GENERAL ELECTRIC

Transmitting Tube GL-814 -- Instructions

U.S. Army Signal Corps Tube Type VT-154

Description

The GL-814 is a filament type of transmitting tube incorporating new design principles involving the use of directed electron beams. Features resulting from the use of these principles in the 814 are that the screen absorbs little power and that efficient suppressor action is supplied by space-charge effects produced between the screen and the plate. The resultant high power sensitivity makes this tube especially suited for use as an r-f amplifier, frequency multiplier, oscillator, and plate-modulated amplifier. The plate connection is brought out through a separate seal at the top of the bulb to maintain low grid-plate capacitance.

Technical Information

These data are for reference only. For design information see the specifications.

GENERAL CHARACTERISTICS

ELECTRICAL

Number of Electrodes	4
Filament Voltage, volts	10
Filament Current, amperes	3.25
Grid-plate Transconductance, micromhos	3300
Direct Interelectrode Capacitances, mmfd	
Grid-plate (with external shielding)	0.1
Input	13.5
Output	13.5

MECHANICAL

Base Description	Medium 5-pin, Ceramic
Net Weight, oz approx	8
Shipping Weight, lb approx	7

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

CLASS B R-F POWER AMPLIFIER:
(Carrier conditions per tube for use with a max modulation factor of 1.0)

	Typical Operation			*Maximum Ratings		
	CCS		IC & AS	CCS	IC & AS	
D-c Plate Voltage	1000	1250	1500	1250	1500	Volts
D-c Grid Voltage	-28	-28	-35			Volts
Positive D-c Grid Voltage	200	200	250	400	400	Volts
D-c Plate Current	60	60	60	60	60	Ma
Plate Input				75	90	Watts
Positive Grid Input				6.7	6.7	Watts
Plate Dissipation				50	60	Watts
Peak R-f Grid Input Voltage	50	50	56			Volts
Driving Power‡	0.65	0.65	0.85			Approx Watts
Plate Power Output	20	25	30			Watts

CLASS C GRID MODULATED R-F POWER AMPLIFIER:
(Carrier conditions per tube for use with a max modulation factor of 1.0)

	Typical Operation			*Maximum Ratings		
	CCS		IC & AS	CCS	IC & AS	
D-c Plate Voltage	1000	1250	1500	1250	1500	Volts
D-c Grid Voltage	-100	-100	-120	-250	-250	Volts
Positive D-c Grid Voltage	200	200	250	400	400	Volts
Beam Forming Plate Voltage	0	0	0			Volts
D-c Plate Current	60	60	60	60	60	Ma
D-c Grid Current	3	2.8	2.5			Approx Ma
Positive D-c Grid Current	2	1.4	3			Watts
Plate Input				75	90	Watts
Positive Grid Input				6.7	6.7	Watts
Plate Dissipation				50	60	Watts
Peak R-f Grid Input Voltage	129	129	150			Volts
Peak A-f Grid Voltage	64	64	90			Volts
Driving Power	2.5	2.3	4.2			Approx Watts
Plate Power Output	25	29	35			Watts

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR - PLATE MODULATED:
(Carrier conditions per tube for use with a max modulation factor of 1.0)

	CCS		IC & AS	CCS	IC & AS	
D-c Plate Voltage	900	1000	1250	1000	1250	Volts
D-c Grid Voltage	-150	-150	-150	-300	-300	Volts
Positive D-c Grid Voltage	300	300	300	400	400	Volts
D-c Plate Current	120	120	144	120	150	Ma
D-c Grid Current	10	10	10	15	15	Approx Ma
Plate Input				120	180	Watts
Positive Grid Input				6.7	6.7	Watts
Plate Dissipation				34	50	Watts
Peak R-f Grid Input Voltage	215	222	222			Approx Volts
Driving Power	2	2	3.2			Approx Watts
Plate Power Output	76	87	130			Watts

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR:
(Key-down conditions per tube without modulation)§

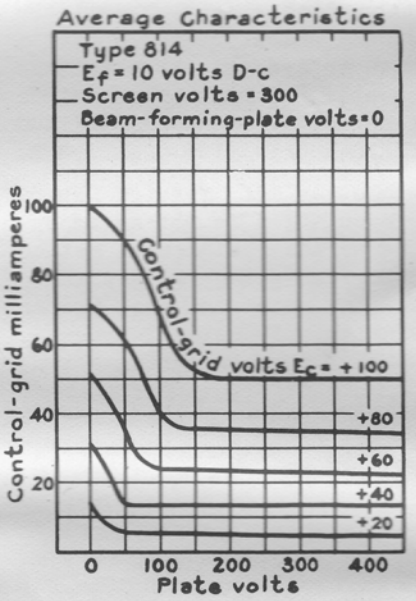
	CCS		IC & AS	CCS	IC & AS	
D-c Plate Voltage	1000	1250	1500	1250	1500	Volts
D-c Grid Voltage	-70	-80	-90	-300	-300	Volts
Positive D-c Grid Voltage	300	300	300	400	400	Volts
Beam Forming Plate Voltage	0	0	0			Volts
D-c Plate Current	150	144	150	150	150	Ma
D-c Grid Current	10	10	10	15	15	Approx Ma
Plate Input				180	225	Watts
Plate Dissipation				50	65	Watts
Positive Grid Input				10	10	Watts
Peak R-f Grid Input Voltage	150	165	170			Approx Volts
Driving Power	1.35	1.5	1.5			Approx Watts
Plate Power Output	100	130	160			Watts

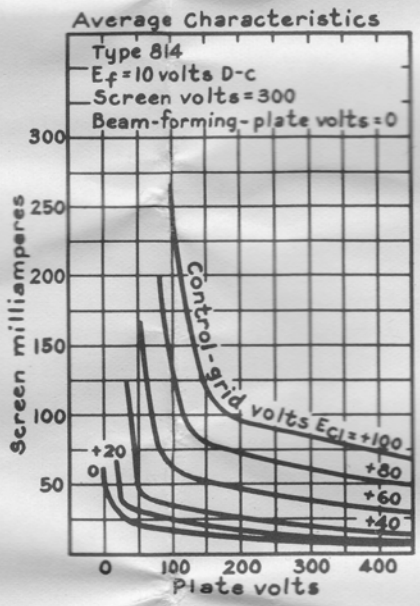
‡ At crest of audio-frequency cycle.
§ Modulation, essentially negative, may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent of the carrier conditions.

APPLICATION NOTES

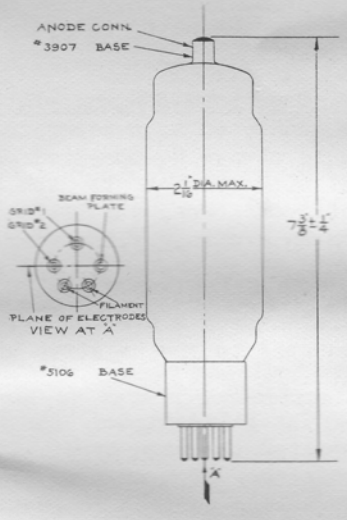
* The GL-814 can be operated at frequencies as high as 30 megacycles. The tube may be operated at higher frequencies provided the maximum values of plate voltage and power input are reduced as the frequency is raised. (Other maximum ratings are the same as shown on the preceding pages.) The tabulation below shows the highest percentage of maximum plate voltage and power input that can be used up to 75 megacycles for the various classes of service. Special attention should be given to adequate ventilation of the bulb at these frequencies.

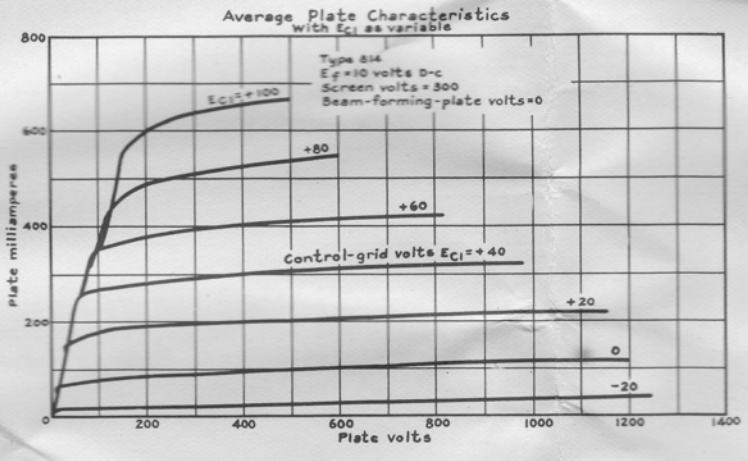
Frequency, Megacycles	30	50	75
Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input			
Class B, R-f	100	90	85
Class C (Plate-modulated	100	80	64
Class C (Grid-modulated	100	90	85
Class C (Unmodulated	100	80	64





Tube Mounting Position
Vertical: Base down
Horizontal: Filament in vertical plane (on edge)





Outline Pliotron GL-814
K-5965391 5-22-40

Installation

The base pins of the GL-814 fit the standard 5-contact socket which should be installed to hold the tube in a vertical position with the base down. If it is necessary to place the tube in a horizontal position, the socket should be mounted with the filament-pin openings one vertically above the other so that the filament will be in a vertical plane (on edge). The plate connection is made to the metal cap on the top of the bulb. A flexible lead should be used to make the connection to the plate cap so that no strain will be placed on the bulb at the base of the cap. The cap should not be made to support circuit parts. Under no circumstances should anything be soldered to the cap because the heat of soldering may crack the glass seal.

The bulb becomes very hot during continuous operation of the tube. Therefore, free circulation of air about the bulb should be provided. Care should be taken that the bulb does not come in contact with any metallic object nor be subjected to the spray of any liquid. The installation of all wires and connections should be made so that they will not be close to or touch the bulb in order to avoid puncture of the glass.

The beam-forming plates of the 814 are connected to a separate base pin. They should always be operated at zero potential with respect to the filament; never positive. When the filament is operated from an a-c supply, the beam-forming plates should be connected to the midpoint of the filament circuit. When the filament is operated from a d-c supply, they should be connected to the negative end of the filament.

The filament of the 814 is of the thoriated-tungsten type. It may be operated either from an a-c or a d-c source. Alternating current is generally used because of its convenience. The characteristics shown under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS are based on a-c filament operation. When the use of a d-c source is necessary to avoid hum, the grid and plate returns should be made to the negative filament terminal. A voltmeter should be connected permanently across the filament terminals to provide a ready check of the filament voltage. This voltage should not vary more than plus or minus 5 per cent from the rated value; otherwise, a loss of filament emission may result. It is recommended that if the average number of daily interruptions of the transmitter is greater than one hundred per day the filament voltage should be maintained at eighty per cent of normal during the stand-by periods. It is further recommended that if the number of interruptions is less than one hundred per day the filament power may be removed during stand-by periods.

The plate dissipation of the 814 (the difference between plate input and power output) should never exceed the maximum values given under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS. The plate should not show color under any condition of operation.

The screen voltage may be obtained either from a separate source, from a potentiometer, or from the plate supply through a series resistor, depending on the service in which the tube is used (see OPERATION). When the screen-resistor method is used, the resistor should have a value sufficient to drop the high voltage to a value which is within the maximum screen-voltage rating given under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS.

In those classes of service where screen-voltage regulation is not an important factor, the series-resistance method for obtaining screen voltage is desirable since it serves to maintain the proper screen current. With this method, however, it is important that the high-voltage supply switch be opened before the filament circuit is opened or the r-f excitation is removed; otherwise, full supply voltage will be placed on the screen. If the screen voltage is obtained from a separate source, or from a potentiometer, plate voltage should be applied before the screen voltage, or simultaneously with it; otherwise, with voltage on the screen only, the screen current may be large enough to cause excessive screen dissipation. A d-c milliammeter should be used in the screen circuit so that the screen current will always be known. The screen input should not exceed the maximum screen-input values shown under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS. The screen should never be allowed to attain a temperature at which it will show color.

The common positive high-voltage supply lead of the 814 should be provided with a protective device, such as a fuse, to prevent the tube from drawing excessive plate and screen current. This device

should open the high-voltage supply when the d-c plate current and d-c screen current reach a value of 50 per cent greater than normal.

Adequate shielding and isolation of the input circuit and the output circuit are necessary if optimum results are to be obtained. In some cases neutralization may be necessary to prevent feedback. The impedance between the screen and filament must be kept as low as possible by the use of a by-pass condenser. When screen voltage is obtained from a series resistance, the screen by-pass condenser should have a voltage breakdown rating high enough to withstand the full plate voltage of the tube. The capacity value of the condenser should be about 0.01 microfarad. Values larger than this may cause excessive a-f by-passing; smaller values may cause excessive r-f feedback from plate to control grid, depending on circuit layout, frequency, and gain.

Heavy leads and conductors together with suitable insulation should be used in all parts of the r-f plate tank circuit so that the losses, due to r-f voltages and currents, may be kept at a minimum. Because proper circuit design becomes very important at the higher frequencies, it is essential that short, heavy leads and circuit returns be used in order to minimize lead inductance and losses.

In order that the maximum ratings given under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS are not exceeded, changes in electrode voltages due to line-voltage fluctuation, load variation, and manufacturing variation of the associated apparatus must be determined. An average value of voltage for each electrode should then be chosen so that under the usual voltage variations the maximum rated voltages will not be exceeded.

When a new circuit is tried or when adjustments are made, the screen and plate voltage should be reduced in order to prevent damage to the tube or associated apparatus in case the circuit adjustments are incorrect. It is advisable to use a protective resistance of about 10,000 ohms, total, in series with the screen lead and a protective resistance of 5000 ohms in series with the high-voltage plate lead during such adjustments. Suitable meters should be provided for measuring tube voltages and currents as well as for making transmitter adjustments. In modulated service the use of cathode-ray oscillograph also is recommended in the making of final adjustments for optimum performance. Under no conditions should the maximum values given under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS be exceeded.

The rated plate voltage of this tube is high enough to be dangerous to the user. Care should be taken during the adjustment of circuits, especially those in which the exposed circuit parts are at the high d-c plate potential.

Operation

As a Class B radio-frequency amplifier, the 814 may be used as shown under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS. The plate is supplied with unmodulated d-c voltage and the grid is excited by r-f voltage modulated at audio frequency in one of the preceding stages. Under these conditions, the plate dissipation is greatest when the carrier is unmodulated. It is important, therefore, that the plate dissipation for this class of operation should not exceed fifty watts for unmodulated conditions. The screen voltage should be obtained from a separate source or from a potentiometer connected across the plate supply. Control-grid bias for the 814 as a Class B r-f amplifier may be obtained from a battery, from a rectifier of good regulation, or from a cathode-bias resistor, suitably by-passed for audio and radio frequencies.

As a grid-modulated Class C r-f amplifier, the 814 may be used as shown under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS. The plate is supplied with unmodulated d-c voltage and the control-grid bias is modulated at audio frequency. The screen voltage should be obtained from a separate source or from a potentiometer connected across the plate supply. Control-grid bias for this service should be obtained from a battery or other d-c source of good regulation. It should not be obtained from a high resistance supply.

As a plate-modulated Class C r-f amplifier, the 814 is capable of being modulated 100 per cent. Operating conditions for this service are shown under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS.

Screen voltage should preferably be obtained from a fixed supply, modulated simultaneously with the plate voltage. In this case, modulation of the screen voltage can be accomplished either by connecting the screen to a separate winding on

the modulation transformer, or by connecting it to a tap on the modulation transformer or choke, through a blocking condenser. With the latter method, an a-f choke of suitable impedance should be connected in series with the screen-supply lead. Control-grid bias for this service should preferably be obtained from a fixed source, although a combination of either grid leak and fixed supply or grid leak and cathode resistor may also be used.

The screen voltage may also be obtained through a voltage-dropping resistor in series with the modulated plate-voltage supply.

As a Class C r-f amplifier for telegraph service, the 814 may be operated as shown under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS. The screen voltage and the control-grid bias may be obtained by any convenient method.

The d-c grid current will vary with individual tubes. Under no condition of operation should the values under MAXIMUM RATINGS be exceeded.

The 814 may be operated at maximum ratings in all classes of service at frequencies as high as 30 megacycles. The tube may be operated at higher frequencies provided the maximum values of plate voltage and power input are reduced as the frequency is raised. (Other maximum ratings are the same as shown under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS.) The tabulation† shows the highest percentage of maximum plate voltage and power input that can be used at 30, 50, and 100 mc for any class of service. Special attention should be given to shielding and to r-f by-passing at these frequencies. When shielding is used, care should be taken to provide adequate tube ventilation and to maintain normal ambient temperature.

With the grid connected to the plate through the shortest possible connection, the resonant frequency of the grid-plate circuit is approximately 190 megacycles.

If more radio-frequency power output is required than can be obtained from a single 814, the push-pull or the parallel connection may be used. For example, two tubes connected in push-pull or in parallel will give approximately twice the power output of one tube. The parallel connection requires no increase in exciting voltage; the push-pull connection requires twice the r-f excitation necessary to drive a single tube. With either connection, the driving power required is approximately twice that for single-tube operation while the grid bias is the same as that for a single tube. The push-pull arrangement has the advantage of balancing the circuit with respect to ground and of cancelling the even-order harmonics from the output. When two or more 814's are operated in parallel, a noninductive resistance of 10 to 100 ohms and a choke coil or other suitable network should be placed in series with the grid lead of each tube, close to the socket terminal, to prevent parasitic oscillations.

Service Information

General Electric tubes are warranted to be of the kind and quality described in the manufacturers' specifications. Before leaving the factory, each tube is subjected to rigid tests and inspections. Performance will depend, to a large extent, upon the application, and upon the care with which the tubes are handled. In case of doubt as to proper operating conditions, information should be secured from the General Electric Office through which the purchase was made.

INTRODUCTION

This service sheet is furnished for the convenience of the customer in applying for adjustment if the quality of the tube does not meet the specification and warranty under which the tube was sold. In order that prompt action can be taken the information required in the service report form should be supplied in complete detail.

INITIAL TEST

To assure satisfactory operation, it is recommended that each tube be tested upon receipt by the customer, preferably in equipment of the same type and rating as that in which it is to be used. Such a procedure will assure that tubes damaged in transportation are not carried in stock. If spare tubes are stocked for long periods, a check test should be made at least every three months. The conditions of test and operation shall not be more severe than the conditions described in the manufacturers' specifications and instructions.

TRANSPORTATION CLAIMS

Should the package be received in a damaged condition, observance of the procedure described on the tag affixed to the container will enable the General Electric Company to assist the customer in filing a claim for tubes damaged in transit.

RETURN PROCEDURE

If any failure of the tube to comply with the specifications or warranties under which the tube was purchased occurs, the purchaser shall

1. Notify the nearest sales office of the General Electric Company. The manufacturer's office will advise the purchaser regarding the correct packing instructions and shipping procedure for returning tubes believed to be defective.
2. Tubes returned for credit adjustment should be packed as carefully as when originally received, for damage sustained in return shipment will make a thorough examination impossible.

If more than one tube is involved, the tubes should be identified by some permanent marking, such as a securely tied tag, which will enable them to be associated with this service report.

PERMISSION FOR DISMANTLING

In returning a vacuum tube for test and examination, the customer gives permission to the General Electric Company to break the glass bulb and to dissect the structure of the tube in case such procedure is considered necessary for complete examination.

Service Report Form - NEMA Standard

Tube Type No. _____ Serial No. _____

Date Received _____ Date First Tested _____

Date Placed in Service _____ Date Inoperative _____

Hours of Cathode Operation _____ Hours of Anode Operation _____

If Stand-by Operation is Used Show Filament Voltage for Stand-by Condition _____

Nature of Defect _____

_____

Describe any unusual phenomena which took place just previous to or at time of failure

_____

_____

Code No. and maker of equipment in which tube was used _____

_____

Was tube used in experimental equipment or experimental adjustment _____

_____

Were all other circuit elements operating properly at time of tube failure _____

_____

PURCHASER $14.25 1948

ADDRESS _____

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

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