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(I) Denotes change since previous issue.

Pilot Wire Insulation and Protection for HCB and HCB-1 Relaying



Before putting protective relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

1.0 APPLICATION

The insulation and protection equipment shown in Figure 1 is used with the HCB or HCB-1 pilot wire relay. A complete installation for one terminal of a line consists of an insulating transformer, neutralizing reactor, capacitors, mutual drainage reactors and neutralizing reactor with surge voltage protectors.

1.1 BYPASS CAPACITOR (C)

The ac bypass capacitor (C) is required only when dc monitoring and/or remote trip relays are used. Otherwise connect H2 to H3 on the insulating transformer (refer to Figure 1). Use a 10 uf capacitor for 50/60 Hz applications.

1.2 EXCITING CAPACITORS (CG)

The exciting capacitors (Cg) and ground connection are omitted when the neutralizing reactor is not used. Use of 1.0 Uf capacitor for 50/60 Hz applications.

For an application using dc monitoring remote-trip relays without the insulating transformer for HCB/HCB-1 relaying, capacitor C should be connected across the wires to minimize the metallic voltage

(wire-wire voltage) generated by the unbalanced impedance of capacitors Cg.

1.3 MUTUAL DRAINAGE REACTOR

The mutual drainage reactor is applied to drain off longitudinally induced voltages which may occur by lightning surges (not a direct stroke) or the parallel association of the pilot wire with faulted power circuits.

The mutual drainage reactors must be applied at more than one terminal or location to provide a path for the drainage currents to flow.

With the mutual drainage reactor only (hence no rise-in-station-ground hazard), the remote and station ground are essentially equal, and the joint ground terminal of the two Siemens L2A600 surge protectors should be connected to station ground.

By forcing equal current flow from the two wires into ground, the reactor minimizes metallic voltage (wire-to-wire voltage). The reactor cannot, however, eliminate all metallic voltage even though the longitudinally induced voltages (common mode) are equal and the currents are equal on the two wires unless the wire resistances are identical.

Since it is not practical to make the wire resistances equal, there is a limit to the amount of induced voltage which can be handled without introducing the possibility of relay misoperation due to the generation of spurious metallic voltage. Care must be taken to assure that the resistance unbalance does not generate a metallic voltage greater than 7 volts when the induced voltage is drained. If this value cannot be obtained then use a cable with sufficient insulation to withstand the induced voltage stress or improve the shielding to reduce this voltage.

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding this particular installation, operation or maintenance of this equipment, the local ABB Power T&D Company Inc. representative should be contacted.

1.4 NEUTRALIZING REACTORS

The neutralizing reactors are applied where the difference between station ground and remote ground can exceed 600 volts rms during power system faults. This rise in station ground potential appears across the neutralizing transformer inserted in the pilot wire. Thus all equipment and circuitry to the left of the neutralizing reactor terminals H2 and H4 (Figure 1) are essentially at station ground. All equipment, circuits, pilot wire, sheath, etc. to the right of H1 and H3 (Figure 1) are at remote ground and must be insulated from station ground and operating personnel in the station area. The shunt capacity to ground of the pilot wire pair should be on the order of 1 μ f or more. If not, capacitance (Cs) should be added as shown to provide equivalent of approximately 1 μ f total on each wire to ground.

The neutralizing reactor and mutual drainage reactor may be used together as shown or may be applied separately depending on the hazards encountered.

The neutralizing reactor may be applied at one terminal only if there is no rise in voltage at the other terminals.

1.5 NEUTRALIZING REACTOR SURGE VOLTAGE PROTECTOR

The neutralizing reactor surge protector, type Siemens L2A600, is recommended to minimize wire to wire voltage during a disturbance with one wire accidentally grounded.

1.6 SHIELD GROUNDING

In order to be electromagnetically effective, the shield must be grounded at least twice to provide a path for the flow of demagnetizing current the question, though, is where? Should the shield be rounded or insulated from the station mat?

If the shield is grounded to the power station mat, the shield may be damaged by current generated by a rise in station-ground potential during a power-system fault. Unless, the shield has sufficient conductivity to withstand the thermal stress, it should be insulated from station ground. Note that an increase in shield conductivity does not cause a proportional increase in shield current due to the inductance in the loop. If the shield is insulated from station ground (i.e. within 500 ft. of station) it is not effective in reducing induced voltage in the insulated section; if this voltage is large, a high conductivity shield which can thermally withstand the stress of a mat ground is indicated. The "insulated shield" section must be remote grounded to minimize electric-field pickup.

Where the two stations are within about 1500 ft. or less of each other a single shield ground should be used or the shield should be tied to both mats. In such an application it is common to interconnect the two mats via large power cables (in addition to the overhead shield wires); these reduce the 60 Hz mat voltage difference. However, they have a limited effectiveness due to the cable inductance.

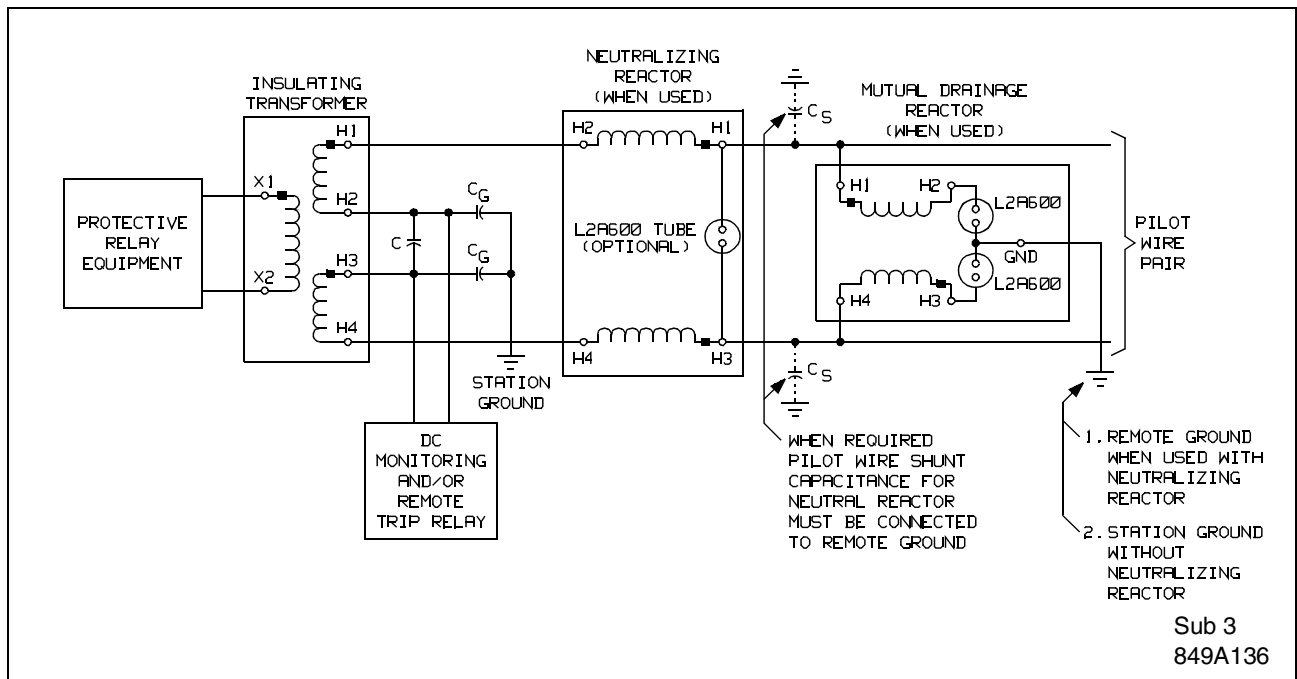


Figure 1. External Schematic of Pilot Wire and Protective Equipment for HCB and HCB-1 Relaying

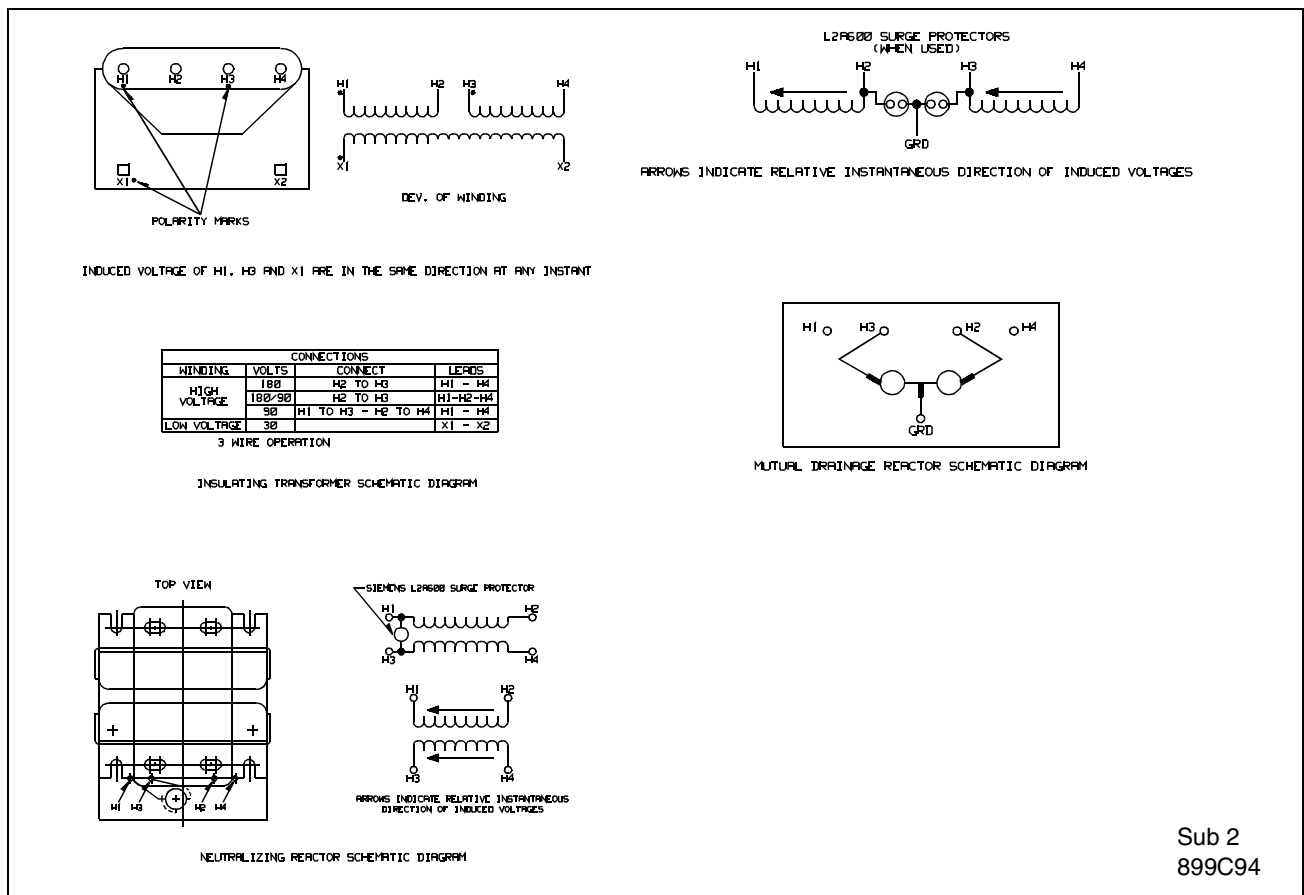


Figure 2 Schematic Diagram of Protective Equipment for HCB and HCB-1 Relaying

TECHNICAL DATA

INSULATING TRANSFORMER					
Style	Rating	Frequency	Schematic	Reference	Outline Reference
7882A26H07 7882A26G08	4/1 6/1	50-60 Hz 50-60 Hz	20D1472 16D9583	Fig. 2 Fig. 2	Fig. 3 Fig. 3

INSULATING TRANSFORMER					
Insulation 60 Sec. Rating	Units	4/1	6/1	4/1	6/1
		60 Hz		50 Hz	
H to L	kV	12	12	12	12
H to GND		12	12	12	12
L to GND		4	4	4	4

INSULATING TRANSFORMER					
General Specifications	Units	4/1	6/1	4/1	6/1
		60 Hz		50 Hz	
Rated Voltage H1-H2 and H3-H4	Volts	60	90	60	90
Rated Voltage X1-X2	Volts	30	30	30	30
Continuous Rating H Windings	mA	12	8	12	8
Resistance of each H Winding	ohms	20.4	46.5	20.4	46.5
Continuous Rating X Winding	mA	48	48	48	48

INSULATING TRANSFORMER					
General Specifications	Units	4/1 1	6/ 60 Hz	4/1 1	6/ 50 Hz
		1.7	1.7	1.7	1.7
Resistance of X Winding	ohms	1.7	1.7	1.7	1.7
Exciting Impedance X1-X2 at 30 V	ohms	850- 1250	850- 1250	850- 1250	790- 1030
Approximate Weight	Pounds	25	25	25	25

SIEMENS L2A600 SURGE VOLTAGE PROTECTOR	
ac rms voltage breakdown	400-450 volts
1 - Second current rating, rms	40 amperes
11 - Cycle current rating, ms	200 amperes

NEUTRALIZING REACTOR					
Style	Freq.	With Siemens L2A600 Tube & Socket	Schematic	Refer- ence	Outline Refer- ence
7882A27G03	50-60	Yes	899C094	Fig. 2	Fig. 4
7882A27G01	50-60	No	899C094	Fig. 2	Fig. 4

AUXILIARIES

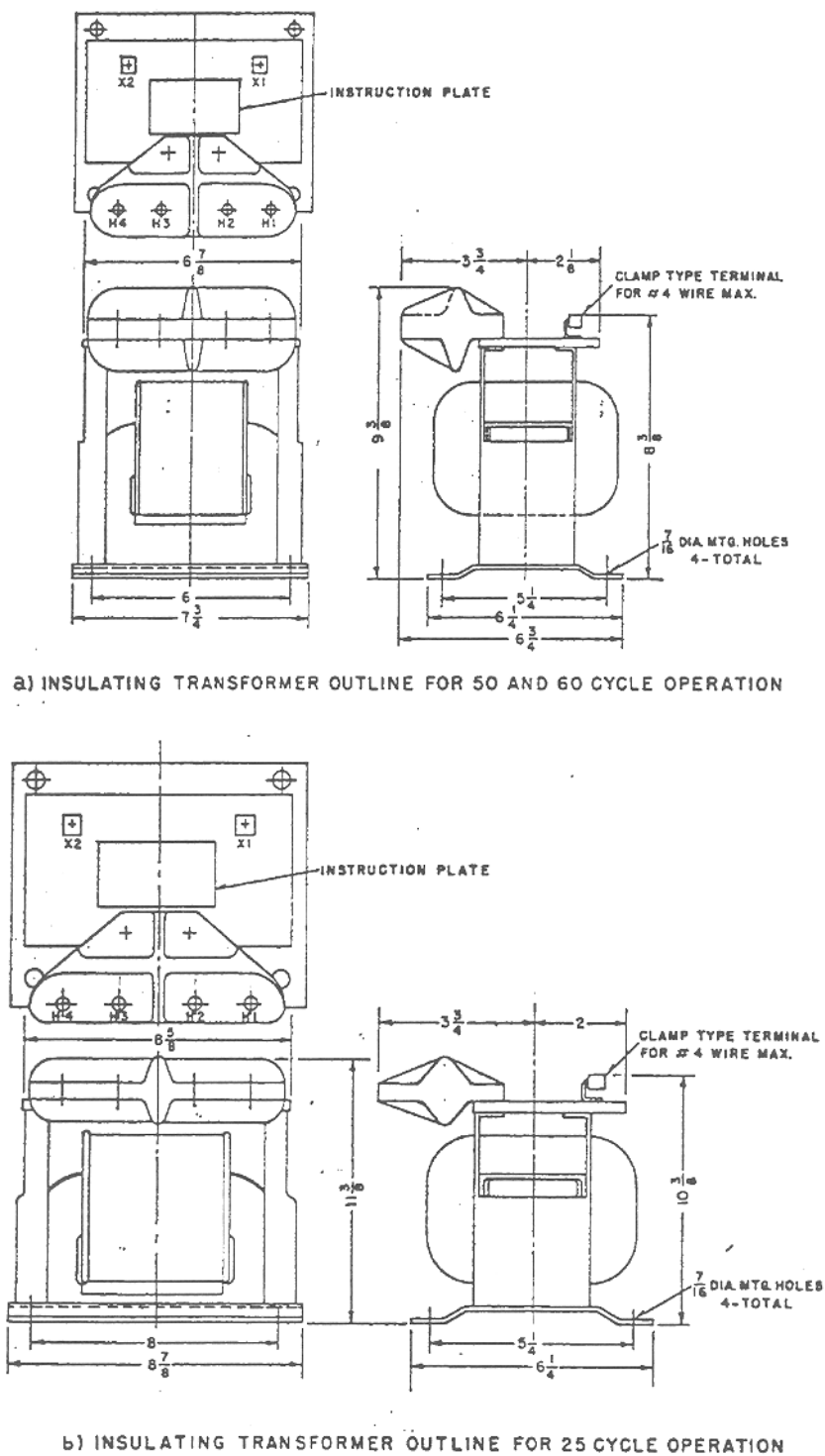
Style 949122, Drawing 4C6483

1 uf exciting capacitor - 2 required per 50-60 Hz
Neutralizing Reactor

NEUTRALIZING REACTOR, (continued)			
General Specifications	Units	60 Hz	50 Hz
Voltage Rating between Windings	volts	500	500
Voltage Rating across Windings in Parallel	volts	4,000	4,000
Exciting Impedance - both Windings in Parallel at 4 kV	ohms	134,000 267,000	56,750 113,500
Leakage Reactance Each Winding	ohms	65	54
Resistance of Each Winding	ohms	88	88
Total Impedance One Reactor Adds to the Pilot Wire Loop	ohms	219	207
Test voltage Windings to Ground	volts	10,000	10,000
Continuous Current Rating Each Winding	mA	10	10
One Second Current Rating Each Winding	mA	50	50
Approximate Weight	pounds	76	76

MUTUAL DRAINAGE REACTORS			
General Specifications	Units	60 Hz	50 Hz
Test voltage Between Windings and Between Windings and Ground for 1 minute	volts	4,000	4,000
Excitation Impedance at 120 volts from H1 to H4 H2 to H3 connect together	ohms	24,000-48,000	17,000-33,000
dc Resistance Each Winding	ohms	8	8
Leakage Reactance Each Winding	ohms	1.5	1.2
One Second Rating Each Winding	amperes	90	90
Two Second Rating Each Winding	amperes	22	22
Approximate Weight	pounds	40	40
Saturation Point H1 & H3, to (Winding in Parallel)	volts, rms	500	400

MUTUAL DRAINAGE REACTORS						
Style	Freq	Inc. Socket for Tube	Inc. L2A600 2 - Tube	Schematic	Reference	Outline
7882A28G03	50/60	Yes	Yes	899C094	Fig. 2	Fig. 5



Sub 1
899C095

Figure 3. Insulating Transformer Outlines, 50 and 60 Hz Operation; Protection Equipment for HCB and HCB-1 Relaying

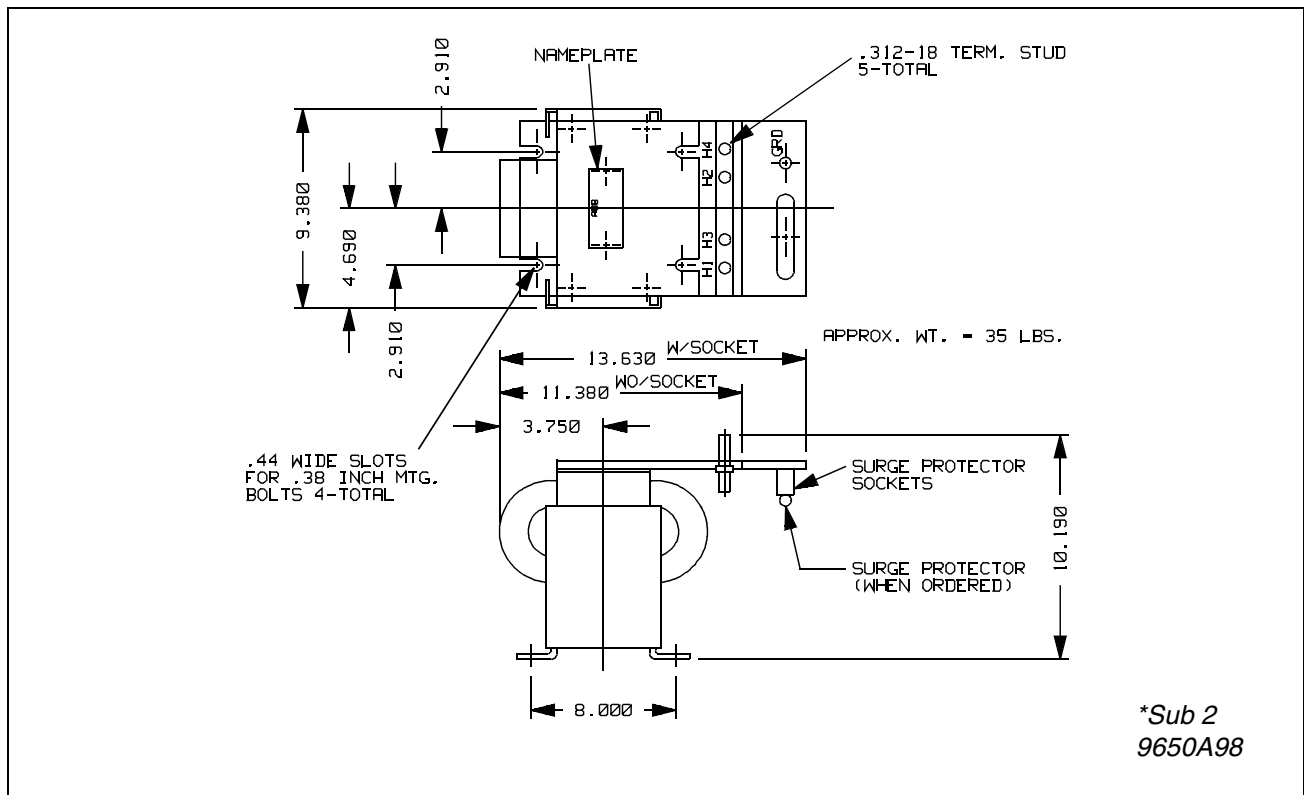


Figure 4. Neutralizing Reactor Outlines, 50 and 60 Hz Operation; Protective Equipment for HCB and HCB-1 Relaying

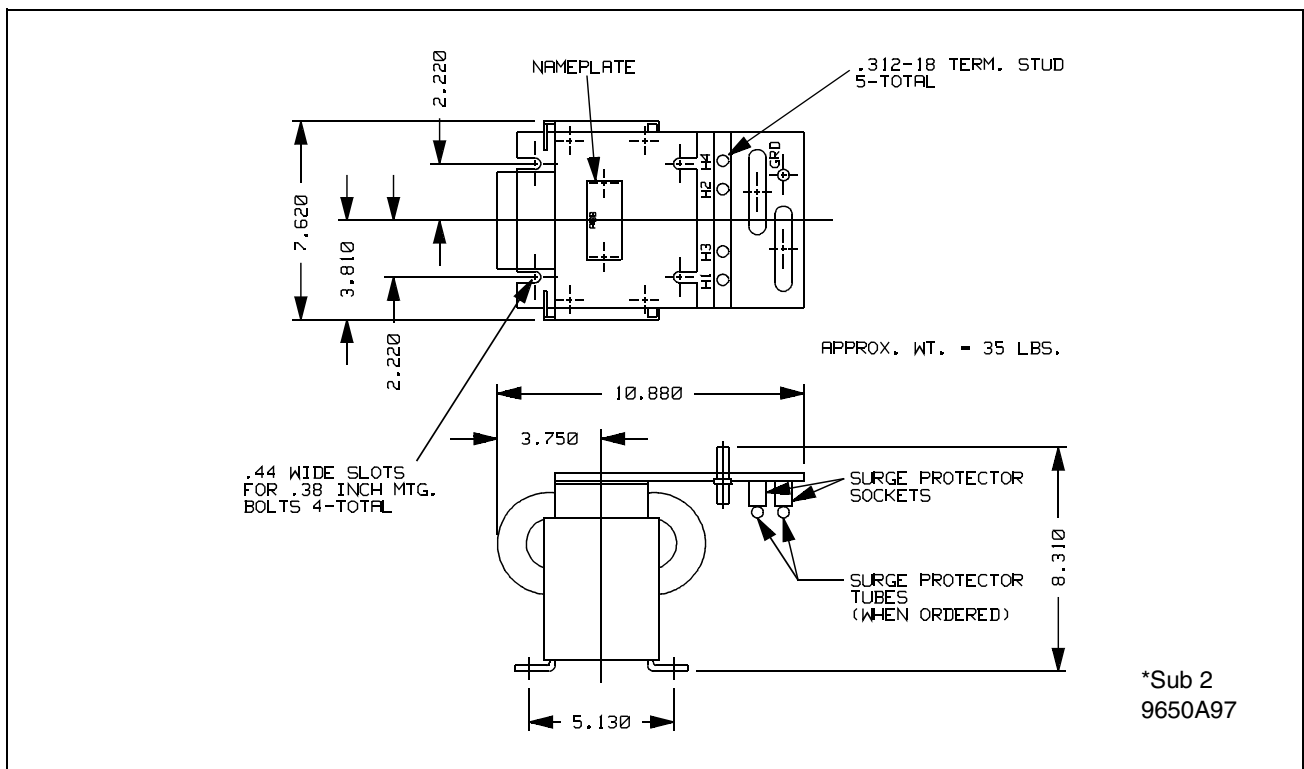


Figure 5. Mutual Drainage Reactor Outline, 50 and 60 Hz Operation; Protective Equipment for HCB and HCB-1 Relaying



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