6F22/EF86

LOW NOISE A.F. PENTODE

Indirectly heated

GENERAL

The 6F22/EF86 is a miniature based low noise A.F. pentode with internal shielding. It is intended for use in the first stages of high gain amplifiers having very small input voltages. Under suitable conditions the hum voltage picked up from the heater by the control grid is less than 1.5μV.

RATING

Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	0.2
Maximum Anode Supply Voltage (volts)	$V_{a(b)\ max}$	550
Maximum Anode Voltage (volts)	$V_{a\ (max)}$	300
Maximum Anode+Screen Voltage (Triode Connection) (volts)	$V_{a+g2(max)}$	250
Maximum Screen Supply Voltage (volts)	$V_{g2(b)max}$	550
Maximum Screen Voltage (volts)	$V_{g2(max)}$	200
Maximum Anode Dissipation (watts)	$P_{a(max)}$	1.0
Maximum Screen Dissipation (watts)	$P_{g2(max)}$	0.2
Maximum Anode+Screen Dissipation (Triode Connection) (watts)	$P_{a+g2(max)}$	1.2
Maximum Mean Cathode Current (mA)	$I_{k(av)max}$	6.0
Maximum Control Grid Voltage ($I_{g1}=+0.3\mu A$) (volts)	$V_{g1(max)}$	—1.3
Maximum Grid/Cathode Resistance ($P_a>0.2W$) (Megohms)	$R_{g1\text{-}k(max)}$	3.0
Maximum Grid/Cathode Resistance ($P_a<0.2W$) (Megohms)	$R_{g1\text{-}k(max)}$	10.0
Maximum Grid/Cathode Resistance ($R_k=0\Omega$) (Megohms)	$R_{g1\text{-}k(max)}$	22.0
Maximum Heater/Cathode Voltage (Cathode Positive) (volts)	$V_{h\text{-}k(max)}$	100
Maximum Heater/Cathode Voltage (Cathode Negative) (volts)	$V_{h\text{-}k(max)}$	50
Maximum Heater/Cathode Resistance (kilohms)	$R_{h\text{-}k(max)}$	20
Maximum Heater/Cathode Resistance (As Phase Inverter) (kilohms)	$R_{h\text{-}k(max)}$	120

THORN — AEI RADIO VALVES & TUBES LTD.

6F22/EF86

LOW NOISE A.F. PENTODE

Indirectly heated

NORMAL PENTODE CHARACTERISTICS		
Anode Voltage (volts)	V_a	250
Screen Voltage (volts)	V_{g2}	140
Suppressor Voltage (volts)	V_{g3}	0
Control Grid Voltage (volts)	V_{g1}	—2.0
Anode Current (mA)	I_a	3.0
Screen Current (mA)	I_{g2}	.55
Control Grid Current (μA)	I_{g1}	0.05
Mutual Conductance (mA/V)	gm	1.85
Anode Impedance (MΩ)	ra	2.2
Inner Mu	$\mu_{g1\text{-}g2}$	38

NORMAL TRIODE CHARACTERISTICS (Screen Tied To Anode Suppressor Tied To Cathode)		
Anode and Screen Voltage (volts)	V_a+g2	250
Control Grid Voltage (volts)	V_{g1}	—5
Anode and Screen Current (mA)	I_a+g2	4
Mutual Conductance (mA/V)	gm	2.0
Anode Impedance (ohms)	ra	16,500
Amplification Factor	μ	33

INTER-ELECTRODE CAPACITANCES (pF)		
Grid 1/Earth	c_{in}	4.0
Anode/Earth	c_{out}	5.5
Anode/Grid 1	$c_{a\text{-}g1}$	<0.05
Heater/Grid 1	$c_{h\text{-}g1}$	<0.0025

DIMENSIONS		
Maximum Overall Length	(mm)	56.0
Maximum Diameter	(mm)	22.2
Maximum Seated Height	(mm)	49.0
Approximate Nett Weight	(ozs)	$\frac{1}{2}$
Approximate Packed Weight	(ozs)	$\frac{3}{4}$

6F22/EF86

LOW NOISE A.F. PENTODE

Indirectly heated

MOUNTING POSITION—Unrestricted

TYPICAL OPERATION—Pentode Connection

H.T. Supply Voltage (volts)	$V_{a(b)}$	100	200	250	300	350	400
Anode Load (kilohms)	R_a	100	100	100	100	100	100
Screen Dropper Resistance (kilohms)	R_{g2}	470	390	390	390	390	390
Cathode Current (mA)	I_k	1.0	1.7	2.1	2.5	2.9	3.3
Cathode Bias Resistance (kilohms)	R_k	1.5	1.0	1.0	1.0	1.0	1.0
Voltage Amplification		95	106	112	116	120	124
Output Voltage (volts)		22	40	50	64	75	87
Distortion at given Output Voltage	(%)	5.0	5.0	5.0	5.0	5.0	5.0
Grid Resistance of next valve (kilohms)		330	330	330	330	330	330

The % Distortion is approximately proportional to the Output Voltage.

TYPICAL OPERATION—Pentode Connection

H.T. Supply Voltage (volts)	$V_{a(b)}$	100	200	250	300	350	400
Anode Load (kilohms)	R_a	220	220	220	220	220	220
Screen Dropper Resistance (megohms)	R_{g2}	1.0	1.0	1.0	1.0	1.0	1.0
Cathode Current (mA)	I_k	0.6	0.8	0.9	1.1	1.4	1.6
Cathode Bias Resistance (kilohms) R_k		2.7	2.2	2.2	2.2	2.2	2.2
Voltage Amplification		150	170	180	188	196	200
Output Voltage (volts)		24.5	36	46	54	63	73
Distortion at given Output Voltage (%)		5.0	5.0	5.0	5.0	5.0	5.0
Grid Resistance of next valve (kilohms)		680	680	680	680	680	680

The % Distortion is approximately proportional to the Output Voltage.

THORN — AEI RADIO VALVES & TUBES LTD.

6F22/EF86

LOW NOISE A.F. PENTODE

Indirectly heated

TYPICAL OPERATION—Triode Connection

H.T. Supply Voltage (volts)	$V_{a(b)}$	200	250	300	350	400
Anode Load (kilohms)	R_a	47	47	47	47	47
Anode Current (mA)	I_a	1.9	2.3	2.7	3.2	3.7
Cathode Bias Resistance (kilohms)	R_k	1.2	1.2	1.2	1.2	1.2
Voltage Amplification		23.5	23.5	24.0	24.5	24.5
Output Voltage (volts)		22	32	43	53	64
Distortion at given Output Voltage (%)		3.1	3.5	3.8	4.0	4.5
Grid Resistance of next valve (kilohms)		150	150	150	150	150

At the start of positive grid current, the % Distortion is approximately proportional to the Output Voltage.

TYPICAL OPERATION—Triode Connection

H.T. Supply Voltage (volts)	$V_{a(b)}$	200	250	300	350	400
Anode Load (kilohms)	R_a	100	100	100	100	100
Anode Current (mA)	I_a	1.0	1.3	1.5	1.7	2.0
Cathode Bias Resistance (kilohms)	R_k	2.2	2.2	2.2	2.2	2.2
Voltage Amplification		27.5	28	28.5	28.5	28.5
Output Voltage (volts)		27.5	39	50	62	73
Distortion at given Output Voltage (%)		3.3	3.7	3.8	4.0	4.0
Grid Resistance of next valve (kilohms)		330	330	330	330	330

At the start of positive grid current, The % Distortion is approximately proportional to the Output Voltage.

6F22/EF86

LOW NOISE A.F. PENTODE

Indirectly heated

TYPICAL OPERATION—Triode Connection

H.T. Supply Voltage (volts)	$V_{a(b)}$	200	250	300	350	400
Anode Load (kilohms)	R_a	220	220	220	220	220
Anode Current (mA)	I_a	0.5	0.65	0.8	0.9	1.05
Cathode Bias Resistance (kilohms)	R_k	3.9	3.9	3.9	3.9	3.9
Voltage Amplification		30.5	30.5	31	31.5	32
Output Voltage (volts)		28	39	51	62	74
Distortion at given Output Voltage (%)		3.1	3.5	3.7	3.7	3.8
Grid Resistance of next valve (kilohms)		680	680	680	680	680

At the start of positive grid current, the % Distortion is approximately proportional to the Output Voltage.

APPLICATION NOTES

Hum

The hum level for the valve alone with Z_{g1} <0.5 MΩ at 50 cps is less than 5 μV with a floating heater supply, about 3μV with one side of the heater earthed and about 1.5μV with the heater supply centre tapped to earth. These values may be closely approached by the use of a PTFE valve holder. With a Nylon loaded Phenolic valve holder a hum level between 10 μV and 30 μV may be expected with one side of the heater earthed and a level between 3 μV and 8μV with the heater supply centre tapped to earth.

Improvement in the hum level may be obtained by the use of a skirted valve holder, and by earthing the heater through the moving contact of a potentiometer of between 50 and 200 ohms connected across the heater supply, the potentiometer then being adjusted for minimum hum level. The use of an unsuitable valve holder will result in a considerable increase in hum above the best attainable level due to interpin capacitance and leakage.

6F22/EF86
LOW NOISE A.F. PENTODE
Indirectly heated

Noise

With an Anode Supply Voltage of 250 volts and an Anode Load of 100 kilohms the equivalent noise voltage at the Control Grid is about 2μV for a bandwidth of from 25 to 10,000 cps.

Microphony

When the valve is employed in the first stage of an Amplifier giving a loudspeaker output of 50 mW for 0.5 mV input (approximately 5W for 5mV), the output from the speaker should not produce in the valve accelerations of more than 0.015g at frequencies greater than 500 cps or more than 0.06g at frequencies less than 500 cps.

General

In normal operation the screen resistor should have a value of from 4 to 5 times that of the anode load resistor. In cases where a particularly high signal to noise ratio is required it may be obtained at the expense of stage gain by increasing the value of the screen resistor to about 10 times that of the anode load resistor, the grid bias being of the order of one volt. This necessitates an increase in the value of the cathode bias resistor, due to the reduction in the cathode current. All resistors used in the stage should be of the high stability cracked carbon or metal film type for minimum noise. Except in the case of high level input or where one portion of the cathode bias resistor is not decoupled in order to apply negative feed back or tone control the cathode to earth impedance at possible hum frequencies should preferably be less than 40 ohms to avoid hum pickup from the heater due to leakage or heater to cathode emission. To achieve this a decoupling condenser of at least 50 μF should be used. A further improvement in the quality of performance may be obtained by the use of a 1 or 2 μF paper screen decoupling condenser together with a 6 volt working electrolytic cathode decoupling condenser of up to 250 μF.

6F22/EF86

LOW NOISE A.F. PENTODE

Indirectly heated

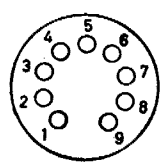
General—*continued*

The suppressor grid may be connected to cathode or to earth as desired. General external screening is not required, the valve having an adequate internal screen connected to pin 2. In addition, a guard ring connected to pin 7 has been fitted internally around the control grid connection to isolate this electrode from the rest of the valve. Pins 2 and 7 should normally be earthed, all earth connections being taken to one point preferably the central spigot of the valve holder.

The valve itself should be situated well away from AC fields, the heater leads being twisted together at least 5 times per inch and drawn away as much as possible from the control grid connection.

Induced hum may also be reduced by the fitting of a small V shaped screen on the central spigot of the valve holder in such manner that it screens pins 4 and 5 from pins 6 and 9.

BASE—Noval (B9A)



Viewed from free end of pins.

6F22/EF86
LOW NOISE A.F. PENTODE
Indirectly heated

CONNECTIONS

Pin 1	Screen Grid	g2
Pin 2	Shield	s
Pin 3	Cathode	k
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Anode	a
Pin 7	Shield	s
Pin 8	Suppressor Grid	g3
Pin 9	Control Grid	g1

THORN — AEI RADIO VALVES & TUBES LTD.