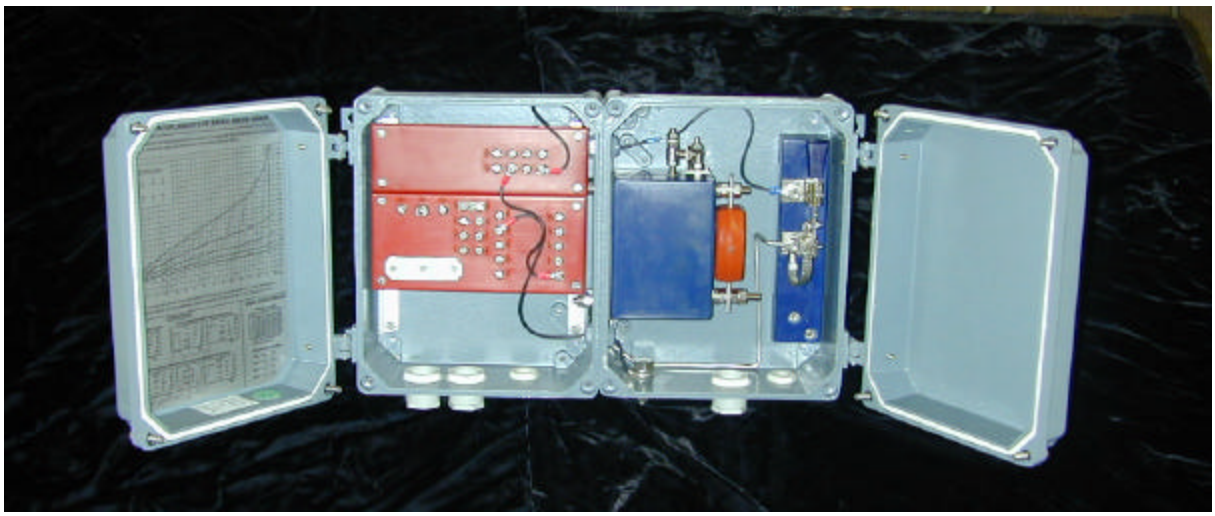
PRODUCT INFORMATION

RFL 9511

Wideband Coupling Units
For Powerline Carrier Systems



1. INTRODUCTION

1.1 GENERAL

The coupling units allow, in conjunction with coupling capacitors, the transmission of carrier frequency signals, and at the same time offer an efficient protection of personnel and equipment against the effects of the power frequency voltage and transient overvoltages.

The RFL Wide Band Coupling unit is used for coupling Power-Line Carrier (PLC) equipment to a single phase of high-voltage power lines, carrying out the following:

- Tuning of coupling capacitor to minimize the coupling impedance.
- Impedance matching between power line and communication equipment.
- Draining to ground of power frequency current, limitation of voltage surges coming from the power line and grounding of the coupling device for protection purposes.

The units can be used for phase-to-ground, phase-to-phase or three-phase coupling. One RFL 9511 unit is used for phase-to-ground coupling. Two RFL 9511 units are required for phase-to-phase coupling with the two being connected together through a differential transformer acting as a hybrid circuit. Three RFL 9511 units and two hybrid circuits are needed for three-phase coupling.

1.2 CONSTRUCTION

The RFL 9511 coupling unit consists of three basic blocks which contain protection, tuning and impedance matching elements. Tuning and matching elements are mounted on epoxy resin plates housed in an aluminum cabinet suited for outdoor mounting. Figure 1 shows the schematic of the RFL 9511 while figure-2 shows the physical construction.

1.2.1 Protection elements

This group comprises the drain coil, the grounding switch, and the air surge arrester. Should higher security be required two optional surge arresters can be added at the factory. The first one is of variable resistance and is installed in parallel with the air surge arrester. The second is a gas surge arrester and is connected between the isolating transformer equipment-side terminals. The purpose of the last surge arrester being to protect the PLC equipment.

The drain coil has an air core to minimize intermodulation, and is wound on a multisection coil form to reduce the distributed capacitance. The coil is molded in an epoxy resin block, which also holds the grounding switch and the surge arrester.

1.2.2 Tuning elements

Tuning elements of the RFL 9511 coupling units consist of two resonant circuits forming a band-pass filter. The first circuit is made up of the leakage inductance of the matching transformer and a capacitor connected between the transformer line-side winding terminals. The second resonant circuit comprises the coupling capacitor and the tuning inductance (adjustable in steps).

According to Publication IEC 481, the bandwidth is defined as the pass band within which composite loss is lower than 2 dB and return loss is greater or equal to 12 dB. The latter condition is more stringent as composite loss at a return loss of 12 dB is normally lower than 1 dB.

Bandwidth increases with frequency, capacitance value and line impedance. The tuning coil is provided with 8 taps to tune the coupling capacitor at different frequencies.

1.2.3 Matching Element

The unit consists of the isolating transformer, which matches the primary impedance of the phase-to-ground coupling, line side, to the secondary one, equipment side. Primary winding is referred to ground whereas the secondary one is balanced.

Line impedance matching is carried out by means of the primary-winding taps, which allow one of the 25 line impedance values available to be selected, whilst one of the four secondary-winding taps is used for equipment impedance matching.

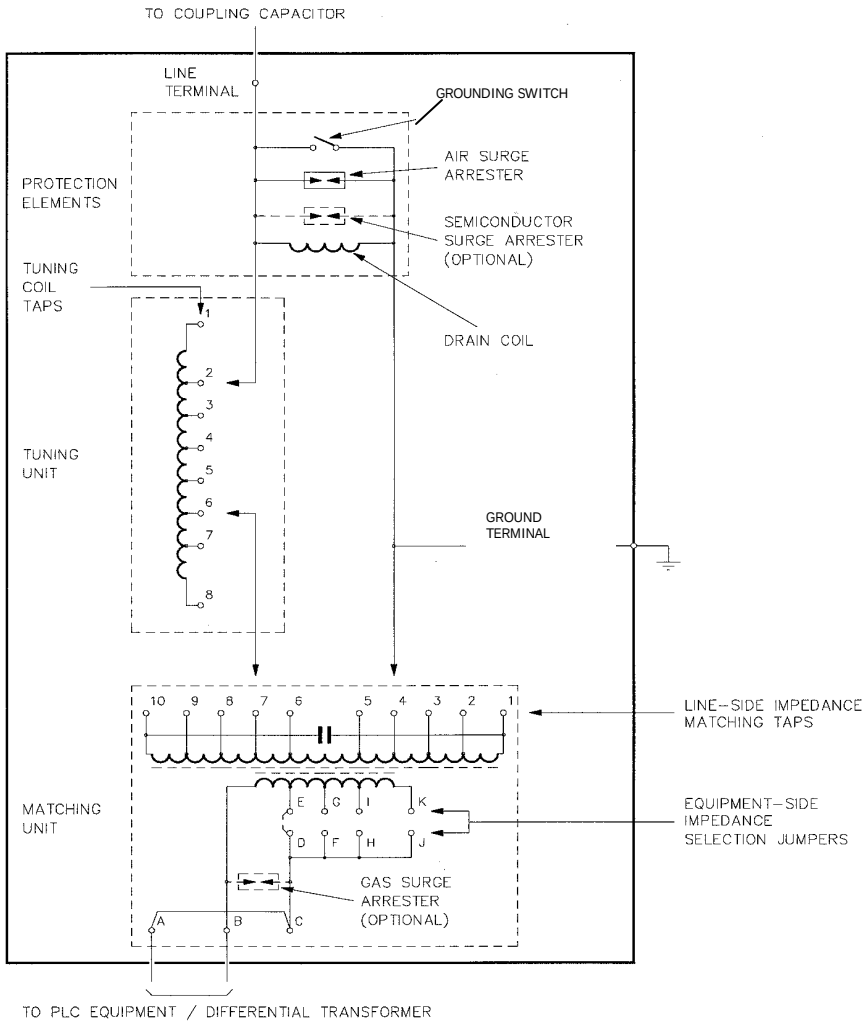


Figure 1 Coupling Unit schematic.

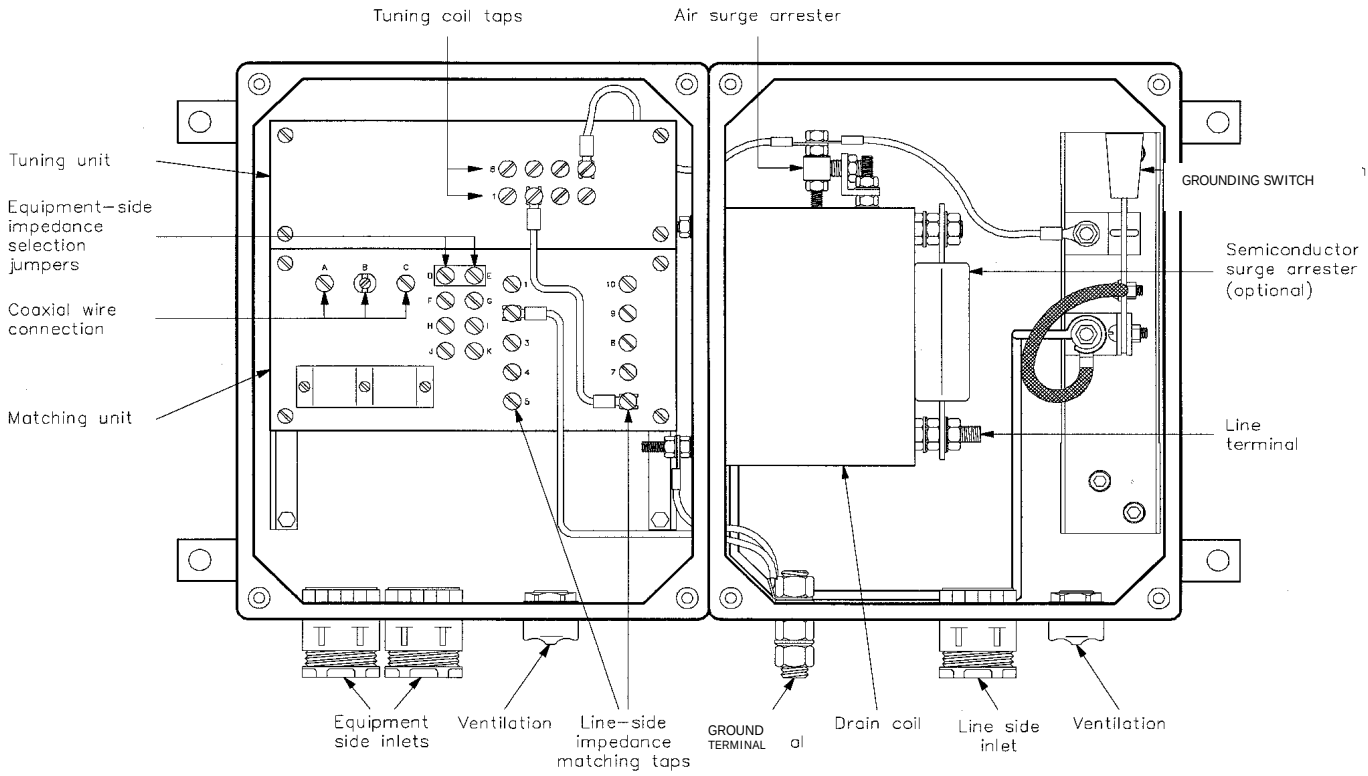


Figure 2 RFL 9511 Coupling Unit

1.3 HYBRID CIRCUITS

The connection of the RFL 9511 units used in a phase-to-phase or three-phase coupling is carried out, respectively, by means of one or two differential transformers acting as a hybrid circuit. The use of the said circuits allows links to be designed that are fault tolerant, which means that if one or two phases fail only a moderate additional attenuation is introduced in the link.

The hybrid circuit is made up of a differential transformer, with a 1: 2 turn ratio between primary and secondary windings, and a resistor, the value of which is half that of the nominal impedance of the equipment, connected between the center tap of the secondary-winding and the point where the shield of the coaxial cables is connected. This resistor only dissipates power if one of the phases used fails.

The differential transformer and the resistor are mounted on an epoxy resin plate housed in an aluminum cabinet suitable for outdoor mounting.

Two versions of hybrid circuit are used depending on the type of coupling required. For phase-to-phase coupling unit DT is used, the circuit diagram of which is shown in Figure 3. Three-phase coupling requires unit DT/T,

which contains the two hybrid circuits necessary for the coupling to the three phases of the power line.

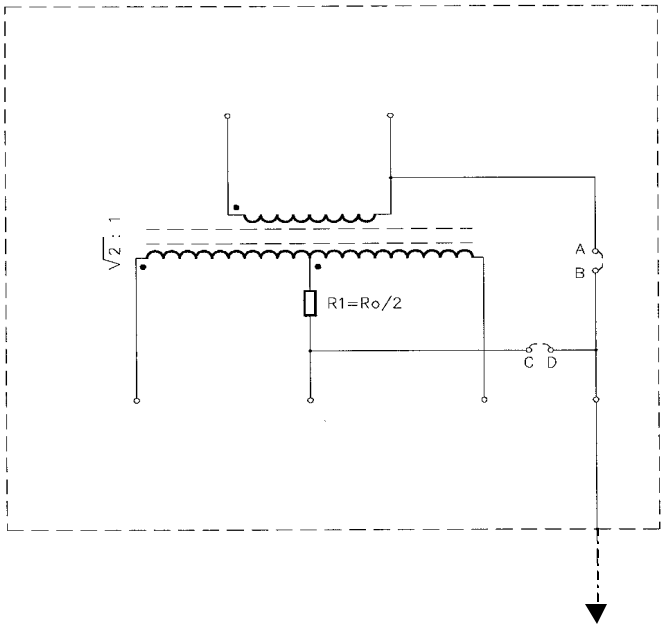


Figure 3 Circuit diagram of differential transformer Model DT

1.4 TECHNICAL CHARACTERISTICS

1.4.1 Electrical characteristics

Frequency range	40 kHz to 500 kHz
Nominal peak-envelope power	100W
Nominal impedance	
Equipment side	50 , 75 or 125 Others on request
Line side	100 to 750 , for phase-to-ground coupling in 25 steps
Distortion and intermodulation	80 dB below the level corresponding to the nominal PEP (IEC 481, clause 9.6)

Bandwidth (corresponding to return loss >12 dB and composite loss <2 dB)	See Figure 4
Temperature range	-25 °C to +60 °C
Power frequency insulation	>5 kVrms (IEC 481, clause 8.1)
Impulse voltage insulation	>2 kVrms (IEC 481, clause 8.2)
Protection elements	
Air surge arrester	
Sparkover voltage	<1 kVrms
Impulse discharge current	>5 kArms (1.2/50μs)
Solid-state surge arrester (optional)	
Model	BBC 0.44
Nominal voltage	440 Vrms
Impulse discharge current	5 kArms (8/20 μs)
Gas Surge Arrestor (Optional)	230Vrms
Drain coil	
Impedance over 40 kHz to 500 kHz	>8 k
Nominal inductance	26 mH
Nominal resistance	7
Maximum impedance at power frequency, in the temperature range indicated	13
Current carrying capacity at power frequency	1 Arms continuous 50 Arms for 0.2 sec.

1.4.2 Mechanical characteristics

Dimensions	
DT	10.4 x 8.4 x 5.2 in (264 x 214 x 132 mm)
UAMP/W and DT/T	10.4 x 16.9 x 5.2 in (264 x 430 x 132 mm)
Maximum diameter of the conductors	0.83 in (21 mm)
Type of finish	Outdoor acrylic paint, RAL 514 color (bluish-grey)
Weight	
UAMP/W	21 lbs (9.5 kg)
DT	11 lbs (5 kg)
DT/T	20 lbs (9 kg)

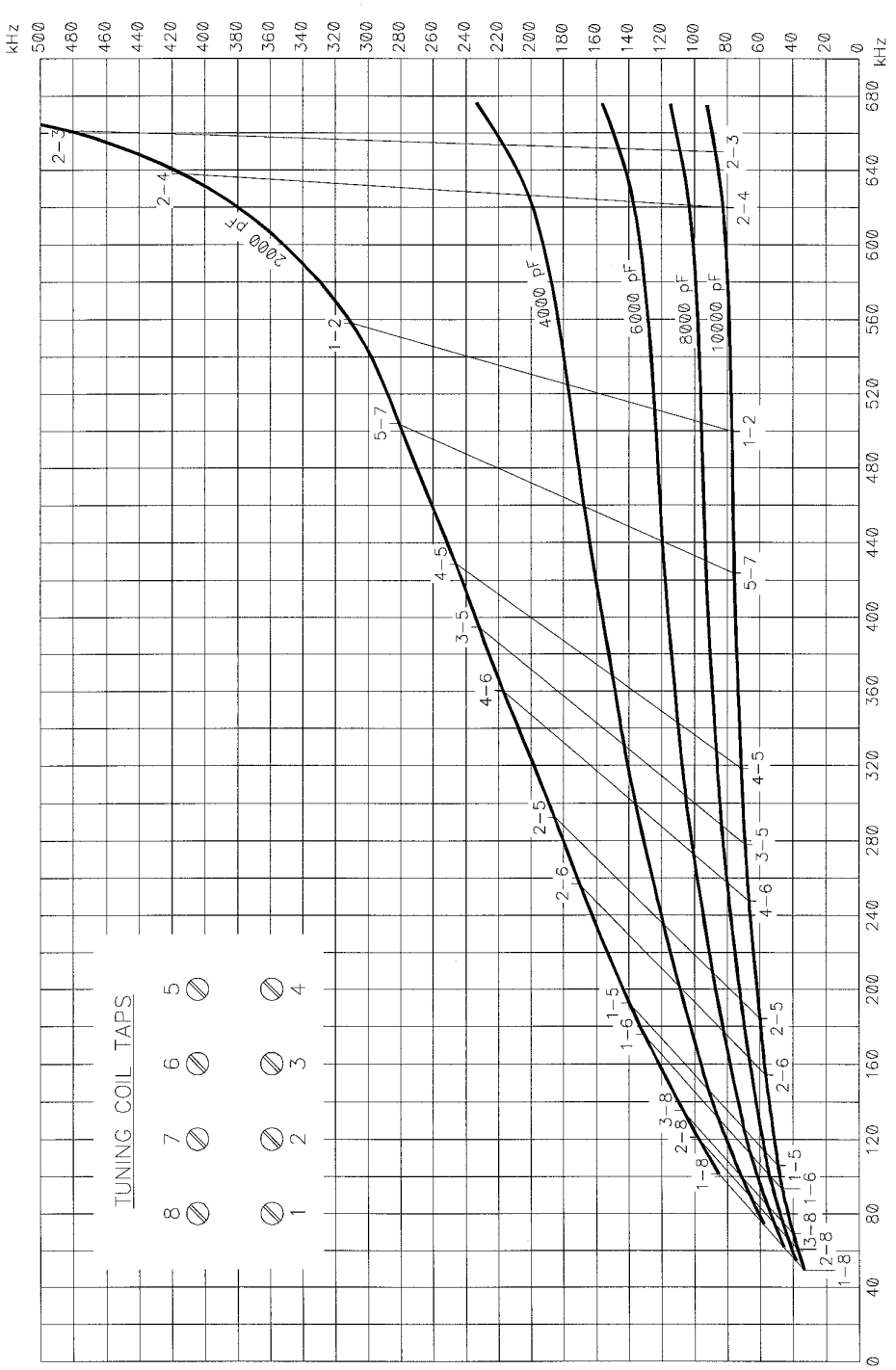


Figure 4
Nominal bandwidth limits for 300 line impedance and phase-to-ground coupling

RFL Electronics Inc.
353 Powerville Road • Boonton Twp., New Jersey 07005-9151 USA
Tel: 973.334.3100 • Fax: 973.334.3863
email: sales@rflelect.com • www.rflelect.com