

Updated
April 2013



PLC 9510P

Ensuring the Reliability of the Electric Power Grid



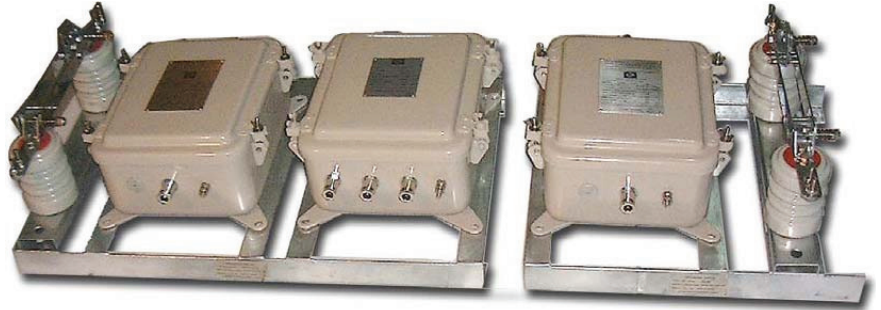
Manufacturer Licensee
Power Line Carrier

Extra Wideband Phase-to-Phase Line Tuners



Key Features

The PLC 9510 line tuner matches the impedance of the powerline carrier (PLC) terminal to that of the high voltage power line in order to reduce the insertion loss for the transmission of PLC signals over the power line. In addition, isolation from the power frequency voltage and transient overvoltages is provided.



This line tuner can be used with PLC communication systems connected to coupling capacitors having a capacitance between 1,400 & 25,000 pF.

All of the characteristics of the 9510P series of line tuners conform to the requirements of IEC 481-74 (Coupling devices for powerline carrier systems). The peak envelope power (PEP) rating is 400 Watts. 600, 800, and 1000 Watt versions can be supplied.

Model PLC 9510P is used for phase-to-phase coupling. Phase-to-ground and three phase versions are also available. Commissioning is simplified since no adjustments are necessary.

Construction

A set of three (3) units are required for phase-to phase coupling. Each set consists of two (2) type JLX filter units and one (1) type LB-BI balance transformer unit. See Figure 1.

The PLC 9510P series high-pass or band-pass Line Tuners filters are enclosed in casings made of fine quality aluminum that can perform under all-weather conditions. Capacitors are of the highest voltage type. Inductor and matching transformer units are molded and sealed. A zinc-oxide lightning arrester is used as the protective device.

External grounding switches are supplied for protection of the user from high voltage spikes which may occur during inspection of the tuner.

Principle

The high-pass or band-pass circuit consists of a drain coil, inductors, and capacitors. A matching Transformer provides potential insulation between line side and equipment (cable) side, and provides the means to make the power line impedance match that of the PLC terminal. The power frequency current derived from the coupling capacitor is drained to ground by the integrated drain coil.

Limitation of voltage surges coming from the power line at the terminals of the tuner is performed by a lightning arrester connected in parallel with the drain coil. The line tuner will be short-circuited to ground when the grounding switch is closed.

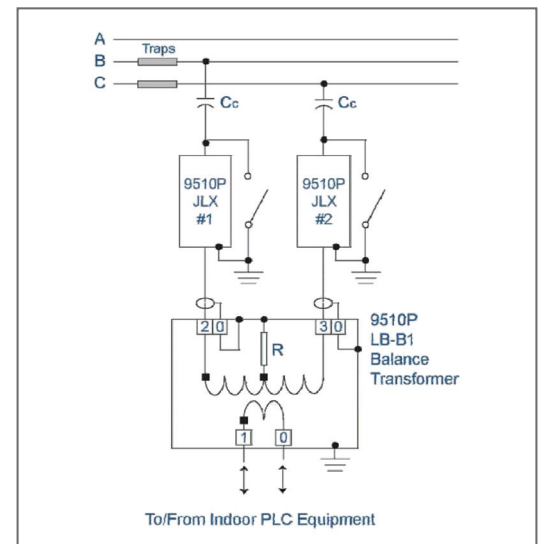


Figure 1 - Outdoor equipment schematic diagram



Technical Specifications

Type	PEP	Capacitance of Capacitor (pF)	Version	Line-Side Impedance (Ohms)	Cable-Side Impedance (Ohms)	Carrier Frequency Range (kHz)	Return Loss (dB)	Schematic Diagram
JLX-1000-5-B5A	1,000	5,000	1	600 800	50/75	88-200	>16	2
JLX-800-5-B5A	800	5,000	2	600 800	75	72-500 56-500	>12	3
JLX-800-5-B5A	800	5,000	3	690 760	75/125	56-184	>14	4
JLX-800-6-B5A	800	6,000	4	690 760	75/125	50-200	>14	4
JLX-800-6.6-B5A	800	6,600	5	600 800	75	52-500 44-500	>12	3
JLX-800-7.5-B5A	800	7,500	6	600 800	75	48-500 40-500	>12	3
JLX-800-8-B5A	800	8,000	7	690 760	75/125	50-200	>14	4
JLX-800-10-B5A	800	10,000	8	720 800	75/125	50-200	>20	4
JLX-800-10-B5A	800	10,000	9	600 800	75	40-500	>12	3
JLX-800-15-B5A	800	15,000	10	600 800	75	40-500	>12	3
JLX-800-20-B5A	800	20,000	11	600 800	75	40-500	>12	3
JLX-800-4.4-B5A	800	4,400	12	600 800	150	80-350	12	5
JLX-800-8.8-B5A	800	8,800	13	600 800	150	35-85	12	5
JLX-800-8.8-B5A	800	8,800	14	600 800	150	80-350	16	5
JLX-800-10-B5A	800	10,000	15	600 800	150	35-500	12	6

Table 1 - Typical PLC 9510P series Line Tuners - other versions available upon request

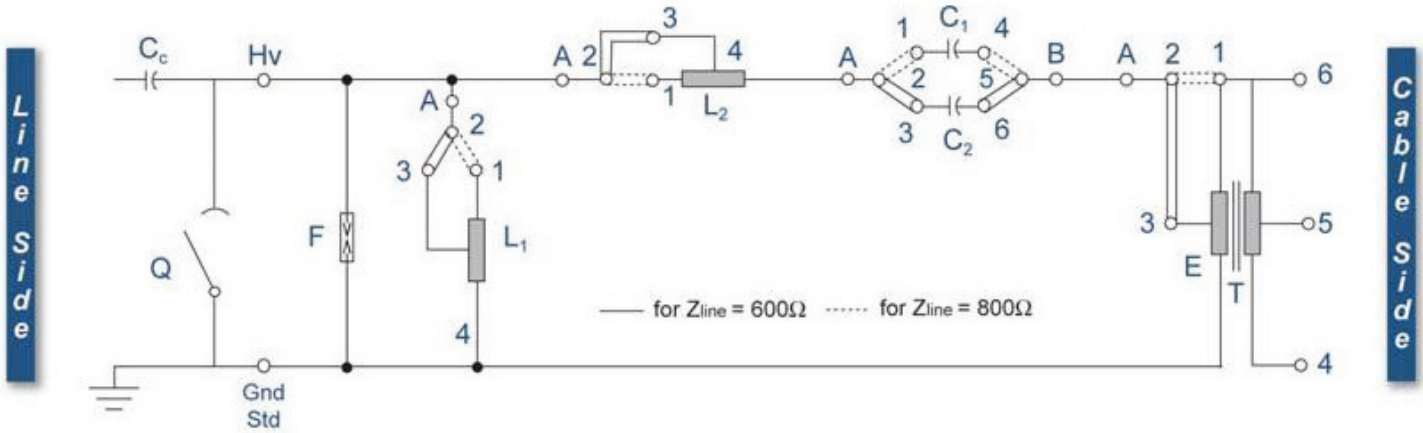


Figure 2 - Schematic Diagram #2

- T - Matching transformer
- F - Lightning arrester
- Q - Grounding switch
- L₁ L₂ - Inductor
- C₁ C₂ - Capacitor
- C_c - Coupling capacitor
- Hv - High voltage terminal

Nominal Impedance (Ω)		Line tuner's matching transformer (T)						Line tuner's inductor (L)	Line tuner's Capacitor (C)	HF hybrid transformer's resistance (R)
Line-Side (per phase)	Cable-Side	1	2	3	E	4	5			
600	50	2 to 3			✓	✓	✓	2 to 3	2 to 3 5 to 6	2 to 3, 5 to 6 2 to 1, 5 to 4
	75				✓	✓	✓			
800	50	2 to 1			✓	✓	✓	2 to 1	2 to 1 5 to 4	2 to 3, 5 to 6 2 to 1, 5 to 4
	75				✓	✓	✓			

Table 2 - Terminal Connections

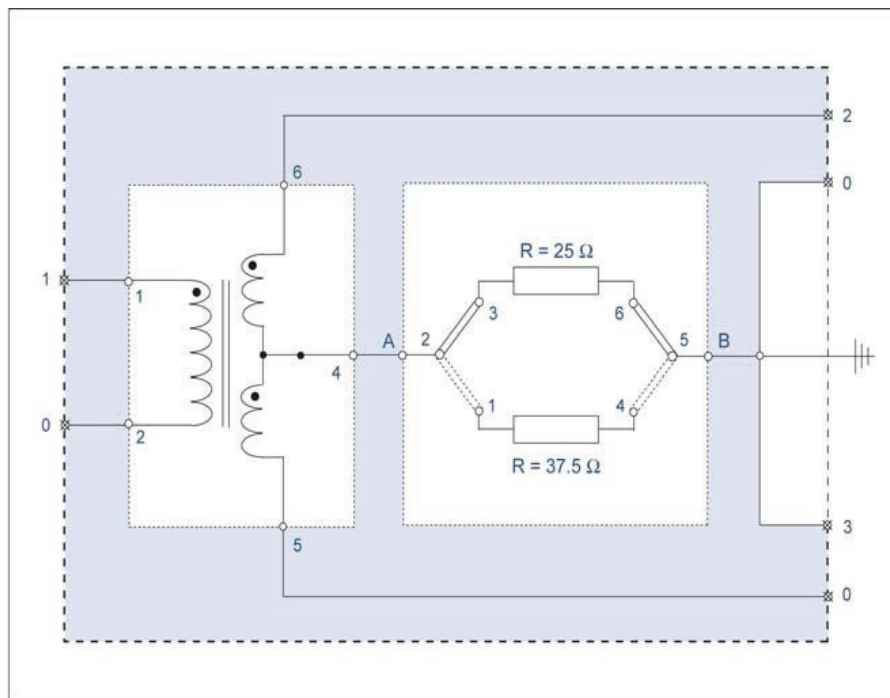


Figure 2.1 - HF Hybrid (Balance) Transformer Schematic

Specifications subject to change without notice.

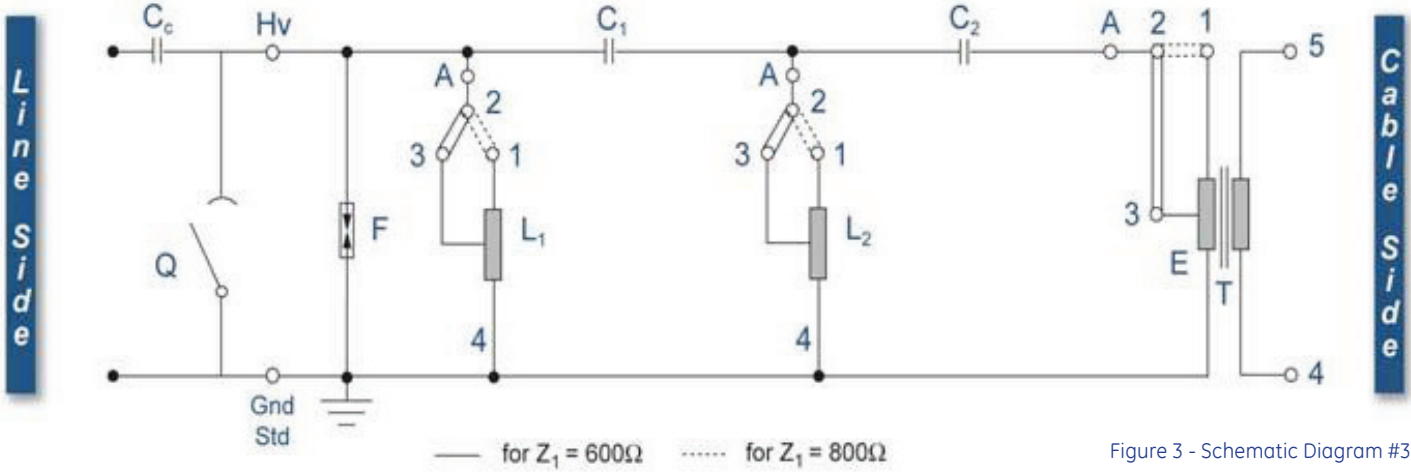


Figure 3 - Schematic Diagram #3

- C - Capacitor
- F - Lightning arrester
- Q - Grounding switch
- L₁ L₂ - Inductor
- T - Matching transformer
- Hv - High voltage terminal

Nominal Impedance		Inductor L ₁ , L ₂	Matching Transformer
Line-Side	Cable-Side		
600	75	2 to 3	2 to 3
800	75	2 to 1	2 to 1

Table 3 - Terminal Connections

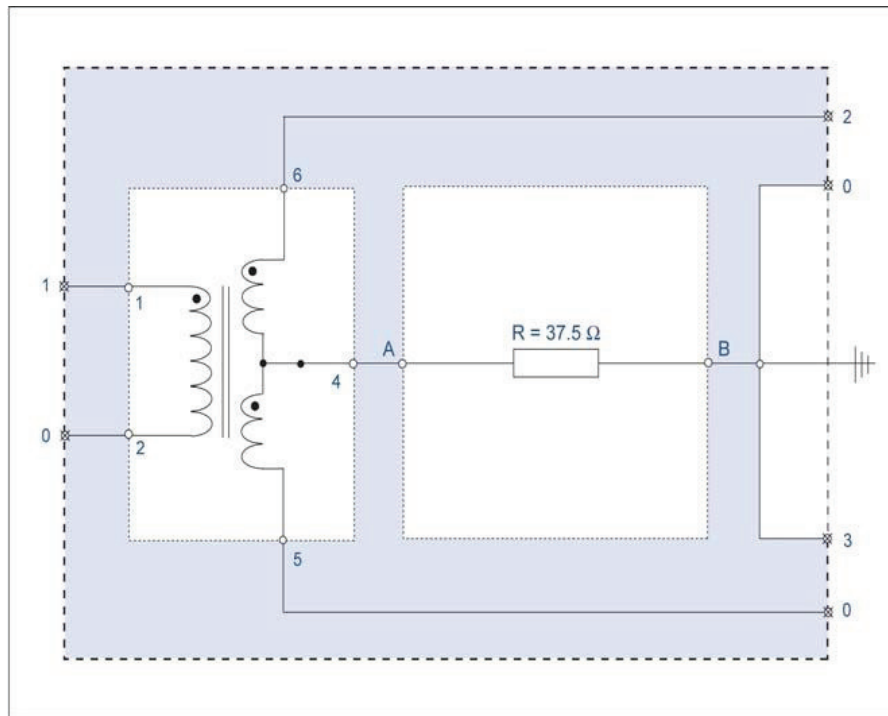


Figure 3.1 - HF Hybrid (Balance) Transformer Schematic

Specifications subject to change without notice.

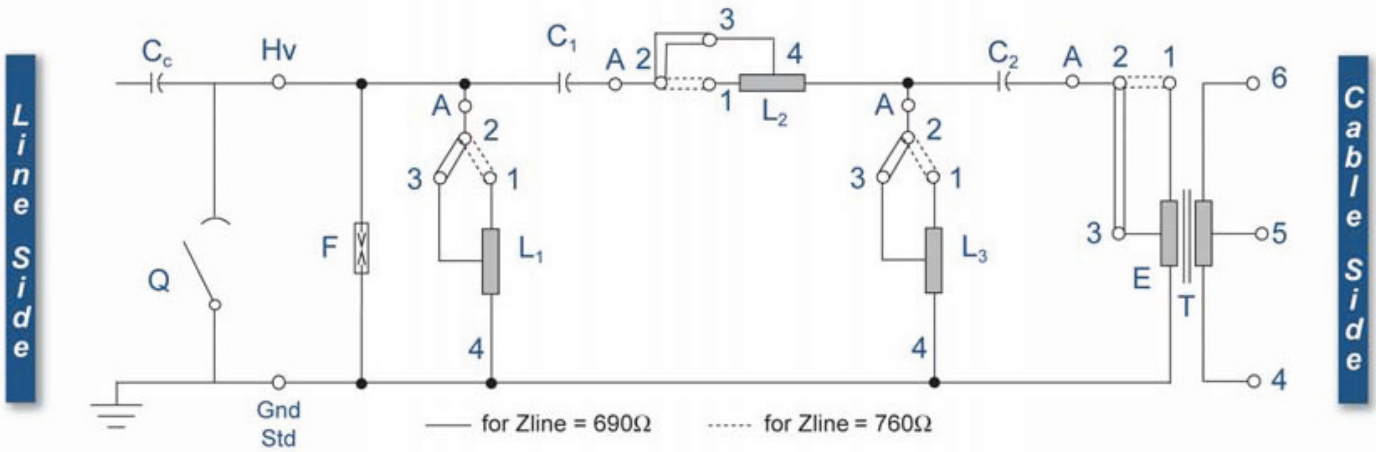


Figure 4 - Schematic Diagram #4

- T - Matching transformer
- F - Lightning arrester
- Q - Grounding switch
- L_1 L_2 L_3 - Inductor
- C_1 C_2 - Capacitor
- C_c - Coupling capacitor
- Hv - High voltage terminal

Nominal Impedance (Ω)		Line tuner's matching transformer (T)						Line tuner's inductor (L_1, L_2, L_3)	HF hybrid transformer's resistance (R)
Line-Side	Cable-Side	1	2	3	E	4	5		
690 (or 720)	75	2 to 3			✓	✓	✓	2 to 3	2 to 3, 5 to 6
	125	2 to 3			✓	✓	✓		2 to 1, 5 to 4
760 (or 800)	75	2 to 1			✓	✓	✓	2 to 1	2 to 3, 5 to 6
	125	2 to 1			✓	✓	✓		2 to 1, 5 to 4

Table 4 - Terminal Connections

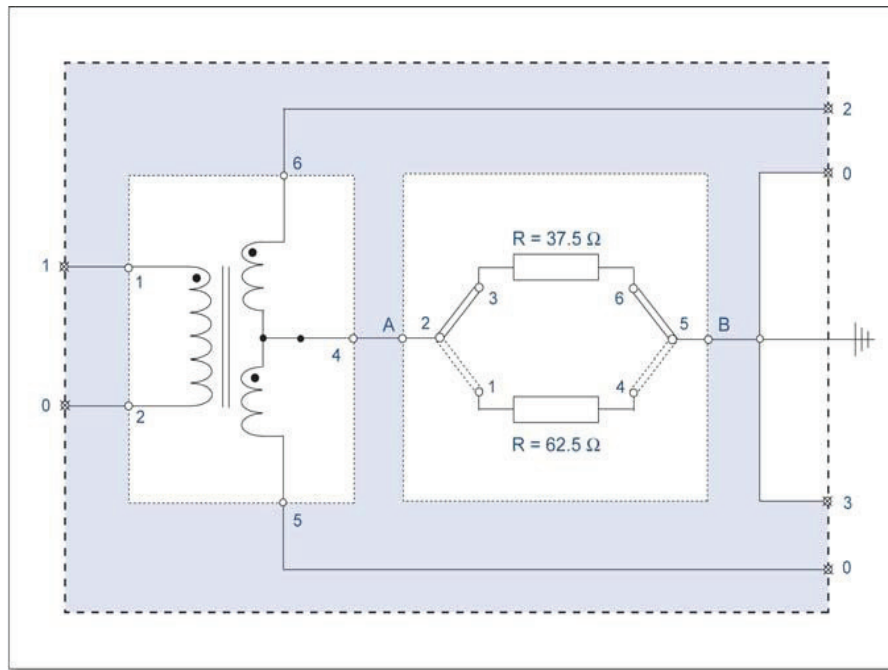


Figure 4.1 - HF Hybrid (Balance) Transformer Schematic

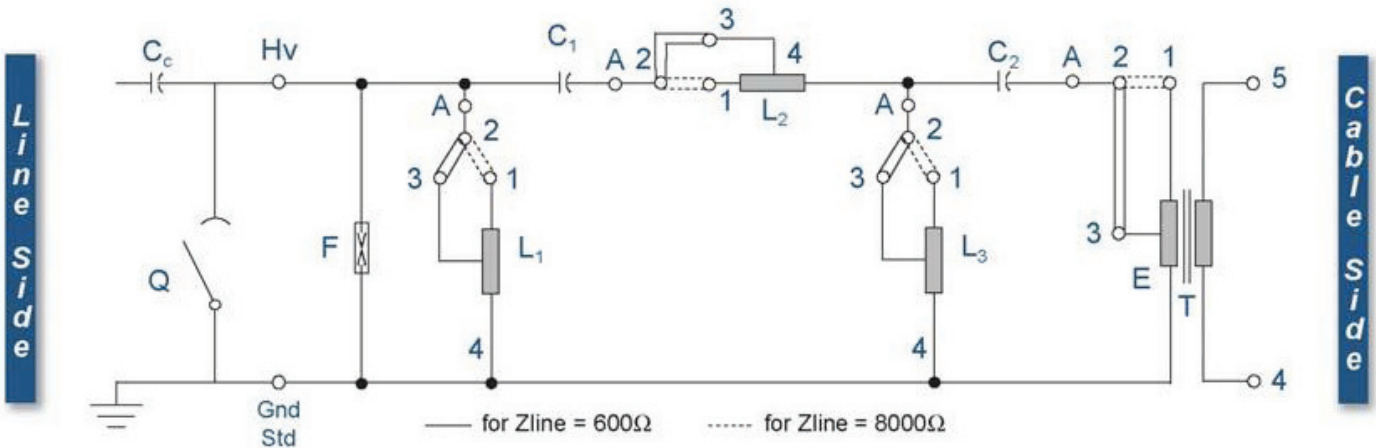


Figure 5 - Schematic Diagram #5

- T - Matching transformer
- F - Lightning arrester
- Q - Grounding switch
- L_1, L_2, L_3 - Inductor
- C_1, C_2 - Capacitor
- C_c - Coupling capacitor
- Hv - High voltage terminal

Nominal Impedance (Ω)		Line tuner's matching transformer (T)	Line tuner's inductor (L_1, L_2, L_3)
Line-Side	Cable-Side		
600	150	2 to 3	2 to 3
800	150	2 to 1	2 to 1

Table 5 - Terminal Connections

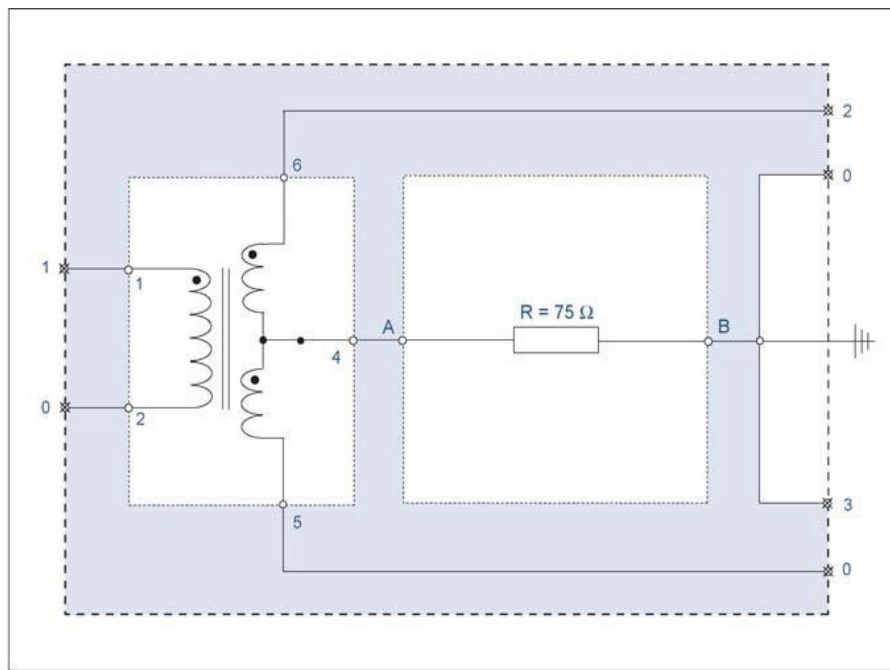


Figure 5.1 - HF Hybrid (Balance) Transformer Schematic

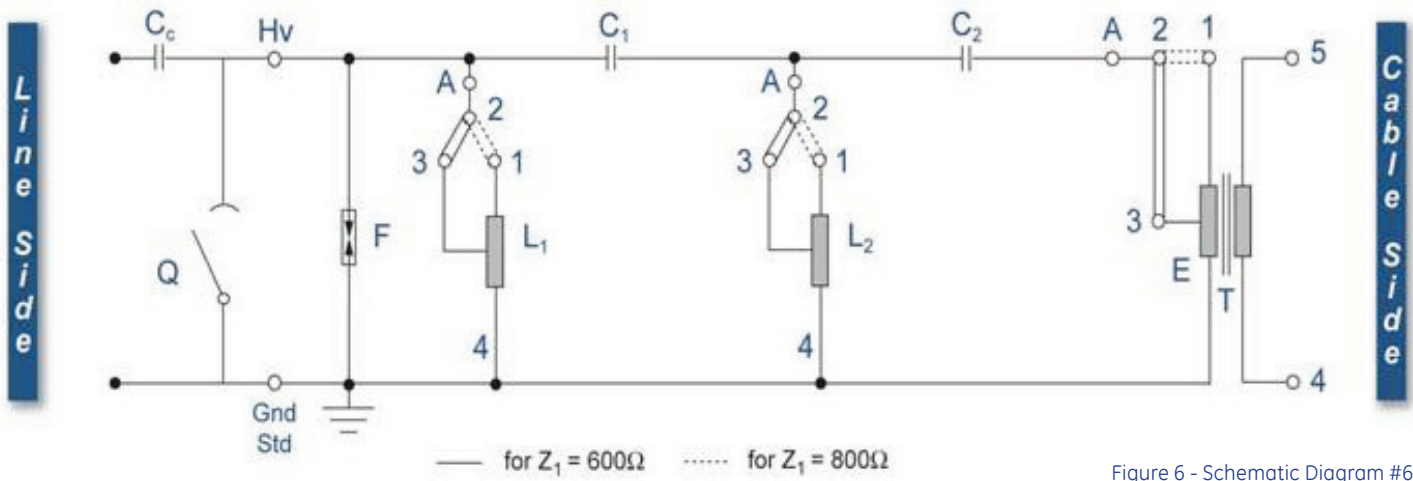


Figure 6 - Schematic Diagram #6

- C - Capacitor
- F - Lightning arrester
- Q - Grounding switch
- L₁ L₂ - Inductor
- T - Matching transformer
- Hv - High voltage terminal

Nominal Impedance (Ω)		Line tuner's matching transformer (T)	Line tuner's inductor (L ₁ , L ₂)
Line-Side	Cable-Side		
600	150	2 to 3	2 to 3
800	150	2 to 1	2 to 1

Table 6- Terminal Connections

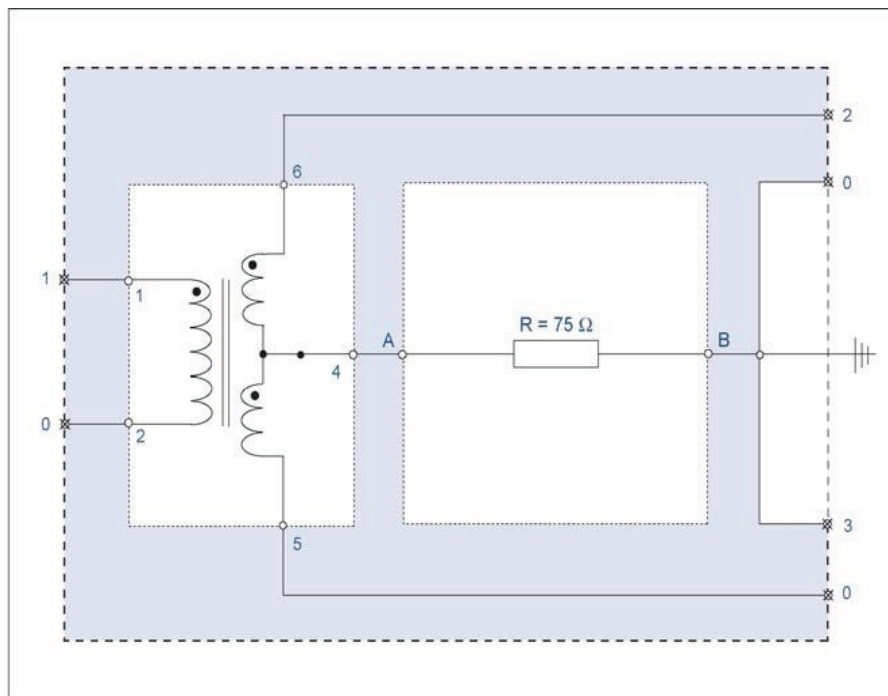


Figure 6.1 - HF Hybrid (Balance) Transformer Schematic



Outdoor Service Conditions

The line tuner shall be capable performing its function when exposed to sunshine, rain, fog, hail, frost, snow, ice, etc. Altitude of installation up to 2000 m. Ambient temperature shall lie in the range -30 degrees C to $+55$ degrees C.

Characteristics

Carrier-frequency range	35 to 500 kHz (see Table 1)
Nominal line-side impedance	600, 800 Ω (others on request)
Nominal equip-side impedance	50, 75, 125 Ω non-balanced or 150 Ω balanced
Capacitance of capacitor	1,400 to 25,000 pF
Methods of coupling	Phase-to-Phase
Return loss	>12 dB
Composite loss	< 2 dB
Nominal peak-envelope power	400, 800, 1000 or 2000W
Intermodulation distortion 3rd and 5th order	>80 dB below PEP
Harmonic distortion	>80 dB below PEP

Safety & Protection

Drain coil

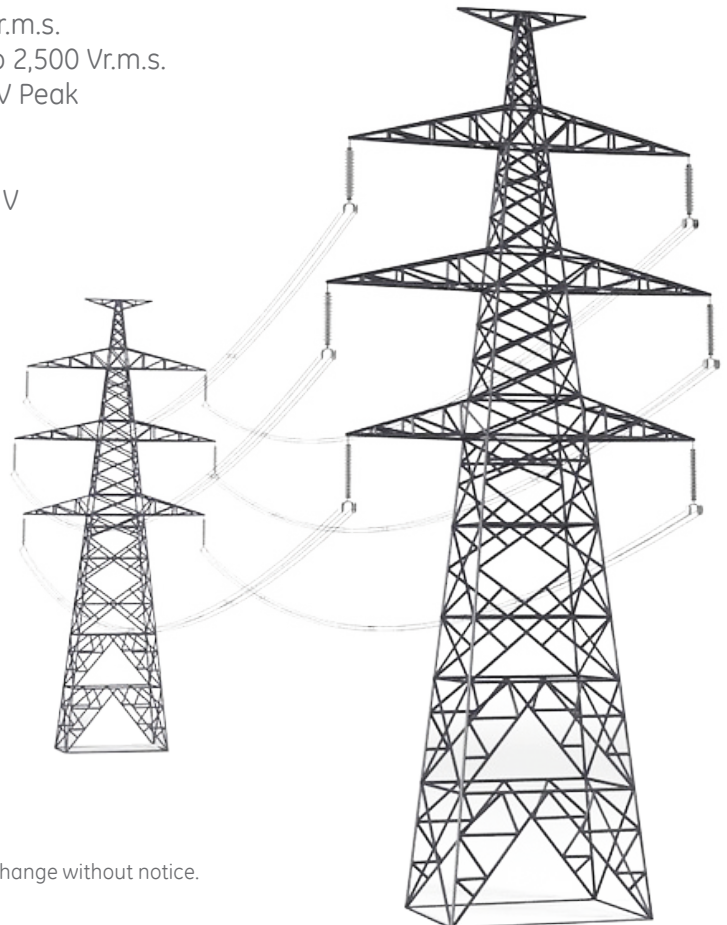
Impedance at power frequency	$<20 \Omega$
Short-time current 0.2s 50/60 Hz	50 A
Continuous current r.m.s. 50/60 Hz	1.0 A
Impulse Voltage	6,800 V

Over voltage protection

Lightening arrester rated voltage	1,000 Vr.m.s.
Power frequency sparkover voltage	1,800 to 2,500 Vr.m.s.
Impulse sparkover voltage peak value 1.2/50 μ s wave	$< 3,400$ V Peak
Capacitance between poles	< 20 pF
Nominal discharge current 8/20 ms wave	5 kA
Residual voltage at rated discharge current	$< 3,000$ V

Grounding switch

Rated current (r.m.s. continuous value)	200 A
Rated Voltage	6000 V





Insulation Requirements

Power frequency level: Power-frequency withstand voltage between the primary and secondary winding of the matching transformer is 5,000 V for 1 min.

Impulse Level

Complete line tuners can withstand impulse voltage of 6,800 V peak, wave shape 1.2/50.

Mechanical

Cable lead-in diameter	11-14 mm
Line connection and equipment ground	M8

Connection

The finished line tuners are all connected as follows when leaving the factory. The cable side is in the 75 Ω (or 150 Ω) position, and generally the line-side is on 800 Ω position. If the impedance of line side or carrier-frequency connection can't be met, change should be made to the terminal jumper link connection according to Tables 2 through 6 which correspond to terminals on the casing of the inductor and matching transformer.

Mounting and Maintenance

For mounting dimensions, see pages 11 and 12.

Using single conductor lead-in wire, connect the HF insulator terminal on top of the aluminum enclosure to the line tuner terminal of the coupling capacitor. Connect the ground stud to earth ground.

The earthing switch is mounted on a bracket next to the aluminum housing of the filter. Use a hot stick to ground the line tuner via the grounding switch before attempting inspection/maintenance, if the power line is live.

The lightning arrester is the filter's protection device whose power frequency sparkover voltage is not more than 2.5 kV and not less than 1.8 kV.

As the protection device of coupling filter, the lightning arrester should be tested once a year. If its power frequency sparkover voltage fails in the available range, the arrester should be replaced.

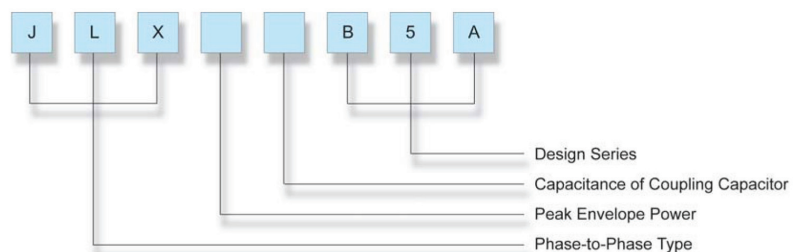
Ordering Information

Specify model, version, quantity, capacitance of the coupling capacitor, line impedance, and required time of delivery.

Non-standard values of line impedance or capacitance of the coupling capacitor can be accommodated upon request.

Product Part Number Breakdown

Use this simple guide to find the product that best fits your needs.



Specifications subject to change without notice.



Physical Details

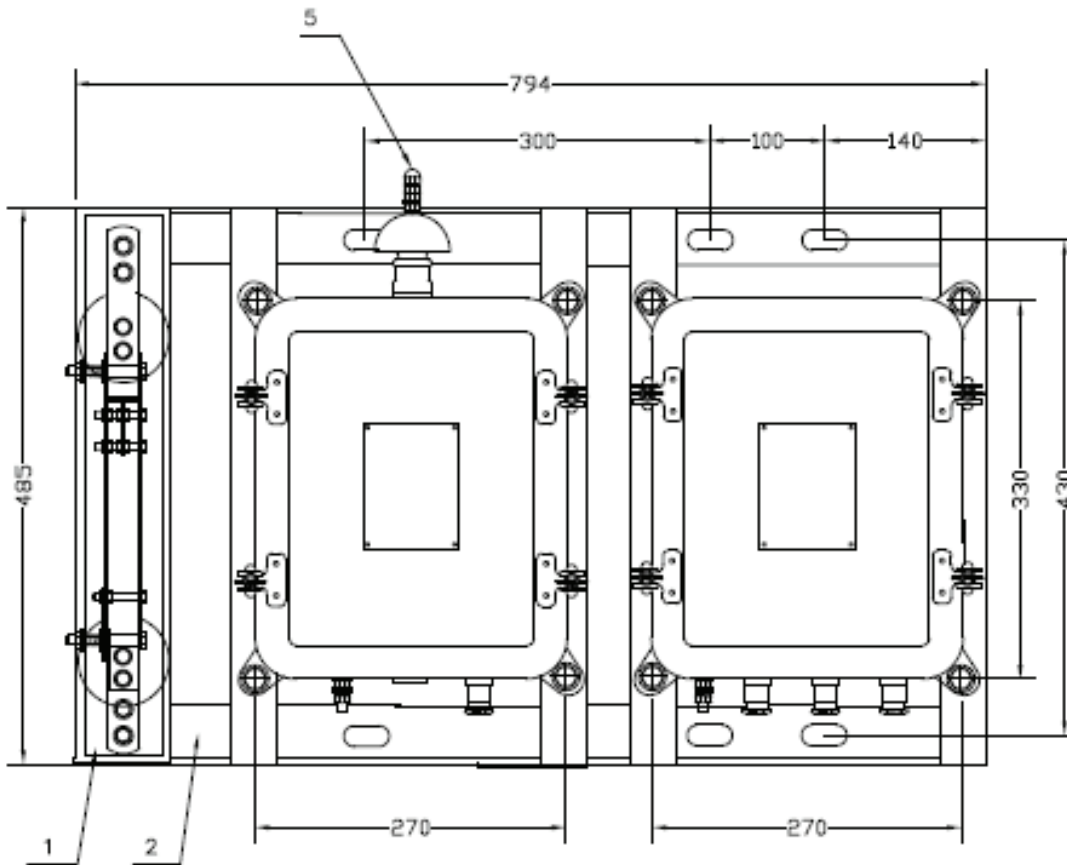
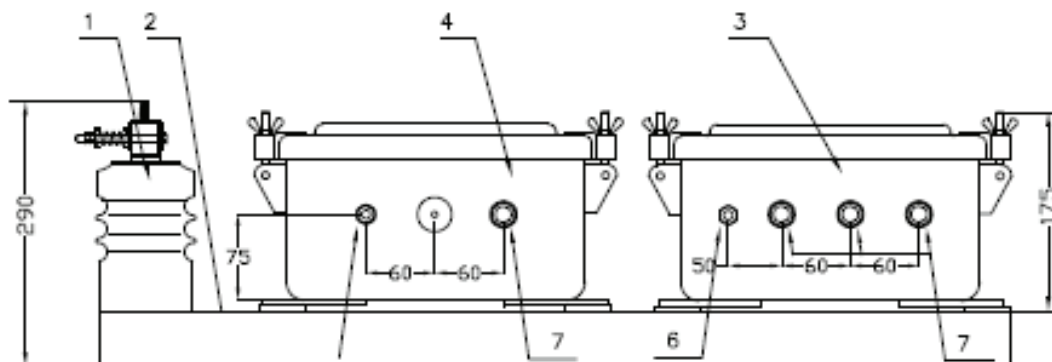


Figure 7 - Assembly Drawing for Coupling Filter, Grounding Switch and HF Hybrid Transformer



NOTES:

COUPLING METHOD: INTER-CIRCUIT (PHASE-PHASE)
 CAPACITANCE: 8000 μ F
 OPERATING FREQUENCY : 40 ~ 500 kHz

- (1) SWITCH GROUND (Ø)
- (2) BASE PLATE
- (3) BALANCE TRANSFORMER (LB-B1)
- (4) TUNER LINE FOR A PHASE (JLX-B5A)
- (5) PUNTO DE CONEXION A CCVT, TERMINAL TYPE A3M8
- (6) CONNEXION GROUNDED TERMINAL TYPE A5M8
- (7) INPUT COAXIAL (COAXIAL CABLE RG11)

DIMENSIONS IN mm

Specifications subject to change without notice.

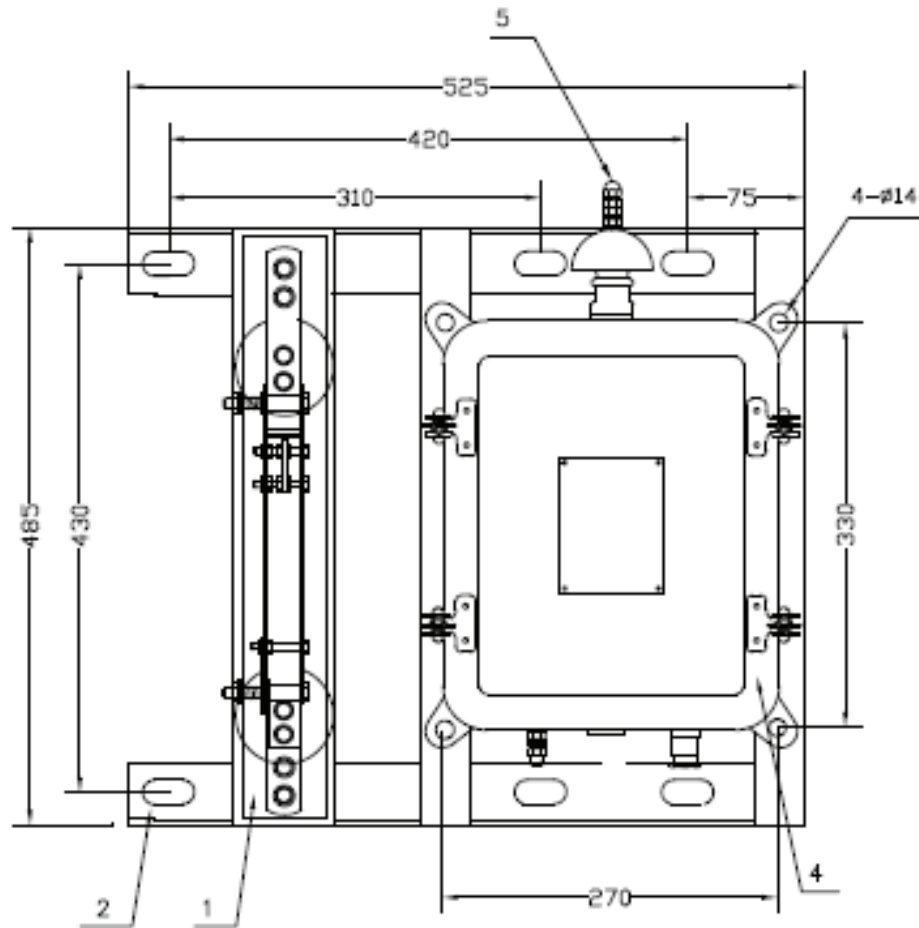
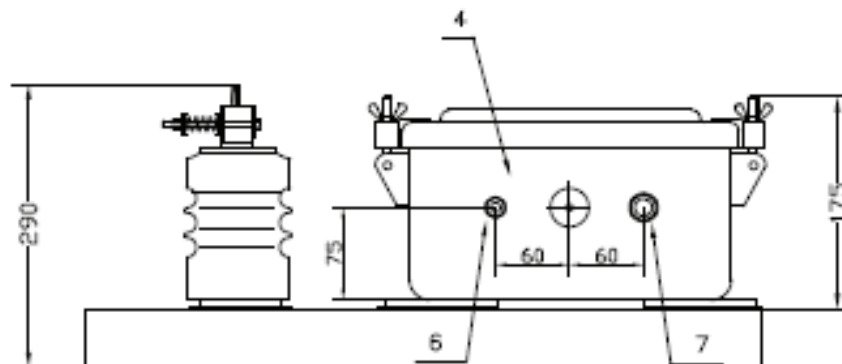


Figure 8 - Assembly Drawing for 9510P Line Tuner and external Grounding Switch

**NOTES:**

COUPLING METHOD: INTER-CIRCUIT (PHASE-PHASE)
 CAPACITANCE: 8000 pF
 OPERATING FREQUENCY : 40 ~ 500 kHz

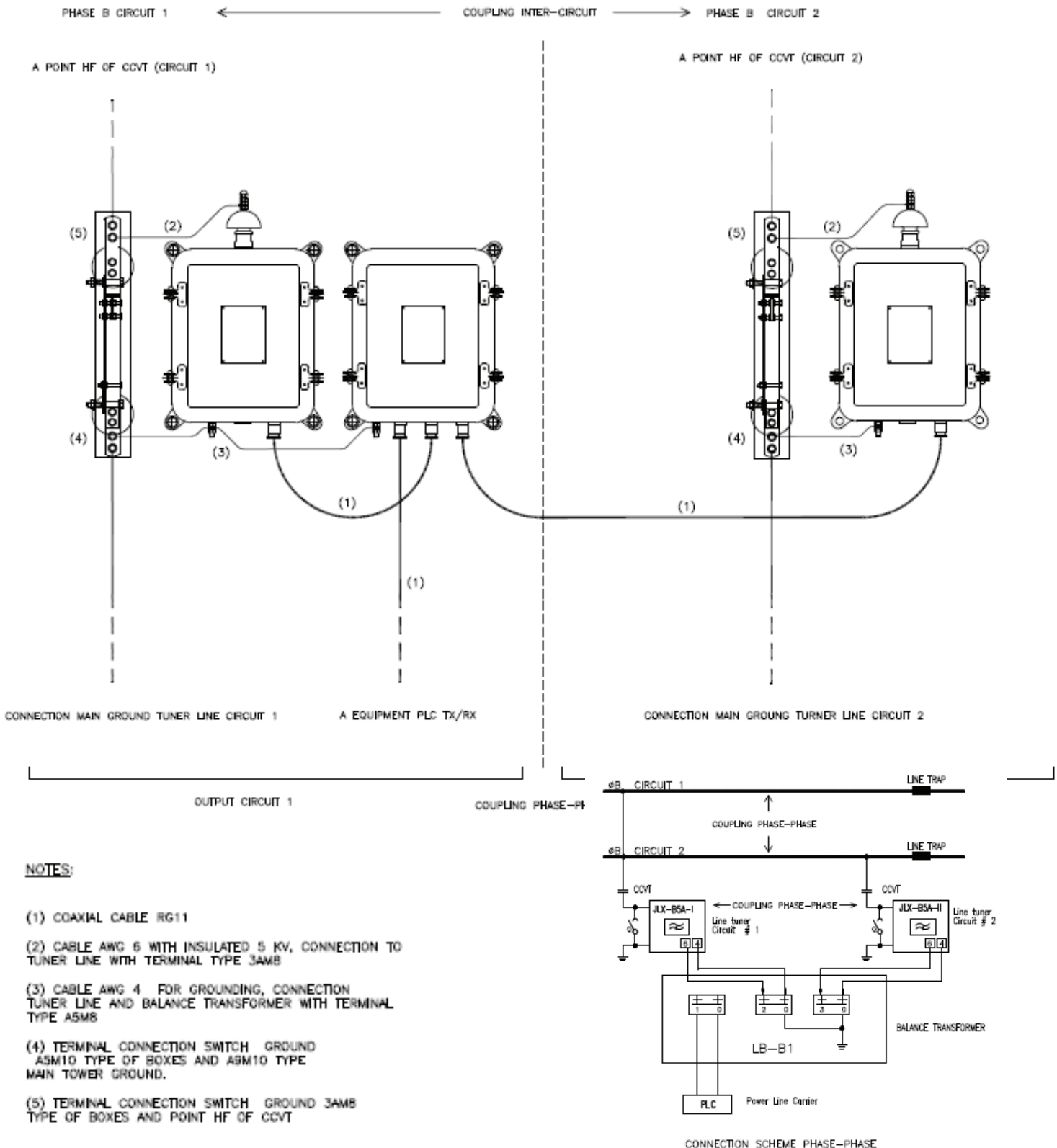
- (1) SWITCH GROUND (Ø)
- (2) BASE PLATE
- (3) BALANCE TRANSFORMER (LB-B1)
- (4) TUNER LINE FOR A PHASE (JLK-B5A)
- (5) PUNTO DE CONEXION A CCVT, TERMINAL TYPE ASMB
- (6) CONNEXION GROUNDED TERMINAL TYPE ASMB
- (7) INPUT COAXIAL (COAXIAL CABLE RG11)

DIMENSIONS IN mm

Specifications subject to change without notice.



Connection Details





Ensuring the Reliability of the Electric Power Grid.

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