

**A) Description**

The W2FMI-1:1-HBH50 is a very high-power balun transmission line transformer designed to match 50-ohm coaxial cable to a balanced load of 50 ohms. It is especially designed to have a characteristic impedance of 50 ohms and significant margins in bandwidth and power-handling capability. The response is essentially flat from 1MHz to 50MHz. The conservative power rating is 5KW of continuous power and 10KW of peak power. The efficiency is 99 percent.

**B) Schematic Diagram**

Figure 1 shows the schematic diagram of this very high power, efficient and broadband balun. It is the Guanella 1:1 balun which uses a bifilar winding. There are ten bifilar turns of No. 12 H. Imideze wire on an Amidon PN FT-200-K. One wire is covered with 2 layers of Scotch No. 92 tape.

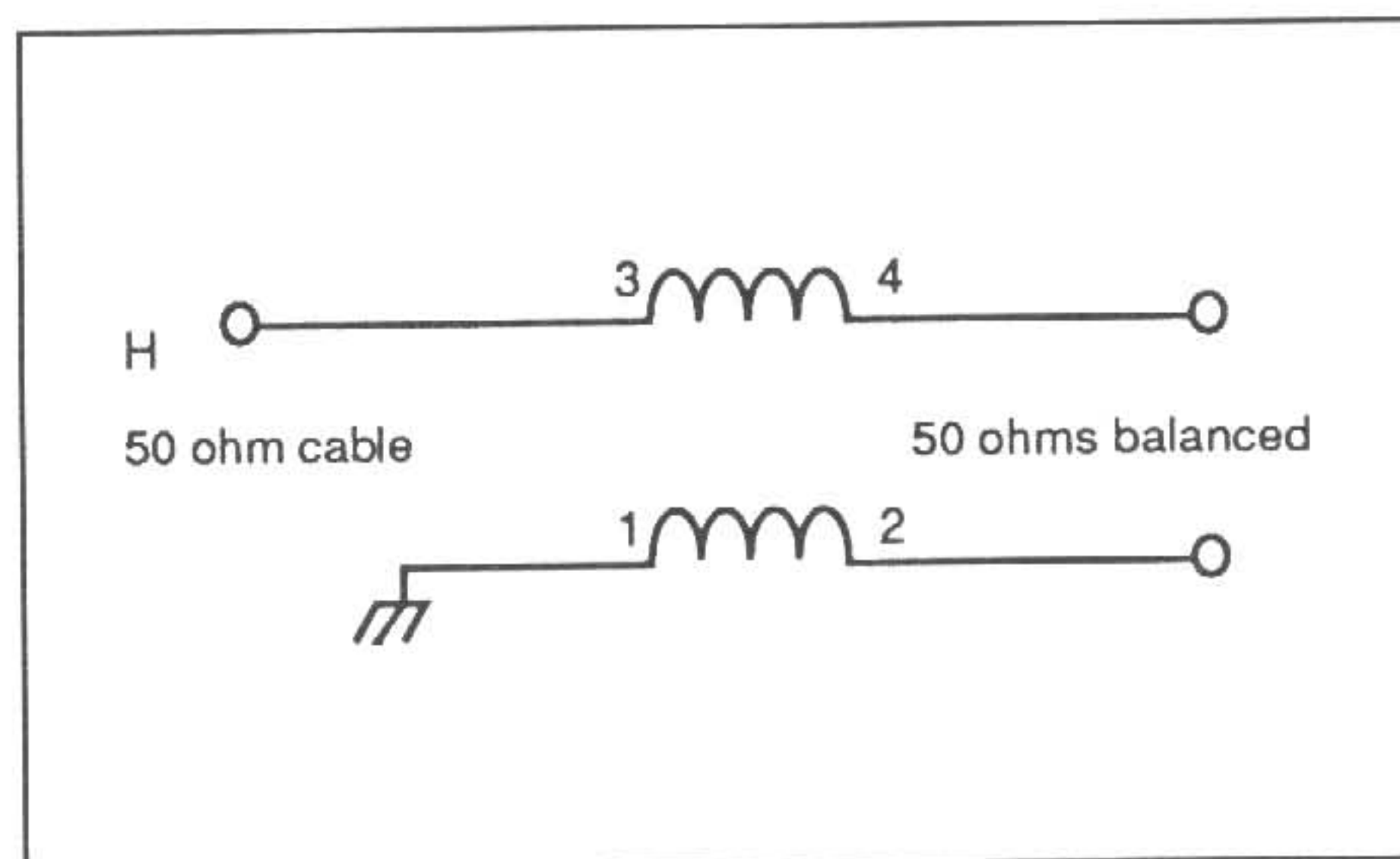


Figure 1. Schematic diagram of the Guanella 1:1 balun transformer

**C) Photograph**

The bottom-view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections.

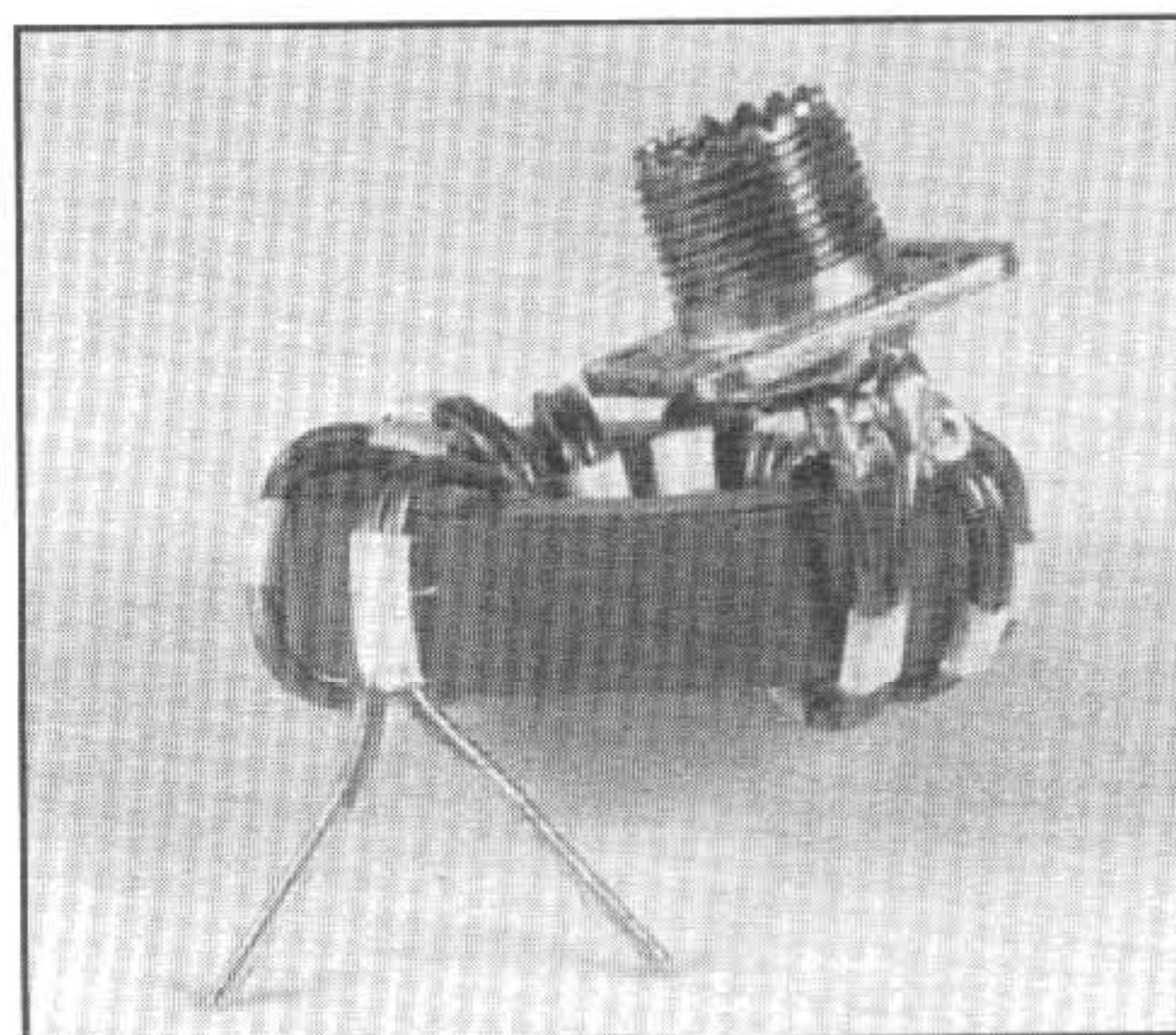


Figure 2 - Bottom-view of the high-power, efficient and broadband W2FMI-1:1-HBH50 transformer.

**A) Description**

The W2FMI-4:1-HBL200 is a high-power balun transmission line transformer designed to match 50-ohm coaxial cable to a balanced load of 200 ohms. The windings are especially designed to have a characteristic impedance of 100 ohms. With these optimized windings, as well as a ferrite core allowing for the best trade-off in low-frequency response for efficiency, this balun is capable of operating with a constant impedance transformation ratio from 1MHz to 50MHz. The conservative power rating is 1KW of continuous power and 2KW of peak power. The efficiency is 98 percent.

**B) Schematic Diagram**

Figure 1 shows the schematic diagram of this highly efficient and broadband balun. It is the 4:1 Guanella balun which sums the voltages of two equal delay lines. There are eight bifilar turns of No. 16 Formvar SF wire on each of the two transmission lines. The core is an Amidon PN FT-200-K. Each wire is covered with an 8-mil wall Teflon sleeving.

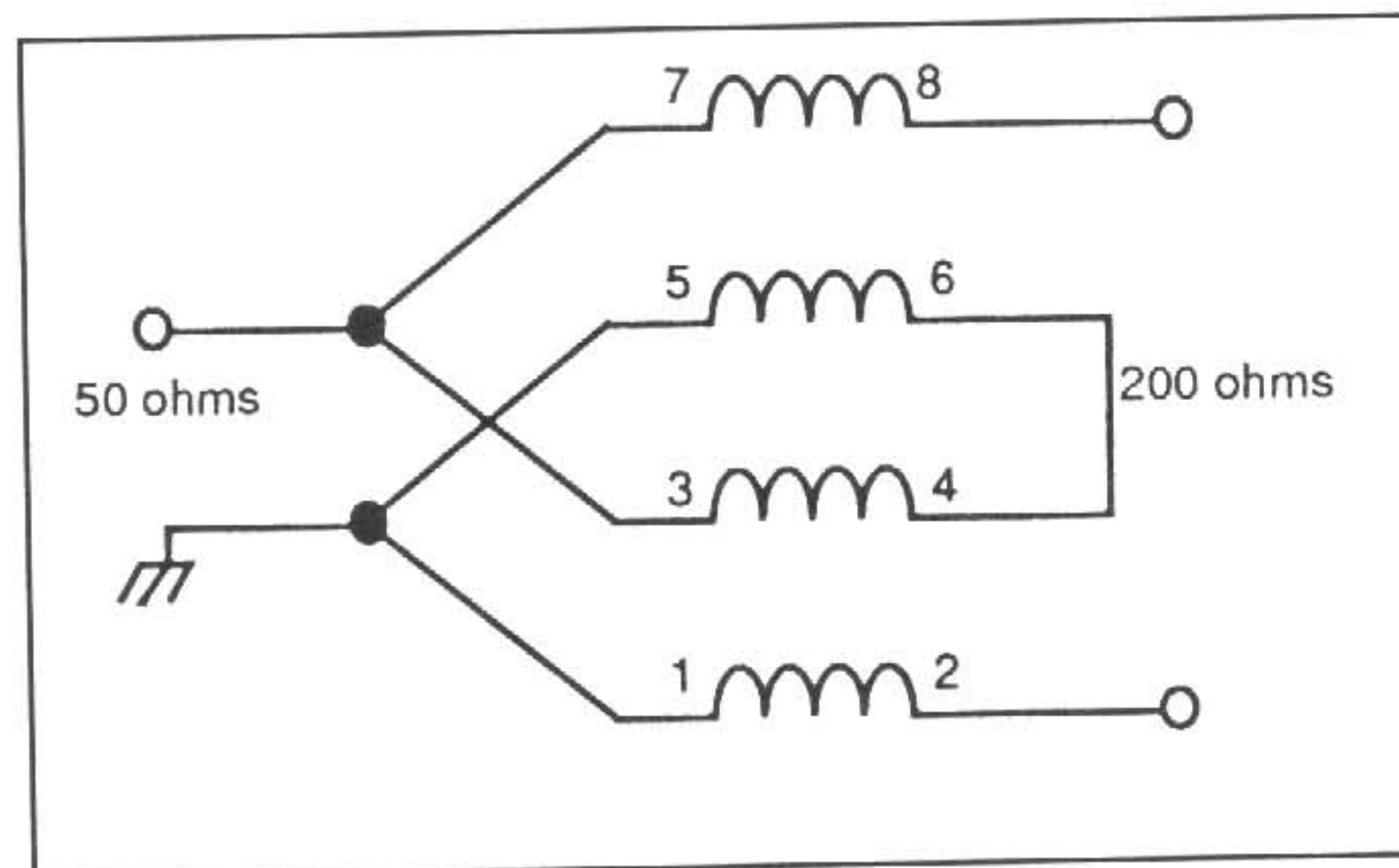


Figure 1. Schematic diagram of the Guanella 4:1 balun transformer design to match 50 ohms to 200 ohms

**C) Photograph**

The bottom-view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections.

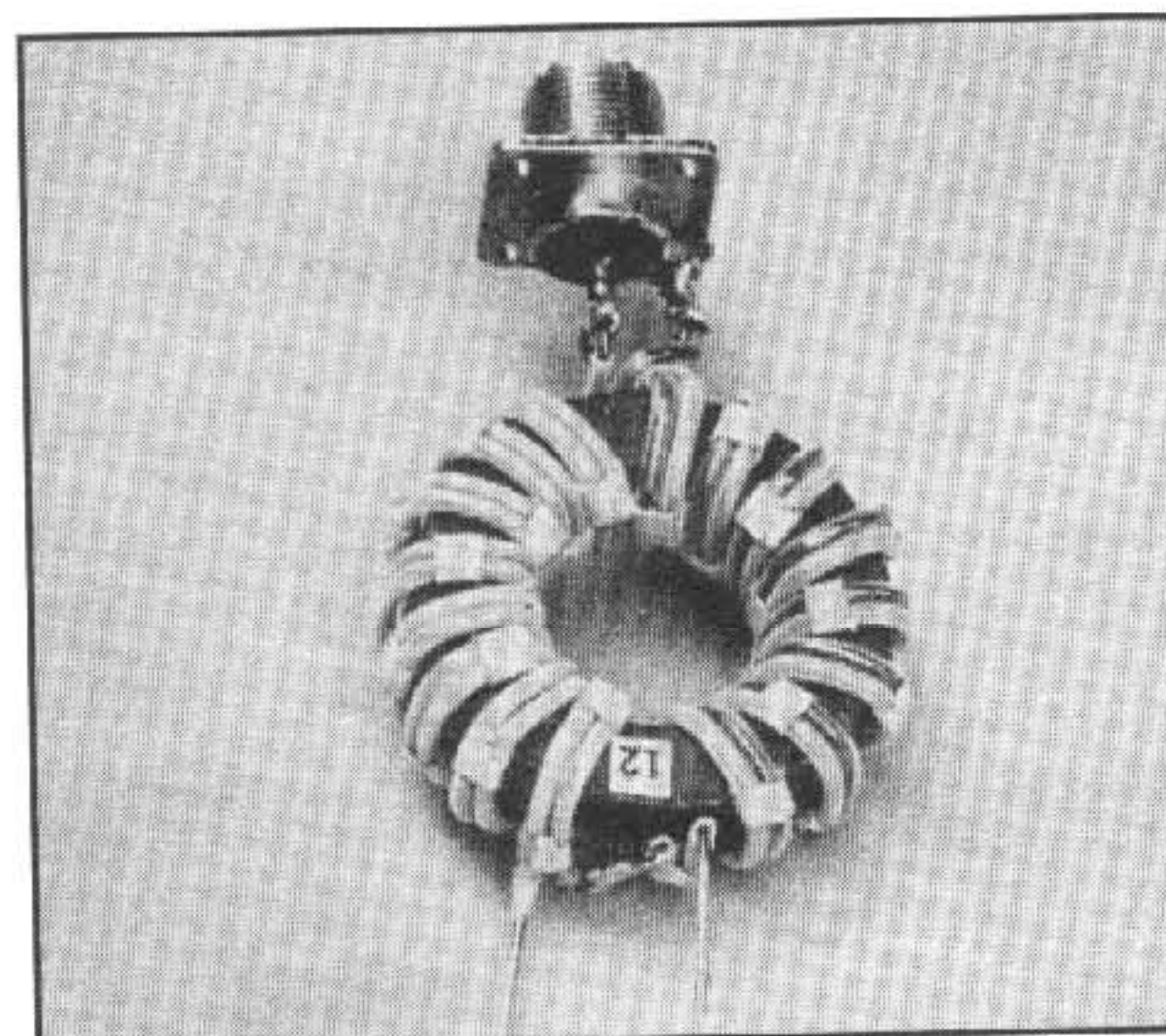


Figure 2 - Bottom-view of the highly efficient and broadband W2FMI-4:1-HBL200 transformer.

**A) Description**

The W2FMI-4:1-HBM200 is a high-power balun transmission line transformer capable of easily handling 2KW of continuous power and 4KW of peak power when matching 50-ohm coaxial cable to a balanced load of 200 ohms. The windings are especially designed to have a characteristic impedance of 100 ohms. With these optimized windings, as well as a ferrite core allowing for the best trade-off in low-frequency response for efficiency, this balun is capable of operating from 1MHz to 50MHz with a constant impedance transformation ratio. The efficiency is 98 percent.

**B) Schematic Diagram**

Figure 1 shows the schematic diagram of this very high-power and broadband balun. It is the 4:1 Guanella balun which sums the voltages of two equal delay lines. There are eight bifilar turns of No. 14 H. Imideze wire on each of the two transmission lines. The core is an Amidon PN FT-240-K. Each wire is covered with about a 15-mil wall Teflon sleeving.

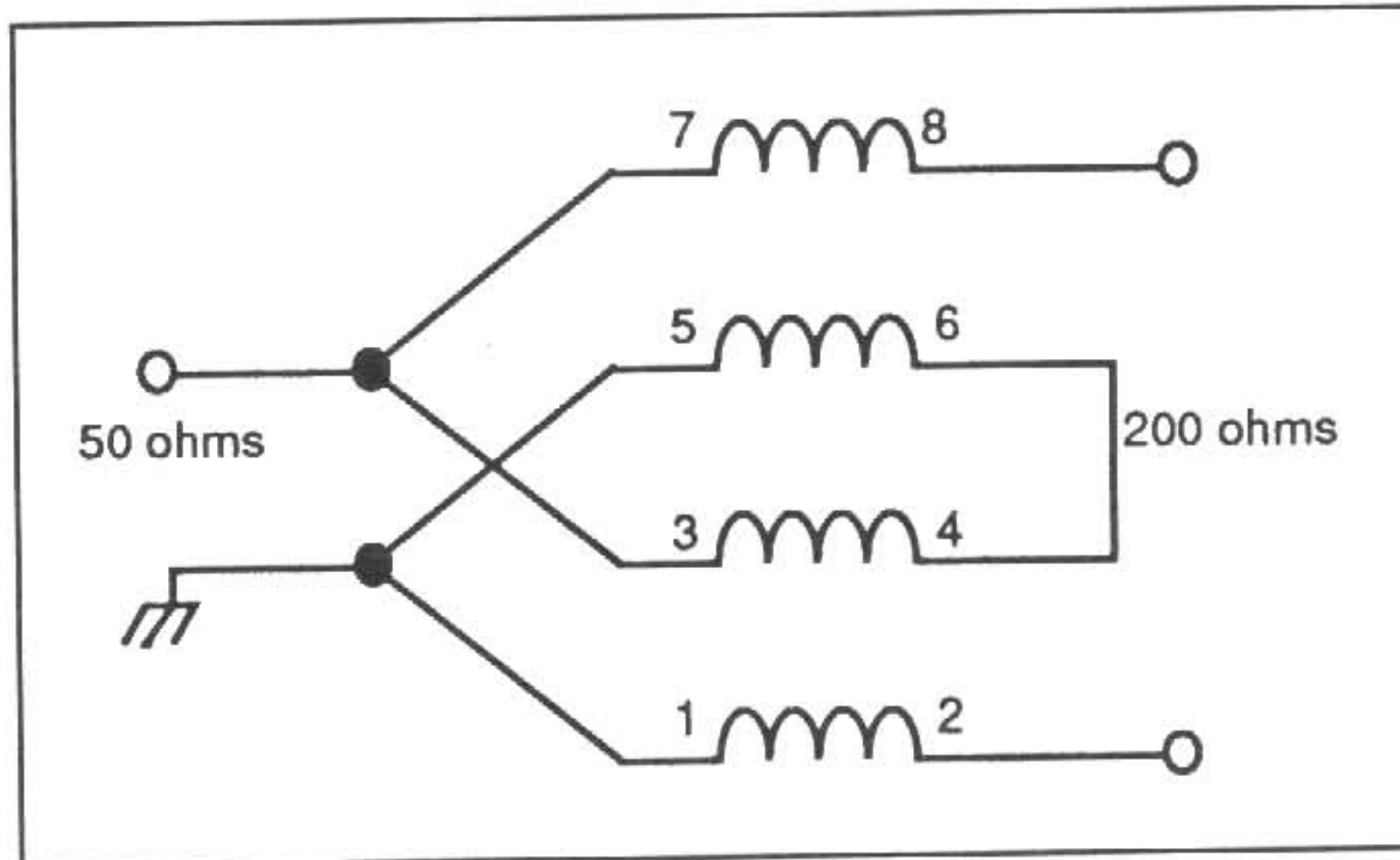


Figure 1. Schematic diagram of the Guanella 4:1 balun transformer designed to match 50 ohms to 200 ohms

**C) Photograph**

The bottom-view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections.

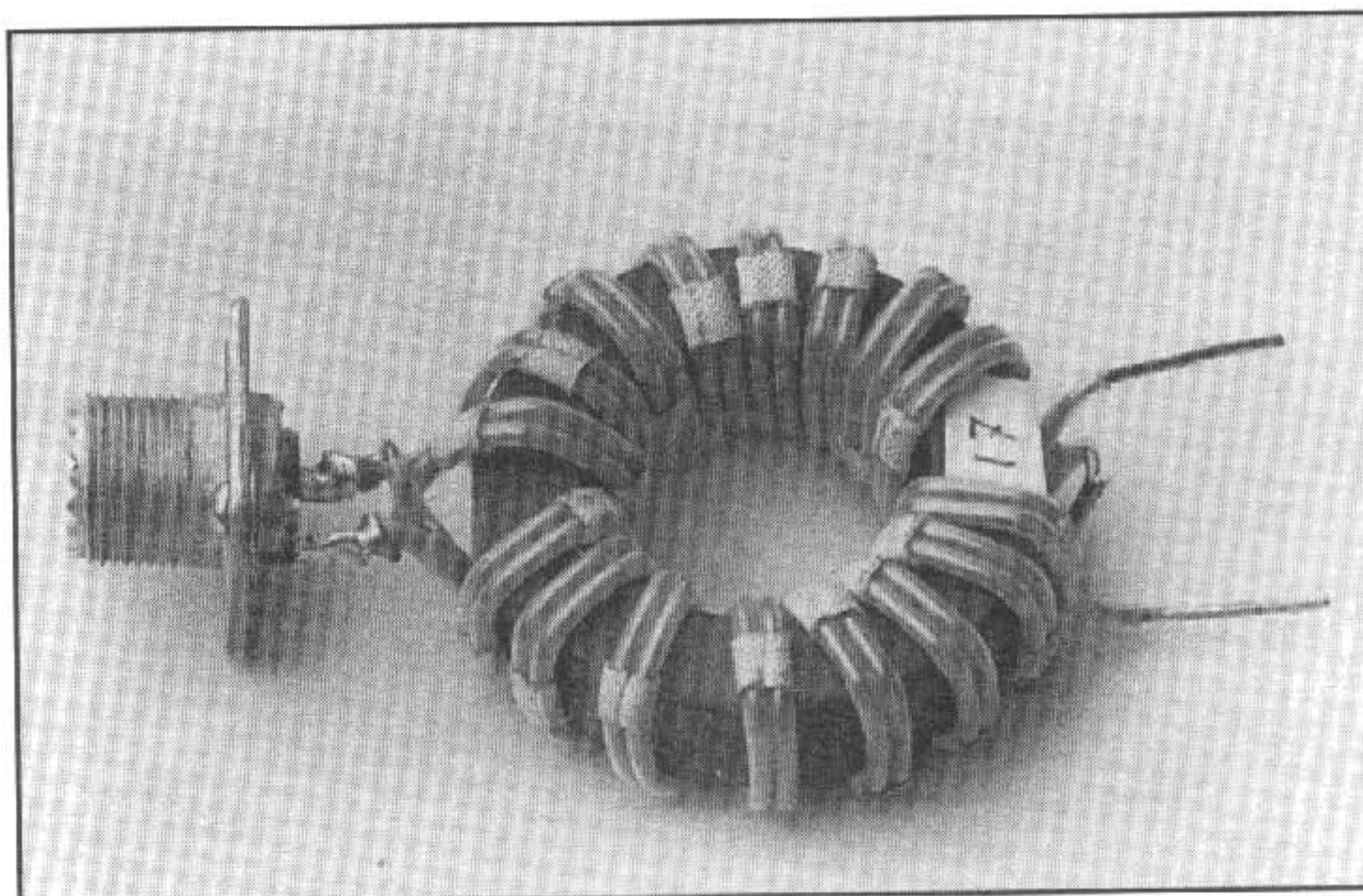


Figure 2 - Bottom-view of the high power and broadband W2FMI-4:1-HBM200 transformer.

### A) Description

The W2FMI-4:1-HBH200 is a very rugged and high-power balun transmission line transformer capable of easily handling 5KW of continuous power and 10KW of peak power when matching 50-ohm coaxial cable to a balanced load of 200 ohms. The extra ruggedness results from the use of a 4C4 ferrite which is the only one that does not suffer permanent damage due to excessive flux in the core. This transformer should be of interest in applications where high-impedances could exceed those of the design objectives (like antenna tuners). When matching 50 ohms to 200 ohms, this transformer has a flat response from 1MHz to 50MHz. The efficiency is 99 percent.

### B) Schematic Diagram

Figure 1 shows the schematic diagram of this very rugged and high-power balun. There are nine bifilar turns of No. 14 H. Imideze wire on each of the two transmission lines. Each wire is covered with about a 15-mil wall Teflon sleeving. The core is a 4C4 3-inch OD ferrite with a permeability of 125. This is a Guanella 4:1 balun which sums voltages of equal delays resulting in a very high-frequency response.

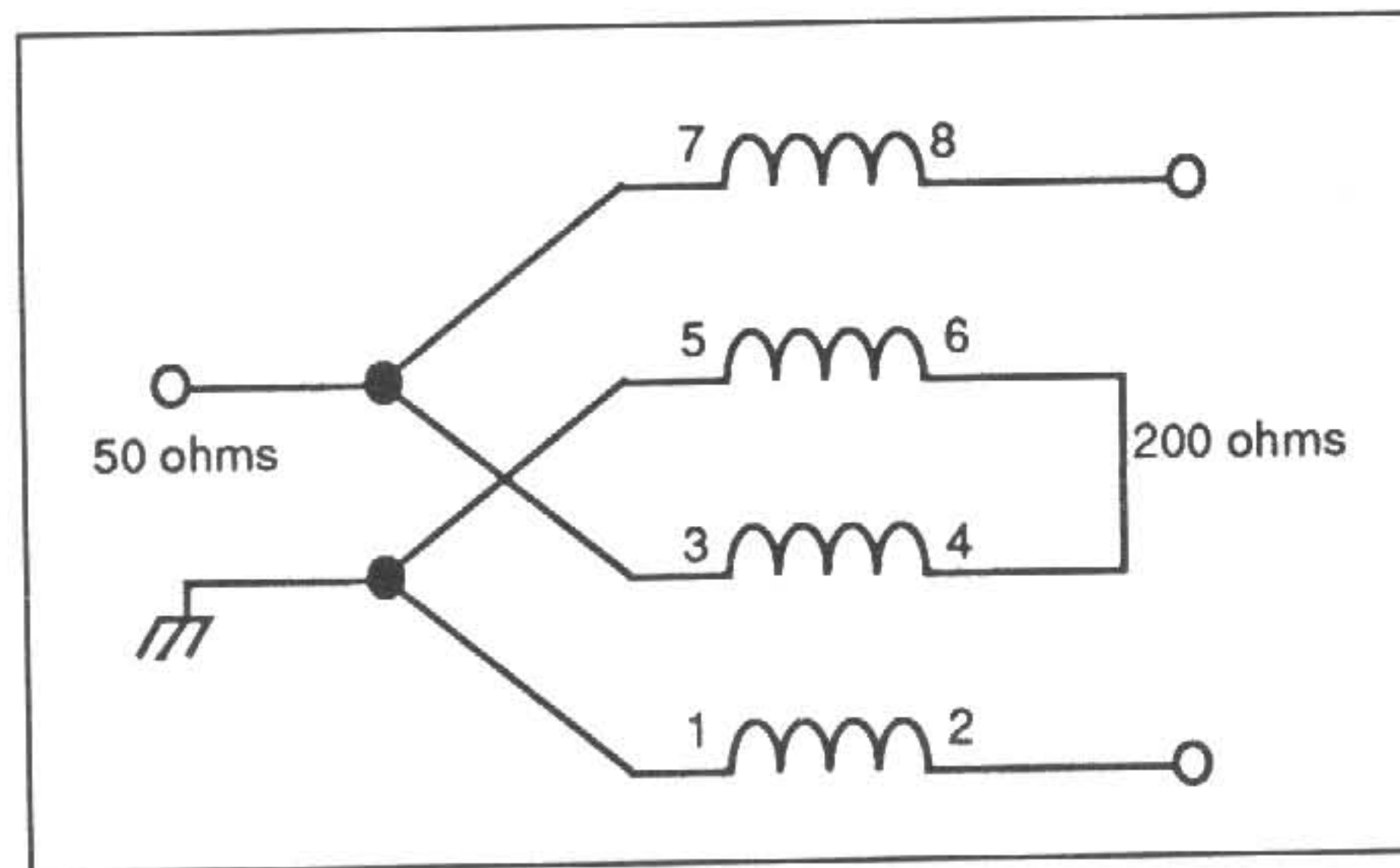


Figure 1. Schematic diagram of the Guanella 4:1 balun transformer designed to match 50 ohms to 200 ohms

### C) Photograph

The bottom-view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections.

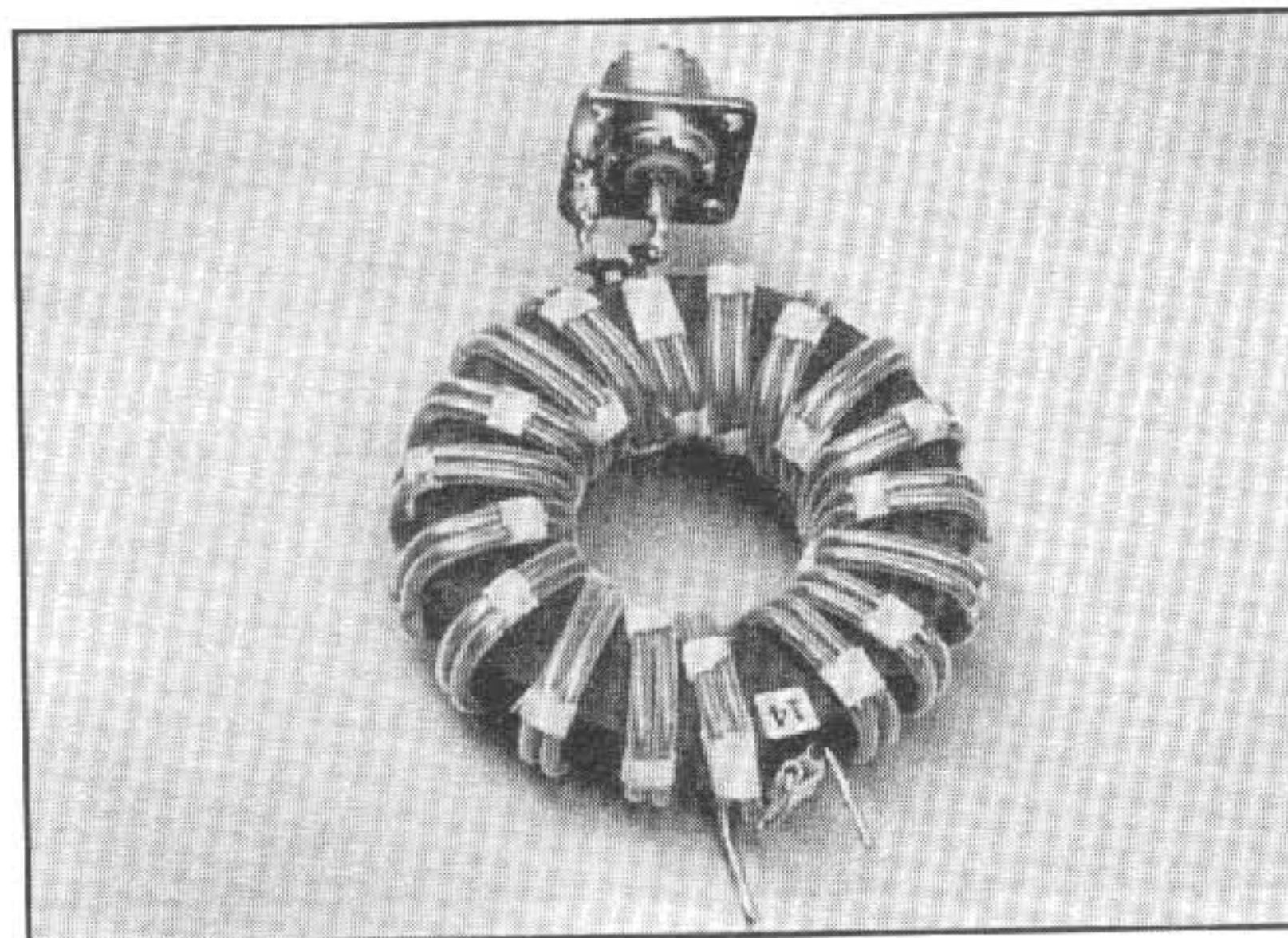


Figure 2 - Bottom-view of the very rugged, high power W2FMI-4:1-HBH200 transformer.

### A) Description

The W2FMI-6:1-HB300 is a high-power compound-balun transmission line transformer designed to match 50-ohm coaxial cable to a balanced load of 300 ohms. It consists of a 1:1.5 unun (50:75-ohm) in series with a 1:4 (75:300-ohm) Guanella balun. In matching 50 ohms to 300 ohms, the response is flat from 1.5MHz to 30MHz. A conservative power rating is 1KW of continuous power and 2KW of peak power. The efficiency is 97 percent.

### B) Schematic Diagram

Figure 1 shows the schematic diagram of this efficient, broadband 6:1 balun. It consists of two transmission lines transformers in series. The 1:1.5 unun on the left has four quintufilar turns on an Amidon PN FT-150-K ferrite core. Winding 7-8 is No. 14 H. Imideze wire and the other four are No. 16 H. Imideze wire. The 1:4 guanella balun on the right has nine bifilar turns of No. 16 Formvar SF wire on each of the two transmission lines. Each wire is covered with a teflon tubing and further seperated by teflon tubing. The core is an Amidon PN FT-268-K.

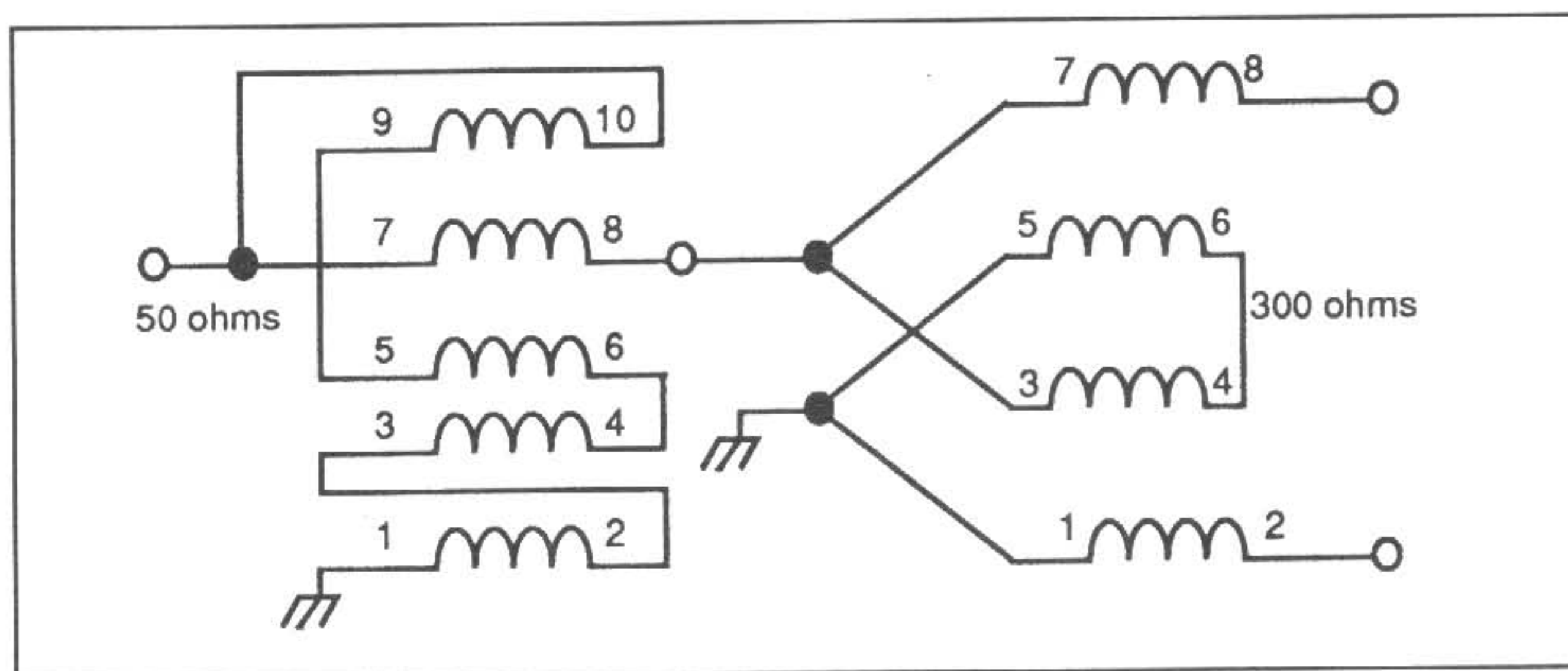


Figure 1. Schematic diagram of the compound balun with a 1:6 ratio designed to match 50 ohms to 300 ohms

### C) Photograph

The bottom-view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections.



Figure 2 - Bottom-view of the high power and broadband W2FMI-6:1-HB300 transformer.

### A) Description

The W2FMI-9:1-HB450 is a high-power, broadband balun transmission line transformer designed to match 50-ohm coaxial cable to a balanced load of 450 ohms. It uses the Guanella approach of connecting transmission line in a series-parallel arrangement such that in-phase voltages are summed at the high-impedance side. At the 50:450-ohm impedance level, the response is flat from 1.5MHz to 30MHz. The power rating is 1KW of continuous power and 2KW of peak power. The efficiency is 97 percent.

### B) Schematic Diagram

Figure 1 shows the schematic diagram of this efficient, broadband balun. Three transmission lines are connected in parallel on the 50-ohm side and in series on the 450-ohm side. If operation is required from 1.5MHz to 30 MHz, then each transmission line should have sixteen bifilar turns. If the transformer is required to operate only from 1.5MHz to 7.5MHz, then 18 bifilar turns is recommended. If operation is restricted to the 7MHz to 30MHz range, then only 14 bifilar turns is recommended. The wires, which are No. 16 Formvar SF, are covered with teflon tubing and further separated by teflon tubing. The objective is a characteristic impedance of 150 ohms. The cores are Amidon PN FT-268-K core.

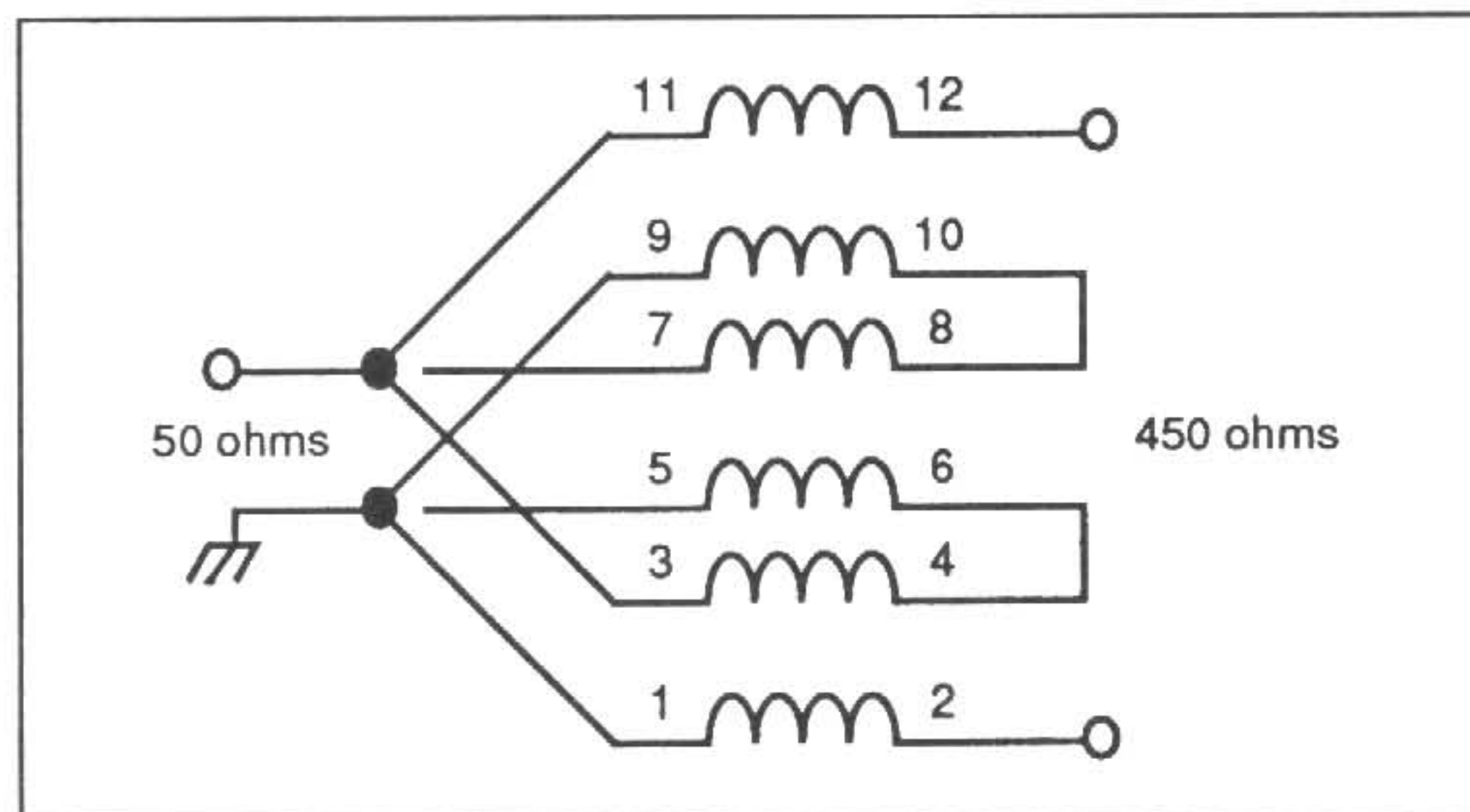


Figure 1. Schematic diagram of the Guanella 9:1 balun transformer designer to match 50 ohms to 450 ohms

### C) Photograph

The bottom-view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections.

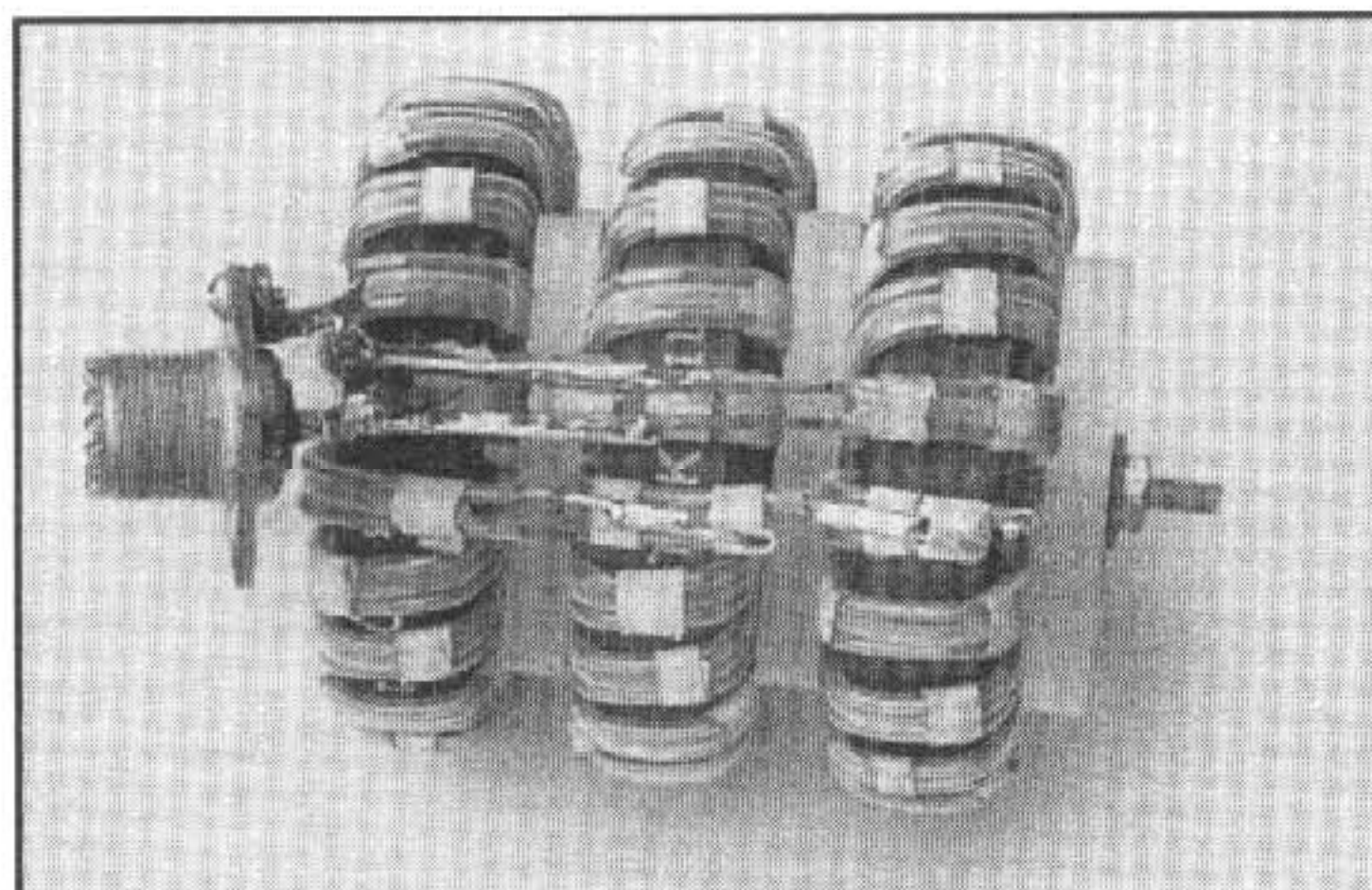


Figure 2 - Bottom-view of the high power and broadband W2FMI-9:1-HB450 transformer.

### A) Description

The W2FMI-2.25:1-HB112.5 is a high-power, compound-balun transmission line transformer designed to match 50-ohm coaxial cable to a balanced load of 112.5 ohms (designed to match into a quad antenna). It consists of two transmission line transformers in series. A 1.78:1 unun (50:28-ohm) is in series with a 1:4 (28:112.5-ohms) Guanella balun. The overall impedance ratio is 2.25:1. When matching 50 ohms to 112.5 ohms, the response is flat from 1.5MHz to 45MHz. The power rating is 1KW of continuous power and 2KW of peak power. The efficiency is 98 percent.

### B) Schematic Diagram

Figure 1 shows the schematic diagram of this efficient and broadband 2.25:1 balun. It consists of two transmission line transformers in series. The 1.78:1 unun on the left has five quadrifilar turns on an Amidon PN FT-150-K. Winding 5-6 is No. 14 Formvar SF wire. The other three are No. 16 Formvar SF wire. The 1:4 Guanella balun on the right has eight bifilar turns on each of the two transmission lines. The core is an Amidon PN FT-200-K. The windings are No. 14 H. Imideze wire. Winding 1-2 is also covered with two layers of Scotch No. 92 tape. The characteristic impedance of the top transmission line is 45 ohms. The bottom transmission line is 55 ohms. This arrangement (which is compensating) produced the highest frequency response when the load is between 110 and 120 ohms.

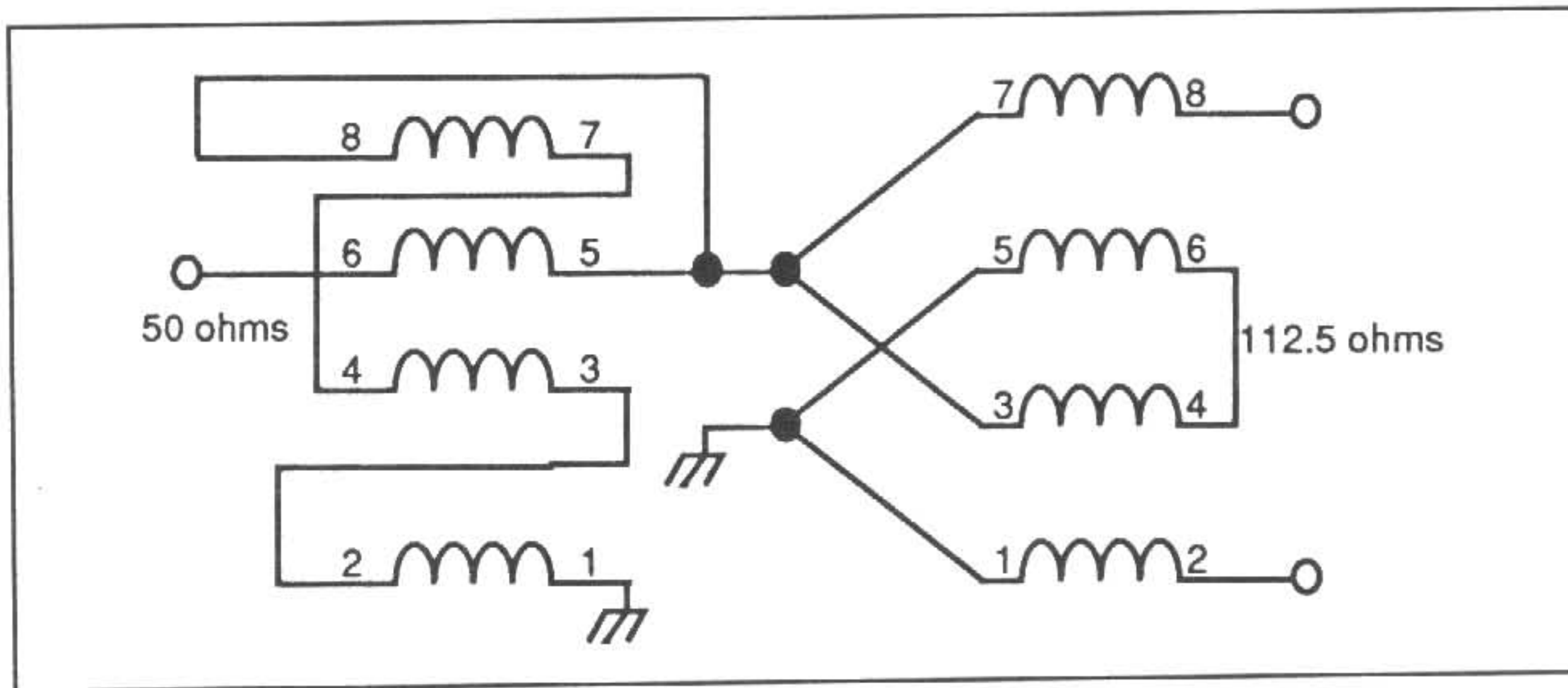


Figure 1. Schematic diagram of the compound balun with a 1:2.25 ratio designed to match 50 ohms to 112.5 ohms

### C) Photograph

A view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections.

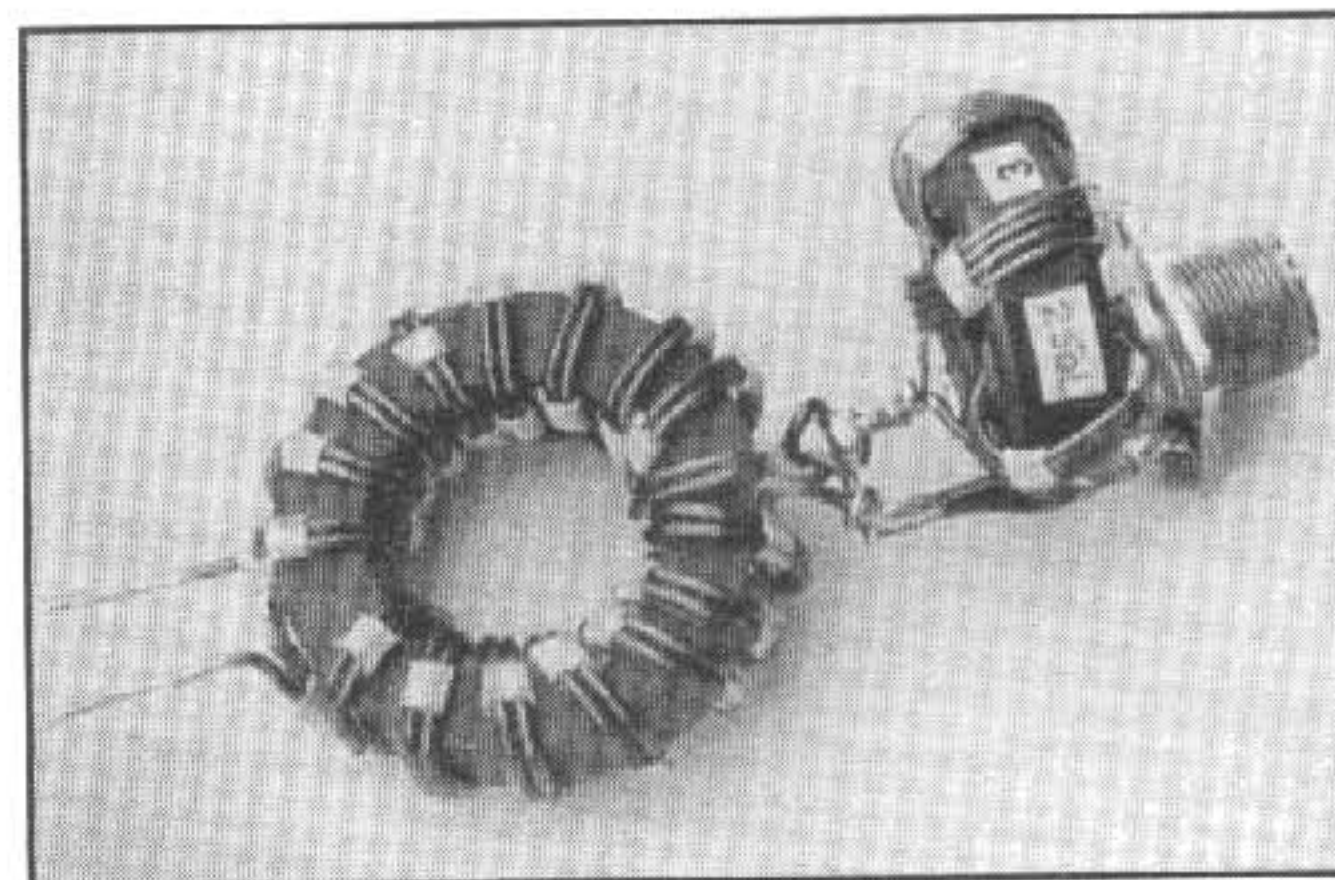


Figure 2 - A view of the compound-balun W2FMI-2.25:1-HB112.5 transformer.

### A) Description

The W2FMI-4:1-HB50 is a high-power, broadband 4:1 Guanella balun designed to match 50-ohm coaxial cable to a balanced load of 12.5 ohms (like a Yagi beam antenna). It uses two tightly wound transmission lines on two rod cores. This utilizes the ability of being able to obtain a characteristic impedance of 25 ohms which is optimal for matching 50 ohms to 12.5 ohms. This cannot be done with tight windings on toroidal cores. Further, since two cores are used, the transformer has about the same broadband response in an unun (unbalanced-to-unbalanced) application. In fact, the bottom core can be removed with little change in the low-frequency limit. In matching 50 ohms to 12.5 ohms, the response is flat from 1.5MHz to 45MHz! The power rating is 1KW of continuous power and 2KW of peak power. The efficiency is 99 percent.

### B) Schematic Diagram

Figure 1 shows the schematic diagram of this efficient and broadband 4:1 balun/unun. It consists of two tightly wound transmission lines on two Amidon PN R61-037-400 ferrite rods (3/8-inch diameter, 3 3/4-inch long ferrite rods with permeability of 125). The bifilar windings are 14 1/2 turns of No. 14 Formvar SF wire. The connections are made in the broadband series-parallel arrangement of the 4:1 Guanella balun. When operating as an unun (terminals 1 and 2 grounded), the bottom rod can be removed since there is no potential gradient along its winding.

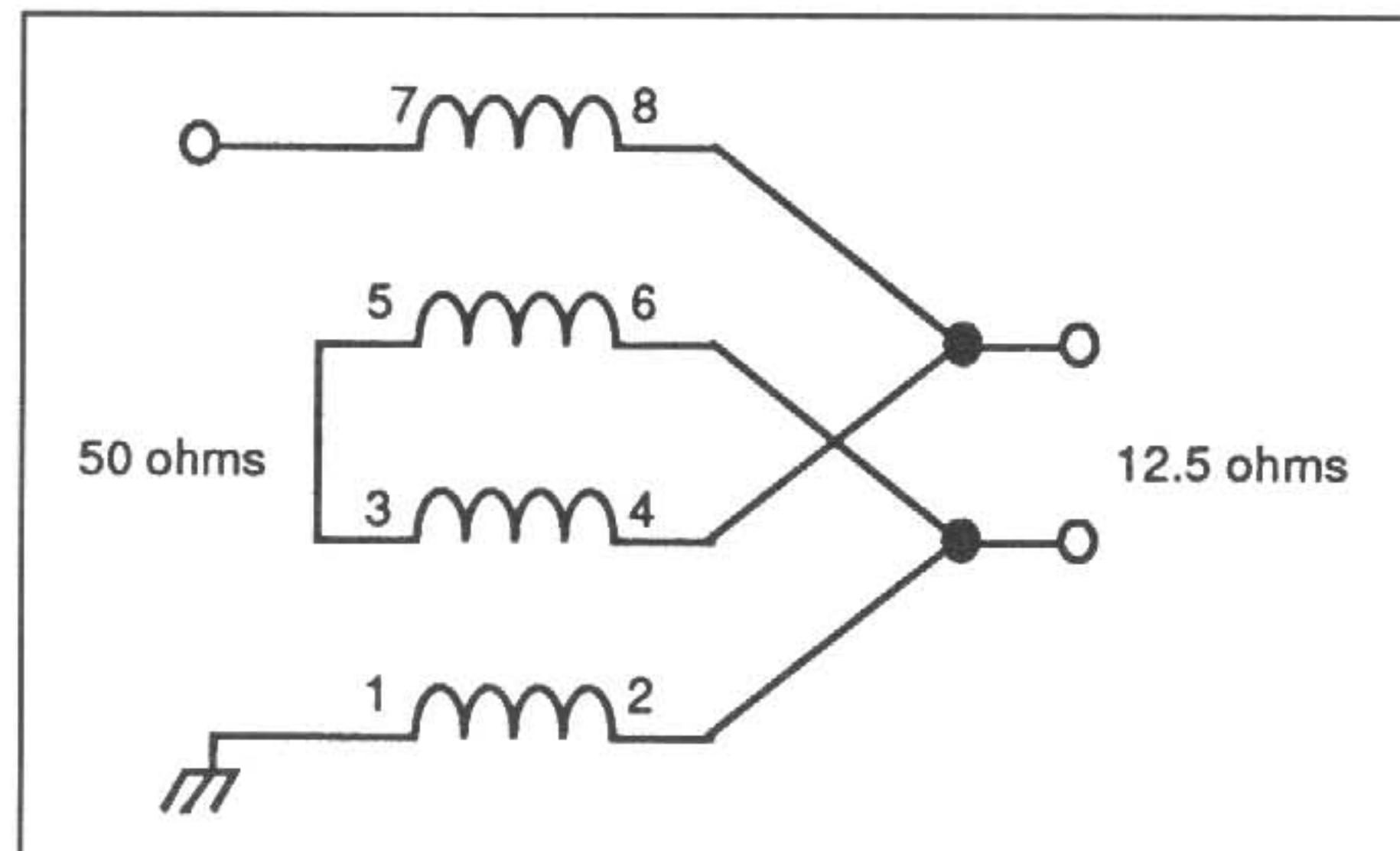


Figure 1. Schematic diagram of the Guanella 4:1 balun transformer designed to match 50 ohms to 12.5 ohms

### C) Photograph

The bottom-view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections. The connector is on the 50 ohm side.

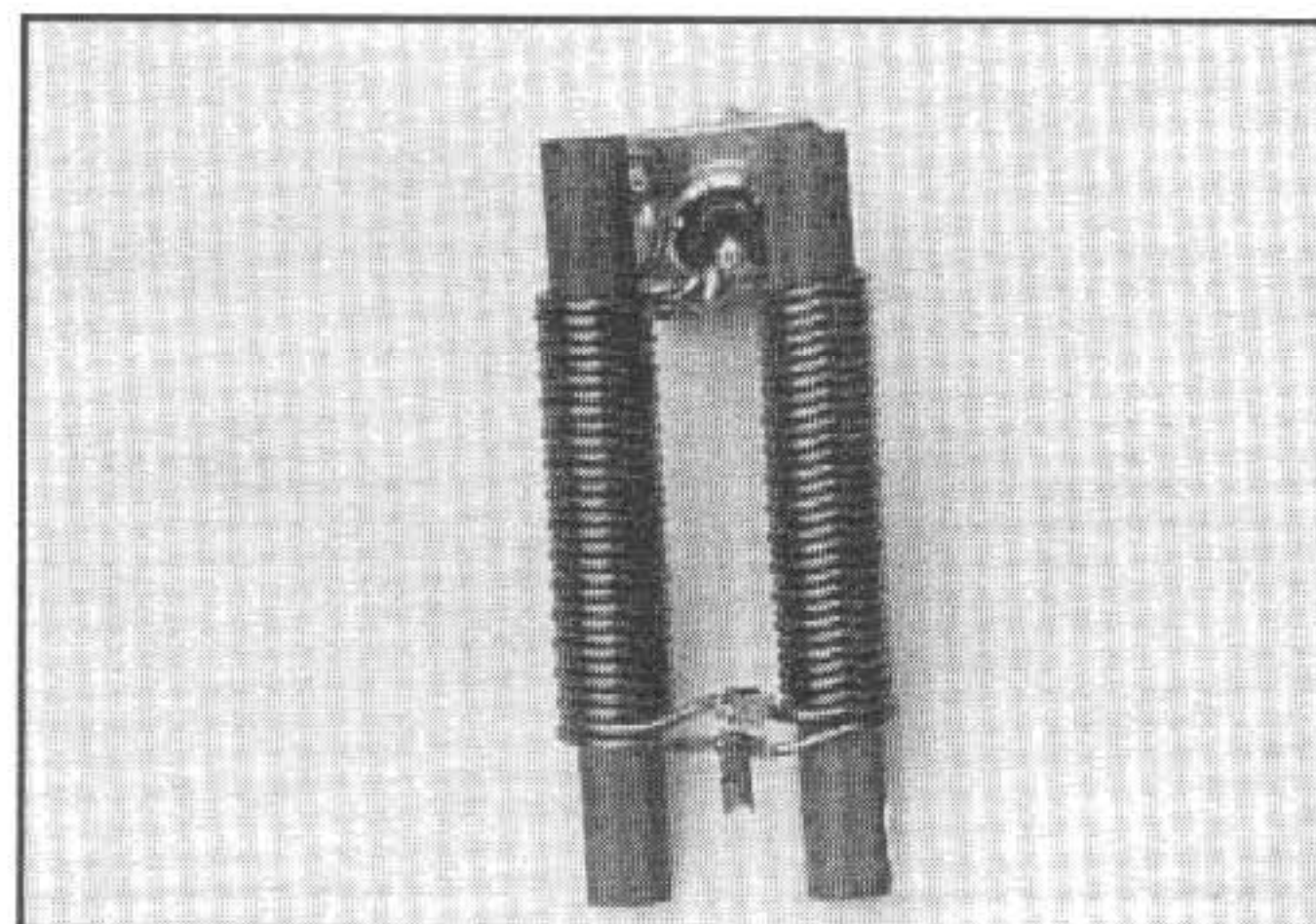


Figure 2 - Bottom-view of the high-power and broadband balun W2FMI-4:1-HB50 transformer.



### A) Description

The W2FMI-12:1-HB600 is a high-power compound-balun transmission line transformer designed to match 50-ohm coaxial cable to a balanced load of 600 ohms. It consists of a 1.33:1 unun (50:37.6-ohms) in series with a 1:16 (37.6:600-ohms) Guanella balun. It is very likely one of the most difficult high-ratio, high-impedance baluns to design and construct. Preliminary measurements show that the response is quite flat from 1.7MHz to 22MHz. The useful range could be somewhat higher. A conservative power rating is 1KW of continuous power and 2KW of peak power. The efficiency is 96 percent.

### B) Schematic Diagram

Figure 1 shows the schematic diagram of this efficient, broadband 12:1 balun. It consists of two transmission lines transformers in series. The 1.33:1 unun on the left has five quintufilar turns of No.14 Formvar SF wire on an Amidon PN FT-150-K ferrite core. The center wire is tapped 2 turns from terminal 6. The 1:16 Guanella balun has 17 bifilar turns of No.16 Formvar SF wire on each of the four Amidon PN FT-268-K ferrite core. Each wire is covered with Teflon sleeving. They are further separated by teflon sleeving yielding the 150-ohm characteristics impedance needed for the impedance level.

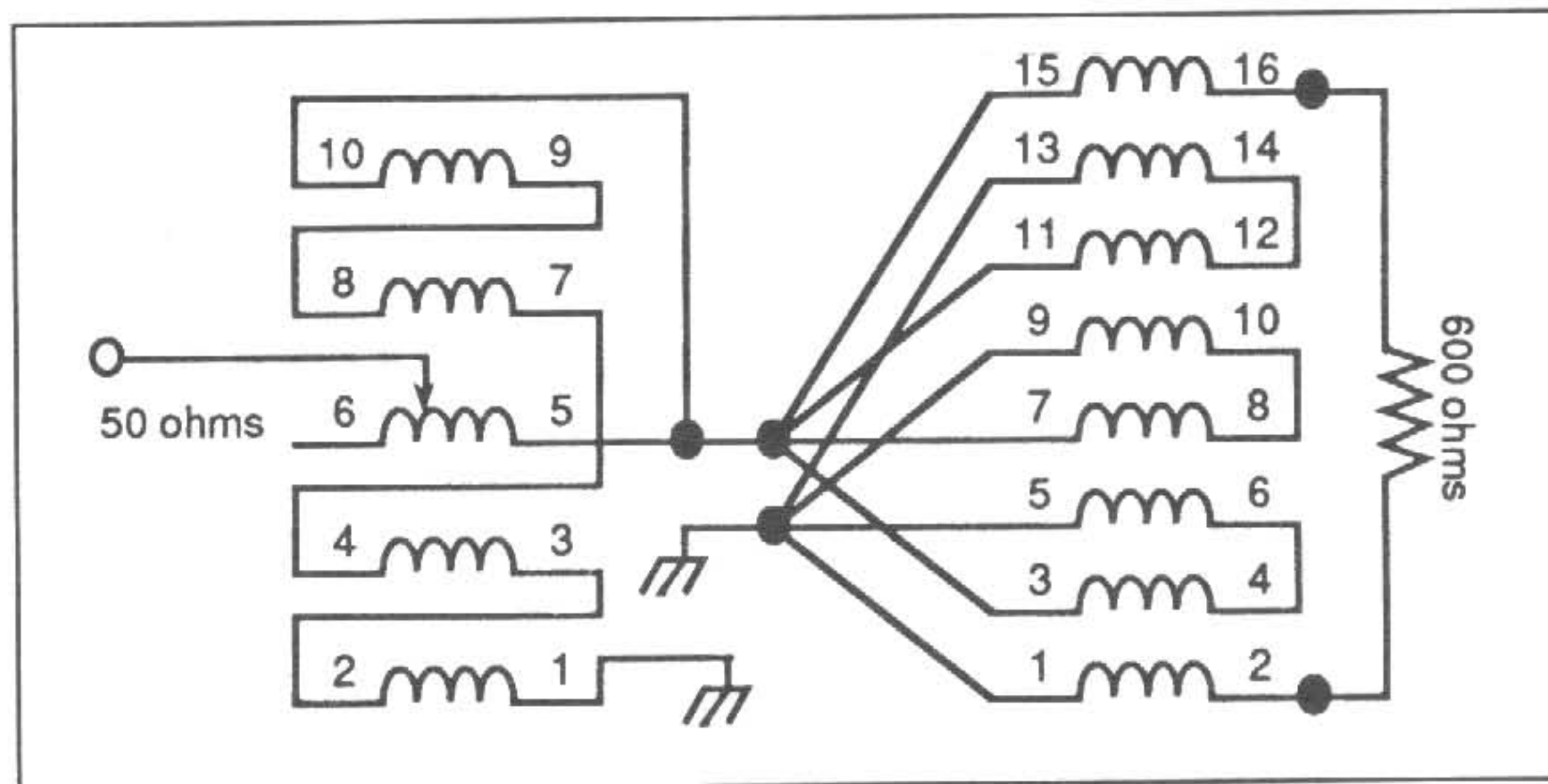


Figure 1. Schematic diagram of the compound balun with a 12:1 ratio designed to match 50 ohms to 600 ohms

### C) Photograph

A view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections.

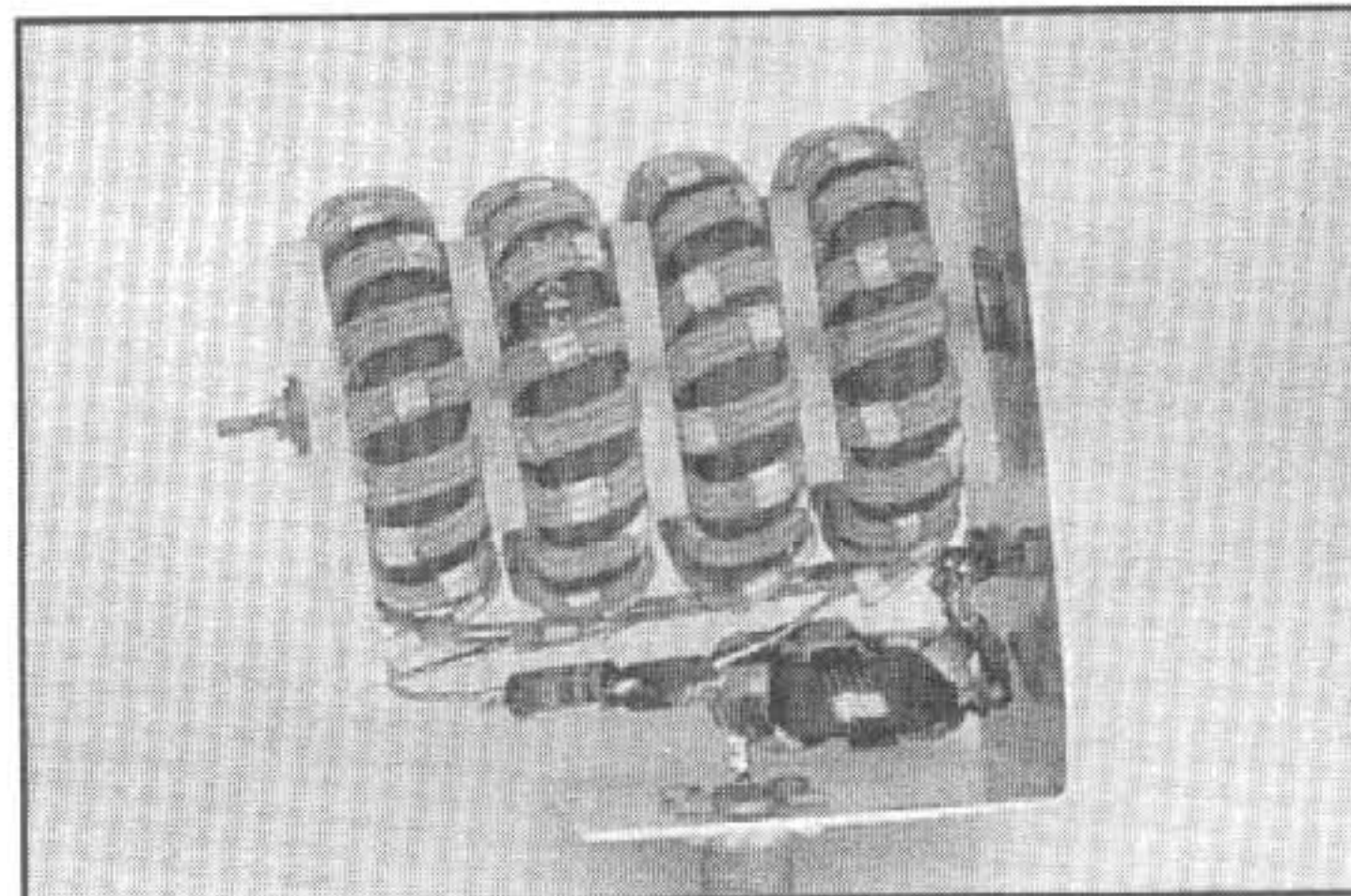


Figure 2 - A view of the high power and broadband W2FMI-12:1-HB600 transformer.

### A) Description

The W2FMI-12:1-MB600 is a medium-power, compound-balun transmission line transformer designed to match 50-ohm coaxial cable to a balanced load of 600 ohms. It consists of a 1.33:1 unun (50:66.7-ohms) in series with a 1:9 (66.7:600-ohms) Guanella balun. Preliminary measurements show that the response is quite flat from 3.5MHz to 30MHz. A conservative power rating is 500 watt of continuous power and 1KW of peak power. The efficiency is 95 percent.

### B) Schematic Diagram

Figure 1 shows the schematic diagram of this efficient, broadband 12:1 balun. It consists of two transmission line transformers in series. The 1.33:1 unun on the left has four septuflar turns on an Amidon PN FT-150-K ferrite core. The top winding is No.14 Formvar SF wire and the other six are No.16 Formvar SF wire. The 1:9 Guanella balun has 14 bifilar turns of No.18 Formvar SF wire on each of the three Amidon PN FT-268-K ferrite core. The bifilar winding are spaced 1/4-inch with scotch No.27 glass tape clamps in order to obtain the optimum characteristic impedance of 200 ohms.

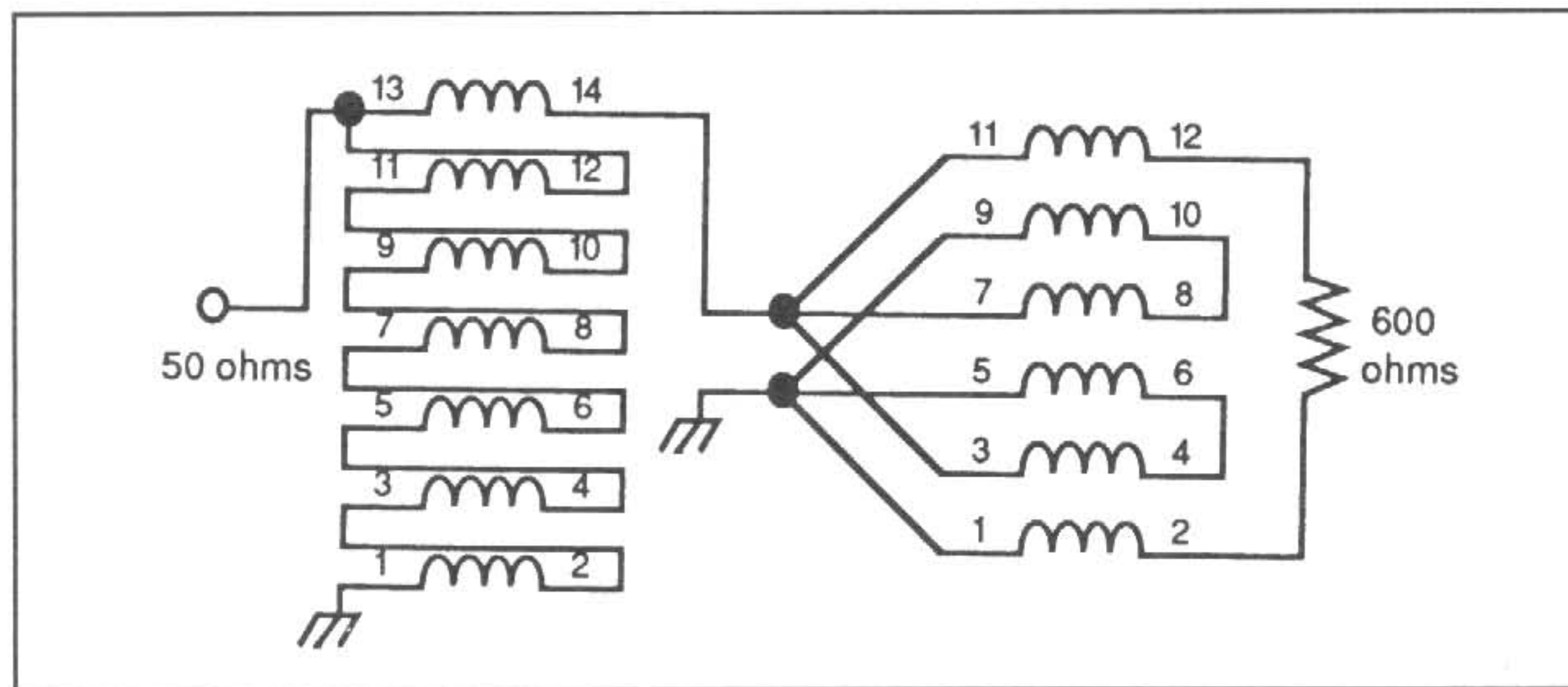


Figure 1. Schematic diagram of the compound balun with a 12:1 ratio designed to match 50 ohms to 600 ohms

### C) Photograph

A view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections.

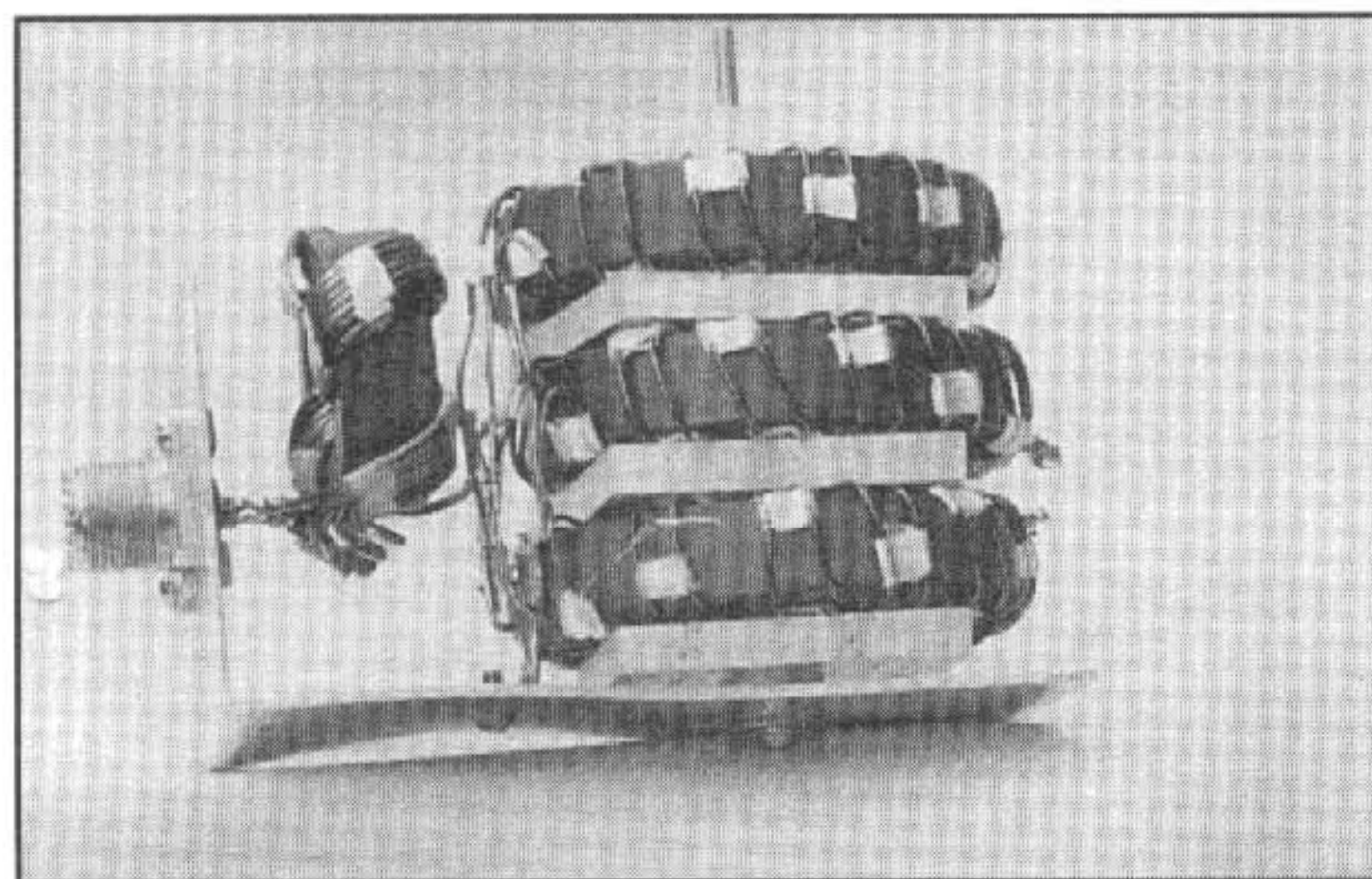


Figure 2 - Photograph of the medium power and broadband W2FMI-12:1-MB600 transformer.

**A) Description**

The W2FMI-1.5:1-LU50 is a low-power unun (unbalanced-to-unbalanced) transmission line transformer designed to match 50 ohms to 32 ohms. It has a constant transformation ratio of 1.5:1 (actually 1.56:1) from 1MHz to 40MHz. In the reverse direction matching 50 ohms to 75 ohms, the response is flat from 1MHz to 20MHz. A conservative power rating is 150 Watts of continuous power and 300 Watts of peak power. The efficiency is 99 percent.

**B) Schematic Diagram**

Figure 1 shows the schematic diagram of this highly efficient and broadband transformer. Five quintufilar turns are wound on a Amidon PN FT-125-K. The center winding in Figure 1 is No. 16 Formvar SF wire. The other four are No. 18 Formvar SF wire.

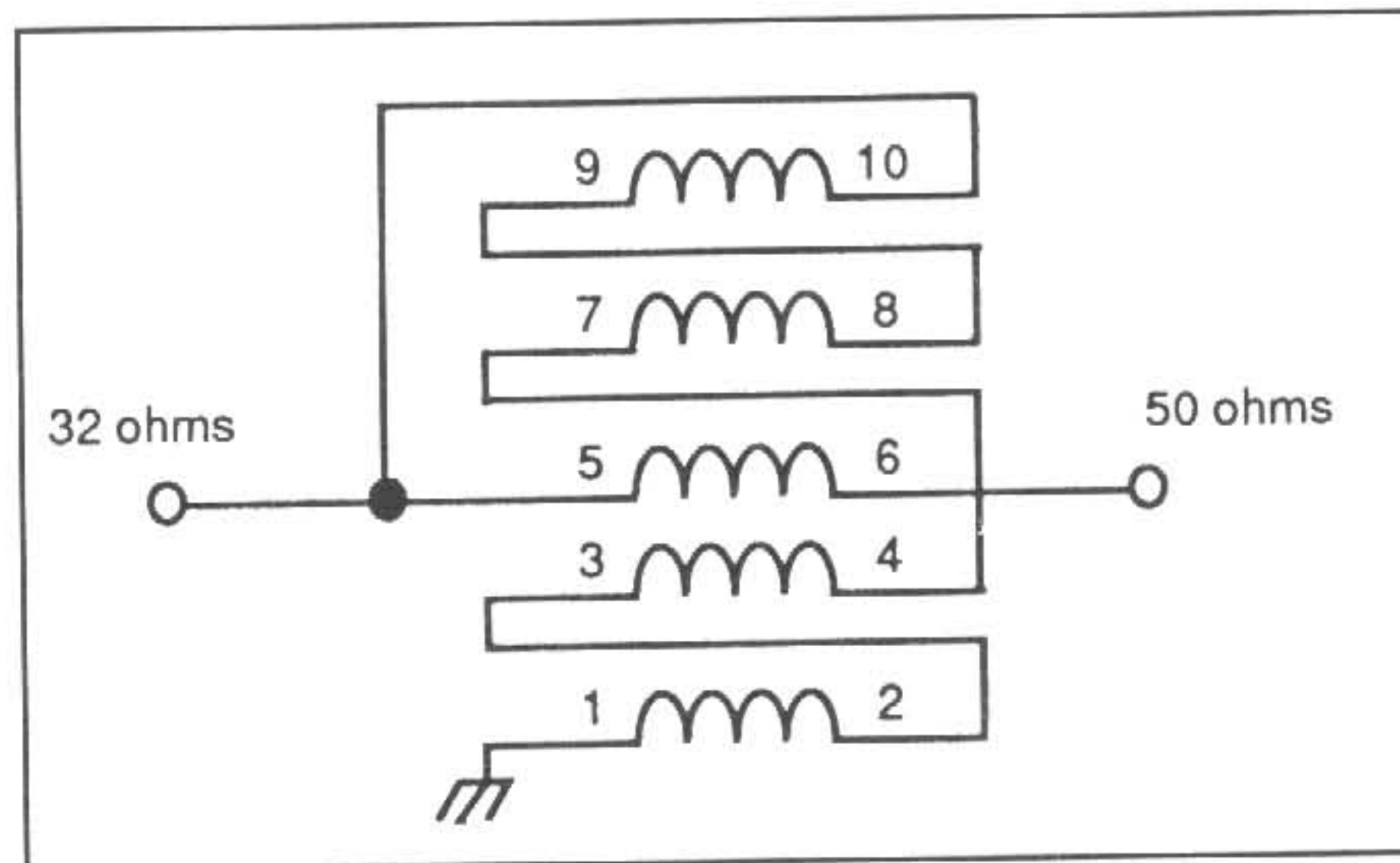


Figure 1. Schematic diagram of the quintufilar UNUN transformer designed to match 50 ohms to 32 ohms

**C) Photograph**

The bottom-view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections. The connector is on the low-impedance side.

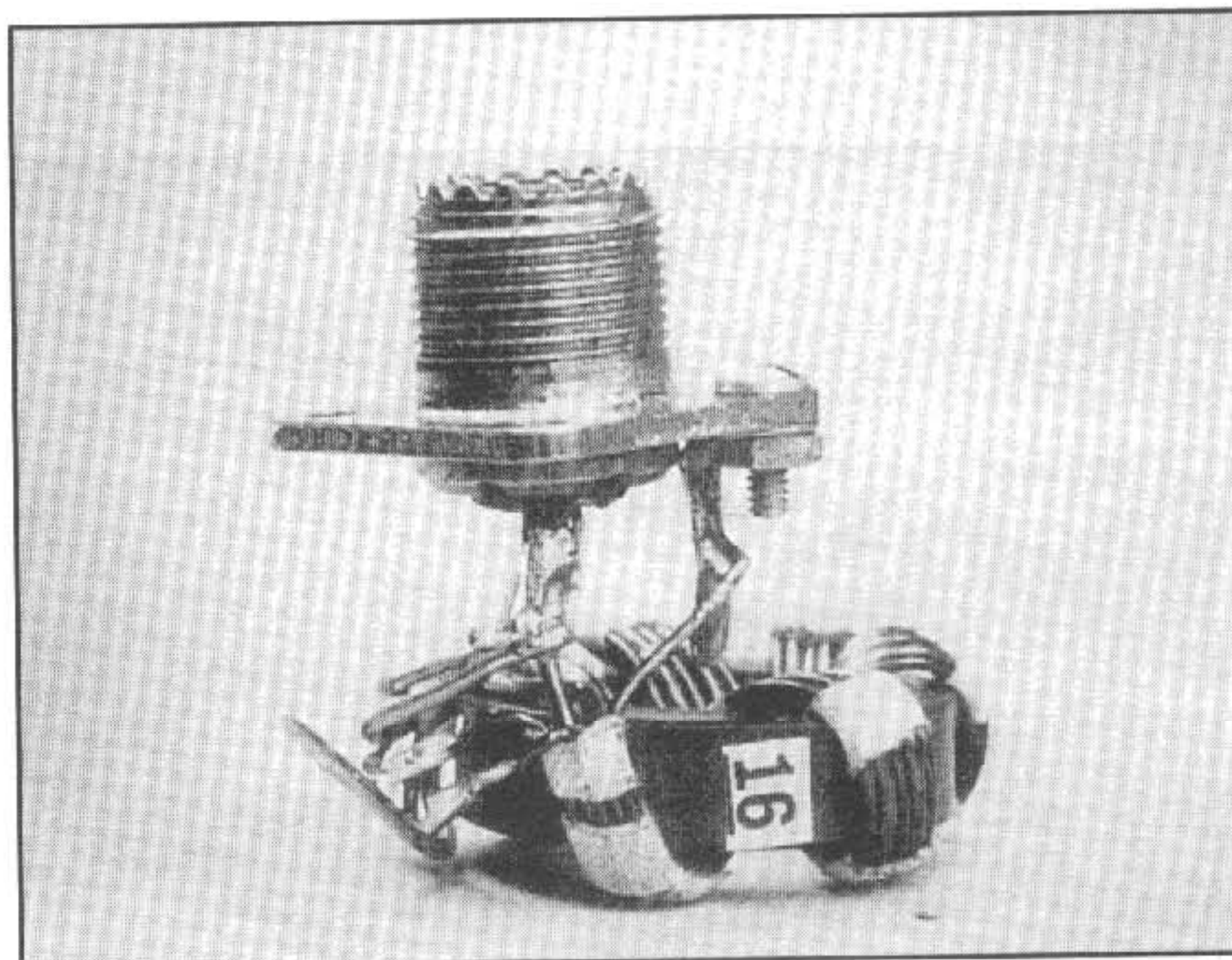


Figure 2 - Bottom-view of the highly efficient and broadband W2FMI-1.5:1-LU50 transformer.

**A) Description**

The W2FMI-1.5:1-LU75 is a low-power unun (unbalanced-to-unbalanced) transmission line transformer designed to match 75 ohms to 50 ohms. It has a constant impedance transformation of 1.5:1 (actually 1.56:1) from 1MHz to 50MHz. In the reverse direction matching 50 ohms to 32 ohms, the response is flat from 1MHz to 25MHz. A conservative power rating is 150 Watts of continuous power and 300 Watts of peak power. The efficiency is 99 percent.

**B) Schematic Diagram**

Figure 1 shows the schematic diagram of this highly efficient and broadband transformer. Five quintufilar turns are wound on an Amidon FT-125-K. The top winding in Figure 1 is No. 16 Formvar SF wire. The other four are No. 18 Formvar SF wire.

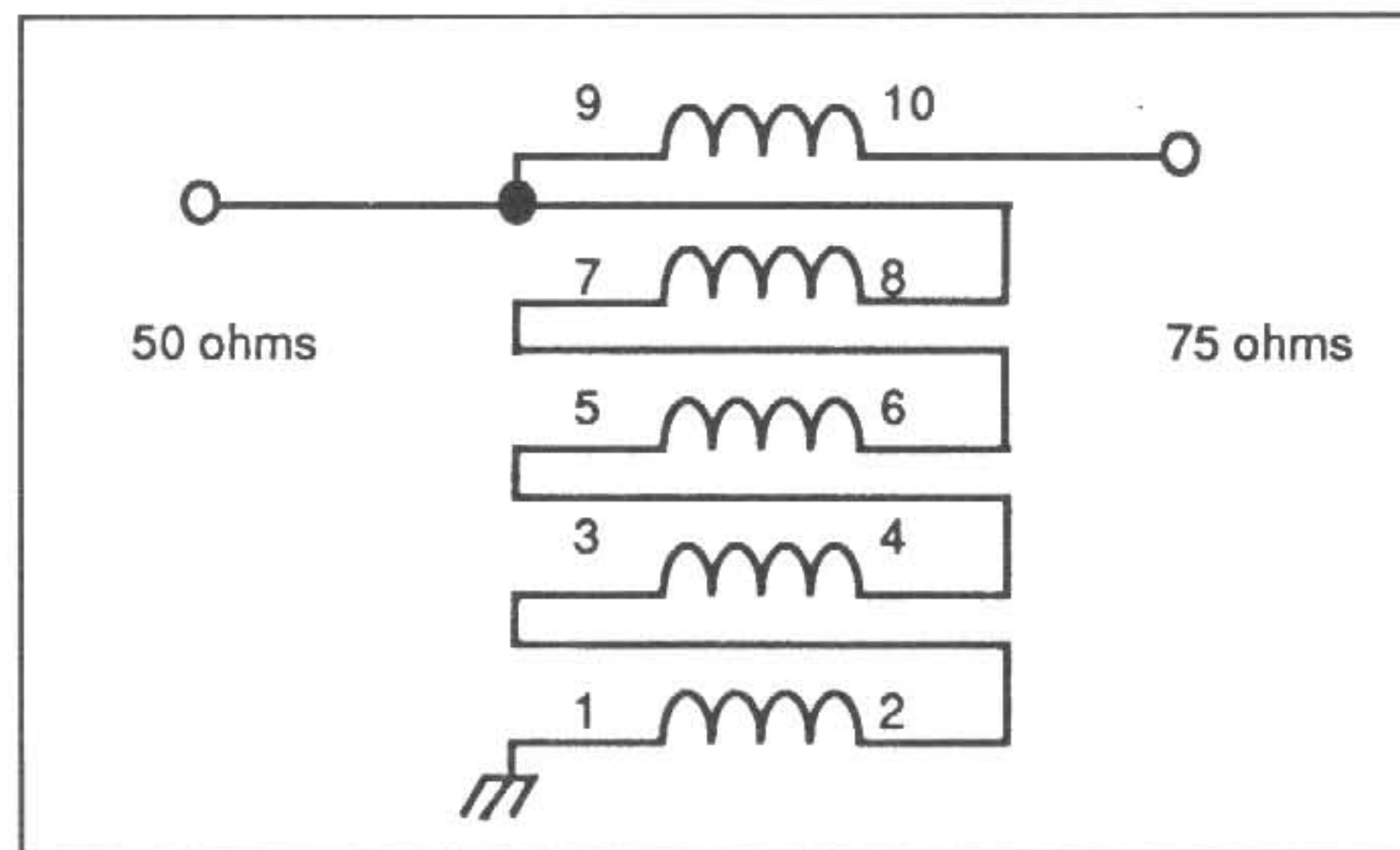


Figure 1. Schematic diagram of the quintufilar UNUN transformer designed to match 75 ohms to 50 ohms

**C) Photograph**

The top-view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections. The connector is on the low-impedance side.

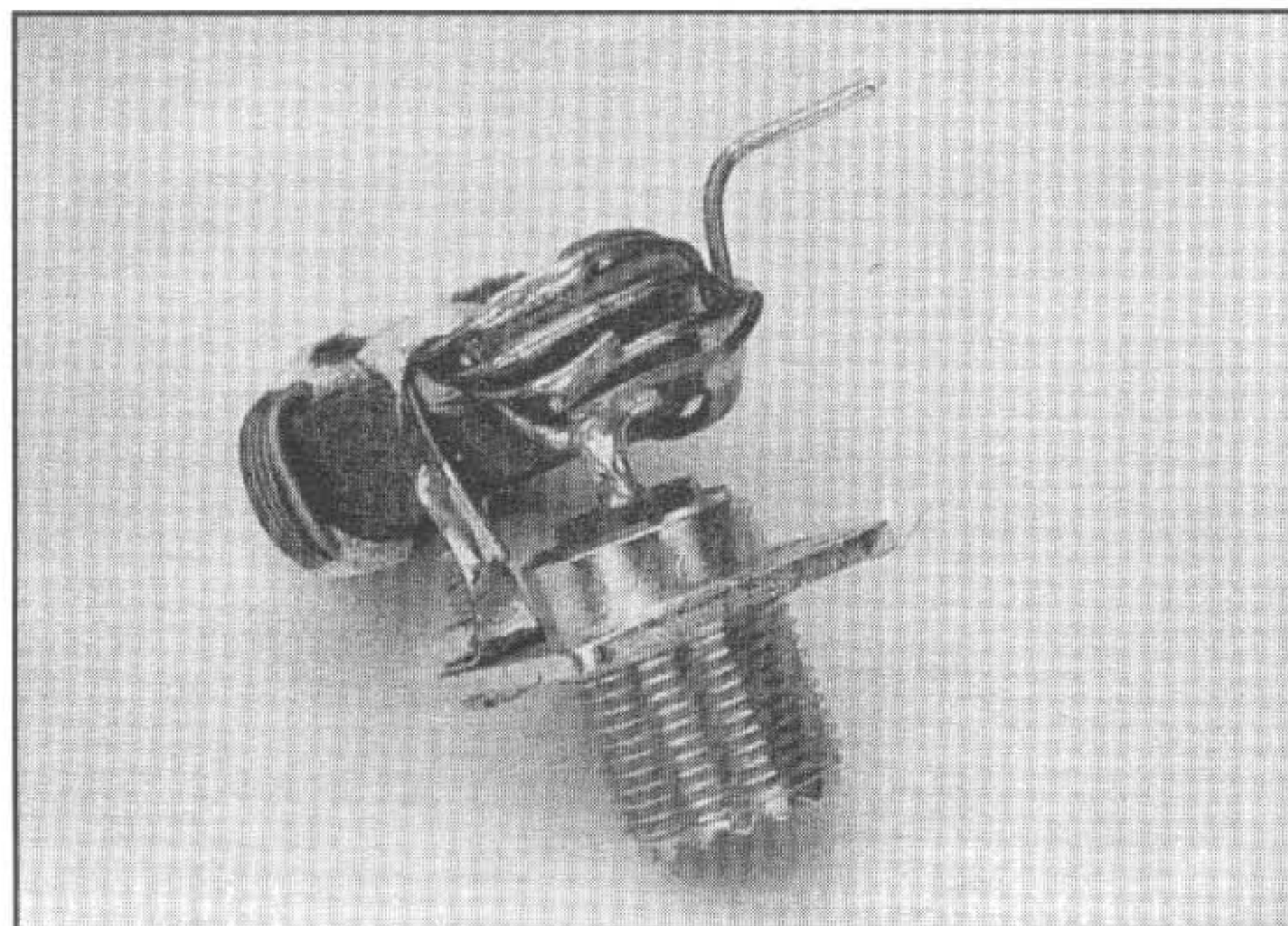


Figure 2 - Top-view of the highly efficient and broadband W2FMI-1.5:1-LU75 transformer.

### A) Description

The W2FMI-2.25:1-LU50 is a low-power unun (unbalanced-to-unbalanced) transmission line transformer designed to match 50 ohms to 22.22 ohms. It has a constant impedance transformation ratio of 2.25:1 from 1MHz to 50MHz. This ratio should satisfy many of the 2:1 requirements. Further, it is much easier to construct since it does not require a tap connection on one of its windings. A conservative power rating is 150 Watts of continuous power and 300 Watts of peak power. The efficiency is 99 percent.

### B) Schematic Diagram

Figure 1 shows the schematic diagram of this very broadband and efficient transformer. Eight trifilar turns of No. 16 Formvar SF wire are wound on an Amidon PN FT-125-K.

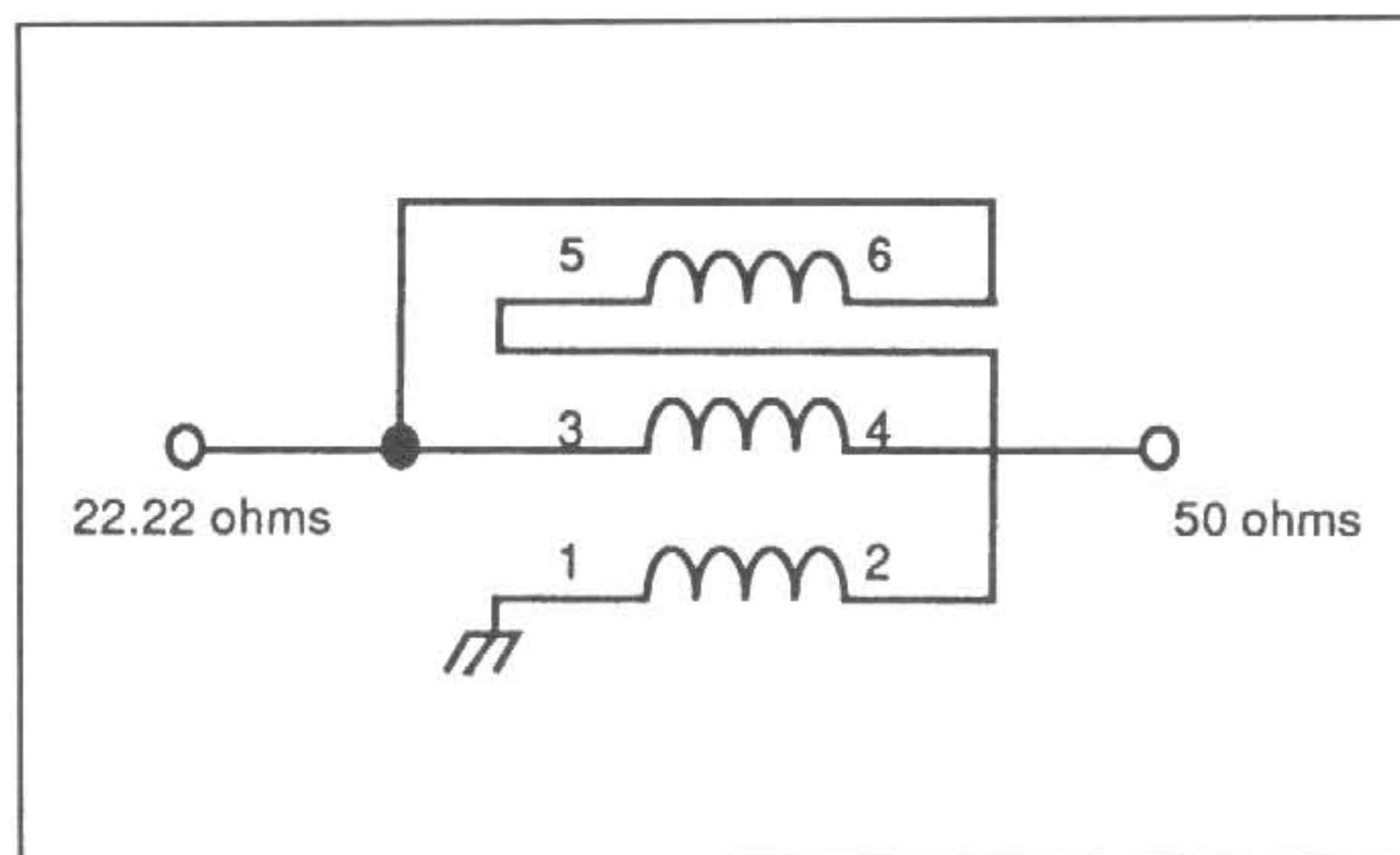


Figure 1. Schematic diagram of the trifilar UNUN transformer designed to match 50 ohms to 22.22 ohms

### C) Photograph

The bottom-view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections. The connector is on the low-impedance side.

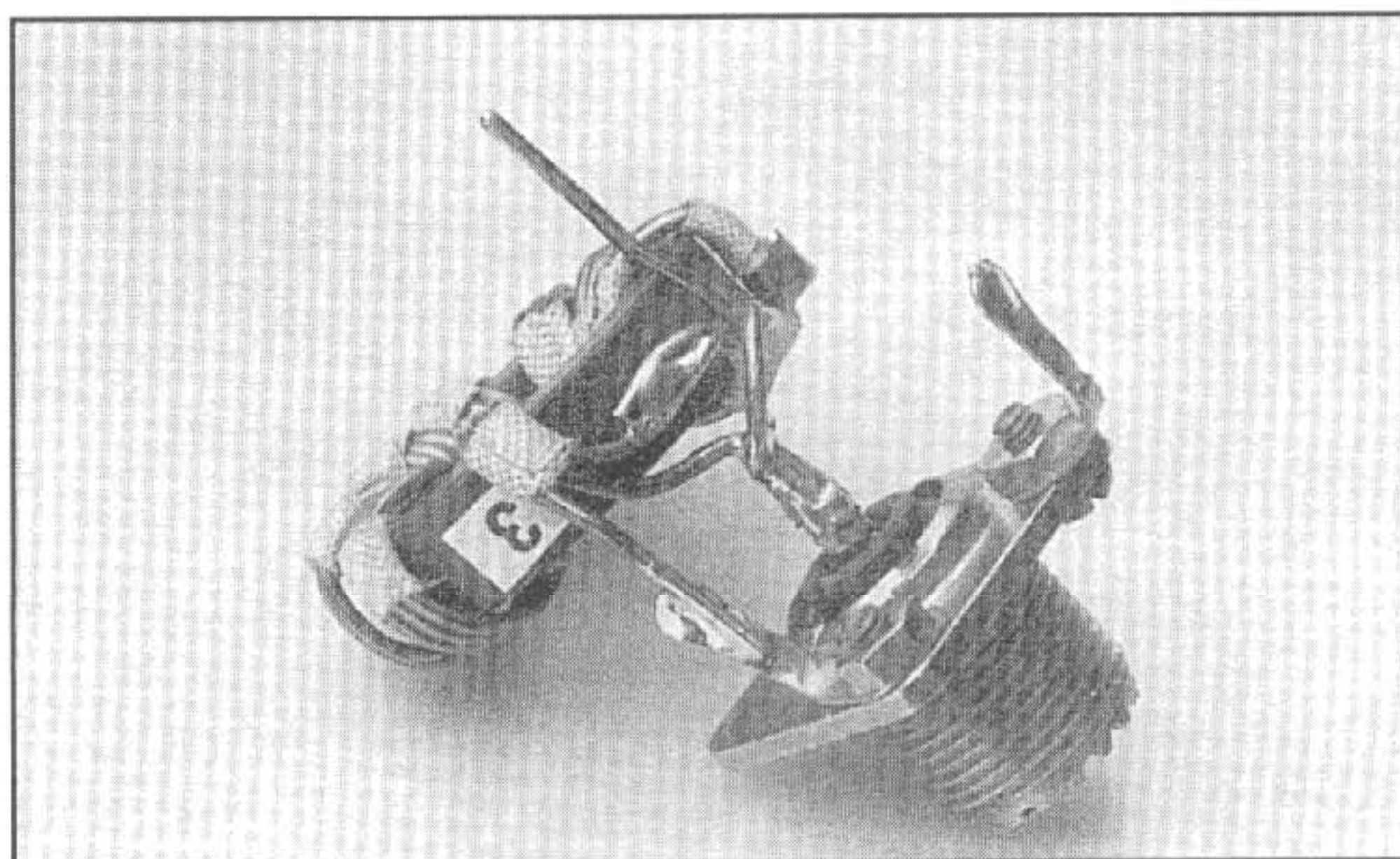


Figure 2 - Bottom-view of the highly efficient and broadband W2FMI-2.25:1-LU50 transformer.

### A) Description

The W2FMI-2:1-LU50 is a low-power unun (unbalanced-to-unbalanced) transmission line transformer designed to match 50 ohms to 25 ohms. It has a constant impedance transformation ratio of 2:1 from 1MHz to 40MHz. A conservative power rating is 150 Watts of continuous power and 300 Watts of peak power. The efficiency is 99 percent.

### B) Schematic Diagram

Figure 1 shows the schematic diagram of this highly efficient and broadband transformer. Eight trifilar turns of No. 16 H. Formvar SF wire are wound on an Amidon PN FT-125-K. The center winding in Figure 1 is tapped at seven turns from terminal 3.

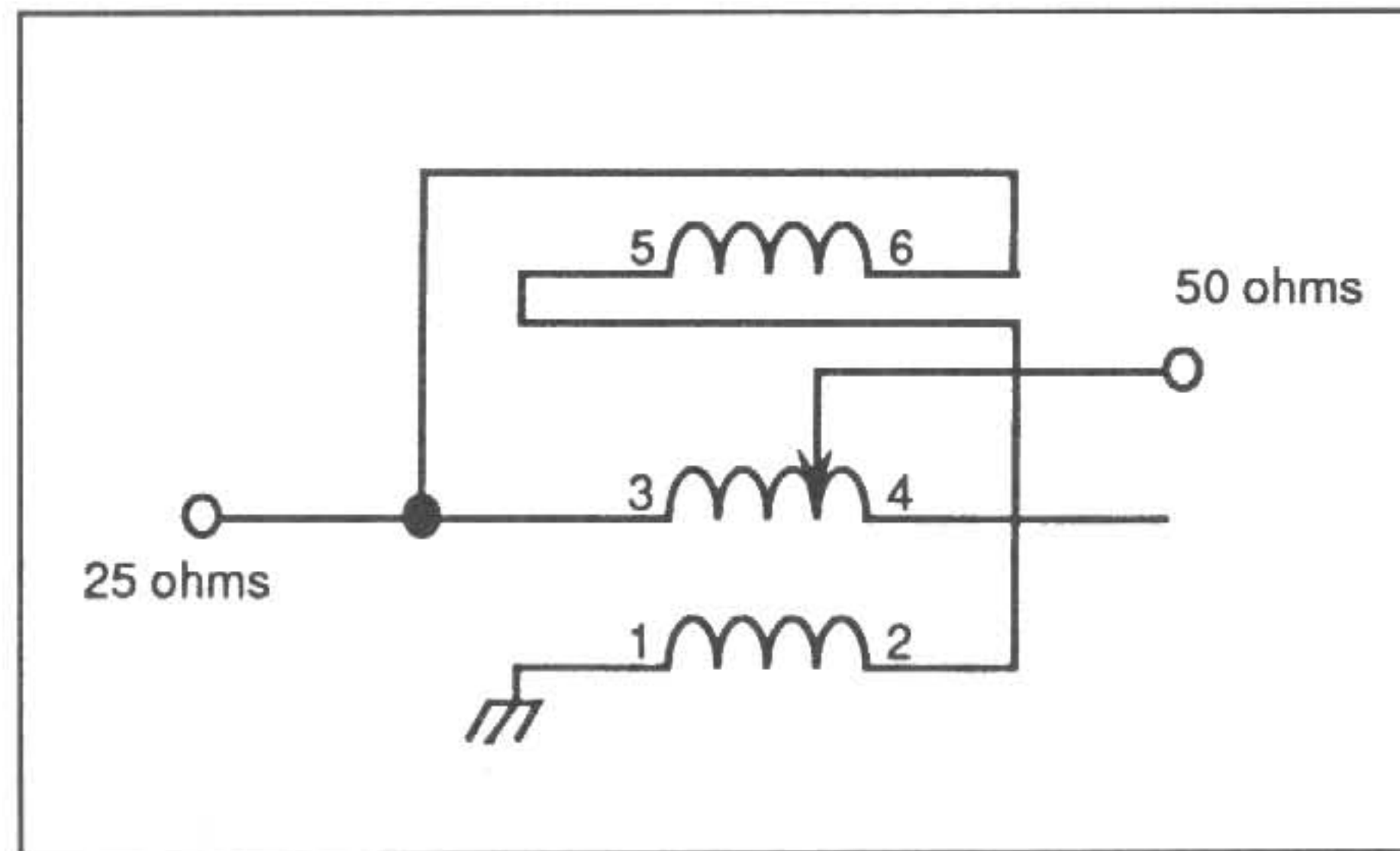


Figure 1. Schematic diagram of the trifilar UNUN transformer designed to match 50 ohms to 25 ohms

### C) Photograph

The bottom-view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections. The connector is on the low-impedance side.

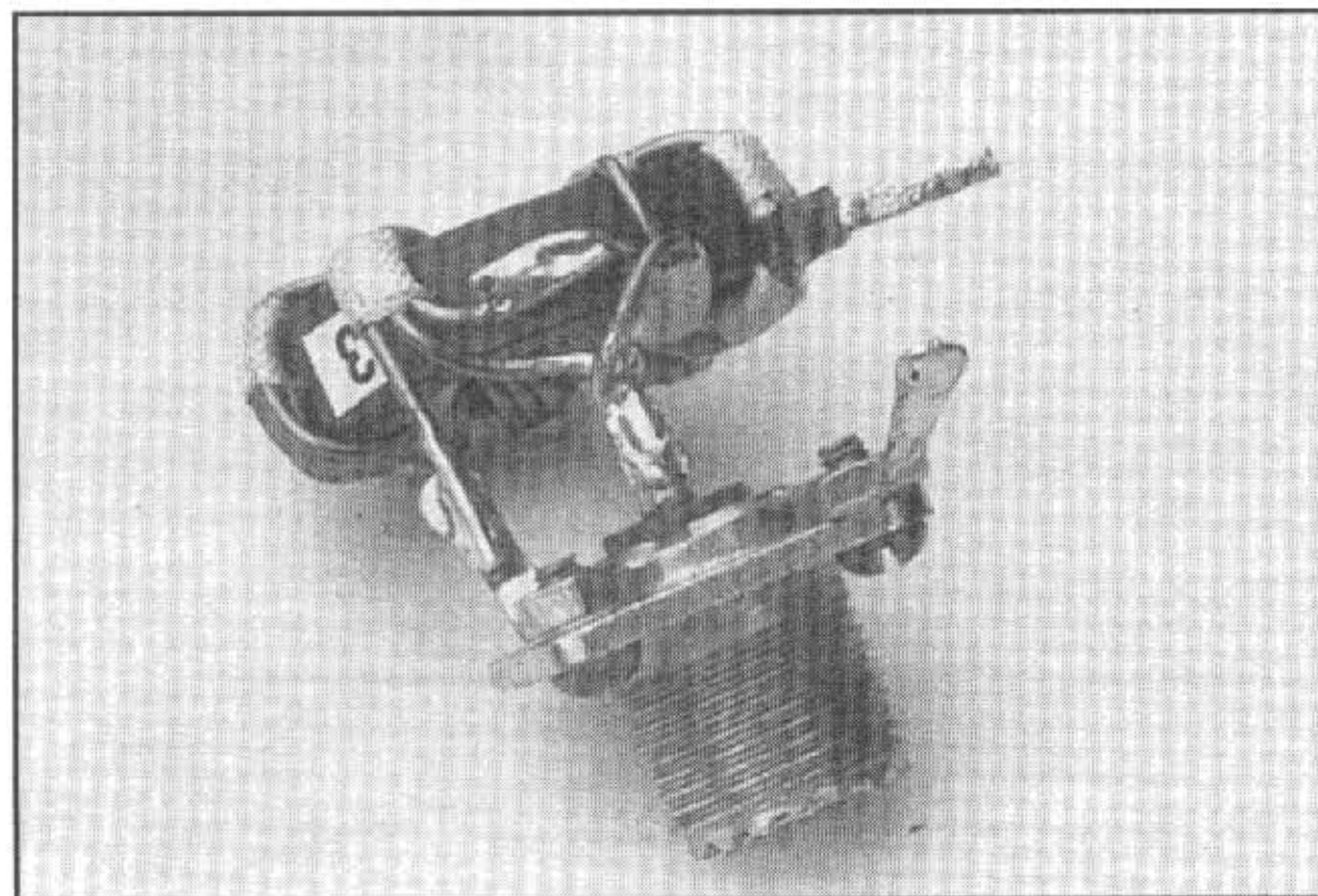


Figure 2-Bottom-view of the highly efficient and broadband dual-output W2FMI-2:1-LU50 transformer.

### A) Description

The W2FMI-2:1-LDU50 is a low-power dual-output unun (unbalanced-to-unbalanced) transmission line transformer designed to match 50 ohms to 22.22 ohms or 25 ohms. In matching 50 ohms to 22.22 ohms (2.25:1), the impedance transformation ratio is constant from 1MHz to 50 MHz. In matching 50 ohms to 25 ohms (2:1), it is constant from 1MHz to 40 MHz. A conservative power rating is 150 Watts of continuous power and 300 Watts of peak power. The efficiency is 99 percent.

### B) Schematic Diagram

Figure 1 shows the schematic diagram of this highly efficient and broadband transformer. Eight trifilar turns of No. 16 Formvar SF wire are wound on an Amidon PN FT-125-K. The center winding in Figure 1 is tapped at seven turns from terminal 3 yielding the 2:1 ratio (connection A). With connection B, the ratio is 2.25:1.

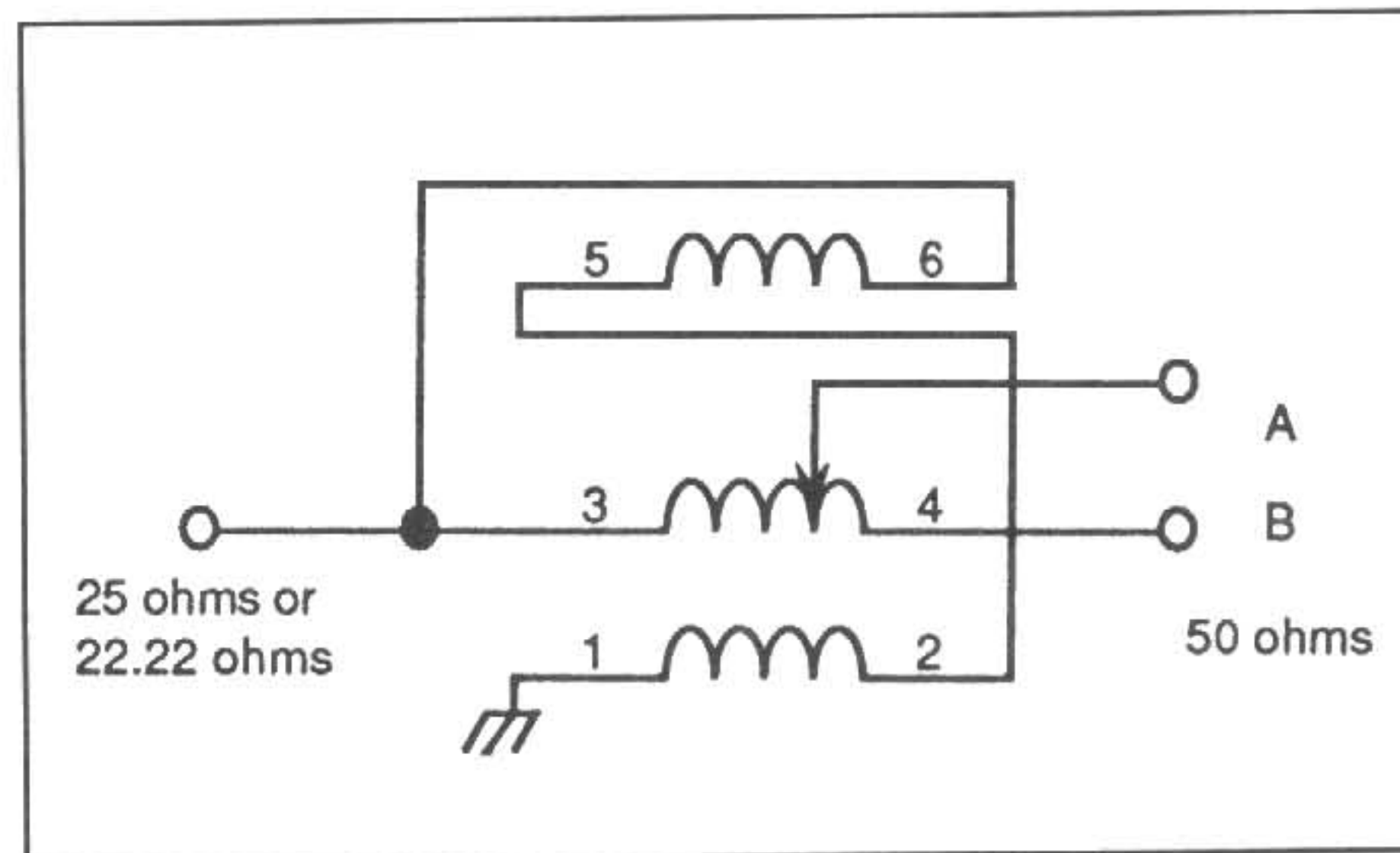


Figure 1. Schematic diagram of the trifilar dual-output UNUN transformer. A connection of 50 ohms to A yields a 2.25:1 ratio

### C) Photograph

The bottom-view of the transformer (before mounting) is shown in Figure 2. The photograph attempts to show the various connections. The connector is on the low-impedance side.

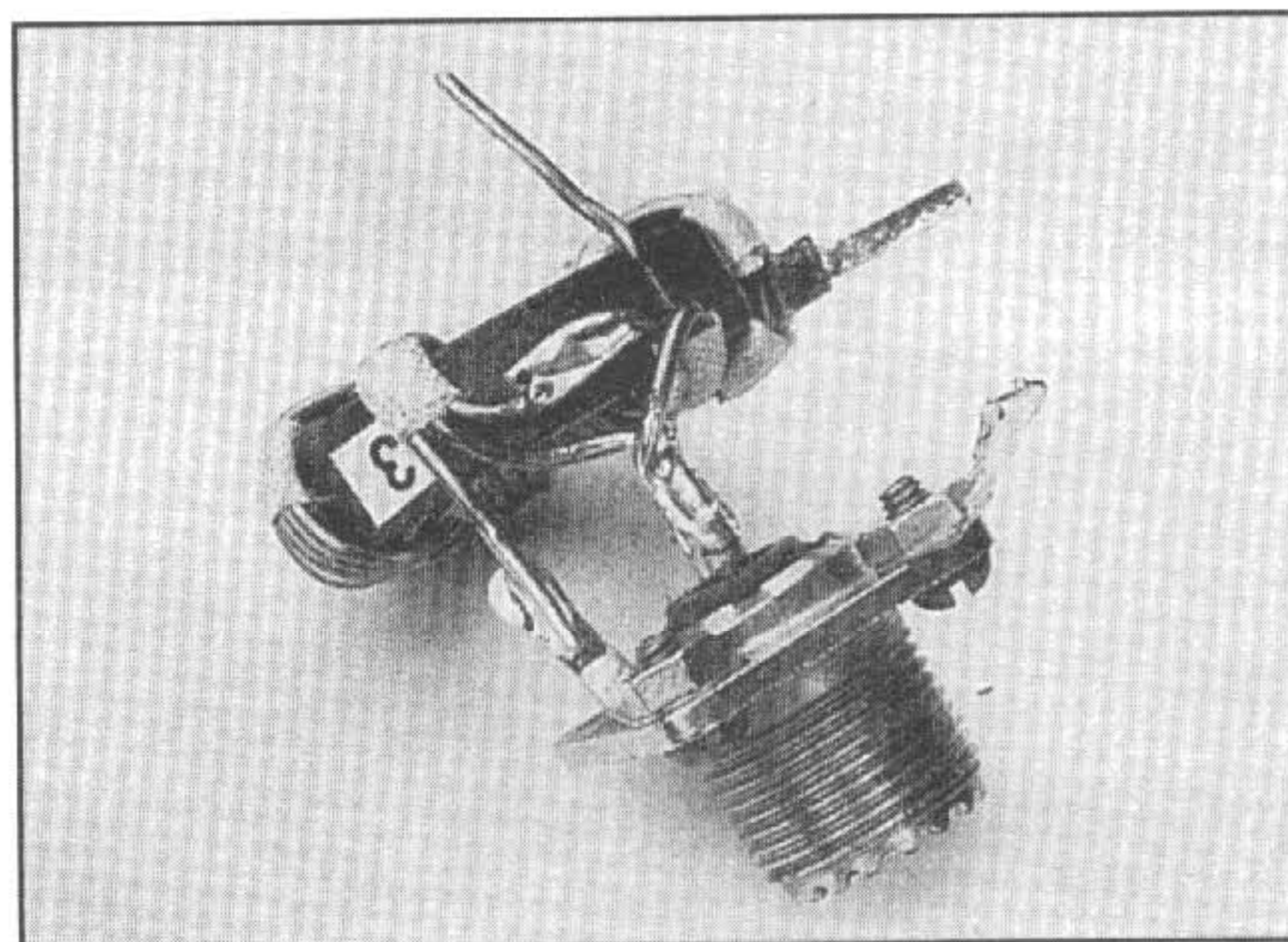


Figure 2 - Bottom-view of the highly efficient and broadband dual-output W2FMI-2:1-LDU50 transformer.