



## RFL 9510 Series Extra Wideband Line Tuners



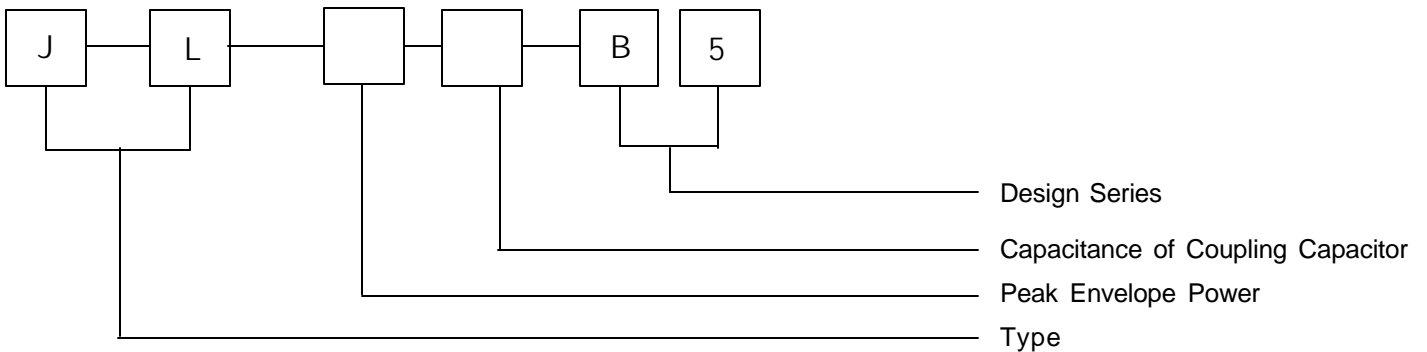
Figure 1. Typical 9510 Line Tuner



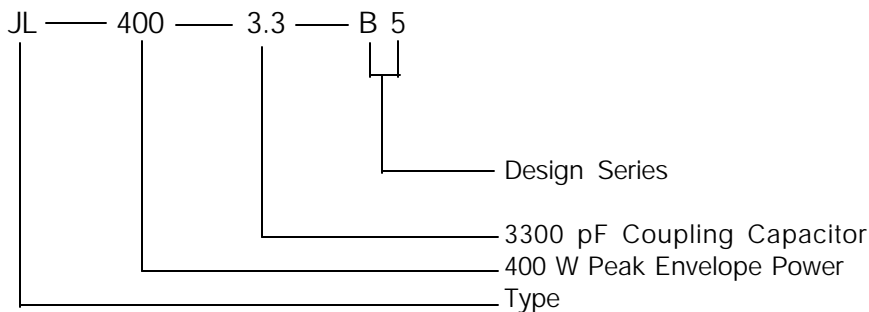
## 1. GENERAL

- 1.1 The RFL 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.
- 1.2 This line tuner can be used with PLC communication systems connected to coupling capacitors having a capacitance between 1,400 and 25,000 pF.
- 1.3 All of the characteristics of the 9510 series of line tuners conform to the requirements of IEC 481-74 (Coupling devices for powerline carrier systems).
- 1.4 The peak envelope power (PEP) rating is 400 Watts. 600, 800, and 1000-Watt versions can be supplied.
- 1.5 Model RFL 9510 is used for phase-to-ground coupling. Phase-to-phase versions are also available.
- 1.6 Commissioning is simplified since no adjustments are necessary.

## 2. BREAKDOWN OF PART NUMBER



Example:





### 3. CONSTRUCTION

The RFL 9510 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.

An external grounding switch is supplied for protection of the user from high voltage spikes which may occur during inspection of the tuner.

### 4. SPECIFICATION

4.1 TABLE 1 9510 series Line Tuners.

Type	Capacitance of Capacitor (pF)	Version	Nominal Line-Side Impedance $\Omega$	Carrier Frequency Working Range (kHz)	Return Loss (dB)	Schematic Diagram
JL - 400 - 3.3 - B5	3,300	1	300	40-60	$\geq 12$	Fig. 2
		2	300	56-108		
		3	400	40-72		Fig. 3
		4	300	92-500		
			400	68-500		
JL - 400 - 3.5 - B5	3,500	5	300	40-60	$\geq 12$	Fig. 2
		6	300	56-108		
		7	400	40-72		Fig. 3
		8	300	92-500		
			400	68-500		
JL - 400 - 4.5 - B5	4,500	9	300	40-72	$\geq 12$	Fig. 2
		10	400	40-100		Fig. 3
		11	300	68-500		
			400	50-500		
JL - 400 - 5 - B5	5,000	12	300	40-76	$\geq 12$	Fig. 2
		13	400	40-120		Fig. 3
		14	300	60-500		
			400	45-500		
JL - 400 - 6.6 - B5	6,600	15	300	40-120	$\geq 12$	Fig. 2
		16	300	46-500		Fig. 3
			400	40-500		
JL - 400 - 7.5 - B5	7,500	17	300 400	40-500	$\geq 12$	Fig. 3
JL - 400 - 8 - B5	8,000	18	300 400	40-500	$\geq 12$	Fig. 3
JL - 400 - 10 - B5	10,000	19	300 400	40-500	$\geq 16$	Fig. 3
JL - 400 - 15 - B5	15,000	20	300 400	40-500	$\geq 16$	Fig. 3
JL - 400 - 20 - B5	20,000	21	300 400	40-500	$\geq 16$	Fig. 3



## 4.2 Schematic Diagrams

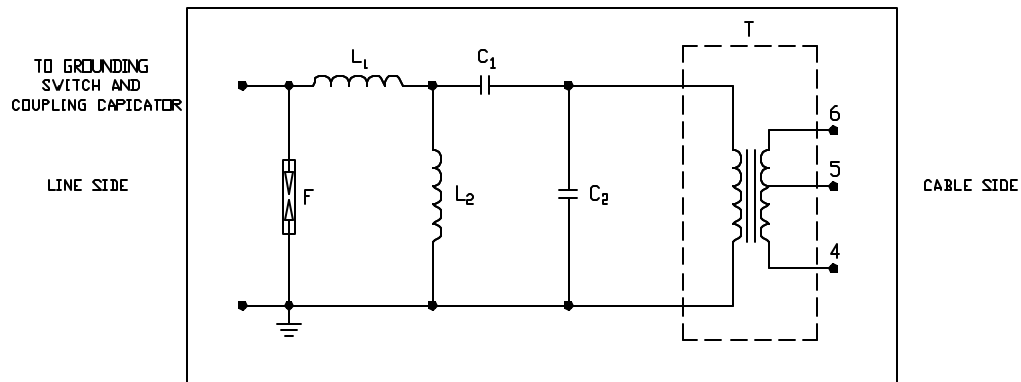


FIGURE 2. TYPICAL SCHEMATIC DIAGRAM #1 (BAND-PASS CONNECTION).

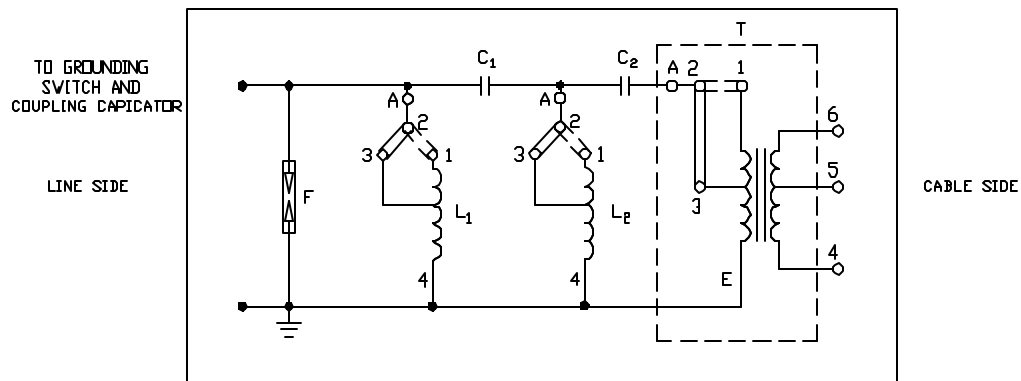


FIGURE 3. TYPICAL SCHEMATIC DIAGRAM #2 (HIGH-PASS CONNECTION).

C - CAPACITOR  
F - LIGHTNING ARRESTER

L - INDUCTOR  
T - MATCHING TRANSFORMER

## 5. 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.



## 6. SERVICE CONDITIONS

### 6.1 Outdoor service conditions.

- 6.1.1 The line tuner shall be capable performing its function when exposed to sunshine, rain, fog, hail, frost, snow, ice, etc.
- 6.1.2 Altitude of installation isn't higher than 1000 m.
- 6.1.3 Ambient temperature shall lie in the range -40 degrees C to +45 degrees C

### 6.2 Characteristics

- 6.2.1 Carrier-frequency range 40 to 500 kHz (see table 1).
- 6.2.2 Nominal line-side impedance 300, 400  $\Omega$  (others on request)
- 6.2.3 Nominal equipment-side impedance 50 or 75 Ohms
- 6.2.4 Capacitance of capacitor 1,400 to 25,000 pF
- 6.2.5 Methods of coupling Phase-to-ground
- 6.2.6 Return loss >12 or 16 dB
- 6.2.7 Composite loss  $\leq 1.3$  dB
- 6.2.8 Nominal peak-envelope power 400, 600, 800 or 1000 W
- Intermodulation distortion 3<sup>d</sup> and 5<sup>th</sup> order  $\leq 80$  dB
- Harmonic distortion  $\leq 80$  dB

### 6.3 Safety and protection

- 6.3.1 Drain coil
  - Impedance at power frequency  $\leq 20 \Omega$
  - Short-time current 0.2s 50/60 Hz 50 A
  - Continous current r.m.s. 50/60 Hz 1.0 A
- 6.3.2 Over voltage protection
  - Lightening arrester rated voltage 1,000 V
  - Power frequency sparkover voltage 1,800 to 2,500 V r. m. s
  - Impulse sparkover voltage peak value 1.2/50 $\mu$ s wave  $\leq 3,400$  V
  - Capacitance between poles <20 pF
  - Nominal discharge current 8/20  $\mu$ s wave 5 kA
  - Residual voltage at rated discharge current  $\leq 3,000$  V
- 6.3.3 Grounding switch (optional)
  - Rated current (r.m.s. continuous value) 200 A

### 6.4 Insulation requirements

- 6.4.1 Power frequency level: Power-frequency withstand voltage between the primary and secondary winding of the matching transformer is 5,000 V for 1 min.
- 6.4.2 Impulse level: Complete line tuners can withstand impulse voltage of 6,800 V peak, wave shape 1.2/50  $\mu$ s.



## 6.5 Connection

The finished line tuners are all connected as follows when leaving the factory. The cable side is in 75  $\Omega$  position, and generally the line-side is on 400  $\Omega$  position. If the impedance of line side or carrier-frequency connection can't meet this case, change should be made in terminal connection according to numbers 1,2,3,5,6 in Table 2 (below) which correspond to terminals on the casing of the inductor and matching transformer respectively.

Table 2 - Terminal Connections

Nominal Impedance		Inductor L1, L2	Matching Transformer				
Line-side	Cable-side		Link	Ground	4	5	6
300	50	2 to 3	2 to 3	✓	✓	✓	
	75			✓	✓		✓
400	50	2 to 1	2 to 1	✓	✓	✓	
	75			✓	✓		✓

Note: " ✓ " means connect to terminals of matching transformer.

## 7. MOUNTING AND MAINTENANCE

- 7.1 For mounting dimensions, see figure 4.
- 7.2 When mounting coupling filter, be sure to connect the HF insulator out of the aluminum enclosure to the line tuner terminal of the coupling capacitor.
- 7.3 The earthing switch has been mounted on the aluminum housing of the filter before shipment. Use a hot-stick to ground the line tuner via the grounding switch before attempting inspection/maintenance, if the power line is live.
- 7.4 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.
- 7.5 As the protection device of coupling filter, the lightning arrester should be tested once a year. If it's power frequency sparkover voltage fails in the available range, the arrester should be replaced.

## 8. ORDERING INFORMATION

- 8.1 Specify model, version, quantity, capacitance of the coupling capacitor, line impedance, ground switch arrangement and required time of delivery.
- 8.2 Non-standard values of line impedance or capacitance of the coupling capacitor can be accommodated upon request.

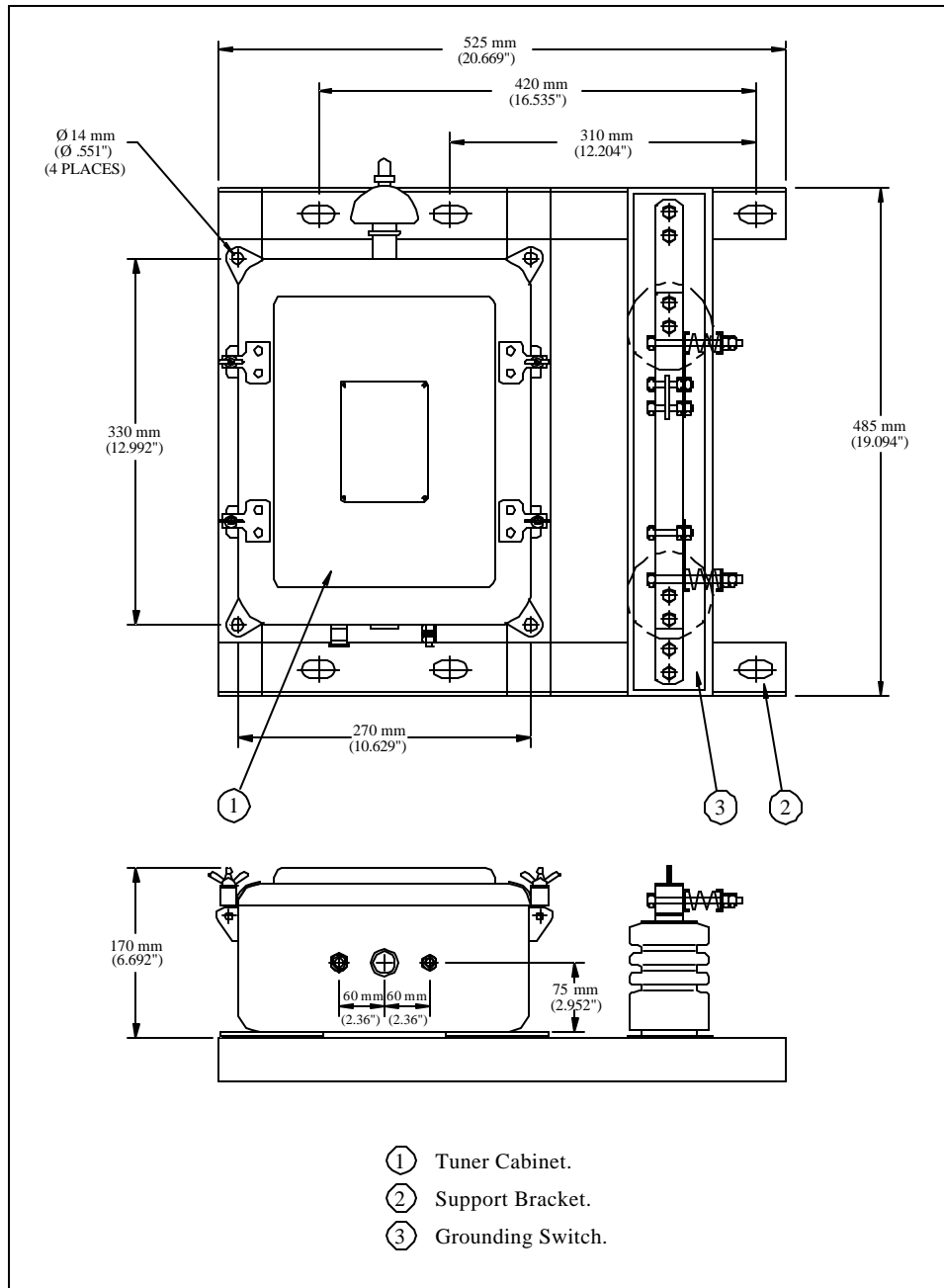


Figure 4. Assembly Drawing for 9510 Line Tuner and external Grounding Switch

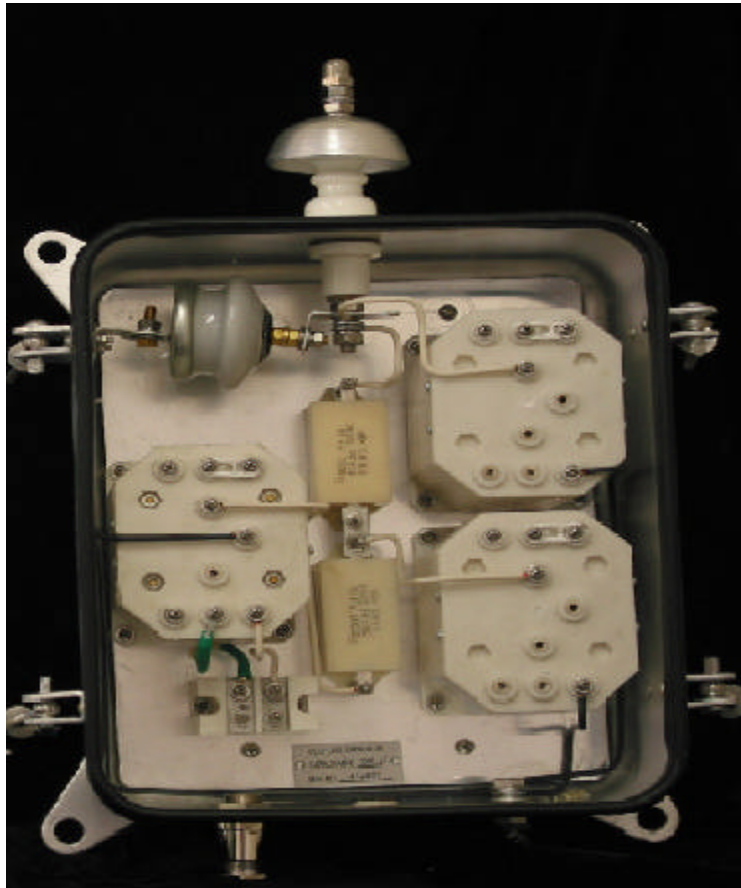


Figure 5. Internal View



NOTES



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