The DIOPLEX

... replaces
the antenna relay
in 50-ohm
c coaxial circuits

Contents

The DIOPLEX
Sweeping the Spectrum
The Ruggedized AAGS
The Dioplex is a device for connecting a receiver to a transmitting antenna to obtain the advantage of a good antenna for receiving as for transmitting. The Dioplex is used without moving parts, together with its diode and possible erratic contacts in the receiving section of the Dioplex. The unit is not only silent but instantaneous and positive, the receiver input diodes are afforded an even higher degree of protection from accidental or inadvertent damage than a separate receiving antenna is used.

The Dioplex is used between a low impedance transmission line and the receiver as shown in Figure 1. With input and output impedances of 50 ohms, it is highly dependent of course, on the efficiency of the final stage of the transmitter.

CIRCUIT DETAILS

The complete circuit diagram for the Dioplex is shown in Figure 1. The input goes from a coaxial conductor to a plug-in coil. Two biased 6X4 diodes operate back-to-back to serve as a voltage-sensitive switching element. Also, half of one of these tubes is used as a 6C4-diode half-wave rectifier to provide diode bias from the transformer. The two anodes rectifiers serve merely as bias voltage stabilizers. The bias will be from 25 to 45 volts on each diode. A 30 microamperes inductor is used to compensate for variations in the internal tube capacities plus stray. These interested in a more detailed description of the operation of the Dioplex are referred to the section headed "Thesbian Theory."

CONSTRUCTION DETAILS

All components of the Dioplex except the transistor are mounted on one of the removable 4 x 5-inch plates of a Bud 3 x 4 x 2-inch utility box. The tube sockets are mounted on an L-shaped bracket that can be simply made of 3/4-inch aluminum. As the coil sockets and coaxial connectors are mounted, the point should be sharpened from the plate to assure good grounding. If sockets with built-in by-pass condensers are used (as in the model shown), the by-pass condensers should be removed from pin 1 of the X4 and from pin 2 of the X5. The oscillator sockets are left for the x-axis connection to the 110-volt a-c line. No switch is provided, since accidental damage to the Dioplex and possibly to the receiver can occur if the X4 tube is not strapped when transmitting.

Although wiring is not critical, a piece of tinned No. 14 wire is arched across the coil sockets. Keeping this lead in the clear reduces stray capacity and provides an easy method of connecting the plate of X4, the cathode of X5, and the "crater" of the mixer component. The "crater" of the transistor is bolted to the L-bracket next to the tube socket as shown in order to provide easy access to the adjusting screw through a 1/4-inch hole drilled in the top plate. The No. 14 wire is also used to ground the unused plate on the coil sockets, thus providing a measure of

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Fig. 1.—The Dioplex is connected
shielding. Insulated wire is used for the other connections.

The high voltage filament leads from the transformer—connected last—are left their original length and looped around inside the box after the top plate is attached. This makes it easy to remove the top plate should occasion rise.

**COIL DATA**

All coils are wound on Amphenol polyimide-impregnated mica coils, 30 pin, coil forms 5/16 inch in diameter and 1 1/2 inches long. Two identical coils are required for each band. Winding data is given in Table I. Since none of the windings is more than 1 inch long, the bottom turns can start 1/4 inch from the base of the forms. In each case, the bottom of the coil winding should connect with pin 3 of the plug-in form and the top of the winding with pin 1—thus providing the widest possible separation at the coil socket. If the winding information is followed closely, it should not be necessary to reset the trimmer condensers when changing bands. The turns should be seated on the forms with Duo-G-E Olyspal No. 1296 cement. The end turns on each coil should be centered all the way around the form, and then four strips of cement can be run lengthwise at 90-degree intervals to hold the entire winding in place.

Since polyimide melts at a relatively low temperature, caution is advised in soldering the coil ends to the pins. The inside of each pin to be soldered should be cleaned with a drill and a hot iron or used just long enough to flow the solder into the pin tips.

**GENERAL INFORMATION**

It is necessary to ensure that a d-c circuit path is present through the units for the metering to work properly.

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**Fig. 2—Circuit diagram of the Diplex**

- C1, C2, C3, C4, C5—0.01 µfd ceramic bypass
- C6—1.0 µfd electrolytic bypass
- C7—33 µfd electrolytic bypass condenser
- L1—See text and Table I

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**Components**

- F—3.5-megacycle crystal
- R1—100 ohm, 1/2 W
- R2—115/2 W, 115 V 1/2 watt
- L1—See text and Table I

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**Table I**

- **Band** | **C1** | **C2** | **C3** | **C4** | **C5** | **C6** | **C7** | **C8** | **C9** | **C10** |
- **14-MHz** | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic |
- **44-MHz** | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic |
- **280-MHz** | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic |
- **560-MHz** | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic |
- **1120-MHz** | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic | 0.01 µfd ceramic |
maintained between the coils and the chassis of the Diodeplex. Ordinarily, the input coil of the receiver or the output link of the transmitter provides this path through the case braids. In doubtful cases, this can be checked with an ohmmeter and if no d-c connection exists, a 2.5 millihenry pi-wound RF choke should be placed across one of the coaxial connectors of the Diodeplex.

Since the Diodeplex design is based on 50-ohm receiver input impedance, deviations from this value will affect principally the amount of power dissipated in the receiver when the transmitter is operating. If there is doubt about the input impedance of the receiver, a 51-ohm 1-watt resistor may be placed across the output connector of the Diodeplex to assure that the combination of this artificial load and receiver never exceeds 50 ohms. In most cases, this shunting resistor will not degrade receiver performance.

The power ratings in Table 1 apply only when the input to the Diodeplex—that is, the side that connects to the transmission line—is across a 50-ohm circuit. Simply using 50-ohm coaxial transmission line is not enough to ensure that this condition exists unless the coaxial line is connected directly to the diodeplex's input terminals without the use of a step-down impedance transformer. The use of such a transformer may result in the transformer's secondary current exceeding 100% of the primary current to unity. The important consideration here, as far as the Diodeplex is concerned, is that the RF stage supplied by the transmitter must not exceed 500 volts at 3.5 ma, 250 volts at 5 ma, 125 volts at 15 ma, 60 volts at 21 ma, and 36 volts at 38 ma. Keeping within these ratings will prevent a receiver from being burned out due to tube failure caused by overload.

The effect of a transmitter connection across the receiver input can be troublesome if the transmitter output stage is not biased beyond cutoff during reception. And with the Diodeplex in place, the coupling between transmitter output stage and receiver is very good, indeed for low-level extraneous signals sometimes generated in a transmitter that normally is considered "off." Operators of single-sideband stations know that an active output stage coupled to the antenna can cause local receiving difficulties. These difficulties will be greatly magnified with the Diodeplex. Blocked-grid

<table>
<thead>
<tr>
<th>Band</th>
<th>Wire</th>
<th>No. of Turns</th>
<th>Length of</th>
<th>Inductance (millihenries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>#32</td>
<td>110*</td>
<td>1 in.</td>
<td>0.125</td>
</tr>
<tr>
<td>7</td>
<td>#36</td>
<td>57*</td>
<td>1 in.</td>
<td>0.035</td>
</tr>
<tr>
<td>14</td>
<td>#19</td>
<td>30*</td>
<td>1 in.</td>
<td>0.00587</td>
</tr>
<tr>
<td>21</td>
<td>#19</td>
<td>30**</td>
<td>1 in.</td>
<td>0.004</td>
</tr>
<tr>
<td>28</td>
<td>#19</td>
<td>13**</td>
<td>5/8 in.</td>
<td>0.00022</td>
</tr>
</tbody>
</table>

* Close-wound. ** Spaced.
CW keying circuits or sufficient protective feed bias on the output stage of the transmitter should prevent such trouble.

The polarities of the electrolytic and selenium rectifiers in the schematic are correct. The cathode of V1 should be positive with respect to ground, while plate 1 of V1 should be negative with respect to ground. Thus the polarities indicated on the electrolytic condensers are correct. The selenium rectifiers are connected "backwards" to provide a static discharge path without the use of a neutralizing condenser.

The D1 voltage across the electrolytic condensers should be checked before using the Dipoles to make certain that the voltage is not exceeded. The voltage on D1 may be checked easily using an oscilloscope.

In most applications the bias provided will be ample to prevent diode conduction during reception. However, exceptionally strong incoming signals reaching the Dipoles can cause excessive conduction. If this problem is encountered, two selenium rectifiers can be wired in series where one is now called for in the schematic. The bias then should be from 4 to 6 volts d-c on each SX4 tube.

Note: The Dipoles are designed to allow the Dipoles to provide sufficient output for the transmitter's output stage under normal operating conditions. However, excessive conduction in the Dipoles can result in reduced output and increased noise. Therefore, it is important to monitor the Dipoles and make adjustments as necessary.

INSTALLATION AND OPERATION

As indicated in Figure 1, the lead from the transmission line to the Dipoles should be as short as practical. The dipole is connected to the coaxial T-connector, or the dipole input can be connected directly to the transmitter output terminals if the method is more convenient. A suitable cable from the Dipoles to the receiver can be any convenient length. Cooperate with your transmitter, the dipole leads can be any convenient length. The coaxial T-connector should be adjusted for best received signal strength. The dipole should be held for all bands. The Dipoles can be, of course, be grouped for a favorite band.

Never attempt to run more than 5000 watts output on CW, AM or SSB or 10,000 watts peak output on VHF on 80 meters! Similarly, keep within the ratings of Table 1 on other bands.

THUMBNAI THEORY

The Dipoles are based on the principle of the transmitter's "T-"T-R" type" using lumped circuit constants instead of the transmission lines or waveguides common in the Dipoles. The Dipoles are constructed of a half-wave filter similar to the Hartreefilter (CWE BAND NEWS, Vol. 6, No. 6, Nov.-Dec. 1945). While not dependent on the Hartreefilter, the Dipoles do require a reasonable impedance match.
The Dioplex accomplishes its purpose by means of deliberate mismatch. In fact, the greater the degree of mismatch in this application, the better protection to the receiver.

A half-wave filter such as the Harmonizer effectively is "not in" a circuit of any impedance at the half-wave frequency. In describing the Harmonizer, a curve was given showing how the voltage on the center condenser varied with mismatch. The Dioplex takes advantage of this phenomenon so that a relatively light-duty short-circuiting device across the center condenser can thwart the effects of a kilowatt rig to get into the receiver through the antenna terminals.

By placing biased diodes back-to-back across the center condenser of the half-wave structure, small signals do not cause conduction in the diodes—and the receiver is connected to the antenna feedline through the half-wave filter. However, when a signal from the transmitter appears across the input to the filter, the diodes become conducting and the receiver is substantially (but not entirely) isolated from the input. At the center condenser, the transmission-line voltage is magnified by a factor approximately equal to the ratio of the reactance of one of the coils to the reactance of the load until conduction commences in the diodes. At this voltage, and at any higher input voltage, the magnification ceases and a current flows through the input coil into the diodes which have a net forward resistance of about 400 ohms.

Thus, the device becomes a voltage divider of two stages—the first stage being the reactance of the input coil and the diode forward resistance, while the second stage consists of the reactance of the second coil and the input impedance of the receiver. Simply stated, then, the design objectives are: (1) As high a coil reactance as practical, (2) as low a diode forward resistance as possible, and (3) a relatively low load impedance.

These objectives place certain restrictions on the application of the Dioplex, and in effect limit its practical realization to low-impedance receiver input—from 50 to 250 ohms or so—and to operation in a low impedance point in the transmission line feeding the transmitter output to the antenna. This system works out nicely for 20-ohm coaxial circuits, and the design given for the Dioplex is for this application.

### Table II—Performance Data

<table>
<thead>
<tr>
<th>Band</th>
<th>Transmitter Output (watts)</th>
<th>Voltage at Receiver* (watts)</th>
<th>RF Input to Receiver* (watts)</th>
<th>Insertion Loss* (watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cont.</td>
<td>Peak</td>
<td>(Col. 3)</td>
<td>(Col. 4)</td>
</tr>
<tr>
<td>3.5</td>
<td>5000</td>
<td>10000</td>
<td>1.25</td>
<td>.03</td>
</tr>
<tr>
<td>7</td>
<td>1150</td>
<td>10000</td>
<td>2.2</td>
<td>.1</td>
</tr>
<tr>
<td>24</td>
<td>290</td>
<td>1500</td>
<td>6.5</td>
<td>.4</td>
</tr>
<tr>
<td>31</td>
<td>130</td>
<td>2000</td>
<td>6.4</td>
<td>.85</td>
</tr>
<tr>
<td>38</td>
<td>64</td>
<td>1000</td>
<td>8.5</td>
<td>1.45</td>
</tr>
</tbody>
</table>

**NOTES**

Col. 1—Determined by the self-reactant dioxide current.
Col. 2—Based on maximum safe input voltage, or an average duty cycle of one-quarter (whichever is lower) in the case of single-sideband suppressed carrier operation.
Col. 3 & 4—Based on continuous CW, AM or NBFM output delivered to a 14-dB receiver input. The RF power actually delivered to the input of the receiver is less than the maximum transmitter output (Col. 3) in each band. For example, 14-dB continuous output at 14 kc would deliver 2-watt receiver input.
Col. 5—Based on a coil Q of 100. Coils in unit described have a Q of about 120, so this rating is conservative.
* Approximate.
**May fatigue.
The other day the editor came back from lunch and upon noting my wrinkled brow and peaceful "hunt and peck" typing system, he wondered out loud: "Are you a guy with an electron stream instead of a brush like in a typewriter?"

I had my brush in hand.

"Larry, go over on the lab and start building something;"

"Can't right now," I said. "I've got to write copy for G-E HAM NEWS, read the proof, get pictures taken, arrange for drawings, and—"

"Look, Larry," he said, "I'll do the dull editorial routine. As soon as you finish the column, go plug yourself in and start cooking up something. Concentrate on stopping your electron stream."

At that I almost pulled a filament. It was the best news of the year for me. And soon as I finish here, I'll be heading for the lab.

The XEs down Mexico way, all het up about their 31st national convention, have been good enough to send a few pictures—including a glimmer shot of a pretty, pretty named Alma Velasquez, who has been dubbed "Queen of the Ham." The Queen will reign at Guadalajara May 30 through 30. We asked the boys if we ought to run the Queen's picture in G-E HAM NEWS. "No," he said, "the boys are more interested in oscillation than osculation." We pointed out that some of the boys might start oscillating if we ran the picture. But he insisted we send every bit of space for technical dope. So we gently locked the Queen's picture away in the file.

Some of the boys on the program look fascinating. After the opening at 6X1K, president of LAMRE, we find, he instantly flowers a demonstration Feed the Condenser structure that the boys recommend for the boys; Defense of the Parish (be they have CD's and not Radiohead) (Now's that again?); Conferencia Sobre El Navio por un Técnico de la General Electric (Good; very good!); El Fomento y Desarrollo de la Televisión (Oh, oh! Thought south of the border?).

The boys just poked his head in and said: "Good luck to all the XEs."

Speaking of national conventions, a bulletin on the 7th National ARRL Convention (Houston, Texas, July 10 through 13), has arrived. It says there are 4246 ham societies and ham units in town, and hams who start filming them up early will have a shot at a complete series of films. The program includes VHF, CHF, CD, TV, TV1, ROWN, TV1, TV6B, TV6C, RC—and undoubtedly a little XXX in the evenings.

The boys have been writing like crazy asking for the suggested article on how to determine the noise factor of a receiver. I'm hard at work on it with W2XDL and will pass on the dope as soon as possible. The thing we're working out, with W2XDL, as a voice control breakin system for SSB . . . By the way, we'd like to hear of experiences with the Draper W2XDL cocked up for this issue . . . and also from those who tried the W2XFL's Mobile Portable Power Supply and W2KLM's Antenna Loading Cell, both of which were described in the last issue of G-E HAM NEWS . . . We're working with W2INFA on converters for 410, and 220 megacycles . . . and with W2XXY on a new final.

Just got a note from George Floyd, W2RYT, founding editor of G-E HAM NEWS. He wants to pass this to all. George is now working with G-E communications equipment in Brynmaur and says he's getting along fine.

A plea from the hard-working utility and telephone linemen comes via the bulletin of the Detroit Amateur Radio Association, and we pass it along because it is not a service someone's life—maybe yours. DON'T HANG YOUR BRYCARE ON A UTILITY OR TELEPHONE POLE!

Three good reasons: (1) Your shack will become an excellent telephone eliminator if wind causes a con- tactor to close, shorting out the power supply. The high duty of the arc may damage the field coils and the high voltage may be dangerous. (2) Your R2 may light (no-2)- (3) You may be killed by the explosion. It's not a pretty sight to see some dark night to restore your phones or power service.

—Lighthouse Larry
### Technical Information

**THE RUGGEDIZED 6AQ5**

The GL-6005 is one of G.E.'s line of 5-Star high reliability tubes which are specially designed to assure dependable life and reliable service under the exacting conditions encountered in mobile work.

Features include mechanical ruggedization and heater-cathode construction designed to withstand many-thousand cycles of intermittent operation. Electrical characteristics and pin connections are identical with the 6AQ5—the beefy power pentode popular in small rigs and receivers.

The tube is described here merely as a matter of general information, inasmuch as few hams require such exacting performance. However, those interested can get full details from bulletin ETX-265.

### TYPICAL OPERATION

**CLASS A, AMPLIFIER**

<table>
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<tr>
<th>Parameter</th>
<th>Value</th>
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</tr>
<tr>
<td>Screen Voltage</td>
<td>180</td>
</tr>
<tr>
<td>Grid Number 1 Voltage</td>
<td>8.5</td>
</tr>
<tr>
<td>Peak A-G Grid 2 Voltage</td>
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</tr>
<tr>
<td>Plate Resistance (Approx)</td>
<td>500</td>
</tr>
<tr>
<td>Transconductance</td>
<td>3700</td>
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<tr>
<td>Zero-Signal Plate Current</td>
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<tr>
<td>Zero-Signal Screen Current</td>
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<tr>
<td>Load Resistance</td>
<td>6500</td>
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<tr>
<td>Harmonic Distortion (Approx)</td>
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<tr>
<td>Power Output</td>
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**CLASS AB, (VALUES FOR TWO TUBES)**

<table>
<thead>
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</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
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<tr>
<td>Screen Voltage</td>
<td>250</td>
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<tr>
<td>Grid Number 1 Voltage</td>
<td>11</td>
</tr>
<tr>
<td>Peak A-G Grid 2 Voltage</td>
<td>30</td>
</tr>
<tr>
<td>Plate Resistance (Each Tube)</td>
<td>6000</td>
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<tr>
<td>Transconductance (Each Tube)</td>
<td>3700</td>
</tr>
<tr>
<td>Zero-Signal Plate Current</td>
<td>70</td>
</tr>
<tr>
<td>Zero-Signal Screen Current</td>
<td>70</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>5000</td>
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<tr>
<td>Harmonic Distortion (Each)</td>
<td>8%</td>
</tr>
<tr>
<td>Maximum-Signal Power Output</td>
<td>10</td>
</tr>
</tbody>
</table>

### SPECIAL CHARACTERISTICS

**Peak Impact Acceleration in Any Direction**: 400 G

**Vibrational Acceleration in Any Direction**: 2.5 G

* Figures in any direction as applied to the Navy Type High Impact (Updraft) Shock Machine for Electronic Devices or its equivalent.

† Vibrational impact in any direction for a period exceeding 100 hours at a frequency of 60 cps.

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