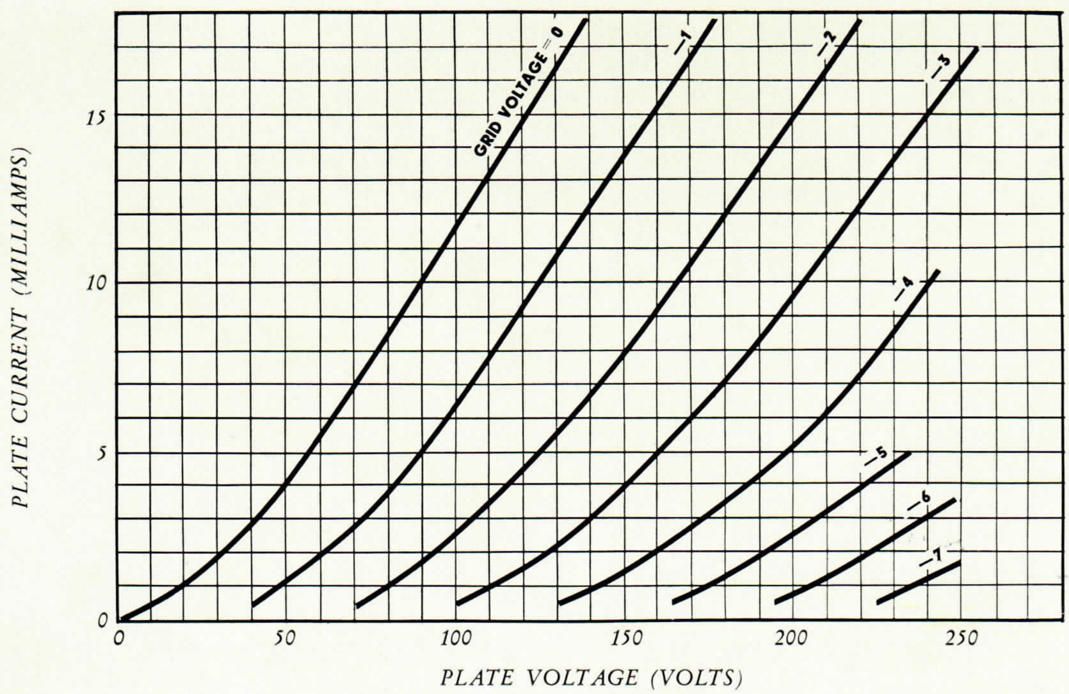
Heater Voltage	6.3	6.3	volts
Heater Current	.33	.33	amp
Plate Supply Voltage	100	130	volts
Cathode Bias Resistor (value is for both sections operating as specified)	68	100	ohms
Plate Current	6.5	7.7	ma
Transconductance	5000	5300	μmhos
Amplification Factor	38	38	
Plate Resistance	7500	7200	ohms
Equivalent Noise Resistance	500	470	ohms

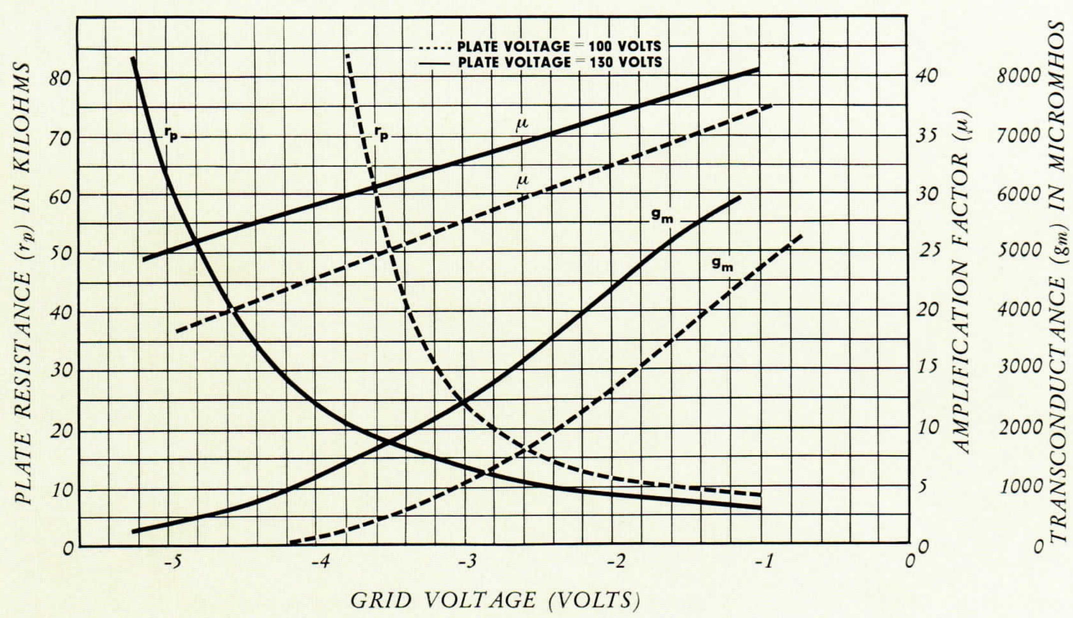
OPERATION RANGE VALUES (each section)

	MIN	AVE	MAX	
Heater Voltage		6.3		volts
Plate Supply Voltage		130		volts
Cathode Bias Resistor (value is for both sections operating as specified)		100		ohms
Heater Current	295	330	365	ma
Plate Current	4.7	7.7	10.7	ma
Transconductance	4200	5300	6400	μmhos
Transconductance, End of Life Point	3600			μmhos
I_{hk} at $E_{hk} = \pm 100$ volts			20	μa
Grid Current			–.5	μa
Cutoff Plate Current at $E_{c1} = -15$ volts			200	μa

Edition 1

AVERAGE CHARACTERISTICS





THE SUPERIOR LIFETIME that extra + plus

YOUR ASSURANCE OF RELIABILITY —
OUR QUALITY CONTROL.

QUALITY cannot be tested into a finished tube. No matter how severe tests may be, or how often they are repeated — it is too late to improve tube quality.

QUALITY CONTROL must start with the raw material and follow the tube through each production stage.

QUALITY CONTROL at LM Ericsson Tube Division is given top priority. It starts with examination of heater wires and nickel strips for cathodes, and ends with careful analysis of pumping, aging and life test results.

RF AMPLIFIER PENTODE 5590
401 A

Especially designed for use at low supply voltages. At a Plate and Grid No 2 voltage of only 45 volts the transconductance is 1900 micromhos at a grid bias of approx. — 1.5 volt. Operation range extends from low to very high frequencies.

COLD CAPACITANCES (external shield connected to cathode)

Grid No 1 to Plate	max. .02	μμF
Input	3.4	μμF
Output	2.9	μμF

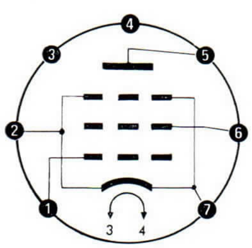
ABSOLUTE MAXIMUM RATINGS

Plate Voltage	200	volts
Grid No 2 Voltage	155	volts
Grid No 1 Voltage, positive value	+ 5	volts
Grid No 1 Voltage, negative value	— 50	volts
Cathode Current	20	ma
Plate Dissipation	1.85	watts
Grid No 2 Dissipation (see Section A)	.55	watt
Heater — Cathode Voltage	100	volts
Bulb Temperature, at hottest point	150	°C
Grid No 1 Circuit Resistance		
with fixed bias	1.0	Mohm
with cathode bias	2.0	Mohms

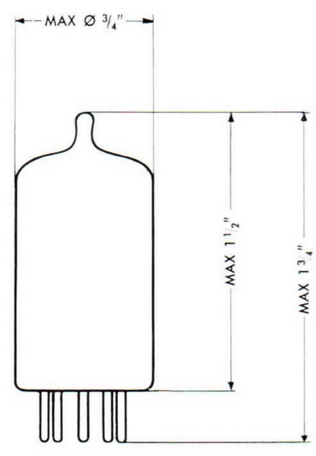
MECHANICAL DATA

Base: Small Button Miniature 7-pin, RETMA E7-1
Bulb: EIA T 5½
Mounting Position: Any

PIN NO.	CONNECTED TO
1.	Grid No 1
2.	Cathode, Grid No 3, Int. Shield
3.	Heater
4.	Heater
5.	Plate
6.	Grid No 2
7.	Cathode, Grid No 3, Int. Shield



BOTTOM VIEW



5590
401 A RF AMPLIFIER PENTODE

Ericsson LM

TYPICAL OPERATION. CLASS A_1

Heater Voltage	6.3	6.3	6.3	volts
Heater Current	.15	.15	.15	amp
Plate Supply Voltage	45	90	120	volts
Grid No 2 Supply Voltage	45	90	120	volts
Cathode Bias Resistor	390	820	1000	ohms
Plate Current	2.7	3.9	5.0	ma
Grid No 2 Current	.8	1.2	1.5	ma
Transconductance	1900	2000	2200	μmhos
Plate Resistance	.3	.45	.5	Mohm
Grid No 1 Voltage for Plate Current = 10 μa	— 5	— 10	— 14	volts

OPERATION RANGE VALUES

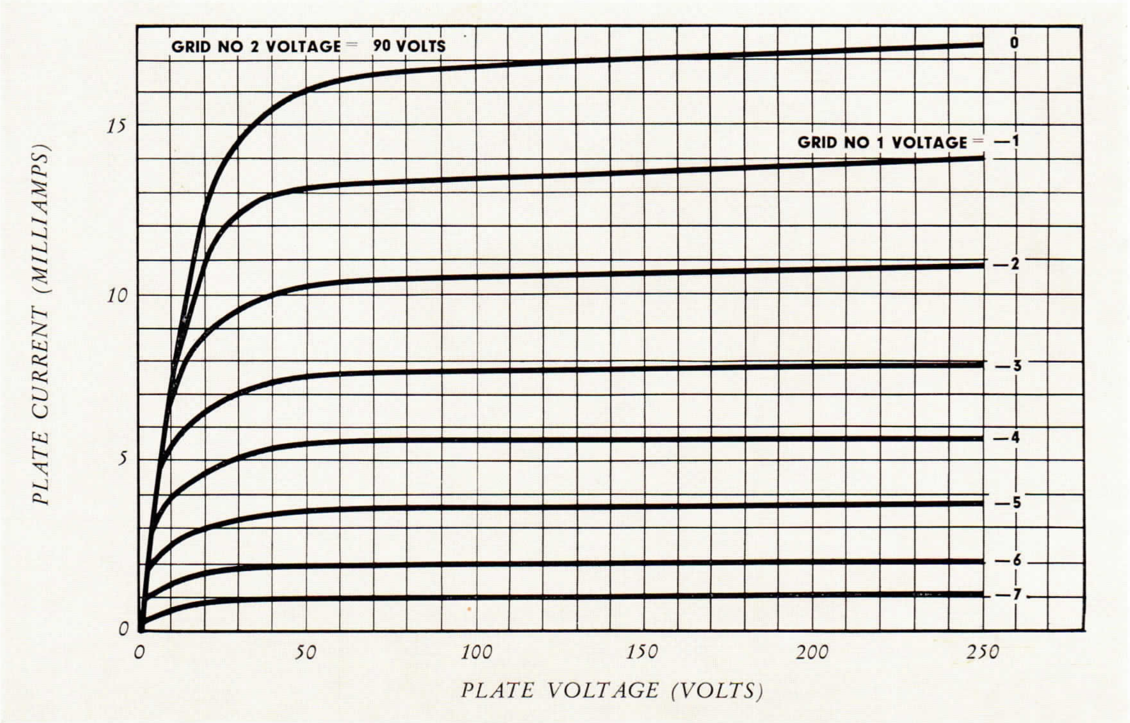
Heater Voltage		6.3		volts
Plate Supply Voltage		90		volts
Grid No 2 Supply Voltage		90		volts
Cathode Bias Resistor		820		ohms
	MIN	AVE	MAX	
Heater Current	135	150	165	ma
Plate Current	2.5	3.9	5.5	ma
Grid No 2 Current		1.2	2.0	ma
Transconductance	1500	2000	2500	μmhos
Transconductance, End of Life Point	1300			μmhos
I_{hk} at E_{hk} = ± 100 volts			20	μa
Grid No 1 Current			–.1	μa
Cutoff Plate Current at E_{c1} = — 15 volts			50	μa
Vibration Output		10		mv
Measured at 2.5 g and 25 cps. E_f = 6.3 v, E_{bb} = 90 v, E_{cc2} = 90 v, R_k = 820 ohms, C_k = 2000 μF, r_p = 2000 ohms.				

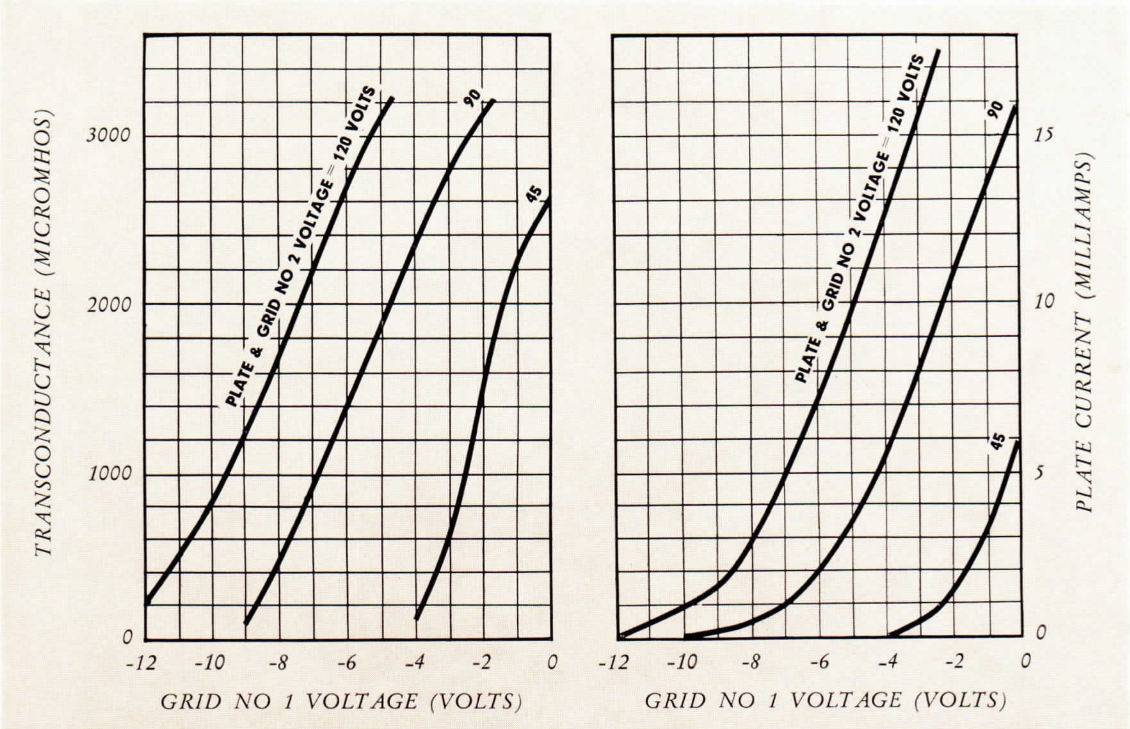
Edition 1

RF AMPLIFIER PENTODE **5590**

401 A

AVERAGE CHARACTERISTICS





5591 / 403 B

RF AMPLIFIER PENTODE

For use as RF amplifier and broadband amplifier. Within its ratings the 5591/403B is an excellent longlife replacement for types 5654 and 6AK5.

COLD CAPACITANCES (external shield connected to cathode)

	MIN	AVE	MAX	
Grid No 1 to Plate			.02	μμF
Input	3.4	4.0	4.6	μμF
Output	2.4	2.8	3.2	μμF

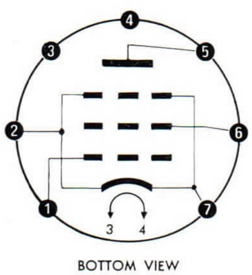
ABSOLUTE MAXIMUM RATINGS

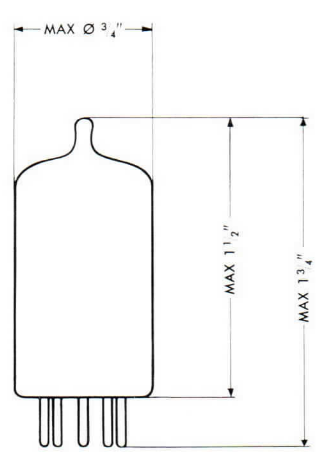
Plate Voltage	200	volts
Grid No 2 Voltage	155	volts
Grid No 1 Voltage, positive value	+ 5	volts
Grid No 1 Voltage, negative value	— 50	volts
Cathode Current	20	ma
Plate Dissipation	1.85	watts
Grid No 2 Dissipation (see Section A)	.55	watt
Heater — Cathode Voltage	100	volts
Bulb Temperature, at hottest point	150	°C
Grid No 1 Circuit Resistance		
with fixed bias	1.0	Mohm
with cathode bias	2.0	Mohms

MECHANICAL DATA

Base: Small Button Miniature 7-pin, RETMA E7-1
Bulb: EIA T 5½
Mounting Position: Any

PIN NO.	CONNECTED TO
1.	Grid No 1
2.	Cathode, Grid No 3, Int. Shield
3.	Heater
4.	Heater
5.	Plate
6.	Grid No 2
7.	Cathode, Grid No 3, Int. Shield





5591

403 B

RF AMPLIFIER PENTODE

Ericsson LM

TYPICAL OPERATION. CLASS A_1

Heater Voltage	6.3	6.3	volts
Heater Current	.15	.15	amp
Plate Supply Voltage	130	180	volts
Grid No 2 Supply Voltage	130	120	volts
Cathode Bias Resistor	200	200	ohms
Plate Current	8.0	7.7	ma
Grid No 2 Current	2.0	1.8	ma
Transconductance	5100	5000	μmhos
Plate Resistance	.35	.5	Mohm
Amplification Factor Grid No 2 to 1	28	28	
Grid No 1 Voltage for Plate Current = 10 μa	— 6.5	— 6.0	volts
Equivalent Noise Resistance	1600	1600	ohms
Transit Time Loading at 100 Mc	40	40	μmhos
Input Conductance at 100 Mc	125	125	μmhos

OPERATION RANGE VALUES

Heater Voltage		6.3		volts
Plate Supply Voltage		130		volts
Grid No 2 Supply Voltage		130		volts
Cathode Bias Resistor		200		ohms
	MIN	AVE	MAX	
Heater Current	130	150	170	ma
Plate Current	5.8	8.0	10.8	ma
Grid No 2 Current	1.3	2.0	2.7	ma
Transconductance	4000	5100	6200	μmhos
Transconductance, End of Life Point	3400			μmhos
I_{hk} at E_{hk} = ± 100 volts			20	μa
Grid No 1 Current			–.1	μa
Cutoff Plate Current at E_{c1} = — 7.5 volts			200	μa
Vibration Output Measured at 2.5 g and 25 cps. E_f = 6.3 v, E_b = 130 v, E_{c2} = 130 v, E_{c1} = — 2 v, r_p = 10,000 ohms.		10		mv

Edition 1

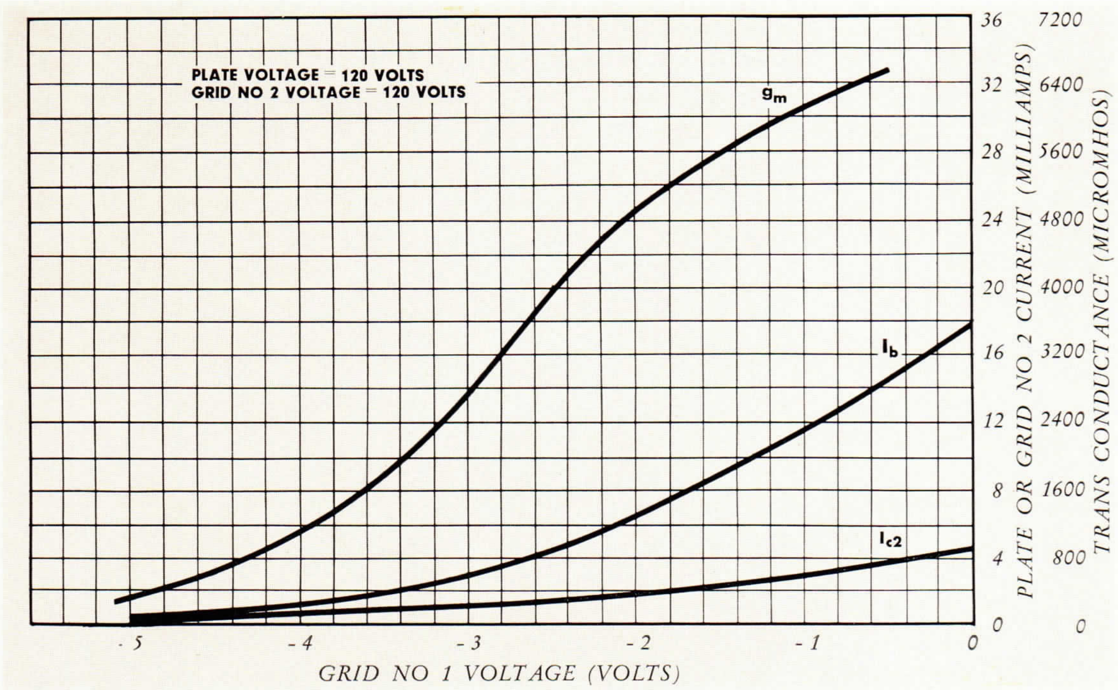
Ericsson LM

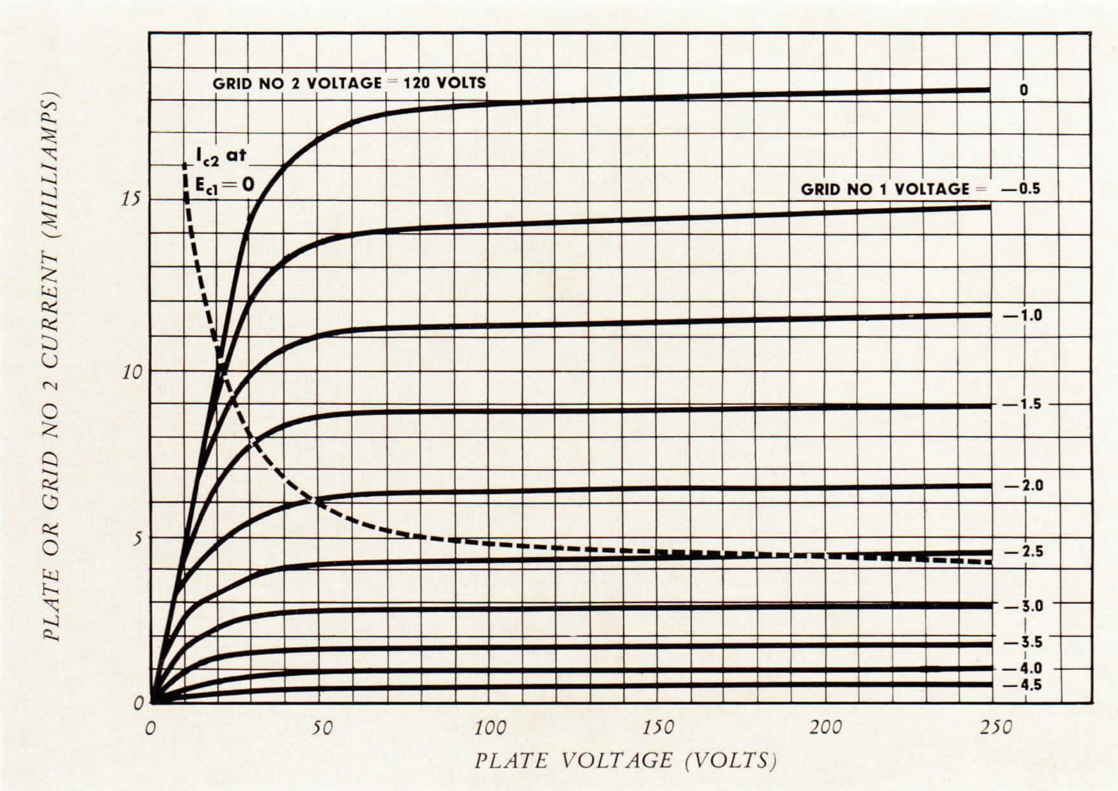
RF AMPLIFIER PENTODE

5591

403 B

AVERAGE CHARACTERISTICS





Ericsson LM

RF AMPLIFIER PENTODE 5847 / 404 A

Intended for use up to ultrahigh frequencies. It features low noise, high transconductance, and low inter-electrode capacitances.
The frame grid, described in Section A, with a lateral wire diameter of only .0065 mm provides high broad-band qualities and freedom from microphonics.

COLD CAPACITANCES (without external shield)

Grid No 1 to Plate	max. .05	μμF
Input	7.0	μμF
Output	2.5	μμF

RANGE VALUES FOR CAPACITANCES (external shield connected to cathode)

	MIN	MAX	
Grid No 1 to Plate		.04	μμF
Input	6.6	7.8	μμF
Output	2.9	3.4	μμF

ABSOLUTE MAXIMUM RATINGS

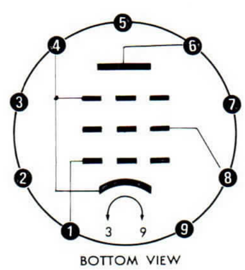
Plate Voltage	200	volts
Grid No 2 Voltage	165	volts
Grid No 1 Voltage, positive value	+ 0	volt
Grid No 1 Voltage, negative value	— 25	volts
Cathode Current	40	ma
Plate Dissipation	3.3	watts
Grid No 2 Dissipation (see Section A)	.85	watt
Heater — Cathode Voltage	55	volts
Bulb Temperature, at hottest point	150	°C
Grid No 1 Circuit Resistance		
with fixed bias	.05	Mohm
with cathode bias	.1	Mohm

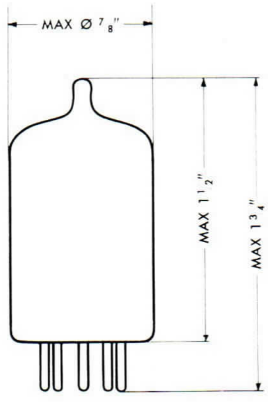
MECHANICAL DATA

Base: Small Button Noval 9-pin, RETMA E9-1
Bulb: EIA T 6½
Mounting Position: Any

PIN NO	CONNECTED TO
1.	Grid No 1
2.	No Connection
3.	Heater, Upper Int. Shield*
4.	Cathode, Grid No 3, Lower Int. Shield
5.	No Connection
6.	Plate
7.	No Connection
8.	Grid No 2
9.	Heater

*The internal shield connected to Pin No 3 should be grounded.





5847

404 A

RF AMPLIFIER PENTODE

Ericsson LM

TYPICAL OPERATION. CLASS A1

Heater Voltage	6.3	6.3	volts
Heater Current	.3	.3	amp
Plate Supply Voltage	150	160	volts
Grid No 2 Supply Voltage	150	160	volts
Grid No 1 Supply Voltage		+ 8.5	volts
Cathode Bias Resistor	110	600	ohms
Plate Current	13.5	13.5	ma
Grid No 2 Current	4.0	4.0	ma
Transconductance	13,000	13,000	μmhos
Plate Resistance	.2	.2	megohm
Grid No 1 Voltage for Plate Current = 10 μa	— 4.5	— 4.5	volts
Equivalent Noise Resistance	500	500	ohms
Transit Time Loading at 100 Mc	100	100	μmhos
Input Conductance at 100 Mc	2000	2000	μmhos

FIGURE OF MERIT

	Tube Cold	*Typical operation**
At LF without external shield $\frac{g_m}{C_{in} + C_{out}}$	1.37	.73
At IF without external shield $\frac{g_m}{\sqrt{C_{in} \cdot C_{out}}}$	3.1	1.7

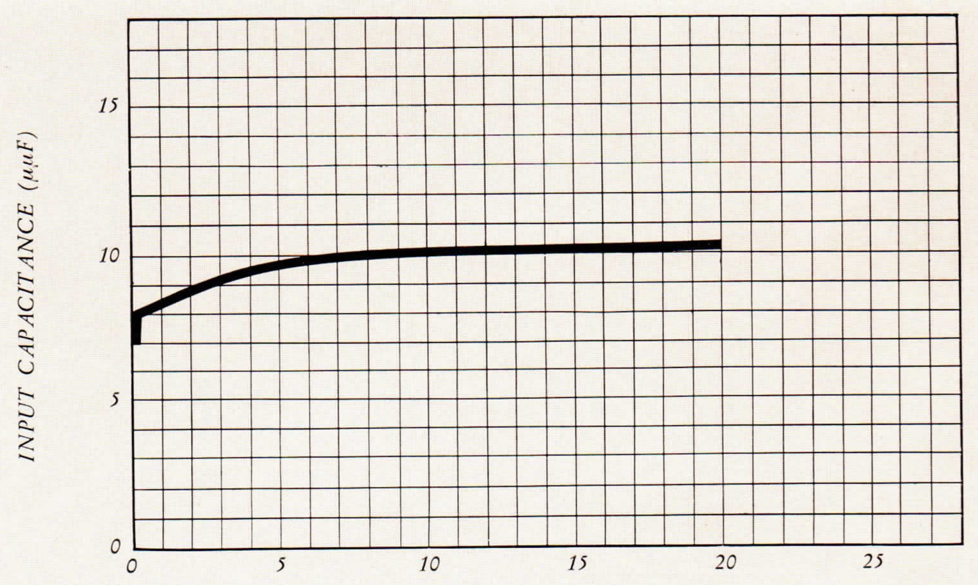
* The following additions have been made for tube sockets and wiring capacitances to get total circuit capacitances under typical operating conditions:
At LF — 5 μμF. At IF — 3 μμF for input circuit and 2 μμF for output circuit.

OPERATION RANGE VALUES

Heater Voltage		6.3		volts
Plate Supply Voltage		150		volts
Grid No 2 Supply Voltage		150		volts
Cathode Bias Resistor		110		ohms
	MIN	AVE	MAX	
Heater Current	280	300	320	ma
Plate Current	9.0	13.5	18.0	ma
Grid No 2 Current		4.0	6.0	ma
Transconductance	10,000	13,000	16,000	μmhos
Transconductance, End of Life Point	8500			μmhos
I_{hk} at E_{hk} = ± 100 volts			20	μa
Grid No 1 Current			— .2	μa
Cutoff Plate Current at E_{c1} = — 10 volts			50	μa
Vibration Output		5		mv
Measured at 2.5 g and 25 cps. E_f = 6.3 v, E_{bb} = 150 v, E_{cc2} = 150 v, R_k = 110 ohms, C_k = 2000 μF, r_p = 2000 ohms.				

Edition 1

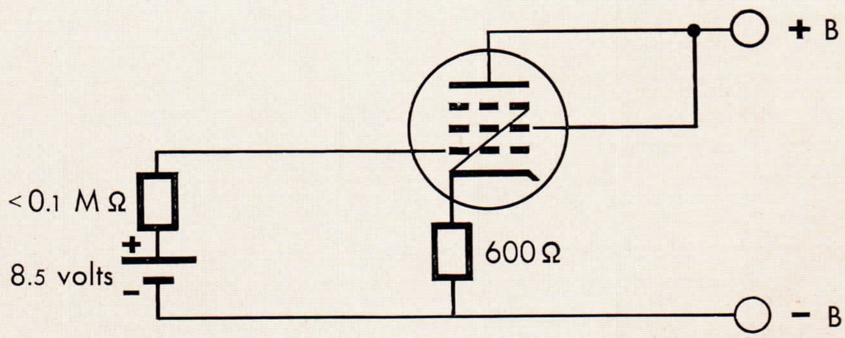
SPECIAL DATA



CAPACITANCES IN OPERATION:

Space-charge effects in electron current flow cause an increase in tube capacitances. Input capacitance as a function of cathode current is shown above.

For best value of figure of merit external shield should be excluded.



BIAS CONSIDERATIONS:

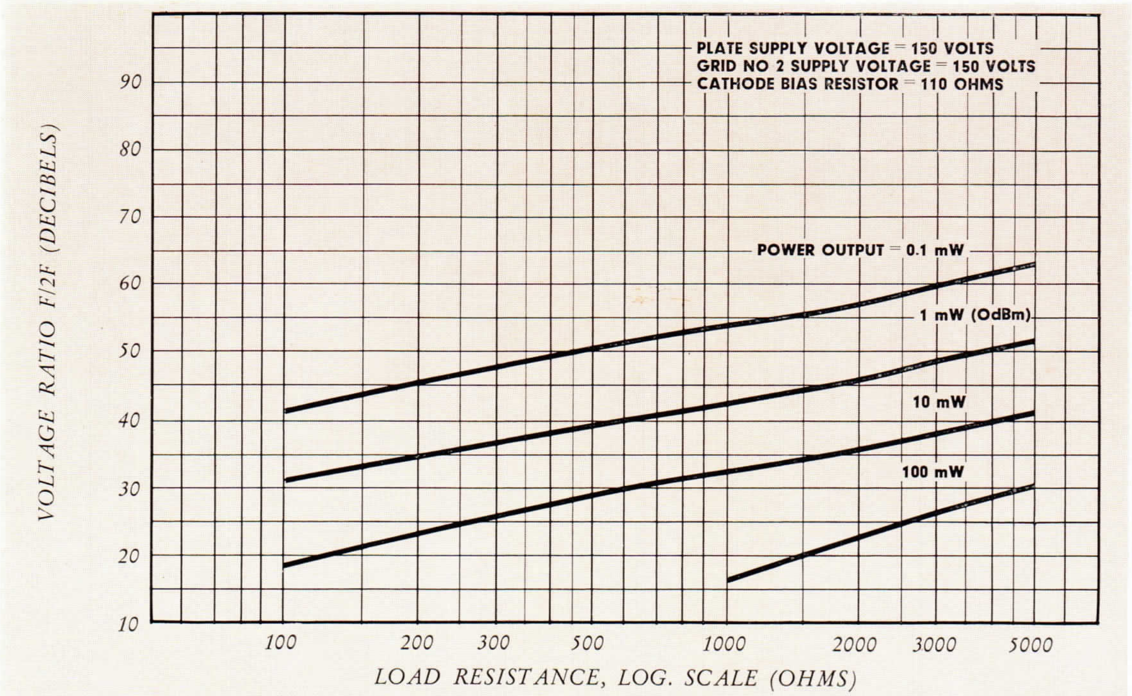
The operating characteristics of high transconductance tubes are sensitive to variations in manufacture. Because of this the use of a 600 ohm cathode resistance, in conjunction with a DC control grid return to a + 8.5 volt supply, is recommended.

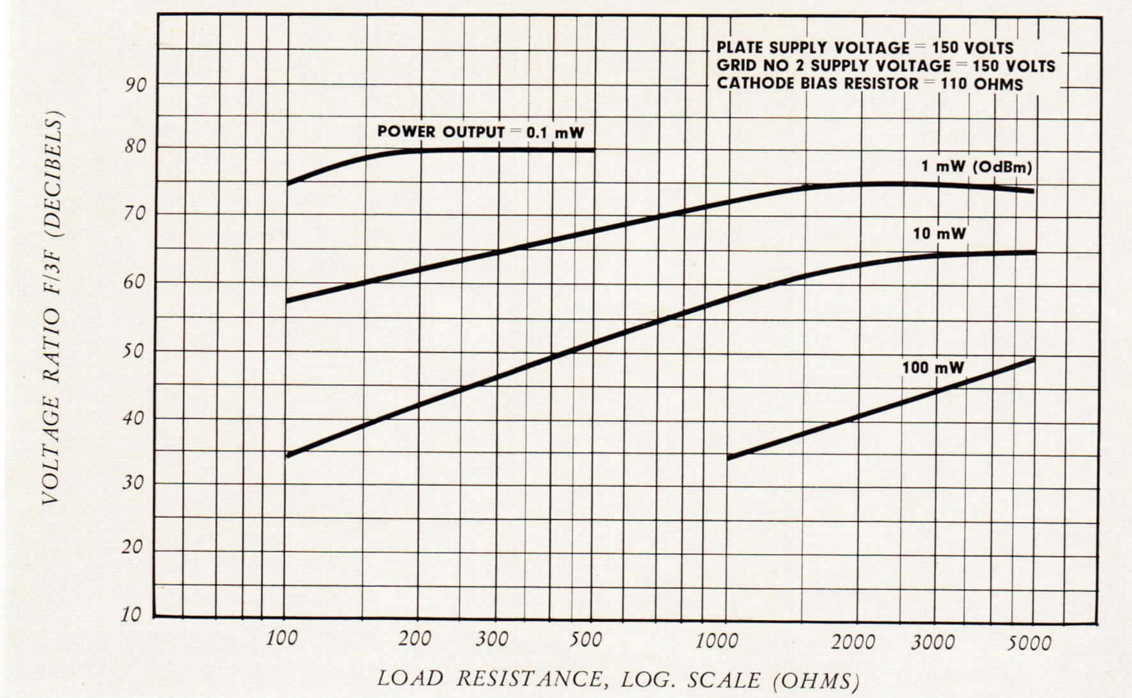
To prevent burning out grid wires by removal of plate voltage when the + 8.5 volt bias is still applied, a limiting resistor of 10,000 ohms in series with the bias supply is suggested. Where the use of such a resistor is not practical, care should be taken to see that the grid bias is not applied before the plate and grid No 2 voltages.

5847

404 A — RF AMPLIFIER PENTODE

Ericsson LM

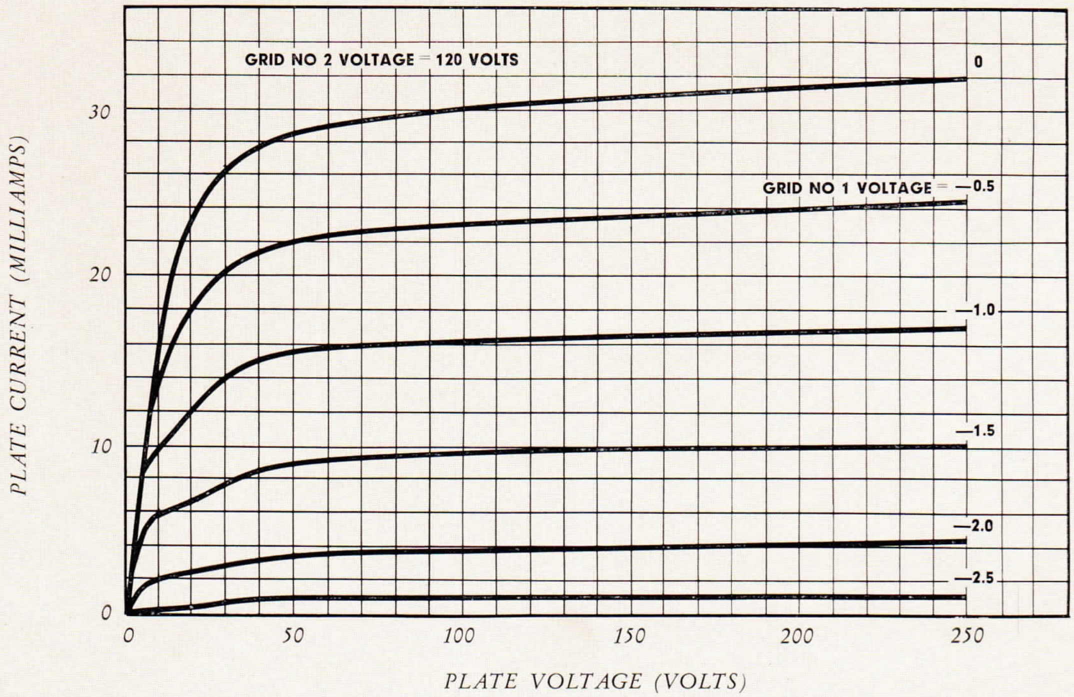


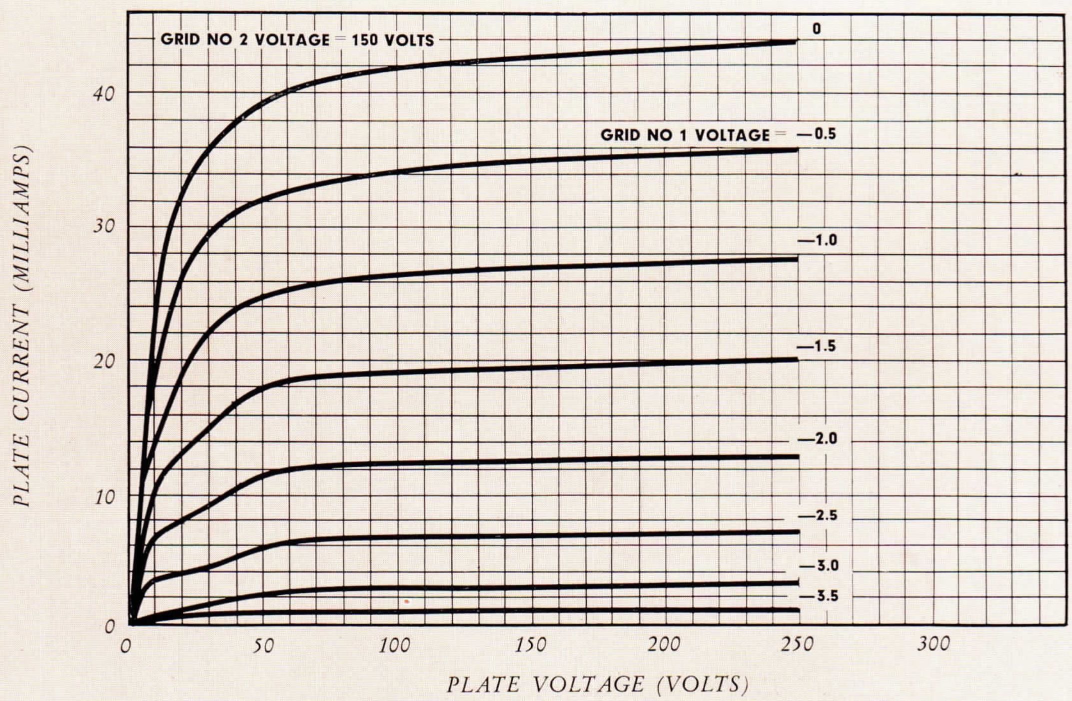


HARMONIC DISTORTION:

The voltage ratio between fundamental frequency (F), second harmonic (2F) and third harmonic (3F) as a function of the load resistance at different power outputs under typical operating conditions is shown.

AVERAGE CHARACTERISTICS





RF AMPLIFIER PENTODE 6028 / 408 A

6028/408A is particularly suitable for use as RF amplifier and broadband amplifier.

COLD CAPACITANCES (external shield connected to cathode)

	MIN	AVE	MAX	
Grid No 1 to Plate			.02	μμF
Input	3.4	4.0	4.6	μμF
Output	2.4	2.8	3.2	μμF

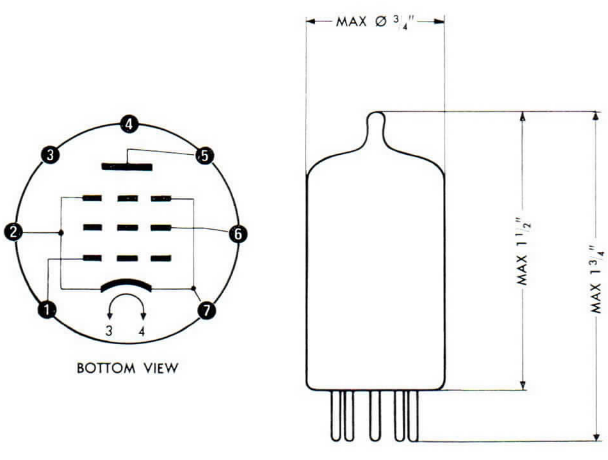
ABSOLUTE MAXIMUM RATINGS

Plate Voltage	200	volts
Grid No 2 Voltage	155	volts
Grid No 1 Voltage, positive value	+ 5	volts
Grid No 1 Voltage, negative value	— 50	volts
Cathode Current	20	ma
Plate Dissipation	1.85	watts
Grid No 2 Dissipation (see Section A)	.55	watt
Heater — Cathode Voltage	130	volts
Bulb Temperature, at hottest point	150	°C
Grid No 1 Circuit Resistance		
with fixed bias	1.0	Mohm
with cathode bias	2.0	Mohms

MECHANICAL DATA

Base: Small Button Miniature 7-pin, RETMA E7-1
Bulb: EIA T 5½
Mounting Position: Any

PIN NO.	CONNECTED TO
1.	Grid No 1
2.	Cathode, Grid No 3, Int. Shield
3.	Heater
4.	Heater
5.	Plate
6.	Grid No 2
7.	Cathode, Grid No 3, Int. Shield



6028 RF AMPLIFIER PENTODE

408 A

Ericsson LM

TYPICAL OPERATION. CLASS A1

Heater Voltage	20.0	20.0	volts
Heater Current	.05	.05	amp
Plate Supply Voltage	120	120	volts
Grid No 2 Supply Voltage	120	120	volts
Cathode Bias Resistor	200	130	ohms
Peak AF Grid No 1 Voltage	2.0	1.5	volts
Zero Signal Plate Current	7.5	9.4	ma
Max. Signal Plate Current	7.7	9.2	ma
Zero Signal Grid No 2 Current	1.9	2.4	ma
Max. Signal Grid No 2 Current	2.7	3.2	ma
Transconductance	5000	5600	μmhos
Plate Resistance	.3	.25	Mohm
Load Resistance	15,000	15,000	ohms
Power Output	.325	.265	watt
Total Harmonic Distortion	12	5.5	%
Amplification Factor Grid No 2 to 1	24	24	
Grid No 1 Voltage for Plate Current = 10 μa	— 6.5	— 6.5	volts
Equivalent Noise Resistance	1600	1600	ohms
Transit Time Loading at 100 Mc	40	40	μmhos
Input Conductance at 100 Mc	125	125	μmhos

OPERATION RANGE VALUES

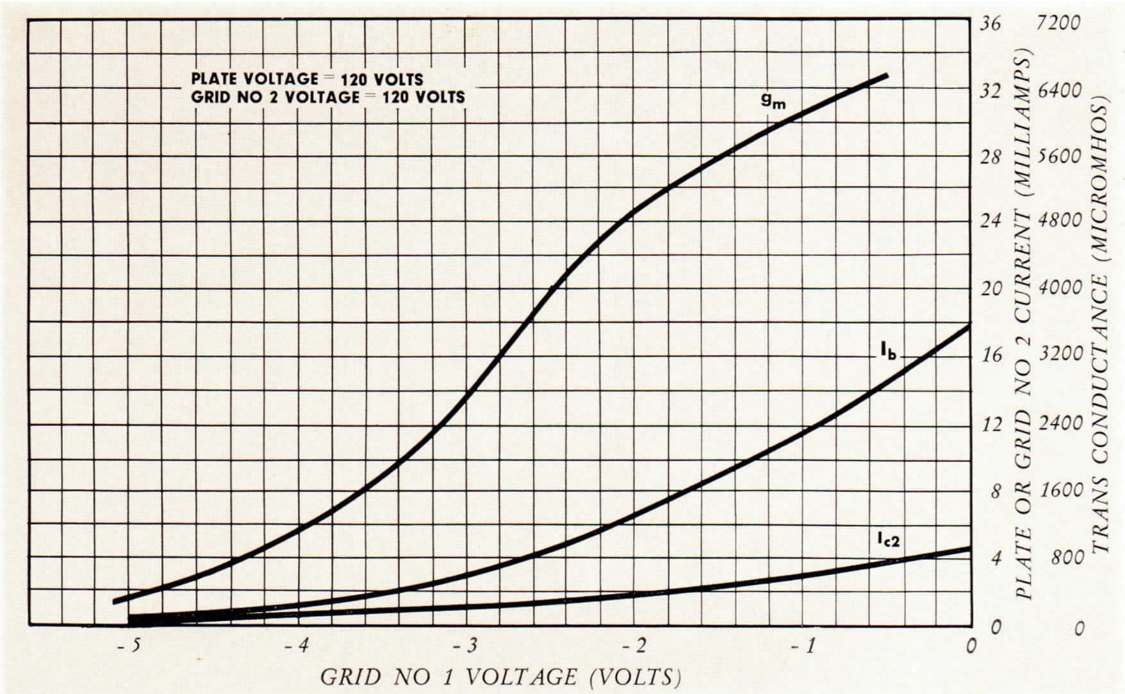
Heater Voltage		20.0		volts
Plate Supply Voltage		120		volts
Grid No 2 Supply Voltage		120		volts
Cathode Bias Resistor		200		ohms
	MIN	AVE	MAX	
Heater Current	45	50	55	ma
Plate Current	5	7.5	9	ma
Grid No 2 Current	1.5	1.9	3	ma
Transconductance	3900	5000	6000	μmhos
Transconductance, End of Life Point	3400			μmhos
I_{hk} at E_{hk} = ± 100 volts			20	μa
Grid No 1 Current			–.1	μa
Cutoff Plate Current at E_{c1} = — 10 volts			200	μa
Vibration Output		10		mv

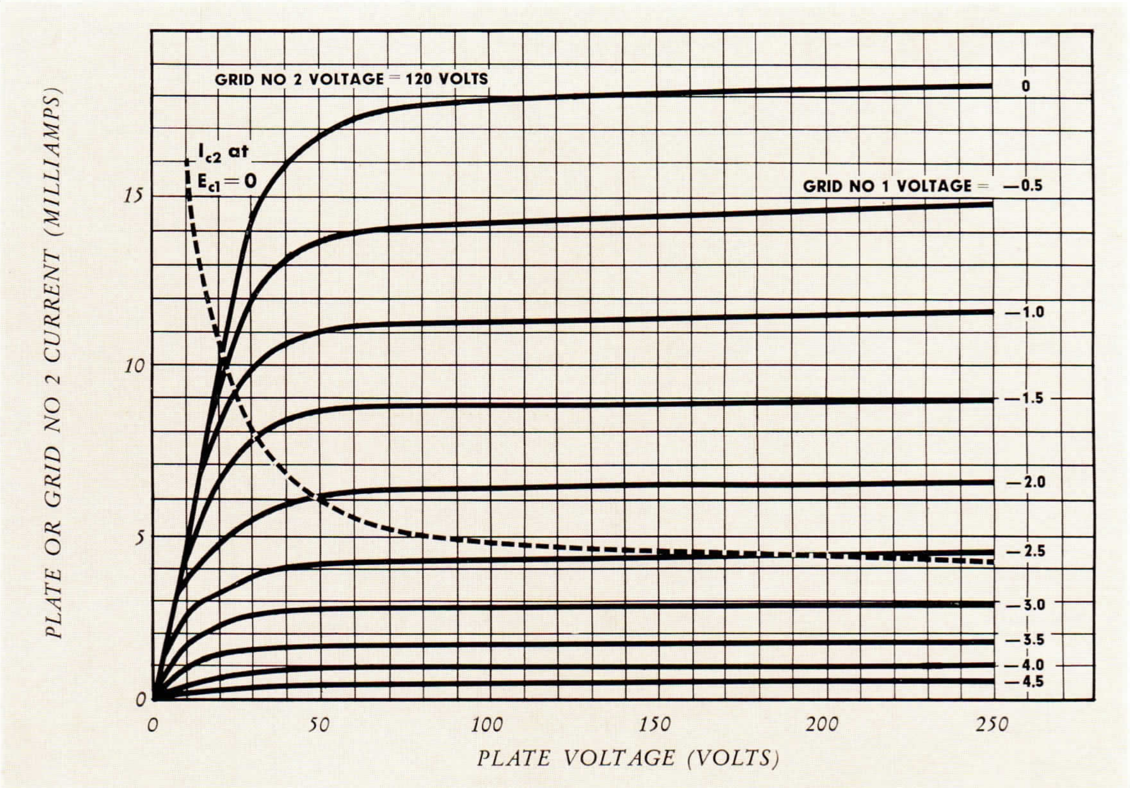
Measured at 2.5 g and 25 cps. E_f = 20.0 v, E_{bb} = 120 v, E_{cc2} = 120 v, R_k = 200 ohms, C_k = 2000 μF, r_p = 10,000 ohms.

Edition 1

RF AMPLIFIER PENTODE **6028** *408 A*

AVERAGE CHARACTERISTICS





POWER AMPLIFIER PENTODE 6761

For use as output tube in telephone equipment and industrial applications, particularly in broadband amplifiers. Within its ratings it is a suitable replacement for type 6216.

COLD CAPACITANCES (without external shield)

Grid No 1 to Plate	.4	μμF
Input	14	μμF
Output	6	μμF

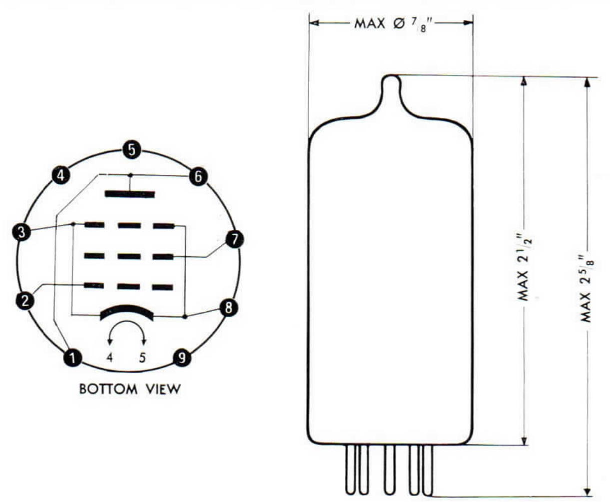
ABSOLUTE MAXIMUM RATINGS

Plate Voltage	275	volts
Grid No 2 Voltage	220	volts
Grid No 1 Voltage, positive value	+ 10	volts
Grid No 1 Voltage, negative value	— 55	volts
Cathode Current	110	ma
Plate Dissipation	11	watts
Grid No 2 Dissipation (see Section A)	1.65	watts
Heater — Cathode Voltage	110	volts
Bulb Temperature, at hottest point	200	°C
Grid No 1 Circuit Resistance		
with fixed bias	.1	Mohm
with cathode bias	.5	Mohm

MECHANICAL DATA

Base: Small Button Noval 9-pin, RETMA E9-1
Bulb: EIA T 6½
Mounting Position: Any

PIN NO.	CONNECTED TO
1.	Plate
2.	Grid No 1
3.	Cathode, Grid No 3
4.	Heater
5.	Heater
6.	Plate
7.	Grid No 2
8.	Cathode, Grid No 3
9.	No Connection



6761 POWER AMPLIFIER PENTODE

Ericsson LM

TYPICAL OPERATION. CLASS A1

Heater Voltage	6.3	volts
Heater Current	1.0	amp
Plate Supply Voltage	130	volts
Grid No 2 Supply Voltage	130	volts
Cathode Bias Resistor	100	ohms
Plate Current	70	ma
Grid No 2 Current	3.5	ma
Transconductance	13,000	μmhos
Plate Resistance approx.	23,000	ohms
Load Resistance	1500	ohms
Power Output	3.0	watts
Total Harmonic Distortion	10	%
Amplification Factor Grid No 2 to 1	8	
Grid No 1 Voltage for Plate Current = 10 μa	— 25	volts

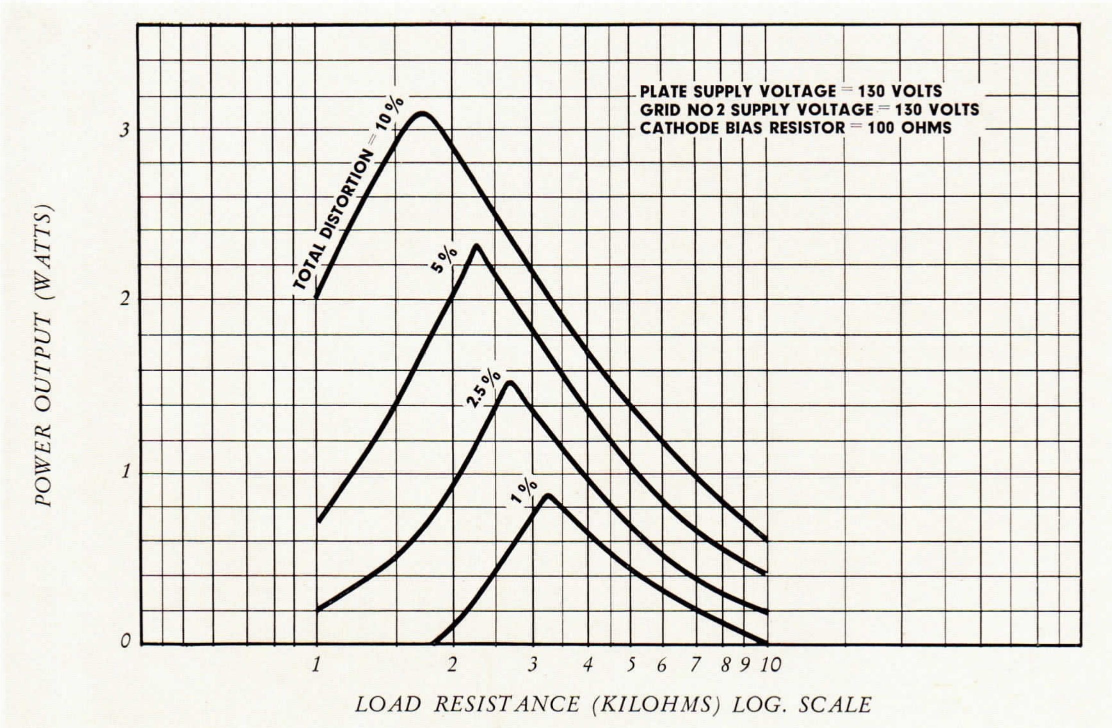
OPERATION RANGE VALUES

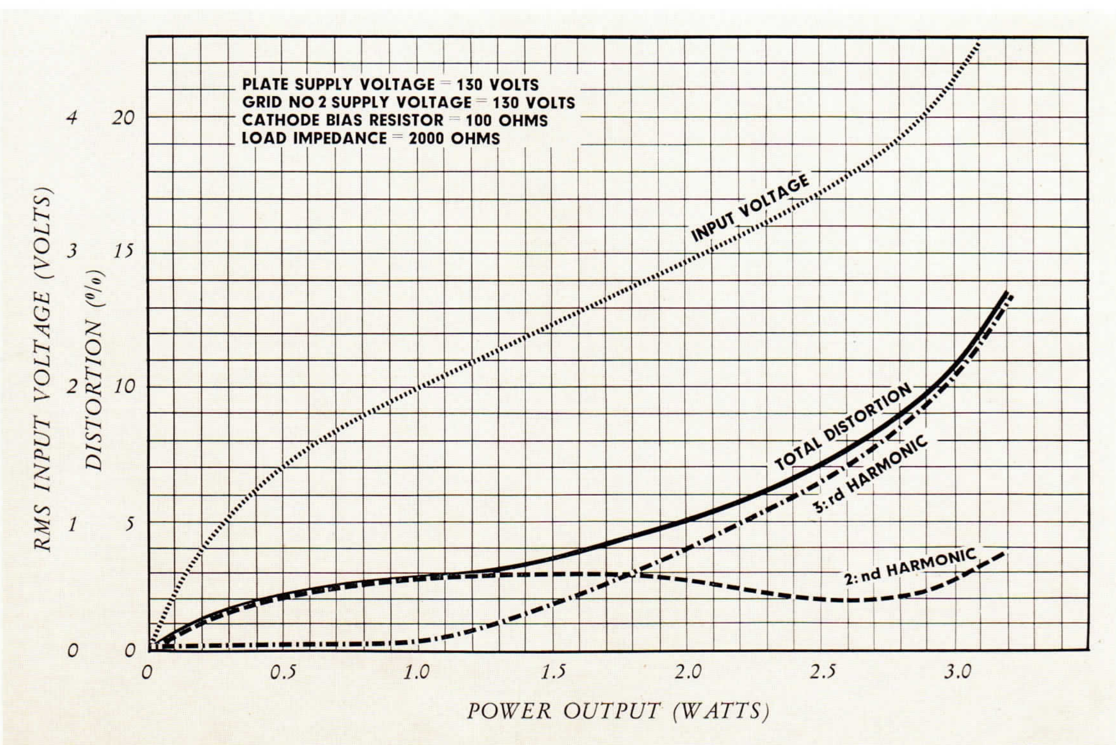
Heater Voltage		6.3		volts
Plate Supply Voltage		130		volts
Grid No 2 Supply Voltage		130		volts
Cathode Bias Resistor		100		ohms
	MIN	AVE	MAX	
Heater Current	900	1000	1100	ma
Plate Current	56	70	84	ma
Grid No 2 Current		3.5	7	ma
Transconductance	11,000	13,000	15,000	μmhos
Transconductance, End of Life Point	8500			μmhos
I_{hk} at E_{hk} = ± 100 volts			50	μa
Grid No 1 Current			−1.0	μa
Cutoff Plate Current at E_{c1} = — 25 volts			100	μa

Edition 1

POWER AMPLIFIER PENTODE 6761

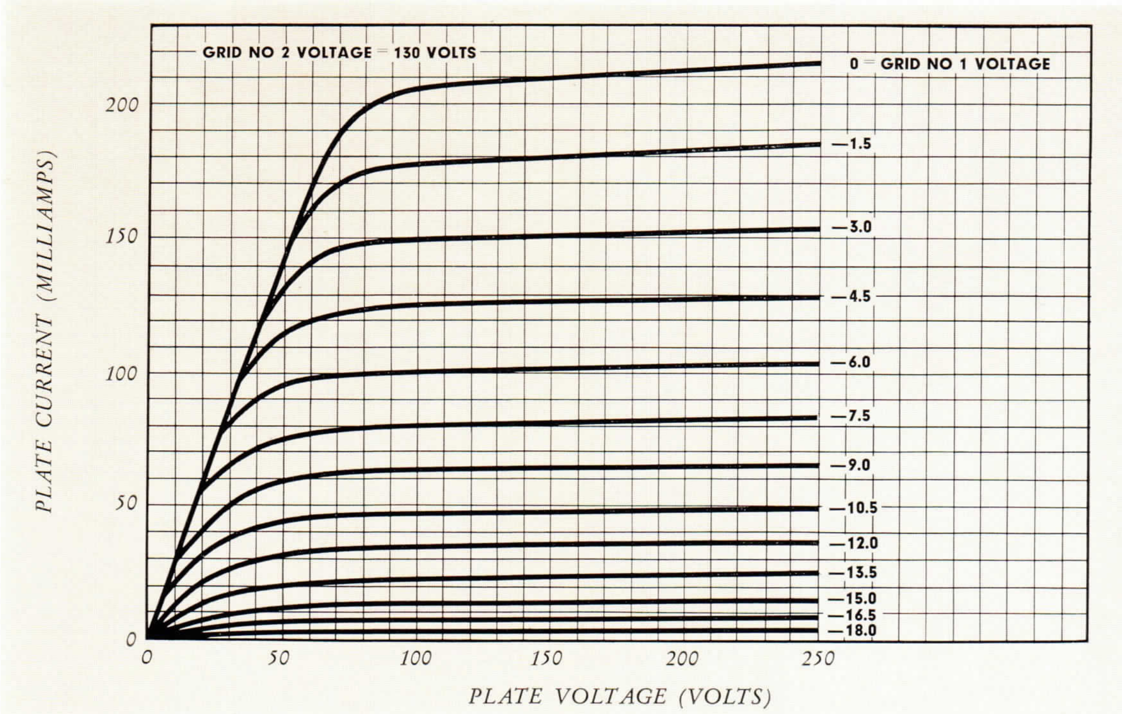
AVERAGE CHARACTERISTICS

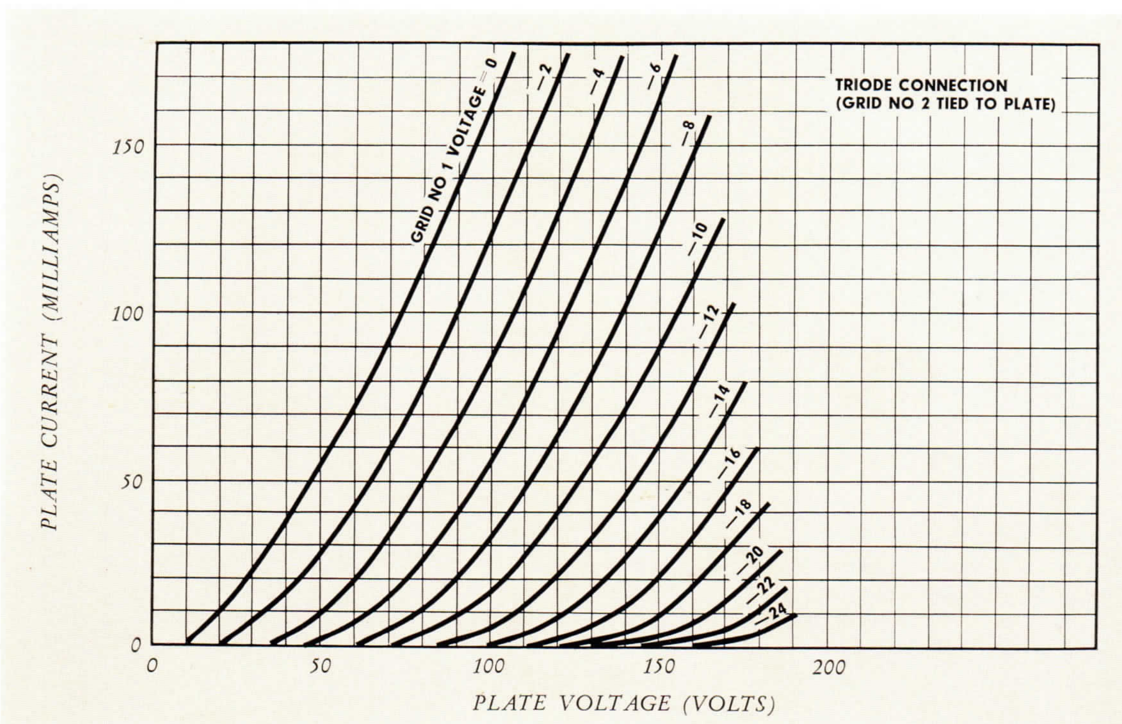




6761 POWER AMPLIFIER PENTODE

AVERAGE CHARACTERISTICS





6928
6AQ5L

POWER AMPLIFIER PENTODE

For medium power applications where very long life and low failure rate is desired. Designed especially for dependable service.

COLD CAPACITANCES (external shield connected to cathode)

	MIN	AVE	MAX	
Grid No 1 to Plate		.35	.5	μμF
Input	6.4	8.0	9.6	μμF
Output	8.8	11.0	13.2	μμF

COLD CAPACITANCES (without external shield)

Grid No 1 to Plate	.6	μμF
Input	7.6	μμF
Output	6.0	μμF

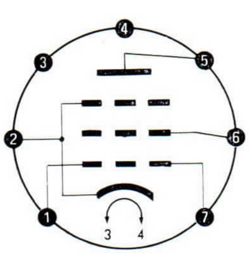
ABSOLUTE MAXIMUM RATINGS

Plate Voltage	220	volts
Grid No 2 Voltage	220	volts
Grid No 1 Voltage, positive value	+ 10	volts
Grid No 1 Voltage, negative value	— 55	volts
Cathode Current	55	ma
Plate Dissipation	9	watts
Grid No 2 Dissipation (see Section A)	1.1	watt
Heater — Cathode Voltage	100	volts
Bulb Temperature, at hottest point	220	°C
Grid No 1 Circuit Resistance		
with fixed bias	.1	Mohm
with cathode bias	.5	Mohm

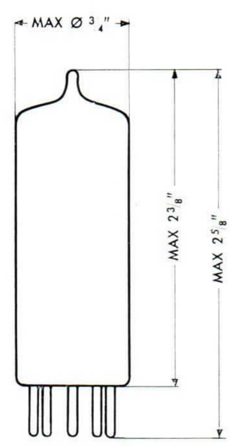
MECHANICAL DATA

Base: Small Button Miniature 7-pin, RETMA E7-1
Bulb: EIA T 5½
Mounting Position: Any

PIN NO.	CONNECTED TO
1.	Grid No 1
2.	Cathode, Grid No 3
3.	Heater
4.	Heater
5.	Plate
6.	Grid No 2
7.	Grid No 1



BOTTOM VIEW



6928 / 6AQ5L POWER AMPLIFIER PENTODE

Ericsson LM

TYPICAL OPERATION. CLASS A1

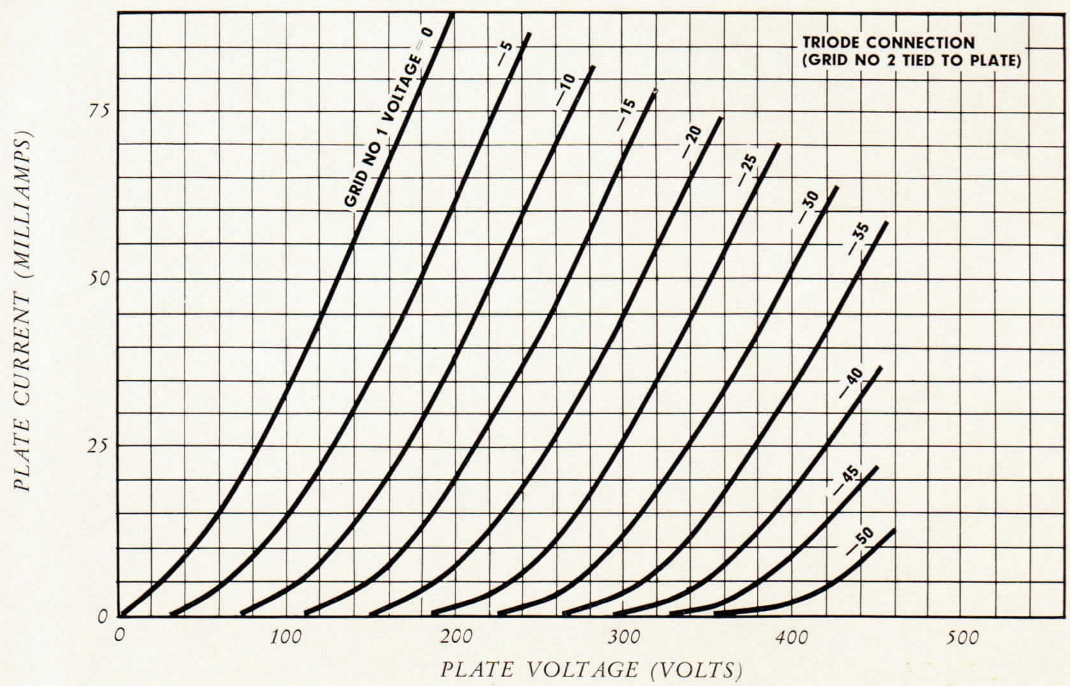
Heater Voltage	6.3	6.3	volts
Heater Current	.36	.36	amp
Plate Supply Voltage	130	180	volts
Grid No 2 Supply Voltage	130	180	volts
Cathode Bias Resistor	200	220	ohms
Plate Current	23	32.5	ma
Grid No 2 Current	2	3	ma
Transconductance	3400	3900	μmhos
Plate Resistance	.08	.08	Mohm
Load Resistance	6000	8000	ohms
Power Output	1.0	2.1	watts
Total Harmonic Distortion	7	8	%
Amplification Factor Grid No 2 to 1	10	10	

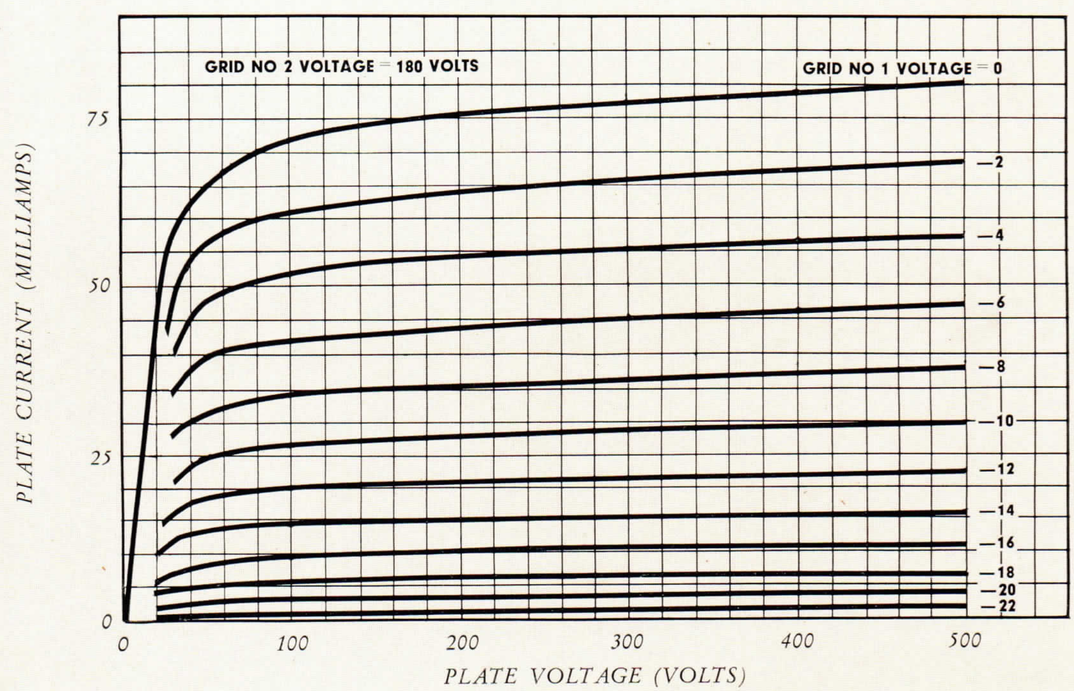
OPERATION RANGE VALUES

Heater Voltage		6.3		volts
Plate Supply Voltage		130		volts
Grid No 2 Supply Voltage		130		volts
Cathode Bias Resistor		200		ohms
	MIN	AVE	MAX	
Heater Current	320	360	400	ma
Plate Current	16	23	30	ma
Grid No 2 Current			5.5	ma
Transconductance	2600	3400	4200	μmhos
Transconductance, End of Life Point	2200			μmhos
I_{hk} at $E_{hk} = \pm 100$ volts			50	μa
Grid No 1 Current			–.1	μa
Cutoff Plate Current at $E_{c1} = -40$ volts			200	μa

Edition 1

AVERAGE CHARACTERISTICS

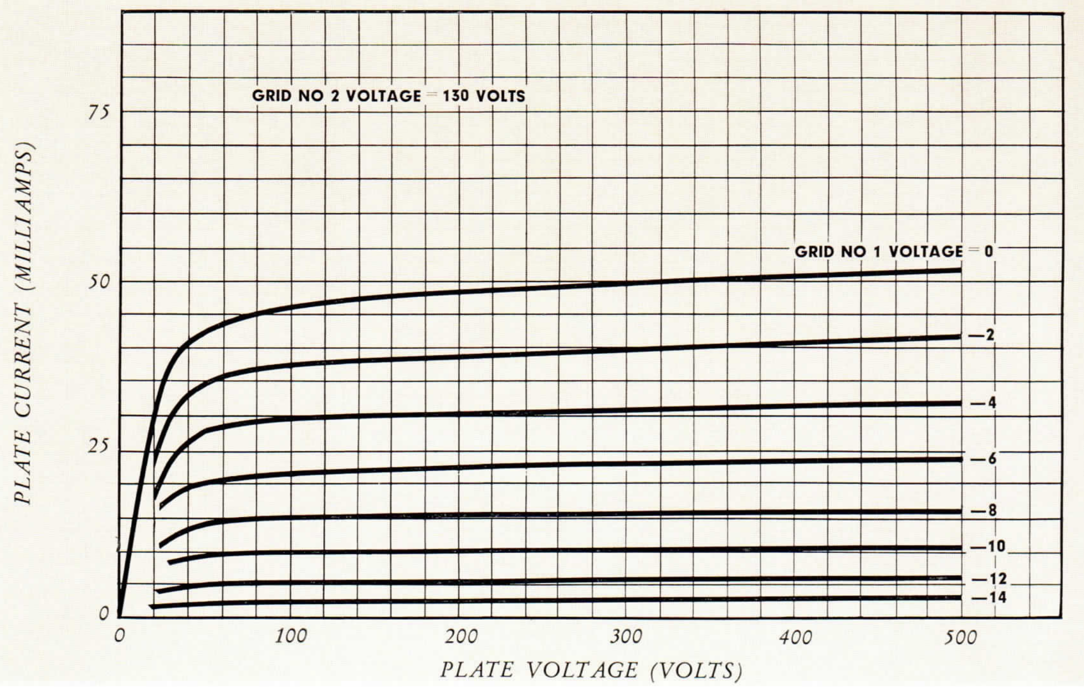


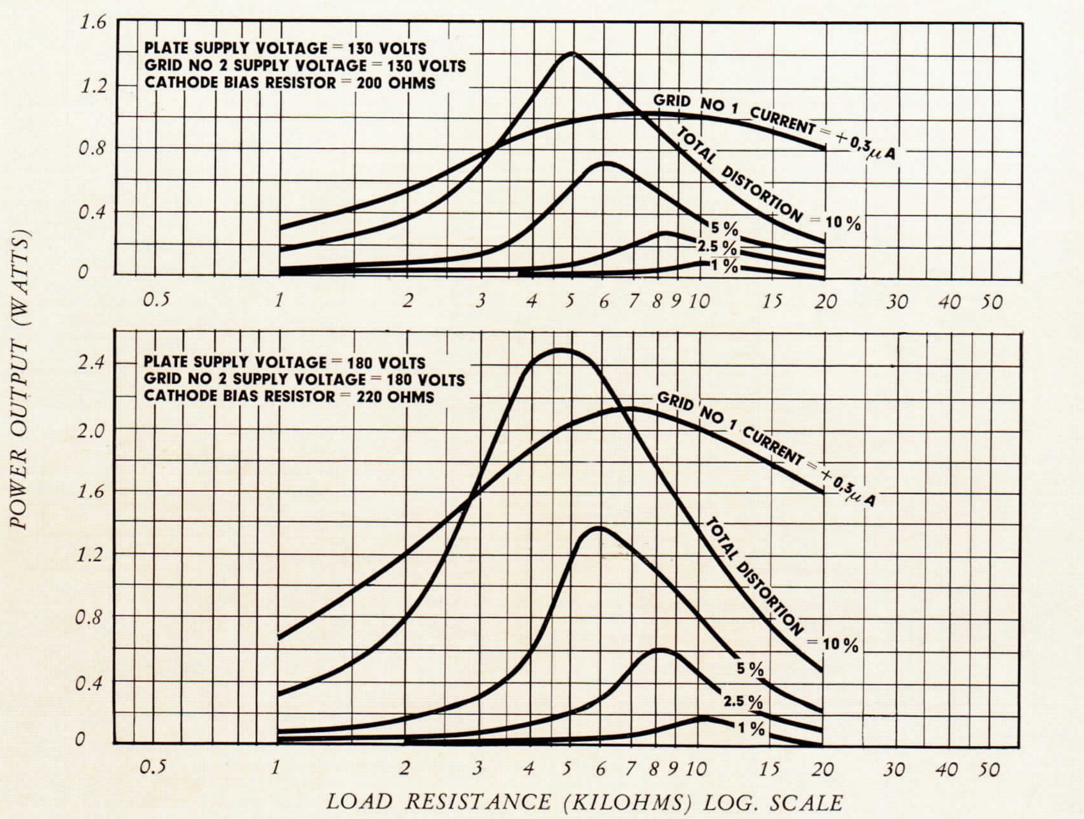


6928
6AQ5L
POWER AMPLIFIER PENTODE

Ericsson LM

AVERAGE CHARACTERISTICS





Edition 1

TETRODE AMPLIFIER 7150

Intended for use in broadband amplifiers from audio frequencies up to about 300 Mc. Pentodelike characteristics render the 7150 very useful in output stages. When triode-connected it is very suitable as a low-noise amplifier in input stages. Low capacitance between plate and cathode make it particularly useful in grounded grid circuits.

The frame grid, described in Section A, with lateral wire diameter of only .0065 mm provides high broadband qualities and freedom from microphonics. The figure of merit is outstanding, especially at intermediate frequencies owing to the low output capacitance.

Compact construction and triple cathode leads provide small transit time loading and low cathode lead inductance. Because of this input conductance is low — approximately 1100 μmhos at 70 Mc.

ABSOLUTE MAXIMUM RATINGS

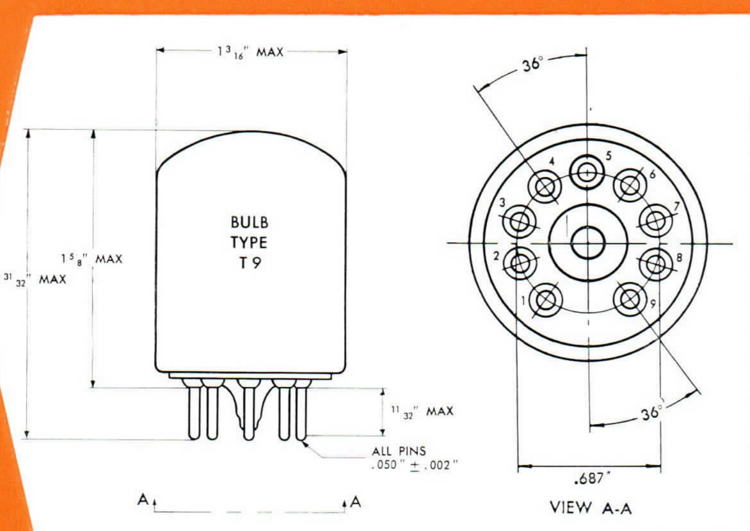
Plate Voltage	165	volts
Grid No 2 Voltage	165	volts
Grid No 1 Voltage, positive value	+ 0	volts
Grid No 1 Voltage, negative value	— 25	volts
Cathode Current	55	ma
Plate Dissipation	4.5	watts
Grid No 2 Dissipation (see Section A)	1.65	watts
[Plate + Grid No 2] Dissipation (Grid No 2 connected to Plate)	5.5	watts
Heater — Cathode Voltage	55	volts
Bulb Temperature, at hottest point	140	°C
Grid No 1 Circuit Resistance		
with fixed bias	.05	Mohm
with cathode bias	.1	Mohm

MECHANICAL DATA

Base: 9-pin, as per drawing
Bulb: EIA T 9
Mounting Position: Any

PIN NO.	CONNECTED TO
1.	Plate
2.	Heater
3.	Cathode
4.	Grid No 1
5.	Heater, Internal Shield*
6.	Cathode
7.	Cathode
8.	No Connection
9.	Grid No 2

* The internal shield connected to Pin No 5 should be grounded as there is a direct flow of electrons from the cathode to the shield when the latter is positive in relation to the cathode.



7150 TETRODE AMPLIFIER

TETRODE CHARACTERISTICS

COLD CAPACITANCES (without external shield)

Grid No 1 to Plate	.03	μμF
Input	16	μμF
Output	2	μμF

TYPICAL OPERATION. CLASS A1

Heater Voltage	6.3	6.3	volts
Heater Current	.45	.45	amp
Plate Supply Voltage	135	125	volts
Grid No 2 Supply Voltage	135	125	volts
Grid No 1 Supply Voltage	+ 8		volts
Cathode Bias Resistor	260	45	ohms
Plate Current	27.5	24	ma
Grid No 2 Current	8.5	7.5	ma
Transconductance	35,800	34,000	μmhos
Plate Resistance, approx.	.03	.03	Mohm
Equivalent Noise Resistance	160	160	ohms
Transit Time Loading at 100 Mc	200	200	μmhos
Input Conductance at 100 Mc	2200	2200	μmhos

FIGURE OF MERIT

	Tube Cold	*Typical operation**
At LF without external shield $\frac{g_m}{C_{in} + C_{out}}$	1.9—2.0	1.0—1.1
At IF without external shield $\frac{g_m}{\sqrt{C_{in} \cdot C_{out}}}$	6.0—6.3	2.9—3.0

* The following additions have been made for tube sockets and wiring capacitances to get total circuit capacitances under typical operating conditions:
At LF — 8 μμF. At IF — 5 μμF for input circuit and 3 μμF for output circuit.

OPERATION RANGE VALUES

Heater Voltage		6.3		volts
Plate Supply Voltage		125		volts
Grid No 2 Supply Voltage		125		volts
Cathode Bias Resistor		45		ohms
	MIN	AVE	MAX	
Heater Current	410	450	490	ma
Plate Current	20	24	30	ma
Grid No 2 Current		7.5	13	ma
Transconductance	28,000	34,000	40,000	μmhos
Transconductance, End of Life Point	22,000			μmhos
I_{hk} at $E_{hk} = \pm$ 100 volts			20	μa
Grid No 1 Current			–.2	μa
Cutoff Plate Current at $E_{c1} = -5$ volts			100	μa

Edition 1

TETRODE AMPLIFIER 7150

TRIODE CHARACTERISTICS*
(Grounded Grid Operation)

COLD CAPACITANCES (without external shield)

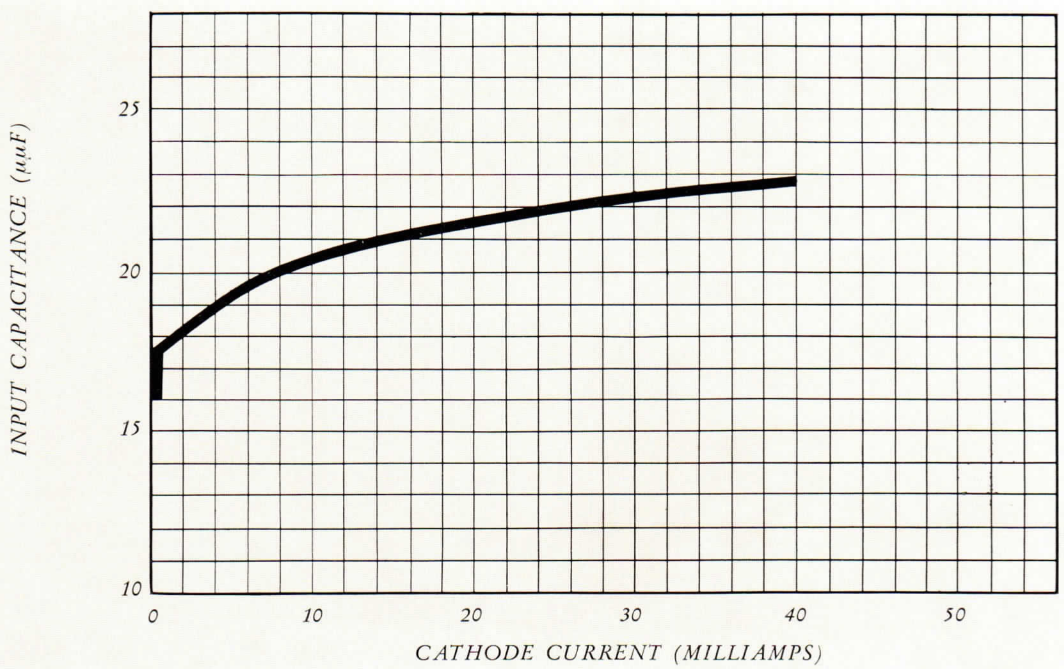
Plate and Grid No 2 to Cathode	.6	μμF
Input (Cathode to Grid, Heater, Int. Shield)	18	μμF
Output (Plate and Grid No 2 to Grid, Heater, Int. Shield)	7	μμF

TYPICAL OPERATION. CLASS A_1

Heater Voltage	6.3	volts
Heater Current	.45	amp
Plate Supply Voltage	125	volts
Cathode Bias Resistor	33	ohms
Plate Current	35	ma
Transconductance	47,000	μmhos
Amplification Factor	35	
Equivalent Noise Resistance	60	ohms

* Grid No 2 connected to Plate.

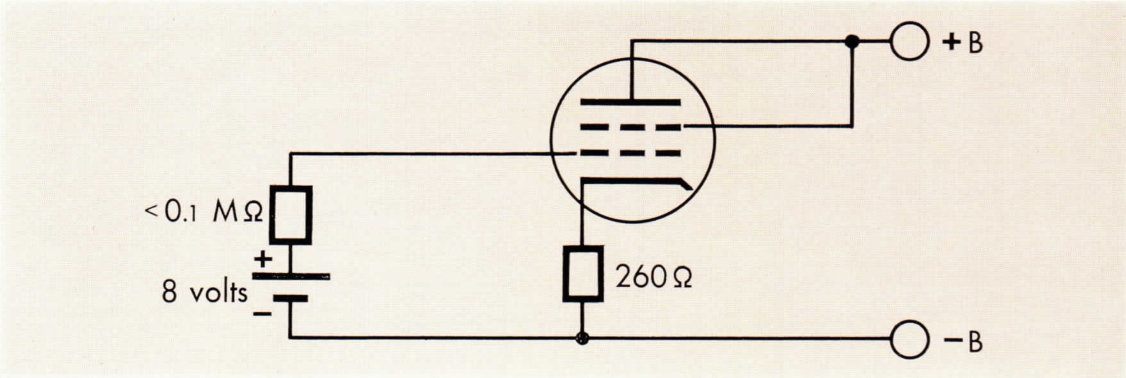
SPECIAL DATA



CAPACITANCES IN OPERATION:

Space-charge effects in electron current flow cause an increase in tube capacitances. Input capacitance as a function of cathode current is shown above.
For best value of figure of merit external shield should be excluded.

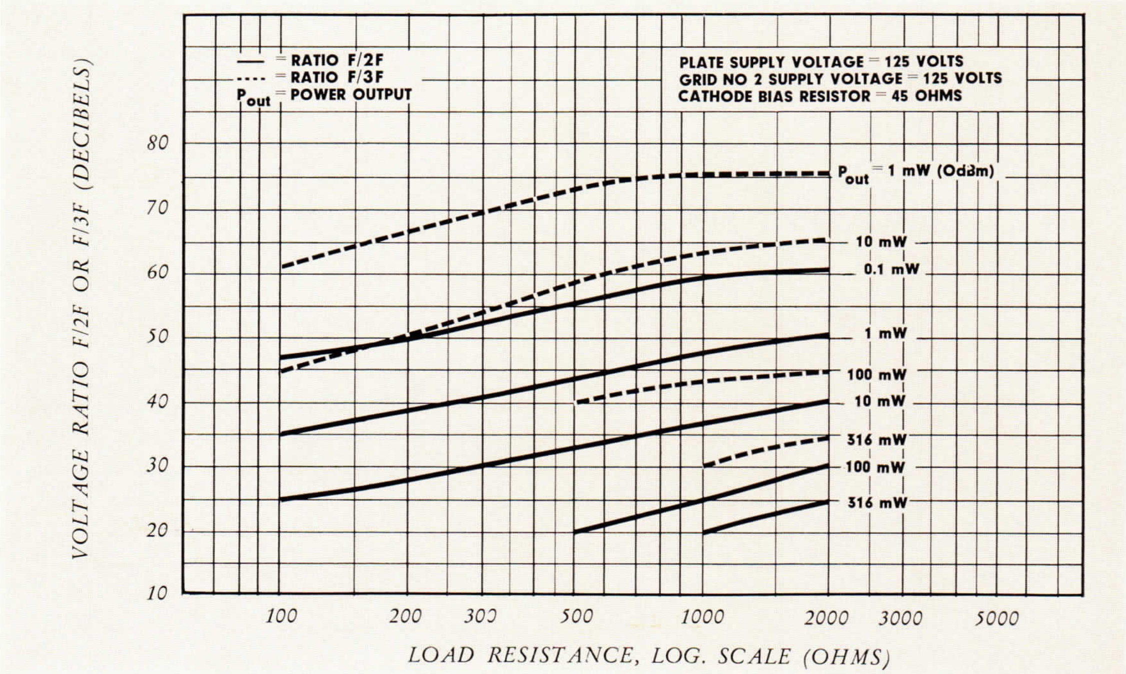
7150 TETRODE AMPLIFIER



BIAS CONSIDERATIONS:

The operating characteristics of high transconductance tubes are sensitive to variations in manufacture. Because of this the use of a 260 ohm cathode resistance, in conjunction with a DC control grid return to a + 8.0 volt supply, is recommended.

To prevent burning out grid wires by removal of plate voltage when the + 8.0 volt bias is still applied, a limiting resistor of 10,000 ohms in series with the bias supply is suggested. Where the use of such a resistor is not practical, care should be taken to see that the grid bias is not applied before the plate and grid No 2 voltages.

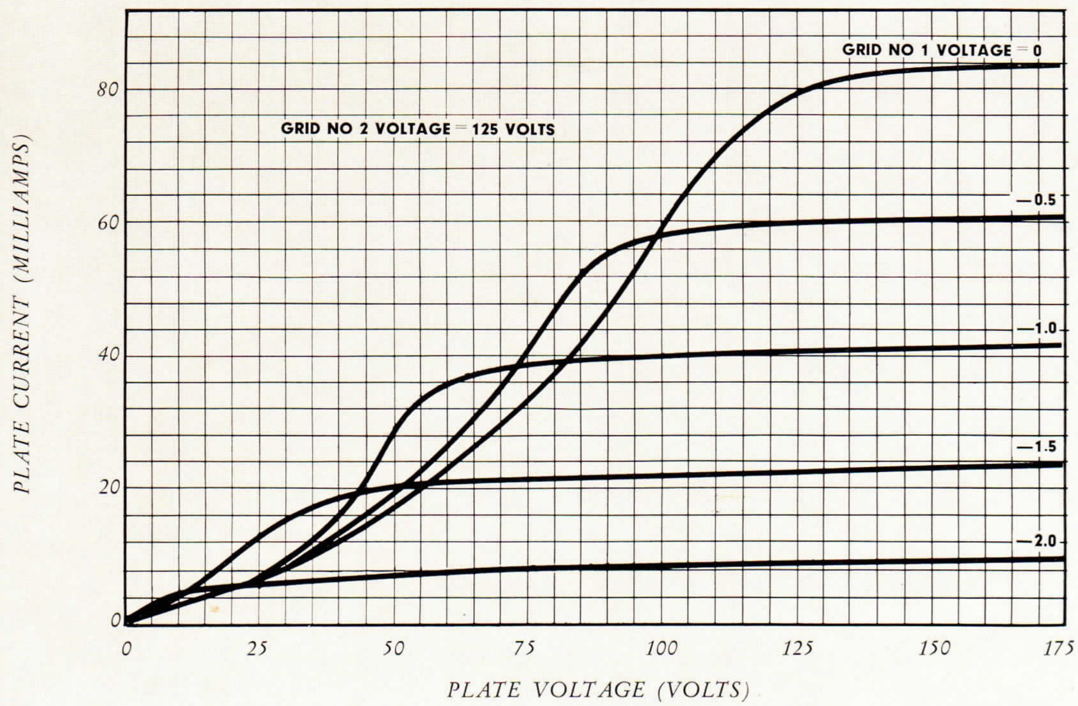


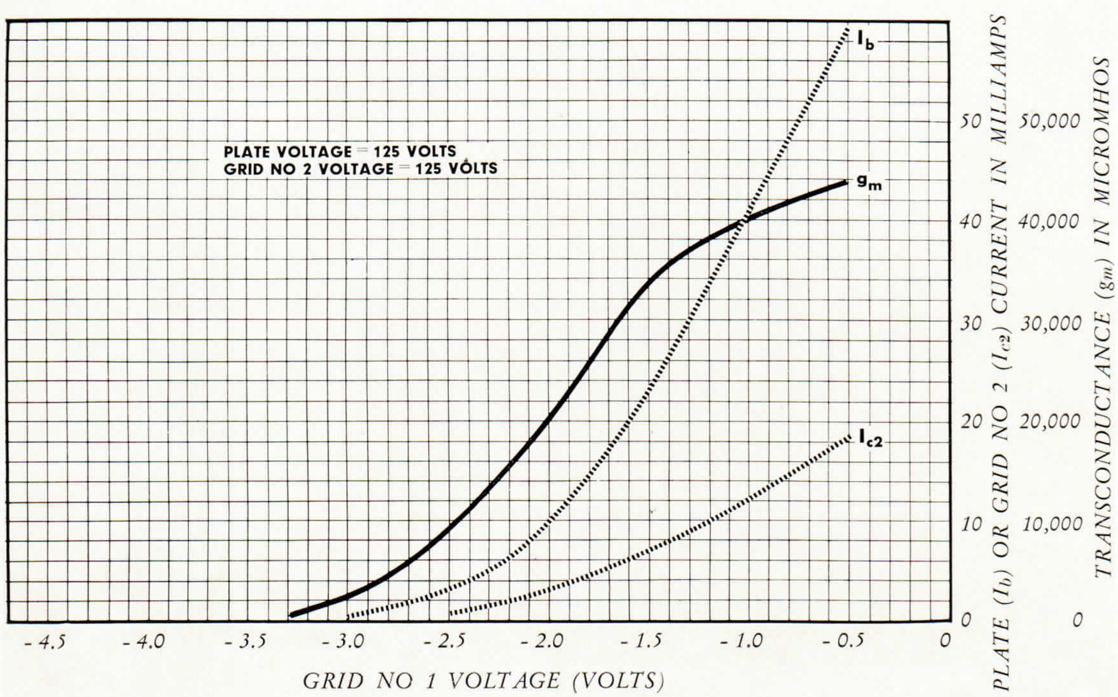
HARMONIC DISTORTION:

The voltage ratio between fundamental frequency (F), second harmonic (2F) and third harmonic (3F) as a function of the load resistance at different power outputs under typical operating conditions is shown.

Edition 1

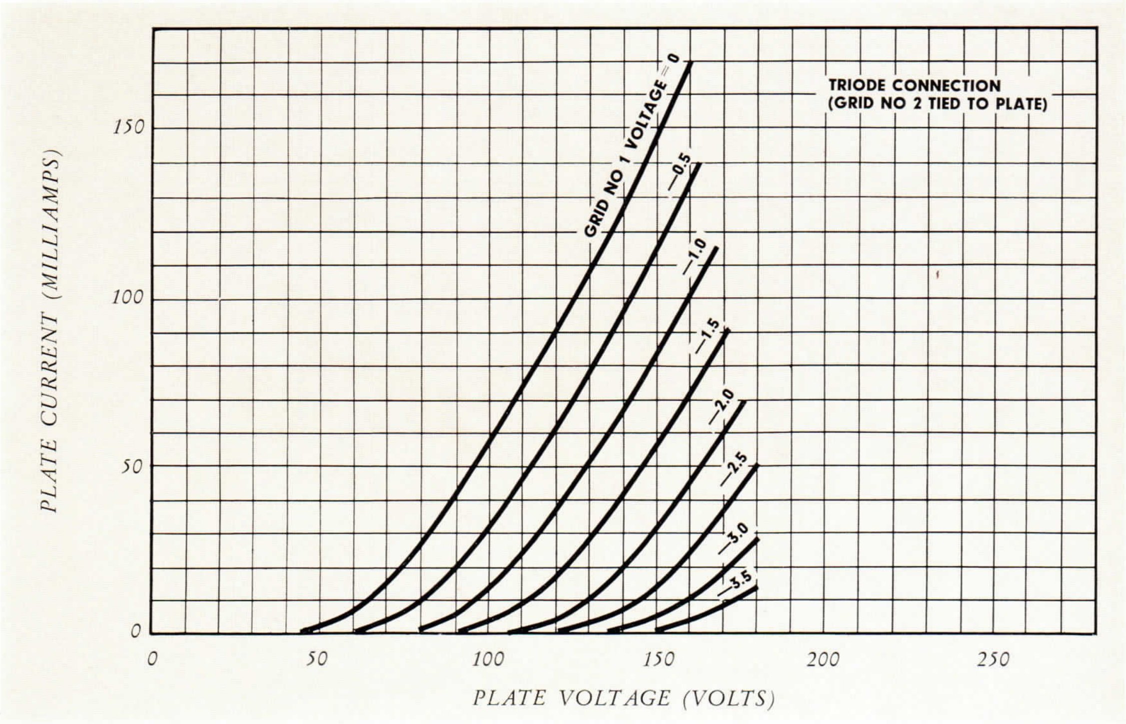
AVERAGE CHARACTERISTICS





7150 TETRODE AMPLIFIER

AVERAGE CHARACTERISTICS



Edition 1

BROADBAND PENTODE 7721

D3a

Broadband amplifier beam pentode with low noise and extremely high transconductance. The tube features very low input conductance and outstanding gain-bandwidth product.

CAPACITANCES (without external shield)

Grid No 1 to Plate, cold tube	max. .035	μμF
Input, cold tube	10±1	μμF
Input, 28 ma Cathode Current	17	μμF
Output, cold tube	2±.3	μμF

ABSOLUTE MAXIMUM RATINGS

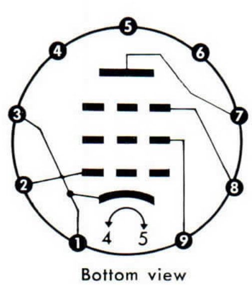
Plate Voltage, peak (intermittent operation)	400	volts
Grid No 2 Voltage, peak (intermittent operation)	400	volts
Plate Voltage, DC	220	volts
Grid No 2 Voltage, DC	180	volts
Beam Plate Voltage, DC	0	volt
Grid No 1 Voltage, positive value	0	volt
Grid No 1 Voltage, negative value	10	volts
Plate Dissipation	4.5	watts
Grid No 2 Dissipation	1.1	watt
Cathode Current	33	ma
Grid No 1 Circuit Resistance, cathode bias	.5	Mohm
Heater — Cathode Voltage	60	volts
Heater — Cathode Resistance, external*	.02	Mohm
Bulb Temperature, at hottest point	170	°C

* The maximum value is recommended in order to avoid influence on the operating conditions by the leakage between heater and cathode.

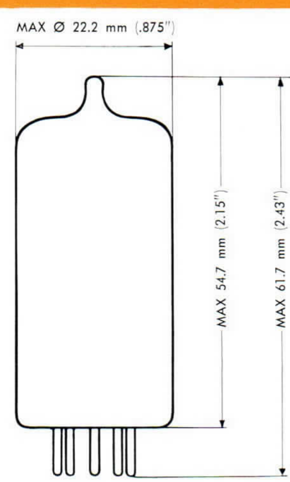
MECHANICAL DATA

Base: Small Button Noval 9-pin, RETMA E9-1
Bulb: EIA T 6½
Mounting Position: Any

PIN NO	CONNECTED TO
1.	Cathode
2.	Grid No 1
3.	Cathode
4.	Heater
5.	Heater
6.	Do not connect
7.	Plate
8.	Beam Plates, Internal Shield
9.	Grid No 2



Bottom view



Pins are goldplated

7721 BROADBAND PENTODE

D3a

Ericsson LM

TYPICAL OPERATION. CLASS A1

Heater Voltage	6.3	volts
Heater Current	.32	amp
Plate Supply Voltage	190	volts
Beam Plate Voltage	0	volt
Grid No 2 Supply Voltage	160	volts
Grid No 1 Supply Voltage	+ 10	volts
Cathode Bias Resistor	400	ohms
Plate Current	22	ma
Grid No 2 Current	6	ma
Transconductance	35,000	μmhos
Plate Resistance	.12	Mohm
Amplification Factor Grid No 2 to 1	85	
Equivalent Noise Resistance	150	ohms
Input Conductance at 100 Mc	1000	μmhos

GAIN-BANDWIDTH PRODUCT

	Tube Cold	Typical operation*	
At LF $\frac{g_m}{2\pi \quad (C_{in}+C_{out})}$	464	232	Mc
At IF $\frac{g_m}{2\pi \sqrt{C_{in} \cdot C_{out}}}$	1246	623	Mc

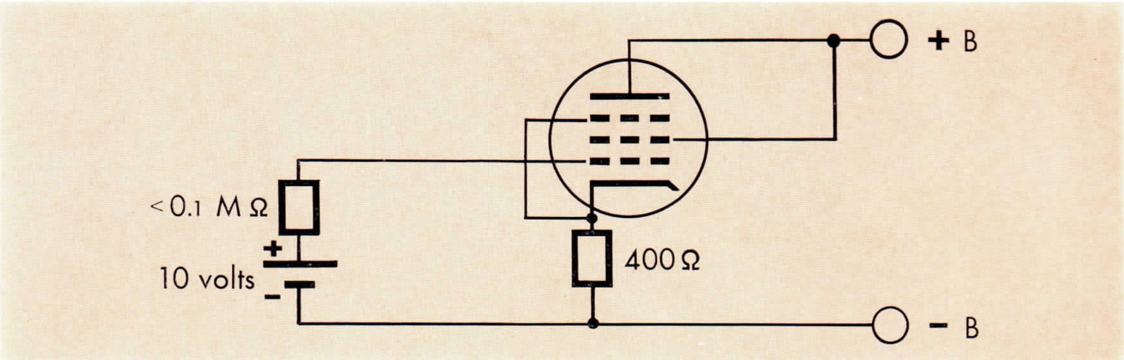
* The following additions have been made for tube sockets and wiring capacitances to get total circuit capacitances under typical operating conditions:
At LF — 5 μμF.
At IF — 3 μμF for input circuit and 2 μμF for output circuit.

OPERATION RANGE VALUES

	MIN	AVE	MAX	
Heater Voltage		6.3		volts
Plate Supply Voltage		190		volts
Grid No 2 Supply Voltage		160		volts
Grid No 1 Supply Voltage		+ 10		volts
Cathode Bias Resistor		400		ohms
Heater Current	300	320	340	ma
Plate Current	21	22	23	ma
Grid No 2 Current	5	6	7	ma
Transconductance	30,000	35,000	40,000	μmhos
Transconductance, End of Life Point	24,000			μmhos
Grid No 1 Current			— .5	μa
I_{hk} at E_{hk} = ± 100 volts			20	μa

Printed in Sweden
GRAFISK REKLAM/RELIEFTRYCK AB STHLM 1963

Tentative Data 3/63 Edition 1

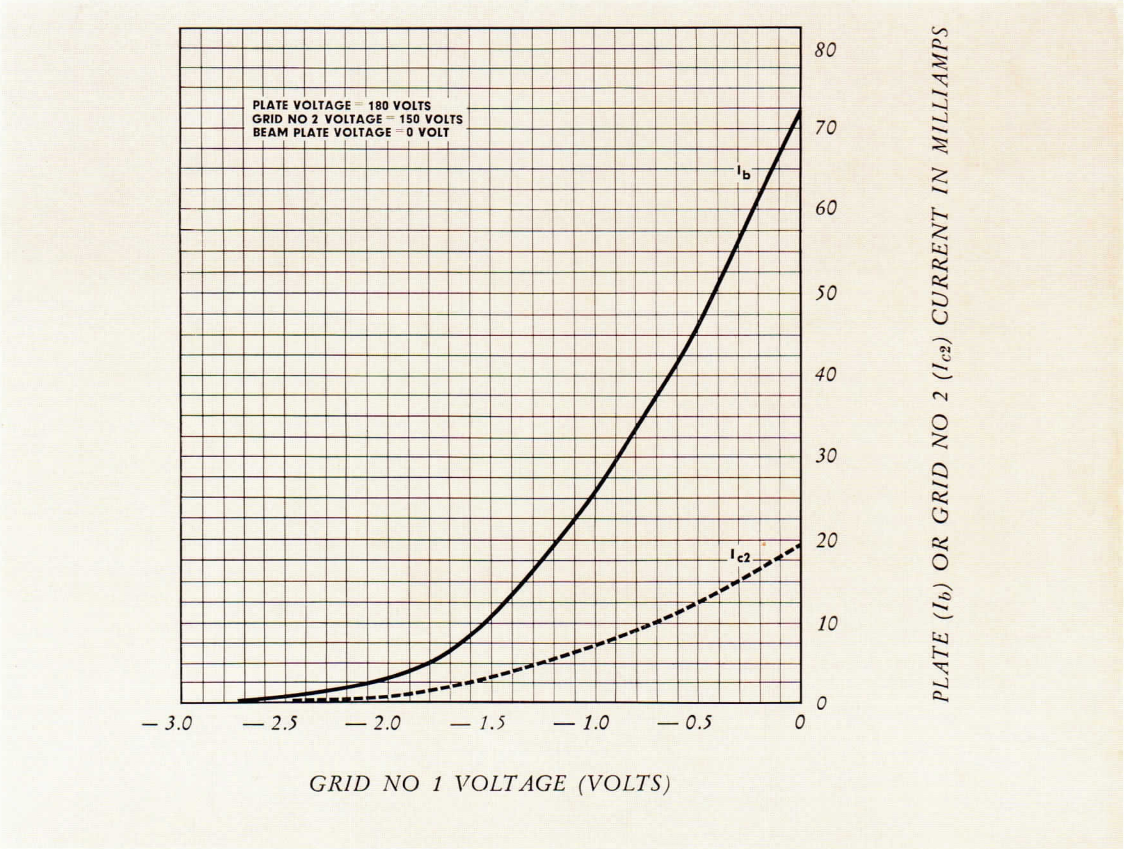


BIAS CONSIDERATIONS:

The use of a 400 ohms cathode resistance, in conjunction with a DC control grid return to a + 10 volt supply is recommended.

To prevent burning out grid wires by removal of plate and/or grid No 2 voltage when the + 10 volt bias is still applied, a limiting resistor of 10,000 ohms in series with the bias supply is suggested. Where the use of such a resistor is not practical, care should be taken to see that the grid bias is not applied before the plate or grid No 2 voltage.

AVERAGE CHARACTERISTICS

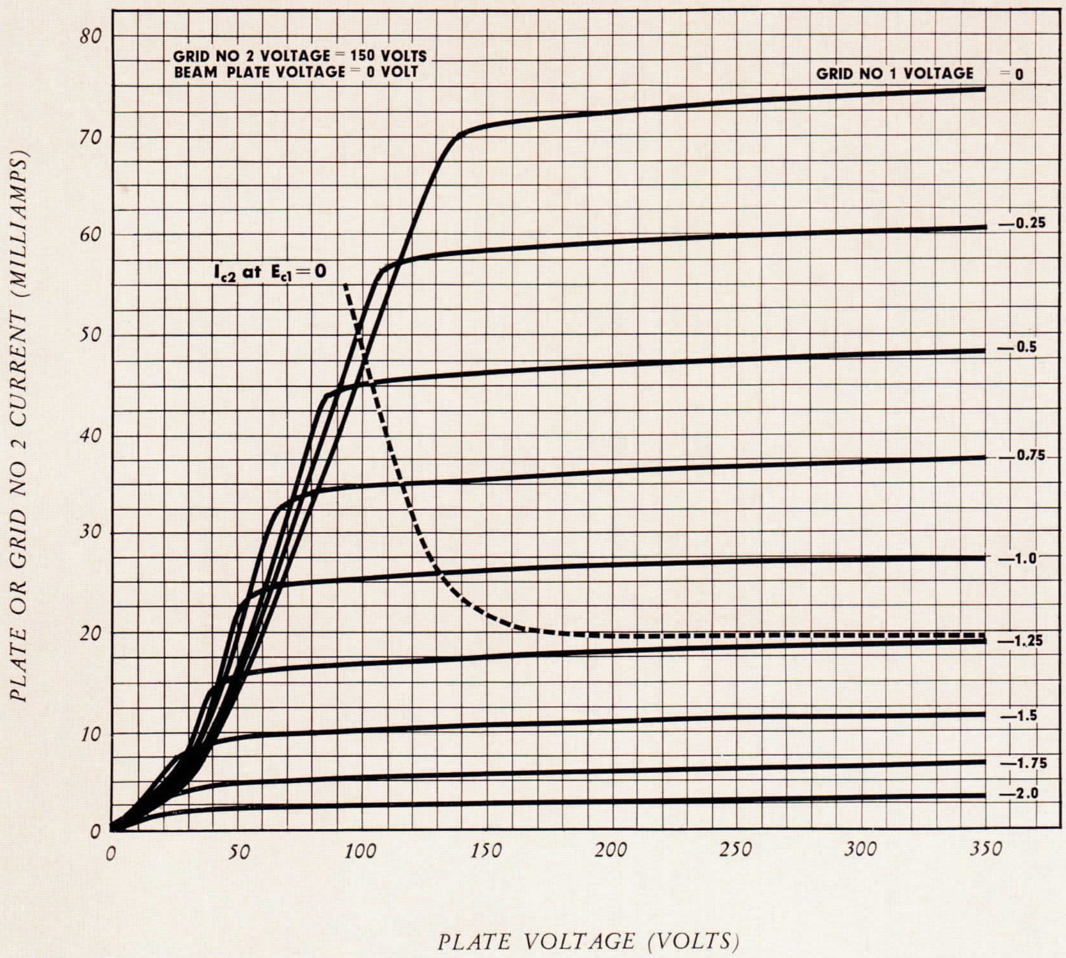


7721

D3a

BROADBAND PENTODE

AVERAGE CHARACTERISTICS



Printed in Sweden
GRAFISK REKLAM/RELIEFTRYCK AB STHLM 1963

RF AMPLIFIER TETRODE

6CY5
CATV

6CY5/CATV is an especially developed longlife version of 6CY5. It is a sharp-cutoff tetrode of 7-pin miniature type, intended for reliable service within the wide range of amplifiers and other equipment used for CATV purposes.

COLD CAPACITANCES (external shield connected to cathode)

Grid No 1 to Plate	0.03	μμF
Input	4.5	μμF
Output	3.0	μμF

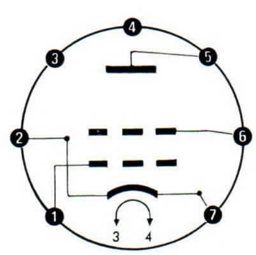
ABSOLUTE MAXIMUM RATINGS

Plate Voltage	200	volts
Grid No 2 Voltage	200	volts
Grid No 1 Voltage, Positive Value	5	volts
Grid No 1 Voltage, Negative Value	50	volts
Plate Dissipation	2.2	watts
Grid No 2 Dissipation (see Section A)	0.55	watt
Cathode Current	22	ma
Heater-Cathode Voltage	100	volts
Grid No 1 Circuit Resistance	0.5	megohm

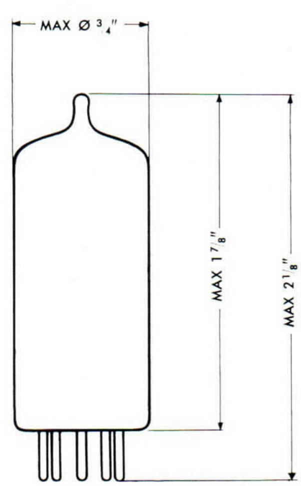
MECHANICAL DATA

Base: Small Button Miniature 7-pin, RETMA E7-1
Bulb: EIA T 5½
Mounting Position: Any

PIN NO.	CONNECTED TO
1.	Grid No 1
2.	Cathode, Int. Shield
3.	Heater
4.	Heater
5.	Plate
6.	Grid No 2
7.	Cathode, Int. Shield



BOTTOM VIEW



6CY5 CATV

RF AMPLIFIER TETRODE

TYPICAL OPERATION

Heater Voltage**	6.3	volts
Heater Current	200	ma
Plate Voltage	125	volts
Grid No 2 Voltage	80	volts
Grid No 1 Voltage	— 1	volt
Plate Current	10	ma
Grid No 2 Current	1.5	ma
Transconductance	8000	μmhos
Plate Resistance	0.1	Mohm
Grid No 1 Voltage for I_b = 20 μA	— 6	volts

OPERATION RANGE VALUES

Heater Voltage		6.3		volts
Plate Supply Voltage		125		volts
Grid No 2 Supply Voltage		80		volts
Grid No 1 Voltage*		— 1		volts
	MIN	AVE	MAX	
Heater Current	185	200	215	ma
Plate Current	6.5	10.0	16.0	ma
Grid No 2 Current		1.5	2.5	ma
Transconductance	6300	8000	10200	μmhos
Transconductance, End of Life Point	5200			μmhos
I_{hk} at E_{hk} = ± 100 volts			20	μa
Grid No 1 Current			— .5	μa
Measured at E_b = 125 V				
E_{c2} = 125 V E_{c1} = — 1,5 V				
R_{g1} = 0,5 Mohms				
Cutoff Plate Current at E_{c1} = — 6 volts			200	μa

Edition 1
Printed in Sweden
GRAFISK REKLAM/RELIEFTRYCK AB STHLM 66

RF AMPLIFIER TETRODE

6EV5
CATV

6EV5/CATV is an especially developed longlife version of 6EV5. It is a sharp-cutoff tetrode of 7-pin miniature type, intended for reliable service within the wide range of amplifiers and other equipment used for CATV purposes.

COLD CAPACITANCES (external shield connected to cathode)

Grid No 1 to Plate	0.025	μμF
Input	4.4	μμF
Output	2.6	μμF

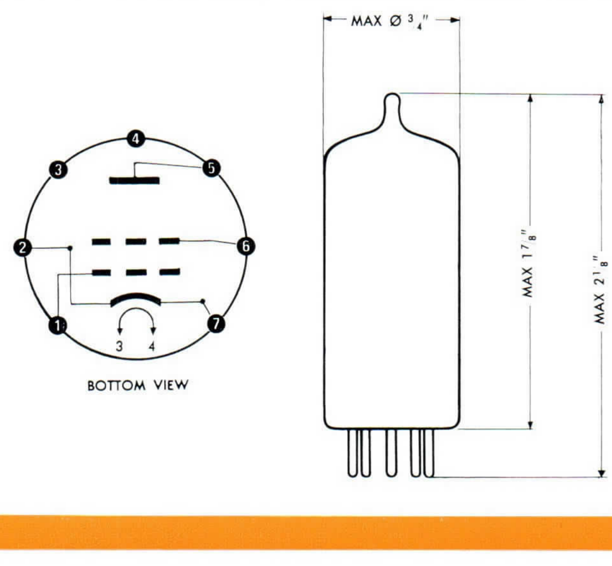
ABSOLUTE MAXIMUM RATINGS

Plate Voltage	300	volts
Grid No 2 Voltage	200	volts
Grid No 1 Voltage, Positive Value	5	volts
Grid No 1 Voltage, Negative Value	50	volts
Plate Dissipation	3.5	watts
Grid No 2 Dissipation (see Section A)	0.25	watt
Cathode Current	22	ma
Heater-Cathode Voltage	100	volts
Grid No 1 Circuit Resistance	0.5	megohm

MECHANICAL DATA

Base: Small Button Miniature 7-pin, RETMA E7-1
Bulb: EIA T 5½
Mounting Position: Any

PIN NO.	CONNECTED TO
1.	Grid No 1
2.	Cathode, Int. Shield
3.	Heater
4.	Heater
5.	Plate
6.	Grid No 2
7.	Cathode, Int. Shield



6EV5 CATV

RF AMPLIFIER TETRODE

Ericsson LM

TYPICAL OPERATION

Heater Voltage	6.3	volts
Heater Current	200	ma
Plate Voltage	250	volts
Grid No 2 Voltage	80	volts
Grid No 1 Voltage	— 1	volt
Plate Current	11.5	ma
Grid No 2 Current	0.9	ma
Transconductance	8800	μmhos
Plate Resistance	0.15	Mohm
Grid No 1 Voltage for Gm = 100 μmhos	— 4.5	volts

OPERATION RANGE VALUES

Heater Voltage		6.3		volts
Plate Supply Voltage		250		volts
Grid No 2 Supply Voltage		80		volts
Grid No 1 Voltage		— 1		volts
	MIN	AVE	MAX	
Heater Current	185	200	215	ma
Plate Curren	8.0	11.5	14.0	ma
Grid No 2 Current		0.9	1.8	ma
Transconductance	7000	8800	11000	μmhos
Transconductance, End of Life Point	5750			μmhos
I_{hk} at E_{hk} = ± 100 volts			20	μa
Grid No 1 Current			— .5	μa
Cutoff Plate Current at E_{c1} = — 6 volts			200	μa

Edition 1
Printed in Sweden
GRAFISK REKLAM / RELIEFTRYCK AB, STHLM 67

C

THE SUPERIOR LIFETIME **that extra plus**

INDIVIDUAL TUBE WARRANTY —

YOU BUY WITH CONFIDENCE.

All LM Ericsson longlife tubes are covered
by an INDIVIDUAL service life warranty.
For most tube types this individual service life warranty
is 10,000 hours.
For complete wording of the warranty refer to Section **D**

LONGLIFE TUBE WARRANTY

GENERAL INFORMATION

LM Ericsson earnestly desire that customers receive satisfactory service from LM Ericsson tubes.

Since defects are not always discernible at the time of manufacture the following warranties have been established allowing reasonable time for the appearance of latent defects.

The stated warranty periods should not be construed as indication of tube life, since, under normal operating conditions average life expectancies exceed warranty periods.

The liability of LM Ericsson under these warranties is limited to replacing, or issuing credit for (at the discretion of LM Ericsson) such tubes as become defective during the warranty periods. No liability is taken for consequential damage.

Adjustment is allowable under these warranties only when claim is presented in accordance with the "Adjustment Procedure".

Final determination as to whether a tube is subject to adjustment rests with AB Svenska Elektronrör, the LM Ericsson tube subsidiary.

These warranties are in lieu of any other warranty or liability whether expressed, implied or statutory and do not extend to any tubes which have been subjected to misuse, abuse, neglect, accident, improper installation or application, or alteration or negligence in use, storage, transportation or handling. Regarding the use and testing of longlife tubes, reference is made to page A6—A10.

To determine which of the following warranties applies to a specific tube type, consult the "Warranty Class Guide".

CLASS A — LONGLIFE TUBE WARRANTY

The tube is warranted against defects in workmanship and materials when used within stated ratings. If such defects appear, full adjustment will be made for failures within 1000 hours of service. For failure after 1000 hours of service, pro rata adjustment will be made based upon the difference between the hours of service at failure and 10,000 hours. No adjustment will be allowed if service exceeds 10,000 hours. Adjustment period expires 24 months from date tube was first placed in service, or 30 months from date tube was shipped by an LM Ericsson Sales Company or Representative, whichever occurs first.

CLASS B — LONGLIFE TUBE WARRANTY

The tube is warranted against defects in workmanship and materials when used within stated ratings. If such defects appear, full adjustment will be made for failures within 1000 hours of service. For failure after 1000 hours of service, pro rata adjustment will be made based upon the difference between the hours of service at failure and 3000 hours. No adjustment will be allowed if service exceeds 3000 hours. Adjustment period expires 12 months from date tube was first placed in service, or 18 months from date tube was shipped by an LM Ericsson Sales Company or Representative, whichever occurs first.

CLASS C — LONGLIFE TUBE WARRANTY

The tube is warranted against defects in workmanship and materials when used within stated ratings. If such defects appear, full adjustment will be made for failures within 50 hours of service. For failure after 50 hours of service, pro rata adjustment will be made based upon the difference between the hours of service at failure and 1000 hours. No adjustment will be allowed if service exceeds 1000 hours. Adjustment period expires 9 months from date tube was first place in service, or 12 months from date tube was shipped by an LM Ericsson Sales Company or Representative, whichever occurs first.

WARRANTY CLASS GUIDE

Tube type	Warranty Class	Tube type	Warranty Class
2C51/396A	A	5847/404A	A
6CY5/CATV	A	6028/408A	A
407A	A	6761	A
416B/6280	C	6927/6J6L	A
5590/401A	A	6928/6AQ5L	A
5591/403B	A	7150	A
5842/417A	B	7721/D3a	A

This warranty is subject to change without notice but such change shall not effect the warranty on LM Ericsson tubes shipped prior to effective date of such change.

ADJUSTMENT PROCEDURE

ADJUSTMENT FOR LOSS OR DAMAGE IN TRANSIT

1 Shipments should be opened immediately upon receipt and tubes inspected for:

a. Broken filaments
b. Loose or shorted elements
c. Broken glass
d. Evidence of rough handling.

2 Notify the Carrier at once, if any of the above listed defects are found. Have their adjuster call and inspect the shipment. Advise your supplier of the damage in detail. Do not return the tubes as no credit will be allowed by the factory.

WARRANTY ADJUSTMENT PROCEDURE

Products found to be defective during the warranty period may be returned for adjustment as follows:

1 Before any action can be taken on adjustment, a Service Report (see overleaf) must be obtained from your LM Ericsson tube sales representative and returned in accordance with the instructions given therein.

2 Tubes may be returned only when Purchaser receives written authorization to do so.

3 Authorization to return defective tubes must be requested not later than one month following the termination of the warranty period.

4 When tubes are returned for adjustment they should be identified by some permanent marking, which will enable them to be identified with their respective Service Report.

5 The customer is expected to prepay the transportation charges on all returns of defective tubes. Replacements for non-servicable tubes still in warranty will be shipped prepaid by the factory sales agency. Servicable tubes, not eligible for in-warranty adjustment, will be returned, transport collect, to the customer.

6 Returned tubes which are defective and not eligible for in-warranty adjustment will be destroyed unless instructions to the contrary are received with the tubes.

7 All tubes returned for examination and adjustment should be as carefully packed as when originally received, since damage sustained in return shipment will make proper examination and adjustment impossible.

8 No billing will be accepted for packing, inspection or labor charges in connection with tubes returned for adjustment.

9 In returning tubes for test and examination, the purchaser gives permission to LM Ericsson to open the tubes and examine their structure in case such procedure is considered necessary.

This adjustment procedure is subject to change without notice.

Before any action can be taken on adjustment, a Service Report (see below) must be obtained from your LM Ericsson tube sales representative and returned in accordance with the instructions given therein.

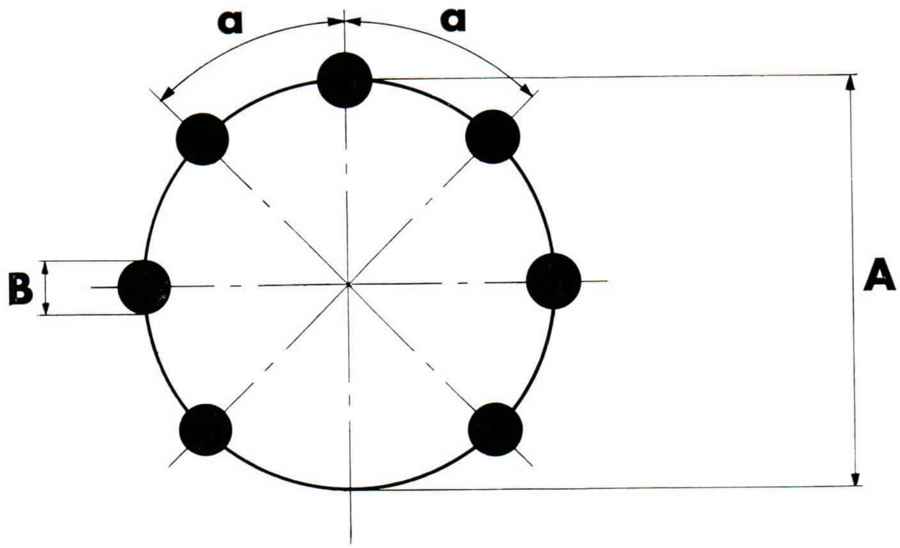
SERVICE REPORT

TUBE TYPE	INDIVIDUAL TUBE NO (marked on bulb side)	SERIAL NO (marked on tube bottom)	TIME OF OPERATION	OPERATION CONDITIONS (Heater Voltage, Plate Voltage, Grid No 2 Voltage, Grid Bias, Class of Service)	DESCRIPTION OF DEFECT

PURCHASER: ORDER NO:

ADDRESS: SHIPMENT RECEIVED:

PURCHASED FROM: DATE OF SERVICE REPORT:

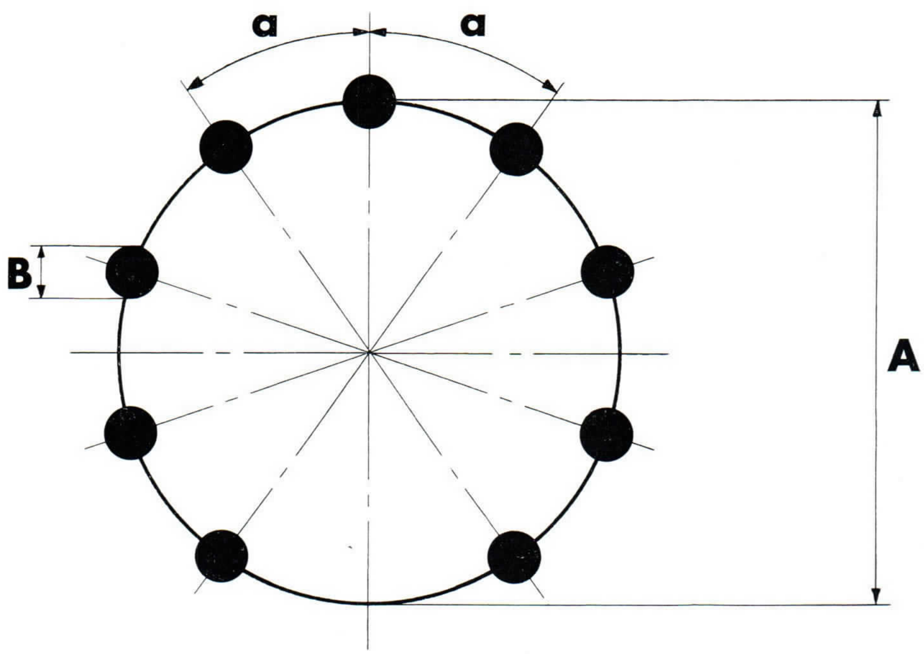


Small Button Miniature ● 7-pin Base **Pin Position**

reference	*inches*	*millimetres*	*degrees*	*notes*
A	0.375	9.525	—	1
B	0.052	1.3208	—	1,2
a	—	—	45	—
Base Pin Diameter	0.040 ± 0.002	1.016 ± 0.05	—	1

1. The millimetre dimensions are derived from the original inch dimensions.
2. The base pins shall be within the shadowed areas.

For complete information of dimensions of Small Button Miniature 7-pin Base and Small Button Noval 9-pin Base, reference is made to Publication No 67 from International Electrotechnical Commission (IEC).



Small Button Noval ● *9-pin Base*

Pin Position

reference	*inches*	*millimetres*	*degrees*	*notes*
A	0.468	11.8872	—	1
B	0.052	1.3208	—	1,2
a	—	—	36	—
Base Pin Diameter	0.040 ± 0.002	1.016 ± 0.05	—	1

Magnoval Base ●

Pin Position *(tentative information)*

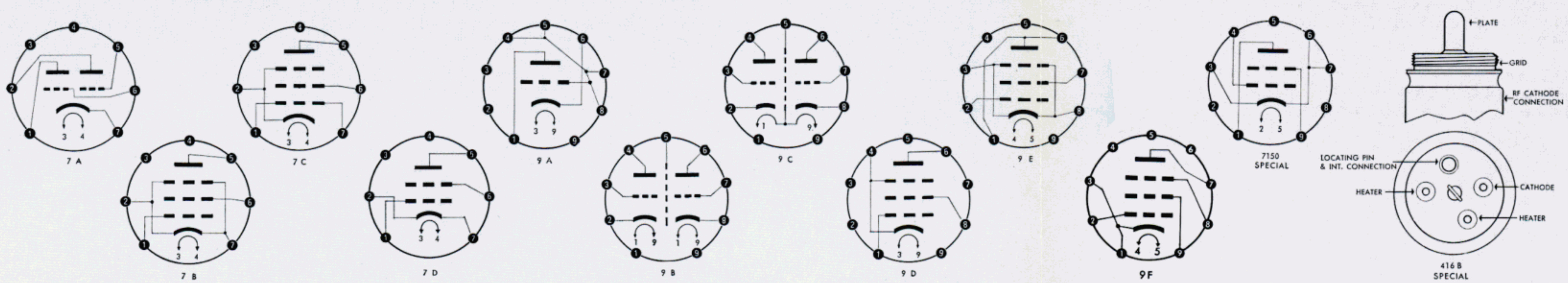
reference	*inches*	*millimetres*	*degrees*	*notes*
A	0.687	17.45	—	1
B	0.065	1.651	—	1,2
a	—	—	36	—
Base Pin Diameter	0.050 ± 0.002	1.270 ± 0.051	—	1

1. The millimetre dimensions are derived from the original inch dimensions.
2. The base pins shall be within the shadowed areas.

For complete information of dimensions of Small Button Miniature 7-pin Base and Small Button Noval 9-pin Base, reference is made to Publication No 67 from International Electrotechnical Commission (IEC).

READY REFERENCE CHART

TUBE CLASS	TUBE SPECIFICATION: Type Number	Proto-type	Bulb EIA	Pin Conn.	HEATER RATINGS: E_f	I_f	ABSOLUTE MAXIMUM RATINGS: E_b	E_{c2}	E_{c1}	I_k	P_p	P_{c2}	E_{hk}	Bulb Temp	CHARACTERISTICS — CLASS A1 AMPLIFIER: E_{bb}	E_{cc2}	R_k or E_{cc1}	Comb. Bias R_k / E_{cc1}	I_b	I_{c2}	g_m	P_{out}	μ	r_p	Capacitances $\mu\mu$F: C_{in}	C_{out}	Grid--Plate	Note	Life Chart No.
					V	A	V	V	V	mA	W	W	V	°C	V	V	ohms or V	ohms/V	mA	mA	μmhos	W	—	Meg					
SINGLE TRIODES	416B/6280		Glass-metal	Spec.	6.1	1.15	270		+1.5 —15	48	7.5		45	100	200			250/+8	30		50,000	.5 at 4000Mc	300		11	1.5	.02	1, 2	
	5842/417A		T6½	9A	6.3	.30	200		0 —25	38	4.5		55	160	130			360/+9	27		27,000		44		9	1.8	Max .55	1, 2	
TWIN TRIODES	2C51/396A*	2C51	T6½	9B	6.3	.30	330		+5 —50	20	1.6		100	160	150		240		8.2		5500		35		2.2	1	1.3		5
	407A	2C51	T6½	9C	20.0 or 40.0	.10 or .05	330		+5 —50	20	1.6		130	160	150		240		8.2		5500		35		2.2	1	1.3		5
	6927/6J6L*	6J6	T5½	7A	6.3	.33	220		+5	17	1.4		100	160	100		68		6.5		5000		38		2.0	.4	1.5		6
TETRODES	6CY5/CATV	6CY5	T5½	7D	6.3	.20	200	200	+5 —50	22	2.2	.55	100	150	125	80	—1		10	1.5	8000			.1	4.5	3	Max .04		
	7150		T9	Spec.	6.3	.45	165	165	0 —25	55	4.5	1.65	55	140	135	135		260/+8	27.5	8.5	35,800			.03	16	2	.03	1	
	7150		T9	Spec.	6.3	.45	165		0 —25	55	5.5		55	140	125		33		35		47,000		35		18	7	.6	1, 2, 4	
PENTODES	5590/401A		T5½	7B	6.3	.15	200	155	+5 —50	20	1.85	.55	100	150	90	90	820		3.9	1.2	2000			.45	3.4	2.9	Max .02	3	3
	5591/403B*	6AK5	T5½	7B	6.3	.15	200	155	+5 —50	20	1.85	.55	100	150	120	120	200		7.5	1.9	5000			.3	4	2.8	Max .02	3	3
	5847/404A		T6½	9D	6.3	.30	200	165	0 —25	40	3.3	.85	55	150	160	160		600/+8.5	13.5	4.0	13,000			.2	7	2.5	Max .05	1	2
	6028/408A		T5½	7B	20.0	.05	200	155	+5 —50	20	1.85	.55	130	150	120	120	200		7.5	1.9	5000			.3	4	2.8	Max .02	3	3
	6761*	6216	T6½	9E	6.3	1.0	275	220	+10 —55	110	11	1.65	110	200	130	130	100		70	3.5	13,000	3		.025	14	6	.4		4
	6928/6AQ5L*	6AQ5	T5½	7C	6.3	.36	220	220	+10 —55	55	9	1.1	100	220	130	130	200		23	2	3400	1		.08	7.6	6	.6		1
	7721/D3a		T6½	9F	6.3	.32	220	180	0 —10	33	4.5	1.1	60	170	190	160		400/+10	22	6	35,000			.12	10	2	.035	1	



BOTTOM VIEW IS SHOWN

Notes

1. *Pins are gold plated*
2. *Grounded grid operation. Value under Grid-Plate may be interpreted »Cathode to Plate».*
3. *External shield connected to cathode pins.*
4. *Grid No 2 connected to plate.*

* *Also available with 18 volt heaters*

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