Sylvania

THE SET-TESTED TUBE

TECHNICAL BULLETINS

IT'S THE TUBE THAT MAKES THE RADIO

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 1

Bulletin Number		
1	Average Characteristics of Sylvania Radio Tubes	
2	SX–199	Dry Cell Amplifier
	SX–120	Dry Cell Power Amplifier
3	SX–201A	Amplifier and Detector
4	SX–200A	Special Detector
5	SX–240	High Mu Amplifier
6	SX–112A	Amplifier and Detector
7	SX–171A	Power Amplifier
8	SX–222	Screen Grid Amplifier
9	SX–226	AC Amplifier
10	SY–227	AC Amplifier and Detector
11	SX–280	Full Wave Rectifier
12	SX–281	Half Wave Rectifier
13	SX–210	Amplifier and Oscillator
14	SX–250	Power Amplifier
15	SX–245	Power Amplifier
16	SY–224	AC Screen Grid Amplifier
17	SX–230	Dry Cell Amplifier and Detector
18	SX–231	Power Output Tube
19	SX–232	Dry Cell Screen Grid Amplifier
20	SY–485	AC Amplifier and Detector
	SX–182B	AC Power Amplifier
	SX–183	AC Power Amplifier
21	SY–236	Automobile Tetrode
22	SY–237	Automobile Triode
23	SY–238	Automobile Pentode
24	SY–247	Pentode Power Amplifier
25	SY–235	Super-Control Tetrode
26	SY–551	Variable Mu Tetrode
27	SY–171C	Power Triode
28	SY–233	Power Pentode
29	SY–239	R. F. Pentode

Average Characteristics of Sylvania Radio Tubes—Amplifiers, Detectors and Rectifiers

Model	Use	Base	Height (Max.)	Diam. (Max.)	Filament		Detector		Plate Volts	Grid Volts	Plate Current MA.	Screen Grid Volts	Screen Grid Current	Plate Resistance Ohms	Mutual Conductance Micromhos	Amplification Factor	Undistorted Power Output Milliwatts	Resistance Load in Series with Plate
					Volts	Amps.	Plate Volts	Plate MA.										
SX-201-A	Detector Amplifier	X	4 11/16"	1 13/16"	5.0	.25	22.5 45.0	2.5 3.5	90 135	-4.5 -9.0	2.5 3.0			11,000 10,000	725 800	8.0 8.0	15.0 55.0	11,000 20,000
SX-200-A	Detector	X	4 11/16"	1 13/16"	5.0	.25	45.0	1.5						30,000	666	20.0		
SX-112-A	Detector Amplifier	X	4 11/16"	1 13/16"	5.0	.25	45.0	4.5	90 135 180	-4.5 -9.0 -13.5	5.2 6.2 7.6			5,600 5,300 5,000	1,500 1,600 1,700	8.5 8.5 8.5	30.0 115.0 260.0	5,600 8,700 10,800
SX-240	Det. Amp. Res. Coupling	X	4 11/16"	1 13/16"	5.0	.25			135 180	-1.5 -3.0	0.2 0.2			150,000 150,000	200 200	30.0 30.0		250,000 250,000
SX-199	Detector Amplifier	X	4 1/8"	1 13/16"	3.0 3.3	.06 .063	22.5	2.5	90	-4.5	2.5			15,500	425	6.6	7.0	15,500
SV-199	Detector Amplifier	V	3 1/2"	1 1/16"	3.0 3.3	.06 .063	22.5	2.5	90	-4.5	2.5			15,500	425	6.6	7.0	15,500
SX-223	Amplifier	X	5 3/8"	1 13/16"	3.3	.132			135 135	-1.5 -1.5	1.5 3.3	45.0 67.0	Not over 1/8 of plate current	850,000 600,000	350 480	300 290		
SY-224	Detector Amplifier	Y	5 3/8"	1 13/16"	2.5	1.75			180 180 250	-1.5 -3.0 -3.0	4.0 4.0 4.0	75.0 90.0 90.0	Not over 1/8 of plate current	400,000 400,000 600,000	1,050 1,000 1,040			
SX-226	Amplifier	X	4 11/16"	1 13/16"	1.5	1.05			90 135 180	-6.0 -9.0 -13.5	3.8 6.3 7.4			3,600 7,200 7,000	955 1,135 1,170	8.2 8.2 8.2	30 80 180	9,800 8,800 10,500
SY-227	Detector Amplifier	Y	4 11/16"	1 13/16"	2.5	1.75			90 135 180 250	-6.0 -9.0 -13.5 -21.0	2.7 4.5 5.0 5.2			11,000 9,000 9,000 9,250	820 1,000 1,000 975	9.0 9.0 9.0 9.0	30 80 165 300	14,000 13,000 18,700 34,000
SY-485	Detector Amplifier	Y	4 11/16"	1 13/16"	3.0	1.25			90 120	-3.0 -4.0	5.0 6.0			10,800 9,300	1,150 1,350	12.5 12.5		
SX-230	Det. Amp.	X	4 3/8"	1 3/8"	2.0	.060			90	-4.5	1.8			13,000	700	9.3	16	15,000
SX-232	Detector Amplifier	X	4 11/16"	1 13/16"	2.0	.060			135	-3.0	1.4	67.5	Not over 1/8 of plate current	1,150,000	505	580		
SY-236	Detector Amplifier	Y	4 11/16"	1 1/16"	6.3	.300			90 135 135	-1.5 -1.5 -1.5	1.8 3.0 3.5	55.0 67.5 75.0	Not over 1/8 of plate current	200,000 300,000 250,000	850 1,050 1,100	170 315 275		

SY-237	Detector Amplifier	Y	4¼"	1⅝"	6.3	.300			90 135	−6.0 −9.0	2.6 4.3				11,500 10,000	780 900	9.0 9.0	30 80	17,500 14,000
SY-235	Amplifier	Y	5⅛"	1¹³⁄₁₆"	2.5	1.75			180 250	−1.5 −3.0	5.8 6.5	75.0 90.0	2.5 2.5		350,000 350,000	1,100 1,050	385 370		
SY-551	Amplifier	V	5⅛"	1¹³⁄₁₆"	2.5	1.75			180 250	−1.5 −3.0	5.8 6.5	75.0 90.0	2.5 2.5		500,000 500,000	1,050 1,050	525 525		
SX-120	Power Amplifier	X	4⅛"	1⅝"	3.0 3.3	.125 .132			90 135	−10.5 −22.5	3.0 6.5				8,000 6,300	415 525	3.3 3.3	45 110	9,600 6,500
SX-231	Power Amplifier	X	4⅛"	1⅝"	2.0	.130			135	−22.5	6.8				4,950	700	3.8	150	9,000
SX-171-A	Power Amplifier	X	4¹¹⁄₁₆"	1¹³⁄₁₆"	5.0	.25			90 135 180	−16.5 −27.0 −40.5	12.0 17.5 20.0				2,250 1,900 1,850	1,330 1,520 1,620	3.0 3.0 3.0	125 370 700	3,200 3,500 5,350
SX-245	Power Amplifier	X	5⅝"	2⅛"	2.5	1.50			180 250 275	−34.5 −50.0 −56.0	27.0 34.0 36.0				1,800 1,750 1,670	1,850 2,000 2,100	3.5 3.5 3.5	780 1,600 2,000	3,500 3,900 4,600
SX-182-B	Power Amplifier	X	5⅛"	2⅛"	5.0	1.25			200	−29.0	18.0				3,330	1,500	5.0		
SX-183	Power Amplifier	X	5⅛"	2⅛"	5.0	1.25			200 250	−45.0 −65.0	20.0 26.0				2,000 1,500	1,500 2,000	3.0 3.0		
SX-210	Power Amplifier Oscillator	X	6¼"	2⅛"	7.5	1.25			250 350 425	−22.0 −31.0 −39.0	10.0 16.0 18.0				6,000 5,150 5,000	1,330 1,550 1,600	8.0 8.0 8.0	400 900 1,600	13,000 11,000 10,200
SX-250	Power Amplifier Oscillator	X	6¼"	2¹¹⁄₁₆"	7.5	1.75			250 300 350 400 450	−45.0 −54.0 −63.0 −70.0 −84.0	28.0 35.0 45.0 55.0 55.0				2,100 2,000 1,900 1,800 1,800	1,800 1,900 2,000 2,100 2,100	3.8 3.8 3.8 3.8 3.8	1,000 1,600 2,400 3,400 4,000	4,300 4,600 4,100 3,670 4,350
SY-233	Power Pentode	Y	4¹¹⁄₁₆"	1¹³⁄₁₆"	2.0	0.260			135	−13.5	14.0	135	3.0		45,000	1,400	63	650	7,500
SY-238	Power Pentode	Y	1¹¹⁄₁₆"	1⅝"	6.3	.300			100 135	−9.0 −13.5	7.0 9.0	100 135	2.0 2.5		81,000 110,000	950 975	80 100	200 525	8,500 15,000
SY-239	R. F. Pentode	Y	4¹¹⁄₁₆"	1⅝"	6.3	.300			90 135 180	−3.0 −3.0 −3.0	4.4 4.4 4.5	90 90 90	1.3 1.2 1.2		375,000 540,000 750,000	900 980 1000	360 530 750		
SY-247	Power Pentode	Y	5⅛"	2⅛"	2.5	1.75			250	−16.5	32.0	250	7.5		35,000	2,500	90	2,500	7,000
SX-281	Half Wave Rectifier	X	6¼"	2¹¹⁄₁₆"	7.5	1.25			700AC		85.0								
SX-280	Full Wave Rectifier	X	5⅝"	2⅛"	5.0	2.0			350AC 400AC 550AC		125.0 110.0 135.0	with choke input only							

It should be borne in mind in using this chart, that the data given represents average characteristics and is not to be construed as indicating maximum and minimum limits.

Complete information regarding tube characteristics is on file here and we will gladly cooperate with customers by supplying any specific data they may require.

If your name is not already on our bulletin mailing list and you want to receive new bulletins as issued, send your request to the Advertising Department, Hygrade Sylvania Corp., Sylvania Division, Emporium, Penna.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturers of Radio Tubes and Incandescent Lamps in U. S. A.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 1

INDEX

Tube types heretofore designated by a symbol and three numerals have been changed to conform to later designations. For example SX-200A now 00A, SY-227 now 27, etc.

Tube Tybe	DESCRIPTION	Bulletin
44	Super Control R. F. Amplifier Pentode	35
45	Power Amplifier	15
46	Power Amplifier	31
47	Power Pentode	24
50	Power Amplifier	14
51	Variable Mu Tetrode	26
55	Double Diode Triode	45
56	AC Amplifier and Detector	41
57	R. F. Pentode	42
58	R. F. Pentode (Variable Mu)	43
59	Three Grid Power Amplifier	49
69	6.3 Volt Double Grid Detector	37
71-A	Power Amplifier	7
79	Complete Class B Amplifier	50
80	Full Wave Rectifier	11
81	Half Wave Rectifier	12
82	Full Wave Mercury Vapor Rectifier	32
83	Full Wave Mercury Vapor Rectifier	46
85	Double Diode Triode	44
89	Power Amplifier	27
V-99	Dry Cell Amplifier and Detector	2
X-99	Dry Cell Amplifier and Detector	
182-B	AC Power Amplifier for Sparton Receivers	20
183	AC Power Amplifier for Sparton Receivers	
485	AC Amplifier and Detector for Sparton Receivers	
864	General Purpose Tube	36
866	Half Wave Mercury Rectifier	30

If your name is not already on our bulletin mailing list and you want to receive new bulletins as issued, send your request to the Advertising Department, Hygrade Sylvania Corp., Sylvania Division, Emporium, Penna.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 2

SV-199
SX-199

CHARACTERISTICS

Use	Detector, Amplifier			
Filament	Thoriated Tungsten			
Voltage	3.0		3.3	d-c volts
Current	0.060	-	0.063	amp.

Direct Interelectrode Capacitances:

C_{gp}	2.3 uuf.
C_{af}	2.5 uuf.
C_{pf}	2.5 uuf.

		X TYPE
Maximum Overall Length	3½"	4⅛"
Maximum Diameter	1⅛"	1⅜"
Bulb	T-8	T-8
Base	Small 4 nub	Small 4 pin

AMPLIFIER

Operating Conditions and Characteristics:

Filament	3.3	d-c volts
Plate	90	maximum volts
Grid	-4.5	volts
Amplification Factor	6.6	
Plate Resistance	15500	ohms
Mutual Conductance	425	umhos
Plate Current	2.5	ma.

DETECTOR

Operating Conditions as Biased Detector:

Filament	**3.3 d-c volts**
Plate	**90 maximum volts**
Grid	**–10.5 approx. volts**

Plate Cur.—Adjusted to 0.2 ma. with no a-c input signal.

Operating Conditions as Grid-Leak Detector:

Grid condenser of 0.00025 uf. capacity; grid leak of from 0.25 to 5.0 megohms; plate voltage of 45 volts; filament voltage 3.3 volts.

The SX-199 is a general purpose tube designed to draw its filament supply from dry cells, the filament operating properly at 3.3 volts and only .06 ampere. Like the SX-201-A tube, it can be used either as a radio or audio frequency amplifier, or as a detector, and the same general remarks apply to it as to the SX-201-A. It is not, of course, being a lower power consuming tube, the equivalent of the SX-201-A tube in the results obtained thru its use, any more than a 50 watt lamp is comparable with a 200 watt lamp. Wherever possible, therefore, it is advisable to use the SX-201-A tube.

It may be obtained with three different styles of base to fit the various sockets in use. When it is supplied with the small short pin-base it is designated "SV-199"; when supplied with the large short pin base commonly called the UV or Navy base, to fit the same socket as the SX-201-A, the designation "SV-199 Large Base" is used; and when supplied with the new long pronged type of base to fit the new Universal sockets, the term "SX-199" is applied.

When used as a detector, plate potentials of 20 to 40 volts may be used without grid voltage.

The proper negative grid voltages for use with each plate voltage when the tube is used as an amplifier are as indicated below.

Plate Voltage	Negative Grid Voltage
60 volts	**1.5–3.0 volts**
80 volts	**3.0–4.5 volts**
100 volts	**4.5–6.0 volts**

SX-120

Use	**Power Amplifier**	
Filament	**Thoriated Tungsten**	
Volts	**3.0**	**3.3**
Amperes	**0.125**	**0.132**
Plate Volts	**135**	
Grid Bias Volts	**–22.5**	

Operating Conditions and Characteristics:			
Ef	**3.3**	**3.3**	**volts**
Ep	**90**	**135**	**volts**
Eg	**–16.5**	**–22.5**	**volts**
Rp	**9600**	**6500**	**ohms**
u	**3.3**	**3.3**	
rp	**8000**	**6300**	**ohms**
gm	**415**	**525**	**umhos**
Ip	**3.0**	**6.5**	**ma.**
U.P.O.	**45**	**110**	**mw.**

Direct Interelectrode Capacitances:	
C_{gp}	**4.1 uuf.**
C_{gf}	**2.0 uuf.**
C_{pf}	**2.3 uuf.**

Maximum Overall Length	**4⅛″**
Maximum Overall Diameter	**1⅜″**
Bulb	**T-8**
Base	**Small SX**

SYLVANIA SX-120

A power tube for use with dry cells.

This is a power tube for use in the last stage of audio frequency amplification in a dry cell operated set in conjunction with the SX-199 tube, it bearing the same relation to the latter as the SX-112-A or SX-171-A bears to the SX-201-A.

The filament voltage is 3.3, the filament current is 0.125 amperes, and the plate is to be operated at 135 volts, with —22.5 volts on the

grid. Unless those plate and grid voltages are used, the use of this tube is not recommended.

In order to permit its use in sets not especially wired for the addition of these voltages the Connectorald No. 120, made by the Alden Manufacturing Company, may be used without any changes in the existing wiring of the set.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 3

DETECTOR and AMPLIFIER
SX-201A

CHARACTERISTICS

Filament	Thoriated Tungsten		
Volts	5.0		
Amperes	0.25		
Plate Volts	135		
Grid bias volts	–9.0		
Operating Conditions and Characteristics:			
Filament Voltage	5.0	5.0	Volts
Plate Voltage	90	135	Volts
Grid Voltage (C bias)	–4.5	–9.0	Volts
Plate Resistance	11,000	10,000	ohms
Amplification Factor	8.0	8.0	
Mutual Conductance	725	800	micromhos
Plate Current	2.5	3.0	milliamperes
Undistorted Power Output	15	55	milliwatts
Direct Interelectrode Capacitances:			
Grid to Plate	8.1 mmf.		
Grid to Filament	3.1 mmf.		
Plate to Filament	2.2 mmf.		
Maximum Overall Length	4 11/16"		
Maximum Overall Diameter	1 13/16"		
Base	Large SX		
Bulb	S–14		

Socket:

The Sylvania SX-201A is designed for use in a vertical position. It is provided with a standard "X" base and requires a standard "X" socket. The base connections are standard.

Filament:

The SX-201A filament is of the thoriated tungsten type, rated at 5 volts, .25 ampere. The emission at rated voltage is well above that ordinarily required in normal operation and when the tube is used at moderate plate voltages, the filament voltage can be lowered to 4.5 or 4.0 volts without impairing the efficiency and with a resultant increase in the life of the tube.

Circuit Requirements:

In order to keep the plate supply power required at a minimum it is essential that a grid bias be employed, the value of which depends upon the plate voltage applied, and is given below:

"B" Battery Voltage	"C" Battery Voltage
Volts	Volts
45.0	-1.5
67.5	-3.0
90.0	-4.5
135.0	-9.0

OPERATION AS A DETECTOR

The SX-201A tube may be employed as a detector tube. It is not critical for plate voltage. The grid return may be connected to either the negative or positive filament terminal as the performance of the tube in the particular circuit indicates. Usually somewhat greater sensitivity will be obtained by returning to the negative side because the input losses of the tube will be decreased.

The standard grid leak and condenser of 2 megohms and 250 micromicrofarads is recommended for ordinary use. The use of a smaller condenser will increase the strength of the high notes while bringing in more interference. The sensitivity may be increased by employing a grid leak of a higher resistance than two meghoms.

OPERATION AS RADIO FREQUENCY AMPLIFIER

The SX–201A tube is widely employed in radio frequency amplification because of its characteristics. The usual voltages which are employed for this are 67.5 on the plate and 4.5 volts bias. Where these tubes are employed in balanced circuits, it is necessary that the interelectrode capacities are held constant. Sylvania tubes will be found to be uniform in this respect.

OPERATION AS AN AUDIO FREQUENCY AMPLIFIER

When the SX–201A tube is employed with good audio transformers very good reproduction can be obtained as in resistance or impedance coupling with the advantage that more amplification is obtainable than is possible by either of the latter methods. The plate voltage usually employed is 90 volts with its proper grid bias 4.5 volts. If more low note amplification is desired, the grid bias may be decreased somewhat, at the expense of increased plate current. When the SX–201A tube is employed as the last audio tube the plate voltage should be increased to 135 volts with 9 volts bias.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturers of Radio Tubes and Incandescent Lamps in U. S. A.

Printed in U. S. A.

Sylvania
REG. U.S. PAT. OFF.
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 4

DETECTOR
SX-200A

CHARACTERISTICS

Filament	Thoriated Tungsten	
Volts	5.0	
Amperes	.25	
Plate Volts	45	Maximum
Grid Bias Volts	0	

Operating Conditions and Characteristics:

Filament Voltage	5.0	Volts
Plate Voltage	45.0	Volts
Grid Voltage (C bias)	0	Volts
Amplification Factor	20	
Plate Resistance	30,000	ohms
Mutual Conductance	666	micromhos
Plate Current	1.5	(approx.) Milliamperes

Direct Interelectrode Capacitances:

Grid to Plate	8.5	mmf.
Grid to Filament	3.2	mmf.
Plate to Filament	2.0	mmf.

Maximum Overall Length	4 11/16"
Maximum Overall Diameter	1 13/16"
Base	Large SX
Bulb	S-14

Socket:

The Sylvania SX-200A is designed for use in a vertical position. It is provided with a standard "X" base and requires a standard "X" socket. The base connections are standard.

Filament:

The filament employed in the SX-200A is of the thoriated tungsten type, similar to that used in the SX-201A.

Circuit Requirements:

The SX-200A detector is a special super-sensitive detector tube containing metallic caesium, the vapors of which are responsible for its extreme sensitivity.

A grid condenser of .00025 Mfd. and a grid leak of 2 megohms are recommended for use with this tube. The use of grid leaks of higher values up to 9 megohms may improve the sensitivity somewhat at the expense of quality.

If the grid bias system of detection is employed, i.e., where no grid condenser and leak are used, but where a "C" battery is placed in the grid circuit of the detector tube to bring the point of operation to the lower bend in the plate current grid voltage characteristics of the tube, the following values of "C" battery voltage should be used, depending on the plate voltage.

Plate "B" Volts	Grid "C" Volts
22.5	-1.0
45.0	-2.2

The SX-200A tube may be substituted in the detector socket of any set for the 201A type without any changes in wiring whatever, with very marked improvements in sensitivity. However, if it is convenient and the greatest degree of sensitivity is desired, some advantages may be gained by connecting the grid return of the detector circuit to the negative side of the filament circuit.

In order to demonstrate the superiority of this tube as a detector a weak signal should be tuned in with a 201A type tube in the detector socket, then the 200A tube should be substituted for the 201A as quickly as possible. The weaker the signal the greater the contrast between the results from the two tubes will be. This sometimes reaches the value of 100% or more. Loud signals from strong or nearby stations will not be so greatly improved, although the SX-200A tube will in all cases operate somewhat better than the 201A type.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturer of Incandescent Lamps and Radio Tubes in U. S. A.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 5

VOLTAGE AMPLIFIER
SX-240

CHARACTERISTICS

Filament	Thoriated Tungsten
Volts	5.0
Amperes	0.25
Plate Volts	180 Maximum
Grid Bias Volts	−4.5

Operating Conditions and Characteristics:-

Filament Voltage	5.0	5.0 volts
Plate Voltage	90	135 volts
Grid Voltage (C Bias)	−1.5	−3.0 volts
Amplification Factor	30	30
Plate Resistance	150,000	150,000 ohms
Mutual Conductance	200	200 micromhos
Plate Current	0.2	0.2 ma.

Direct Interelectrode Capacitances:

Grid to Plate	8.8 mmf.
Grid to Filament	3.4 mmf.
Plate to Filament	1.5 mmf.

Maximum Overall Length	4 11/16"
Maximum Overall Diameter	1 13/16"
Base	Large X
Bulb	S-14

Socket:

The SX–240 is designed for use in a vertical position. It is provided with a standard "X" base and requires a standard "X" socket. The base connections are standard.

Circuit Requirements:

The SX–240 tube is a voltage amplifier tube having a high voltage amplification factor and high plate impedance, and is sometimes referred to as a High Mu tube. It is intended for operation in radio receivers employing resistance or impedance coupling between stages, and is to be used only in the stages calling specifically for this type of tube. It should not be substituted indiscriminately for the 201A type of tube.

Its high amplification factor permits the SX–240 to operate at the best efficiency in connection with resistance and impedance coupling which is used in a few sets, especially custom built or home made sets. This type of coupling is favored by some set builders as compared with the more ordinary transformer coupling, due to its ability to amplify equally, tones of all frequencies, which they claim produces better tone quality. Transformer design has, however, been improved to the extent that there is a difference of opinion among radio engineers as to this claim, with the balance in favor of the use of transformer coupling. This is evidenced by the far greater number of sets which employ transformer coupling, although its cost is greater.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturer of Incandescent Lamps and Radio Tubes in U. S. A.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 6

AMPLIFIER and DETECTOR
SX-112A

CHARACTERISTICS

Filament	Coated
Volts	5.0
Amperes	0.25
Plate Volts	180 Maximum
Grid Bias Volts	-13.5

Operating Conditions and Characteristics:

Filament Voltage	5.0	5.0	5.0	volts
Plate Voltage	90	135	180	volts
Grid Voltage (C Bias)	-4.5	-9	-13.5	volts
Amplification Factor	8.5	8.5	8.5	
Plate Resistance	5600	5300	5000	ohms
Mutual Conductance	1500	1600	1700	micromhos
Plate Current	5.2	6.2	7.6	milliamperes
Undistorted Power Output	30	115	260	milliwatts

Direct Interelectrode Capacitances:

Grid to Plate	8.1 mmf.
Grid to Filament	4.2 mmf.
Plate to Filament	2.1 mmf.

Maximum Overall Length	4 11/16"
Maximum Overall Diameter	1 13/16"
Base	Large SX
Bulb	S-14

Socket:

The SX–112A is designed for use in a vertical position. It is provided with a standard "X" base and requires a standard "X" socket. The base connections are standard.

Filament:

It is identical in appearance and characteristics with the older type known as the SX–112 tube, except for the fact that its filament consumes only ¼ ampere as compared with the ½ ampere of the SX–112. Its filament is of the oxide coated type operating at a low temperature, and is very rugged.

Circuit Requirements:

The SX–112A tube is intended for use where a tube of lower plate impedance than the SX–201A tube is desired. It is, therefore, particularly useful in the last audio frequency stage, where a tube of moderate battery requirements in plate, grid, and filament circuits is needed. Its lower impedance will more nearly match that of the loud speaker than that of the 201A type and thereby produce better tone quality. It may also be used in the other audio frequency positions and as a detector tube to some advantage.

This tube is of the type generally designated by the term "Power Tube". It is designed to amplify comparatively strong signals without distortion, and thereby to improve the quality of reception so that it will be more natural and pleasing to the musically trained ear. It is not intended to increase the receiving range of the set or to bring in weak signals any stronger than the 201A type of tube.

The use of this tube in the last audio frequency stage cannot be recommended for the best results unless plate voltages of at least 135 volts with the rated "C" voltages are used.

The SX–112A may be employed as a detector tube by applying 67 volts to the plate and employing the usual values of grid leak and condenser. With this tube better amplification of the low notes will be noticed because of the reduced plate impedance of the tube.

The SX–112A may be also employed as an R. F. amplifier by employing the proper "C" bias for the operating voltage used. This tube will give much better amplification than the 201A tube and trouble due to oscillation may be experienced. Proper neutralization of the circuits for this tube will permit its use with greatly increased gain.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturer of Incandescent Lamps and Radio Tubes In U. S. A.

Printed in U. S. A

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 7

POWER AMPLIFIER
SX-171A

CHARACTERISTICS

Filament	Coated
Volts	5.0
Amperes	0.25
Plate Volts	180 Maximum
Grid Bias Volts	–40.5

Operating Conditions and Characteristics:

Filament Voltage	5.0	5.0	5.0	volts
Plate Voltage	90	135	180	volts
Grid Voltage	–16.5	–27	–40.5	volts
Amplification Factor	3	3	3	
Plate Resistance	2250	1960	1850	ohms
Mutual Conductance	1330	1520	1620	micromhos
Plate Current	12	17.5	20	milliamperes
Undistorted Power Output	125	370	700	milliwatts

Direct Interelectrode Capacitances:

Grid to Plate	7.4 mmf.
Grid to Filament	3.5 mmf.
Plate to Filament	2.1 mmf.

Maximum Overall Length	4 11/16"
Maximum Overall Diameter	1 13/16"
Base	Large X
Bulb	S–14

Socket:

The Sylvania SX–171A is designed for use in a vertical position. It is provided with a standard "X" base and requires a standard "X" socket. The base connections are standard.

Filament:

The filament may be operated from a storage battery or from the A. C. line through a step down transformer. In either case the voltage applied to the filament terminals of the tube should be the rated value of 5.0 volts. If alternating current is used the filament leads should be of twisted pair.

Circuit Requirements:

When the filament is operated from a D. C. source the grid and plate returns should be made to the negative filament terminal. When A. C. is used on the filament the plate and grid returns should be brought either to the mid-tap of a resistor of from 20 to 40 ohms across the filament winding, or the mid-tap of the filament winding itself.

To prevent distortion and over-loading, negative grid bias, as shown in the table of operating voltages, should always be used. If the tubes are A. C. operated increase the negative bias two and one-half volts. Bias may be obtained by means of a "C" battery or by means of the voltage drop through a resistor in the plate return lead or by a voltage divided across the "B" supply. The proper value of the resistor in the plate return lead is 2,150 ohms when 180 volts are used; 1,700 ohms when 135 volts are used, and 1,600 ohms when 90 volts are applied to the plate.

To obtain greater power output without increasing the plate voltage, two SX–171A tubes may be operated in parallel or push-pull. The parallel connection permits increased power output without any increased signal applied to the power stage, while the push-pull circuit for maximum power output requires that the input signal to the power stage be doubled.

The maximum undistorted power output of the SX–171A when compared with other power amplifier tubes at maximum operating voltages is as follows:

TYPE	Plate Voltage (Volts)	Grid Bias Voltage (Volts)	Plate Current (Milliamperes)	Max. Undistorted Power Output (Milliwatts)
SX–171A	**180**	**–40.5**	**20**	**700**
SX–210	425	–39.0	18	1600
SX–245	275	–56.0	36	2000
SX–250	450	–84.0	55	4600

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturers of Radio Tubes and Incandescent Lamps in U. S. A.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 8

SCREEN GRID R. F. AMPLIFIER

SX-222

CHARACTERISTICS

Filament	Thoriated Tungsten	
Volts	3.3	
Amperes	0.132	
Plate Volts	135	Maximum
Screen Volts	67.5	Maximum
Grid Bias Volts	−1.5	

Operating Conditions and Characteristics:

Filament Voltage	3.3	3.3	volts
Plate Voltage	135	135	volts
Control Grid Voltage	−1.5	−1.5	volts
Screen Grid Voltage	45	67.5	volts
Amplification Factor*	300	290	
Plate Resistance	850,000	600,000	ohms
Mutual Conductance	350	480	micromhos
Plate Current	1.5	3.3	milliamperes

*In general the amplification per stage in a screen grid stage is determined by the mutual conductance and load impedance.

Direct Interelectrode Capacitances:

Grid to Plate	.025 Max.	mmf.
Grid to Filament and Screen	3.2 Max.	mmf.
Plate to Filament and Screen	12.0 Max.	mmf.

Overall Length	4 1/16" to 5 1/4"
Maximum Overall Diameter	1 13/16"
Base	Large X
Cap	.346" to .369"
Bulb	S-14

Socket:

The Sylvania SX–222 is designed for use with the Standard "X" socket, which should be mounted so as to hold the tube in a vertical position. The connection for the control grid is made to the metal cap at the top of the bulb.

Filament:

The Voltage applied to the filament terminals of the SX–222 should not exceed the rated value of 3.3 volts. It may be supplied by either dry-cells (connected to give 4.5 volts) or a storage battery (6 volts), depending upon whether 3.3 volt or 5.0 volt filament tubes are used in the other stages of the radio receiver.

If dry-cell Sylvania tubes (such as the SX–199 and SX–120) are used, the filament of the SX–222 may be connected directly in parallel with the filaments of the other tubes and operated from the same common rheostat.

When the SX–222 is to be used in conjunction with storage battery tubes (such as the SX–201A, SX–112A, etc.), each SX–222 should have a 15 ohm resistor (tapped at 12 ohms) in series with its negative filament lead. Resistor and filament may then be connected directly in parallel with the 5 volt filaments of the other tubes and operated from the same common rheostat.

It is recommended that both the filament and plate voltage be disconnected before any tube is inserted in or removed from its socket.

Screen:

The positive voltage for the screen should be obtained from a tap on the plate battery or from a tap so located on the B-Supply device as to definitely give the required screen voltage (refer ro operating voltages and conditions). Never attempt to obtain the screen voltage by connecting the screen through a series resistor to a high plate voltage source, such as that of the power amplifier tube. Such a series resistor connection will not in general be satisfactory for screen voltage supply because of the considerable variation in screen current of different tubes.

The screen voltage obtained from the definite voltage tap on the B–battery or the B–supply device may be made variable between 0 and 45 volts by the use of a potentiometer. As the voltage applied to the screen is reduced by adjustment of the potentiometer, the mutual conductance of the SX–222 is decreased with consequent reduction in volume. The potentiometer therefore makes a suitable volume control for the receiver.

It should be noted that when the potentiometer method of volume control is used with a B-battery source of screen potential, precautions should be taken to provide for opening the screen grid circuit connection to the B-battery when the radio set is not in use. If this precaution is not observed, current will continue to flow through the potentiometer and shorten the life of the battery.

Circuit Requirements:

When the SX–222 is used as a screen grid radio-frequency amplifier, neutralization of the interelectrode capacity between grid and plate to prevent feed–back through the tube is unnecessary because of the in-

ternal shielding by the screen. It is necessary, however, to take every precaution to avoid external coupling between the grid and plate circuit elements if stable operation of the SX–222 is to be obtained in circuits designed to give maximum gain per stage.

In multi-stage amplifier circuits, it is necessary to completely and effectively shield each stage, and to include within the stage shield all of the component parts of that stage. Unless the coils and condensers of the various stages are shielded from each other, the amplification possibilities of the tube cannot be realized.

The grid and plate circuit returns should be made to the negative filament terminal. The grid bias voltage of −1.5 volts may be obtained from a C-battery or from the drop in the 12-ohm portion of the tapped 15-ohm resistor mentioned under the section on filament. It should be noted that the tapped resistor method of obtaining the control-grid bias is usable only when the filament of the SX–222 is operated from a 6-volt A-supply.

If the SX–222 is to be operated as a screen grid audio-frequency amplifier or as a space charge grid audio-frequency amplifier, resistance coupling should be used in its plate circuit. For either case, the value of the plate coupling resistor should be of from 100,000 to 250,000 ohms. With the value of 250,000 ohms, a voltage amplification of 40 per stage should be obtained from either type of circuit.

It the SX–222 is operated as a screen grid audio frequency amplifier, a plate supply voltage of 135 to 180 volts applied through a plate coupling resistor of from 100,000 to 250,000 ohms is recommended. Under these conditions, the screen is operated preferably with +22.5 volts, and the grid with from −¾ to −1½ volts. A higher value of screen voltage may be used but because of the greater voltage amplification obtained at the increased voltage, more critical circuit adjustment will be required.

When the SX–222 is connected as a space charge grid audio-frequency amplifier, the inner grid is operated at +22.5 volts in order to neutralize the electron space charge around the filament. The outer grid then becomes the control grid and should be biased negatively by from 0 to −1½ volts depending upon the conditions of operation. For best results, the use of a variable control-grid bias potentiometer is recommended.

The screen grid audio-frequency connection, in comparison with the space charge grid connection, will give somewhat lower maximum amplification but it will permit of better audio frequency fidelity.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturers of Radio Tubes and Incandescent Lamps in U. S. A.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 9

AMPLIFIER (AC FILAMENT)
SX-226

CHARACTERISTICS

Filament	Coated
Volts	1.5
Amperes	1.05
Plate Volts	180 Maximum
Grid Bias Volts	-13.5

Operating Conditions and Characteristics:

Filament Voltage	1.5	1.5	1.5	volts
Plate Voltage	90	135	180	volts
Grid Voltage	–6*	–9*	–13.5*	volts
Amplification Factor	8.2	8.2	8.2	
Plate Resistance	8600	7200	7000	ohms
Mutual Conductance	955	1135	1170	micromhos
Plate Current	3.8	6.3	7.4	ma.
Undistorted Power Output	30	80	180	mw.

Direct Interelectrode Capacitances:

Grid to Plate	8.1 uuf.
Grid to Filament	3.5 uuf.
Plate to Filament	2.2 uuf.

Maximum Overall Length	4 11/16"
Maximum Overall Diameter	1 3/16"
Bulb	S-14
Base	Large "X"

*Grid volts measured from mid-point of AC operated filament.

Circuit Requirements:

This tube is intended for use in radio or audio frequency stages of AC operated receivers which employ the SY-227 as a detector. This tube should not be used as a detector tube.

The filament of the SX-226 has been especially chosen to operate at a low voltage to decrease the voltage drop along the filament The filament is of the oxide coated type and is arranged in the form of an inverted "V" as in the SX-201A tube.

The filament rating is 1.05 amperes at 1.5 volts. For satisfactory life it is advisable to operate the filament at 1.40 volts so as to permit normal line voltage fluctuations without applying a voltage greatly in excess of 1.5 volts to the filament.

The SX-226 has been designed to give about the same performance as the SX-201A. It is absolutely necessary to apply a grid bias to these tubes. This bias must be applied between the grid and the electrical center of the filament in order to prevent hum. With proper bias the ripple will be very small. If the hum seems excessive it is quite likely a result of regeneration in the RF stages giving rise to carrier modulation. It may be wise to return the grid bias to the movable arm of a low resistance potentiometer which is connected across the filament winding of the transformer, so that tube changes or circuit variations may be readily accommodated.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 10

DETECTOR AND AMPLIFIER
(AC HEATER)

SY-227

CHARACTERISTICS

*Heater	Coated Uni-potential Cathode
Volts	2.5
Amperes	1.75
Plate Volts	275 Maximum
Grid Bias Volts	−24

Operating Conditions and Characteristics:

Filament Voltage	2.5	2.5	2.5	2.5	volts
Plate Voltage	90	135	180	250	volts
Grid Voltage	−6	−9	−13.5	−21	volts
Amplification Factor	9	9	9	9	
Plate Resistance	11000	9000	9000	9250	ohms
Mutual Conductance	820	1000	1000	975	mic'hos
Plate Current	2.7	4.5	5.0	5.2	ma.
Undistorted Power Output	30	80	165	300	mw.

Direct Interelectrode Capacitances:

Grid to Plate	3.3 uuf.
Grid to Cathode	3.5 uuf.
Plate to Cathode	3.0 uuf.

Maximum Overall Length	4 1/16"
Maximum Overall Diameter	1 9/16"
Bulb	S-14
Base	Large "Y"

*Recommended practice is to have no potential difference between heater and cathode, but if this practice is not followed, the heater may be biased preferably negative, but allowably positive, with respect to the cathode by not more than 45 volts.

Circuit Requirements:

This tube meets the demand for a quick heater tube of this type which is free from hum. Other outstanding characteristics are long life, freedom from microphonic troubles and ability to withstand considerable voltage fluctuation.

The quiet humless operation of the Sylvania type SY–227 tube has been obtained by retaining the hairpin type filament instead of the coiled type. The electromagnetic field set up by alternating current flowing on one side of the filament loop is almost entirely offset by the field set up on the other side of the loop. Because this field is very greatly reduced, the hum is almost entirely absent.

The life of a heater tube depends very greatly on the type of insulator employed between the cathode sleeve and heater. By reducing the mass of this material, quicker heating has been secured. By carefully selecting the material used for the insulator, one has been obtained which does not cause the filament current to decrease with life, thus greatly increasing the life of the tube.

Special precautions have been taken to insure non-microphonic 227 tubes. A new shaped mica support member has been employed. This member is secured to the rest of the assembly at three points, so that a true three-point suspension is realized. As a further check against microphonism every tube is tested in a standard circuit.

The heating time of this tube is such that at about nine seconds distant signals will be brought in with maximum volume, while locals will be brought in at the end of six or seven seconds.

Use as a Detector

The SY–227 may be employed as a detector of either the grid leak condenser type or the bias type. The usual values of grid leak and condenser may be employed and the grid return should be made direct to the cathode. Many manufacturers are employing bias detectors and the SY–227 is admirably adapted for this purpose. As much as 250 volts is applied to the plate of the tube, and the proper grid bias to limit the current to about .8 milliampere with no signal, is used. With most circuits a bias of 28 volts will be required. This circuit permits the detector to handle large grid swings without overloading, and consequently may be used to handle the output of several SY–224 tubes. Because such a large input voltage may be handled without overloading, it is possible to obtain loud-speaker operation by feeding the SY–227 detector output directly into the power tubes, eliminating the first stage of audio.

Use as an Audio Amplifier

The SY–227 is a very good audio amplifier tube because of the low hum which results from the use of this tube. It has a fairly low plate impedance, so that the low notes are amplified considerably, resulting in a more uniform response throughout the audio frequency range. The usual voltages employed are 135 on the plate with a grid bias of 9 volts.

Use as a Radio Amplifier

The SY–227 has several advantages over other three element tubes as a radio frequency amplifier. In the first place, its interelectrode capacity is much less than that of any other three element tube. In the second place, it has a cathode which is insulated from the heater. This allows each tube to obtain its own grid bias from its own current. This results in the elimination of couplings between amplifier tubes, which otherwise occur when a common bias resistor is used.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturer of Incandescent Lamps and Radio Tubes in U. S. A.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 11

FULL WAVE RECTIFIER
SX-280

CHARACTERISTICS

Filament	Coated
Volts	5.0
Amperes	2.0
1. AC Voltage per Plate (volts RMS)	350
DC Output Current (maximum ma.)	125
2. AC Voltage per Plate (maximum volts RMS)	400
DC Output Current (maximum ma.)	110
3. AC Voltage per Plate (maximum volts RMS)	550
DC Output Current (maximum ma.)	135

This rating is permissible only with filter circuits having an input choke of at least 20 h. If desired, a condenser of not more than 0.1 uf. may be used across the input of the filter.

Maximum Overall Length	$5\frac{5}{8}$"
Maximum Overall Diameter	$2\frac{3}{16}$"
Bulb	S-17
Base	SX

Socket:

The Sylvania SX-280 is designed for use in a vertical position. It is provided with a standard "X" base and requires a standard "X" socket. The filament is connected to the filament prongs while the two plates are connected to the grid and plate prongs, respectively.

Filament:

The filament employed in the SX-280 is of the oxide coated type. This filament is operated on alternating current from a five volt winding on the power transformer. The filament voltage should be held close to its rated value of 5 volts. Since the filament current is rather high (2.0 amperes) it is necessary to employ wire of the proper current carrying capacity. It is unnecessary to provide the filament winding with a center tap for most applications.

Circuit Requirements:

The power transformer for use in connection with the SX-280 tube must be provided with two windings, a filament winding as noted in the preceding paragraph and a high voltage center tapped winding.

The A. C. input voltage per plate must be limited to 250 volts RMS when the maximum D. C. load current of 125 milliamperes is drawn from the tube if a capacitative input to the filter is used. If load requirements are such that the D. C. current will never exceed 110 milliamperes, the transformer may be designed to supply an input voltage of 400 RMS volts per plate, with a capacitative input to the filter. It is possible to increase the load current to 135 milliamperes and the input voltage to 550 RMS volts per plate if a filter circuit using a choke of at least 20 henries is employed with no input condenser or a condenser of 0.1 mfd. maximum capacity.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 12

HALF WAVE RECTIFIER
SX-281

CHARACTERISTICS

Filament	Coated
Volts	7.5
Amperes	1.25
AC Plate Voltage (maximum volts RMS)	700
DC Output Current (maximum ma.)	85
Maximum Overall Length	6¼"
Maximum Overall Diameter	2⅛"
Base	Large SX
Bulb	S-19

Socket:

The Sylvania SX-281 is designed for use in a vertical position. It is provided with a standard "X" base and requires a standard "X" socket. The filament is connected to the filament prongs, while the plate is connected to the grid prong, no connection being made to the plate prong.

Filament:

The coated ribbon filament of the SX-281 is designed to operate on alternating current from a 7.5 volt winding on the power transformer. The filament should be held close to its rated value. Since the filament current is rather high (1.25 amperes) it is necessary to employ wire of the proper current carrying capacity. It is usually unnecessary to center tap the filament winding.

Circuit Requirements:

The SX-281 may be employed in a half wave rectifier circuit, or two may be employed in a full wave rectifier circuit.

In the case of the half wave circuit, the high voltage winding of the power transformer is designed to supply to the plate a voltage generally between 600 and 700 volts RMS, depending upon the D. C. output voltage and current desired, as well as upon the constants of the associated equipment.

In the full wave circuit, each half of the high voltage winding of the power transformer is designed to supply a voltage usually between 600 and 700 volts depending upon the load requirements. There will thus be a total A. C. voltage from 1200 to 1400 volts RMS across both halves of the transformer winding.

For use with the half wave circuit, the filter should be of the condenser input type. Filter condensers whose rating is sufficient to withstand the high voltages encountered must be employed. For use with full wave circuit either condenser or choke input may be employed.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 13

POWER AMPLIFIER
SX-210

CHARACTERISTICS

Filament	Thoriated Tungsten
Volts	7.5
Amperes	1.25
Plate Volts	425 Maximum
Grid Bias Volts*	-39

Operating Conditions and Characteristics:

Filament Voltage	7.5	7.5	7.5	volts
Plate Voltage	250	350	425	volts
Grid Voltage	*-22	*-31	*-39	volts
Amplification Factor	8	8	8	
Plate Resistance	6000	5150	5000	ohms
Mutual Conductance	1330	1550	1600	micromhos
Plate Current	10	16	18	ma.
Undistorted Power Output	400	900	1600	mw.

Direct Interelectrode Capacitances:

Grid to Plate	8 uuf.
Grid to Filament	5 uuf.
Plate to Filament	4 uuf.

Maximum Overall Length	5 5/8"
Maximum Overall Diameter	2 3/16"
Bulb	S-17
Base	Large "X"

*Grid volts measured from mid-point of AC operated filament.

Circuit Requirements:

The SX–210 tube is intended for use in power amplifiers, either of the built-in or external types, for supplying large quantities of undistorted power to heavy duty loud speakers where great volume is required. It supplies a large reserve power when operated under the recommended conditions of plate and grid voltage. This insures the amplification, without distortion, of the strongest signals which may be desired in ordinary home use, the reserve being sufficient to take care of the peaks in the signal voltage, which often attain several times the value of the mean voltage.

In order to produce these results a comparatively high plate voltage is required, and a correspondingly high negative grid bias. These voltages may be obtained economically from the AC lighting service lines using one or more rectifying tubes to rectify the AC to pulsating DC voltage, with a condenser and filter system to smooth out the pulsations which would cause a hum. Such devices are generally designated as "B" and "C" supply units or power packs, and are built in as part of most power amplifiers. Operation of this tube at plate voltage lower than 250 is not recommended.

The SX–210 may also be used as an oscillator or modulator in transmission systems.

It has a high mutual conductance, an amplification constant which is high in comparison with other types of power output tubes, and a moderate plate impedance, enabling it to match the impedance of most of the devices to which it will be required to supply power. It's plate current consumption is relatively small, thereby conserving the demand made on the "B" supply unit.

The construction of the SX–210 tube is distinctly different in several respects from that of tubes of the same type made by most other manufacturers. It has a long heavy oxide coated filament instead of the usual short thoriated tungsten filament, which operates at a dull red temperature. This filament insures long life at the maximum plate current at which the tube is rated.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturer of Incandescent Lamps and Radio Tubes in U. S. A.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 14

POWER AMPLIFIER
SX-250

CHARACTERISTICS

Filament	Coated
Volts	7.5
Amperes	1.25
Plate Volts	450 Maximum
Grid Bias Volts*	-84

Operating Conditions and Characteristics:

E_f	7.5	7.5	7.5	7.5	7.5	Volts
E_p	250	300	350	400	450	Volts
E_g	-45*	-54*	-63*	-70*	-84*	Volts
u	3.8	3.8	3.8	3.8	3.8	
R_p	2100	2000	1900	1800	1800	Ohms
G_m	1800	1900	2000	2100	2100	umhos
I_p	28	35	45	55	55	ma.
U.P.O.	1000	1600	2400	3400	4600	mw.

Direct Interelectrode Capacitances:

C_{gp}	9	uuf.
C_{gf}	5	uuf.
C_{pf}	3	uuf.

Maximum Overall Length	6¼"
Maximum Overall Diameter	2 11/16"
Base	Large SX
Bulb	S-21

*Grid volts measured from mid-point of filament.

Socket:

The Sylvania SX-250 is designed for use in a vertical position. It is provided with a standard "X" base and requires a standard "X" socket. The base connections are standard.

Filament:

The coated filament of the SX-250 is designed to be operated from the AC line through a step-down transformer. The filament voltage should be closely held to the rated value of 7.5 volts. Because of the high current all leads in the filament circuit must be of high current carrying capacity.

Circuit Requirements:

The following table shows the operating voltages and characteristics at the most commonly used plate voltages:—

TABLE I

Filament Voltage AC	Plate Voltage (Volts)	Grid Bias Voltage (Volts)	Plate Current Milliamperes	Peak Grid Swing (Volts)	Maximum Undistorted Output (Milliwatts)
7.5	250	–45	28	45	1000
7.5	300	–54	35	54	1600
7.5	350	–63	45	63	2400
7.5	400	–70	55	70	3400
7.5	450	–84	55	84	4600

To prevent distortion and overloading, negative grid bias as shown in Table I should always be used with SX-250. This bias is best obtained by means of the voltage drop through a resistor in the plate return lead. The proper value for a single tube and two tubes in push-pull or parallel is given.

TABLE II

Plate Voltage (Volts)	Grid Bias Voltage (Volts)	Plate Current Milliamperes	Resistor	
			Single Tube Ohms	Two Tubes Ohms
250	–45	28	1600	800
300	–54	35	1550	775
350	–63	45	1400	700
400	–70	55	1275	640
450	–84	55	1520	760

This method of obtaining grid bias is known as self bias and must be used in resistance coupled circuits. In a circuit of this kind if the tube has abnormally high plate current, the grid bias will be increased, decreasing the plate current; resulting in almost normal plate current being taken by the tube.

If increased power output is desired, two SX-250 may be employed in either parallel or push-pull. The parallel connection permits increased power output without any increase in the signal applied to the power stage, while the push-pull connection for maximum power output requires that the input signal to the power stage be doubled.

The maximum undistorted power output of the SX-250 when compared to other power amplifier tubes at maximum operating voltages is as follows:—

Type	Plate Voltage (Volts)	Grid Bias Voltage (Volts)	Plate Current Milliamperes	Maximum Undistorted Power Output Milliwatts
SX-171A	180	-40.5	20	700
SX-210	425	-39.0	18	1600
SX-245	275	-56.0	36	2000
SX-250	**450**	**-84.0**	**55**	**4600**

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturer of Incandescent Lamps and Radio Tubes in U. S. A.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 15

POWER AMPLIFIER
SX-245

CHARACTERISTICS

Filament	Coated
Volts	2.5
Amperes	1.5
Plate Volts	275 Maximum
Grid Bias Volts*	−56

Operating Conditions and Characteristics:

E_f	2.5	2.5	2.5	Volts
E_p	180	250	275	Volts
E_g	−34.5*	−50*	−56*	Volts
u	3.5	3.5	3.5	
R_p	1900	1750	1670	Ohms
G_m	1850	2000	2100	umhos
I_p	27	34	36	ma.
U.P.O.	780	1600	2000	mw.

Direct Interelectrode Capacitances:

C_{gp}	8	uuf.
C_{gf}	5	uuf.
C_{pf}	3	uuf.

Maximum Overall Length	5 5/8"
Maximum Overall Diameter	2 5/16"
Bulb	S-17
Base	Large SX

*Grid volts measured from mid-point of AC operated filament. Self-bias is advisable in all cases; required if grid resistor (max. value 1.0 megohm) is used.

Socket:

The Sylvania SX-245 is designed for use in a vertical position. It is provided with a standard "X" base and requires a standard "X" socket. The base connections are standard.

Filament:

The coated filament of the SX-245 is designed to be operated from a storage battery or from the A. C. line through a step-down transformer. In either case the voltage applied to the filament terminals should be the rated value of 2.5 volts. Because of the high current and low voltage, all connections in the filament circuit must be of particularly low resistance. All filament leads should be of high current carrying capacity.

The filament rating of 2.5 volts permits operation of the power tube from the same voltage source which is used to light the heaters of either SY-227 or SY-224. The saving of an extra filament winding is of particular importance with midget receivers.

Circuit Requirements:

The following table shows the operating voltages and characteristics at the two most commonly used plate voltages:—

TABLE I

Filament Voltage AC AC or DC	Plate Voltage (Volts)	Grid Bias Voltage (Volts)	Plate Current Millamperes	Peak Grid Swing (Volts)	Maximum Undistorted Power Output (Milliwatts)
2.5	180	-34.5	27	34.5	780
2.5	250	-50.0	34	50.0	1600
2.5	275	-56.0	36	56.0	2000

To prevent distortion and overloading, negative grid bias as shown in Table I should always be used with SX-245. This bias is best obtained by means of the voltage drop through a resistor in the plate return lead. The proper value of this resistor is 1550 ohms when 275 volts are used on the plate, 1470 ohms when 250 volts are used on the plate, or 1300 ohms when 180 volts are used. This method of obtaining grid bias is known as self bias and must be used in resistance coupled circuits. In a circuit of this kind if the tube has abnormally high plate current, the grid bias will be increased, decreasing the plate current; resulting in almost normal plate current being taken by the tube.

If the filament is operated from a DC source, the grid and plate returns should be made to the negative filament terminal. If AC is used on the filament, the plate and grid returns should be brought to either the mid tap of the filament winding or the center tap of a 20 ohm resistor across the filament winding.

If increased power output is desired, two SX-245 may be employed in either parallel or push-pull. The parallel connection permits increased power output without any increase in the signal applied to the power stage, while the push-pull connection for maximum power output requires that the input signal to the power stage be doubled.

The maximum undistorted power output of the SX-245 when compared to other power amplifier tubes at maximum operating voltages is as follows:—

Type	Plate Voltage (Volts)	Grid Bias Voltage (Volts)	Plate Current Milliamperes	Maximum Undistorted Power Output (Milliwatts)
SX-171A	180	-40.5	20	700
SX-210	425	-39.0	18	1600
SX-245	**275**	**-56.0**	**36**	**2000**
SX-250	450	-84.0	55	4600

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturers of Radio Tubes and Incandescent Lamps in U. S. A.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 16

SCREEN GRID R. F. AMPLIFIER

(A. C. HEATER)

SY-224

CHARACTERISTICS

*Heater	Coated Uni-potential Cathode			
Volts			2.5	
Amperes			1.75	
Plate Volts			275	Maximum
Screen Volts			90	Maximum
Grid Bias Volts			−3	

Operating Conditions and Characteristics:

Filament Voltage	2.5	2.5	2.5	volts
Plate Voltage	180	180	250	volts
Control Grid Voltage	−1.5	−3	−3	volts
Screen Grid Voltage	75	90	90	volts
**Amplification Factor	420	400	615	
Plate Resistance	400000	400000	600000	ohms
Mutual Conductance	1050	1000	1025	micromhos
Plate Current	4	4	4	ma.
Screen Grid Current	Not over 1/3 plate current.			

Direct Interelectrode Capacitances:

Grid to Plate	0.010 maximum uuf.
Input Capacity	5.0 uuf.
Output Capacity	10.0 uuf.

Overall Length	$4^{11}/_{16}$" – $5^{1}/_{4}$"
Maximum Overall Diameter	$1^{13}/_{16}$"
Cap	0.346"–0.369"
Bulb	S–14
Base	Large "Y"

*Recommended practice is to have no potential difference between heater and cathode. If this practice is not followed, the heater of either type may be made negative with respect to the cathode by not more than 45 volts.

**In general, the amplification per stage in a screen grid stage is determined by the mutual conductance and load impedance.

Circuit Requirements:

The Quick Heating SY-224 has been developed to meet the demand for a quick heating 224 tube which is free from hum.

A special method of insulating the filament has been employed which results in extremely long life. This tube will withstand a considerable voltage fluctuation without impaired life.

The heating time varies from ten to fifteen seconds, depending on local conditions.

The SY-224 may be used as a detector, employing plate rectification. If this is done several volts input may be handled without overloading while the output voltage will be sufficiently high to apply directly to the grid of the power tube, thus eliminating the customary first audio stage with its distortion. In order to use this tube to best advantage it is necessary that shielding be employed to keep electrostatic coupling between plate and control grid circuit at a minimum.

The following changes in operating voltages heretofore employed with the SY-224 tube are recommended.

The control grid bias voltage is increased from 1½ volts to 3 volts, while the screen grid voltage should be raised from 75 volts to 90 volts.

The plate voltage may be increased to 250 volts. Under these conditions the plate resistance is greatly increased. This is greatly desired in connection with intermediate amplifiers.

The control grid bias voltage is increased so that a larger grid swing may be handled, especially in the third RF stage, without overloading taking place. This will prevent to a large extent carrier modulation. The loss in gain due to increasing the control bias is compensated for by increasing the screen grid voltage.

If the potential of the screen-grid is varied to control volume it is very necessary that a "bleeder" or shunt resistance be employed to furnish a larger part of the current which flows through the biasing resistor so that the bias will remain constant regardless of volume control position. A dual volume control should be employed so that the input signal applied to the first tube is reduced, as well as the screen-grid voltage.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturers of Radio Tubes and Incandescent Lamps in U. S. A.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 17

DETECTOR and AMPLIFIER
SX-230

CHARACTERISTICS

Filament	Coated
Volts	2.0
Amperes	0.060
Plate Volts	90 Maximum
Grid Bias Volts	–4.5

Operating Conditions and Characteristics:

Filament Voltage	2.0 volts
Plate Voltage	90 volts
Grid Voltage	–4.5 volts
Amplification Factor	9.3
Plate Resistance	13000 ohms
Mutual Conductance	700 micromhos
Plate Current	1.8 ma.
Undistorted Power Output	.6 mw.

Direct Interelectrode Capacitances:

Grid to Plate	6.4 uuf.
Grid to Filament	3.7 uuf.
Plate to Filament	2.1 uuf.

Maximum Overall Length	4¼"
Maximum Overall Diameter	1⅝"
Bulb	S–12
Base	Small "X"

If a grid coupling resistor is used, its maximum value should not exceed 2.0 megohms.

Circuit Requirements:

This tube has been developed to supply a general purpose tube for portable receivers. There are two requirements which have to be met in this tube. First, the filament power consumption must be as low as possible; second, this tube must be as free from microphonic disturbances as possible.

The plate is rectangular in form similiar to that used in other tubes except it is considerably smaller.

The characteristics of this tube are similiar to the SX–199, and the SX–230 may be used interchangeably with the SX–199 if the filament voltage is reduced to 2.0 volts. It is possible that a tuned radio frequency receiver may require re-neutralization when the SX–230 is used in the radio frequency stages.

The SX–230 may be used in circuits of convential design, either as a radio frequency amplifier, a detector, or an intermediate audio amplifier. The grid and plate circuit returns should be completed through a C battery of correct voltage, to the negative filament terminal except in the case of a grid-leak-condenser detector, where the grid return is made directly to the positive side of the filament.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturer of Incandescent Lamps and Radio Tubes in U. S. A.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 18

POWER OUTPUT TUBE
SX-231

CHARACTERISTICS

Filament Voltage	2.0 volts
Filament Current	0.130 amperes
Plate Voltage, Maximum and Recommended	135 volts
Grid Voltage (C-Bias)	-22.5 volts
Plate Current	7 Milliamperes
Plate Resistance	4200 ohms
Amplification Factor	3.8
Mutual Conductance	900 Micromhos
Undistorted Power Output	170 Milliwatts

Approximate Direct Interelectrode Capacitances:

Grid to Plate	6 mmf.
Grid to Filament	3.5 mmf.
Plate to Filament	2 mmf.

Maximum Overall Dimensions:

Length	4¼"
Diameter	1⅜"
Base	Small "UX"
Socket	UX

Circuit Requirements:

The SX-231 is a power output tube designed for use in portable receivers or wherever economy of operation is essential.

The filament is of the oxide coated type and is assembled in the shape of a V. The filament requires two volts and draws 130 milliamperes. The filament should be operated between 1.9 and 2.1 volts and the latter figure should not be exceeded.

The maximum plate voltage for this tube is 135 volts. It is recommended that this voltage be employed whenever possible. If a lower voltage is used, the output will be somewhat decreased. The proper grid bias for 135 volts is 22½ volts. It is important that the grid bias be kept at this value or else the plate current will rise to a high value which will impair the performance of the tube. The grid return should be made to the negative side of the filament.

If the correct bias is used, it is not necessary to employ a speaker filter or transformer as with other power tubes, since the plate current relatively small.

The SX-231 is equipped with a base which permits it to fit in a UX socket. The tube should operate in a vertical position.

The SX-231 is interchangeable with the SX-120 if the filament voltage is reduced to two volts. The undistorted power output of the SX-231 is approximately one and one-half times that of the SX-120.

Reactivation of this tube should not be attempted as the filament is of the coated type. Extreme care is taken in the handling of this filament at all stages of manufacture from the preparation of the base metal to the completed wire. Ample life tests have proven that the tube will give long life and will perform satisfactorily during that life. Because of coated filament employed in this tube slight traces of gas will not affect performance. Special precautions are taken, however, to obtain a high vacuum.

The filament emission is approximately five times greater than in the 120 type of tube while the filament power consumption is only two-thirds as much. This will account for the increased power capacity of this tube over the 120 type.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 19

SCREEN GRID TUBE
SX-232

CHARACTERISTICS

Filament Voltage	2.0 volts
Filament Current	0.06 amperes
Plate Voltage, Maximum and Recommended	135 volts
Grid Voltage (C-Bias)	–3 volts
Screen Voltage Maximum	67.5 volts
Plate Current	1.5 milliamperes
Screen Current	⅓ of plate current
Plate Resistance	800,000 ohms
Amplification Factor	440
Mutual Conductance	550 microhmos
Effective Grid-Plate Capacitance	0.02 mmf. max.

Dimensions:

Maximum Overall Length	5¼"
Maximum Diameter	1 13/16"
Control Grid Contact Cap (Diameter)	.346 - .369"
Base	Large "UX"
Socket	UX

Circuit Requirements:

The SX-232 is a screen grid tube suitable for use as a radio-frequency amplifier, detector and frequency amplifier. Its chief use will be found as a radio-frequency amplifier and detector.

The filament employed in the SX-232 is of the oxide coated type, and is similar to that of the filament in the SX-230 tube. This filament is very rugged considering its size. Special precautions are taken in coating the filament and extensive life tests have shown very satisfactory results. Special precautions have been taken to make this tube as microphonic free as possible.

RADIO FREQUENCY AMPLIFIER

The SX-232 tube under normal operating conditions requires three volts for control grid bias. This may be obtained by batteries, or by means of a self bias arrangement, consisting of a resistor. The latter is preferable if possible, since the bias will adjust itself automatically and permit the tubes to be operated under constant conditions, as the batteries will gradually run down.

The SX-232 is a high impedance tube and must be worked into a high impedance if reasonable amplification is expected. Transformer or impedance coupling is generally used with this tube.

It is, of course, necessary to use ample shielding to reduce electrostatic and magnetic couplings as far as possible. The input and output circuits of each tube should be isolated as much as possible. Considerably more amplification is possible with this tube than with the SX-222.

DETECTOR

The SX-232 tube may be used as a resistance coupled detector to feed the first audio amplifier. The plate should range from 150,000 to 300,000 ohms. The screen grid may be fed through a series resistor since the screen grid current is reduced to a very small value. This resistor should be of such value to insure that the screen grid voltage is less than half of the plate voltage.

AUDIO FREQUENCY AMPLIFIER

The SX-232 tube is suitable for use in a resistance coupled amplifier. The plate resistor should not be higher than 250,000 ohms or a considerable loss in quality will result. It will be necessary to make certain that the screen grid voltage at the tube is not more than half of the plate voltage or the tube will not operate properly.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
REG. U.S. PAT. OFF.
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 20

TUBES for SPARTON, CONTINENTAL and AC DAYTON RECEIVERS

SY-485
SX-182B
SX-183

These tubes have been developed to meet the demand for a complete line of SYLVANIA radio tubes for all receivers.

DETECTOR AND AMPLIFIER

SY-485

CHARACTERISTICS

Filament Voltage	3.0	volts
Filament Current	1.4	amperes
Plate Voltage	150	volts
Grid Voltage	−7.5	volts
Plate Current	6	ma.
Plate Resistance	10,000	
Amplification Factor	12.5	
Mutual Conductance	1250	

The SY–485 is a quick heating indirectly heated cathode type amplifier and detector. Especial precautions have been taken to make these tubes free from gas trouble.

POWER AMPLIFIER

SX-182B

Filament Voltage	5.0	volts
Filament Current	1.25	amperes
Plate Voltage	250	volts
Grid Voltage	−35	volts
Plate Current	16	ma.
Plate Resistance	3000	
Amplification Factor	5	
Mutual Conductance	1500	

POWER AMPLIFIER

SX-183

CHARACTERISTICS

Filament Voltage	5.0	volts
Filament Current	1.25	amperes
Plate Voltage	250	volts
Grid Voltage	−60	volts
Plate Current	25	ma.
Plate Resistance	1800	
Amplification Factor	3.0	
Mutual Conductance	1600	

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Largest Licensed Manufacturers of Radio Tubes and Incandescent Lamps in U. S. A.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 21

SCREEN GRID R. F. AMPLIFIER

S-36

CHARACTERISTICS

Heater*	Coated Uni-potential Cathode					
Volts	6.3					
Amperes	0.3					
Plate Volts	250					Maximum
Screen Volts	90					Maximum
Grid Bias Volts	-3					

Operating Conditions and Characteristics:

Filament Voltage	6.3	6.3	6.3	6.3	6.3	Volts
Plate Voltage	90	135	135	180	250	Volts
Grid Voltage	-1.5	-1.5	-1.5	-3.0	-3.0	Volts
Screen Voltage	55	67.5	75	90	90	Volts
Amplification Factor**	170	315	275	370	440	
Plate Resistance	200000	300000	250000	350000	400000	ohms
Mutual Conductance	850	1050	1100	1050	1100	micromhos
Plate Current	1.8	3	3.5	3.1	3.5	ma.
Screen Grid Current	Not over 1/5 of plate current					

Direct Interelectrode Capacitances:

Grid to Plate	0.010	uuf.
Grid to Cathode	3.7	uuf.
Plate to Cathode	4.2	uuf.

Maximum Overall Length	4⅝ to 4 11/16"
Maximum Overall Diameter	1⅝"
Cap	0.346" to 0.369"
Bulb	S-12
Base	Small "Y"

*Heater to cathode bias should not not exceed 45 volts.

**In general, the amplification per stage in a screen grid stage is determined by the mutual conductance and load impedance.

Filament:

The "triple fold" filament may be operated on AC or DC, the voltage required being 6.3 volts. The filaments may be operated in series or parallel. Since these tubes give satisfactory performance over a wide range of filament voltages, it is not necessary to employ taps on the primary of the power transformer. The center of the filament winding or a center tapped resistor may be employed to tie the filament winding preferably to the cathode. Bias up to 45 volts between heater and cathode may be employed, but the heater should be biased negative with respect to the cathode.

The use of this filament results in very rapid heating of the tube so that the receiver comes into action much sooner than with other makes of these tubes. When these tubes are operated on AC the hum level is greatly reduced over that ordinarily encountered.

Circuit Requirements:

This screen grid tube may be used as a radio frequency amplifier, a detector or an intermediate frequency amplifier, in circuits especially designed for it.

This tube employs an indirectly heated cathode of special design which permits a heater voltage range of from 5.5 to 8.5 volts without appreciably affecting the performance or serviceability of the tube. No resistor in the heater circuit is required for this type operated from a 6 volt battery.

The socket required for the S-36 is a standard "Y" type and may be mounted to hold the tube vertically or horizontally. The base connections are same as for the SY-224.

It is necessary to employ adequate shielding and filtering of leads if stable operation of the S-36 is to be obtained in radio frequency circuits.

The voltage between heater and cathode should not exceed 45 volts.

Volume control of the receiver should be accomplished by varying the control grid bias.

The screen grid voltage should not be obtained by means of a series resistor but rather by a fixed tap so that no variation of screen voltage will occur with different tubes.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 22

GENERAL PURPOSE AMPLIFIER
S-37

CHARACTERISTICS

Heater*	Coated Uni-Potential Cathode				
Volts				6.3	
Amperes				0.3	
Plate Volts				250	maximum
Grid Bias Volts				-20	
Operating Conditions and Characteristics:					
Filament Voltage	6.3	6.3	6.3	6.3	volts
Plate Voltage	90	135	180	250	volts
Grid Voltage	-6	-9	-13.5	-20	volts
Amplification Factor	9	9	9	9.2	
Plate Resistance	11500	10000	10000	9400	ohms
Mutual Conductance	780	900	900	980	micromhos
Plate Current	2.6	4.3	4.7	5.5	ma.

Direct Interelectrode Capacitances:

Grid to Plate	2.1 uuf.
Grid to Cathode	3.3 uuf.
Plate to Cathode	2.5 uuf.

Maximum Overall Length	4¼"
Maximum Overall Diameter	1⅝"
Bulb	S-12
Base	Small "Y"

*Heater to cathode bias should not exceed 45 volts.

Filament:

The "triple fold" filament may be operated on AC or DC, the voltage required being 6.3 volts. The filaments may be operated in series or parallel. Since these tubes give satisfactory performance over a wide range of filament voltages, it is not ncesssary to employ taps on the primary of the power transformer. The center of the filament winding or a center tapped resistor may be employed to tie the filament winding preferably to the cathode. Bias up to 45 volts between heater and cathode may be employed, but the heater should be biased negative with respect to the cathode.

The use of this filament results in very rapid heating of the tube so that the receiver comes into action much sooner than with other makes of these tubes. When these tubes are operated on AC the hum level is greatly reduced over that ordinarily encountered.

Circuit Requirements:

The S-37 may be used in circuits of conventional design as an amplifier, detector, oscillator or automatic volume control tube.

This tube employs an indirectly heated cathode of special design which permits a heater voltage range of from 5.5 to 8.5 volts without appreciably affecting the performance or serviceability of the tube. No resistor in the heater circuit is required for this type operated from a 6 volt battery.

The socket required for the S-37 is a standard "Y" type and may be mounted to hold the tube vertically or horizontally. The base connections are same as for the SY-227.

The voltage between heater and cathode should not exceed 45 volts.

The S-37 may be used as either type of detector. If grid leak detection is used, a condenser of .00025 uf and a grid leak of from 1 to 5 megohms will give excellent sensitivity. However, more stable operation and better quality will be obtained by using a low value of grid leak. For plate detection the bias may be secured either from a fixed voltage source or by automatic biasing from a resistor in the cathode circuit.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
REG. U.S. PAT. OFF.
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 23

POWER AMPLIFIER PENTODE

SY-238

CHARACTERISTICS

Heater*	Coated Uni-potential Cathode
Volts	6.3
Amperes	0.3
Plate Volts	135
Screen Volts	135
Grid Bias Volts	−13.5

Operating Conditions and Characteristics:

Filament Voltage	6.3	6.3	Volts
Plate Voltage	100	135	Volts
Grid Voltage	−9**	−13.5**	Volts
Screen Voltage	100	135	Volts
Amplification Factor	80	100	(approx.)
Plate Resistance	84000	102000	(approx.) ohms
Mutual Conductance	950	975	micromhos
Plate Current	7	9	ma.
Screen Grid Current	2	2.5	ma.
Power Output	200	525	mw.
Load Impedance	8500	13500	ohms

Direct Interelectrode Capacitances:

Grid to Plate	0.30 uuf.
Grid to Cathode	4.1 uuf.
Plate to Cathode	8.5 uuf.

Maximum Overall Length	4 3/16" to 4 11/16"
Maximum Overall Diameter	1 3/16"
Cap	0.346" to 0.369"
Bulb	S-12
Base	Small "Y"

*Heater to cathode bias should not exceed 45 volts.

**If the tube is self-biased, the biasing resistor should be by-passed by a large condenser. With self-bias, the maximum grid resistor is 1 megohm; without self-bias, the grid resistor should not exceed 0.5 megohm.

The SY–238 is a screen grid designed to give large audio power output for small signal voltages impressed on the grid. This is made possible by the addition of a "suppressor" grid between the screen and the plate. This grid is connected to the cathode and is therefore at the same potential and practically eliminates secondary emission effects which reduce the power output of tetrodes.

This tube employs an indirectly heated cathode of special design which permits a heater voltage range of from 5.5 to 8.5 volts without appreciably affecting the performance or serviceability of the tube. No resistor in the heater circuit is required for this type operated from a 6 volt battery.

The socket required for the SY–238 is a standard "Y" type and may be mounted to hold the tube vertically or horizontally.

The control grid is brought out at the top of the tube. The base connections are same as for the SY–236.

The load impedance should be maintained fairly constant at the recommended value in order to obtain as high an output as possible consistent with a minimum of distortion.

The voltage between heater and cathode should not exceed 45 volts.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

TECHNICAL BULLETIN
ON
SYLVANIA RADIO TUBES

B U L L E T I N 24

Pentode Power Amplifier

SY-247

CHARACTERISTICS

Filament Voltage	2.5	Volts
Filament Current	1.5	Amperes
Plate Voltage	250	Volts
Plate Current	32.5	Milliamperes
Control Grid Bias	16.5	Volts
Screen Grid Potential	250	Volts
Screen Current	7	ma
Plate Impedance	38000	ohms
Mutual Conductance	2500	micromhos
Power Output	2.5	watts
Recommended Load	7000	ohms

The tube employs a standard Y type base and is the same physical size as the SX-245. The base connections are as follows:

Filament standard heater prongs.

Control grid standard control grid prong for SY-227.

Screen grid standard cathode prong for SY-227.

Plate standard plate prong for SY-227.

"It's the Tube that makes the Radio"

The power output pentode is a five element tube containing three grids, a plate and a filament or cathode. This tube differs from a tetrode in that an extra "suppressor" grid is inserted between the screen and plate. This grid is connected to the center of the filament. Because of its potential it prevents slow speed electrons from leaving the plate and reaching the screen, thus reducing secondary emission, while it has no great effect on electrons flowing at higher speeds to the plate from the cathode. In the absence of this grid, secondary emission effects limit the power output of a tetrode very greatly while the removal of this limitation in the pentode greatly extends the operating range.

It is common practice to design the output load of a triode to be twice the plate impedance of the tube. The Pentode exhibits different characteristics and it will be found that the best load ranges from 15 to 30% of the plate impedance of the tube, 7000 ohms being satisfactory for normal operating conditions with the SY-247.

Power sensitivity is defined as the square root of power delivered to the load divided by the RMS value of applied signal voltage to the grid. The following table shows a comparison of various types of tubes for

power sensitivities. The data in the table assumes that a peak signal equal to the grid bias is applied to the grid.

Type	Watts	Sensitivity
SX-112A	.195	.0594
SX-171A	.700	.0292
SX-245	1.60	.0358
SX-250	4.50	.0239
SY-247	2.85	.1326

In order to use the SY-247 Pentode in a receiver there are certain precautions which must be observed in order to secure best results. The third harmonic is present in the output and the operating conditions must be so chosen that this is kept below an objectionable value. The following data shows second and third harmonic components for various plate loads for a typical tube and is of importance to the receiver designer.

Load R	% Second Harmonic	% Third Harmonic	Watt Output
4000	3.9	3.8	2.15
6000	1.7	5.4	2.60
8000	1.7	6.7	2.80
10000	5.5	8.0	2.77
12000	10.9	9.0	2.66
16000	17.8	9.3	2.40

The plate impedance of the pentode is very high and the load impedance must be high compared with that used for ordinary tubes. Because of the high plate current it is necessary to employ an air gap in the coupling device to eliminate core saturation to permit high inductance values to be economically obtained.

ISSUED BY

Sylvania Products Company

Emporium, Pennsylvania

TECHNICAL BULLETIN
ON
SYLVANIA RADIO TUBES

B U L L E T I N 25

Super-Control Tetrode

SY-235

CHARACTERISTICS

Heater Voltage	2.5	Volts
Heater Current	1.75	Amperes
Plate Voltage	250	Volts
Screen Voltage	90	Volts
Control Grid Voltage	-3.0	Volts
Plate Current	5.0	Ma
Screen Current	.5	Ma
Plate Resistance	350,000	
Amplification Factor	370	
Mutual Conductance	1,050	

Direct Interelectrode Capacitances

Grid to Plate	0.010	mmf.
Input	5	mmf.
Output	10	mmf.

Overall Lengths	4 11/16"-5 1/4"
Max. Overall Diameter	1 3/16"
Cap	0.346" - 0.369"
Bulb	S-14
Base	SY

Same base connections as SY-224

"It's the Tube that makes the Radio"

The Super-Control tube has been developed to retain the advantages of the '24 tube and to eliminate some of the disadvantages which have arisen in using this type.

The high amplification factor of the tetrode, while it resulted in improved receiver performance, in general, did however cause certain undesirable effects. The tetrode of '24 type operates with a lower control grid bias than triodes for the same plate voltage and therefore strong local signals would drive the grids of the amplifier tubes so far negative that plate current cut-off resulted. Under these conditions the local signal modulated the desired signal, modulation distortion was increased and modulation hum became evident.

In the type 235 tube the plate current control grid voltage curve is so shaped that cut-off of plate current does not occur until the grid bias has been increased greatly. This reduces the higher order curvature which is responsible for the defects mentioned above. The construction employed in this tube is such that at normal voltages the high amplification of the '24 tube is obtained while at high control grid biases the low distortion characteristics of a low mu tube are automatically obtained.

It will generally be possible to eliminate the pre-selector stage so universally used during the past Season, between the antenna and first radio frequency amplifier.

Elimination of this stage will reduce the receiver noise since the attenuation between the antenna and first grid has been removed, requiring less amplification per stage for the same results. The ratio of signal to tube noise or "hiss" will thus be greatly increased.

The 235 tube is designed for volume control by variation of the control grid bias and either manual or automatic volume control may be employed. The maximum bias required for satisfactory volume control range will depend on the number of stages being controlled and will range from thirty to fifty volts with present tubes. Provision should be made so that the control grid bias will not be reduced lower than three volts.

Briefly the advantages of the 235 tube are as follows:

(a) Decreased modulation distortion
(b) Decreased cross talk
(c) Decreased hum modulation
(d) Decreased receiver noise
(e) Improved range of volume control.

ISSUED BY

Sylvania Products Company

Emporium, Pennsylvania

TECHNICAL BULLETIN
ON
SYLVANIA RADIO TUBES

B U L L E T I N 26

Variable Mu Tetrode

SY-551

CHARACTERISTICS

Heater Voltage	2.5	Volts
Heater Current	1.75	Amperes
Plate Voltage	250	Volts
Screen Voltage	90	Volts
Control Grid Voltage	-3.0	Volts
Plate Current	4.0	Ma
Screen Current	.5	Ma
Plate Resistance	500,000	
Amplification Factor	525	
Mutual Conductance	1,050	

Direct Interelectrode Capacitances

Grid to Plate	0.010	mmf.
Input	5	mmf.
Output	10	mmf.

Overall Lengths	4 11/16"-5 1/4"
Max. Overall Diameter	1 3/16"
Cap	0.346" - 0.369"
Bulb	S-14
Base	SY

Same base connections as SY-224

"It's the Tube that makes the Radio"

The Variable Mu tube has been developed to retain the advantages of the '24 tube and to eliminate some of the disadvantages which have arisen in using this type.

The high amplification factor of the tetrode, while it resulted in improved receiver performance, in general, did however cause certain undesirable effects. The tetrode of '24 type operates with a lower control grid bias than triodes for the same plate voltage and therefore strong local signals would drive the grids of the amplifier tubes so far negative that plate current cut-off resulted. Under these conditions the local signal modulated the desired signal, modulation distortion was increased and modulation hum became evident.

In the type 551 tube the plate current control grid voltage curve is so shaped that cut-off of plate current does not occur until the grid bias has been increased greatly. This reduces the higher order curvature which is responsible for the defects mentioned above. The construction employed in this tube is such that at normal voltages the high amplification of the '24 tube is obtained while at high control grid biases the low distortion characteristics of a low mu tube are automatically obtained.

It will generally be possible to eliminate the pre-selector stage so universally used during the past Season, between the antenna and first radio frequency amplifier. Elimination of this stage will reduce the receiver noise since the attenuation between the antenna and first grid has been removed, requiring less amplification per stage for the same results. The ratio of signal to tube noise or "hiss" will thus be greatly increased.

The 551 tube is designed for volume control by variation of the control grid bias and either manual or automatic volume control may be employed. The maximum bias required for satisfactory volume control range will depend on the number of stages being controlled and will range from thirty to fifty volts with present tubes. Provision should be made so that the control grid bias will not be reduced lower than three volts.

Briefly the advantages of the 551 tube are as follows:

(a) Decreased modulation distortion
(b) Decreased cross talk
(c) Decreased hum modulation
(d) Decreased receiver noise
(e) Improved range of volume control.

ISSUED BY

Sylvania Products Company

Emporium, Pennsylvania

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 27

TRIPLE-GRID POWER AMPLIFIER

89

RATING AND CHARACTERISTICS

Heater Voltage	6.3 Volts
Heater Current	0.4 Ampere
Overall Length	4 9/16" — 4 17/64"
Maximum Diameter	1 9/16"
Bulb	ST-12
Base	Small 6-pin

CLASS A POWER AMPLIFIER-TRIODE CONNECTION
(Grids No. 2 and No. 3 tied to plate; grid No. 1 is control-grid)

Operating Conditions and Characteristics:

Heater Voltage	6.3	volts
Plate Voltage*	160	volts
Grid Voltage (grid No. 1 only)	-20	volts
Load Resistance (optimum for maximum U. P. O.)**	7,000	ohms
Amplification Factor	4.7	
Plate Resistance	3,000	ohms
Mutual Conductance	1,570	micromhos
Plate Current	17	milliamperes
Undistorted Power Output (5% 2nd harmonic)	300	milliwatts

*Maximum plate voltage = 180 volts.

**Approximately twice this value is recommended for load of driver for Class B stage.

CLASS A POWER AMPLIFIER-PENTODE CONNECTION

(Grid No. 3 tied to cathode; grid No. 2 is screen; grid No. 1 is control-grid)

Operating Conditions and Characteristics:

Heater Voltage	6.3		volts
[1]Plate Voltage	163	180	volts
[2]Screen Voltage (grid No. 2)	163	180	volts
Grid Voltage (grid No. 1)	–17	–18	volts
Load Resistance	8,000	9,000	ohms
Amplification Factor	125	135	
Plate Resistance	~~7,900~~ 79,000	82,500	ohms
Mutual Conductance	1,575	1,635	micromhos
Plate Current	17	20	milliamperes
Screen Current	2.5	3.0	milliamperes
Power Output	1.25	1.5	watts

CLASS B POWER AMPLIFIER-TRIODE CONNECTION

(Grid No. 3 tied to plate; grids No. 2 and No. 1 connected together)

Operating Conditions and Characteristics:

Heater Voltage		6.3	volts
Plate Voltage		180	volts max.
Grid Voltage (grids No. 1 and No. 2 together)		0	volts
Plate Current per Tube (Maximum)		3	milliamperes
Peak Plate Current per Tube (Max.)		75	milliamperes
Maximum Grid Dissipation per Tube		0.35	watts
Maximum Continuous Power Output (2 tubes)		6	watts
Load Resistance per Tube	3,400	2,350	ohms
[3]Average Power Output (2 tubes)	[4]2.5	[5]3.5	watts

[1]Maximum plate voltage = 180 volts.

[2]Maximum screen voltage = 180 volts.

[3]Power measured across indicated value of resistor in plate circuit of each tube, with indicated signal applied through 250 ohm resistance in the grid circuit for the 2.5 watt case and through a 500 ohm resistance for the 3.5 watt condition.

[4]With 5% total harmonic distortion and signal input of 16 volts R. M. S.

[5]With 8% total harmonic distortion and signal input of 24 volts R. M. S.

when reproducing broadcast programs will be well below this value. This condition is typical with Class B operation, and the fact that peak plate current per tube is shown as 75 ma should be taken into consideration only from the standpoint of the necessity of supplying these tubes with current from a source having good regulation. In estimating the average load on the battery or B supply device, the peak figure can be disregarded almost entirely.

Operation:

The tube may be operated in either a vertical or horizontal position. In operating the tube horizontally it is preferable to keep the plane of the press vertical, in order to secure maximum strength—this may be done by seeing that the socket is so placed that the large holes for the filament prongs are positioned with one vertical above the other. (This allows two possible positions for the socket; one rotated 180 degrees from the other, and the position which permits best wiring of the socket may be selected.) The large plate power dissipated by this tube under some conditions of service causes the bulb to become overheated, and adequate ventilation should be provided around the bulb to prevent overheating. The use of a tight fitting shield should be avoided.

The heater is designed to operate under the same operating conditions as that imposed on other 6.3 volt tubes. It is desirable to maintain operation within the range of 5.5 to 7.5 volts in order to secure normal life. To secure minimum variations in heater voltage ur 'er service conditions when operating from an automobile battery, the heaters should be connected directly across the battery terminals, and the leads to the battery should have minimum resistance. It is preferable to keep the heater cathode voltage below 45 volts.

Resistors used in the grid circuit of Type 89, operating as a Class A amplifier (either pentode or triode) should not exceed 1 megohm when the tube is self-biased. Without self-bias this resistor should be limited to .5 megohm. Excessive resistances in the grid circuits may cause loss of bias and overheating and damage to the tube.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed In U. S. A.

power sensitivity of the 89 is less than that of Type 41; this difference amounts to approximately 25%. (The peak signal voltage for Type 89 is 17 volts, while with the same total plate voltage the peak signal required by Type 41 is 12.5 volts).

The increased flexibility of Type 89 will be noted when its characteristics as Class A power amplifier triode and Class B output tube are noted. As a Class A triode tube the rated plate current of 17 milliamperes is several times the maximum permissible current for Type 37, and the power output obtainable, 300 milliwatts, is approximately double that given by the latter tube. The chief use of the tube in this class of service is as a driver tube to operate two additional 89s as Class B output tubes. It will be noted that the maximum grid dissipation per tube as a Class B output tube is 350 milliwatts per tube, or 700 milliwatts for a pair of 89s. Thus the output of a single 89 in Class A service will not be sufficient to drive a pair of 89s to 6 watts output. The output obtainable is on the order of 3 watts. It should be remembered that the interstage transformers used with Class B tubes seldom exceed 60% efficiency, so that the power input of the succeeding stage will be reduced to less than 200 milliwatts. In some cases it may be preferable to employ two Type 37 tubes in push-pull as drivers. The gain of such push-pull stage being approximately the same because of the higher amplification factor of Type 37, and the normal power output approximately the same. The power output obtainable from a pair of 37 tubes is 300 milliwatts with normal excitation, and the tubes may be over-loaded to a greater extent than is possible with Type 89 without the rapid increase in harmonic distortion. The plate current required is also appreciably less than that taken by Type 89, which may be an important factor in instances where the capacity of the batteries or B battery supply is limited. The total plate current required by two Type 37 tubes is 9.4 ma as compared with 17 ma taken by Type 89.

When the grids are connected for Class B power output service, a high amplification factor is secured by connecting Number 1 and Number 2 grids together, as already mentioned. This is similar to the connection employed in Type 46, permitting operation at zero control grid bias with high values of plate voltage. The plate current varies with the signal applied to the grids of the Class B stage, starting at 3 ma per tube without signal and reaching a maximum of approximately 50 ma per tube at the highest output obtainable of 6 watts under average signal conditions, and with a receiver designed to give the maximum power output of approximately 3 watts, the plate current taken by a pair of 89s will seldom exceed 20 to 25 ma when read on a DC meter in the plate supply lead, and the average current

Type 89 is a pentode power amplifier tube of the cathode type designed especially for use in automobile and similar types of receivers. The tube is quite similar in characteristics to Type 41. The number of useful applications for the tube being increased by bringing the suppressor grid out to a separate base pin, and by special design of each of the three grids which are required to secure pentode characteristics. This construction makes it possible to use the tube not only as a pentode, but also as either a Class A or Class B power output triode.

In normal service as a pentode, the arrangement of grids is entirely conventional. The Number 1 grid, nearest to the cathode, is the control grid; Number 2 grid, placed just outside of the control grid, acts as the screen grid; and Number 3 grid, between screen grid and plate, is connected back to the cathode externally to act as a suppressor grid. When operation as a Class A power amplifier is desired, Number 2 and Number 3 grids are connected to the plate and act as a single electrode; the Number 1 grid being used as a control grid in the normal manner. To operate the tube as a Class B output tube, it is only necessary to connect Number 1 and Number 2 grids together, utilizing these grids as the control grid (thus securing the necessary high amplification factor), while Number 3 grid is connected to the plate.

Type 89 is approximately the same in physical dimensions as Type 38, except that the bulb shape differs slightly (the ST-12 bulb is used) and a six prong base is used in place of a five prong. The tube is not interchangeable with Type 38 in ordinary service, as the characteristics differ appreciably, this difference being essential in securing increased power output from the tube. A top cap is provided for the control grid connection similar to the arrangement with Type 38.

As may be determined from an inspection of the ratings given on preceding pages, the various connections employed on the three grids determined the characteristics of the tube. In designing the tube great care was required in order to secure the desired performance with any type of connection, but once the proper grid structure is determined it is only necessary to arrange the external connections properly to secure the desired performance.

Characteristics:

It will be noted that when operated as a pentode the characteristics differ only slightly from those obtained with Type 41. The slightly decreased amplification factor permits a higher grid bias to be applied to the control grid. The signal voltage must be correspondingly increased in order to secure full power output. Thus the

TECHNICAL BULLETIN
ON
SYLVANIA RADIO TUBES

B U L L E T I N 27

Power Triode

SY-171C

CHARACTERISTICS

Heater Voltage	6.5	**Volts**
Heater Current	.275	**Amps**
Plate Voltage	135	**Volts**
Plate Current	10.0	**Ma**
Grid Voltage	-12.0	**Volts**
Mutual Conductance	1400	
Amplification Factor	6.5	
Plate Resistance	4500	

Maximum Overall Dimension-

Length	4-1/4"
Diameter	1-9/16"

Bulb	S-12
Base	Small T
Socket	T

"It's the Tube that makes the Radio"

The type SY-171C is a power output tube employing an indirectly heated cathode and is especially designed for automotive use. The amplification factor of this tube is higher than the SX-171A, being 6.5. The plate resistance is increased somewhat. The power output at rated voltages of 135 volts plate and a grid bias of 12.0 volts is .200 watts.

The filament is a tungsten coil running through the cathode, fully and positively insulated from the cathode by a complete ceramic sleeve. With this construction the heating time of the tube is 12 to 15 seconds. A desirable feature is low leakage current between heater filament and cathode sleeve, of importance in D. C. series operation. Since the hum is not excessive when AC is used to heat the filament, it is evident that the slight fluctuations in DC line current will not introduce noise unless it occurs through direct coupling between the filament leads and the R. F. circuits.

Life tests have been made on several hundred tubes of these types, both at normal voltage of 6.5 volts and also at 4.5, 5.5, 7.5, and 8.5 volts. As a result of these tests the following comments are made:
An average life of 1000 hours or more may be expected in the range from 5.5 to 6.5 volts. the same comments to apply when they are operated at .25 amperes in series from a D.C. source of high voltage. A life of 500 hours (equivalent to well over a year's service in automobile sets at the usual average of 1 hour per day) is ob-

tained when the tube is operated over the usual range of voltages encountered in average automobile service (5.5 to 8 volts.)

The filament rating of this tube has been set at 6.5 volts, .275 amperes after careful study of tube design possibilities and automobile operating conditions. The rating of 6.3 volts is being used by some manufacturers, but since the tube may be operated over the range of 5.5 to 8.5 volts, it is obvious that the 6.5 and the 6.3 volt ratings represent no real difference in design, while as a matter of practical meter reading it is slightly more convenient to use the 6.5 value.

The filament current ratings have also varied from our value of .275 amperes to .30 and .40 amperes. In the automotive field where the tubes are operated in parallel without series resistors, these tubes are completely interchangeable as far as the filaments are concerned. In D.C. service where the tubes are operated in series from 115 or 230 volts D.C., the .275 and .3 ampere tube may be used interchangeably, our recommendation being that the series resistor be selected so that with 125 or 250 volt lines the filament current will be .30 amperes. Under such conditions the normal range of current would be approximately .25 to .30 amperes and the corresponding filament voltage 5.5 to 7.5 volts, assuring the user of satisfactory life. It is evident from these considerations that the 6.5 volt .275 ampere tubes

are fully interchangeable with 6.3 volt .30 ampere models so far as filament characteristics are concerned, and that in all cases except series operation they are interchangeable with 6.3 volt .40 ampere tubes.

ISSUED BY

Sylvania Products Company

Emporium, Pennsylvania

TECHNICAL BULLETIN
ON
SYLVANIA RADIO TUBES

B U L L E T I N 28

Power Pentode

SY-233

CHARACTERISTICS

Filament Voltage	2.0	Volts
Filament Current	.260	Ampere
Plate Voltage	135	Volts
Screen Voltage	135	Volts
Grid Voltage	13.5	Volts
Plate Current	4	ma.
Screen Current	3	ma.
Plate Impedance	45,000	ohms
Mutual Conductance	1,400	micromhos
Amplification Factor	63	
Load Resistance	7,500	ohms
Undistorted Power Output	650	Milliwatts

The tube employs a Standard Y type base and is the same physical size as the SY-227. The base connections are as follows:-

Filament standard heater prongs.
Suppressor grid heater prong nearest screen grid.
Control grid standard grid prong for SY-227.
Screen grid standard cathode prong for SY-227.
Plate Standard plate prong for SY-227.

The SY-233 is a new 2 volt power pentode developed to afford considerable improvement in battery receiver performance. With the introduction of the SY-233, the battery receiver may now give performance comparable with that which may be obtained with the new automobile series of tubes or with the standard AC tubes, when the SY-238 or SY-247 tubes, respectively, were employed.

The SY-233 possesses the same advantages as the other pentodes mentioned above. The power output corresponds to that obtained with a SX-171A operated with 180 volts applied to the plate. Because of its high amplification factor it will be possible to eliminate the first audio stage and operate directly into the pentode, thus saving the filament and plate drains of this tube.

The "suppressor grid" is connected to one side of the filament and is located between the plate and the screen. The "suppressor" is connected to the filament prong nearest the screen grid terminal.

The plate impedance of the pentode is very high and the load should be closely held to the recommended value.

The filament voltage must be controlled so that only 2.0 volts is applied to the filament. Usually one of these sources

will be used as a filament supply: Dry Cells, Storage Cell or Air Cell Battery.

Dry Cells show an increase in voltage after they have not been in use for some time, and therefore, it is necessary to employ a variable series resistor to adjust the voltage to a correct value.

Storage Cells usually will drop to two volts after use for a short time, and will gradually taper below this value. For this reason it is not necessary to employ a series resistor.

Air Cell Batteries deliver slightly in excess of two volts. A series resistor fixed in value may be employed since the voltage will never rise with this battery.

ISSUED BY

Sylvania Products Company

Emporium, Pennsylvania

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 29

SUPER CONTROL R. F. AMPLIFIER PENTODE

39

CHARACTERISTICS

Heater*	Coated Uni-potential cathode
Volts	6.3 AC or DC
Amperes	.3
Plate Volts	250 maximum
Screen Volts	90 maximum
Grid Bias Volts	-3 minimum

Operating Conditions and Characteristics:

Filament Voltage	6.3	6.3	6.3	6.3	volts
Plate Voltage	90	135	180	250	volts
Screen Voltage	90	90	90	90	volts
Grid Voltage (Variable)	-3.0	-3.0	-3.0	-3.0	volts (min.)
Amplification Factor	360	530	750	1000	
Plate Resistance	375,000	540,000	750,000	1,000,000	ohms
Mutual Conductance	960	980	1,000	1,000	micromhos
Mutual Conductance:					
(-30 volts bias)	10	10	10	10	micromhos
(-40 volts bias)	Very small, but not zero				
Plate Current	4.4	4.4	4.5	4.5	milliamperes
Screen Current	1.3	1.25	1.25	1.25	milliamperes

Interelectrode Capacitances:	
Effective Grid - Plate Capacitances	.007 uuf (max.)
Input Capacitance	3.5 uuf
Output Capacitance	9.6 uuf
Overall Length	4 3/16"-4 11/16"
Maximum Overall Diameter	1 9/16"
Cap	0.346"-0.369"
Bulb	S-12
Base	Small "Y"

*Heater to cathode bias should not exceed 45 volts.

The 39 is a super-control pentode for use as a radio frequency and intermediate frequency amplifier, in AC Line receivers, automobile receivers or any receivers operating from 110 volt power line.

The 39 is designed with a "suppressor" grid between the screen and plate. The "suppressor" is connected inside the tube to the cathode and hence is effective in eliminating the secondary emission effects which limit the voltage swing range permissible in the usual screen grid tube at low plate voltage, that is, at a plate voltage approximately equal to the screen voltage. This is of considerable importance in the design of receivers for use with 110 volt DC lines, where the plate voltage is limited to about 90 volts. The plate resistance of this tube is considerably higher than that of the 36 tube for the same operating voltages, which is desired in superheterodyne work.

The 39 is very effective in reducing modulation distortion and cross talk. Its design, as far as cut-off characteristics are concerned, is similar to the SY-235 in that cut-off occurs at about 40 volts negative control grid bias. This feature makes the tube very desirable for use in circuits incorporating automatic volume control.

The cathode structure is similar to that employed in the 36. It is designed to insure adequate performance over the normal voltage variations of automobile battery during charge and discharge. This feature, together with that of general freedom from microphonic and battery circuit disturbances of the heater cathode type, makes this new tube especially suited for use in automobile receivers.

The 39 is also well suited to the design requirement of radio receivers for operation from a DC power line. In such receivers, the heaters of two or more 39 tubes may be connected in series to operate at 0.3 of an ampere. This is made possible by the design of the cathode which will give satisfactory operation over a wide voltage range which will be encountered due to normal line voltage variations.

Filament:

The "triple fold" filament may be operated on AC or DC, the voltage required being 6.3 volts. The filaments may be operated in series or parallel. Since these tubes give satisfactory performance over a wide range of filament voltages, it is not necessary to employ taps on the primary of the power transformer. The center of the filament winding or a center tapped resistor may be employed to tie the filament winding preferably to the cathode. Bias up to 45 volts between heater and cathode may be employed, but the heater should be biased negative with respect to the cathode.

The use of this filament results in very rapid heating of the tube so that the receiver comes into action much sooner than with other makes of these tubes. When these tubes are operated on AC the hum level is greatly reduced over that ordinarily encountered.

Socket:

The socket required for the 39 is the Standard "Y" type. It may be mounted to hold the tube either in a vertical or horizontal position.

Socket connections are identical with those employed in the 36 tube. The grid connection is made to the cap on the top of the tube.

Circuit Requirements:

Stable operation of the 39 in radio frequency circuits designed to give maximum gain per stage requires separation of the input and output circuit elements. Complete stage shielding is required and adequate filtering must be provided if oscillation and instability are to be prevented. Heater to cathode bias should not exceed 45 volts.

The screen voltage may be obtained from a bleeder circuit across the supply source in the case of power line operated receivers or from a battery tap in the case of automobile receivers. The use of a series resistor is not recommended to obtain the required screen grid voltage unless the tube is operated self-biased.

Volume controlling may be accomplished by varying the negative voltage applied to the grid. In order to obtain adequate volume control, it is necessary that an available grid bias voltage of approximately 45 volts be obtainable. The 39 may be employed as the first detector in a superheterodyne circuit, and may be utilized to advantage in this position. In such service the grid bias may or may not be made variable. With variable bias on the first detector, the peak oscillator voltage should be about 1 volt less than the minimum grid bias, which will be approximately 7 volts. This practice will eliminate the possibility of cross modulation caused by the first detector drawing grid current. Without variable bias on the first detector, the oscillator peak voltage should be considerably less than the grid bias to prevent grid current on very strong signal swings. The 39 tube is not suited for use as a second detector in a superheterodyne, or as a detector in a tuned R. F. receiver where it is required to work directly into an audio amplifier. If additional volume control is required the 39 may be employed as a first detector, and volume controlling be accomplished by varying the grid bias on this tube as well as on the radio frequency or intermediate frequency stage.

The 39 may be used as an intermediate audio amplifier working out of a diode detector.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 30

HALF-WAVE MERCURY VAPOR RECTIFIER

866

CHARACTERISTICS

Filament		Coated
Volts		2.5
Amperes		5.0
Maximum Peak Inverse Voltage	7500	Volts
Maximum Peak Plate Current	0.6	Amperes
Tube Voltage Drop (approx.)	15	Volts
Maximum Overall Length	6 5/8	
Maximum Overall Diameter	2 7/16	
Cap	0.550"–0.576"	
Bulb	S-19	
Base	X	

Filament Pins only are used.

Plate-cap.

Installation:

The 866 is designed for use with the standard "X" socket and a plate clip. Only a socket making very good filament contact and capable of carrying 5 amperes continuously should be used with the 866. Unless this precaution is followed, poor contact at the filament prongs will cause not only overheating of the prongs and socket but also high internal tube drop with consequent injury to the tube.

The 866 must be mounted so that it is in a vertical position with the filament end down. The bulb becomes hot during continuous operation and for this reason should not be touched by any inflammable material and should not come in contact with any metallic body nor be subjected to the drops or spray of any liquid.

This tube is designed to operate without forced ventilation at an air temperature of from 0° to 50°C (32° to 122°F). If greater than the larger value is encountered, forced ventilation should be provided. In any case, free circulation of air is necessary.

The filament should be operated on alternating current which is normally used for lighting rectifier filaments. Rheostat control should be placed in the primary (power) circuit of the transformer. A filament voltmeter should be connected directly across the terminals of the filament at the socket. The return lead (positive) of the filter and load circuit may be connected to the center tap of the filament winding, or to either end of the winding.

If an inverse peak voltage of more than 2100 volts is used, the plate supply of the circuit should be provided with a time delay relay having a period of at least 30 seconds so that the filament will be allowed to come up to temperature before plate voltage is applied.

Operation:

During shipment the mercury may have become spattered onto the filament and plate. Therefore, when the 866 is first placed in operation, the filament should be lighted at normal temperature for approximately 15 minutes without any applied plate voltage, in order to properly distribute the mercury. Having once placed the tube in service, it should not be necessary to repeat this process.

The filament of the 866 should always be operated at rated voltage. Less than this voltage may cause a high tube voltage drop with consequent bombardment of the filament and eventual loss of emission. Greater than rated voltage will shorten the life of the filament.

As indicated under RATING, there are two fundamental limitations on the operation of the 866. These are the maximum peak inverse voltage of 7500 volts and the maximum peak plate current of 0.6 amperes.

Maximum peak inverse is the highest peak voltage that a rectifier tube can safely stand in the direction opposite to that in which it is designed to pass current. In other words, it is the safe arc-back limit with the tube operating within the specified temperature range. In

single phase circuits, the peak inverse voltage on a rectifier tube is approximately 1.4 times the RMS value of the plate voltage applied to the tube. This value is based on the assumption that the voltage is sinusoidal. In polyphase circuits, the peak inverse must be determined vectorially.

Maximum peak plate current is the highest peak current that a rectifier tube can safely stand in the direction in which it is designed to pass current. If a large choke is used in the filter circuit next to the rectifier tube, the peak plate current is not much greater than the load current, but if a large condenser is used in the filter next to the rectifier tube, the peak current is often as much as four times the load current. In order to determine accurately the peak current in any circuit, the best procedure usually is to measure it with a peak form of meter or to use an oscillograph.

A circuit, therefore, which results in lower peak currents, that is, one in which a filter choke is connected between the rectifier tube and the first filter condenser, should be used wherever possible.

If the 866 is used in a circuit having more than 2100 volts peak inverse, the filament should always be lighted for 30 seconds before the plate voltage is applied. This requirement may be taken care of automatically, as described in the section on INSTALLATION, by the insertion of a time delay relay in the plate circuit.

Type of Circuit	Number of 866's Required	Input Voltage R.M.S. Volts	Output Voltage D.C. Volts	Output Current D.C. Amperes
Single phase Full Wave	2	1750 per tube	1570	0.4
Single phase Full Wave	2	1750 per tube	1980*	0.22*
Single phase Full Wave	4	3500 total	3150	0.4
Single phase Full Wave	4	3500 total	3960*	0.22*
Three phase Half Wave	3	2050 per leg	2400	0.5
Three phase Half Wave Double Y	6	2050 per leg	2400	1.2
Three phase Full Wave	6	2050 per leg	4800	0.6

*Condenser input to filter.

The values given in Table 1 are based on the use of a suitable choke preceding any condenser in the filter circuit, except as indicated for the single phase connections. If the choke is not used, the tabulated DC output current values cannot be obtained without exceeding the peak current rating of the tube. In the case of the Double Y circuit, the inter-phase re-actor itself acts as a choke.

Each tabulated value of DC voltage is the effective DC output voltage from the tube, and any drop in the filter, therefore, must be subtracted from the value given, in order to obtain the available output. Owing to the low tube voltage drop of approximately 15 volts, the only reduction in rectified voltage when the load is increased, is due to the drop in the transformer and filter windings.

In the case of the three phase full-wave and single phase full-wave circuits, two 866 tubes are used in series. This arrangement is made possible by the low and constant voltage drop within this tube. These two circuits are desirable where higher DC voltages are required. In the three phase full-wave circuit, six phase wave form is obtained.

The 866 has a characteristic blue glow when it is operating. In service the bulb will eventually darken, but this change has no effect on the performance of the tube.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 31

POWER AMPLIFIER
46

CHARACTERISTICS

Filament Voltage	2.5	volts A-C
Filament Current	1.50	Amperes
Maximum Overall Length	5 5/8"	
Maximum Diameter	2 1/16"	
Bulb	S-17	
Base		Medium 5-pin

CLASS "B" AMPLIFIER

Operating Conditions and Characteristics:

Filament Voltage		2.5	volts A-C
Plate Voltage	300	400	Max. volts
Grid Voltages (Both grids tied together)	0	0	volts
Plate Current	4	6	milliamperes
Peak Plate Current	150	200	milliamperes
Load Resistance per Tube	1300	1450	ohms
Max. Signal Voltage	40	41	volts RMS
Max. Continuous Power Output (2 tubes)*	16	20	watts
Max. Plate Dissipation (avg. per tube)	10	10	watts

CLASS "A' AMPLIFIER

Operating Conditions and Characteristics:

Filament Voltage	2.5	volts A-C
Plate Voltage	250	Max. volts
Grid Voltage (grid adjacent to plate tied to plate)	–33	volts
Amplification Factor	5.6	
Plate Resistance	2380	ohms
Mutual Conductance	2350	micromhos
Plate Current	22	milliamperes
Load Resistance (optimum for max.U.P.O.)**	6400	ohms
Max. Undistorted Power Output	1.25	watts

*Power measured across indicated value of resistor in plate circuit of each tube, with indicated signal applied through 250 ohms resistance in the grid circuit.
**Approximately twice this value is recommended for load of driver for Class B stage.

Sylvania Type 46 is a special power Amplifier tube, intended for use as a Class "B" amplifier. The tube has been so designed that by rearranging the connections to the two grids it can also be used as a driver tube (Class A amplifier.)

In structure the tube is very similar to the pentode, Type 47, except that no suppressor grid is provided, and the pitch of the control and screen grids is slightly changed to secure the desired characteristics. Each grid is provided with a separate base connection. When the two grids are connected together a high amplification factor is obtained and the tube may be operated at zero grid bias. Under these operating conditions a pair of these tubes is capable of delivering up to twenty watts of undistorted power. If the outer grid is connected to the plate, the tube may be used as a Class A amplifier tube to drive the Class B tubes.

CIRCUIT REQUIREMENTS

Filament:

The filament is intended for AC operation from a 2.5 volt secondary winding of the power transformer. The rated filament current for this tube is 1.50 amperes, and it is, therefore, necessary that the filament circuit wiring and filament contacts of the socket have sufficient current carrying capacity to handle this current.

The filament winding should either be center tapped or provided with a mid-tapped resistor of about 20 ohms resistance, which is shunted across the winding. The grid and plate returns should be connected to this mid-tap.

Some care should be used in laying out the circuit to keep the hum due to induction at a minimum if a filament type of tube is used as a "driver." This hum may be further reduced by employing a variable center-tapped resistor across the filament supply for the driver stage if a filament type tube is employed for this stage.

Base:

The base of the 46 is of the medium 5 pin type. It fits the standard "Y" socket, the filament contacts of which must be capable of handling 1.50 amperes.

Bulb:

The bulb is the same size as that used for the 45 and 47 tubes, and becomes very hot under some conditions of operation, so that provision for ventilation should be made.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 32

FULL-WAVE MERCURY VAPOR RECTIFIER

82

RATING AND CHARACTERISTICS

Filament	**2.5**	**volts**
Filament Current	**3.5**	**amperes**
Maximum A-C Voltage per Plate	**500**	**volts (RMS)**
Maximum Peak Inverse Voltage	**1400**	**volts**
Maximum D-C Output Current (Contin.)	**125**	**milliamperes**
Maximum Peak Plate Current	**400**	**milliamperes**
Tube Voltage Drop (approx.)	**15**	**volts**

Maximum Overall Length	**4 1/16″**
Maximum Diameter	**1 3/8″**
Bulb	**S-14**
Base	**Medium 4-pin**

Type 82 is a full-wave rectifier designed for the same general class of service as Type 80, but having certain advantages and also some limitations which must be taken into consideration in the design of circuits utilizing the tube. It is not intended to replace the 80 in existing types of sets, and is not recommended for such service.

In the high vacuum type of rectifier the voltage drop across the tube depends upon the current flow gradually increasing with increased load. This results in poor regulation and also in a dissipation of considerable energy in the tube. The introduction of mercury vapor in the 82 greatly modifies the operating characteristics. The ionized mercury vapor neutralizes the space charge so that the voltage drop remains practically constant regardless of changes in load current, thus greatly improving the regulation of the tube, and reducing the amount of energy dissipated on the plate. The voltage drop is approximately 15 volts. This characteristic is of particular importance when circuit requirements are such as to cause a considerable variation in the amount of current taken from the rectifier tube. This condition occurs when Class B Amplifier is being operated in an AC receiver, and Type 82 is particularly suitable as a power source for such amplifiers because of the improved characteristics obtained with this design.

The same rugged type of filament is used in the 82 as was used in Type 80, and the heating time approximately the same. In operation the tube glows with a bluish white color in the space inside the plates, the glow being caused by the mercury vapor.

CIRCUIT REQUIREMENTS

Filament:

The filament is intended for AC operation from secondary winding of the power transformer. A center tapped connection is desirable, but since the filaments are connected in parallel high voltage return may also be made to one side of the filament winding. This latter connection places some additional AC voltage across the filter, but this is small enough so that the usual filtering is adequate to take care of this difference. It is important to keep the filament voltage close to the rated value of 2.5 as a low filament temperature is as detrimental with this design as is the case with voltages above normal.

Base:

The base of the 82 is the same as the base of the 80. A socket making good filament contact and capable of carrying 3.5 amperes is essential.

Bulb:

The bulb is smaller than the usual rectifier bulb, and becomes hot during operation, so that provision for ventilation should be made.

Transformer:

The usual center tapped high voltage winding is provided on the power transformer, and must be limited to the maximum value of 500 volts RMS, or as much below this value as is required for the

particular circuit in which the tube is to be used. The voltage drop across the tube is low so that the output of the tube is on the order of 100 volts higher than is obtained from the 80 tube under normal conditions. It may be desirable to provide electrostatic shielding between the transformer windings supplying current to the receiving tube filaments and the rectifier tube windings in order to minimize the pick-up of noise from the mercury vapor tube.

If the full advantage of good regulation afforded by the 82 tube is to be taken, it is necessary that the resistance of the transformer winding and that of the choke be kept as low as possible. If this cannot be done, reasonably good regulation may be obtained by employing a bleeder across the filter circuit.

Shielding:

The ionization of the mercury vapor in the tube occurs alternatively in each plate, during which alternation of the AC voltage at the instance of ionization a surge occurs, and it may be necessary to take additional precautions to keep induced RF impulses out of the input circuit of the receiver in order to avoid pick-up of noise. It is usually not necessary to shield the bulb itself, but the base and socket may require shielding in particularly sensitive receivers. RF chokes connected in series with each plate lead and placed within this shield are helpful in reducing noise. A by-pass condenser from plate to filament is also effective.

Fuse:

It is desirable to fuse the transformer circuit in order to prevent damage should an arc occur in the tube. This occasionally happens when the tube is first placed in service, due to accumulation of mercury on the press, although the design of the tube is such as to minimize this possibility.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 33

INTERMEDIATE POWER PENTODE

41

RATING AND CHARACTERISTICS

Heater		Coated Uni-potential	
Volts		6.3	
Amperes		.65	
Plate Volts		180	Maximum
Screen Volts		180	Maximum
Grid Bias Volts		-12.5	
Operating Conditions and Characteristics—			
Filament Voltage	6.3	6.3	volts AC or DC
Plate Voltage	167.5	125	volts
Screen Voltage	167.5	125	volts
Grid Voltage	-12.5	-10.0	volts
Amplification Factor	215	210	
Plate Resistance	120,000	150,000	ohms
Mutual Conductance	1800	1400	Michromhos
Plate Current	16.5	11.0	ma.
Screen Current	3.5	3.0	ma.
Load Resistance	11,000	13,000	ohms
Max. Undistorted Power Output	1.20	.65	Watts
Interelectrode Capacitances:			
Grid-Plate Capacitance		.5	uuf.
Input Capacitance		7.5	uuf.
Output Capacitance		8.6	uuf.
Overall Length (Maximum)			4 11/16"
Maximum Overall Diameter			1 13/16"
Bulb			S-14
Base			Medium 6-pin

Sylvania Type 41 is a special 6.3 volt cathode type power output pentode, designed especially for use in automobile receivers, DC line receivers and any other applications where considerable output is desired if not more than 180 volts is available. It is not recommended to apply more than 180 volts to the tube since excessive temperatures will result because of the small bulb size and the tube will be damaged. The Sylvania Type 42 should be employed where more than 180 volts is available.

The 41 is considerably different in construction than is the 38, and cannot be used to replace the 38 since 41 is equipped with a six prong base.

When operated self-biased with 180 volts applied this tube is capable of delivering 1.2 watts to a load of 11,000 ohms with minimum second harmonic.

CIRCUIT REQUIREMENTS

Filament:

The filament is intended for AC or DC operation at 6.3 volts and requires .65 amperes. An indirectly heated cathode is used in this tube permitting series operation of filaments without any loss in effective voltage supplied to the plate.

The normal voltage range encountered in automobile service will not appreciably change the operating characteristics of the tube, making it unnecessary to employ series resistors in the filament circuit.

Base:

The 41 tube employs a medium 6 prong base. The prongs are arranged in a similar fashion to those of a 5 prong base except that two pins instead of one are located opposite the filament pins. The filament pins are the two large pins. Looking at the bottom of the base and going in a clockwise direction from the filament pins, the connections are as follows: plate, screen, control grid and cathode. A standard 6 prong socket is used to accommodate the tube.

Bulb:

The bulb is the S-14, the same size as required for the 27 and 01A tubes.

Grid Resistor:

The 41 will find general application as an output tube, resistance coupled from either the detector tube or the first audio stage if diode

detection is used. If resistance coupling is used, the grid resistor must not exceed 250,000 ohms in value. This value should be employed **only** when the tube is operated entirely self biased. If the tube is operated with a fixed bias or partially so, the resistor should not exceed 100,000 ohms.

The recommended load resistance should be used if possible in order to keep the second harmonic at a minimum. If, however, the tubes are used in Push-Pull Class A, somewhat lower third harmonic in the output may be obtained by employing a lower load for both tubes than normal since the second harmonics will cancel in push-pull.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 34

CATHODE TYPE POWER PENTODE

42

RATING AND CHARACTERISTICS

Heater	Coated Uni-Potential	
Volts	6.3	
Amperes	.65	
Plate Volts	250	Maximum
Screen Volts	250	Maximum
Grid Bias Volts	-16.5	
Operating Conditions and Characteristics:		
Filament Voltage	6.3	volts
Plate Voltage	250	volts
Screen Voltage	250	volts
Grid Voltage	-16.5	volts
Amplification Factor	220	
Plate Resistance	100,000	ohms
Mutual Conductance	2200	Micromhos
Plate Current	34	ma.
Screen Current	6.5	ma.
Load Resistance	9000	ohms
Maximum Undistorted Power Output	3.0	watts
Interelectrode Capacitances:		
Grid-Plate Capacitance	.5	uuf.
Input Capacitance	7.5	uuf.
Output Capacitance	8.6	uuf.
Overall Length (Maximum)	5 5/8"	
Maximum Overall Diameter	2 3/16"	
Bulb	S-17	
Base	Medium 6-pin	

Sylvania Type 42 is a new cathode type power output pentode equipped with a 6.3 volt heater. This tube completes the Sylvania 6.3 volt line which is especially designed for AC line operated receivers. This tube cannot be used to replace the 47 in receivers already built because it employs a 6.3 heater and also requires a six prong socket. Its characteristics are similar to those of the 47 except that the possible power output has been considerably increased.

The use of the 42 as an output tube will greatly reduce the hum usually present in the average receiver employing filament type pentodes.

When operated with 250 volts plate and 16.5 volts grid bias and supplied with a peak signal equal to the grid bias, the 42 is capable of delivering three watts with minimum second harmonic.

CIRCUIT REQUIREMENTS

Filament:

The filament is intended for AC or DC operation at 6.3 volts, and requires .65 amperes. An indirectly heated cathode is used in this tube.

Base:

The 42 tube employs a medium 6 prong base. The prongs are arranged in a similar fashion to those of a 5 prong base except that two pins instead of one are located opposite the filament pins. The filament pins are the two large pins. Looking at the bottom of the base and going in a clockwise direction from the filament pins, the connections are as follows: plate, screen, control grid and cathode. A standard 6 prong socket is used to accommodate the tube.

Bulb:

The bulb is the S-17, the same size as required for the 47.

Grid Resistor:

The 42 will find general application as an output tube, resistance coupled from either the detector tube or the first audio stage if diode detection is used. If resistance coupling is used, the grid resistor must not exceed 250,000 ohms in value. This value should be employed **only** when the tube is operated entirely self biased. If the tube is operated with a fixed bias or partially so, the resistor should not exceed 100,000 ohms.

The recommended load resistance should be used if possible in order to keep the second harmonic at a minimum. If, however, the tubes are used in Push-Pull Class A, somewhat lower third harmonic in the output may be obtained by employing a lower load for both tubes than normal since the second harmonics will cancel in push-pull.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 35

SUPER CONTROL R. F. AMPLIFIER PENTODE

44

RATING AND CHARACTERISTICS

Heater*	Coated Uni-Potential Cathode				
Volts				6.3	AC or DC
Amperes				.3	
Plate Volts				250	maximum
Screen Volts				90	maximum
Grid Bias Volts				−3	minimum
Operating Conditions and Characteristics:					
Filament Voltage	6.3	6.3	6.3	6.3	volts
Plate Voltage	90	135	180	250	volts
Screen Voltage	90	90	90	90	volts
Grid Voltage: (variable)	−3.0	−3.0	−3.0	−3.0	volts
Amplification Factor	152	257	426	630	
Plate Resistance	150,000	250,000	410,000	600,000	ohms
Mutual Conductance	1010	1030	1040	1050	
Mutual Conductance (−10 volts bias)	275	275	275	275	micromhos
Mutual Conductance (−40 volts bias)	11	11	12	12	micromhos
Mutual Conductance (−50 volts bias)	1	1	1	1	micromhos
Plate Current	6.0	6.25	6.4	6.5	ma.
Screen Current	1.55	1.5	1.4	1.4	ma.
Interelectrode Capacitances:					
Effective Grid-Plate Capacitance				.007	uuf. (max.)
Input Capacitance				3.7	uuf.
Output Capacitance				9.6	uuf.

Overall Length	4⅝"—4¹¹⁄₁₆"
Maximum Overall Diameter	1⅝"
Cap	0.346"—0.369"
Bulb	S-12
Base	Small "Y"

*Heater to cathode bias should not exceed 45 volts.

The 44 is a super-control pentode for use as a radio frequency and intermediate frequency amplifier in AC operated receivers, automobile receivers or any receiver operating from 110 volt power line. The term "super-control" is used to indicate that the tube is similar in characteristics to the "variable" or "multi" mu tubes, Types 35 and 51. The 44 will replace the 39 because of its improved characteristics.

The 44 is designed with a "suppressor" grid between the screen and plate. The suppressor grid is connected to the cathode thus operating at a much lower potential than the elements between which it is placed and retarding the interchange of secondary electrons between these elements. It is this effect in the normal screen grid tube which makes it necessary to operate the plate at voltages well above the screen grid potential in order to secure high plate resistance. With the addition of the suppressor it is possible to operate the plate at the same, or even lower, voltages than that applied to the screen without serious loss in gain.

The 44 is very effective in reducing modulation distortion and cross talk. The cut-off characteristics of this tube very closely approximate those of the 35.

The 44 incorporates the new Sylvania "triple fold" filament, which results in a very low hum level when operated on AC. The heating time with this filament has been reduced to 8 or 9 seconds depending upon local conditions. Heater cathode leakage has been greatly reduced, and noise will be found at a minimum. The cathode structure is similar to that employed in the 36. It is designed to insure adequate performance over the normal voltage variations of automobile battery during charge and discharge. This feature, together with that general freedom from microphonic and battery circuit disturbances of the heater cathode type, makes this new tube especially suited for use in automobile receivers. The voltage applied between heater and cathode should be kept as low as possible in order to minimize leakage effects between heater and cathode.

The 44 is also well suited to the design requirement of radio receivers for operation from DC power line. In such receivers the heaters of two or more 44 tubes may be connected in series to operate at 0.3 of an ampere. This is made possible by the design of the cathode

which will give satisfactory operation over the voltage range which will be encountered due to normal line voltage variations.

Socket:

The socket required for the 44 is the standard "Y" type. It may be mounted to hold the tube either in a vertical or horizontal position. Socket connections are identical with those employed in the 36 tube. The grid connection is made to the cap on the top of the tube.

Filament:

The "triple fold" filament may be operated on AC or DC, the voltage required being 6.3 volts. The filaments may be operated in series or parallel. Since these tubes give satisfactory performance over a wide range of filament voltages, it is not necessary to employ taps on the primary of the power transformer. The center of the filament winding or a center tapped resistor may be employed to tie the filament winding preferably to the cathode. Bias up to 45 volts between heater and cathode may be employed but the heater should be biased negative with respect to the cathode.

Circuit Requirements:

Stable operation of the 44 in radio frequency circuits designed to give maximum gain per stage requires separation of the input and output circuit elements. Complete stage shielding is required and adequate filtering must be provided if oscillation and instability are to be prevented. Heater to cathode bias should not exceed 45 volts.

The screen voltage may be obtained from a tap on the B-supply battery for automobile receivers or from a bleeder circuit across the supply source in the case of AC-DC power line operated receivers. The use of a series resistor is not recommended to obtain the required screen grid voltage unless the tube is operated self-biased.

Volume controlling may be accomplished by varying the negative voltage applied to the grid. In order to obtain adequate volume control it is necessary that an available grid bias voltage of approximately 55 volts be obtainable. The 44 may be employed as the first detector in a superheterodyne circuit, and the bias may or may not be made variable. With variable bias on the first detector, the peak oscillator voltage should be about 1 volt less than the minimum grid bias which will be approximately 7 volts. This practice will eliminate the possibility of cross modulation caused by the first detector drawing grid current. Without variable bias on the first detector, the oscillator peak voltage should be considerably less than the grid bias to prevent grid current on very strong signal swings. The 44 tube is not suited

for use as a second detector in the superheterodyne or as a detector in a tuned R. F. receiver where it is required to work directly into an audio amplifier. If additional volume control is required the 44 may be employed as a first detector, and volume controlling be accomplished by varying the grid bias on this tube as well as on the radio frequency or intermediate frequency stage.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 36

SPECIAL NON-MICROPHONIC GENERAL PURPOSE TUBE

864

CHARACTERISTICS

Filament	**Coated**
Voltage	**1.1 volts DC**
Current	**0.25 amperes**
Plate Voltage	**135 volts maximum**
Grid Voltage	**−9 volts**

Operating conditions and characteristics:

Filament Voltage	**1.1 volts DC**
Plate Voltage	**90 volts**
Grid Voltage	**−4.5 volts**
Plate Current	**2.9 milliamperes**
Amplification Factor	**8.2**
Plate Resistance	**13500 ohms**
Grid-Plate Transconductance	**610 micromhos**

Approximate Direct Interelectrode Capacitances:

Plate to Grid	**2.3 uuf.**
Grid to Filament	**5.4 uuf.**
Plate to Filament	**3.5 uuf.**

Maximum Overall Dimensions:

Length	**4″**
Diameter	**1⅛″**
Bulb	**T-9**
Base	**Small 4-Pin**
Socket	**Standard 4-Contact**

The 864 is a high vacuum, three electrode tube of the general purpose type constructed for use under conditions where freedom from microphonic disturbance is required. It is applicable as detector, amplifier, or oscillator to battery-operated equipment which may be subject to either impact or continuous vibration.

OPERATING RECOMMENDATIONS

The socket may be arranged to hold the 864 either in a vertical or in a horizontal positon. Socket connections are conventional (same as '45). Cushioning of the socket will generally be unnecessary except in high-gain circuits.

The coated filament in the 864 should be operated at its rated value of 1.1 volts, measured at the socket with the tube in operation.

The grid of the 864 should always be biased sufficiently negative in any application to limit the d-c plate current through the tube to 4.0 milliamperes.

When the 864 is used in high-gain resistance-coupled amplifiers, considerable leeway of plate supply voltage is permissible provided that the coupling resistor and grid bias are chosen so as to limit the average voltage at the plate to the maximum value of 135 volts. The average voltage is that existing when no signal is impressed. A grid resistor in excess of 2.0 megohms is not recommended.

The 864 may be used as an oscillator with a plate voltage as high as 90 volts providing the d-c plate current is limited to 4.0 milliamperes.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 37

SPECIAL DETECTOR

69

TENTATIVE CHARACTERISTICS

Heater*	Coated Uni-potential Cathode	
Volts	6.3	
Amperes	.3	
Plate Volts	250	Maximum
Grid Volts	-9.0	

Operating Conditions and Characteristics:

Filament Voltage	6.3	volts
Plate Voltage	180	volts
Grid Voltage	-3.0	
Amplification Factor	30	
Plate Resistance	20700	ohms
Mutual Conductance	1450	micromhos
Plate Current	4.5	milliamperes

Maximum Overall Length	4¼"
Maximum Overall Diameter	1⅛"
Bulb	S-12
Base	Small "Y"

*Heater to cathode bias should not exceed 45 volts.

The Sylvania Special Detector is a tube containing two cathodes and two grids surrounded by a single plate. It is possible with the structure to obtain full wave grid rectification, automatic volume control action, and considerable audio amplification at the same time. The tube is designed with remote control characteristics which appreciably improve its automatic volume control features.

A center tapped low impedance intermediate transformer is used to supply signal to the detector. The two grids are connected to each side of the secondary of the transformer while the grid leak of proper value is inserted in series with the center tap lead to the cathode. The current flowing through the grid leak produces a direct current voltage nearly proportional to the signal which is in the proper direction to be used for altering the control grid bias on the amplifier tubes ahead of the detector.

Sufficient audio output voltage is available in the plate circuit of this tube to drive a single power pentode to full output when resistance coupling is used. If transformer coupling is employed it is possible to drive a pair of pentodes in push-pull to full output.

CIRCUIT REQUIREMENTS

Heater:

The Type 69 has a heater rating of 6.3 volts .3 ampere.

Base:

The base of the 69 is of the small 6-pin type which has recently become standard. The heater pins are the two large pins, the cathode and plate pins occupy the same relative position as in the standard 5-pin bases, while the remaining two pins are connections for the two grids.

Bulb:

The 69 is enclosed in an S-12 bulb, making it the same size as the 37 and 56.

Cathode:

The two cathodes are connected together within the tube, one connection only being brought out. For ordinary applications this cathode pin is connected to ground through the socket.

Circuit Recommendations:

The input impedance of the 69 is lower than that of a tetrode, normally employed as a second detector. For this reason it is desirable to employ a low impedance "feeder" or coupling device. This may be accomplished readily by taking the usual intermediate transformer, moving the two coils together and only tuning the secondary. This results in a slight saving since only one resonating condenser is required. A bifilar winding may be employed with only the secondary tuned. The former method is usually most satisfactory.

The secondary of the transformer should be electrically center tapped. For best results the L-C ratio should be as high as possible, a value of 8 or more milliamperes wherever possible is satisfactory.

Considerably better results will be obtained if RF pentodes are used in the intermediate stages instead of RF tetrodes. Types recommended are 39 and 41 for 6.3 volt service. It is possible for the plate voltage on the RF pentodes to drop to the screen voltage without greatly altering the tube characteristics, while for regular tetrodes serious over-loading will result when the plate voltage begins to approach the screen voltage. From this consideration it is at once apparent that a much greater plate swing can be tolerated with pentodes than with tetrodes before operation is seriously impaired.

In order to utilize the DC voltage developed across the grid leak for volume control purposes, it is necessary to remove all grids from a DC ground connection. The tuned circuits should be closed through by-pass condensers. If these condensers are too high in capacity the circuit will be slow in control action. The value of .05 mfd. has been found to be about the maximum value recommended.

The noise level in the receiver will probably be increased unless the antenna primary coil is connected directly to ground. In some receivers the primary and secondary terminals are tied together on the ground side. The primary must be separated and grounded or else noise will be coupled through the common impedance of the isolating by-pass condenser.

The volume control is usually applied to the RF and IF tubes. It is possible to volume control with the first detector in addition to the other tubes unless the first detector operates as an oscillator in addition. If the first detector is used for volume control purposes, an isolating resistor should be used in the grid return to prevent coupling with the other tubes. Considerable reduction in birdies at the fourth harmonic of the intermediate frequency may result if an isolating resistor is used between the RF and IF grid returns.

Normal tube hiss and air noise under most conditions is sufficient to keep the tubes supplied with grid bias enough to prevent the tubes from drawing grid current. The intermediate amplifier should be provided with a small amount of steady bias, obtained by the drop in a resistor placed in the cathode circuit of this tube. This is necessary to prevent over-loading of this tube because of the value of amplified signal applied to its grid compared to that applied to the grid of the radio frequency amplifier tube.

The plate circuit of the detector tube requires some filtering because of the presence of second harmonic components in that circuit. The usual .001 mfd. condenser will not be sufficient and the insertion of a resistor up to 10,000 ohms in series with the plate lead, or the inclusion of an intermediate frequency choke will be found helpful.

Coupling from the plate circuit of the detector may be effected in several different ways. Resistance coupling is the simplest where only one output tube is used. Transformer coupling may be employed

to drive tubes in push-pull, in which case no intermediate audio amplifier is required. This represents considerable saving over the diode system of detection which requires an intermediate audio amplifier.

Manual volume controlling with push-pull tubes may be readily accomplished by the use of a dual volume control available from several suppliers at this time. Each grid of the power tubes is connected to the arm of each section of the control.

The Sylvania Special Detector tube offers many advantages not found in other systems of detection heretofore offered the manufacturer. Some of these advantages are:—

Greater output voltage.

Greatly extended voltage range for volume control.

Delayed automatic volume control action.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 38

SPECIAL DETECTOR

29

TENTATIVE CHARACTERISTICS

Heater*	Coated Uni-potential Cathode	
Volts	2.5	
Amperes	1.0	
Plate Volts	250	maximum
Grid Volts	-9.0	

Operating Conditions and Characteristics:

Filament Voltage	2.5	volts
Plate Voltage	180	volts
Grid Voltage	-3.0	
Amplification Factor	30	
Plate Resistance	20700	ohms
Mutual Conductance	1450	micromhos
Plate Current	4.5	milliamperes

Maximum Overall Length	4¼"
Maximum Overall Diameter	1⅝"
Bulb	S-12
Base	Small "Y"

*Heater to cathode bias should not exceed 45 volts.

The Sylvania Special Detector is a tube containing two cathodes and two grids surrounded by a single plate. It is possible with the structure to obtain full wave grid rectification, automatic volume control action, and considerable audio amplification at the sane time. The tube is designed with remote control characteristics which appreciably improve its automatic volume control features.

A center tapped low impedance intermediate transformer is used to supply signal to the detector. The two grids are connected to each side of the secondary of the transformer while the grid leak of proper value is inserted in series with the center tap lead to the cathode. The current flowing through the grid leak produces a direct current voltage nearly proportional to the signal which is in the proper direction to be used for altering the control grid bias on the amplifier tubes ahead of the detector.

Sufficient audio output voltage is available in the plate circuit of this tube to drive a single power pentode to full output when resistance coupling is used. If transformer coupling is employed it is possible to drive a pair of pentodes in push-pull to full output.

CIRCUIT REQUIREMENTS

Heater:

The heater for the Type 29 tube has a rating of 2.5 volts 1.0 ampere.

Base:

The base of the 29 is of the small 6-pin type which has recently become standard. The heater pins are the two large pins, the cathode and plate pins occupy the same relative position as in standard 5-pin bases, while the remaining two pins are connections for the two grids.

Bulb:

The 29 is enclosed in an S-12 bulb, making it the same size as the 37 and 56.

Cathode:

The two cathodes are connected together within the tube, one connection only being brought out. For ordinary applications this cathode pin is connected to ground through the socket.

Circuit Recommendations:

The input impedance of the 29 is lower than that of a tetrode, normally employed as a second detector. For this reason it is desirable to employ a low impedance "feeder" or coupling device. This may be accomplished readily by taking the usual intermediate transformer, moving the two coils together and only tuning the secondary. This results in a slight saving since only one resonating condenser is required. A bifilar winding may be employed with only the secondary tuned. The former method is usually most satisfactory.

The secondary of the transformer should be electrically center tapped. For best results the L-C ratio should be as high as possible, a value of 8 or more milliamperes wherever possible is satisfactory.

Considerably better results will be obtained if RF pentodes are used in the intermediate stages instead of RF tetrodes, such as 58 for 2.5 volt service. It is possible for the plate voltage on the RF pentodes to drop to the screen voltage without greatly altering the tube characteristics, while for regular tetrodes serious over-loading will result when the plate voltage begins to approach the screen voltage. From this consideration it is at once apparent that a much greater plate swing can be tolerated with pentodes than with tetrodes before operation is seriously impaired.

In order to utilize the DC voltage developed across the grid leak for volume control purposes, it is necessary to remove all grids from a DC ground connection. The tuned circuits should be closed through by-pass condensers. If these condensers are too high in capacity the circuit will be slow in control action. The value of .05 mfd. has been found to be about the maximum value recommended.

The noise level in the receiver will probably be increased unless the antenna primary coil is connected directly to ground. In some receivers the primary and secondary terminals are tied together on the ground side. The primary must be separated and grounded or else noise will be coupled through the common impedance of the isolating by-pass condenser.

The volume control voltage is usually applied to the RF and IF tubes. It is possible to volume control with the first detector in addition to the other tubes unless the first detector operates as an oscillator in addition. If the first detector is used for volume control purposes, an isolating resistor should be used in the grid return to prevent coupling with the other tubes. Considerable reduction in birdies at the fourth harmonic of the intermediate frequency may result if an isolating resistor is used between the RF and IF grid returns.

Normal tube hiss and air noise under most conditions is sufficient to keep the tubes supplied with grid bias enough to prevent the tubes from drawing grid current. The intermediate amplifier should be provided with a small amount of steady bias, obtained by the drop in a resistor placed in the cathode circuit of this tube. This is necessary to prevent over-loading of this tube because of the value of amplified signal applied to its grid compared to that applied to the grid of the radio frequency amplifier tube.

The plate circuit of the detector tube requires some filtering because of the presence of second harmonic components in that circuit. The usual .001 mfd. condenser will not be sufficient and the insertion of a resistor up to 10,000 ohms in series with the plate lead, or the inclusion of an intermediate frequency choke will be found helpful.

Coupling from the plate circuit of the detector may be effected in several different ways. Resistance coupling is the simplest where only one output tube is used. Transformer coupling may be employed to drive tubes in push-pull, in which case no intermediate audio amplifier is required. This represents considerable saving over the

diode system of detection which requires an intermediate audio amplifier.

Manual volume controlling with push-pull tubes may be readily accomplished by the use of a dual volume control available from several suppliers at this time. Each grid of the power tubes is connected to the arm of each section of the control.

The Sylvania Special Detector tube offers many advantages not found in other systems of detection heretofore offered the manufacturer.

Some of these advantages are:—

Greater output voltage.

Greatly extended voltage range for volume control.

Delayed automatic volume control action.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 39

CATHODE TYPE POWER PENTODE

43

TENTATIVE RATING AND CHARACTERISTICS

Heater	Coated Uni-potential	
Volts	25.0	DC
Amperes	.300	
Plate Volts	135	maximum
Screen Volts	135	maximum
Grid Bias Volts	-20.0	

Operating Conditions and Characteristics:

Filament Voltage	25	volts
Plate Voltage	95	volts
Screen Voltage	95	volts
Grid Voltage	-15.0	volts
Amplification Factor	90	
Plate Resistance	45,000	ohms
Mutual Conductance	2,000	micromhos
Plate Current	20.0	ma.
Screen Current	6.0	ma.
Load Resistance	4,500	ohms
Maximum Undistorted Power Output	.900	watts

Maximum Overall Length	5⅝"
Maximum Overall Diameter	2⅛"
Bulb	S-17
Base	Medium 6-pin.

Sylvania Type 43 is a new cathode type power output pentode equipped with a 25 volt heater. This tube will permit the DC line operated receiver to deliver acceptable power output without requiring several tubes as output tubes, as has heretofore been necessary.

The Type 43 is equipped with a heater requiring .3 ampere, which means that it may be used in series with the rest of the .3 ampere tubes. The increased voltage drop across the heater of this tube eliminates the necessity of employing series resistors to reduce the line voltage. The elimination of this series resistor permits the tubes to heat up more rapidly than otherwise.

The use of the 43 as an output tube will reduce the hum and line interference noise usually present in a DC line operated receiver employing filament type pentodes.

When operated with 95 volts on screen and plate and 15 volts grid bias, and supplied with a peak signal equal to the grid bias, the 43 is capable of delivering .9 watts with minimum second harmonic distortion.

CIRCUIT REQUIREMENTS

Filament:

The filament is intended for DC operation at 25.0 volts, and requires .30 amperes. An indirectly heated cathode is used in this tube.

Cathode:

The cathode may be connected directly to the heater. The heater may be biased positive or negative with respect to the cathode by no more than 90 volts.

Base:

The 43 tube employs a medium 6 prong base. The prongs are arranged in a similar fashion to those of a 5 prong base except that two pins instead of one are located opposite the filament pins. The filament pins are the two large pins. Looking at the bottom of the base and going in a clockwise direction from the filament pins, the connections are as follows: plate, screen, control grid and cathode. A standard 6 prong socket is used to accommodate the tube.

Bulb:

The bulb is the S-17, the same size as required for the 247.

Operation:

Since the 43 will be used in a series filament circuit with other tubes, a high positive voltage will be impressed between the heater and cathode. This voltage may cause leakage currents up to nearly 200 microamperes in some instances. This leakage current may prove harmful in some applications and care should be taken in laying out the circuit to prevent difficulties arising from this leakage current.

Resistance coupling **must not** be employed with this tube. Impedance or transformer coupling may be used.

The tubes may be operated singly or in push-pull Class A, in which case no power is required from the driver stage and any tube which will deliver sufficient voltage to the grids may be used as the intermediate audio amplifier. As with other push-pull combinations, the load resistance per tube may be reduced, reducing the third harmonic, while the second will cancel due to push-pull circuit.

Considerably more power may be obtained by over-biasing the tubes and driving them until considerable grid current flows. In this case, the driver stage will have to supply considerable input power to the 43 tubes.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 40

SUPER-CONTROL R. F. AMPLIFIER PENTODE

34

Filament			Coated	
Voltage			2.0	d-c volts
Current			0.060	ampere
Operating Conditions and Characteristics:				
Filament	2.0	2.0	2.0	d-c volts
Plate	67.5	135	180	max. volts
Screen	67.5	67.5	67.5	volts
Grid	-3	-3	-3	min. volts
Amp. Factor*	224	360	620	
Plate Resistance	400,000	600,000	1,000,000	ohms
Mutual Conductance	560	600	620	umhos
Mutual Conductance**	15	15	15	umhos
Plate Current	2.7	2.8	2.8	ma.
Screen Current	1.1	1.0	1.0	ma.
Approx. Direct Interelectrode Capacitances:				
Grid-Plate Capacitance			0.020	max. uuf.
Input Capacitance			6.4	uuf.
Output Capacitance			12.8	uuf.
Overall Length			$4^{11}/_{16}$"-$5^{1}/_{4}$"	
Maximum Diameter			$1^{13}/_{16}$"	
Bulb			S-14	
Cap			Small Metal	
Base			Medium 4-pin	

*In general, the amplification per stage in a screen grid stage is determined by the mutual conductance and load impedance.

**At -22.5 volts bias

The Type 34 is a pentode suitable for RF amplifier service. This tube is provided with remote cut-off characteristics, and the filament requires 60 milliamperes at 2.0 volts.

The 34 is designed with a "suppressor" grid between the screen and plate. The suppressor grid is connected to the cathode thus operating at a much lower potential than the elements between which it is placed and retarding the interchange of secondary electrons between these elements. It is this effect in the normal screen grid tube which makes it necessary to operate the plate at voltages well above the screen grid potential in order to secure high plate resistance. With the addition of the suppressor it is possible to operate the plate at the same, or even lower, voltage than that applied to the screen without serious loss in gain.

The S-34 is very effective in reducing modulation distortion and cross talk.

The S-34 makes it possible to obtain very good results with battery receivers so that the resulting performance is comparable to AC operated receivers.

CIRCUIT REQUIREMENTS

Stable operation of the 34 in radio frequency circuits designed to give maximum gain per stage requires separation of the input and output circuit elements. Complete stage shielding is required and adequate filtering must be provided if oscillation and instability are to be prevented.

The screen voltage may be obtained from a tap on the B-supply battery or from a bleeder circuit across the supply source. The use of a series resistor is not recommended to obtain the required screen grid voltage unless the tube is operated self-biased.

Volume controlling may be accomplished by varying the negative voltage applied to the grid. In order to obtain adequate volume control it is necessary that an available grid bias voltage of approximately 35 volts be obtainable. The 34 may be employed as the first detector in a superheterodyne circuit, and the bias may or may not be made variable. Without variable bias on the first detector, the oscillator peak voltage should be considerably less than the grid bias to prevent grid current on very strong signal swings. The 34 tube is not suitable for use as a second detector in the superheterodyne or as a detector in a tuned RF receiver where it is required to work directly into an audio amplifier. If additional volume control is required the 34 may be employed as a first detector, and volume controlling be accomplished by varying the grid bias on this tube as well as on the radio frequency or intermediate frequency stage.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U S A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 41

56

CHARACTERISTICS

Heater Voltage	2.5	volts A-C or D-C
Heater Current	1.0	ampere
Direct Interelectrode Capacitances:		
Grid-Plate	3.2	uuf.
Grid-Cathode	3.2	uuf.
Plate-Cathode	2.2	uuf.
Maximum Overall Length	4¼"	
Maximum Diameter	1⅝"	
Bulb	S-12	
Base	Small 5-pin	

AMPLIFIER (Class A)

Operating Conditions and Characteristics:

Heater Voltage	2.5	volts
Plate Voltage	250	volts maximum
Grid Voltage*	−13.5	volts
Amplification Factor	13.8	
Plate Resistance	9500	ohms
Mutual Conductance	1450	micromhos
Plate Current	5	milliamperes

DETECTOR

Operating Conditions as Biased Detector:

Heater Voltage	2.5	volts
Plate Voltage	250	volts maximum
Grid Voltage*	−20	volts approx.

Plate Current—Adjusted to 0.2 ma. with no a-c input signal.

*If grid coupling resistor is used, its maximum value should not exceed 1.0 megohm.

Operating Conditions as Grid-Leak Detector:

Grid condenser of 0.00025 uf. capacity: grid leak of from 1 to 5 megohms; plate voltage of 45 volts; heater voltage of 2.5 volts.

OSCILLATOR

Operating Conditions as Oscillator:

Heater Voltage	**2.5 volts**
Plate Voltage	**90 volts maximum**
Grid Voltage	**0 volts**

The 56 is a general purpose tube designed as a companion tube to the 57 and 58. These tubes employ heaters requiring one ampere at 2.5 volts. The 56 is mounted in an S-12 bulb and is the same size as the automobile series of tubes, 37, etc. In spite of the smaller size and decreased heater current rating, the characteristics and performance obtained from this tube are superior to that of the 27. This tube may be used to advantage in resistance coupled amplifiers because of the increased amplification factor.

CIRCUIT REQUIREMENTS

Heater:

The heater is intended for operation at 2.5 volts. The transformer winding supplying the heater should be designed to deliver 2.5 volts to the heater terminals when rated voltage is applied to the primary.

The heater circuit wiring and heater contacts of the socket should have adequate current carrying capacity in order to minimize circuit drop and contact resistance.

Base:

The base of the 56 of the small 5-pin type, and fits any standard "Y" socket. The tube may be operated vertically or horizontally.

Cathode:

The cathode connection should be returned to the mid-tap of the heater supply winding or to a center-tapped resistor across that winding. If this cannot conveniently be done, it is permissible to bias the heater negative with respect to the cathode by not more than 45 volts. If the cathode is not connected directly to the heater in A-C receivers, attention should be given to keeping the circuit impedance between these elements as low as possible. Unless this is done, hum may arise due to heater-cathode leakage.

APPLICATION

As an amplifier, the 56 is applicable either to radio-frequency or audio-frequency circuits. Recommended operating conditions for service using transformer coupling are given under **Characteristics.**

For circuits utilizing resistance coupling, typical operating conditions are as follows:

Heater Voltage	**2.5 volts**
Plate Supply Voltage	**250 volts**
Grid Voltage	**–9 volts approx.**
Plate Load	**50000–100000 ohms**
Plate Current	**1–2 milliamperes**

A grid coupling resistor in excess of 1.0 megohm should not be used.

The 56 is also useful in the driver stage (Class A amplifier) of a Class B power amplifier. For this type of service, the following operating conditions are suggested:

	DRIVER STAGE	
	Single 56	**Push-pull 56's**
Heater Voltage	**2.5**	**2.5 volts**
Plate Voltage	**250**	**250 volts**
Grid Voltage	**–13.5**	**–13.5 volts**
Plate Load	**21000**	**16000* ohms**

*Plate to plate load.

As a detector, the 56 may be used as a biased detector or as a grid-leak detector. Operating conditions for each type of service are given under **Characteristics.** In general, grid-leak detection is the more sensitive, but grid-bias detection permits the handling of greater volume with high quality. For biased detector service, the grid bias may conveniently be obtained from the voltage drop in a resistor between cathode and ground. The value of this self-biasing resistor is not critical, 100000 to 150000 ohms being suitable. The higher value will permit the application of a larger input signal.

The 56 may be employed as a two-electrode detector preferably by connecting the plate to the cathode for the one electrode and using the grid for the other. With this arrangement, a-c input voltages as high as 40 volts RMS may be applied between grid and cathode.

As an oscillator, the 56 may be operated with a plate voltage of approximately 90 volts and zero grid bias. A lower value of plate voltage may be found desirable in some applications.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 42

57

CHARACTERISTICS

Heater Voltage	2.5	volts A-C or D-C
Heater Current	1.0	ampere

Direct Interelectrode Capacitances:

Effective Grid-Plate	0.010	maximum uuf. (with shield-can)
Input	5.2	uuf.
Output	6.8	uuf.

Overall length	4 19/32"–4 27/32"
Maximum Diameter	1 9/16"
Bulb	ST-12
Cap	Small Metal
Base	Small 6-Pin

AMPLIFIER (Class A)

Operating Conditions and Characteristics:

Heater Voltage	2.5	volts
Plate Voltage	250	volts maximum
Screen Voltage	100	volts maximum
Grid Voltage	−3	volts
Amplification Factor	Greater than 1500	
Plate Resistance	Greater than 1.5	Megohms
Mutual Conductance	1225	micromhos
Grid Voltage for Cathode Current Cut-off	7	volts approx.
Plate Current	2.0	milliamperes
Screen Current	1.0	ma. maximum

DETECTOR

Operating Conditions as Biased Detector:

Heater Voltage	**2.5 volts**
Plate Voltage	**250 volts maximum**
Screen Voltage	**100 volts maximum**
Grid Voltage	**–6 volts approx.**

Plate Load—250000 ohms or 500 h. choke shunted by 0.25 meg. for resistance load, plate supply voltage will be voltage at plate plus voltage drop in load caused by specified plate current.

Plate Current—Adjust to approx. 0.1 ma. with no a-c input signal.

INSTALLATION

Base:

The base of these tubes is of the small 6-Pin type. Its pins require the use of a standard six-contact socket which may be installed to operate the tube either in a vertical or in a horizontal position. For horizontal operation, the socket should be positioned with the heater pin openings one vertically above the other. The external connections to the base are as follows: (looking at the bottom of base going in a clockwise direction from the large pins) large pins; heater; small pins; plate; screen; suppressor; cathode. The control grid connection is made to the cap on top of the tube.

Bulb:

The bulb surface temperature on the hottest part of the bulb under operating conditions should not exceed 150 degrees F. as measured by a small thermo-couple. Shield-cans, if used, should provide sufficient ventilation to prevent the bulb temperature from rising above the recommended maximum value.

Heater:

The heater is designed to operate at 2.5 volts. The transformer winding supplying the heater circuit should be designed to operate the heater at this recommended value for full load operating conditions under average line voltages. Since the performance of these tubes is susceptible to variations of applied heater voltage, it is desirable to minimize these variations as much as possible. A transformer having primary taps is recommended so that adjustment may be made to give 2.5 volts to the heater for the particular line voltage at each installation.

Radio Frequency Amplifier:

The 57 may be used satisfactorily in applications where the r-f signal applied to the grid is relatively low, that is, of the order of a few volts. In such cases either screen or control grid voltage (or both) may be varied to control the receiver volume. When larger signals are involved, a super-control amplifier tube should be employed to prevent the occurrence of excessive cross-modulation and modulation distortion.

The plate circuit load should be as high as is practicable. A tuned impedance load will be satisfactory for intermediate-frequency amplifiers operating at a fixed frequency. The gain per stage can be made as high as 200 or more with ordinary care in design. For other applications requiring uniform sensitivity over a wide band of radio frequencies, coupling devices to meet the specific requirements will be necessary.

Modulator or First Detector:

The 57 may be employed as a superheterodyne first detector but a tube having super-control characteristics is to be preferred, especially if signals of large magnitude are to be received, and if supplementary volume control is to be obtained in this stage.

NOTE:—The 57 is not recommended as a dynatron oscillator.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

imum volume control range capabilities of these tubes will not be experienced.

Shield-can:

The shield-can design is an important factor influencing the effective grid-plate capacitances of these tubes. When the shield-can is provided with a collar which closely fits the tubular part of the dome, the combined effect of the can construction and the internal shield will give low effective grid-plate capacity.

In receivers employing a built-in loud-speaker, acoustic shielding may be necessary to prevent microphonic feed-back when a strong radio-frequency carrier voltage is present on the tube elements. It should be noted also that condenser plates may cause an audio howl due to mechanical feed-back from the speaker.

CIRCUIT APPLICATION OF 57

Biased Detector:

The 57 is particularly useful as a biased detector because of its ability to deliver a large audio-frequency output voltage with little distortion when a small radio-frequency signal is applied to the control grid, provided the coupling device is satisfactory.

Resistance coupling gives best results as far as quality is concerned, although the use of a high impedance choke (500 H) shunted by a resistance of about 0.25 megohm will give considerably higher output and sensitivity.

The detector bias may be obtained from a bleeder circuit, from a resistor in the cathode circuit, or from a partial self-biasing circuit. The cathode-resistor method permits of higher output at low percentage modulation, since the input signal may be increased almost in inverse proportion to the modulation without objectionable distortion.

Automatic Volume Control Rectifier:

The 57 may be used to supply the control grid bias for the radio and intermediate-frequency stages in automatic volume control circuits. Resistance loading in the plate circuit is the only possible form for this service. Fixed bias obtained from a bleeder circuit is recommended for this type of service as greatest sensitivity of control is obtained thereby. The same tube may be used with fair sensitivity under certain conditions for the dual function of supplying the input voltage to the audio amplifier and the d-c bias voltage for automatic volume control purposes. However, these functions can be accomplished more satisfactorily through the use of two tubes each operated under optimum voltage and load conditions.

Cathode:

The cathode should preferably be connected directly to the mid-tap of the heater winding. This practice follows the recommendation that no bias be applied between heater and cathode, and that resistance between them be kept as low as possible in order to prevent hum in the circuit. When this practice is not followed, the heater may be biased negative with respect to the cathode by not more than 45 volts. If the use of a large resistor is necessary between heater and cathode in some circuit designs, it should be by-passed by a condenser of at least 4 microfarads or objectionable hum may develop.

Screen:

The screen voltage may be obtained from a potentiometer or bleeder circuit across the B-supply source. Due to the screen current characteristics of these tubes, a resistor in series with the high voltage supply may be employed for obtaining the screen voltage provided the cathode-resistor method of bias control is used. This method, however, is not recommended if the high voltage B-supply exceeds 250 volts. Furthermore, it should be noted that the use of a resistor in the screen circuit will have an effect on the change in plate resistance with variation in suppressor voltage in case the suppressor is utilized for control purposes.

Suppressor:

The suppressor may be connected directly to the cathode or it may be made negative with respect to the cathode, as explained under **design structure considerations.** For the latter condition, the suppressor voltage may be obtained from a potentiometer or bleeder circuit for manual volume and selectivity control or from the drop in a resistor in the plate circuit or the automatic volume control tube.

Shielding:

Shielding of all the components of each stage is required in order to prevent inter-stage coupling and to obtain stable operation of these tubes in radio-frequency circuits designed to give maximum gain per stage. Unless complete stage shielding is used, the amplification possibilities of this tube cannot be realized. The use of radio-frequency filters in all leads entering the stage shields is advised to reduce coupling in external parts of the circuit. In constructing these filters, it is necessary to keep the impedance of the circuit from screen to ground as low as possible by the use of a high quality by-pass condenser. Unless proper attention is given to the elimination of external coupling and to provision for complete and effective stage shielding, the max-

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 43

S-58

CHARACTERISTICS

Heater Voltage	2.5 volts A-C or D-C
Heater Current	1.0 ampere

Direct Interelectrode Capacitances:

Effective Grid-Plate	0.010 maximum	uuf. (with shield-can)
Input	5.2	uuf.
Output	6.8	uuf.

Overall length	4 19/32" — 4 27/32"
Maximum Diameter	1 9/16."
Bulb	ST-12
Cap	Small Metal
Base	Small 6-Pin

AMPLIFIER (Class A)

Operating Conditions and Characteristics:

Heater Voltage	2.5	Volts
Plate Voltage	250	volts maximum
Screen Voltage	100	volts maximum
Grid Voltage	−3	volts Mininum
Amplification Factor	1280	
Plate Resistance	800000	ohms
Mutual Conductance	1600	micromhos
Mutual Conductance (at −40 volts bias)	10	micromhos
Mutual Conductance (at −50 volts bias)	2	micromhos
Plate Current	8.2	milliamperes
Screen Current	3.0	ma. maximum

1st DETECTOR IN SUPERHETERODYNE CIRCUIT

Operating Conditions with Variable Bias:

Heater Voltage	**2.5 volts**
Plate Voltage	**250 volts maximum**
Screen Voltage	**100 volts maximum**
Grid Voltage	**-10 volts minimum**

(With a 9-volt oscillator peak swing)

NOTE:—With an oscillator peak swing 1 volt less than the grid bias, these values are not critical and may be chosen to meet receiver design requirements.

INSTALLATION

Base:

The base of these tubes is of the small 6-pin type. Its pins require the use of a standard six-contact socket which may be installed to operate the tube either in a vertical or in a horizontial position. For horizontial operation, the socket should be positioned with the heater pin openings one vertically above the other. The external connections to the base are as follows:—(looking at the bottom of base going in a clock wise direction from the large pins) large pins; heater; small pins; plate; screen; suppressor; cathode. The control grid connection is made to the cap on top of the tube.

Bulb:

The bulb surface temperature on the hottest part of the bulb under operating conditions should not exceed 150 degrees F. as measured by a small thermo-couple. Shield-cans, if used, should provide sufficient ventilation to prevent the bulb temperature from rising above the recommended maximum value.

Heater:

The heater is designed to operate at 2.5 volts. The transformer winding supplying the heater circuit should be designed to operate the heater at this recommended value for full load operating conditions under average line voltages. Since the performance of these tubes is susceptible to variations of applied heater voltage, it is desirable to minimize these variations as much as possible. A transformer having primary taps is recommended so that adjustment may be made to give 2.5 volts to the heater for the patricular line voltage at each installation.

Cathode:

The cathode should preferably be connected directly to the mid-tap of the heater winding. This practice follows the recommendation

cations requiring uniform sensitivity over a wide band of radio frequencies coupling devices to meet the specific requirements will be necessary. If a grid coupling resistor is required, its maximum value should not exceed 1.0 megohm.

Modulator or First Detector:

The 58 may be used to advantage as a superheterodyne first detector. It is capable of producing under the proper conditions of grid and local oscillator voltage, a gain in the first detector stage of about one third that which can be obtained in an intermediate-frequency amplifier stage. In addition, this gain can be controlled as in the case of the radio-frequency amplifier by varying the d-c grid bias either from a separate supply or from a variable resistor in the cathode circuit. This is a particularly desirable feature in receivers employing automatic volume control, because it enables a much lower threshold input to be received without loss of amplification and permits the reception of high input voltages without loss of control.

When variable grid bias is used on the first detector, it is possible to use an oscillator voltage nearly equal to the grid bias at full sensitivity since only a very small signal is applied under such conditions. However, under these conditions, a fairly large interfering signal (of the order of one volt) may be present. It is desirable, therefore, to apply a peak oscillator voltage about one volt less than the grid bias to eliminate the possibility of cross-modulation caused by the first detector drawing grid current.

Without variable bias on the first detector, it is necessary to have the oscillator peak voltage considerably less than the grid bias. It should be less than the grid bias by an amount equal to the peak value of the largest signal to be received plus the corresponding value of any probable interference voltage. This method reduces the sensitivity to a great extent and is therefore not recommended. To compensate for the loss in sensitivity, a local-distance switch with a smaller value of grid bias may be used, but this practice is not usually to be commended.

Grid Bias Detector:

The 58 is not recommended as a grid bias detector because of the remote "cut-off" point, which results in an insensitive detector. It is impossible to obtain linear detection with this tube.

NOTE:—The 58 is not recommended for use as a dynatron oscillator.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

vided with a collar which closely fits the tubular part of the dome, the combined effect of the can construction and the internal shield will give low effective grid-plate capacity.

In receivers employing a built-in loud-speaker, acoustic shielding may be necessary to prevent microphonic feed-back when a strong radio-frequency carrier voltage is present on the tube elements. It should be noted also that condenser plates may cause an audio howl due to mechanical feed-back from the speaker.

Radio Frequency Amplifier:

The 58 is especially applicable to radio receiver design because of its ability to reduce cross-modulation effects, its remote "cut-off" feature, and its flexible adaptability to circuit combinations and to receiver design.

To realize the maximum benefit of the long "cut-off" feature of this tube, it is necessary to apply a variable grid bias and to maintain the screen at a constant potential with respect to the cathode. However, good results may be obtained by using a variable cathode resistance which, of course, reduces the screen potential with respect to the cathode by the same amount that the bias is increased, thus hastening the "cut-off" and reducing the ability of the tube to handle large signals. This undesirable effect may be nullified by means of a series resistor in the screen circuit.

The use of series resistors for obtaining satisfactory control of screen voltage in the case of four-electrode tubes is usually impossible because of secondary emission phenomena. In the 58, however, the suppressor practically removes these effects and it is therefore possible to obtain satisfactorily the screen voltage from the plate supply or from some high intermediate voltage providing these sources do not exceed 250 volts. With this method the screen to cathode voltage will fall off very little from minimum to maximum value of cathode-control resistor. In some cases it may actually rise. This rise of screen to cathode voltage above the normal maximum value is allowable because the screen and the plate current are reduced simultaneously by a sufficient amount to prevent damage to the tube. It should be recognized in general that the series resistor method of obtaining screen voltages from a higher voltage supply necessitates the use of the variable-cathode resistor method of controlling volume, When screen and control grid voltages are obtained in this manner. the remote "cut-off" advantage of the 58 may be fully realized.

The plate circuit load should be as high as is practicable. A tuned impedance load will be satisfactory for intermediate-frequency amplifiers operating at a fixed frequency. The gain per stage can be made as high as 200 or more with ordinary care in design. For other appli-

that no bias be applied between heater and cathode, and that resistance between them be kept as low as possible in order to prevent hum in the circuit. When this practice is not followed, the heater may be biased negative with respect to the cathode by not more than 45 volts. If the use of a large resistor is necessary between heater and cathode in some circuit designs, it should be by-passed by a condenser of at least 4 microfarads or objectionable hum may develop.

Screen:

The screen voltage may be obtained from a potentiometer or bleeder circuit across the B-supply source. Due to the screen current characteristics of these tubes, a resistor in series with the high voltage supply may be employed for obtaining the screen voltage provided the cathode-resistor method of bias control is used. This method, however, is not recommended if the high voltage B-supply exceeds 250 volts. Furthermore, it should be noted that the use of a resistor in the screen circuit will have an effect on the change in plate resistance with variation in suppressor voltage in case the suppressor is utilized for control purposes.

Suppressor:

The suppressor may be connected directly to the cathode or it may be made negative with respect to the cathode, as explained under **Design Structure Considerations.** For the latter condition, the supressor voltage may be obtained from a potentiometer or bleeder circuit for manual volume and selectivity control or from the drop in a resistor in the plate circuit of the automatic volume control tube.

Shielding:

Shielding of all the components of each stage is required in order to prevent inter-stage coupling and to obtain stable operation of these tubes in radio-frequency circuits designed to give maximum gain per stage. Unless complete stage shielding is used, the amplification possiblilities of this tube can not be realized. The use of radio-frequency filters in all leads entering the stage shields is advised to reduce coupling in external parts of the circuit. In constructing these filters, it is necessary to keep the impedance of the circuit from screen to ground as low as possible by the use of a high quality by-pass condenser. Unless proper attention is given to the elimination of external coupling and to provision for complete and effective stage shielding, the maximum volume control range capabilities of these tubes will not be experienced.

Shield-can:

The shield-can design is an important factor influencing the effective grid-plate capacitances of these tubes. When the shield-can is pro-

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 44

DOUBLE DIODE TRIODE

85

TENTATIVE CHARACTERISTICS

Heater Voltage	6.3 volts AC or DC
Heater Current	.3 Amperes

Overall Length	$4^{11}/_{16}$"
Maximum Diameter	$1^{9}/_{16}$"
Bulb	S-12
Cap	Same as 224.
Base	Small 6-pin

TRIODE UNIT

Operating Conditions and Characteristics:
(Class A Amplifier)

Plate Voltage	250 volts maximum
Grid Voltage	−20 volts
Amplification Factor	8.3
Plate Resistance	7500 ohms
Mutual Conductance	1100 micromhos
Plate Current	8 milliamperes
Load Resistance	20000 ohms
Power Output (5% 2nd harmonic distortion)	200 milliwatts

DIODE UNITS

Two diode plates are placed symmetrically around a cathode, the sleeve of which is common to the triode unit. Each diode plate has its own base pin.

Rating Conditions and Characteristics:

With an applied d-c plate voltage of 10 volts, the space current per plate with no external load should exceed 0.5 milliampere.

Type 85 is a universal heater type tube designed for AC, DC, or storage battery operation, consisting of two diodes and a triode in a single bulb. It may be used as a combined diode detector, triode amplifier and automatic volume control tube.

In operation, the two diodes and the triode are independent of each other except for the common cathode sleeve, which has one emitting surface for the diodes and another for the triode. This independence of operation permits of unusual flexibility in circuit arrangement and design. For example, the diodes of this tube can perform at the same time the functions of detection and of automatic volume control with sensitivity control and time delay action confined to the a. v. c. circuit; while at the same time the triode may be used as an amplifier under its own optimum conditions.

Type 85 is supplied in the S-12 bulb, making for small over-all size; requires a heater wattage of only 1.9 watts; is rigidly supported mechanically; provided with a symmetrical arrangement of diode plates, and separate terminals for each electrode.

The simplest form of tube detector is the diode. Its action depends on the uni-directional passage of current between plate and cathode. In the direction opposite to that producing current, the resistance of the diode is extremely high, while in the other direction its resistance is quite low. This means high rectifying efficiency.

The current flowing between plate and cathode through a low resistance current measuring device depends not only on the applied signal voltage (at a fixed cathode temperature) but also on the tube resistance and follows approximately the relationship $i=k$ times the $\frac{3}{2}$ power of the signal voltage. If the load resistance is made sufficiently high the effect of the tube resistance is negligible and the dynamic characteristic becomes linear. Since the diode resistance is low, the load resistance required to produce approximate linearity is conveniently obtainable. Under these conditions, the diode as a means of rectifying the incoming signal, is particularly suitable because of its freedom from distortion.

Since the diode is a simple rectifier, it does not amplify. If increased voltage output is desired, an auxiliary amplifier stage is necessary.

Two diodes may be used for full-wave rectification or their plates may be connected in parallel (with decreased tube resistance) for half-wave rectification. With full-wave rectification, the circuit may be balanced for carrier input so that no carrier frequency is supplied to the grid of the following amplifier and no carrier frequency filtering is theoretically necessary. Half-wave rectification as compared with

full-wave rectification provides approximately twice the signal output but requires carrier frequency filtering.

APPLICATION

The 85 is recommended for performing the simultaneous functions of automatic volume control, detection and amplification. This three-in-one feature is of decided practical importance to the set designer.

The application of this tube to receiver circuit design gives the engineer wide latitude in possible tube-unit connections. Since the 85 really consists of two diodes and a triode, each of these tube-units may be used in a circuit just as though it were in a separate bulb.

For **detection,** the diodes may be utilized in a full-wave circuit or in a half-wave circuit. In the latter case, one plate only or the two plates in parallel may be employed. The use of the half-wave arrangement will provide approximately twice the a. v. c. voltage as compared with the full-wave arrangement.

For **automatic volume control** the controlling bias voltage may be obtained by either of two general methods. In one case, the required voltage is obtained from the detector circuit by utilizing the voltage drop caused by the rectified current flowing through a resistor in the detector circuit. In the other case, the required voltage is obtained by utilizing one diode for the sole purpose of automatic volume control. This latter method is of particular interest since it confines the sensitivity and time delay function to a. v. c. circuit. Time delay action is, of course, determined by the use of a resistance and condenser combination having the desired time constant. The sensitivity control action is determined by applying a negative voltage to the a. v. c. diode plate of such a value as to accomplish the desired reduction.

For **amplification,** the triode may be employed in conventional circuit arrangements. Grid bias for the triode, depending upon circuit design, may be obtained from a fixed voltage tap on the d-c power supply or may be obtained by utilizing the variable voltage drop caused by the rectified current flowing through a resistor in the detector circuit.

INSTALLATION

The **base** of the 85 is of the small 6-pin type. Its pins require the use of a standard six-contact socket which may be installed to operate the tube either in a vertical or in a horizontal position. For horizontal operation, the socket should be positioned with its heater pin openings one vertically above the other. The control grid connection is made to the cap on top of the tube.

The **bulb** surface temperature on the hottest part of the bulb under operating conditions should not exceed 150°F. as measured by a small thermo-couple. Shield-cans, if used, should provide sufficient ventilation to prevent the bulb temperature from rising above the recommended value.

The **heater** is designed to operate at 6.3 volts. The transformer winding supplying the heater circuit should be designed to operate the heater at this recommended value for full load operating conditions under average line voltage.

The **cathode** should preferably be connected directly to the mid-tap of the heater winding. This practice follows the recommendation that no bias be applied between heater and cathode, and that the resistance between them be kept as low as possible in order to prevent hum in the circuit. When this practice is not followed, the heater may be biased negative with respect to the cathode by not more than 45 volts. If the use of a large resistor is necessary between heater and cathode in some circuit designs, it should be by-passed by a condenser of at least 4 microfarads or objectionable hum may develop.

Complete **shielding** of detector circuits employing the 85 is generally necessary to prevent RF or IF coupling between the diode circuits and the circuits of other stages.

In the case of full-wave detection, with circuits balanced to ground, shielding and IF-by-pass filters are not theoretically required. However, due to the practical difficulties of circuits balancing, their use is desirable. In the case of half-wave detector circuits, their use is always necessary.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 45

DOUBLE DIODE TRIODE

55

TENTATIVE CHARACTERISTICS

Heater Voltage	2.5 volts
Heater Current	.75 amperes

Overall Length	4 11/16"
Maximum Diameter	1 9/16"
Bulb	S-12
Cap	Same as 224
Base	Small 6-pin.

TRIODE UNIT

Operating Conditions and Characteristics:
(Class A Amplifier)

Plate Voltage	250 volts maximum
Grid Voltage	−20 volts
Amplification Factor	8.3
Plate Resistance	7500 ohms
Mutual Conductance	1100 micromhos
Plate Current	8 milliamperes
Load Resistance	20000 ohms
Power Output (5% 2nd harmonic distortion)	200 milliwatts

DIODE UNITS

Two diode plates are placed symmetrically around a cathode, the sleeve of which is common to the triode unit. Each diode plate has its own base pin.

Rating Conditions and Characteristics:

With an applied d-c plate voltage of 10 volts, the space current per plate with no external load should exceed 0.5 milliampere.

Type 55 is a heater type tube designed for 2.5 volt operation, consisting of two diodes and a triode in a single bulb. It may be used as a combined diode detector, triode amplifier and automatic volume control tube.

In operation, the two diodes and the triode are independent of each other except for the common cathode sleeve, which has one emitting surface for the diodes and another for the triode. This independence of operation permits of unusual flexibility in circuit arrangement and design. For example, the diodes of this tube can perform at the same time the functions of detection and of automatic volume control with sensitivity control and time delay action confined to the a. v. c. circuit; while at the same time the triode may be used as an amplifier under its own optimum conditions.

Type 55 is supplied in the S-12 bulb, making for small over-all size; requires a heater wattage of only 1.9 watts; is rigidly supported mechanically; provided with a symmetrical arrangement of diode plates, and separate terminals for each electrode.

The simplest form of tube detector is the diode. Its action depends on the uni-directional passage of current between plate and cathode. In the direction opposite to that producing current, the resistance of the diode is extremely high, while in the other direction its resistance is quite low. This means high rectifying efficiency.

The current flowing between plate and cathode through a low resistance current measuring device depends not only on the applied signal voltage (at a fixed cathode temperature) but also on the tube resistance and follows approximately the relationship $i=k$ times the $\frac{3}{2}$ power of the signal voltage. If the load resistance is made sufficiently high the effect of the tube resistance is negligible and the dynamic characteristic becomes linear. Since the diode resistance is low, the load resistance required to produce approximate linearity is conveniently obtainable. Under these conditions, the diode as a means of rectifying the incoming signal, is particularly suitable because of its freedom from distortion.

Since the diode is a simple rectifier, it does not amplify. If increased voltage output is desired, an auxiliary amplifier stage is necessary.

Two diodes may be used for full-wave rectification or their plates may be connected in parallel (with decreased tube resistance) for half-wave rectification. With full-wave rectification, the circuit may be balanced for carrier input so that no carrier frequency is supplied to the grid of the following amplifier and no carrier frequency filtering

is theoretically necessary. Half-wave rectification as compared with full-wave rectification provides approximately twice the signal output but requires carrier frequency filtering.

APPLICATION

The 55 is recommended for performing the simultaneous functions of automatic volume control, detection and amplification. This three-in-one feature is of decided practical importance to the set designer.

The application of this tube to receiver circuit design gives the engineer wide latitude in possible tube-unit connections. Since the 55 really consists of two diodes and a triode, each of these tube-units may be used in a circuit just as though it were in a separate bulb.

For **detection,** the diodes may be utilized in a full-wave circuit or in a half-wave circuit. In the latter case, one plate only or the two plates in parallel may be employed. The use of the half-wave arrangement will provide approximately twice the a. v. c. voltage as compared with the full-wave arrangement.

For **automatic volume control** the controlling bias voltage may be obtained by either of two general methods. In one case, the required voltage is obtained from the detector circuit by utilizing the voltage drop caused by the rectified current flowing through a resistor in the detector circuit. In the other case, the required voltage is obtained by utilizing one diode for the sole purpose of automatic volume control. This latter method is of particular interest since it confines the sensitivity and time delay function to a. v. c. circuit. Time delay action is, of course, determined by the use of a resistance and condenser combination having the desired time constant. The sensitivity control action is determined by applying a negative voltage to the a. v. c. diode plate of such a value as to accomplish the desired reduction.

For **amplification,** the triode may be employed in conventional circuit arrangements. Grid bias for the triode, depending upon circuit design, may be obtained from a fixed voltage tap on the d-c power supply or may be obtained by utilizing the variable voltage drop caused by the rectified current flowing through a resistor in the detector circuit.

INSTALLATION

The **base** of the 55 is of the small 6-pin type. Its pins require the use of a standard six-contact socket which may be installed to operate the tube either in a vertical or in a horizontal position. For horizontal operation, the socket should be positioned with its heater pin openings one vertically above the other. The control grid connection is made to the cap on top of the tube.

The **bulb** surface temperature on the hottest part of the bulb under operating conditions should not exceed 150°F. as measured by a small thermo-couple. Shield-cans, if used, should provide sufficient

ventilation to prevent the bulb temperature from rising above the recommended value.

The **heater** is designed to operate at 2.5 volts. The transformer winding supplying the heater circuit should be designed to operate the heater at this recommended value for full load operating conditions under average line voltages.

The **cathode** should preferably be connected directly to the mid-tap of the heater winding. This practice follows the recommendation that no bias be applied between heater and cathode, and that the resistance between them be kept as low as possible in order to prevent hum in the circuit. When this practice is not followed, the heater may be biased negative with respect to the cathode by not more than 45 volts. If the use of a large resistor is necessary between heater and cathode in some circuit designs, it should be by-passed by a condenser of at least 4 microfarads or objectionable hum may develop.

Complete **shielding** of detector circuits employing the 55 is generally necessary to prevent RF or IF coupling between the diode circuits and the circuits of other stages.

In the case of full-wave detection, with circuits balances to ground, shielding and IF by-pass filters are not theoretically required. However, due to the practical difficulties of circuit balancing, their use is desirable. In the case of half-wave detector circuits, their use is always necessary.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 46

FULL-WAVE MERCURY VAPOR RECTIFIER 83

TENTATIVE RATING AND CHARACTERISTICS

Filament	**5.0**	**volts**
Filament Current	**3.0**	**amperes**
Maximum A-C Voltage per Plate	**500**	**volts (RMS)**
Maximum Peak Inverse Voltage	**1400**	**volts**
Maximum D-C Output Current (Contin.)	**250**	**milliamperes**
Maximum Peak Plate Current	**800**	**milliamperes**
Tube Voltage Drop (approx.)	**15**	**volts**

Maximum Overall Length ..... $5\frac{3}{8}''$
Maximum Diameter ..... $2\frac{1}{16}''$
Bulb **ST-16**
Base ..... **Medium 4-pin**

The S-83 is a full-wave rectifier designed for the same general class of service as Type 280, but having certain advantages and also some limitations which must be taken into consideration in the design of circuits utilizing the tube. It is not intended to replace the 280 in existing types of sets, and is not recommended for such service.

In the high vacuum type of rectifier the voltage drop across the tube depends upon the current flow gradually increasing with increased load. This results in poor regulation and also in a dissipation of considerable energy in the tube. The introduction of mercury vapor in the S-83 greatly modifies the operating characteristics. The ionized mercury vapor neutralizes the space charge so that the voltage drop remains practically constant regardless of changes in load current, thus greatly improving the regulation of the tube, and reducing the amount of energy dissipated on the plate. The voltage drop is approximately 15 volts. This characteristic is of particular importance when circuit requirements are such as to cause a considerable variation in the amount of current taken from the rectifier tube. This condition occurs when Class B amplifier is being operated in an AC receiver, and Type 83 is particularly suitable as a power source for such amplifiers because of the improved characteristics obtained with this design.

The same rugged type of filament is used in the S-83 as was used in Type 280, and the heating time approximately the same. In operation the tube glows with a bluish white color in the space inside the plates, the glow being caused by the mercury vapor.

CIRCUIT REQUIREMENTS

Filament:

The filament is intended for AC operation from secondary winding of the power transformer. A center tapped connection is desirable, but since the filaments are connected in parallel the high voltage return may also be made to one side of the filament winding. This latter connection places some additional AC voltage across the filter, but this is small enough so that the usual filtering is adequate to take care of this difference. It is important to keep the filament voltage close to the rated value of 5.0 as a low filament temperature is as detrimental with this design as is the case with voltages above normal.

Base:

The base of the S-83 is the same as the base of the 280. A socket making good filament contact and capable of carrying 3.0 amperes is essential.

Bulb:

The bulb is similar to the usual rectifier bulb, and becomes hot during operation, so that provision for ventilation should be made.

Transformer:

The usual center tapped high voltage winding is provided on the power transformer, and must be limited to the maximum value of 500 volts RMS, or as much below this value as is required for the particular circuit in which the tube is to be used. The voltage drop across the tube is low so that the output of the tube is on the order of 100 volts higher than is obtained from the 280 tube under normal conditions. It may be desirable to provide electrostatic shielding between the transformer windings supplying current to the receiving tube filaments and the rectifier tube windings in order to minimize the pick-up of noise from the mercury vapor tube.

If the full advantage of good regulation afforded by the S-83 is to be taken, it is necessary that the resistance of the transformer winding and that of the choke be kept as low as possible. If this cannot be done, reasonably good regulation may be obtained by employing a bleeder across the filter circuit.

Shielding:

The ionization of the mercury vapor in the tube occurs alternatively in each plate, during which alternation of the AC voltage at the instance of ionization a surge occurs, and it may be necessary to take additional precautions to keep induced RF impulses out of the input circuit of the receiver in order to avoid pick-up noise. It is usually not necessary to shield the bulb itself, but the base and socket may require shielding in particularly sensitive receivers. RF chokes connected in series with each plate lead and placed within this shield are helpful in reducing noise. A by-pass condenser from plate to filament is also effective.

Fuse:

It is desirable to fuse the transformer circuit in order to prevent damage should an arc occur in the tube. This occasionally happens when the tube is first placed in service, due to accumulation of mercury on the press, although the design of the tube is such as to minimize this possibility.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 47

TWO VOLT RF PENTODE

15

RATING AND CHARACTERISTICS

Heater*	Coated Uni-potential Cathode
Volts	2.0
Amperes	.22
Plate Volts	135 Maximum
Screen Volts	67.5 Maximum
Grid Bias Volts	−1.5 Minimum

Operating Conditions and Characteristics:

Filament Voltage	2.0 volts
Plate Voltage	135 volts
Screen Voltage	67.5 volts
Grid Voltage (Variable)	−1.5 volts
Amplification Factor	500
Plate Resistance	800,000 Ohms
Mutual Conductance	625 micromhos
Plate Current	1.85 ma.
Screen Current	.6 ma.

Interelectrode Capacitances:

Effective Grid-Plate Capacitances	.01 uuf. maximum
Input Capacitance	2.35 uuf.
Output Capacitance	7.80 uuf.

Overall Length	4 3/16"-4 11/16"
Maximum Overall Diameter	1 9/16"
Cap	Small Metal
Bulb	S-12
Base	Small 5-pin.

*Heater to cathode bias should not exceed 22.5 volts.

CATHODE TYPE RF PENTODE

The first heater type tube with heater current consumption low enough to bring it into the class of battery operated tubes is available in Type 15, a pentode tube designed for RF amplification and detection.

Limitations as to physical size of cathode make it necessary to take a higher current than is required for a filament type tube of equivalent characteristics, and it is not anticipated that Type 15 will be used in more than one or two sockets of the receiver where circuit design requirements are such as to make an independent cathode connection desirable.

Some of the important applications of this tube are as follows:

1—Combined first detector-oscillator tube in superheterodyne receivers where an oscillator coupling coil is placed between cathode and ground.

2—Second detector where pentode characteristics and self-bias may be used to extend detector operating range, permitting increased output voltages to be obtained.

3—In any circuit where self-bias or a separate cathode connection is of importance.

In the design of this tube the smallest cathode which can be handled in production has been selected. The diameter is just large enough to permit a coated "V" filament to be inserted, this forming the heater. With this design the tube can be used on AC if desired, without the introduction of appreciable hum.

The heater power required has been reduced to 20% of the amount taken by the efficient 6.3 volt cathode used in Types 36, 37 and 44, and is only .45 watt. The average heater current required is .22 amperes, or somewhat more than three times that taken by Type 32.

Base:

Type 15 utilizes a small 5 pin base. The connections are the same as for Type 36. The connections are as follows: (clockwise from filament pins; looking at bottom of base) Filament, plate, screen grid, cathode, filament. The control grid terminal is brought out to a top cap.

Bulb:

The S-12 bulb is used for this tube, making it the same size as Type 36.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 48

TWO VOLT CLASS B AMPLIFIER

19

RATING AND CHARACTERISTICS

Filament Voltage	2.0 volts
Filament Current	.26 amperes
Overall Length	4¼"
Maximum Diameter	1 9/16"
Bulb	S-12
Base	Small 6-pin

Operating Conditions and Characteristics:

Filament Voltage	2.0	2.0	2.0	volts
Plate Voltage	135	135	135	volts
Grid Voltage	0	-3.0	-6.0	volts
Plate Current (no signal)	10.0	4.0	1.0	ma.
Plate Current*	27.0	25.0	22.0	ma.
Input Power required	170	130	95	milliwatts
Average Power Output	2.1	1.9	1.6	watts
Load Resistance (plate to plate)	10,000	10,000	10,000	ohms

*Signal 50 volts grid to grid.

TWO VOLT CLASS B AMPLIFIER

Sylvania Type 19 is a complete Class B amplifier tube designed for 2 volt operation. This tube fills the need for a high output Class B combination in the two volt group which heretofore has been met to a limited extent by employing two Type 30 tubes biased to cut-off. Under these conditions approximately 22.5 volts is required for bias, making it necessary to employ a total of 180 volts of B battery which is not desirable from the standpoint of cost. Type 19 requires from zero to six volts bias, depending upon the applied plate voltage and the desired no signal drain of the receiver. With only 135 volts applied to the plates, more power is delivered from this tube than is obtained from a pair of Type 30's operating with 157.5 volts on the plates.

CIRCUIT REQUIREMENTS

Filament:

The filament employed in Type 19 is of the oxide coated type and requires .26 amperes at 2.0 volts. This is the same drain as required by a single Type 33, while the power delivered is much greater. Further, the total distortion with Type 19 will be less than 5%, while the third harmonic distortion of Type 33 exceeds this value.

Base:

Type 19 utilizes a small 6-pin base. The connections are as follows: (clockwise from filament pins; looking at bottom of base) Filament, plate No. 2, grid No. 2, grid No. 1, plate No. 1, filament. The plate and grid terminals of the same section are adjacent.

Application:

As a Class B tube, Type 19 may be operated with 135 volts on the plate. If additional power is required, as much as 180 volts may be supplied. Reference to the "Rating and Characteristic" sheet will show that about 100 milliwatts of input power will be required to deliver 1.6 watts. A Type 30 tube, operated at 135 volts plate and a bias of 9 volts, will not deliver sufficient power to reach this value, but approximately 1.25 watts can be obtained. Increasing the voltage on the driver tube to 180 volts will not help materially since the detector tube cannot deliver enough voltage to operate the Type 30 at maximum power output. An additional audio amplifier stage will be required. Use of Type 49 as a driver tube will permit driving the Type 19 to higher power output, but will also require an additional audio stage to obtain more than 1.5 watts.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 49

TRIPLE GRID POWER AMPLIFIER

59

RATING AND CHARACTERISTICS

Filament Voltage	2.5 volts A-C
Filament Current	2.0 amperes
Maximum Overall Length	5 5/8"
Maximum Diameter	2 1/16"
Bulb	ST-16
Base	medium 7-pin

CLASS "B" AMPLIFIER

Operating Conditions and Characteristics:

Filament Voltage	2.5	2.5	volts A-C
Plate Voltage	300	400	max. volts
Grid Voltage (both grids tied together)	0	0	volts
Plate Current (no signal)*	10	13	milliamperes
Load Resistance (plate to plate)	4,000	6,000	ohms
Maximum Continuous Power Output (2 tubes)**	15	20	watts

CLASS A AMPLIFIER TRIODE

Operating Conditions and Characteristics:

Filament Voltage	2.5	volts A-C
Plate Voltage	250	max. volts
Grid Voltage (grid adjacent to plate tied to plate)	-28	volts

*For single tube.

**Power measured across indicated value of resistor in plate circuit of each tube, with indicated signal applied through 250 ohms resistance in the grid circuit.

Amplification Factor	6.0	
Plate Resistance	2,400	ohms
Mutual Conductance	2,600	micromhos
Plate Current	26	milliamperes
Load Resistance (optimum for max. U. P. O.)***	5,000	ohms
Maximum Undistorted power Output	1.25	watts

CLASS A POWER AMPLIFIER-PENTODE CONNECTION

(Grid No. 3 tied to cathode; grid No. 2 is screen; grid No. 1 is control-grid.)

Operating Conditions and Characteristics:

Heater Voltage	2.5	volts
Plate Voltage	250	volts
Screen Voltage (grid No. 2)	250	volts
Grid Voltage (grid No. 1)	−18	volts
Amplification Factor	100	
Plate Resistance	40,000	ohms
Mutual Conductance	2,500	micromhos
Plate Current	35	milliamperes
Screen Current	9	milliamperes
Load Resistance****	6,000	ohms
Power Output (7% total distortion)	3.0	watts

Type 59 is a triple grid power amplifier tube of the cathode type, designed especially for household receivers and other applications where the low hum and increased flexibility will be advantageous. The three grids are brought out to separate base pins and the design of each is so that pentode characteristics similar to the Type 47 may be obtained, Class B operation similar to the Type 46 may also be had by connecting the grids in another way, while a third method of connection permits of very acceptable performance as a triode.

In normal service as a pentode, the arrangement of grids is entirely conventional. The Number 1 grid, nearest to the cathode, being the control grid; Number 2 grid, placed just outside of the control grid, acts as the screen grid; and Number 3 grid, between screen grid and plate, is connected back to the cathode externally to act as a suppressor grid. When operation as a Class A power amplifier is desired, Number 2 and Number 3 grids are connected to the plate and act as a single electrode; the Number 1 grid being used as a control grid in the normal manner. To operate the tube as a Class B output tube, it is only necessary to connect Number 1 and Number 2 grids together, utilizing these grids as the control grid, (thus securing the necessary high amplification factor), while Number 3 grid is connected to the plate.

Type 59 is approximately the same in physical dimensions as Type 83. The bulb size is similar to that of Type 47 but the shape differs

***Approximately twice this value is recommended for load of driver for Class B stage.

****A load resistance of 7000 ohms will give the same power output as 6000 ohms but with 20% greater distortion.

somewhat (the ST-16 is used). A seven pin base is used to accommodate the increased number of terminals.

As may be determined from an inspection of the ratings given on preceeding pages, the various connections employed on the three grids determine the characteristics of the tube. In designing the tube great care was required in order to secure the desired performance with any type of connection, but once the proper grid structure is determined it is only necessary to arrange the external connections properly to secure the desired performance.

Characteristics:

It will be noted that when operated as a Class B tube, the plate current with no signal is considerably higher than in the case of Type 46. The plate current varies with the signal applied to the grids of the Class B stage, starting at 15 ma. per tube without signal and reaching a maximum of 60 ma. per tube at the highest output obtainable of 20 watts under average signal conditions.

When operated as a Class A power amplifier triode, the normal plate current under recommended operating conditions is 26 ma., slightly higher than Type 46. It is to be noted, however, that with this connection, the same power output is delivered with a peak signal on the grid of 28 volts instead of 33 as with Type 46. This may be employed as a single driver stage to feed a pair of 59's as Class B amplifiers. The amount of hum introduced in the system by the driver tube will be negligible because Type 59 employs an indirectly heated cathode. A single 59 as a driver will deliver sufficient power to drive the Class B tubes to about 20 watts. It is necessary to use efficient input transformers in Class B work so that as much power as possible of that developed by the driver tube will be available.

When operated as a pentode Type 59 delivers the same power output into the same load as Type 47, but requires 18 peak volts of signal instead of 16.5. This difference, however, is not sufficient to be of much importance. Type 59 tube connected as a pentode will result in much less hum in a receiver due to the fact that an indirectly heated cathode is employed.

Operation:

The tube may be operated in either a vertical or horizontal position. In operating the tube horizontally it is preferable to keep the plane of the press vertical, in order to secure maximum strength—this may be done by seeing that the socket is so placed that the large holes for the filament prongs are positioned with one vertical above the other. (This allows two possible positions for the socket; one rotated 180 degrees from the other, and the position which permits best wiring of the socket may be selected.) The large plate power dissipated by this tube under some conditions of service causes the bulb to become overheated, and adequate ventilation should be provided around the bulb to prevent overheating. The use of a tight fitting shield should be avoided.

The heater is designed to operate under the same operating conditions as that imposed on other 2.5 volt tubes. The transformer should be designed so that 2.5 volts is available at the terminals of the socket with maximum line voltage. It is preferable to keep the heater cathode voltage below 45 volts.

Resistors used in the grid circuit of Type 59, operating as a Class A amplifier (either pentode or triode) should not exceed .5 megohm when the tube is self-biased. Without self-bias this resistor should be limited to .25 megohm. Excessive resistances in the grid circuits may cause loss of bias and overheating and damage to the tube.

ISSUED BY
SYLVANIA DIVISION
Hygrade Sylvania Corporation
Emporium, Penna.

Printed in U. S. A.

Sylvania
REG. U.S. PAT. OFF.
Set-Tested Radio Tubes

TECHNICAL BULLETIN

NUMBER 50

6.3 VOLT COMPLETE CLASS B AMPLIFIER

79

RATING AND CHARACTERISTICS

Filament Voltage	6.3 volts
Filament Current	0.6 amperes
Overall Length	$4^{9}/_{32}$" - $4^{17}/_{32}$"
Maximum Diameter	$1^{5}/_{16}$"
Bulb	ST-12
Base	Small 6-pin
Cap	Small metal

Operating Voltages and Currents:

Filament Voltage	6.3	volts
Plate Voltage	180	volts
Grid Voltage	0	volts
Plate Current (no signal)	7.5	ma.
Load Resistance (plate to plate)	10,000	ohms

Performance Under Load:

Signal*	20	28	40	46	60	volts
Plate Current	22	30	40	42	46	milliamperes
Power Input	30	75	235	380	975	milliwatts
2nd Harmonic	2.0	2.3	2.2	2.3	3.0	percent
3rd Harmonic	1.0	0.5	2.8	5.2	9.0	percent
Total Distortion	2.35	2.35	3.5	5.7	9.5	percent
Power Output	1.25	2.5	4.5	5.0	6.25	watts

All Characteristics shown are for two triodes operating as "Class B" service.

All plate currents are sum of currents flowing to each plate.

*RMS signal volts—grid to grid.

COMPLETE CLASS B AMPLIFIER

Sylvania Type 79 is a highly efficient complete Class B power amplifier tube especially adapted to the requirements of automobile service. Important advantages include small bulb size, and high power output with minimum battery drain. The power gain is increased in comparison with other Class B power amplifier tubes of the cathode type, as may be seen by reference to the table.

CIRCUIT REQUIREMENTS

Filament:

The filament structure of Type 79 consists of two standard "triple fold" heaters connected in parallel requiring .6 ampere at 6.3 volts.

Base.

Type 79 utilizes a small 6-pin base. The connections are as follows: (Clockwise from filament pins; looking at bottom of base) heater plate No. 2, grid No. 2, Cathode, plate No. 1, heater; top connection grid No. 1.

Bulb:

Type 79 is mounted in the ST-12 bulb, and has the same overall length as Type 36.

Application:

As a Class B tube, Type 79 may be operated with 180 volts applied to the plate and zero grid bias. Reference to the "Rating and Characteristic" sheet will show that 5.0 watts power output may be obtained with a signal of 46 volts RMS—grid to grid—and a power input of 380 milliwatts. Corresponding power outputs may be obtained for different values of applied signal as shown on the "Rating and Characteristic" sheet. The plate current taken by Type 79 without a signal is 7.5 ma. (3.7 ma. per plate), while with a signal applied the current depends upon the amplitude of this signal. The tube may be operated with a continuous plate current of 42 ma., and is capable of withstanding peak swings of considerably greater magnitude, provided these swings are not continuous.

Type 37 may be used as a driver tube when outputs of 2 to 4 watts are desired. The output available will depend upon the efficiency of the interstage transformer and the exact value of plate voltage available from the source. Power output increases rapidly with increase in plate voltage, due to increased performance of both driver and Class B stage. For higher outputs Type 89 or two Type 37 tubes in push-pull are satisfactory. Type 41, a pentode, is also available for supply of maximum power inputs shown in the tabulation. Experimental work indicates that it is possible to obtain satisfactory performance from this tube if the interstage transformer is provided with a parallel load to prevent second harmonic distortion from reaching high values due to change in driver load impedance.

ISSUED BY

SYLVANIA DIVISION

Hygrade Sylvania Corporation

Emporium, Penna.

Printed in U. S. A.

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

TYPE 1-V

HALF-WAVE HIGH VACUUM RECTIFIER

CHARACTERISTICS

Heater Voltage	6.3 volts AC or DC
Heater Current	0.3 amp.
Maximum Overall Length	4-1/4"
Maximum Diameter	1-9/16"
Bulb	ST-12
Base	Small 4-pin

Operating Conditions and Characteristics:	
Heater Voltage	6.3 volts AC or DC
AC Plate Voltage RMS	250 volts Max.
DC Load Current (continuous)	50 ma. Max.
Peak Load Current	200 ma. Max.
Voltage Between Heater and Cathode	300 peak volts Max

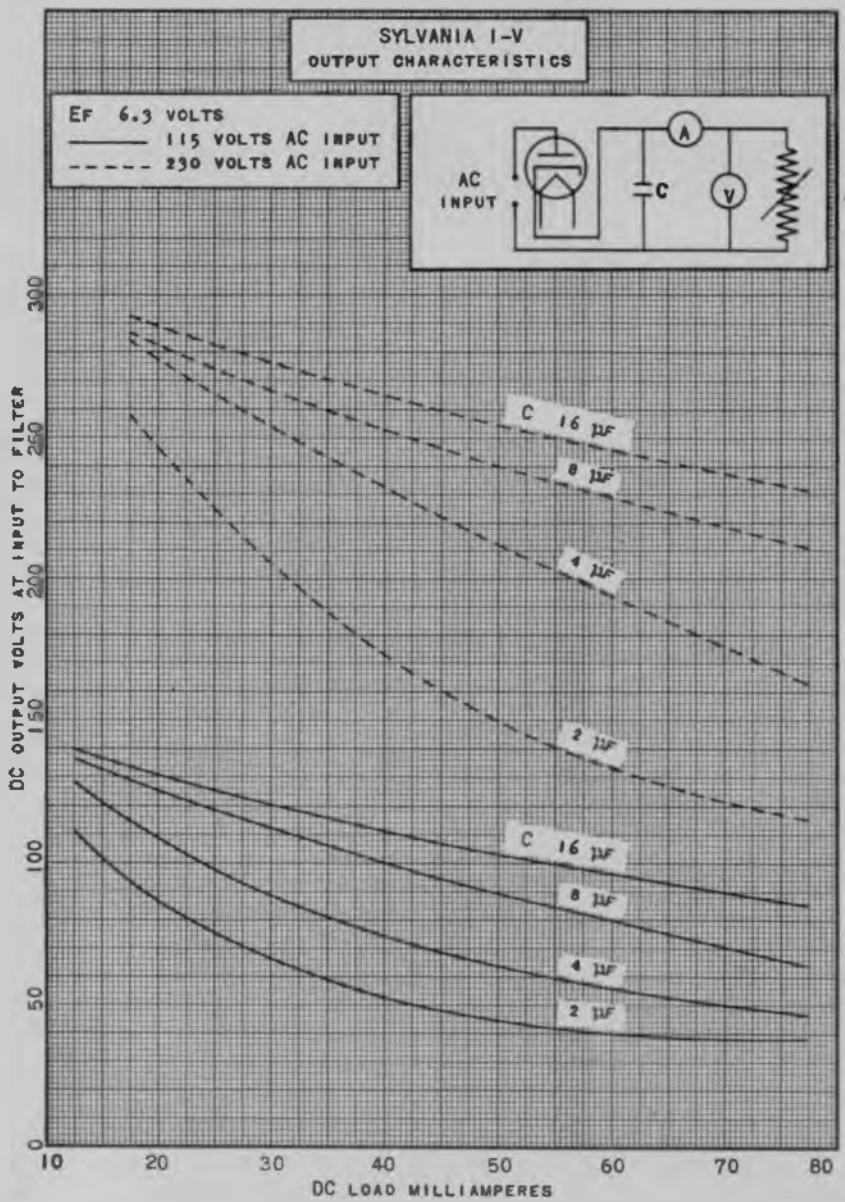
CIRCUIT APPLICATION

The use of a 6.3 volt heater in Type 1-V makes the tube adaptable to small receivers designed either for AC-DC service or for storage battery operation (automotive service). This dual operation is made possible through proper circuit design which permits changing from one type of service to the other by means of a convenient switching device. In AC-DC sets the heaters of all tubes are arranged in series; for automobile service they are connected in parallel.

The filament and cathode are electrically insulated from each other so as to permit operation with a difference of potential existing between these elements. The maximum permissible voltage is 300 volts DC. In general this condition is assured provided the tube is operated within its specified maximum plate voltage.

Type 1-V is directly interchangeable with the mercury vapor rectifier Type 1, formerly designated as KR-1, in equipment where the AC plate voltage does not exceed 250 volts RMS. The performance and use of the 1-V tube is quite similar to that of any other high vacuum type rectifier adaptable to half-wave circuits.

Output characteristics for both kinds of service are given in curve form on page 2.



ISSUED BY
HYGRADE SYLVANIA CORPORATION
EMPORIUM, PENN'A.

7-19-33

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

TYPE 5Z3

FULL-WAVE HIGH VACUUM RECTIFIER

CHARACTERISTICS

Filament Voltage	5.0 volts AC
Filament Current	3.0 amp.
Maximum Overall Length	5-9/8"
Maximum Diameter	2-1/16"
Bulb	ST-16
Base	Medium 4-pin

Operating Conditions and Characteristics:	
Filament Voltage	5.0 volts AC
AC Voltage Per Plate RMS	500 volts Max.
DC Load Current	250 ma. Max.

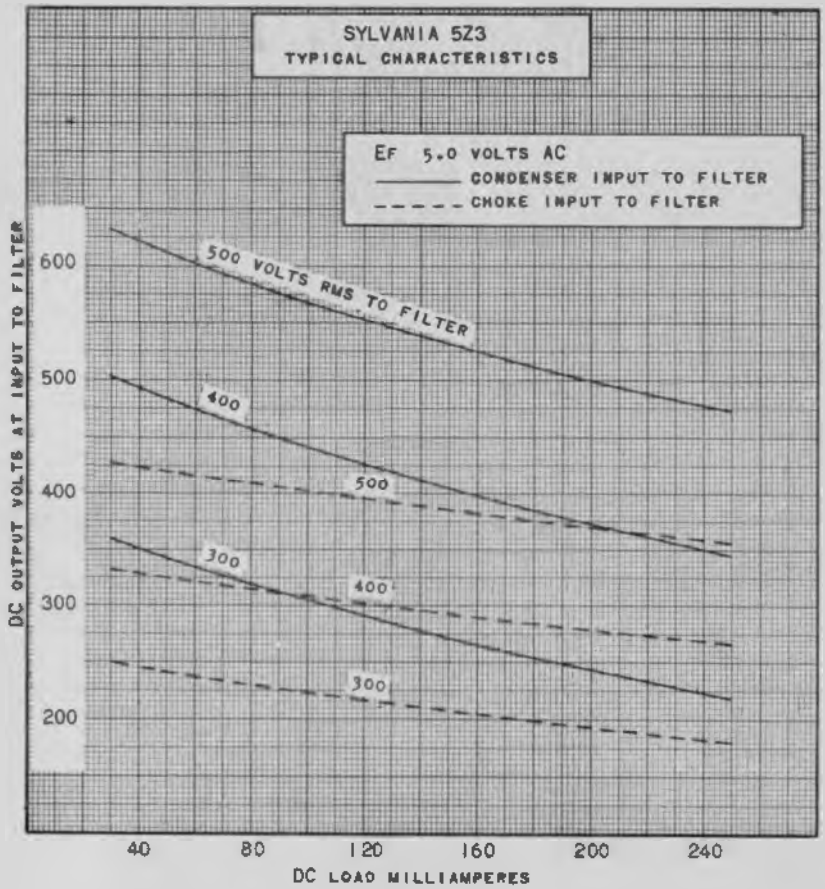
CIRCUIT APPLICATION

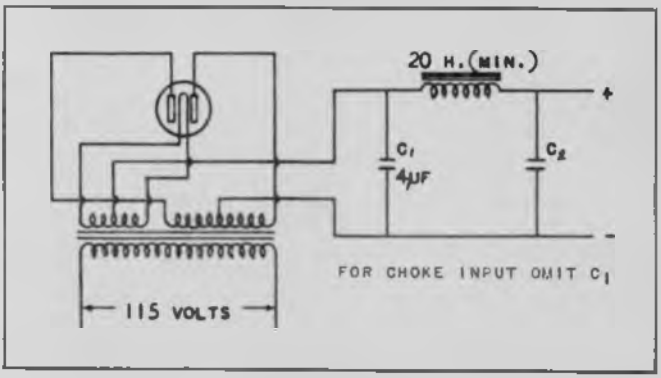
The 5Z3 is a high vacuum rectifier having a filament type construction which resembles that used in Types 80 and 83. It is designed for full-wave circuit applications, especially where there are heavy demands for rectified power. Type 5Z3 is comparable with the mercury vapor Type 83 in rating and characteristics, except for a slight difference in regard to voltage regulation.

Type 5Z3 should not be considered to be directly interchangeable with Type 80, even though the filament voltage ratings are the same for both rectifiers. The former tube offers considerably better regulation characteristics. Circuit conditions should be carefully analyzed with special attention given to the filter requirements.

The performance of the 5Z3 is quite similar to that of any other high vacuum type rectifier. Conventional filter circuits, either of the condenser-input or choke-input type, are applicable but care must be exercised not to exceed the recommended maximum values of plate voltage and output current. Choke input filters will reduce the peak plate current, and afford improved voltage regulation, although there will be a sacrifice in DC output voltage.

Data on the operating characteristics of the 5Z3 are shown in curve form on page 2.





ISSUED BY
HYGRADE SYLVANIA CORPORATION
EMPORIUM, PENN'A.

7-19-39

NUMBER 69

2A3

Sylvania
Set-Tested Radio Tubes

TECHNICAL BULLETIN

TYPE 2A3

POWER AMPLIFIER TRIODE

CHARACTERISTICS

Filament Voltage AC or DC	2.5 VOLTS
Filament Current	2.5 AMP.
Direct Interelectrode Capacitances (Approx.)	
Grid to Plate	13 UUF
Grid to Filament	9 UUF
Plate to Filament	4 UUF
Maximum Overall Length	5-3/8"
Maximum Diameter	2-1/16"
Bulb	ST-16
Base	Medium 4-Pin

CLASS A AMPLIFIER

Filament Voltage	2.5 VOLTS
Plate Voltage	250 VOLTS MAX.
Grid Voltage*	-45 VOLTS
Plate Current	60 MA.
Plate Resistance	800 OHMS
Mutual Conductance	5250 MICROMHOS
Amplification Factor	4.2
Load Resistance	2500 OHMS
Power Output (with 5 o/o 2nd Harmonic)	3.5 WATTS

PUSH-PULL CLASS A AMPLIFIER

	Fixed-Bias	Self-Bias	
Filament Voltage	2.5	2.5	VOLTS
Plate Voltage	300 Max.	300	Max. VOLTS
Grid Voltage*	-62	-62	VOLTS
Plate Current Per Tube	40	40	MA.
Plate to Plate Load Resistance	3000	5000	OHMS
Power Output	15	10	WATTS
Total Harmonic Distortion	2.5	5	PERCENT

*Note: Grid volts measured from mid-point of filament when operated on AC.

CIRCUIT APPLICATION

THIS TUBE IS A THREE ELECTRODE HIGH VACUUM TYPE POWER AMPLIFIER FOR USE IN THE OUTPUT STAGE OF AC OPERATED RECEIVERS. AN OUTSTANDING FEATURE IS THE ABILITY OF THE TUBE TO DELIVER VERY LARGE AMOUNTS OF POWER UNDER CLASS A OPERATING CONDITIONS. THIS IS ACCOMPLISHED BY PROPER DESIGN WHICH PROVIDES A VERY HIGH MUTUAL CONDUCTANCE (5250 MICROMHOS). FOR SIMILAR OPERATING CONDITIONS THE VALUES OF POWER OUTPUT ARE GREATER THAN THOSE OF ANY OTHER RADIO RECEIVER TUBE OF COMPARABLE SIZE AND RATING.

CHARACTERISTIC OF POWER AMPLIFIERS OF THE TRIODE TYPE, IT IS TO BE NOTED THAT THE PLATE CURRENT IS COMPARATIVELY HIGH, THE GRID BIAS VOLTAGE LARGE, THE AMPLIFICATION FACTOR RELATIVELY SMALL, AND THE PLATE RESISTANCE EXCEPTIONALLY LOW IN VALUE.

ANY OF THE CONVENTIONAL METHODS MAY BE USED FOR THE INPUT COUPLING PROVIDED THAT TOO MUCH RESISTANCE IS NOT ADDED IN THE GRID RETURN. THE DC RESISTANCE IN THE GRID CIRCUIT SHOULD BE LESS THAN 0.5 MEGOHM FOR A SELF-BIAS ARRANGEMENT; WITH FIXED BIAS THE LIMIT IS 10,000 OHMS. IF THE ABOVE VALUES ARE EXCEEDED THE BIAS VOLTAGE MAY BE REDUCED AS A RESULT OF GRID CURRENT. THIS CONDITION WILL CAUSE EXCESSIVE PLATE CURRENT TO FLOW, IMPAIRING THE PERFORMANCE OF THE TUBE.

A RESISTOR OF APPROXIMATELY 700 OHMS WILL PROVIDE THE APPROPRIATE BIAS VOLTAGE FOR THE SELF-BIAS OPERATION OF TYPE 2A3 IN EITHER SINGLE STAGE OR PUSH-PULL SERVICE. IT IS ESSENTIAL THAT THIS SELF-BIASING RESISTOR BE SUITABLY BY-PASSED TO REDUCE BIAS VOLTAGE FLUCTUATION RESULTING FROM CURRENT VARIATIONS IN THE RESISTOR.

IN COMPARISON WITH SINGLE STAGE SERVICE IT WILL BE NOTED THAT OVER-BIASED PUSH-PULL OPERATION OF POWER TUBES PROVIDES GREATLY INCREASED OUTPUT. THE OPERATING CONDITIONS FOR SUCH SERVICE ARE DETERMINED ON THE FOLLOWING BASIS: AT THE MOST POSITIVE LIMIT OF THE SIGNAL VOLTAGE SWING THERE IS TO BE NO FLOW OF GRID CURRENT; ALSO, CANCELLATION OF THE SECOND HARMONIC DISTORTION AS A RESULT OF THE PUSH-PULL ARRANGEMENT. THE OUTPUT IS THEREFORE LIMITED ALMOST ENTIRELY BY THE THIRD HARMONIC CONTENT.

INSTALLATION

THE BASE CONNECTIONS FOR THE 2A3 ARE AS FOLLOWS (LOOKING AT THE BOTTOM OF THE BASE AND PROCEEDING CLOCKWISE FROM LEFT FILAMENT PIN): FILAMENT, PLATE, GRID, FILAMENT. THE TUBE MUST BE OPERATED IN A VERTICAL POSITION.

THE LOW VOLTAGE FILAMENT WINDING ON THE POWER TRANSFORMER SHOULD BE DESIGNED TO FURNISH THE RECOMMENDED VALUE OF 2.5 VOLTS FOR THE AVERAGE LINE VOLTAGE SUPPLY. THE WINDING SHOULD EITHER BE CENTER-TAPPED OR SHUNTED WITH A 20 OHM CENTER-TAPPED RESISTOR, WITH THE MID-TAP CONNECTED TO THE GRID AND PLATE RETURN.

THE ST-16 BULB IS STANDARD FOR THE 2A3. PROVISION SHOULD BE MADE FOR FREE CIRCULATION OF AIR AROUND THE BULB BECAUSE IT MAY BECOME QUITE HOT DURING OPERATION.

ISSUED BY
HYGRADE SYLVANIA CORPORATION
EMPORIUM, PENN'S.

7-19-33

NUMBER 64

Sylvania
Set-Tested Radio Tubes

6C6
6D6

TECHNICAL BULLETIN

TYPE 6C6
TRIPLE GRID AMPLIFIER, DETECTOR

CHARACTERISTICS

Heater Voltage	6.3	volts AC or DC
Heater Current	0.3	amp.
Overall Length	4-11/16" to 4-15/16"	
Maximum Diameter	1-9/16"	
Bulb	ST-12	
Cap	Small Metal	
Base	Small 6-pin	
Direct Interelectrode Capacitances (with tube shield):		
Effective Grid to Plate	0.007	μμf Max.
Input	4.7	μμf
Output	6.8	μμf

CLASS A AMPLIFIER

Heater Voltage	6.3	volts AC or DC
Plate Voltage	250	volts Max.
Screen Voltage	100	volts Max.
Grid Voltage for Cathode Current Cut-off	-7	volts (approx.)
Plate Current	2.0	ma.
Grid Voltage	-3	volts
Screen Current	0.5	ma.
Amplification Factor	1500	Min.
Plate Resistance	1.5	megohms Min.
Mutual Conductance		

DETECTOR

Operation as a Biased Detector:

Heater Voltage	6.3	volts
Plate Voltage	250	volts Max.
Screen Voltage	100	volts Max.
Grid Voltage	-6	volts (approx.)

Plate Load--: 0.25 megohm or a 500 henry choke shunted by a 0.25 megohm for resistance load; the plate voltage will be the plate supply voltage minus the voltage drop in the load as determined by the specified plate current.

Plate Current--: Adjust to 0.1 ma. (approx.) with no AC input signal.

CIRCUIT APPLICATION

Type 6C6 is an efficient RF pentode having a sharp cut-off and is the same as Type 57 except for heater rating. It is recommended for use as a detector or detector-oscillator in superheterodyne receivers; also as a control tube and as an audio amplifier with resistance coupling.

TYPE 606

TRIPLE GRID SUPER-CONTROL AMPLIFIER

CHARACTERISTICS

Heater Voltage	6.3	volts AC or DC
Heater Current	0.3	amp.
Overall Length	4-11/16" to 4-15/16"	
Maximum Diameter	1-9/16"	
Bulb	ST-12	
Cap	Small Metal	
Base	Small 6-pin	

Direct Interelectrode Capacitances (with shield can):		
Effective Grid-Plate	0.007	μμf Max.
Input	4.7	μμf
Output	6.8	μμf

Operating Conditions and Characteristics:		
Heater Voltage	6.3	volts AC or DC
Plate Voltage	250	volts Max.
Screen Voltage	100	volts Max.
Grid Voltage	-3	volts
Plate Current	8.2	ma.
Screen Current	2.0	ma.
Plate Resistance	0.8	megohm
Amplification Factor	1280	
Mutual Conductance	1600	μmhos
Grid Voltage for:		
Mutual Conductance 10 μmhos	-40	volts
2 μmhos	-50	volts

CIRCUIT APPLICATION

The 606 is a remote cut-off tube otherwise similar to the 6C6. It is designed for RF and IF amplification, or for use as a first detector in superheterodyne circuits. In this latter service translation gain is lower than that obtained from Type 6C6, but AVC voltage may be applied to this grid to secure increased range of control. Mutual conductance, high plate resistance, and low output capacity are features of the design of this tube. Except for heater rating this tube is identical with Type 58 of the 2.5 volt group.

ISSUED BY
HYGRADE SYLVANIA CORPORATION
Emporium, Penn'a.

7-19-33