HYTRON RADIO TUBES

# U. S. ARMY SIGNAL CORPS. TYPE VT-55

## 865

### Screen-Grid R-F Power Amplifier

865 is a screen-grid transmitting tube of the thoriated-tungsten filament type for use as an r-f power amplifier and frequency multiplier. The plate connection is brought out of the top of the bulb to maintain low grid-plate capacitance. Neutralization to prevent feedback is generally unnecessary in adequately shielded circuits. The 865 can be operated at maximum ratings at frequencies as high as 15 megacycles. The maximum plate dissipation rating for class C telegraph service is 15 watts.

## CHARACTERISTICS and RATINGS

| | | |
|---|---|---|
| FILAMENT VOLTAGE (A.C. or D.C.) | 7.5 | Volts |
| FILAMENT CURRENT | 2.0 | Amperes |
| AMPLIFICATION FACTOR (Approx.) | 150 | |
| TRANSCONDUCTANCE (For plate current of 18 ma.) | 850 | Micromhos |
| DIRECT INTERELECTRODE CAPACITANCES: | | |
| Grid-Plate (With external shielding) | 0.15 max. | μμf |
| Input | 8.5 | μμf |
| Output | 8.0 | μμf |
| BULB | ST-16 | |
| CAP | Small Metal | |
| BASE | Medium 4-Pin Bayonet | |

## MAXIMUM CCS RATINGS and TYPICAL OPERATING CONDITIONS

*CCS = Continuous Commercial Service*

### As R-F Power Amplifier - Class B Telephony

*Carrier conditions per tube for use with a max. modulation factor of 1.0*

| | | CCS | |
|---|---|---|---|
| D-C PLATE VOLTAGE | | 750 max. | Volts |
| D-C SCREEN VOLTAGE | | 175 max. | Volts |
| D-C PLATE CURRENT | | 30 max. | Milliamperes |
| PLATE INPUT | | 22.5 max. | Watts |
| SCREEN INPUT | | 3 max. | Watts |
| PLATE DISSIPATION | | 15 max. | Watts |
| TYPICAL OPERATION: | | | |
| D-C Plate Voltage | 500 | 750 | Volts |
| D-C Screen Voltage | 125 | 125 | Volts |
| D-C Grid Voltage # | -30 | -30 | Volts |
| D-C Plate Current | 30 | 22 | Milliamperes |
| D-C Grid Current (Approx.) *° | 5 | 3 | Milliamperes |
| Driving Power (Approx.) * | 2 | 1.5 | Watts |
| Power Output (Approx.) | 3 | 4.5 | Watts |

### As Plate-Modulated R-F Power Amplifier - Class C Telephony

*Carrier conditions per tube for use with a max. modulation factor of 1.0*

| | | CCS | |
|---|---|---|---|
| D-C PLATE VOLTAGE | | 500 max. | Volts |
| D-C SCREEN VOLTAGE | | 175 max. | Volts |
| D-C GRID VOLTAGE | | -250 max. | Volts |
| D-C PLATE CURRENT | | 60 max. | Milliamperes |
| D-C GRID CURRENT | | 15 max. | Milliamperes |
| PLATE INPUT | | 30 max. | Watts |
| SCREEN INPUT | | 2 max. | Watts |
| PLATE DISSIPATION | | 20 max. | Watts |
| TYPICAL OPERATION: | | | |
| D-C Plate Voltage | 375 | 500 | Volts |
| D-C Screen Voltage | 125 | 125 | Volts |
| D-C Grid Voltage | -120 | -120 | Volts |
| D-C Plate Current | 50 | 40 | Milliamperes |
| D-C Grid Current (Approx.) * | 11 | 9 | Milliamperes |
| Driving Power (Approx.) | 3 | 2.5 | Watts |
| Power Output (Approx.) | 8.5 | 10 | Watts |

#, *, °: See next page.

## As R-F Amplifier and Oscillator - Class C Telegraphy

*Key-down conditions per tube without modulation* **

| | | | | CCS | |
|---|---|---|---|---|---|
| D-C PLATE VOLTAGE | | | | 750 *max.* | Volts |
| D-C SCREEN VOLTAGE | | | | 175 *max.* | Volts |
| D-C GRID VOLTAGE | | | | -250 *max.* | Volts |
| D-C PLATE CURRENT | | | | 60 *max.* | Milliamperes |
| D-C GRID CURRENT | | | | 15 *max.* | Milliamperes |
| PLATE INPUT | | | | 45 *max.* | Watts |
| SCREEN INPUT | | | | 3 *max.* | Watts |
| PLATE DISSIPATION | | | | 15 *max.* | Watts |
| TYPICAL OPERATION: | | | | | |
| D-C Plate Voltage | 375 | 500 | 625 | 750 | Volts |
| D-C Screen Voltage | 125 | 125 | 125 | 125 | Volts |
| D-C Grid Voltage | -80 | -80 | -80 | -80 | Volts |
| D-C Plate Current | 55 | 50 | 45 | 40 | Milliamperes |
| D-C Grid Current (Approx.) * | 11 | 9 | 6 | 5.5 | Milliamperes |
| Driving Power (Approx.) | 2.5 | 3.0 | 1.2 | 1.0 | Watts |
| Power Output (Approx.) | 8.5 | 10 | 14 | 16 | Watts |

* Subject to wide variations depending on the impedance of the load circuit. High-impedance load circuits require more grid current and driving power to obtain the desired output. Low-impedance circuits need less grid current and driving power, but plate-circuit efficiency is sacrificed. The driving stage should have a tank circuit of good regulation and should be capable of delivering considerably more than the required driving power.

o At crest of audio-frequency cycle with modulation factor of 1.0.

** Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

\# Grid voltages are given with respect to the mid-point of filament operated on a.c. If d.c. is used, each stated value of grid voltage should be decreased by one-half the filament voltage and the circuit returns made to the negative end of the filament.

## INSTALLATION

The *base* of the 865 fits the standard 4-contact socket, which should be installed to hold the tube in a vertical position with the base down.

The *bulb* of the tube becomes hot during continuous operation so that free circulation of air around the tube should be provided.

The *filament* of the 865 is of the thoriated-tungsten type. The filament voltage should not be allowed to vary more than ±5% from the normal value; otherwise a loss of emission may result. It is recommended that, in intermittent service where the average number of daily transmissions is greater than 100, the filament be maintained at 80% of normal voltage during standby periods. If the number of transmissions is less than 100 per day, the filament power during standby may be either removed or maintained at 80% of normal voltage, whichever is preferred. However, in such applications as amateur service where the average number of daily transmissions is usually not greater than 100 and where the standby periods are usually no longer than the transmission periods, the filament voltage may be maintained at normal value during standby periods.

The *plate* of the 865 shows no color at the maximum plate-dissipation rating for each class of service.

The *screen voltage* may be obtained from a separate source, from a voltage divider across the plate supply, or through a voltage-dropping resistor in series with the plate supply, depending on the service in which the tube is used (see APPLICATION). When screen voltage is obtained from a separate source or from a voltage divider, plate voltage should be applied before or with the screen voltage. Otherwise, with voltage on the screen only, the screen current may rise high enough to cause excessive screen dissipation. When screen-voltage regulation is not an important factor, the series resistance method for obtaining screen voltage is desirable because of its simplicity and because it limits the d-c power input to the screen. With this method, however, it is important that the high-voltage switch be opened before the r-f excitation is removed and before the filament circuit is opened; otherwise full plate voltage will be placed on the screen.

The screen current is a very sensitive indication of plate-circuit loading and it rises excessively (often to the point of damaging the tube) when the amplifier is operated without load. Therefore, care should be taken when tuning an 865 under no-load conditions in order to prevent exceeding the screen-input rating of the tube.

A *protective device*, such as a high-voltage fuse or a relay should be used to protect both the plate and screen against overloads. When a voltage divider of

poor regulation or a series resistor is used for obtaining the screen voltage, this device should be placed in the common positive high-voltage supply lead. It should remove the high-voltage supply when the d-c plate current reaches a value 50% greater than normal. When the screen voltage is obtained from a separate source or from a voltage divider of good regulation, a protective device should be placed in the screen-supply lead. It should remove the screen voltage when the screen current reaches a value 50% greater than normal.

*Shielding* of the r-f amplifier stage using the 865 is required for stable operation. The r-f impedance between the screen and filament must be kept low, usually by means of a suitable by-pass condenser. The capacitance of the condenser may be about 0.01 μf.

*When a new circuit is tried or when adjustments are made, it is advisable to reduce the plate voltage.* This may be done conveniently by means of a protective resistance of about 5000 ohms in series with the high-voltage supply lead. *The plate and screen voltages of this tube are high enough to be dangerous to the user. Care should be taken during the adjustment of circuits, especially when exposed circuit parts are at high d-c plate potential.*

## APPLICATION

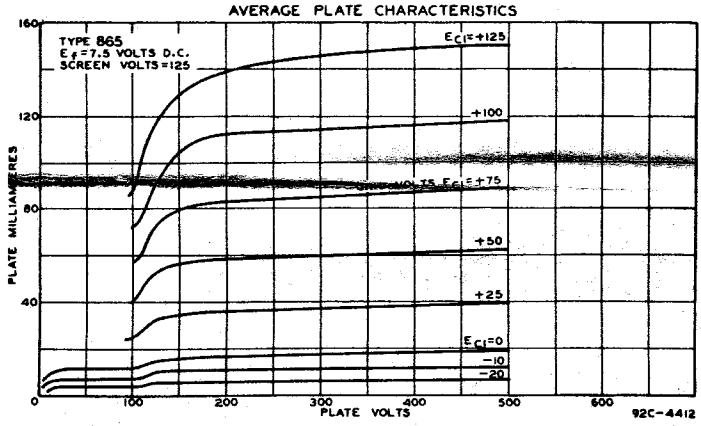
In *class B r-f power amplifier service*, the 865 is supplied with unmodulated d-c plate voltage. The grid is excited with r-f voltage modulated at audio frequency in a preceding stage. Screen voltage may be obtained from a separate source or from a voltage divider connected across the plate supply. Control-grid bias may be obtained from a battery, from a rectifier of good regulation, or from a cathode resistor, suitably by-passed for both audio and radio frequencies.

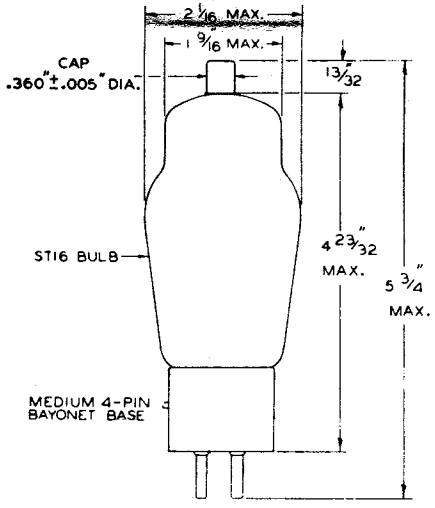
In *plate-modulated class C r-f power amplifier service*, the 865 can be modulated 100%. The screen voltage should be obtained preferably from a fixed source or from a voltage divider connected across the plate-voltage supply. If a series resistor is used to obtain the screen voltage, the resistor should be connected in series with the *unmodulated* plate-voltage supply. The screen voltage must be modulated simultaneously with the plate voltage so that the ratio of plate voltage to screen voltage remains constant. Modulation of a fixed screen-voltage supply can be accomplished either by connecting the screen to a separate winding on the modulation transformer or by connecting it through a blocking condenser to a tap on the modulation transformer or choke. With the latter method, an a-f choke of suitable impedance for low frequencies should be connected in series with the screen-supply lead. Control-grid bias should be obtained from a grid resistor, or from a combination of grid resistor and fixed supply, or grid resistor and ~~cathode resistor~~. The cathode resistor should be by-passed for both audio and radio frequencies. The combination method of grid resistor and fixed supply has the advantage of not only protecting the tube from damage through loss of excitation but also of minimizing distortion by bias-supply compensation.

In *class C r-f telegraph service*, the 865 may be supplied with screen voltage from a fixed supply such as a voltage divider, or from a separate source. The regulation of the supply need be only good enough to prevent the screen voltage from rising higher than twice the maximum screen voltage rating under key-up conditions. The screen voltage should not be obtained from a series resistor. Control-grid bias may be obtained by any convenient method, excepting when a preceding stage is keyed; in this case, sufficient fixed bias should be used to maintain the plate current at a low value when the key is up.

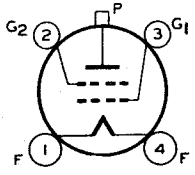
The 865 can be operated at maximum ratings in all classes of service at frequencies as high as 15 megacycles. The tube may be operated at higher frequencies provided the maximum values of plate voltage and plate input are reduced as the frequency is raised (other maximum ratings are the same as shown under CHARACTERISTICS). The tabulation shows the highest percentage of maximum plate voltage and plate input that can be used up to 60 megacycles. Special attention must be given to shielding and r-f by-passing at these frequencies.

| FREQUENCY | 15 | 30 | 60 | Mc |
|---|---|---|---|---|
| MAX. PERMISSIBLE PERCENTAGE OF MAX. RATED PLATE VOLTAGE AND PLATE INPUT: | | | | |
| class B r-f | 100 | 90 | 78 | Per Cent |
| class C plate-mod. | 100 | 78 | 55 | Per Cent |
| class C telegraph | 100 | 78 | 55 | Per Cent |




**Bottom View of Socket Connections**




F = FILAMENT
$G_1$ = GRID
$G_2$ = SCREEN
P = PLATE