SIEMENS

RS 2012 CL
10 kW
Metal-Ceramic Tetrode

A new forced-air cooled power tetrode
power gain 25 dB solid-state driver

Properties

The RS 2012 CL is a metal-ceramic power tetrode designed for frequencies up to 110 MHz. The screen grid, control grid and cathode terminals are arranged in coaxial form. Its high linearity makes the RS 2012 CL especially suitable for commercial single-sideband communications transmitters. The second and third order intermodulation products measured by the two tone method with a peak power of 10 kW are better than 38 dB and 50 dB down respectively. A stage power gain of about 25 dB can be achieved with this tube.

The rugged electrode construction allows the RS 2012 CL to be used in both fixed and mobile transmitters. The use of a seamless drawn molybdenum tube with punched apertures to control the electron current produces a very stable grid structure. The introduction of this type of grid design into power tubes offers the tube user the following important advantages:

1. With a suitable combination of grid apertures and stiffening struts, the stability and hence reliability of the punched grid considerably exceeds that of conventional wire grids.

2. The punched holes of the screen and control grids are exceptionally true to size and can be reproduced in fabrication. This results in constant characteristic curves and consequently very low spreads.

The RS 2012 CL contains the well-proven mesh cathode used for many years in Siemens power tubes. Together with its tubular molybdenum supports, this cathode represents a very robust construction.

Technical data RS 2012 CL

General data

Filament   Characteristic values

$E_f = 10\,V$; $I_e = 35\,A$ at $E_b = E_{c\,2} = E_{c\,1} = 300\,V$

$I_f = 86\,A$; $\mu_{g\,1\,g\,2} = 8.4$ at $E_b = 2\,kV$, $E_{c\,2} = 600$ to $1000\,V$, $I_b = 3\,A$

$S = 67{,}000\,\mu$mhos at $E_b = 2\,kV$, $E_{c\,2} = 800\,V$, $I_b = 2.5$ to $3.5\,A$

Directly heated, thoriated tungsten cathode

Capacitances

Tube alone			Tube with header socket
$C_{ag\,2}$	$=$	22 pF	
$C_{g\,1\,g\,2}$	$=$	115 pF	137 pF
$C_{kg\,2}$	$=$	5.5 pF	10 pF
$C_{kg\,1}$	$=$	78 pF	104 pF
$C_{ag\,1}$	$=$	0.7 pF	
C_{ak}	$=$	0.07 pF	

Air cooling (sea level, 25 °C ambient temperature)

Plate dissipation	P_p	12	7	kW
Air flow rate	V	12	7.3	m³/min
		424	258	cfm
Pressure drop	Δp	88	35	mm H₂O
		3½	1⅜	in H₂O

High frequency linear amplifier, class B operation $I_{g\,1} = 0$
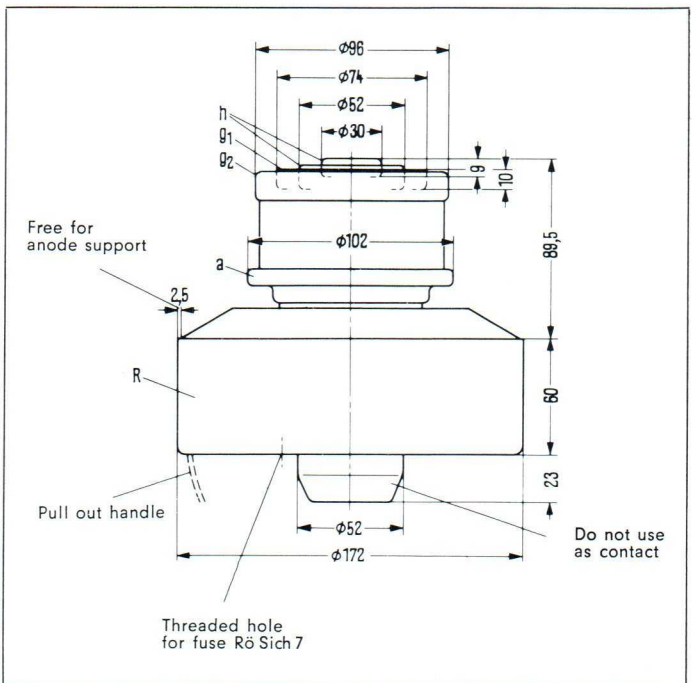Grounded cathode circuit, single-sideband modulation

Maximum ratings

F	$\leq$	30	MHz
E_b	$=$	9	kV
$E_{c\,2}$	$=$	1000	V
$E_{c\,1}$	$=$	-250	V
$I_{k\,pk}$	$=$	35	A
P_p	$=$	12	kW
$P_{g\,1}$	$=$	70	W
$P_{g\,2}$	$=$	200	W

Fig. 1   Grid-cathode structure of the RS 2012 CL

Fig. 2   Dimensional drawing RS 2012 CL

Operating data $F = 30$ MHz

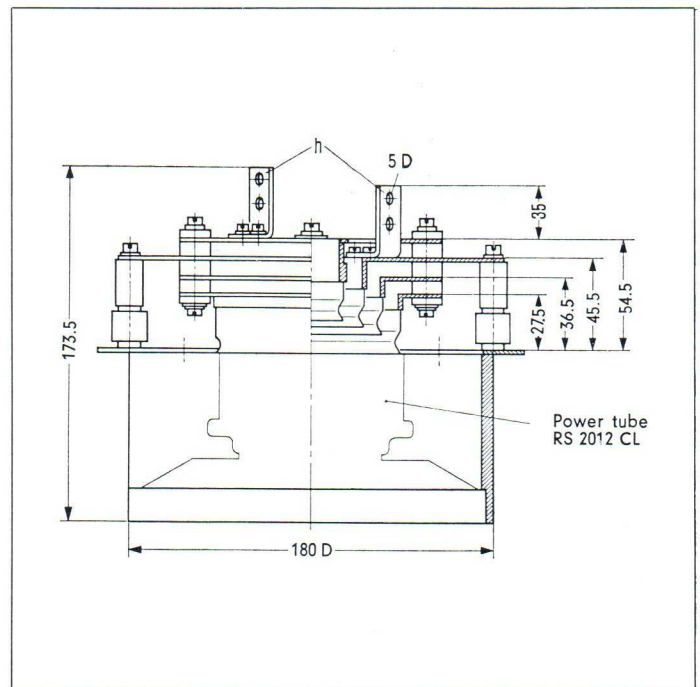| Drive	Zero	Single tone	Two tone	
P_0 =	0	11	5.5	kW
E_b =	8	8	8	kV
E_{c2} =	800	800	800	V
E_{c1} ≈	−100	−100	−100	V
e_{c1s} ≈	0	90	90	V
I_b =	1	2.2	1.5	A
I_{g2} ≈	0	90	30	mA
P_a =	8	17.6	12	kW
P_p =	8	6.6	6.5	kW
P_{g2} =	0	72	24	W
η =	0	62.5	46	%
IM_3 =			38	dB
IM_5 =			50	dB

Fig. 3   Header socket Rö Kpf 212

Application

To use the RS 2012 CL in transmitter circuits, a header socket Rö Kpf 212 with insulated air duct is required (fig. 3). Threaded holes are provided in the electrode connectors for fixing capacitors.

As a typical application for the tetrode RS 2012 CL, fig. 4 shows the basic circuit diagram of a 10 kW power amplifier for a short wave communications transmitter covering the frequency range 1.5 to 30 MHz.

The output stage of this transmitter is driven by a solid-state driver stage delivering an alternating grid voltage of 70 Vrms for 10 kW output power. The input capacitance of the tube with header socket is about 245 pF. The transistors in the driver stage work into switched filter circuits; the complete frequency range is divided into several partial bands. This permits a load resistance R of about 100 Ω to be selected. The transistor amplifier must then deliver about 50 W. Presently wideband linear transistor amplifiers offered on the market are capable of up to 300 W.

The low feedback capacitance of the tetrode makes neutralization over the band 1.5 to 30 MHz uncritical. It need only be set up once and not tuned. To further improve the excellent linear properties of the tetrode, r. f. feedback can also be incorporated. However, if using the circuit shown in fig. 4, it should be remembered that the input resistance of the RS 2012 CL then becomes lower. The terminating resistor R and tube input resistance parallel to it constitute the total load resistance of the transistor driver stage. The resistance looking back into the driver must then be very high compared with R to assure that an effective degree of feedback is obtained. The intermodulation product levels $IM_3 \leqq 38$ dB and $IM_5 \leqq 50$ dB stated in the technical data can only be achieved with the RS 2012 CL if the corresponding intermodulation levels at the tube input are 6 to 10 dB better.

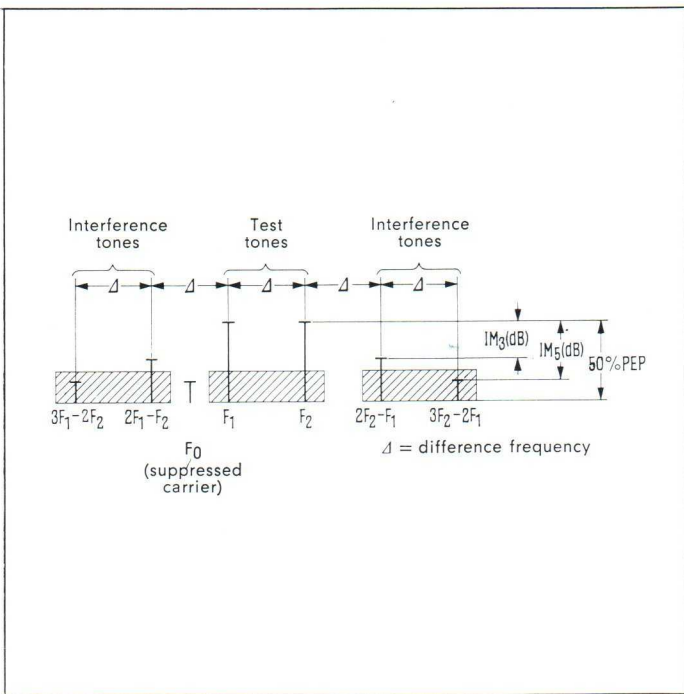Fig. 4   Basic circuit diagram of a 10 kW SW power amplifier
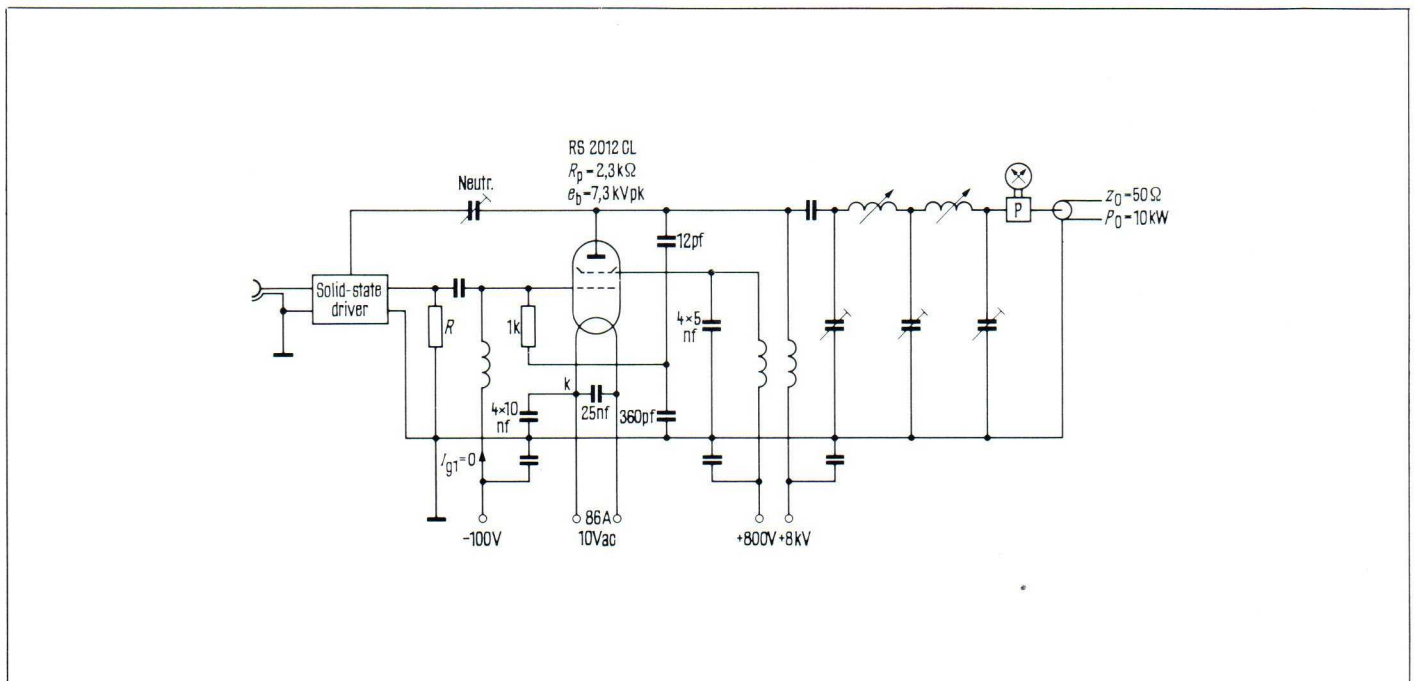
Fig. 5 Frequency schematic of the test and interference tones

The intermodulation products are measured by the two tone method. Both tones must have the same amplitude and drive the tube 100 % in one sideband. The frequencies of the two test tones are selected such that the second and third order difference tones fall in the other sideband. The ratio of the level of one test tone to the difference products IM_3 and IM_5 is then measured at the tube output with a selective level meter. The frequency schematic in fig. 5 shows the frequency locations of the test and interference tones.