INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

HI-COUPLER

STYLE 148A432G04 – 40 to 300 kHz
(with 2-winding matching transformer)

SUPERSEDES I.L. 41-948.11C
*Denotes change from superseded issue.

EFFECTIVE FEBRUARY 1974

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APPLICATION

The Hi-Coupler is designed for use with a coupling capacitor to couple one or more carrier frequencies to a power line.

DESCRIPTION

Mechanical

The Hi-Coupler is contained in a small aluminum housing which mounts on the hinged panel in the base of the Westinghouse Type PC-5 or PCA-5 Coupling Capacitors. The transformer link, inductor link, the link connectors for the capacitors, the spark gap and the voltage jacks are mounted on the front panel of the Hi-Coupler. The connections for the coupling capacitor, coaxial cable and ground are on the rear of the unit. The outline of the Hi-Coupler is shown on Fig. 3.

Electrical

The electrical circuits of this unit are shown on Fig. 1., Internal Schematic. The coaxial cable from the power-line carrier equipment is connected to transformer T-1 primary. A link connector selects impedance ratios to match a 60-ohm coaxial cable to line impedances of 60 to 1500 ohms. The inductor L-1 with one or more of capacitors C-1, C-2 or C-3 and the coupling capacitor form a single-section high-pass filter of the constant-K type. The Hi-Coupler is designed to operate with coupling capacitors of .002 mfd. to .015 mfd. Combinations of capacitors C-1, C-2 and C-3 give a capacitance value close enough to the value of any of the coupling capacitors. The inductor is variable in 10 steps from 0.4 mh to 8.0 mh. This range provides the required adjustment for the coupling capacitor value, line impedance, and lowest operating frequency. The inductor consists of three sections.

Pin jacks are provided for measuring the voltage on the coaxial cable and the voltage across the inductor.

CHARACTERISTICS

Power Rating:	100 watts continuous.
Frequency Range:	40 to 300 kHz with coupling capacitors of .002 to .015 mfd.
Transmission Line: Impedance:	Matches a 50 to 70 ohm coaxial cable to line impedances of 50 to 1500 ohms.
Operating Temperature Range:	-40°C to +60°C.
Insertion Loss: (See Fig. 2)	Typical values, using 500-ohm non-inductive load.

Coupling C	Freq.	Coupling Loss
.003mfd.	40kHz	4.5db
.003mfd.	50-200 kHz	1.5db
.006mfd.	40-200 kHz	0.6db
.010mfd.	40-200 kHz	0.6db

INSTALLATION

General (When Supplied Unmounted)

When the Hi-Coupler is unpacked, it should be checked carefully for damage or shortage. Report any transportation damage to both the transportation company and to the nearest Westinghouse District Office.

Remove the screws from the bottom and left side of the unit and mount it with the same screws on the panel in the base of the coupling capacitor.

Connections for Phase-to-Ground Operation

Make the following connections to the terminals on the rear of the Hi-Coupler (When supplied unmounted):

Connect terminal 1 to a ground terminal on the panel.

Connect terminal 4 to the terminal on the top of the drain coil.

Cables for these connections are supplied with the Hi-Coupler.

The coaxial cable from the power-line carrier equipment is to be connected to Hi-Coupler terminals 3 (center conductor) and 5 (shield lead). NOTE: The primary winding of the T1 transformer is isolated from ground to eliminate the path for the flow of 60-Hz. current over the cable shield in the event of induction or difference of ground potential. However, if this is not a problem, the coaxial-cable shield may be grounded at the Hi-Coupler by making a connection between terminals 1 and 5.

Connections for Phase-to-Phase Operation

For phase-to-phase operation with the two Hi-Couplers operating with their outputs in phase (push-push), both units are connected as described for phase-to-ground operation.

However, if conventional phase-to-phase operation (push-pull) is desired, reverse the connections of the coaxial cable to terminals 3 and 5 of one of the Hi-Couplers by connecting the center conductor to terminal 5 and the shield lead to terminal 3. The coaxial cable to the other Hi-Coupler is connected as described for phase-to-ground operation.

It is not necessary to run a separate coaxial cable from the carrier equipment to each Hi-Coupler. A single coaxial cable is run to one Hi-Coupler, then continued to the second one where the coaxial cable connections may be reversed. For the unit with the reversed connections, note that this also reverses the "polarity" of pin jacks J-1 and J-2 on the front panel. Thus J-2 becomes "Ground" under this condition.

ADJUSTMENTS

Preliminary

CAUTION: Close the carrier grounding switch when changing the capacitor links or the inductor link. Do not depend on the drain coil for personal safety. Do not touch any terminal when a transmitter is on.

The links for the capacitors C-1, C-2 and C-3 can be placed in the correct position before the coupling capacitor is connected to the power line. The link marked SHORT is always open, except as noted in a later paragraph.

Close the capacitor links as shown in the following table.

System Voltage KV	Coupling Capacitor MFD.	Hi-Coupler Capacitance MFD.	Close Links
* 46	.015	.011	C-1,C-2,C-3
69	.010	.009	C-1,C-2
115	.006	.006	C-1
* 138	.005	.005	C-2,C-3
161	.0042	.003	C-2
230	.003	.003	C-2
* 287	.0025	.002	C-3
* 345	.002	.002	C-3

The impedance ratios of the matching transformer are as follows:

Coaxial cable terminal – 60 ohms (50 to 70 ohms).

Transformer Tap Position	Matching Impedance
1	60
2	85
3	120
4	175
5	245
6	350
7	500
8	750
9	1060
10	1500

The final adjustment of the ratio of the transformer must be made after the inductor is adjusted. However, if the impedance of the power line is known, set the transformer link to the position for the nearest value. If the impedance of the power line is not known, set the transformer link to tap number 8.

Adjustment for Phase-to-Ground Operation

Since the adjustment of the inductor will be affected by reactance of the power line it must be adjusted after installation of the equipment. A vacuum-tube voltmeter suitable for carrier frequencies is required for adjusting the inductor. Adjustment of the Hi-Coupler must be made at 50 kHz. for a pass band of 40 to 200 kHz. When the adjustment is made using the signal from a transmitter or using a signal generator, all other carrier-frequency signals must be temporarily removed from the channel.

Begin the adjustment with the inductor link on position 11.

CAUTION: Always close the carrier grounding switch in the base of the coupling capacitor before changing the inductor link.

Adjustment With A Local Transmitter

Connect the vacuum-tube voltmeter from the l.h. spark-gap electrode (ground) to jack J-3. Turn on the transmitter and adjust the inductance link for maximum voltage reading. If several transmitters are connected to the Hi-Coupler, use the lowest frequency transmitter for this adjustment.

Change the voltmeter connection from jack J-3 to jacks J-1 (coaxial shield) and J-2. Adjust the transformer link to a position which gives a voltage reading approximately equivalent to the nominal power of the transmitter into a resistance of 60 ohms.

$E = \sqrt{WR}$, where W= watts output, and R = load resistance.

For a 10-watt transmitter:

$E = \sqrt{(10)\ (60)} = 24.5$ volts

This completes the adjustment of the Hi-Coupler except for checking the voltage at jack J-2 with full power being transmitted.

The Hi-Coupler power rating of 100 watts continuous, is based on an impedance of 60 ohms at the coaxial-cable terminal.

Adjustment With A Signal Generator

The Hi-Coupler can be adjusted by means of a signal generator in the absence of other signals.

Terminate the output of a 60-ohm signal generator in a pad consisting of a 50-ohm series resistor and a 10-ohm shunt resistor. It is preferable to connect the signal generator to the remote end of the coaxial cable; however, if this is not feasible, connect the generator to jacks J-2 and J-1. Adjust the signal generator to 50 kHz. Connect the vacuum-tube voltmeter to jack J-3 and ground and adjust the inductor link for the maximum voltage reading. Then adjust the transformer link for maximum voltage reading.

Adjustment For Phase-to-Phase Operation

When adjusting the two Hi-Couplers used for phase-to-phase operation, it is necessary to open-circuit one unit while the other is being adjusted. This is done by opening all the capacitor links. (Be sure to close the grounding switch first.) Adjust one unit by the same procedure used for phase-to-ground operation, then open circuit the first unit, replace the links in the second unit and repeat the adjustment. The voltage readings for the two units should be approximately the same and the transformer and inductance links should be at the same position on both units. With both units connected recheck the transformer taps as described under Adjustment With a Local Transmitter.

Operation as Impedance Matching Transformer

In some installations where only the higher carrier frequencies are used with the higher value coupling capacitors, better coupling may be obtained by using only an impedance-matching transformer rather than the high-pass filter circuit of the Hi-Coupler. The conditions controlling this choice of coupling are so variable that no specific recommendation can be given. Only an operational test of the installation will determine which gives the best results.

To operate the Hi-Coupler as an impedance-matching transformer, close the link marked SHORT, open the inductor link. The transformer ratio is then adjusted in accordance with the instructions given for phase-to-ground operation with a local transmitter.

Spark Gap Adjustment

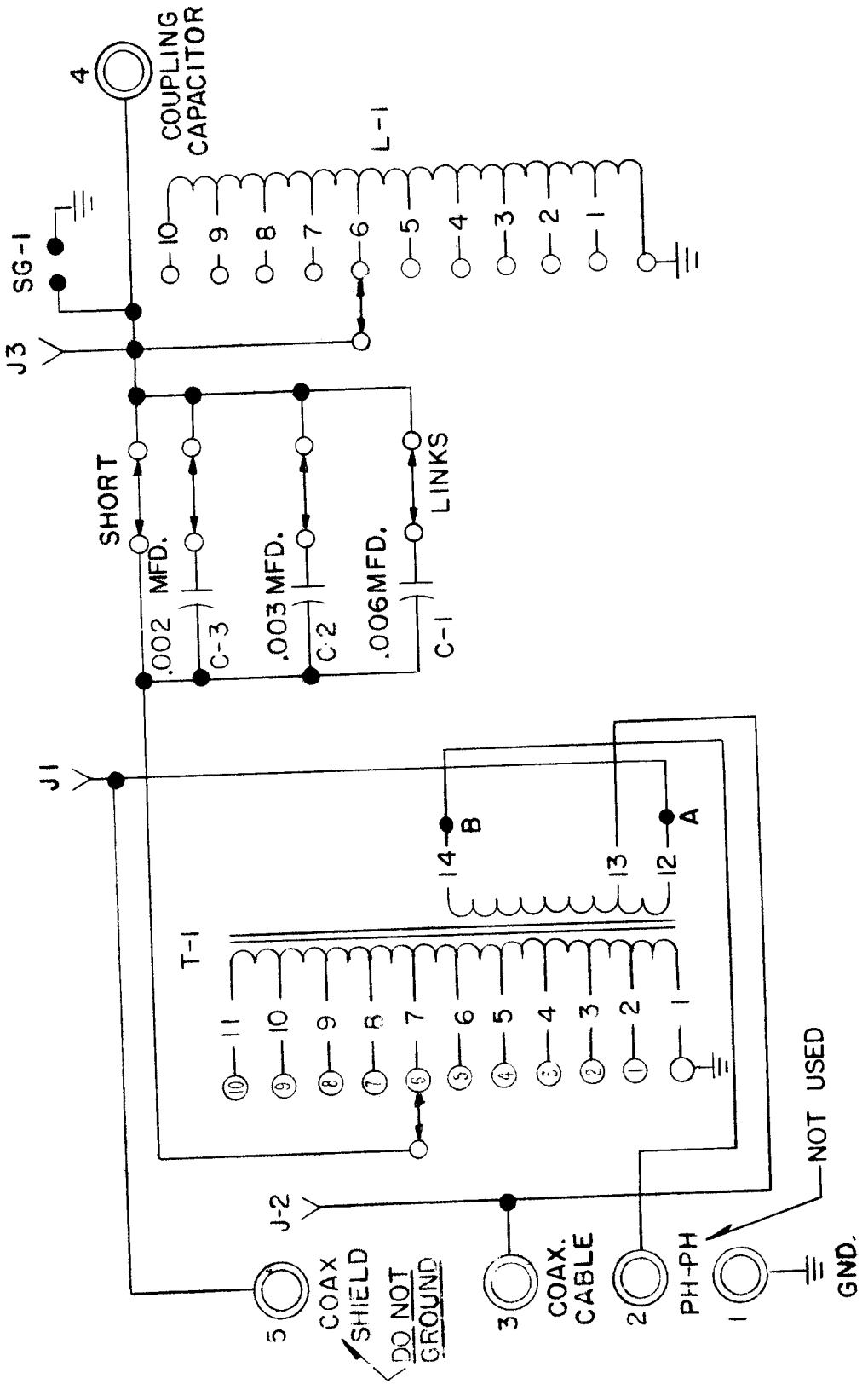
The spark gap is adjusted to .015 inch when the unit is shipped. This spacing should be checked to see that is has not been changed.

MAINTENANCE

The Hi-Coupler will require very little maintenance. It should be checked occasionally to see if there has been excessive burning of the spark gap. If the electrodes show signs of burning, clean the points and adjust the gap to .015 inch.

ELECTRICAL PARTS LIST

CIRCUIT SYMBOL	FUNCTION	DESCRIPTION	STYLE NUMBER
C-1	Capacitor-Series	Mica, .006 mfd. ± 5% 3000V PACW	584C256H03
C-2	Capacitor-Series	Mica, .003 mfd. ± 5% 3000V PACW	584C256H02
* C-3	Capacitor-Series	Mica. .002 mfd. ± 5% 3000V PACW	584C256H04
J-1	Jack-Coaxial Cable Shield	Pin Jack (black)	330C686H03
J-2	Jack-Coaxial Cable Voltage	Pin Jack (red)	330C686H02
J-3	Jack-Inductor Voltage	Same as J-2	
L-1	Inductor-Shunt	0.4 to 8.0 MH	584C242G01
SG-1	Spark Gap	Point Type	2 of 219B550H01
T-1	Transformer-Impedance-Matching	60 ohms/85, 120, 175, 245, 350, 500, 1060, 1500 ohms	584C259H01



* *Fig. 1. Hi-Coupler – Internal Schematic (Dwg. 629A850)*

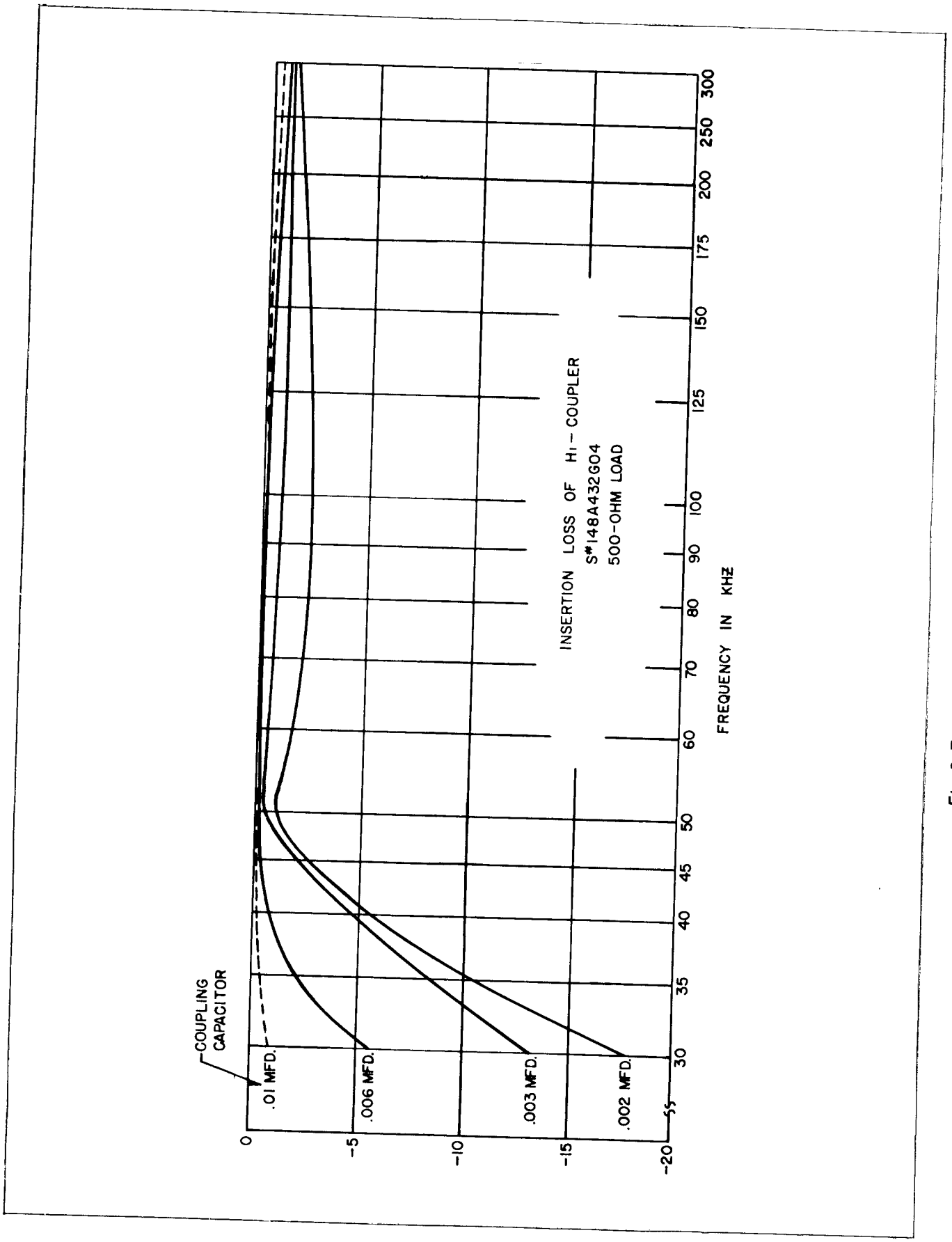
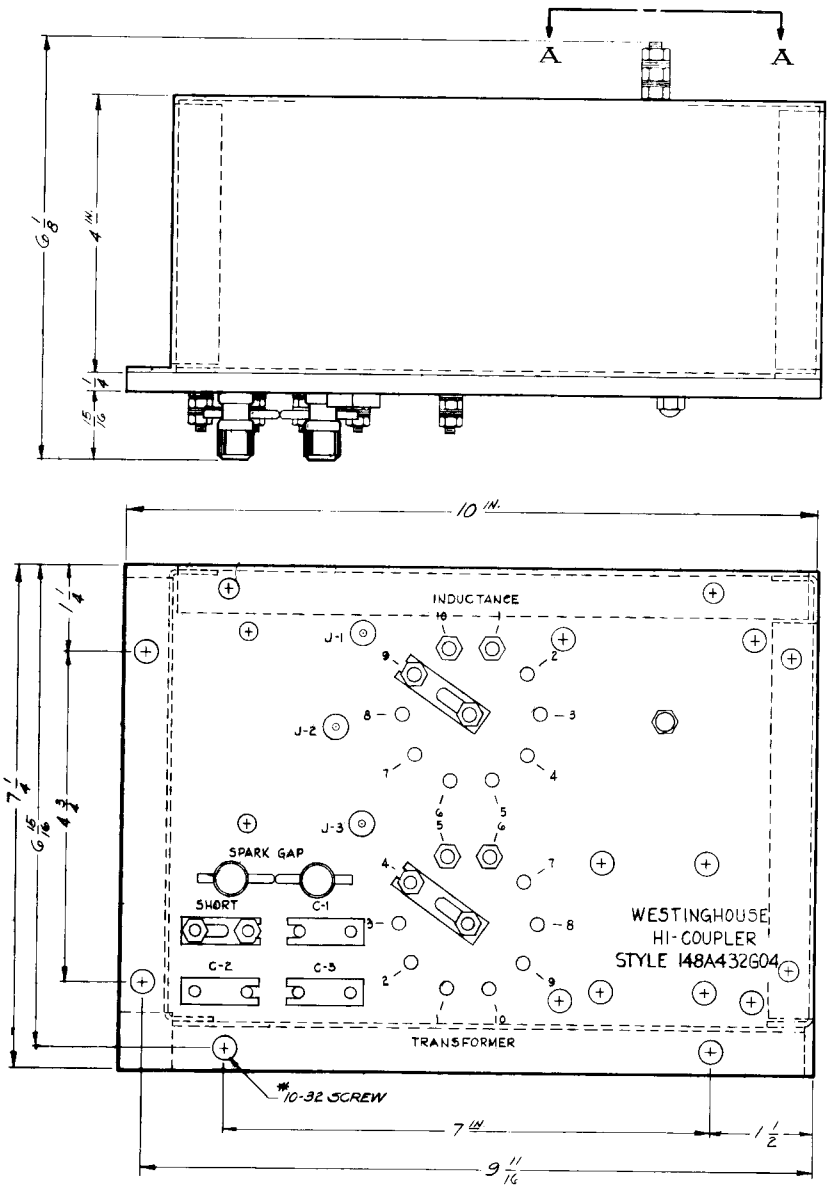


Fig. 2. Typical Insertion Loss of Hi-Coupler (862A347)



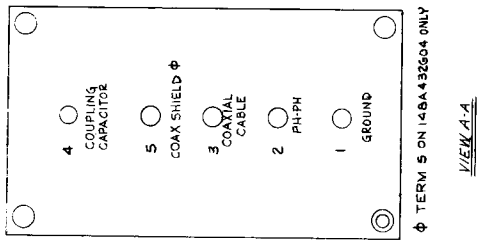
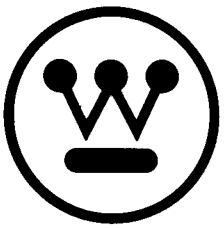


Fig. 3. Hi-Coupler Outline (Dwg. 756D063)



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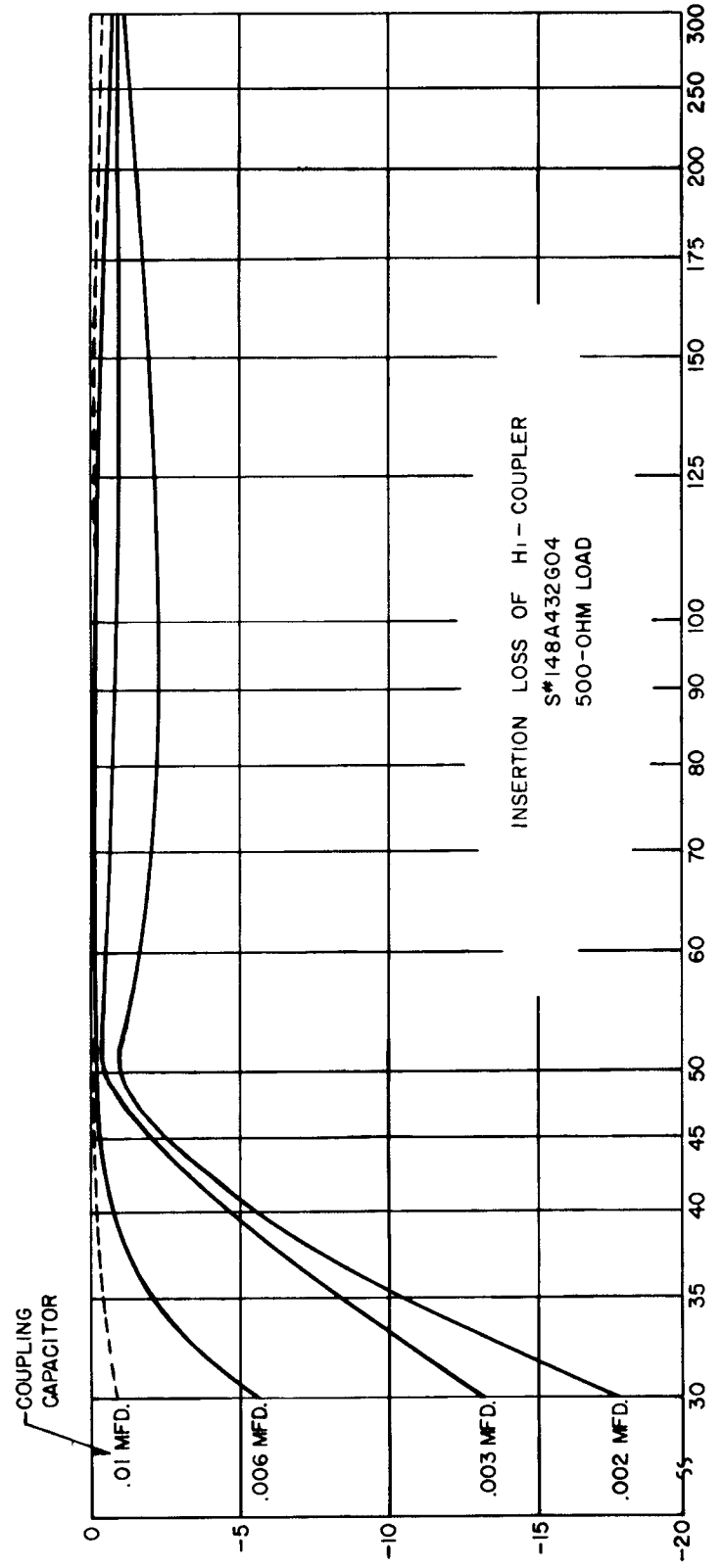

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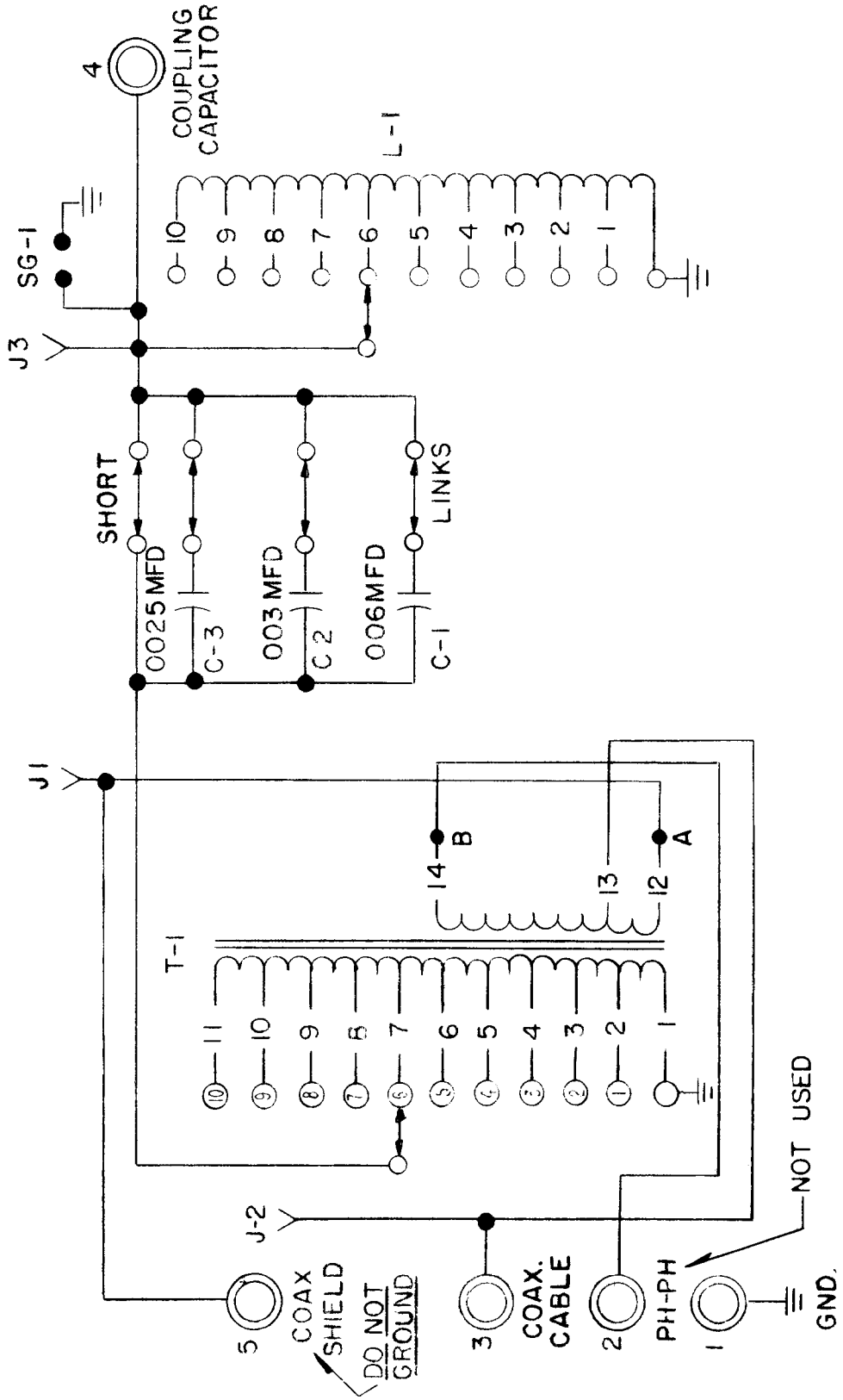

Fig. 1. Hi-Coupler – Internal Schematic (Dwg. 629A850)

ELECTRICAL PARTS LIST

CIRCUIT SYMBOL	FUNCTION	DESCRIPTION	STYLE NUMBER
C-1	Capacitor-Series	Mica, .006 mfd. ± 5% 3000V PACW	584C256H03
C-2	Capacitor-Series	Mica, .003 mfd. ± 5% 3000V PACW	584C256H02
C-3	Capacitor-Series	Mica, .0025 mfd. ± 5% 3000V PACW	584C256H01
J-1	Jack-Coaxial Cable Shield	Pin Jack (black)	330C686H03
J-2	Jack-Coaxial Cable Voltage	Pin Jack (red)	330C686H02
J-3	Jack-Inductor Voltage	Same as J-2	
L-1	Inductor-Shunt	0.4 to 8.0 MH	584C242G01
SG-1	Spark Gap	Point Type	2 of 219B550H01
T-1	Transformer-Impedance-Matching	60 ohms/85, 120, 175, 245, 350, 500, 1060, 1500 Ohms	584C259H01

Change the voltmeter connection from jack J-3 to jacks J-1 (coaxial shield) and J-2. Adjust the transformer link to a position which gives a voltage reading approximately equivalent to the nominal power of the transmitter into a resistance of 60 ohms.

$E = \sqrt{WR}$, where W= watts output, and R = load resistance.

For a 10-watt transmitter:

$E = \sqrt{(10)\ (60)} = 24.5$ volts

This completes the adjustment of the Hi-Coupler except for checking the voltage at jack J-2 with full power being transmitted.

The Hi-Coupler power rating of 100 watts continuous, is based on an impedance of 60 ohms at the coaxial-cable terminal.

Adjustment With A Signal Generator

The Hi-Coupler can be adjusted by means of a signal generator in the absence of other signals.

Terminate the output of a 60-ohm signal generator in a pad consisting of a 50-ohm series resistor and a 10-ohm shunt resistor. It is preferable to connect the signal generator to the remote end of the coaxial cable; however, if this is not feasible, connect the generator to jacks J-2 and J-1. Adjust the signal generator to 50 kHz. Connect the vacuum-tube voltmeter to jack J-3 and ground and adjust the inductor link for the maximum voltage reading. Then adjust the transformer link for maximum voltage reading.

Adjustment For Phase-to-Phase Operation

When adjusting the two Hi-Couplers used for phase-to-phase operation, it is necessary to open-circuit one unit while the other is being adjusted. This is done by opening all the capacitor links. (Be sure to close the grounding switch first.) Adjust one unit by the same procedure used for phase-to-ground operation, then open circuit the first unit, replace the links in the second unit and repeat the adjustment. The voltage readings for the two units should be approximately the same and the transformer and inductance links should be at the same position on both units. With both units connected recheck the transformer taps as described under Adjustment With a Local Transmitter.

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To operate the Hi-Coupler as an impedance-matching transformer, close the link marked SHORT, open the inductor link. The transformer ratio is then adjusted in accordance with the instructions given for phase-to-ground operation with a local transmitter.

Spark Gap Adjustment

The spark gap is adjusted to .015 inch when the unit is shipped. This spacing should be checked to see that is has not been changed.

MAINTENANCE

The Hi-Coupler will require very little maintenance. It should be checked occasionally to see if there has been excessive burning of the spark gap. If the electrodes show signs of burning, clean the * points and adjust the gap to .015 inch.

Connections for Phase-to-Phase Operation

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It is not necessary to run a separate coaxial cable from the carrier equipment to each Hi-Coupler. A single coaxial cable is run to one Hi-Coupler, then continued to the second one where the coaxial cable connections may be reversed. For the unit with the reversed connections, note that this also reverses the "polarity" of pin jacks J-1 and J-2 on the front panel. Thus J-2 becomes "Ground" under this condition.

ADJUSTMENTS

Preliminary

CAUTION: Close the carrier grounding switch when changing the capacitor links or the inductor link. Do not depend on the drain coil for personal safety. Do not touch any terminal when a transmitter is on.

The links for the capacitors C-1, C-2 and C-3 can be placed in the correct position before the coupling capacitor is connected to the power line. The link marked SHORT is always open, except as noted in a later paragraph.

Close the capacitor links as shown in the following table.

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161	.0042	.003	C-2
230	.003	.003	C-2
287	.0025	.0025	C-3
345	.002	.0025	C-3

The impedance ratios of the matching transformer are as follows:

Coaxial cable terminal – 60 ohms (50 to 70 ohms).

Transformer Tap Position	Matching Impedance
1	60
2	85
3	120
4	175
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6	350
7	500
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Begin the adjustment with the inductor link on position 11.

CAUTION: Always close the carrier grounding switch in the base of the coupling capacitor before changing the inductor link.

Adjustment With A Local Transmitter

Connect the vacuum-tube voltmeter from the l.h. spark-gap electrode (ground) to jack J-3. Turn on the transmitter and adjust the inductance link for maximum voltage reading. If several transmitters are connected to the Hi-Coupler, use the lowest frequency transmitter for this adjustment.

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Pin jacks are provided for measuring the voltage on the coaxial cable and the voltage across the inductor.

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Transmission Line: Impedance:	Matches a 50 to 70 ohm coaxial cable to line impedances of 50 to 1500 ohms.
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Insertion Loss: (See Fig. 2)	Typical values, using 500-ohm non-inductive load.

Coupling C	Freq.	Coupling Loss
.003mfd.	40kHz	4.5db
.003mfd.	50-200 kHz	1.5db
.006mfd.	40-200 kHz	0.6db
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General (When Supplied Unmounted)

When the Hi-Coupler is unpacked, it should be checked carefully for damage or shortage. Report any transportation damage to both the transportation company and to the nearest Westinghouse District Office.

Remove the screws from the bottom and left side of the unit and mount it with the same screws on the panel in the base of the coupling capacitor.

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Make the following connections to the terminals on the rear of the Hi-Coupler (When supplied unmounted):

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Cables for these connections are supplied with the Hi-Coupler.

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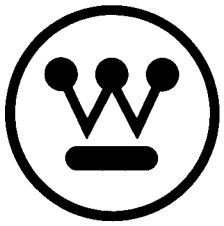
EFFECTIVE FEBRUARY 1973



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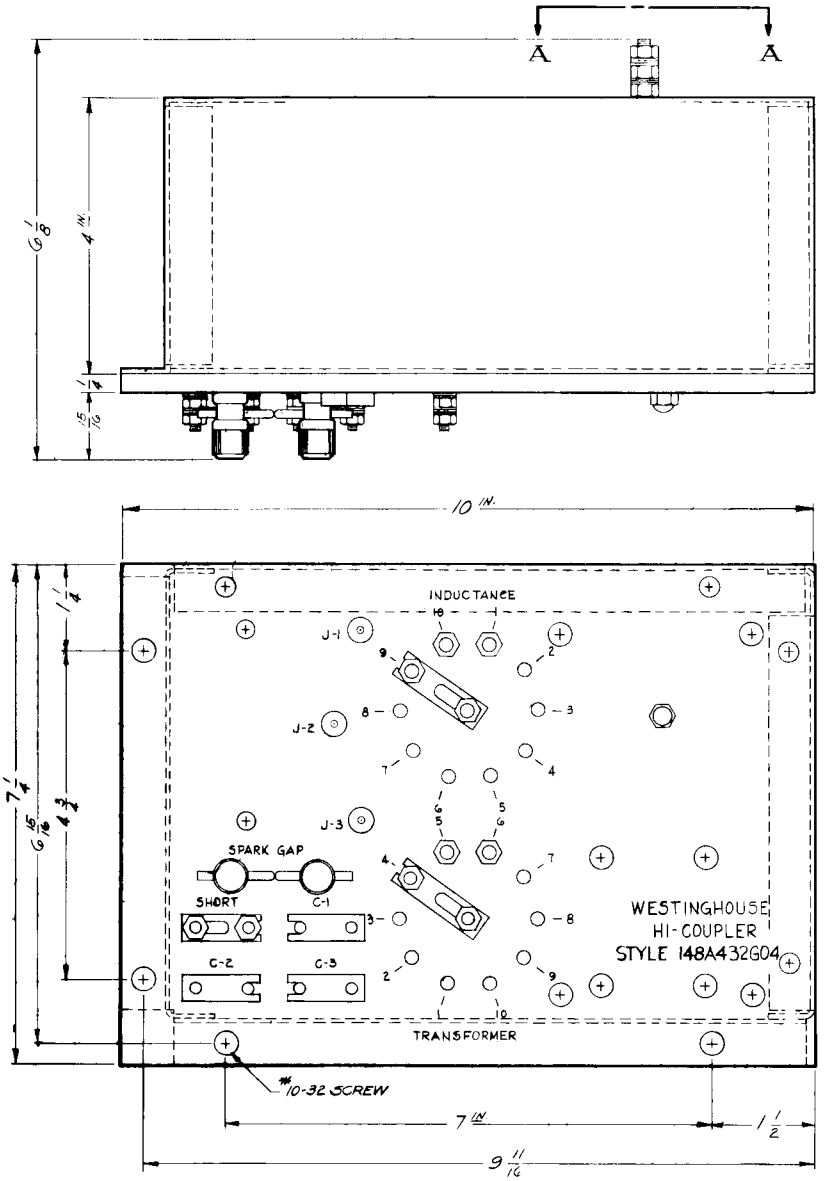


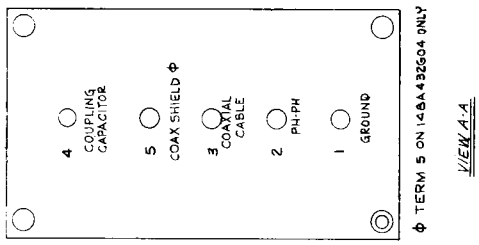


Fig. 3. Hi-Coupler Outline (Dwg. 756D063)

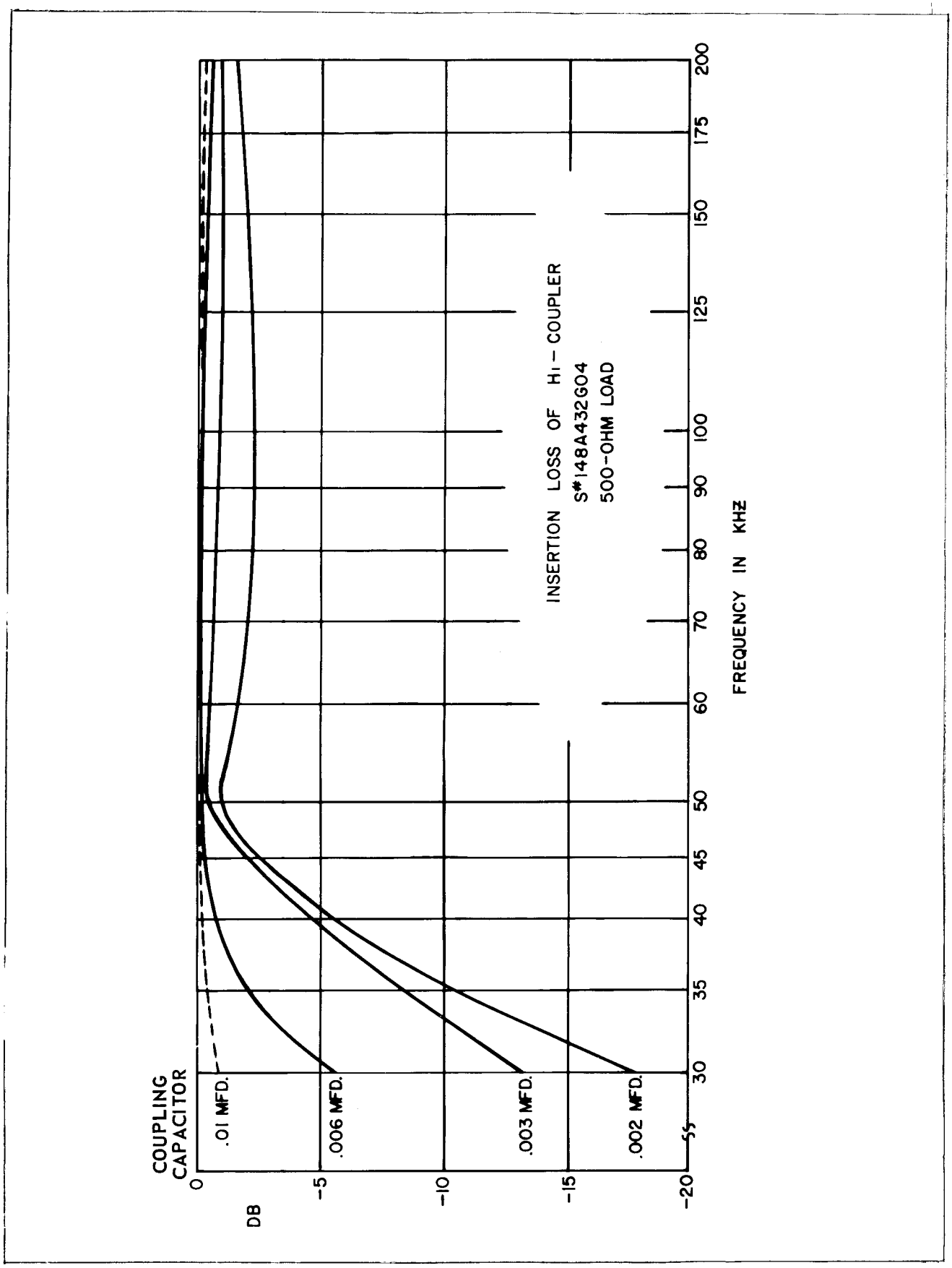
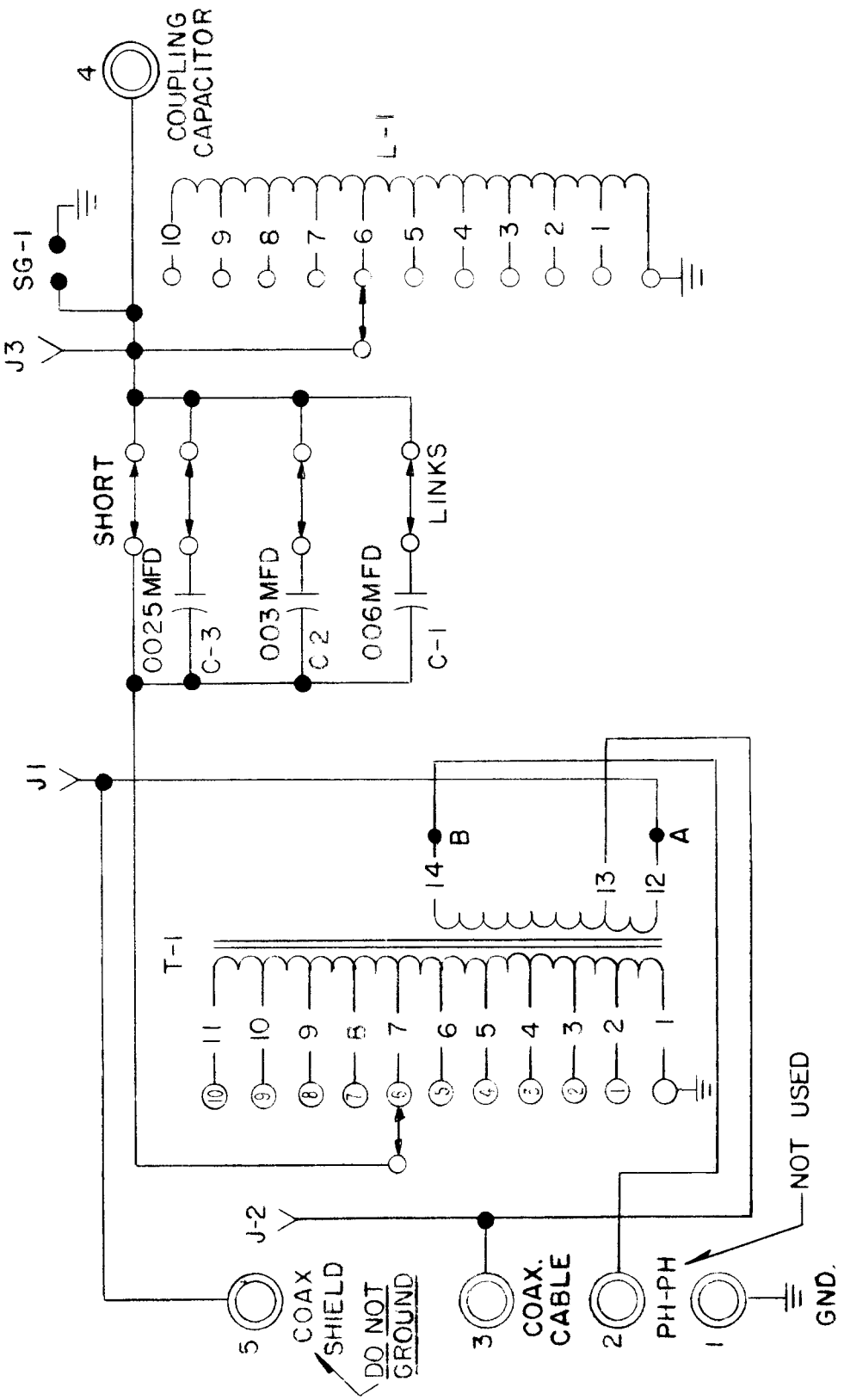


Fig. 2. Insertion Loss of Hi-Coupler (862A347)



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Adjustment With A Signal Generator

The Hi-Coupler can be adjusted by means of a signal generator in the absence of other signals.

Terminate the output of a 60-ohm signal generator in a pad consisting of a 50-ohm series resistor and a 10-ohm shunt resistor. It is preferable to connect the signal generator to the remote end of the coaxial cable; however, if this is not feasible, connect the generator to jacks J-2 and J-1. Adjust the signal generator to 50 kHz. Connect the vacuum-tube voltmeter to jack J-3 and ground and adjust the inductor link for the maximum voltage reading. Then adjust the transformer link for maximum voltage reading.

Adjustment For Phase-to-Phase Operation

When adjusting the two Hi-Couplers used for phase-to-phase operation, it is necessary to open-circuit one unit while the other is being adjusted. This is done by opening all the capacitor links. (Be sure to close the grounding switch first.) Adjust one unit by the same procedure used for phase-to-ground operation, then open circuit the first unit, replace the links in the second unit and repeat the adjustment. The voltage readings for the two units should be approximately the same and the transformer and inductance links should be at the same position on both units. With both units connected recheck the transformer taps as described under Adjustment With a Local Transmitter.

Operation as Impedance Matching Transformer

In some installations where only the higher carrier frequencies are used with the higher value coupling capacitors, better coupling may be obtained by using only an impedance-matching transformer rather than the high-pass filter circuit of the Hi-Coupler. The conditions controlling this choice of coupling are so variable that no specific recommendation can be given. Only an operational test of the installation will determine which gives the best results.

To operate the Hi-Coupler as an impedance-matching transformer, close the link marked SHORT, open the inductor link. The transformer ratio is then adjusted in accordance with the instructions given for phase-to-ground operation with a local transmitter.

Spark Gap Adjustment

The spark gap is adjusted to .015 inch when the unit is shipped. This spacing should be checked to see that is has not been changed.

MAINTENANCE

The Hi-Coupler will require very little maintenance. It should be checked occasionally to see if there has been excessive burning of the spark gap. If the electrodes show signs of burning, clean the * points and adjust the gap to .015 inch.

Connections for Phase-to-Phase Operation

For phase-to-phase operation with the two Hi-Couplers operating with their outputs in phase (push-push), both units are connected as described for phase-to-ground operation.

However, if conventional phase-to-phase operation (push-pull) is desired, reverse the connections of the coaxial cable to terminals 3 and 5 of one of the Hi-Couplers by connecting the center conductor to terminal 5 and the shield lead to terminal 3. The coaxial cable to the other Hi-Coupler is connected as described for phase-to-ground operation.

It is not necessary to run a separate coaxial cable from the carrier equipment to each Hi-Coupler. A single coaxial cable is run to one Hi-Coupler, then continued to the second one where the coaxial cable connections may be reversed. For the unit with the reversed connections, note that this also reverses the "polarity" of pin jacks J-1 and J-2 on the front panel. Thus J-2 becomes "Ground" under this condition.

ADJUSTMENTS

Preliminary

CAUTION: Close the carrier grounding switch when changing the capacitor links or the inductor link. Do not depend on the drain coil for personal safety. Do not touch any terminal when a transmitter is on.

The links for the capacitors C-1, C-2 and C-3 can be placed in the correct position before the coupling capacitor is connected to the power line. The link marked SHORT is always open, except as noted in a later paragraph.

Close the capacitor links as shown in the following table.

System Voltage KV	Coupling Capacitor MFD.	Hi-Coupler Capacitance MFD.	Close Links
46	.015	.0115	C-1,C-2,C-3
69	.010	.009	C-1,C-2
115	.006	.006	C-1
138	.005	.0055	C-2,C-3
161	.0042	.003	C-2
230	.003	.003	C-2
287	.0025	.0025	C-3
345	.002	.0025	C-3

The impedance ratios of the matching transformer are as follows:

Coaxial cable terminal – 60 ohms (50 to 70 ohms).

Transformer Tap Position	Matching Impedance
1	60
2	85
3	120
4	175
5	245
6	350
7	500
8	750
9	1060
10	1500

The final adjustment of the ratio of the transformer must be made after the inductor is adjusted. However, if the impedance of the power line is known, set the transformer link to the position for the nearest value. If the impedance of the power line is not known, set the transformer link to tap number 8.

Adjustment for Phase-to-Ground Operation

Since the adjustment of the inductor will be affected by reactance of the power line it must be adjusted after installation of the equipment. A vacuum-tube voltmeter suitable for carrier frequencies is required for adjusting the inductor. Adjustment of the Hi-Coupler must be made at 50 kHz. for a pass band of 40 to 200 kHz. When the adjustment is made using the signal from a transmitter or using a signal generator, all other carrier-frequency signals must be temporarily removed from the channel.

Begin the adjustment with the inductor link on position 11.

CAUTION: Always close the carrier grounding switch in the base of the coupling capacitor before changing the inductor link.

Adjustment With A Local Transmitter

Connect the vacuum-tube voltmeter from the l.h. spark-gap electrode (ground) to jack J-3. Turn on the transmitter and adjust the inductance link for maximum voltage reading. If several transmitters are connected to the Hi-Coupler, use the lowest frequency transmitter for this adjustment.

APPLICATION

The Hi-Coupler is designed for use with a coupling capacitor to couple one or more carrier frequencies to a power line.

DESCRIPTION

Mechanical

The Hi-Coupler is contained in a small aluminum housing which mounts on the hinged panel in the base of the Westinghouse Type PC-5 or PCA-5 Coupling Capacitors. The transformer link, inductor link, the link connectors for the capacitors, the spark gap and the voltage jacks are mounted on the front panel of the Hi-Coupler. The connections for the coupling capacitor, coaxial cable and ground are on the rear of the unit. The outline of the Hi-Coupler is shown on Fig. 3.

Electrical

The electrical circuits of this unit are shown on Fig. 1., Internal Schematic. The coaxial cable from the power-line carrier equipment is connected to transformer T-1 primary. A link connector selects impedance ratios to match a 60-ohm coaxial cable to line impedances of 60 to 1500 ohms. The inductor L-1 with one or more of capacitors C-1, C-2 or C-3 and the coupling capacitor form a single-section high-pass filter of the constant-K type. The Hi-Coupler is designed to operate with coupling capacitors of .002 mfd. to .015 mfd. Combinations of capacitors C-1, C-2 and C-3 give a capacitance value close enough to the value of any of the coupling capacitors. The inductor is variable in 10 steps from 0.4 mh to 8.0 mh. This range provides the required adjustment for the coupling capacitor value, line impedance, and lowest operating frequency. The inductor consists of three sections.

Pin jacks are provided for measuring the voltage on the coaxial cable and the voltage across the inductor.

CHARACTERISTICS

Power Rating:	100 watts continuous.
Frequency Range:	40 to 200 kHz with coupling capacitors of .002 to .015 mfd.
Transmission Line Impedance:	Matches a 50 to 70 ohm coaxial cable to line impedances of 50 to 1500 ohms.
Operating Temperature Range:	-40°C to +60°C.
Insertion Loss: (See Fig. 2)	Typical values, using 500-ohm non-inductive load.

Coupling C	Freq.	Coupling Loss
.003mfd.	40kHz	4.5db
.003mfd.	50-200 kHz	1.5db
.006mfd.	40-200 kHz	0.6db
.010mfd.	40-200 kHz	0.6db

INSTALLATION

General (When Supplied Unmounted)

When the Hi-Coupler is unpacked, it should be checked carefully for damage or shortage. Report any transportation damage to both the transportation company and to the nearest Westinghouse District Office.

Remove the screws from the bottom and left side of the unit and mount it with the same screws on the panel in the base of the coupling capacitor.

Connections for Phase-to-Ground Operation

Make the following connections to the terminals on the rear of the Hi-Coupler (When supplied unmounted):

Connect terminal 1 to a ground terminal on the panel.

Connect terminal 4 to the terminal on the top of the drain coil.

Cables for these connections are supplied with the Hi-Coupler.

The coaxial cable from the power-line carrier equipment is to be connected to Hi-Coupler terminals 3 (center conductor) and 5 (shield lead). NOTE: The primary winding of the T1 transformer is isolated from ground to eliminate the path for the flow of 60-Hz. current over the cable shield in the event of induction or difference of ground potential. However, if this is not a problem, the coaxial-cable shield may be grounded at the Hi-Coupler by making a connection between terminals 1 and 5.

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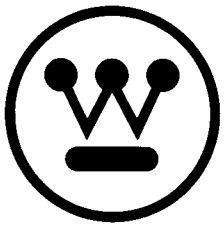
HI-COUPLER

STYLE 148A432G04 – 40 to 200 kHz
(with 2-winding matching transformer)

SUPERSEDES I.L. 41-948.11A
*Denotes change from superseded Issue.

EFFECTIVE DECEMBER 1969



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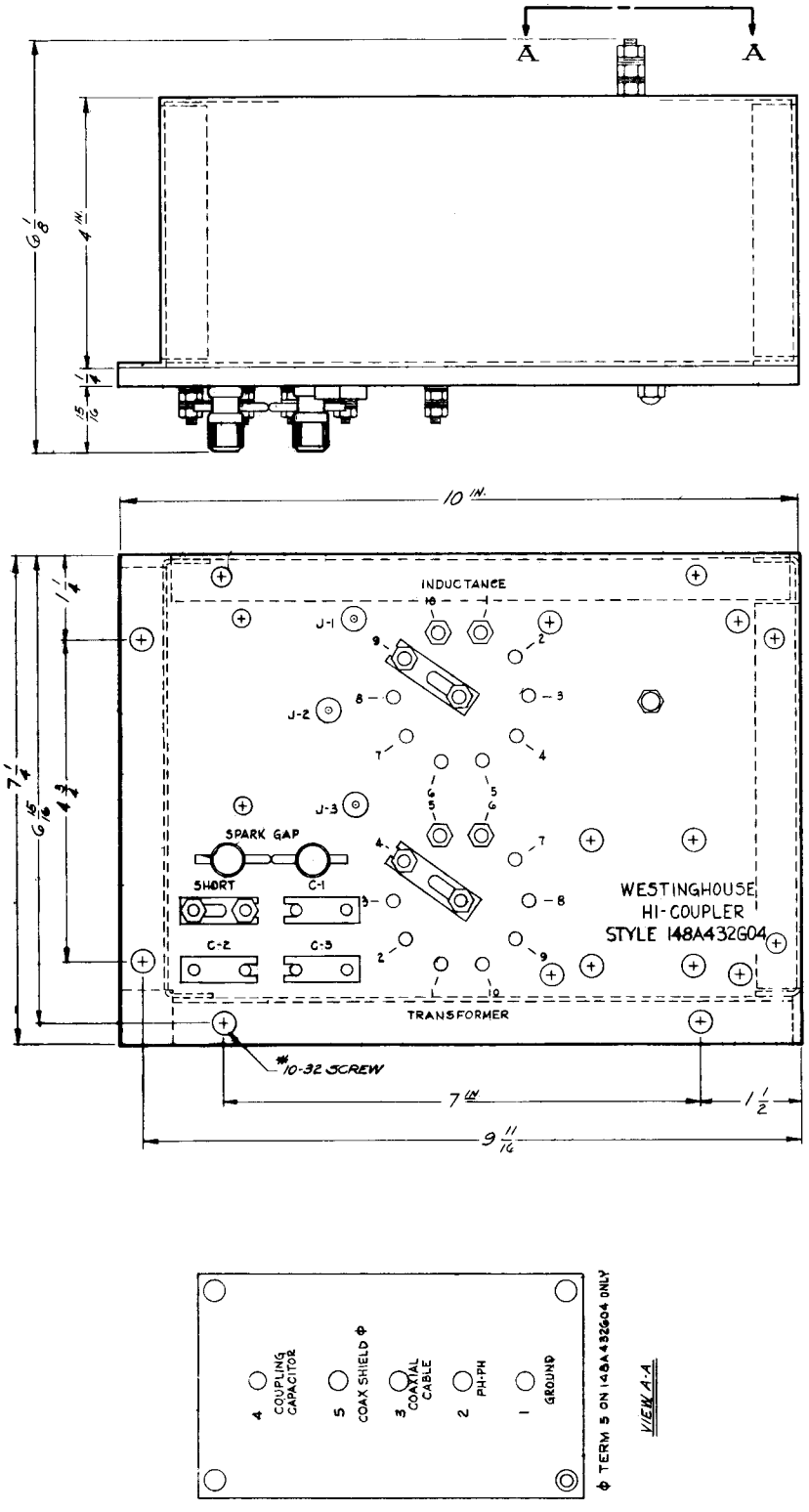

Fig. 3. Hi-Coupler Outline (Dwg. 756D063)

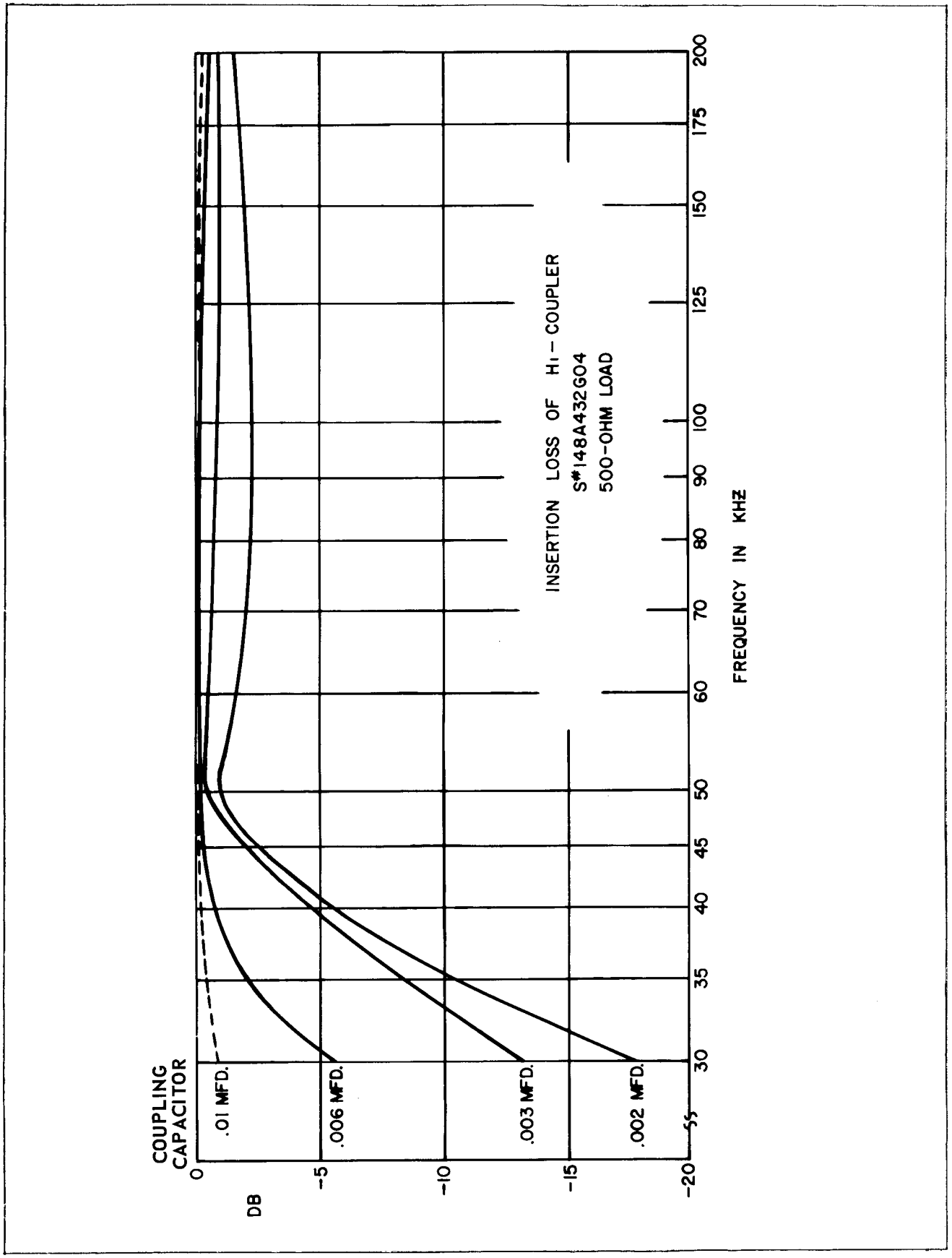

Fig. 2. Insertion Loss of Hi-Coupler (862A347)

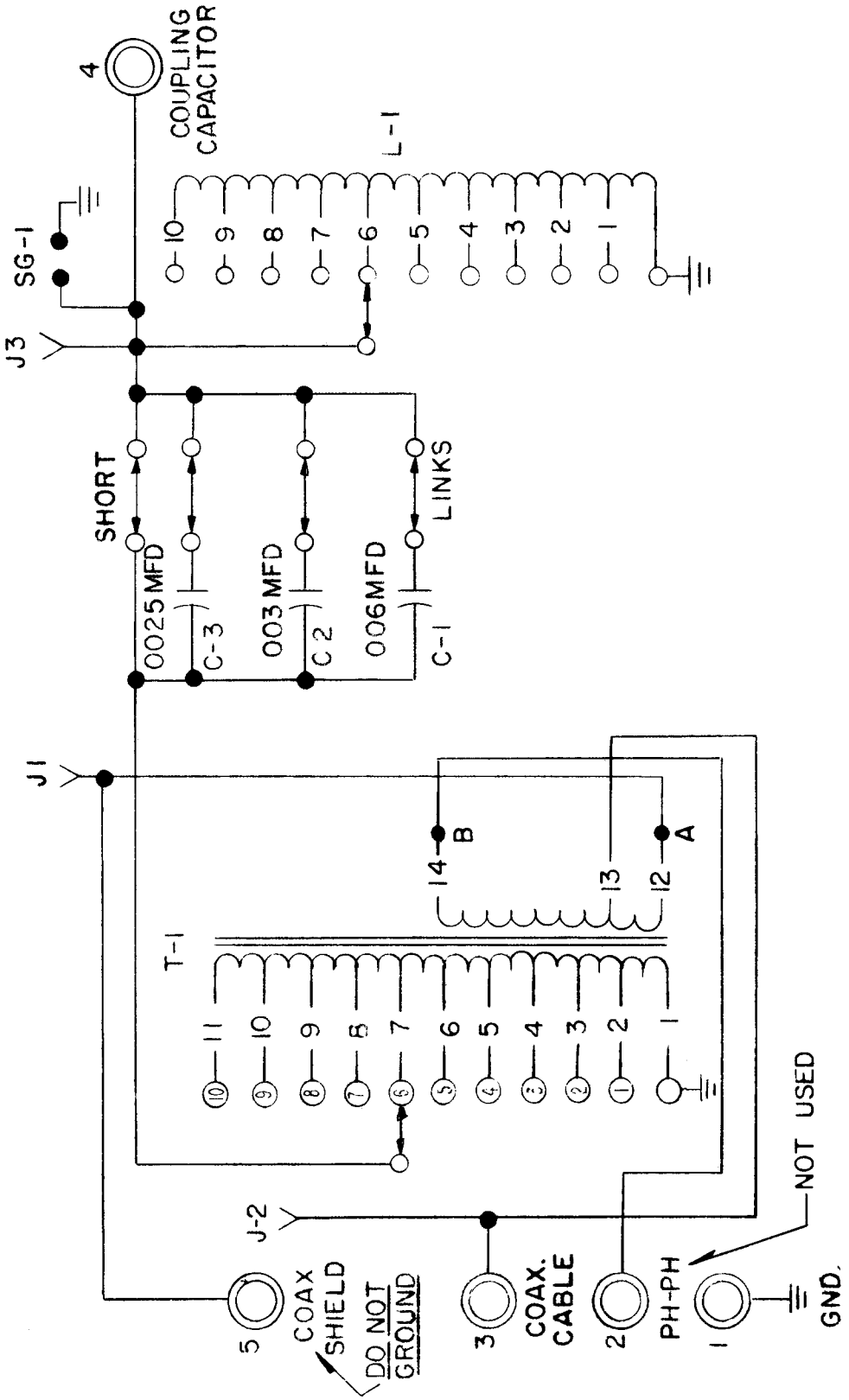

Fig. 1. Hi-Coupler – Internal Schematic (Dwg. 629A850)

ELECTRICAL PARTS LIST

CIRCUIT SYMBOL	FUNCTION	DESCRIPTION	STYLE NUMBER
C-1	Capacitor-Series	Mica, .006 mfd. ± 5% 3000V PACW	584C256H03
C-2	Capacitor-Series	Mica, .003 mfd. ± 5% 3000V PACW	584C256H02
C-3	Capacitor-Series	Mica, .0025 mfd. ± 5% 3000V PACW	584C256H01
J-1	Jack-Coaxial Cable Shield	Pin Jack (black)	330C686H03
J-2	Jack-Coaxial Cable Voltage	Pin Jack (red)	330C686H02
J-3	Jack-Inductor Voltage	Same as J-2	
L-1	Inductor-Shunt	0.4 to 8.0 MH	584C242G01
SG-1	Spark Gap	Point Type	2 of 219B550H01
T-1	Transformer-Impedance-Matching	60 ohms/85, 120, 175, 245, 350, 500, 1060, 1500 Ohms	584C259H01

Change the voltmeter connection from jack J-3 to jacks J-1 (coaxial shield) and J-2. Adjust the transformer link to a position which gives a voltage reading approximately equivalent to the nominal power of the transmitter into a resistance of 60 ohms.

$E = \sqrt{WR}$, where W = watts output, and R = load resistance.

For a 10-watt transmitter:

$E = \sqrt{(10)\ (60)} = 24.5$ volts

This completes the adjustment of the Hi-Coupler except for checking the voltage at jack J-2 with full power being transmitted.

The Hi-Coupler power rating of 100 watts continuous, is based on an impedance of 60 ohms at the coaxial-cable terminal.

Adjustment With A Signal Generator

The Hi-Coupler can be adjusted by means of a signal generator in the absence of other signals.

Terminate the output of a 60-ohm signal generator in a pad consisting of a 50-ohm series resistor and a 10-ohm shunt resistor. It is preferable to connect the signal generator to the remote end of the coaxial cable; however, if this is not feasible, connect the generator to jacks J-2 and J-1. Adjust the signal generator to 50 kHz. Connect the vacuum-tube voltmeter to jack J-3 and ground and adjust the inductor link for the maximum voltage reading. Then adjust the transformer link for maximum voltage reading.

Adjustment For Phase-to-Phase Operation

When adjusting the two Hi-Couplers used for phase-to-phase operation, it is necessary to open-circuit one unit while the other is being adjusted. This is done by opening all the capacitor links. (Be sure to close the grounding switch first.) Adjust one unit by the same procedure used for phase-to-ground operation, then open circuit the first unit, replace the links in the second unit and repeat the adjustment. The voltage readings for the two units should be approximately the same and the transformer and inductance links should be at the same position on both units. With both units connected recheck the transformer taps as described under Adjustment With a Local Transmitter.

Operation as Impedance Matching Transformer

In some installations where only the higher carrier frequencies are used with the higher value coupling capacitors, better coupling may be obtained by using only an impedance-matching transformer rather than the high-pass filter circuit of the Hi-Coupler. The conditions controlling this choice of coupling are so variable that no specific recommendation can be given. Only an operational test of the installation will determine which gives the best results.

To operate the Hi-Coupler as an impedance-matching transformer, close the link marked SHORT, open the inductor link. The transformer ratio is then adjusted in accordance with the instructions given for phase-to-ground operation with a local transmitter.

Spark Gap Adjustment

The spark gap is adjusted to .060 inch when the unit is shipped. This spacing should be checked to see that it has not been changed.

MAINTENANCE

The Hi-Coupler will require very little maintenance. It should be checked occasionally to see if there has been excessive burning of the spark gap. If the electrodes show signs of burning, clean the points and adjust the gap to .060 inch.

Connections for Phase-to-Phase Operation

For phase-to-phase operation with the two Hi-Couplers operating with their outputs in phase (push-push), both units are connected as described for phase-to-ground operation.

However, if conventional phase-to-phase operation (push-pull) is desired, reverse the connections of the coaxial cable to terminals 3 and 5 of one of the Hi-Couplers by connecting the center conductor to terminal 5 and the shield lead to terminal 3. The coaxial cable to the other Hi-Coupler is connected as described for phase-to-ground operation.

It is not necessary to run a separate coaxial cable from the carrier equipment to each Hi-Coupler. A single coaxial cable is run to one Hi-Coupler, then continued to the second one where the coaxial cable connections may be reversed. For the unit with the reversed connections, note that this also reverses the "polarity" of pin jacks J-1 and J-2 on the front panel. Thus J-2 becomes "Ground" under this condition.

ADJUSTMENTS

Preliminary

CAUTION: Close the carrier grounding switch when changing the capacitor links or the inductor link. Do not depend on the drain coil for personal safety. Do not touch any terminal when a transmitter is on.

The links for the capacitors C-1, C-2 and C-3 can be placed in the correct position before the coupling capacitor is connected to the power line. The link marked SHORT is always open, except as noted in a later paragraph.

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System Voltage KV	Coupling Capacitor MFD.	Hi-Coupler Capacitance MFD.	Close Links
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287	.0025	.0025	C-3
345	.002	.0025	C-3

The impedance ratios of the matching transformer are as follows:

Coaxial cable terminal – 60 ohms (50 to 70 ohms).

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3	120
4	175
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6	350
7	500
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The final adjustment of the ratio of the transformer must be made after the inductor is adjusted. However, if the impedance of the power line is known, set the transformer link to the position for the nearest value. If the impedance of the power line is not known, set the transformer link to tap number 8.

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Since the adjustment of the inductor will be affected by reactance of the power line it must be adjusted after installation of the equipment. A vacuum-tube voltmeter suitable for carrier frequencies is required for adjusting the inductor. Adjustment of the Hi-Coupler must be made at 50 kHz. for a pass band of 40 to 200 kHz. When the adjustment is made using the signal from a transmitter or using a signal generator, all other carrier-frequency signals must be temporarily removed from the channel.

Begin the adjustment with the inductor link on position 11.

CAUTION: Always close the carrier grounding switch in the base of the coupling capacitor before changing the inductor link.

Adjustment With A Local Transmitter

Connect the vacuum-tube voltmeter from the l.h. spark-gap electrode (ground) to jack J-3. Turn on the transmitter and adjust the inductance link for maximum voltage reading. If several transmitters are connected to the Hi-Coupler, use the lowest frequency transmitter for this adjustment.

APPLICATION

The Hi-Coupler is designed for use with a coupling capacitor to couple one or more carrier frequencies to a power line.

DESCRIPTION

Mechanical

The Hi-Coupler is contained in a small aluminum housing which mounts on the hinged panel in the base of the Westinghouse Type PC-5 or PCA-5 Coupling Capacitors. The transformer link, inductor link, the link connectors for the capacitors, the spark gap and the voltage jacks are mounted on the front panel of the Hi-Coupler. The connections for the coupling capacitor, coaxial cable and ground are on the rear of the unit. The outline of the Hi-Coupler is shown on Fig. 3.

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Pin jacks are provided for measuring the voltage on the coaxial cable and the voltage across the inductor.

CHARACTERISTICS

Power Rating:	100 watts continuous.
Frequency Range:	40 to 200 kHz with coupling capacitors of .002 to .015 mfd.
Transmission Line Impedance:	Matches a 50 to 70 ohm coaxial cable to line impedances of 50 to 1500 ohms.
Operating Temperature Range:	-40°C to +60°C.
Insertion Loss: (See Fig. 2)	Typical values, using 500-ohm non-inductive load.

Coupling C	Freq.	Coupling Loss
.003mfd.	40kHz	4.5db
.003mfd.	50-200 kHz	1.5db
.006mfd.	40-200 kHz	0.6db
.010mfd.	40-200 kHz	0.6db

INSTALLATION

General (When Supplied Unmounted)

When the Hi-Coupler is unpacked, it should be checked carefully for damage or shortage. Report any transportation damage to both the transportation company and to the nearest Westinghouse District Office.

Remove the screws from the bottom and left side of the unit and mount it with the same screws on the panel in the base of the coupling capacitor.

Connections for Phase-to-Ground Operation

Make the following connections to the terminals on the rear of the Hi-Coupler (When supplied unmounted):

Connect terminal 1 to a ground terminal on the panel.

Connect terminal 4 to the terminal on the top of the drain coil.

Cables for these connections are supplied with the Hi-Coupler.

The coaxial cable from the power-line carrier equipment is to be connected to Hi-Coupler terminals 3 (center conductor) and 5 (shield lead). NOTE: The primary winding of the T1 transformer is isolated from ground to eliminate the path for the flow of 60-Hz. current over the cable shield in the event of induction or difference of ground potential. However, if this is not a problem, the coaxial-cable shield may be grounded at the Hi-Coupler by making a connection between terminals 1 and 5.

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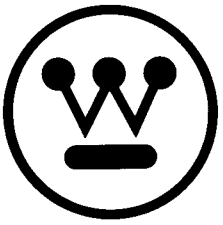
EFFECTIVE MAY 1967



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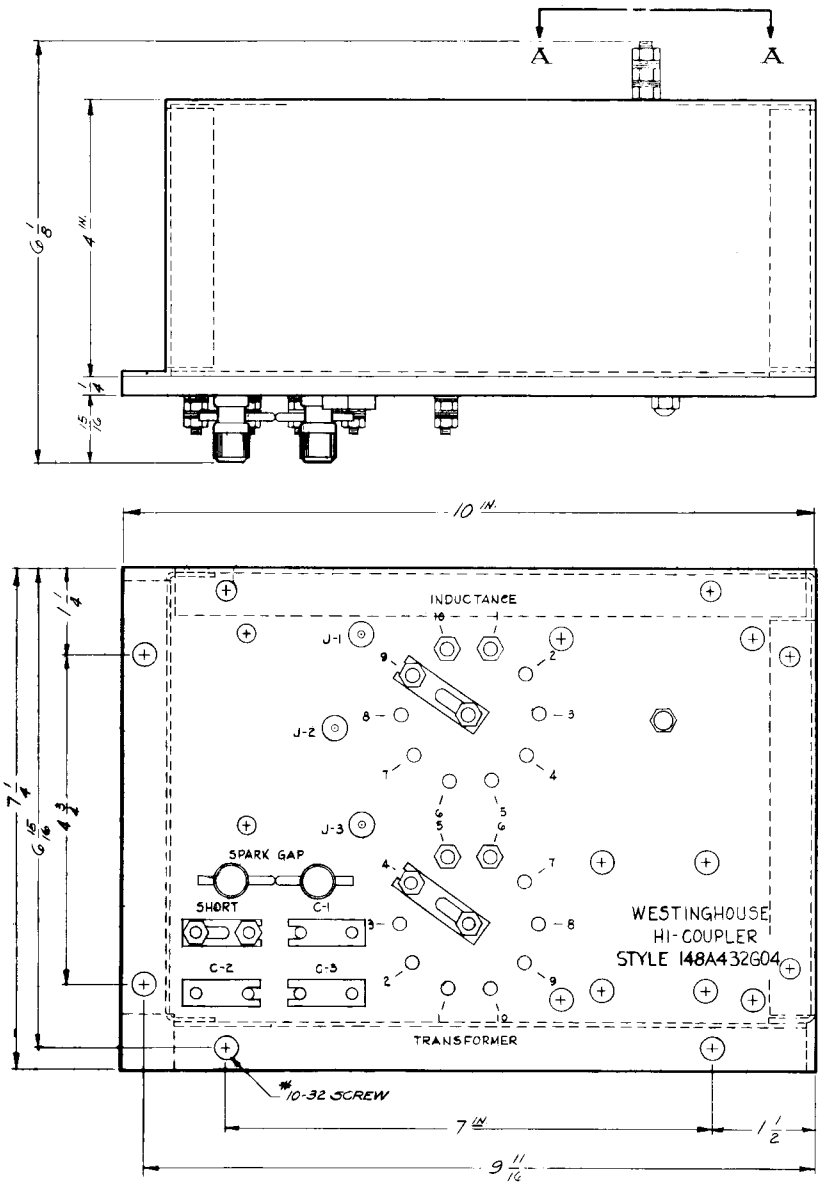

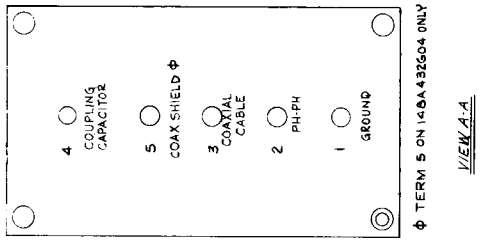

Fig. 3. Hi-Coupler Outline (Dwg. 756D063)