



ELECTRONIC TUBE REFERENCE

18048C3M

Voltage - Pentode electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

PENTODE

Special-quality Philips C3m pentode for AF, IF, RF, oscillator, and output service. Manufacturer documentation specifies a 10,000-hour life test, making extended professional service life a defining feature of this versatile signal and low-power output tube.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	8
NOMINAL HEATER	20 V / 125 mA	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Pentode	
TRANSCONDUCTANCE	0.0065 S
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM SCREEN VOLTAGE	300 V
MAXIMUM PLATE DISSIPATION	4 W
MAXIMUM SCREEN DISSIPATION	1 W
MAXIMUM GRID DISSIPATION	0.05 W
MAXIMUM CATHODE CURRENT	30 mA
<i>Special-quality long-life Philips C3m pentode for AF, IF, RF, output, and oscillator service, with a 10,000-hour life-test specification.</i>	

18048C3M — Special Quality Long-Life Pentode

The **18048C3M** (also designated as **18048/C3m**) is a Special Quality (SQ), long-life pentode designed for high-reliability applications. Enclosed in a robust metal envelope, this tube is engineered for a wide range of functions, including audio frequency (A.F.), intermediate frequency (I.F.), and radio frequency (R.F.) amplification, as well as serving as an output tube or oscillator. It features a long operational life expectancy of 10,000 hours under typical operating conditions.

Mechanical Construction and Pinout

The 18048C3M is constructed with a metal envelope and utilizes an eight-pin LOCTAL base with a center ground/shield pin. The physical dimensions of the tube are characterized by a maximum overall diameter of 32 mm and a maximum height of 70 mm (measuring 55 mm from the top of the envelope to the base).

The LOCTAL base pinout configuration, viewed from the bottom, is as follows:

Pin	Connection
Pin 1	Heater (f)
Pin 2	Anode (a)
Pin 3	Grid 3 (g3)
Pin 4	Grid 2 (g2)
Pin 5	No Connection (NC)
Pin 6	Grid 1 (g1)
Pin 7	Cathode, internal shield (k, s)
Pin 8	Heater (f)
Center Pin	Ground / external shield

Heater and Electrical Insulation

The 18048C3M features an indirectly heated cathode designed for either AC or DC operation, supporting both series and parallel supply configurations.

The nominal heater ratings and their strict operational limits are:

- **Nominal Heater Voltage (Vf):** 20 V (with an absolute limit of 20 V ± 5% in parallel supply configurations)
- **Nominal Heater Current (If):** 125 mA (typical range of 120–130 mA, with an absolute limit of 125 mA ± 1.5% in series supply configurations)

Heating Time and Insulation Resistance

Under typical operating conditions ($V_{ba} = 225\text{ V}$, $V_{g3} = 0\text{ V}$, $V_{bg2} = 155\text{ V}$, $R_k = 250\ \Omega$), the typical heating time (T_h) required for the anode current (I_a) to rise from 0 to 4 mA is 26 seconds, with an acceptable range of 19 to 33 seconds.

The insulation resistance between the heater and cathode, measured with the cathode positive at a heater-to-cathode voltage (V_{kf}) of 50 V, is exceptionally high:

- **New Tube Insulation (Risol):** $> 100\text{ M}\Omega$
- **End of Life Limit:** $50\text{ M}\Omega$

For insulation between any other arbitrary pair of electrodes measured at 50 V:

- **New Tube Insulation (Risol):** $> 1000\text{ M}\Omega$
- **End of Life Limit:** $300\text{ M}\Omega$

Hum Performance

The tube exhibits excellent low-noise characteristics. When operated with a 20 V heater supply at 50 Hz with a grounded center tap, a grid resistor (R_{g1}) of $0.5\text{ M}\Omega$, and a cathode bypass capacitor (C_k) greater than $100\ \mu\text{F}$, the hum voltage ($V_{g1\text{hum}}$) referred to grid 1 is less than $10\ \mu\text{V}$ under a straight response filter.

Typical Operating Characteristics

In standard pentode Class A amplifier service, the typical operating parameters are defined under specific biasing conditions:

Parameter	Typical Value	Range / Limit
Anode Supply Voltage (V_{ba})	225 V	—
Grid 3 Voltage (V_{g3})	0 V	—
Grid 2 Supply Voltage (V_{bg2})	155 V	—
Cathode Bias Resistor (R_k)	$250\ \Omega$	—
Anode Current (I_a)	16 mA	13.5–19 mA (End of life limit: 11.5 mA)
Grid 2 Current (I_{g2})	3 mA	2–4 mA
Mutual Conductance (S)	6.5 mA/V	5.5–7.8 mA/V (End of life limit: 4.5 mA/V)
Internal Plate Resistance (R_i)	$0.25\text{ M}\Omega$	$> 0.2\text{ M}\Omega$

Parameter	Typical Value	Range / Limit
Grid 2 to Grid 1 Amplification (μg_{2g1})	19	—
Equivalent Noise Resistance (Req, R.F.)	1.2 k Ω	< 2.0 k Ω
Equivalent Noise Resistance (Req, A.F. 500–3000 Hz)	5 k Ω	—
Equivalent Noise Resistance (Req, Triode R.F.)	650 Ω	—

Grid Current Characteristics

Under the same typical operating conditions with a grid 1 resistor (R_{g1}) of 0.1 M Ω , the negative grid current ($-I_{g1}$) is less than 0.5 μA , with an end-of-life limit of 1.0 μA . The grid current starting point, where positive grid current ($+I_{g1}$) reaches 0.3 μA , occurs at a negative grid 1 voltage ($-V_{g1}$) of less than 1.3 V.

Output Power Example

When configured as a single-ended output stage under typical operating conditions ($V_{ba} = 225$ V, $V_{g3} = 0$ V, $V_{bg2} = 155$ V, $R_k = 250$ Ω) with an AC anode load resistance ($R_{a\sim}$) of 10 k Ω , the 18048C3M delivers an output power (W_o) of 1.5 W at a total harmonic distortion (dtot) of 10%.

Interelectrode Capacitances

The 18048C3M features low interelectrode capacitances, which are critical for stable high-frequency operation. The capacitances vary depending on whether the tube is wired in a pentode or triode configuration.

Pentode Connection Capacitances

- **Grid 1 Capacitance (C_{g1}):** 8.5 pF (range: 7.5–9.5 pF)
- **Grid 1 Capacitance at $I_k = 19$ mA:** 10.5 pF (reflecting space-charge effects)
- **Anode Capacitance (C_a):** 6.0 pF (range: 4.5–7.7 pF)
- **Combined Input/Output Capacitance ($C_{g1} + C_a$):** < 16 pF
- **Anode to Grid 1 Capacitance (C_{ag1}):** 0.014 pF (maximum limit: < 0.018 pF)
- **Anode to Grid 3 Capacitance (C_{ag3}):** 1.2 pF
- **Anode to Heater Capacitance (C_{af}):** 0.12 pF
- **Grid 1 to Grid 2 Capacitance (C_{g1g2}):** 3 pF
- **Grid 1 to Cathode Capacitance (C_{g1k}):** 4.5 pF
- **Grid 1 to Heater Capacitance (C_{g1f}):** 0.02 pF (maximum limit: < 0.04 pF)
- **Grid 2 to Grid 3 Capacitance (C_{g2g3}):** 2.2 pF

- **Cathode to Heater Capacitance (C_{kf}):** 7 pF

Triode Connection Capacitances (Grids 2 and 3 tied to Anode)

- **Grid 1 Capacitance (C_{g1}):** 5 pF (maximum limit: < 6 pF)
- **Anode Capacitance (C_a):** 7.5 pF (maximum limit: < 9 pF)
- **Anode to Grid 1 Capacitance (C_{ag1}):** 3.2 pF (maximum limit: < 4 pF)

Limiting Values (Design Centre Limits)

To ensure the 10,000-hour life expectancy and reliable operation, the following Design Centre Limits must not be exceeded:

- **Cold Anode Voltage (V_{ao}):** max 550 V
- **Anode Voltage (V_a):** max 300 V
- **Anode Dissipation (W_a):** max 4 W
- **Triode Connection Combined Dissipation (W_a + W_{g2} + W_{g3}):** max 5 W
- **Cold Grid 3 Voltage (V_{g3o}):** max 550 V
- **Grid 3 Voltage (V_{g3}):** max 300 V
- **Grid 3 Dissipation (W_{g3}):** max 1 W
- **Cold Grid 2 Voltage (V_{g2o}):** max 550 V
- **Grid 2 Voltage (V_{g2}):** max 300 V
- **Grid 2 Dissipation (W_{g2}):** max 1 W
- **Negative Grid 1 Voltage (-V_{g1}):** max 100 V
- **Grid 1 Dissipation (W_{g1}):** max 50 mW
- **Grid 1 Resistor (R_{g1}):**
 - Max 0.5 MΩ when W_a > 1.5 W
 - Max 3 MΩ when W_a < 1.5 W
- **Cathode Current (I_k):** max 30 mA
- **Heater-to-Cathode Voltage (V_{kf}):** max 120 V
- **Heater-to-Cathode Circuit Resistance (R_{kf}):** max 20 kΩ
- **Bulb Temperature (t_{bulb}):** max 120 °C

Qualitative Curve Observations and Alternative Connections

The 18048C3M exhibits distinct electrical behaviors depending on how its multiple grids are connected.

Pentode vs. Tetrode Connection

When operated as a pentode (with grid 3 connected to cathode, V_{g3} = 0 V), the tube provides a smooth knee in its anode current versus anode voltage (I_a vs. V_a) curves, maintaining high internal plate resistance and stable amplification. In contrast, if wired in a tetrode configuration (where grid 3 is tied

directly to the anode), the I_a vs. V_a curves exhibit a pronounced dynatron kink at anode voltages below the grid 2 voltage ($V_a < V_{g2}$). This kink is caused by secondary emission from the anode being attracted to the more positive grid 2, a phenomenon effectively suppressed by the suppressor grid (grid 3) in the standard pentode connection.

Triode Connection

In a triode configuration where grid 2 and grid 3 are tied to the anode, the I_a vs. V_a curves display typical triode characteristics. Under this mode of operation, the maximum combined dissipation limit ($W_a + W_{g2} + W_{g3}$) is restricted to 5 W.

Diode Connection (Strapper Configuration)

For testing or specialized detection purposes, the tube can be operated in a 'strapper' diode configuration where the anode, grid 3, grid 2, and grid 1 are all tied together. In this diode-connected state, the total diode current (I_d) rises rapidly, exceeding 200 mA at a diode voltage (V_d) of 20 V. Under these conditions, the current distribution among the strapped electrodes is highly unequal:

- **Grid 1 Current (I_{g1}):** ~110 mA (carrying the largest share of the current)
- **Grid 2 Current (I_{g2}):** ~70 mA
- **Grid 3 Current (I_{g3}):** ~15 mA
- **Anode Current (I_a):** ~10 mA

Technical Summary

The **18048C3M** is a high-reliability, Special Quality pentode featuring a metal envelope, a LOCTAL base, and a 20 V, 125 mA heater. Designed for a long service life of 10,000 hours, it is highly versatile, serving as an A.F., I.F., or R.F. amplifier, output tube, or oscillator. At its typical operating point of 225 V on the anode and 155 V on grid 2, it exhibits a transconductance of 6.5 mA/V, an internal resistance of 0.25 M Ω , and can deliver 1.5 W of output power into a 10 k Ω load. Its design allows for flexible configurations, including standard pentode, tetrode, triode, and strapped-diode connections, provided that its strict Design Centre Limits—such as the 4 W anode dissipation and 120 °C bulb temperature—are carefully respected.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1963 Philips Electron Tubes Handbook V1

Published test conditions and operating points. Values on this page are preserved as reported by this source.

1963 PHILIPS ELECTRON TUBES HANDBOOK V1

Section 1 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode supply voltage	225 V	—
Screen supply voltage	155 V	—
Grid 3 voltage	0 V	—
Cathode resistor	250 ohm	—

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode current	13.5–19 mA	NewTubeRange
Screen current	2–4 mA	NewTubeRange
Transconductance	5500–7800 uS	NewTubeRange
Internal resistance	0.2— M0hm	—
Amplification factor grid2/grid1	19	—
Equivalent noise resistance RF	—2 k0hm	—

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid-to-other-elements capacitance	7.5–9.5 pF	—
Anode capacitance	4.5–7.7 pF	—
Anode-to-grid1 capacitance	—0.018 pF	—
Triode-connection input capacitance	—6 pF	TriodeConnection

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Triode-connection output capacitance	—9 pF	TriodeConnection
Triode-connection anode-grid capacitance	—4 pF	TriodeConnection

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