S/N-6 CASCODE 2 METER PRE-AMPLIFIER

Fig. 1. Front view of the S/N-6 Cascode 2 Meter Pre-amplifier.

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Here it is fellows! Another pre-amplifier from the shack of W9RL, designer of the popular S-9ER, which appeared in HAM NEWS Vol. 1 No. 4. This 2 meter cascade pre-amplifier utilizes the recently announced 6K7T in a neutralized circuit which matches the output to the receiver.

This is W9RL's answer to those many requests for a cascade amplifier using this new tube. It is relatively simple to construct and the average amateur should have no trouble in making it work properly. One word of caution—the circuit constants and layout must be followed faithfully.

The newcomer and the oldtimer will find that the 8/N-6 will improve the signal-to-noise ratio—6 DB noise figure—give added gain—18 to 24 DB—and put in what used to be weak stations.

--Lighthouse Larry

GENERAL DESCRIPTION

The 8/N-6 cascade 2 meter pre-amplifier is entirely self contained (except power supply) in a 3 x 3 x 3 inch metal box. All parts mount directly on the rear of the front panel so that construction is easy and straightforward. The 6K7T and 6AK5 c/c tubes are mounted horizontally on the front panel. Coupling fittings are used for the r-f input and output connections. All tuning adjustments of the coils are made from the front of the panel.

The plate voltage required for the two tubes is low—150 volts d-c—and can be taken off the communications receiver. Filament voltage required is 6.3 volts a-c or d-c of 0.353 amperes.

DESIGN CONSIDERATIONS

Many 2 meter converters and receivers, today, lack two important features which are necessary for DX work at this frequency. These two features are (1) high signal-to-noise ratio (low noise figure) (2) gain. Of these two, high signal-to-noise ratio is the most important. An amplifier could increase the gain but if it did not improve the signal-to-noise ratio nothing would be achieved—that is, you would notice an increase in output level but at the same time the noise level would be increased proportionally.

The opposite case would be an amplifier with a high signal-to-noise ratio with no increase in gain. This would be a decided advantage but even in this instance is that the signal would appear louder to the ear, however, the S-meter would show no increase in signal level. These two amplifiers are exaggerated cases, since fortunately practically all r-f Amplifiers improve the signal-to-noise ratio to a certain extent and give an increase in gain.

In the design of the 8/N-6, the above two features were deemed to be of utmost importance. Since the first stage of such an amplifier, receiver, or converter is the most important from a signal-to-noise ratio standpoint, it was given careful design consideration. The cascade circuit was chosen because if properly designed it will produce a high signal-to-noise ratio. A period could be used in this circuit for high gain, however, it would produce more noise because of the current division at the screen grid. Therefore, the low-noise twin triode type 6K7T, particularly designed for cascade circuits, was chosen.

The selection of a brand was not too difficult. At first a pentode connected 6AK5 feeding a pentode connected 6AK5 in a cascade circuit was calculated for signal-to-noise ratio. Under optimum conditions this calculated to be approximately 9 DB (noise figure)

Electrical Circuit

Fig. 2. Circuit diagram of the S/N-6 pre-amplifier.

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CIRCUIT DETAILS

Refer to the schematic diagram shown in Fig. 2. The cascade section of the unit, which consists of both triode sections of the 6BQ7, is of the parallel d + type. This type of circuit has the advantage over the series-type circuit, in that a lower plate supply voltage is required and the heater-cathode voltage is lower.

The input circuit has been designed to accommodate either a 70 ohm or 300 ohm unbalanced line. For 70 ohm input, jack J1 is connected as shown. For 300 ohm input, if it is connected to the junction of C1 and L1 as indicated by the dotted lines. Capacitors C1 and C3 and inductors together with the attached antenna form a broadband input network to cover the entire two meter band. Capacitors C2 and C4 are added for the center of the band so further adjustments are necessary.

The plate circuit of the first triode section of the 6BQ7 consists of L1, C4, C5, and R2. Capacitor C5 and Resistor R2 form a decoupling network for the supply voltage. The inductance L5 is of primary importance in that it has a decided bearing on the signal-to-noise ratio. If it is replaced by an x-fader, the signal-to-noise ratio may be very low. Inductance L2 raises fairly broad but it should be adjusted for the center of the band by the brass slug.

Capacitor C5 feeds the signal into the cathode of the second triode section of the 6BQ7. Part of this signal is fed through L3, the neutralizing inductance, which forms a parallel resonant circuit with the grid-to-plate capacitance of the first triode section. This effectively tunes out the grid-to-plate capacitance which is necessary for high signal-to-noise ratio and good stability.

The second triode section of the 6BQ7 is operated as a grounded grid stage. Bias voltage for this section is fed through L4, the neutralizing inductance, which forms a parallel resonant circuit with the grid-to-plate capacitance of the first triode section. This effectively tunes out the grid-to-plate capacitance which is necessary for high signal-to-noise ratio and good stability.

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CIRCUIT CONSTANTS

(All resistors and capacities +10%, tolerances unless specified otherwise)

| R5 | 1800 ohms, 1/2 watt |
| R7 | 10000 ohms, 0.01 watt |
| L1, L2, L4 | 3 turns No. 24 enamelled wire, stranded diameter of wire, wound on Mullins type 69047 coil form, brass slug. |
| L5 | 6 turns No. 24 enamelled wire, stranded diameter of wire, wound on Mullins type 69047 coil form, brass slug. |
| L6 | 7 turns No. 24 enamelled wire, stranded diameter of wire, wound on Mullins type 69047 coil form, brass slug. |
| J1, J2 | center jacks |
| 6BK1 socket | 5-pin miniature (vector type 5-4-9-7) |
| 6ARS socket | 5-pin miniature (Clanch-6, 1000 mmf, capacitance built-in) |
The final stage consists of a type 6AK5 operating as a pentode. The input to this stage is conventional. The plate circuit utilizes another demodulating network formed by resistor R7 and capacitor C10. Incorporated, also, is an impedance matching network formed by inductance L5, capacitors C11 and C13. Inductance L5 is adjusted by the brass slug to resonance at the center of the band, then with the receiver connected to J3, variable inductor C13 is adjusted for the loudest signal.

COMPONENT PARTS

Particular attention should be given to Figs. 3 and 4 which show clearly the 6BE7 socket and the 6AK5 socket. The 6BE7 socket is manufactured by Vector, type B-M-97. It is recommended this type be used as it permits easy mounting of the components and short leads. The 6AK5 socket is manufactured by Cinch-Eric and is of a special type. This particular socket has 1000 nead beta capacitors built in on all pins except pins 1 and 5. No information was available on the type number during the construction of this model, therefore, another was constructed using a standard National type XDA-C-7 ceramic socket and by-passing pins 3, 6 and 7 with 1000 nead disc type capacitors (C9, C10, C14) to ground with shortest leads possible. No difference was noted between the two models, therefore, the builder can use whichever is available.

Capacitors C1, C2, C11 and C13 should be of the value and type specified. The other condensers specified can either be of the tubular type or disc type. It is highly recommended the tubular type be used, with the exception of those used in by-passing the 6AK5 mentioned above, to facilitate short and direct connections.

The coil form used is type 60047 manufactured by the James E. Miller Manufacturing Co. This type of coil form has an adjustable brass mug. It is very important that brass or copper plugs be used as iron plugs will ruin the Q at this frequency. It is recommended the coil forms specified be used. All of the resistors specified are of standard composition type with tolerances of ±2%.

CONSTRUCTION DETAIRS

It is recommended that the mechanical layout shown in Figs. 3, 4 and 5 be followed faithfully. This layout was determined by trial from an electrical and mechanical standpoint.

The B-N is constructed on a 3 x 4 x 5 inch box with removable front and back panels. All of the components are mounted on the back of the front panel as illustrated in Figs. 3 and 4. Before mounting the components all of the black crinkle paint should be removed. This will facilitate and insure good ground connections. Also the tops on the rear of the cabinet panel should be cleaned of all paint to further insure a good ground connection.

Dimensions are given in Fig. 5 for locating the various holes. No dimensions are given for the socket holes for input and output jack. These will depend on the type the builder uses.

As will be noted in Figs. 3 and 5, coil L1, L2, and L3 are in line with the input jack J1 and are mounted close to the Vector socket. Coil L4 is mounted above and to the right of the 6BE7 socket with all L4 mounted to the right of the 6AK5 socket. If the dimensions outlined in Fig. 5 are followed, the coil will mount close to the socket permitting short and good connections. In winding the coils, leave approximately one inch of end at the coils for soldering.

The power plug, which is clearly seen in Fig. 1, can either be mounted on the side of the box or on the rear panel. This is left up to the discretion of the builder as its location is not critical.

Fig. 3. Rear view of front panel illustrating layout.

WIRING DETAIRS

In wiring the S/N-6, the work will be much easier if a small-tip soldering iron is used. As will be noted from the photographs, the capacitors are closely grouped around the Vector socket which makes the soldering operation a little difficult if a large-tip iron is used.

In wiring the 6BE7 stage, use is made of the hogs on the Vector socket as tie points. The lug above pin number 1 is used as a tie-point for C1, L1, and R2. The lug above pin 5 is used as the tie-point for C1, L5, and R5. The lug above pin 9 is the tie-point for C6, R3, and L3. The lugs at the top of the frame are all tied together. This is used as the B plus tie-point. Resistors R2 and R4 and capacitor C18 are placed between the two sets of lugs on the frame with one end tied to the B plus tie-point. This results in a neat and workmanlike appearance. Use is also made of the four lugs on the socket mounting ring. These are used as ground tie-points for C2, C3, C4, E1, R1, and L4 and also for pin 9. The 6AK5 socket is wired in the conventional manner using short direct connections. Boldering hogs placed at the socket mounting holes are used as ground tie-points.

ALIGNMENT

The photograph procedure is straightforward and simple in principle. The output of the pre-amplifier should be connected to the antenna terminals of the receiver by a short piece of cable. The cable should not be over twelve inches long and must be shielded to avoid picking up extraneous signals.

With the receiver tuned to 146 megacycles, a signal of this frequency should be fed into the avenna input (either 70.db or 300 db input). This signal can be obtained from a signal generator, transmitter, or a
Operating Information

The old expression, "the receiver is no better than the antenna," applies equally well here. Use a good antenna and one with the proper impedance—either 32 ohms or 300 ohms unbalanced. If you do this, the pre-amplifier will be a worthy one, and if it is properly constructed, you can expect a noise figure of 5 DB and a signal gain of 18-20 DB.

On-the-air tests were conducted at W2RMX's shack over a period of a month. During this time the S/N-6 was put through various tests and it proved its value. Signals were heard which could not be detected without the S/N-6. Also, a definite improvement in signal-to-noise was noted on weak stations which could be detected without the pre-amplifier. This was to be expected, however, since any pre-amplifier, or receiver with a noise figure of 6 DB is an exceptionally good one. (Compare this with the average communication receiver which is liable to have a noise figure of 30 DB.)

To those of you who build this 2 meter pre-amplifier, be sure to use good quality parts, good workmanship and above all follow the article faithfully and you'll enjoy lots of DX.
Announcing

THE EDISON RADIO AMATEUR AWARD

To gain greater recognition for the many vital and humane public services performed by radio amateurs, General Electric offers the Edison Radio Amateur Award for 1932.

Who is eligible for the Edison Radio Amateur Award: Radio amateurs eligible for nomination will be those men and women who, during 1932, have performed a meritorious public service on behalf of an individual or a group, in a disaster area, in civil defense, or in similar situations.

Nominations may be made by any amateur, club, association, or individual familiar with the service performed.

Winner of the award will receive the Edison Radio Amateur trophy in a public ceremony in a centrally located metropolitan city. National recognition will be accorded the winner of the award, and as a token of appreciation for his service, General Electric will present him with a 24-hour watch to clock DX accurately.

How to nominate a candidate: To nominate a candidate for the award, you need only submit his name, address, call letters, and a description of the service performed.

Entries will be reviewed by a distinguished group of impartial judges, and the decisions of the judges will be based on (1) the greatest benefit to the individual or group and (2) the greatest amount of ingenuity and service displayed in performance of the service.

Your candidate must hold a radio amateur's license issued by the F.C.C., Washington, D.C., and the service must have been performed while he was pursuing his hobby as an amateur within the continental limits of the United States. Your letter must be postmarked not later than December 31, 1932.

Judges who will decide which candidate's achievement is most worthy of the award, are:

Mr. E. B. Hartiman, President, The American Red Cross.
Mr. G. E. Sterling, Commissioner, Federal Communications Commission.
Mr. G. L. Doolland, President, American Radio Relay League.

Winner will be announced on or before March 1, 1933, and the award will be publicly bestowed soon thereafter.

Employees of the General Electric Company may nominate candidates for the Edison Radio Amateur Award, but are not permitted to receive the award.

Choose your candidate . . . prepare your letter of nomination . . . and mail to Edison Award Committee, Tube Dept., General Electric Co., Schenectady 5, N. Y.
Have you nominated your candidate for the Edmon Radio Amateur Award sponsored by the G.E. Tube Department? I hope all of you readers saw our October oil in CQ and QST announcing this award. For those who may have overlooked it we have reprinted the ad on the preceding page.

I hope you readers will take time out and stimulate an amateur who you feel is worthy of this award. We want to find the amateur who has performed a meritorious public service and inform Mr. and Mrs. Q. Public of his deed so that they will realize that amateurs are doing very useful work in various parts of the world, whereas they are rarely heard. We want the public to know that amateurs of today are always ready to give unselfishly of their time to help in any emergency whether it be floods, tornadoes, motor storms or relaying medical information to save a person's life; they are doing valuable work in Civil Defense and other similar public services. We want the public to look upon the amateur not as the one who causes Transcend Valley Indians but a person whom they can call upon for help.

This is another step forward in promoting better understanding and goodwill between Mr. and Mrs. John Q. Public and the amateur.

So how about it fellows! Let's find this amateur. Send your nominating letter in as soon as possible. Remember all letters must be postmarked not later than December 31, 1952.

Would you like to see an issue of Ham News devoted to the calculation of signal-to-noise ratio? This would be a mathematical treatise on the subject by W9CJD and would restate the design and calculations of typical r-f amplifiers. As a rule higher CFDs and higher mathemetics would be used,—off the shelfW9CJD is a great thinker and I am sure most of you readers would enjoy this publication, drop me a note and let me know. If there are enough votes we received, it will appear in a future issue.

Here is a very interesting definition of "sea power." It is that power generated by a fleet weighing one million megwatts and jumping 20 inches high every 3 seconds—a microswatt. Just think, it would take one million microswatts jumping in harmony to produce one watt.

A news release that passed over my desk recently told of the demonstration of a "transistorized" megaphone which amplified the normal speaking voice to a volume comparable to a cheerleader's most ardent yell. The article goes on to say "The transistors in the megaphone operate from tiny batteries, the size of a miniature cigarette lighter, eliminating the use of bulky, high-voltage batteries and the need for an external power supply. The little batteries are concealed with the transistors in the amplification unit. The new unit has a volume control which permits the adjustment of the normal speaking voice from a raspy sound to an insodible whisper." Can you just picture the pocket transistorized modulator of nineteen unamplifying modulating the R/W What about the modulator transformer? I don't know—Another news release told of experimental transmitters operating at temperatures well above the boiling point of water—700 degrees. That's pretty neat! And a recent article mentioned that some transmitters can operate up in the megacycles. This new field of electronics is certainly one of the most intriguing of all.

Would you like to see an article in Ham News on a "transistorized" receiver or transmitter? It is hoped that not too far in the distant future we may have such an article.

Here's another newy item. The G.E. Company will supply electronic signaling equipment for automatic and simultaneous control of civil air raid warning instruments throughout the state of Delaware. The equipment produces electronic tones, which when broadcast over the State Police radio system, are useful only to special civil defense radio receivers. The receivers are connected with public address systems and on receiving the tones, activate the device so as to produce the standard civil air raid warning signals.

It's comforting to know that some people in the United States are not just sitting around and glibly saying "It can't happen here." This brings up a mighty interesting opinion that are you, as we are all doing for Civil Defense? Have you joined your local Civil Defense organization?

---Lighthouse Larry
GENERAL DESCRIPTION

Principal Application: The 6BK7 is a miniature triode designed primarily for use as a cascade amplifier at frequencies below approximately 300 megacycles. The electrical characteristics of the 6BK7 are similar to those of the 12AV7; however, the 6BK7 incorporates an internal shield which reduces the feed-through capacitance between sections and thus makes the 6BK7 especially suited for use in cascade amplifiers and other applications in which a minimum of coupling between the two sections is required.

Cathodes: Coated Unipolar
Heater Voltage: A-C or D-C: 6.3 Volts
Heater Current: 0.15 Amperes
Envelope: T-65/12 Glass
Base: E0-1, Small Button 8 Pin Mounting Position: Any

PHYSICAL DIMENSIONS

TERMINAL CONNECTIONS

Pin 1 - Plate (Section 2)
Pin 2 - Grid (Section 2)
Pin 3 - Cathode (Section 2)
Pin 4 - Heater
Pin 5 - Heater
Pin 6 - Plate (Section 1)
Pin 7 - Grid (Section 1)
Pin 8 - Cathode (Section 1)
Pin 9 - Internal Shield

MAXIMUM RATINGS

Cathode Plate Voltage: 300 Volts
Negative D-C Grid Voltage: 50 Volts
Video Plate Dissipation: 2.7 Watts
Plate-Grid Voltage: 90 Volts

* It is recommended that this tube be derated 6% of the maximum power rating when operating at a maximum grid bias of +100 volts. The power dissipation should be reduced 15% when operating at a maximum grid bias of +150 volts.

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FROM: G-E Electronic Tube Distributors

E. L. YOCHER, W3WPA—EDITOR