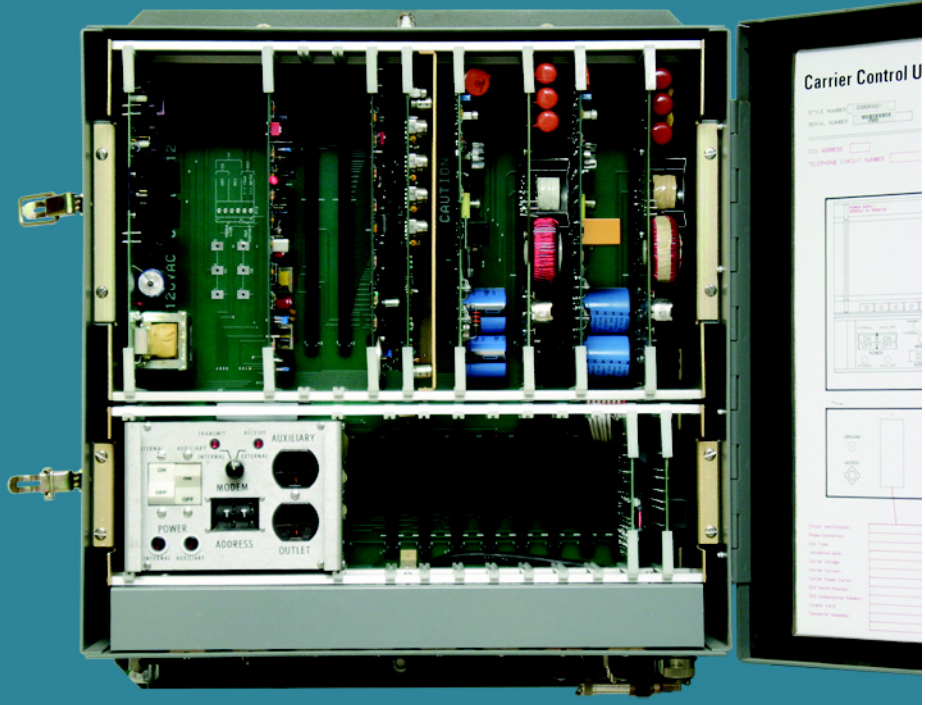
CANNON



CCU-711 Carrier Control Unit Technical Manual

COOPER Power Systems

Rev 5.2
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Revision	Date	Description
1	12/19/2001	Initial Release.
2	03/12/2002	Text Revisions.
3	07/25/2003	Added Power Output Measurement Test Setup Chapter.
4	07/31/2006	Updates.
4.1	04/12/2007	Updated document template.
5.0	10/27/2008	Updated photos.
5.1	03/19/2009	Updated front and back covers.
5.2	05/21/2009	Updated coax cable crimping illustration

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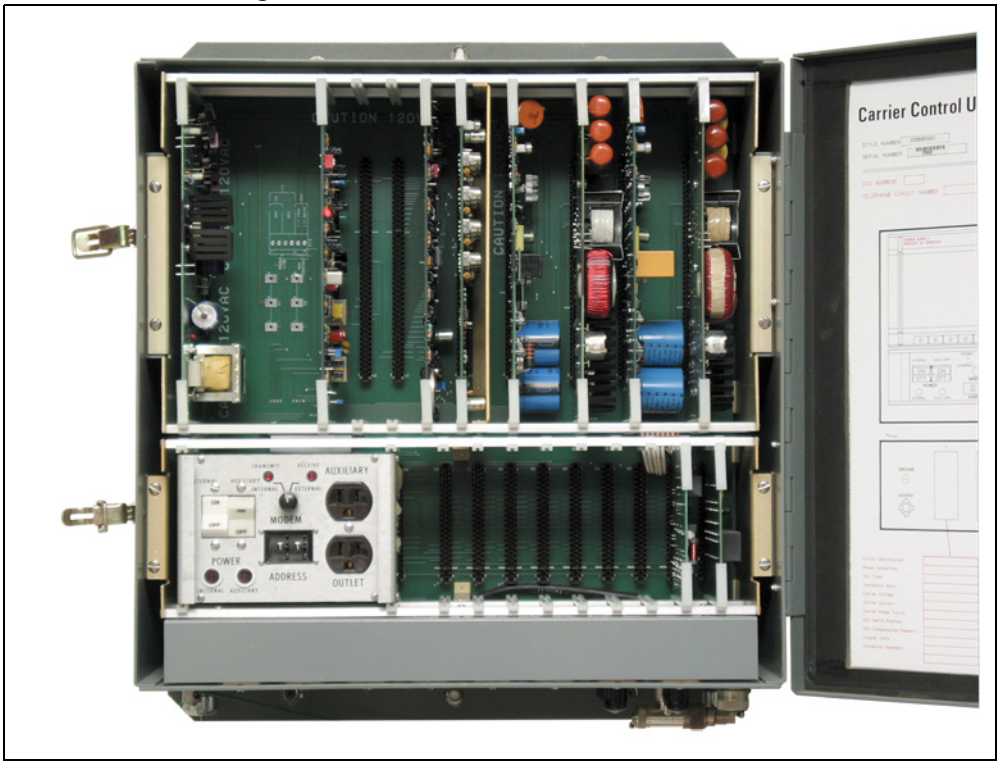
Chapter 1
CCU-711 Introduction

1.1 CCU-711 Overview

This document contains the field installation and maintenance instructions for the various configurations of the CCU-711 Carrier Control Unit. The CCU-711 receives, translates, and retransmits commands from the Yukon Master Station to remote terminals. The CCU-711 is available in several configurations. Within this manual, it is assumed that the best CCU configuration has been selected for the application.

Figure 1.1 CCU-711 Carrier Control Unit



The instructions are arranged in the normal sequence of performance. When the CCU-711 is installed and operational, the individual procedures may be performed as required to maintain the CCU. This manual is divided into the following sections:

- Chapter 1, “CCU-711 Introduction”
- Chapter 2, “CCU-711 Installation”
- Chapter 3, “Primary Coupling Assembly Installation”
- Chapter 4, “CCU-711 Injection Tuning”
- Chapter 5, “CCU-711 Troubleshooting and Repair”

1.2 Common Functions

The CCU-711 is installed at a distribution substation, on the distribution bus. Since the enclosure is weatherproof, the CCU can be mounted either indoors or outdoors.

The Yukon Master Station transmits commands and data messages to the CCU-711 via a voice grade two-way communication channel. A microcomputer in the CCU formats these messages for Cannon Power Line Carrier (PLC) transmission. The Cannon PLC message is amplified by the CCU and coupled to the distribution lines via a Primary Coupling Assembly (PCA) for transmission to the field terminals. Each CCU can be coupled to up to eight distribution buses or feeders. The CCU receives reply messages from field terminals via the distribution lines. The microcomputer formats these reply messages for compatibility with the Yukon Master Station format. The CCU monitors the quality, accuracy, and completeness of message communication using parity.

All transmit switching is done at zero power levels which enhances the reliability of the CCU-711 and extends the life of the CCU relays. As a backup, the CCU has two power amplifiers. If a failure is detected in one power amplifier, the other power amplifier can be selected at the Yukon Master Station.

Each CCU-711 is also equipped with an external serial interface connector, compatible with an RS-232C serial port, which is used to interface the CCU with test equipment.

Chapter 2
CCU-711 Installation

Refer to the following sections for information on installing a CCU-711.

2.1 CCU-711 Specifications

The following sections describe the CCU-711 specifications:

2.1.1 Communication Options

The communication options of the CCU-711 are:

- Bell 3002 communications link or equivalent (telephone, radio, microwave, or pilot wire)
- Asynchronous, serial, 300/1200 bps internal modem: Bell 103/108 or 202 equivalents. 4800 bps optional
- External serial interface port
- IDLC protocol
- Error detection:
  - 16 bit CRC code on each frame for communication with the Yukon Master Station
  - 6 bit CRC code on each frame for communication with the Cannon PLC devices
- Carrier frequencies: 9.6 kHz and 12.5 kHz
- Modulation: Coherent Phase Shift Keying (CPSK)
- Typical data rate: 70 to 80 bps

2.1.2 Environmental

The environmental specification of the CCU-711 are:

- Temperature: -40 to +55o C
- Relative Humidity: 0-100% non-condensing

2.1.3 Electrical Requirements

The electrical requirements of the CCU-711 are:

- Power source: 120 VAC +/-10%, 50/60 Hz
- Power consumption: 600 W maximum; 50 W standby
- Auxiliary power outlet: 120 V RMS, 10 A (US standard only)
- Surge protection: ANSI C37.90A

2.1.4 Dimensions and Weight

The dimensions of the CCU-711 are:

21.3" H x 19.7" W x 8.1" D
(54.1 cm H x 50 cm W x 20.6 cm D)

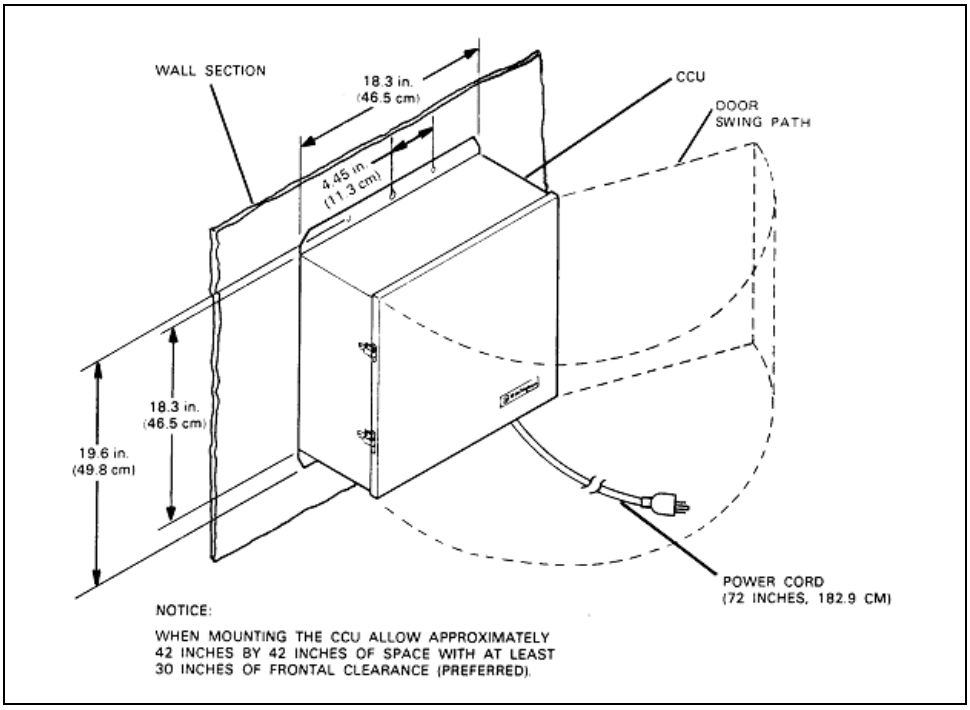
The weight of the CCU is 33 pounds (14.85 kg).

2.2 Site Requirements

The following list describes the CCU-711 site requirements:

- Two-way communication channel (leased line, telephone dial-up, microwave radio, or satellite).
- 120 VAC, 60 Hz power (20 ampere breaker minimum) receptacle must be accessible by the power cord.
- Indoor location (preferred).
- Eye level mounting height.
- Recommended maximum cable distance of 200 feet from the CCU mounting location to the SCUs.
- Mounting space of approximately 42 inches by 42 inches with at least 30 inches of frontal clearance (preferred) or an area with the same dimensions on the substation superstructure.

Figure 2.1 CCU-711 Installation Site



NOTE: *An outdoor mounting location may necessitate the use of waterproof wiring. The CCU power cord may be eliminated by wiring the CCU directly to the electric circuit.*

2.3 Unpacking and Inspection

When a CCU-711 is shipped from the factory, the circuit boards are removed from the board racks and individually wrapped for protection. When transporting a CCU-711, the circuit boards should be removed from the CCU and individually wrapped and packaged for protection during handling and shipping.

1. Carefully remove the CCU circuit boards from the shipping carton.

CAUTION Make sure that cooling fins do not come loose from the integrated circuits when the circuit boards are unwrapped. Operating the CCU circuit boards without the cooling fins may damage the circuit boards. Inspect work area and packaging material for loose cooling fins and reinstall any cooling fins that may have separated from the circuit board.

2. Inspect the CCU case for shipping damage.
3. Unwrap, inspect, and inventory the circuit boards found in the following checklist:

Table 2.1 CCU-711 Circuit Board Checklist

Part #	Name	Qty
1994D94G03	Power control panel	1
7298C27G02	Coupler board connector panel	1-8
2608C68	Modem or modem faker board	1
5552C22	Power supply board	1
5552C14	Logic board	1
5552C15	Receiver front end	1
5552C16	Power amplifier driver/supply board	2
5552C17	Power amplifier output board	2
5552C18	Power amplifier select board	1
2608C32G07	Coupler board	1-8

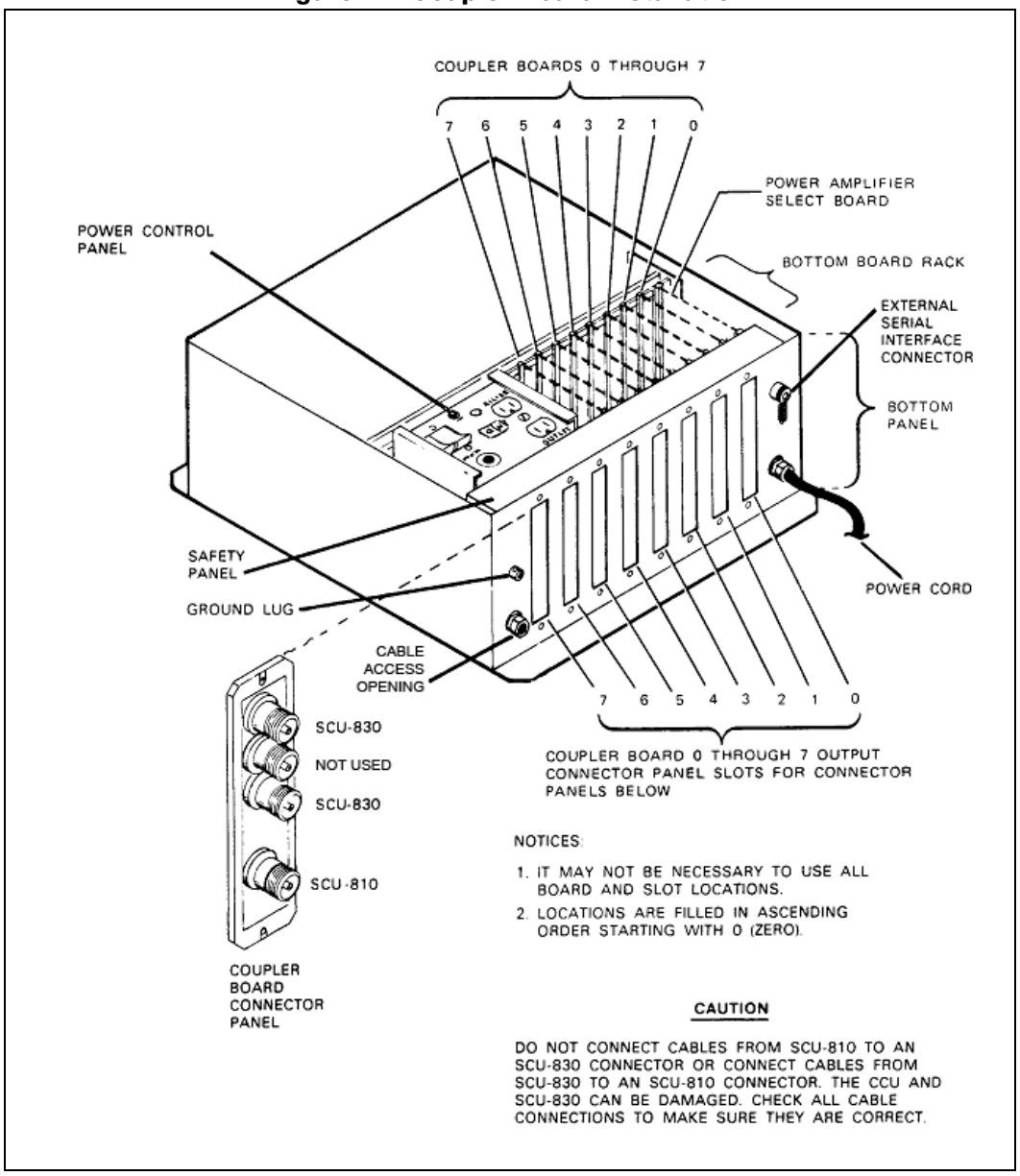
2.4 Coupler Board Connector Panel Installation

To install couple board connector panels:

1. Place the CCU-711 on its back on a flat surface and open the CCU door.
2. Remove the safety panel from the bottom of the rack assembly by removing the three screws.
3. For each coupler board connector panel to be installed, remove the associated panel blank from the CCU bottom panel by removing the top and bottom screws. It may not be necessary to use all board and slot locations. Locations are filled in ascending order starting with 0 (zero).

4. Position each coupler board connector panel into the specified CCU bottom panel location so the cable connector is to the rear of the CCU case. Secure the connector panel using the screws removed in step 3.

Figure 2.2 Coupler Board Installation



5. Make sure that each coupler board connector panel is correctly located and secured.
6. Insert the ribbon cable for each coupler board connector panel into the connector on the bottom board rack back plane.
7. Reinstall the safety panel on the bottom of the rack assembly with the three screws.

2.5 CCU-711 Case Installation

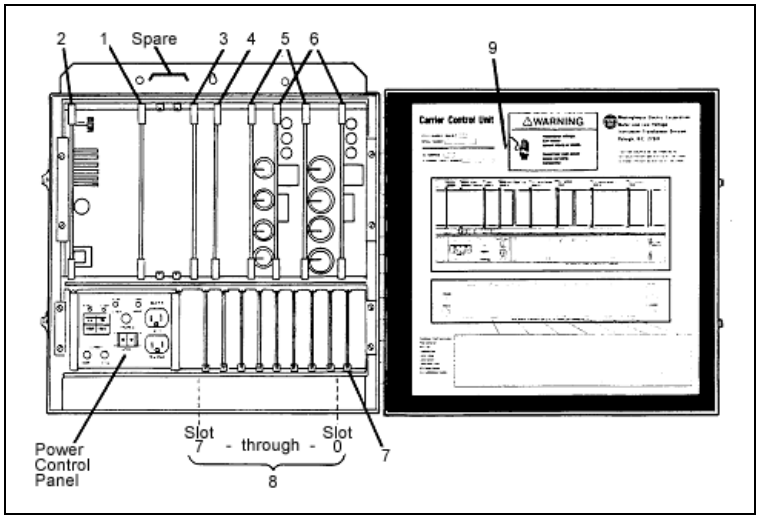
To install a CCU-711 case:

1. Make sure that the power cord is long enough to reach the 120 VAC receptacle. Do not plug the power cord into the 120 VAC receptacle at this time.
2. Drill two screws into the wall of the mounting location spaced horizontally 8.9" apart at eye level.
3. Secure the CCU to the mounting location using weather resistant hardware.

2.6 Circuit Board Installation

The following sections provide the installation procedures for each of the circuit boards in the power control panel rack. The position of each circuit board is shown on the inside of the CCU-711 door panel. Each circuit board is marked with a number that corresponds to a number located on the door. Be sure to install each board in its proper position.

Figure 2.3 Circuit Board Installation



The following circuit boards are labeled in the above figure.

1. Modem or faker board
2. Power supply board
3. Logic board
4. Receiver front end board
5. Power amplifier driver/supply board (2)
6. Power amplifier output board (2)
7. Power amplifier select board
8. Coupler board (up to 8)
9. Board information label

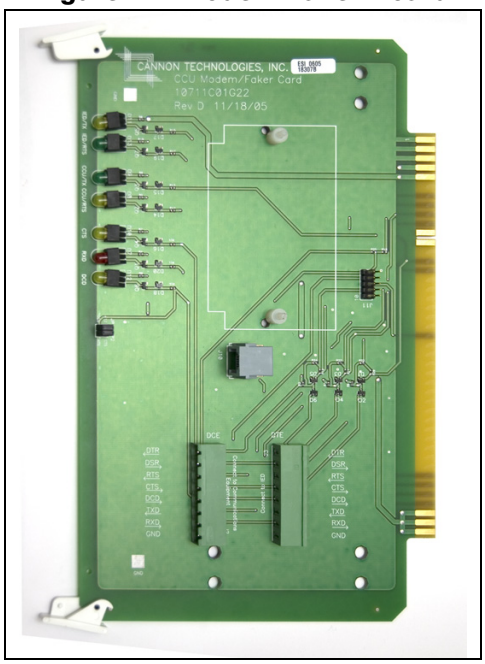
2.7 Modem Faker Board Installation

To install the modem faker board, perform the following procedures:

CAUTION Do not install the circuit board while internal power is applied to the CCU. Equipment damage can result.

1. Make sure that the INTERNAL power switch on the power control panel is in the OFF position.
2. Remove the protective wrapping from the board and inspect for damage.
3. Route the communication line through the cable access opening on the bottom left side of the CCU case, see Figure 2.2 on page 6.

Figure 2.4 Modem Faker Board



4. If a SelectComm interface module is installed on the modem faker board, refer to the CCU SelectComm Interface Module instructional leaflet for additional information.

   If a radio is being used to communication with the CCU, wire point-to-point from the DCE connector on the modem faker board to the radio terminal block. See the following table for wiring connections.

Table 2.2 Wiring Connections

On Radio	On Faker Board
2	TXD
3	RXD
4	RTS
5	CTS
6	DSR
7	GND
8	DCD

5. Unlatch the two white board locks on the outer edge of the board.
6. Position the board in the specified board rack slot so that the DCE connectors are on the right side.
7. Slide the board into the rack slot and push on the board edge until the white board locks close against the board.
8. Fully press the board locks against the board to lock it into position.

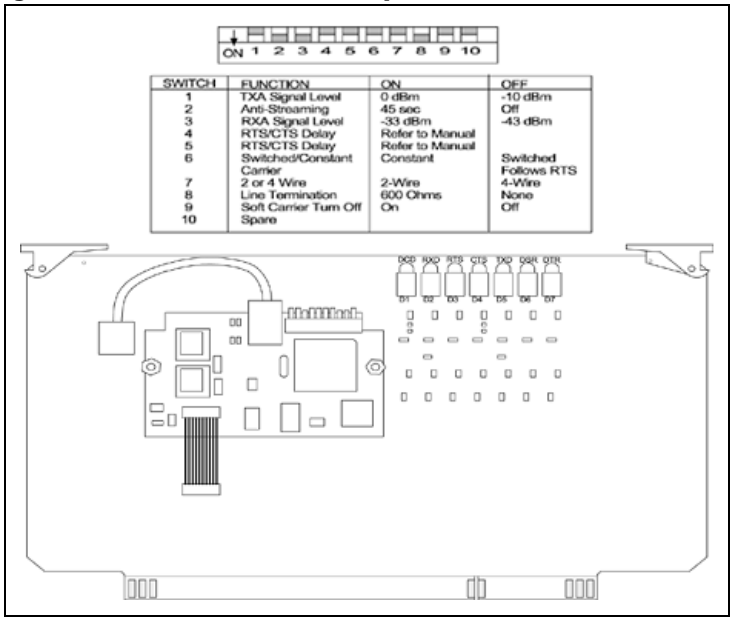
2.8 Modem Board Installation

To install the modem board, perform the following procedures:

WARNING Remove electrical service from the CCU source or unplug the CCU power cord. 120 VAC is present at the input power socket near the modem terminal connectors. Personal injury or death could result if power is not removed from the CCU.

1. Make sure that the INTERNAL power switch on the power control panel is in the OFF position.
2. Remove the protective wrapping from the board and inspect for damage.
3. Make sure the four jumpers and two switches are positioned as shown below.

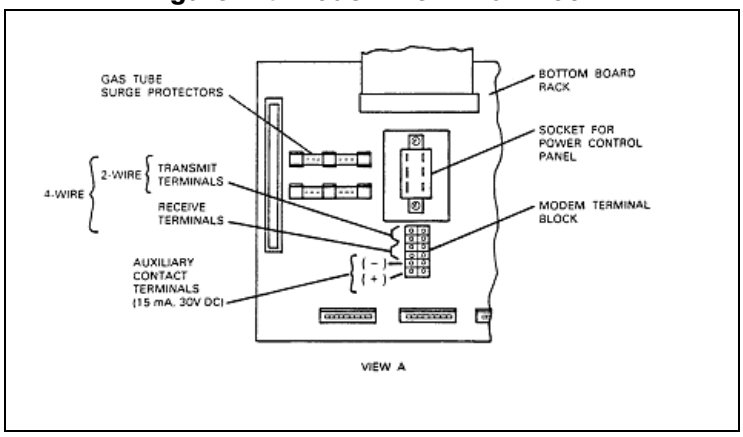
Figure 2.5 Modem Board Jumper and Switch Verification



4. Unlatch the two white board locks on the outer edge of the board.
5. Position the board in the specified board rack slot making sure the jumpers and switches are to the right side.
6. Slide the board into the rack slot and push on the board edge until the white board locks close against the board.
7. Fully press the board locks against the board to lock it into position.
8. Slide the power control panel out from the bottom of the board rack.

9. Route the communication line through the cable access opening on the bottom left side of the CCU case to the modem terminal block on the lower left edge of the bottom board rack.

Figure 2.6 Modem Terminal Block



10. Connect the communication transmit and receive wires to the transmit and receive terminals on the modem terminal block.
11. Reinstall the power control panel into the bottom board rack.

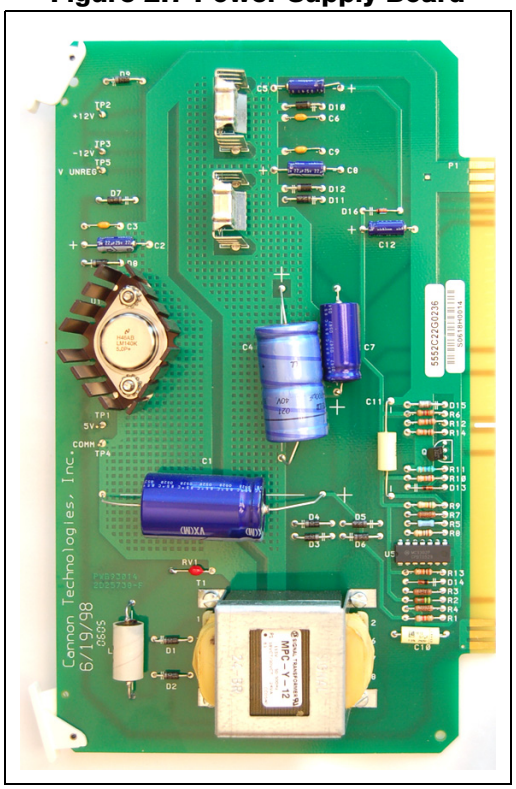
2.9 Power Supply Board Installation

To install the power supply board, perform the following procedures:

CAUTION Do not install the circuit board while internal power is applied to the CCU. Equipment damage can result.

1. Make sure that the INTERNAL power switch on the power control panel is in the OFF position.
2. Remove the protective wrapping from the board and inspect for damage.
3. Unlatch the two white board locks on the outer edge of the board.

Figure 2.7 Power Supply Board



4. Position the board in the specified board rack slot making sure the board components are to the right side.
5. Slide the board into the rack slot and push on the board edge until the white board locks close against the board.
6. Fully press the board locks against the board to lock it into position.

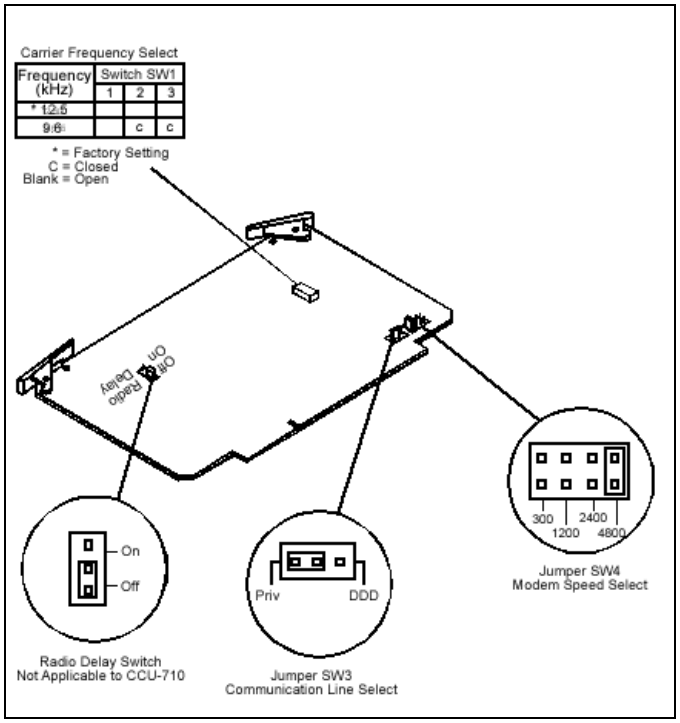
2.10 Logic Board Installation

To install the logic board, perform the following procedures:

CAUTION Do not install the circuit board while internal power is applied to the CCU. Equipment damage can result.
In addition, do not place the logic board on a conductive surface. Accidental shorting of the on-board battery can result. Place board on ship wrapping until installed.

1. Make sure that the INTERNAL power switch on the power control panel is in the OFF position.
2. Remove the protective wrapping from the board and inspect for damage.
3. Make sure the two jumpers and one switch are positioned as shown in figure below. The SW4 jumper should be selected for the proper baud rate.

Figure 2.8 Logic Board Jumper and Switch Verification



4. Unlatch the two white board locks on the outer edge of the board.
5. Position the board into the specified board rack slot making sure the jumpers and switch are to the right side.
6. Slide the board into the rack slot and push on the board edge until the white board locks close against the board.
7. Fully press the board locks against the board to lock it into position.

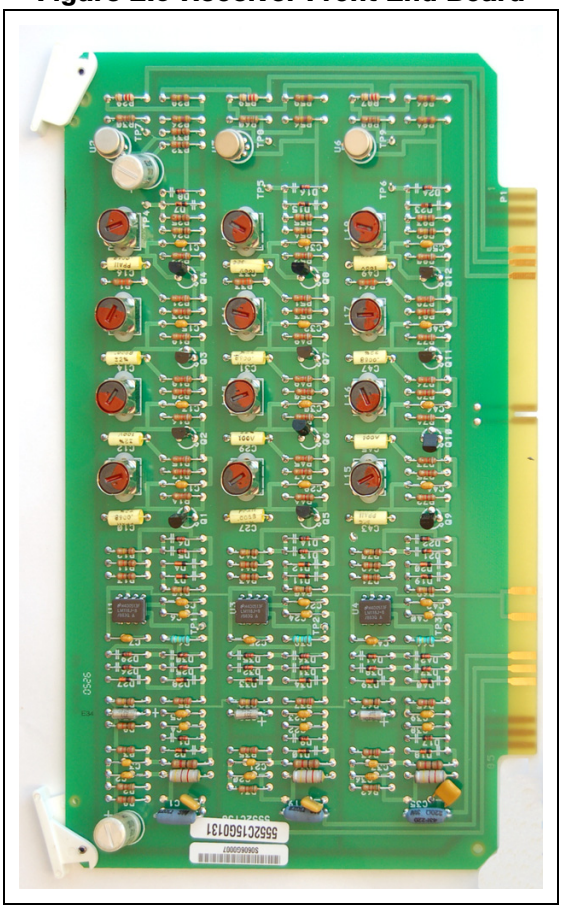
2.11 Receiver Front End Board Installation

To install the receiver front-end board, perform the following procedures:

CAUTION Do not install the circuit board while internal power is applied to the CCU. Equipment damage can result.
In addition, do not place the logic board on a conductive surface. Accidental shorting of the on-board battery can result. Place board on ship wrapping until installed.

1. Make sure that the INTERNAL power switch on the power control panel is in the OFF position.
2. Remove the protective wrapping from the board and inspect for damage.
3. Unlatch the two white board locks on the outer edge of the board.

Figure 2.9 Receiver Front End Board



4. Slide the board into the specified board rack slot making sure the board components are to the right side.
5. Push on the board edge until the white board locks close against the board.
6. Fully press the board locks against the board to lock it into position.

2.12 Power Amplifier Driver/Supply Board Installation

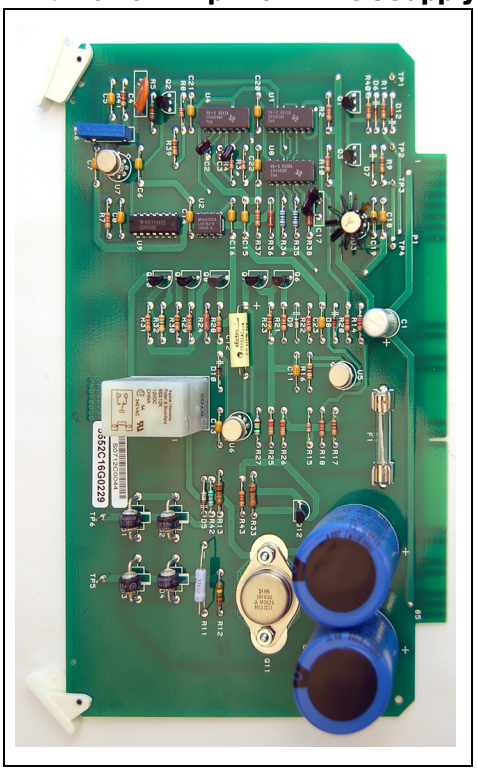
The CCU-711 has two identical power amplifier driver/supply boards. To install the power amplifier driver/supply boards, perform the following procedures:

WARNING Do not install the circuit board while internal power is applied to the CCU. Up to 170 Volts are present on the board when it in installed with internal power applied to the CCU. Personal injury or death can result from electric shock.

CAUTION Make sure the cooling fins do not come loose from the integrated circuits. Operating the board without the cooling fins may result in circuit board damage. Inspect the board and install the cooling fins on U3 if they are loose.

1. Make sure that the INTERNAL power switch on the power control panel is in the OFF position.
2. Remove the protective wrapping from the board and inspect for damage. Make sure the cooling fins are installed on integrated circuit U3. Reinstall cooling fins if necessary.
3. Unlatch the two white board locks on the outer edge of the board.

Figure 2.10 Power Amplifier Driver/Supply Board



4. Slide the board into the specified board rack slot making sure the board components are to the right side.
5. Push on the board edge until the white board locks close against the board.
6. Fully press the board locks against the board to lock it into position.
7. Repeat step 2 through step 6 for the second power amplifier driver/supply board.

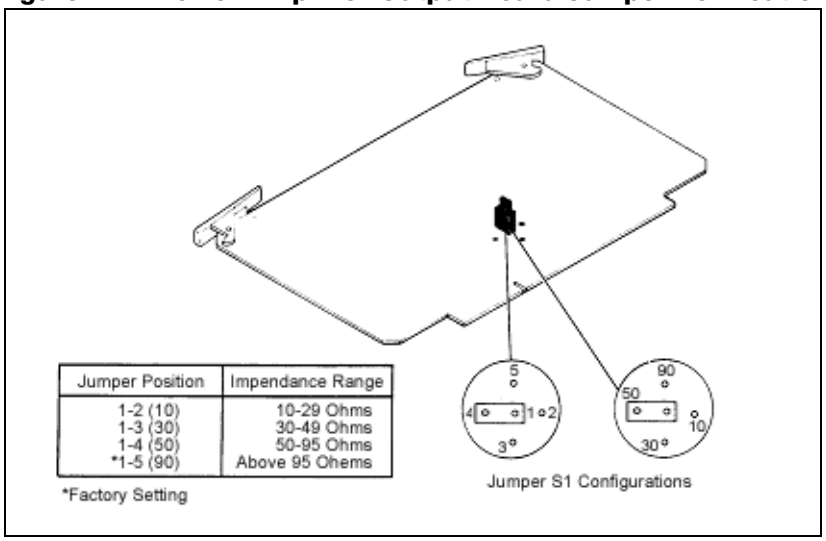
2.13 Power Amplifier Output Board Installation

The CCU-711 has two identical power output boards. To install the power amplifier output boards, perform the following procedures:

CAUTION Do not install the circuit board while internal power is applied to the CCU. Equipment damage can result.

1. Make sure that the INTERNAL power switch on the power control panel is in the OFF position.
2. Remove the protective wrapping from the board and inspect for damage.
3. Make sure the impedance jumper S1 is set to positon 4 (50 Ohms) for an impedance range of 50-95 Ohms. If another impedance range is specified for this CCU, set the impedance jumper to the specified position.

Figure 2.11 Power Amplifier Output Board Jumper Verification



4. Unlatch the two white board locks on the outer edge of the board.
5. Slide the board into the specified board rack slot making sure the jumpers are to the right side.
6. Push on the board edge until the white board locks close against the board.
7. Fully press the board locks against the board to lock it into position.
8. Repeat steps 2 through 7 for the second power amplifier output board.

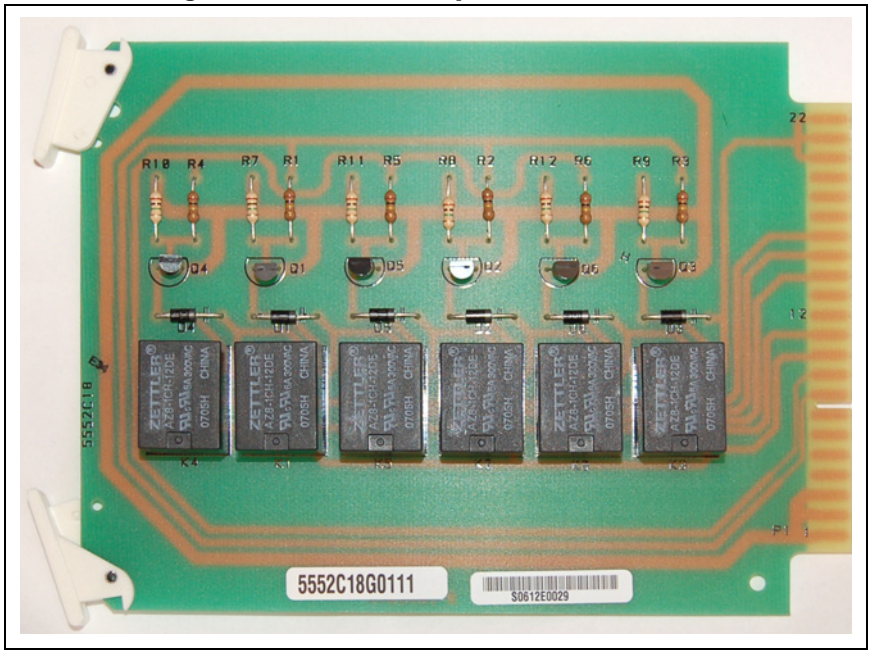
2.14 Power Amplifier Select Board Installation

To install the power amplifier select board, perform the following procedures:

CAUTION Do not install the circuit board while internal power is applied to the CCU. Equipment damage can result.

1. Make sure that the INTERNAL power switch on the power control panel is in the OFF position.
2. Remove the protective wrapping from the board and inspect for damage.
3. Unlatch the two white board locks on the outer edge of the board.

Figure 2.12 Power Amplifier Select Board



4. Slide the board into the specified board rack slot making sure the board components are to the right side.
5. Push on the board edge until the white board locks close against the board.
6. Fully press the board locks against the board to lock it into position.

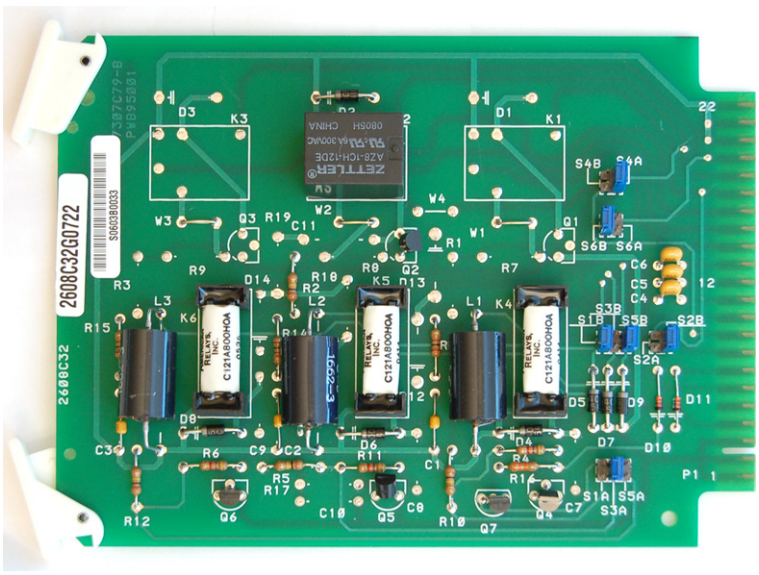
2.15 Coupler Board Installation

Up to eight coupler boards may be installed in the CCU-711. Perform the following steps to install each board:

CAUTION Do not install the circuit board while internal power is applied to the CCU. Equipment damage can result.

1. Make sure that the INTERNAL power switch on the power control panel is in the OFF position.
2. Remove the protective wrapping from the board and inspect for damage and identify the board by part number.
3. Insert the jumper in A or B position for S1, S2, S3, S4, S5, and S6.

Figure 2.13 Coupler Board Jumpers



Configuration	S1 A	S1 B	S2 A	S2 B	S3 A	S3 B	S4 A	S4 B	S5 A	S5 B	S6 A	S6 B
S-Board	X		X		X		X		X		X	
H-Board		X		X		X		X		X		X
* H/S Board		X		X	X		X			X		X

*Factory Setting

Notice:

1. Insert jumper in a A or B position for S1, S2, S3, S4, S5, and S6.
2. Factory Setting is for phase-tp-ground coupling of SCU=810 with Jumper W2 in place. For phase-to-phase coupling for SCU-810. cut Jumper S2.

4. The factory setting is for phase-to-ground coupling of the SCU-810 with jumper W2 in pace. For phase-to-phase coupling of the SCU-810, cut jumper S2.
5. Unlatch the two white board locks on the outer edge of the board.
6. Slide the board into the specified board rack slot making sure the jumpers are to the right side.
7. Push on the board edge until the white board locks close against the board.
8. Fully press the board locks against the board to lock it into position.

Chapter 3
Primary Coupling Assembly Installation

The Primary Coupling Assembly (PCA) couples the high frequency (12.5 kHz or 9.6 kHz), low-energy carrier signals of the CCU to the distribution primary. The PCA also isolates the CCU from the low frequency (60 Hz), high energy levels on the distribution primary.

Each CCU-711 can interface with up to eight individual 3-phase distribution buses or feeders. Therefore, the number of PCAs may vary for each CCU-711. Each PCA consists of three standard components for capacitive coupling:

- Primary Coupling Capacitor (PCC)
- Signal Coupling Unit (SCU-810)
- Signal Coupling Unit (SCU-830) for magnetic coupling, which used to increase reception from field devices.

Figure 3.1 Primary Coupling Assembly Components (PCA)

3.1 PCA Specifications

The following tables contain the PCA specifications.

3.1.1 PCC Specification

The following table contains the PCC specification:

Table 3.1 Primary Coupling Capacitor Specs

Spec	Value	Value
Style No.	1500B00003-002	1500B00003-001
Dimensions (including flanges)		
Height	30.5 in. (76.2 cm)	18.43 in. (46.8 cm)
Width	13.5 in. (34.3 cm)	13.99 in. (35.5 cm)
Depth	4.1 in. (10.4 cm)	4.1 in. (10.4 cm)
Weight	52 lb. (23.6 kg)	43 lb. (94.6 kg)
Operating Range		
Temperature	-40 to +55 degrees C	-40 to +55 degrees C
Humidity	0 to 100% (noncondensing)	0 to 100% (noncondensing)
Operating Voltage	20.8 kV (line to ground)	14.4 kV (line to ground)
Insulating Medium	Wemcol (non-PCB fluid)	Wemcol (non-PCB fluid)
kVar Rating[a]	100	50
Microfarad Rating	0.61	0.61
BIL[b]	200 kV	125kV

a. Kilovolts amperes reactive
b. Basic impulse insulation level

3.1.2 SCU-810 Specification

The following table contains the SCU-810 specification:

Table 3.2 SCU-810 Spec

Spec	Value
Style No.	1994D89GO4
Dimensions (including flanges)	
Height	12.8 in. (32.4 cm)
Width	9.8 in. (24.8 cm)
Depth	6.1 in. (15.6 cm)
Weight	14.5 lb. (6.5 kg)
Operating Range	
Temperature	-40 to +55 degrees C
Humidity	0 to 100% (noncondensing)

3.1.3 SCU-830 Specification

The following table contains the SCU-830 specification:

Table 3.3 SCU-830 Spec

Spec	Value
Style No.	2606C91
Dimensions (including flanges)	
Height	8.5 in. (21.6 cm)
Width	8.0 in. (20.3 cm)
Depth	2.38 in. (6.0 cm)[a]
Weight	2.125 lb. (11 kg)
Operating Range	
Temperature	-40 to +55 degrees C
Humidity	0 to 100% (noncondensing)
Operating Frequency	
2606C91GO1	12.5 kHz
2606C91GO2	9.6kHz

a. Add 4.25 in. (10.80 cm) for clamp

3.2 Unpacking and Inspection

Carefully remove each PCC, SCU-810, and SCU-830 from its individual shipping carton and inspect for shipping damage.

3.3 Installation

When installing the PCA, mount each PCC as close to the distribution bus or feeder as practical. Mount the SCU-810 to allow for convenient and safe servicing and to permit the door to be fully opened. To install the PCA, perform the following applicable procedures in the sequence provided.

Figure 3.2 PCA Installation

3.3.1 Site Preparation

Each CCU-711 can be coupled with up to eight individual distribution buses or feeders. One SCU-810 is used for each distribution bus or feeder. Each SCU-810 is coupled using three capacitors for three-phase installation. The following procedure describes PCA installation.

One or two SCU-830s can be used with each PCA configuration. The SCU-830s use feeder neutrals as their carrier signal sensing point.

Use the following guidelines when installing PCCs:

- As close as practical to fused-device (15 A maximum required, current limiting recommended) and distribution bus
- Sufficient workspace.
- Meets utility company standard practices.
- No more than 15 feet of cable distance from SCU-810.

Use the following guidelines when installing SCU-810s:

- No more than 400 feet of coax cable distance from CCU.
- Safe and convenient access.
- Vertical mounting (coaxial connector on bottom).
- Sufficient space around the SCU-810 for the door to fully open, for access to connections and for workspace.
- No more than 15 feet of cable distance from PCC.

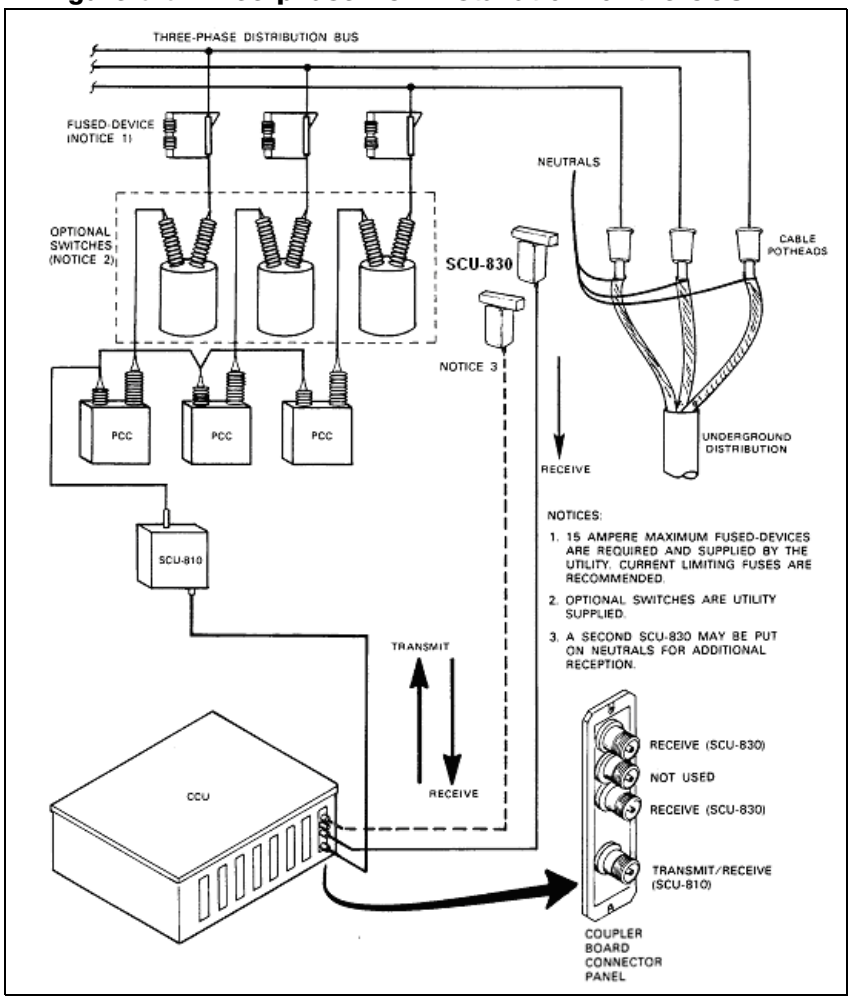
3.3.2 PCC and SCU-810 Preparation

Perform the following before installing a PCC and SCU-810:

1. For each PCA to be installed on the structure, mark the location of the associated PCC, SCU-810, fused-device, and any optional utility supplied devices.
2. Following the route that the cable will take, measure the distance between the CCU and SCU-810 locations.

CAUTION Ensure that at least five feet of slack is calculated into the cable length to avoid stressing the coax cable or equipment connections. Excessive stress can damage the coax cables or equipment connections.
Cables that are too short should be replaced by the next longer size cable. Cables should not be cut or spliced. More than one cable can be installed in the same conduit when the cables follow the same route.

Figure 3.3 Three-phase PCA Installation for the CCU-711



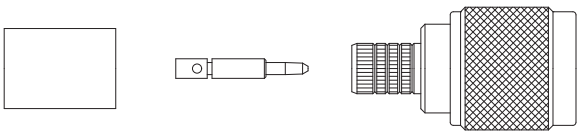
3. Install conduits with weather heads at both ends between the CCU and SCU-810 locations. Ensure that the conduit diameter is large enough to contain all coax cables to be routed through it. Each coax cable (RG-213) has a diameter of 0.405 inches and each connector has a diameter of 0.8125 inches.
4. For each SCU-830 to be installed, identify and/or mark the location on the superstructure. SCU-830s should be located on superstructure close to specified feeder neutrals.
5. Following the route that the cable will take, measure the distance between the CCU and SCU-830 locations. Recommended maximum cable length is 200 feet.

3.3.3 Coax Cable

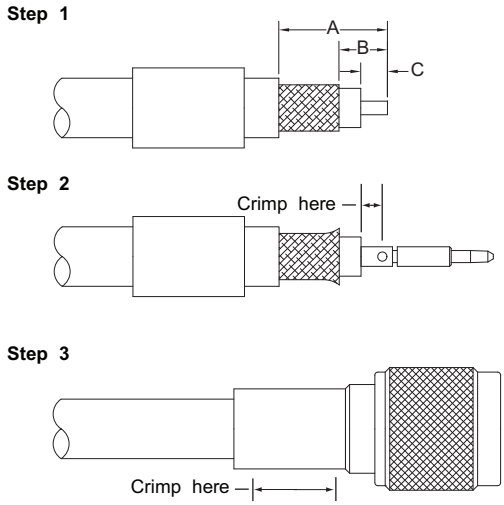
Complete the following instructions to crimp the coax cable for use with the SCUs and PCCs.

1. Place outer ferrule over cable. Strip cable to dimensions shown in table below.
2. Crimp contact onto center conductor of cable using the tool cavity shown in table below. (Alternative: Solder contact onto center conductor using soft solder and minimum heat.)
3. Slide inner ferrule of connector body between braid and insulator cable until contact snaps in place (cable insulator butts connector insulator inside board assembly.) Slide outer ferrule over braid and up against connector body. Crimp outer ferrule using the tool cavity shown in figure below.

Figure 3.4 Coax Cable with Type N Connector



Amphenol Number	Connector Type	Cable RG-/U	Strip Dimensions, inches (mm)			Hex Crimp Data			
			a	b	c	Cavity for Contact	Cavity for Outer Ferrule	Die Set for Tool 227-944	CTL Series Tool No.
82-4426-11RFX	N Plug	8, 213, 214 Ethernet Cables	.630(16.0)	.303(7.7)	.157(4.0)	.100(2.5)	.429(10.9)	227-1221-25	CTL-3



Step 1 Strip cable jacket, braid, and dielectric to dimensions shown. All cuts are to be sharp and square. **Important:** Do not nick braid, dielectric, and center conductor. Tinning of center conductor is not necessary if contact is to be crimped. For solder method, tin center conductor avoiding excessive heat.

Step 2 Slide outer ferrule onto cable as shown. Flare slightly end of cable braid as shown to facilitate insertion of inner ferrule. **Important:** Do not comb out braid. Place contact on cable center conductor so it butts against cable dielectric. Center conductor should be visible through inspection hole in contact. Crimp or solder contact in place as follows: **Crimp Method:** Use Die Set Cavity for contact indicated in table above. **Solder Method:** Soft solder contact to cable center conductor. Do not get any solder on outside surface of contact. Avoid excessive heat to prevent swelling of dielectric.

Step 3 Install cable assembly into body assembly so inner ferrule portion slides under braid. Push cable assembly forward until contact snaps into place in insulator. Slide outer ferrule over braid and up against connector body. Crimp outer ferrule using Die Set Cavity specified in table above.

3.4 PCC Installation

Since conditions at each substation are unique, the installation procedures may be altered as long as the intent of the procedure is accomplished and the utility company standards are maintained.

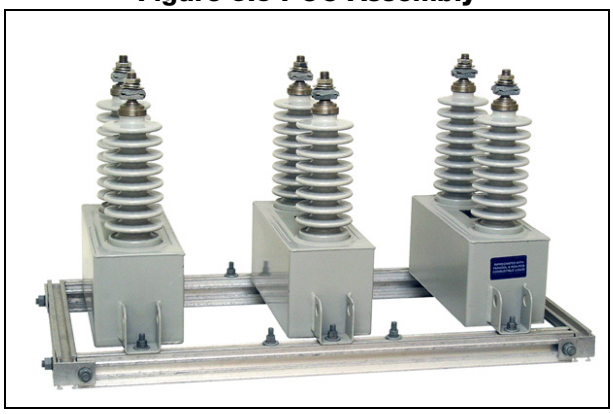
WARNING The fused-device must be in the open position or the optional switch (if installed) must be open before any steps in this procedure are performed. Opening the fused-device or switch removes the high distribution voltage (up to 20.8 kV) from the capacitor side of the circuit. Personal injury or death will result from voltage contact.

1. Make sure that a fused-device (15 ampere maximum is required, current limiting is recommended) is installed in accordance with established utility company standards and is in the open position.
2. Verify that other devices (such as optional switches) are installed in accordance with established utility company standards and are in the open position.
3. Install capacitor mounting bracket to the substation superstructure in the location selected during the site preparation procedure.

WARNING Before attempting to handle the capacitor, use an insulated switch stick (hot stick) to short the capacitor bushings together and to short the high voltage bushings to the capacitor case. A residual voltage charge could be present at the capacitor bushings. Personal injury or death can result from electrical shock.

4. For three-phase installation place each of the three PCCs on the capacitor mounting bracket with the high voltage bushing away from the supporting structure.

Figure 3.5 PCC Assembly



5. Using suitable hardware, secure both sides of each PCC to the bracket.
6. With the fused-device or optional switch (if installed) open, use utility company procedures and standards to connect the high voltage bushing of each capacitor to the load side of each fused-device or, to the load side of each optional switch (if installed).
7. Route a conductor (installed No. 6 AWG soft copper wire) between each capacitor and the SCU-810 location. The end of the conductor at the SCU-810 will be connected during the SCU-810 installation procedure.
8. Using established utility company procedures, secure the end of the conductor at the capacitor to the low voltage bushing of each capacitor.

3.5 SCU-810 Installation

To install a SCU-810 installation:

1. Secure the SCU-810 directly to the vertical mounting surface using suitable hardware.

WARNING The SCU-810 case must be grounded to the substation system ground. Grounding the case prevents a voltage potential from occurring between the SCU-810 case and the substation structure. Personal injury or death will result if the SCU-810 case is not grounded.

2. Route a No. 6 AWG soft copper ground wire between the substation system ground and the SCU-810 case.
3. Secure one end of the ground wire to the ground lug on the lower right side of the SCU-810 case.

Figure 3.6 SCU-810

4. Secure the other end of the ground wire to the substation system ground.
5. Using established utility company procedures, secure the end of the conductor from each PCC to the top terminal of the SCU-810. Use the duct seal provided with the SCU-810 to seal the top terminal of the SCU 810.
6. Obtain the coax cables to be routed between the CCU and each SCU-810 as determined during the site preparation procedure. Label both ends of each cable with the SCU-810 destination.

WARNING Do not make any coax cable connections until the PCC is tested and determined to be safe. A component failure in the PCC could result in the presence of high voltage at SCU-810 coax connectors. Personal injury or death can result from high voltage contact.

7. Route the coax cables between the CCU and SCU-810, but do not make any cable connections. Coax cable connections will be made as part of testing and initialization.
8. Tie, and secure cable at the CCU. Seal all conduit weather heads.

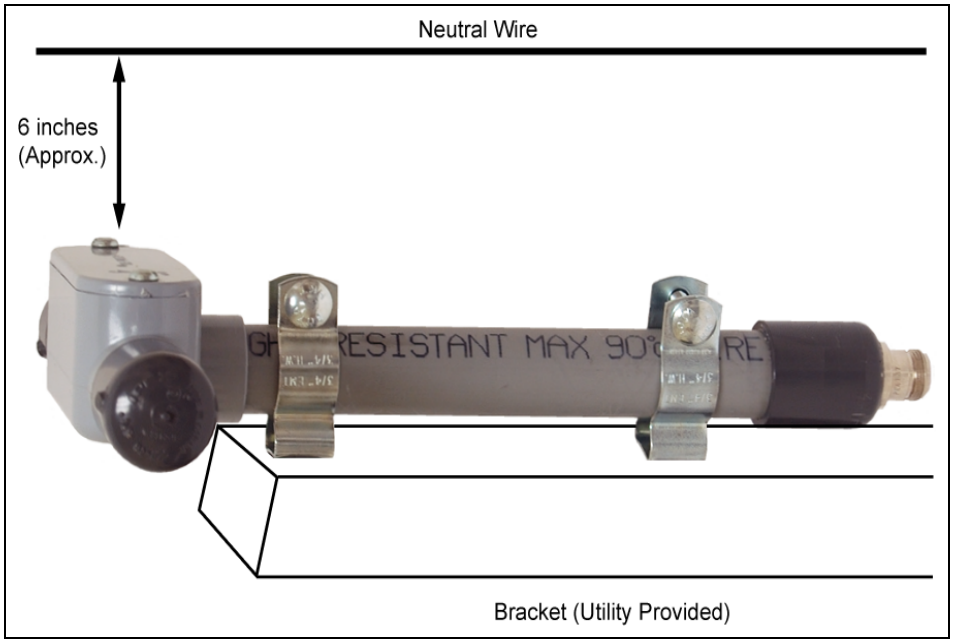
3.6 SCU-830 Installation

The SCU-830 must be located on the superstructure where signal currents from feeder neutrals are combining. If signal currents must be received from more than one feeder neutral, (such as each neutral of a three-phase underground distribution cable), locate the SCU-830 on superstructure so that neutral currents from the associated feeder neutrals will pass near it.

WARNING Exercise care and perform all procedures in accordance with established utility company standards when installing the SCU. The SCU-830 is physically close to distribution voltage (up to 20.8 W). Personal injury or death will result from high voltage contact.

1. Make a bracket that will support the SCU-830 approximately six inches from the neutral with the head of SCU-830 perpendicular to the neutral. Secure the bracket to the utility pole or substation structure.
2. Secure the SCU-830 to the bracket.

Figure 3.7 SCU-830 Installation



3. Obtain the coax cables to be routed between the CCU and each SCU-830 as determined during the site preparation procedure.
4. Route the coax cable between the CCU and SCU-830.
5. Seal all conduit weather heads.

CAUTION The coax connectors must be tightened by hand. Equipment damage could result from over tightening the connectors.

6. Install (by hand) the coaxial cable end to the connector on SCU-830.
7. Install (by hand) the coaxial cable end to the CCU.

NOTE: *The coaxial cable must be connected to the first or third coax connection on the CCU's coupler board connector panel. The second coax connection is no longer used; see Figure 3.3 on page 23.*

Chapter 4
CCU-711 Injection Tuning

This chapter describes how to perform CCU-711 injection tuning.

WARNING Before tuning the repeater, the PCA must be installed in accordance with the procedures in this manual. An improperly installed PCA can cause high voltage to be applied to the repeater. Personal injury or death can result from voltage contact. Verify that the exterior of the PCA and the associated hardware are not damaged and that the fused-device is not blown.

4.1 Introduction to Injection Tuning

The fundamental concept behind tuning CCUs is impedance matching. The apparent impedance of the distribution system as seen at the injection point must be matched in the carrier equipment settings. This practice optimizes signal transfer from the injection equipment to the distribution system to enhance signal coverage.

Impedance is measured using Ohm's law and dividing a Voltage reading by a Current reading. To change the impedance, the Voltage tap in the SCU-810 can be moved up or down. For new CCU or Repeater installations, start with a SCU-810 tap position of 4.

The following are reasons for performing injection tuning:

- Major distribution system changes
- A new CCU installation
- Improve two-way communications
- Yearly maintenance at each injection point

4.1.1 Recommended Equipment

The following equipment is required to perform signal tuning:

- Oscilloscope (Velleman HPS10SE)
- Hot stick or gloves to change the Signal Coupling Unit (SCU) tap

In addition, the CCU or Repeater must transmit a Cannon PLC signal to a fake meter during the tuning process. To accomplish this, do one of the following:

- Create a fake MCT, assign it to the CCU communication route, and create a MACS Schedule within the Yukon Tabular Data Console application that reads a fake MCT every 30 seconds.
- Contact a Yukon operator and instruct them to read a fake MCT.
- Use a handheld computer, MCT-Minder software, and a Tester cable to read a fake MCT.
- Use a laptop computer, Portable System Tester (PST) software, and a Tester cable to read a fake MCT.

4.1.2 Safety Information

Exercise caution when working with all injection equipment. Personal injury or death can result if safety precautions are not followed.

- Make sure that all grounds are present and intact before touching any CCU, SCU or repeater.
- Never remove the coax cable from any device with the capacitor cutouts closed (in).
- If the capacitor cutouts are closed (in), the SCU is Hot and its high voltage connection requires the use of hot gloves.

4.1.3 Setting up the Oscilloscope

The following oscilloscope settings are recommended for tuning Cannon PLC equipment:

- Display: Vpp (peak-peak)
- Time/div: 20 µs (microseconds)
- Volts/div (for measuring Voltage): 1
- Volts/div (for measuring Current): 0.1

4.2 Preparing the CCU-711 for Tuning

Before tuning the CCU-711, verify that each Primary Coupling Assembly (PCA) and associated hardware is installed properly and that the exterior of each PCA and the associated hardware are not damaged. Also verify that the fused-device is not blown. In addition, make sure the fused-devices or the remote controlled oil switches are closed.

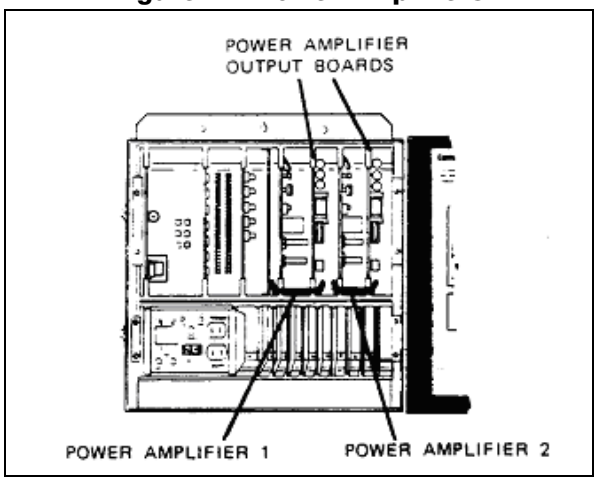
WARNING Exercise caution while working near the PCA circuits when it is energized. The energized condition applies high voltage to the PCA and up to 10 VRMS to the coaxial connections at the CCU. Personal injury or death can result if safety precautions are not followed.

Perform the following steps to prepare a CCU-711 for tuning:

1. Check the grounding on the CCU and SCU.
2. Turn off the power to the CCU.
3. Remove the Power Amplifier output board (Amp output board) to test.
4. Set the impedance jumper (S1) on the board to position 5 (95 Ohms); see Figure 4.2 on page 31.

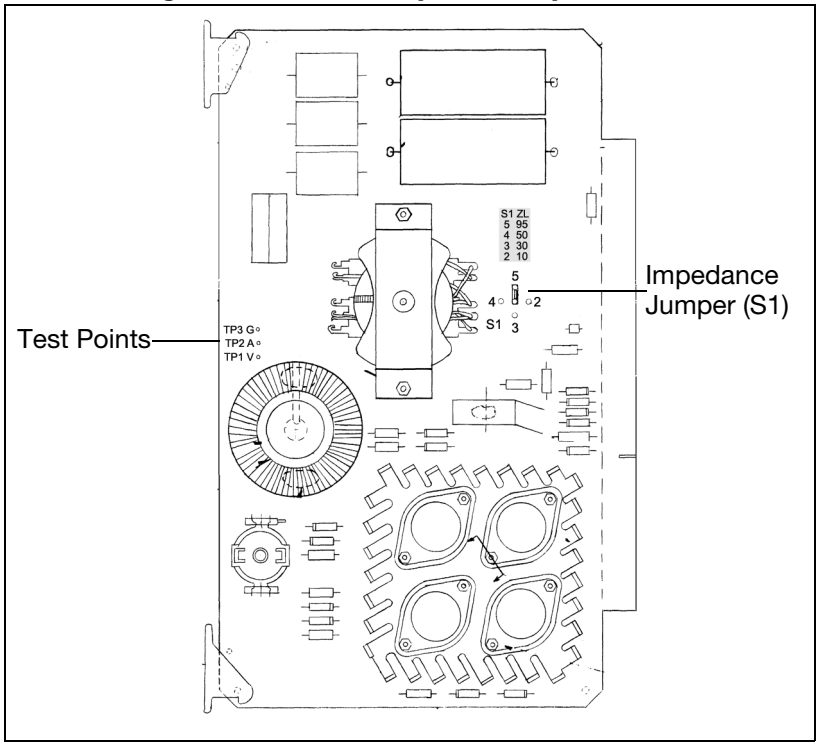
NOTE: *Two power amplifiers exist inside the CCU-711. The Yukon Master Station message structure specifies the power amplifier that is used. Each power amplifier consists of one power amplifier driver/supply board and one power amplifier output board.*

Figure 4.1 Power Amplifiers



5. Replace the power amplifier output board.
6. (Optional) If you are using a handheld computer with MCT-Minder software or a laptop computer with Portable System Tester software, use a Tester cable to connect the handheld or laptop to the external serial interface on the CCU. In addition, set the modem switch on the CCU power supply module to External.
7. Connect the ground lead on the oscilloscope to the ground pin (TP3 G) on the Power Amplifier output board.

Figure 4.2 Power Amplifier Output Board



4.3 Tuning the CCU-711

Perform the following steps to tune a CCU-711:

1. Connect the oscilloscope probe to the Voltage pin (TP2 V) on the Power Amplifier output board; see Figure 4.2 on page 31.
2. Turn on the power to the CCU and turn on the oscilloscope.
3. Set Channel 1 on the oscilloscope to 1 Volt/division to read the voltage.
4. Wait for the predefined MACS Schedule to read the fake meter or contact a Yukon operator and instruct them to read a fake MCT.

   Optionally, execute a meter read using MCT-Minder or Tester software.
5. As the CCU transmits, observe the Volts peak-peak reading on the oscilloscope and write down this reading.
6. Turn off the power to the CCU and move the oscilloscope probe to the Current pin (TP2 A) on the Power Amplifier output board; see Figure 4.2 on page 31.
7. Select a Volts/div setting of 0.1 on the oscilloscope.
8. Wait for the predefined MACS Schedule to read the fake meter or contact a Yukon operator and instruct them to read a fake MCT.

   Optionally, execute a meter read using MCT-Minder or Tester software.
9. As the CCU transmits, observe the Current peak-peak reading on the oscilloscope and write down this reading.
10. Multiply the voltage reading by 100. This is V and it should be between 400 and 600 V.
11. Multiply the current reading by 10. This is I and should be between 4 A and 6 A.
12. Determine the system impedance (R) by taking the voltage reading (V) and dividing it by the current reading (I). R=V/I
13. The goal of testing is to get R as close to 100 Ohms as possible:
    - If R is above 100, move the tap on the SCU up one level.
    - If R is below 100, move the tap on the SCU down one level.
14. Repeat step 1 through step 13 until the impedance (R) is as close to 100 as possible.
15. Repeat the tuning procedure for each remaining distribution bus.

4.4 Returning the CCU-711 to Operation

Perform the following steps to return a CCU-711 to normal operation:

1. Turn off the power to the CCU and disconnect the oscilloscope from the CCU.
2. If you were using a handheld computer or laptop, disconnect it and set the CCU modem switch on the power supply module back to Internal.
3. Remove the oscilloscope from the test pins on the Power Amplifier output board.
4. Remove the Power Amplifier output board (Amp output board).
5. Change the impedance jumper (S1) back to position 4 (50 Ohms); see Figure 4.2 on page 31.
6. Replace the Power Amplifier output board.
7. Turn on the power to the CCU.
8. Wait for a meter reading to occur to verify the CCU is in working order or verify a successful meter reading with a Yukon Master Station operator.

Chapter 5
CCU-711 Troubleshooting and Repair

The following sections describe CCU-711 troubleshooting and repair procedures. Repair of the CCU-711 is limited to the replacement of the circuit boards and power control panel.

WARNING Make sure power to the CCU has been turned off for at least five minutes before removing the power amplifier driver/supply board. Up to l70 Volts is present on the board when power is applied and until capacitors discharge. Personal injury or death can result from electric shock.

5.1 Circuit Board Replacement

To replace a circuit board:

CAUTION Do not remove or install circuit boards while internal power is applied to the CCU. Equipment damage can result.

1. Set the Internal and Auxiliary power switches to the power control panel to the Off position.
2. Unlock the circuit board by lifting up on the two white board locks.
3. Slide the board out of the slot in the bottom board rack.
4. Install a new board.
5. Perform the testing and initialization procedure.

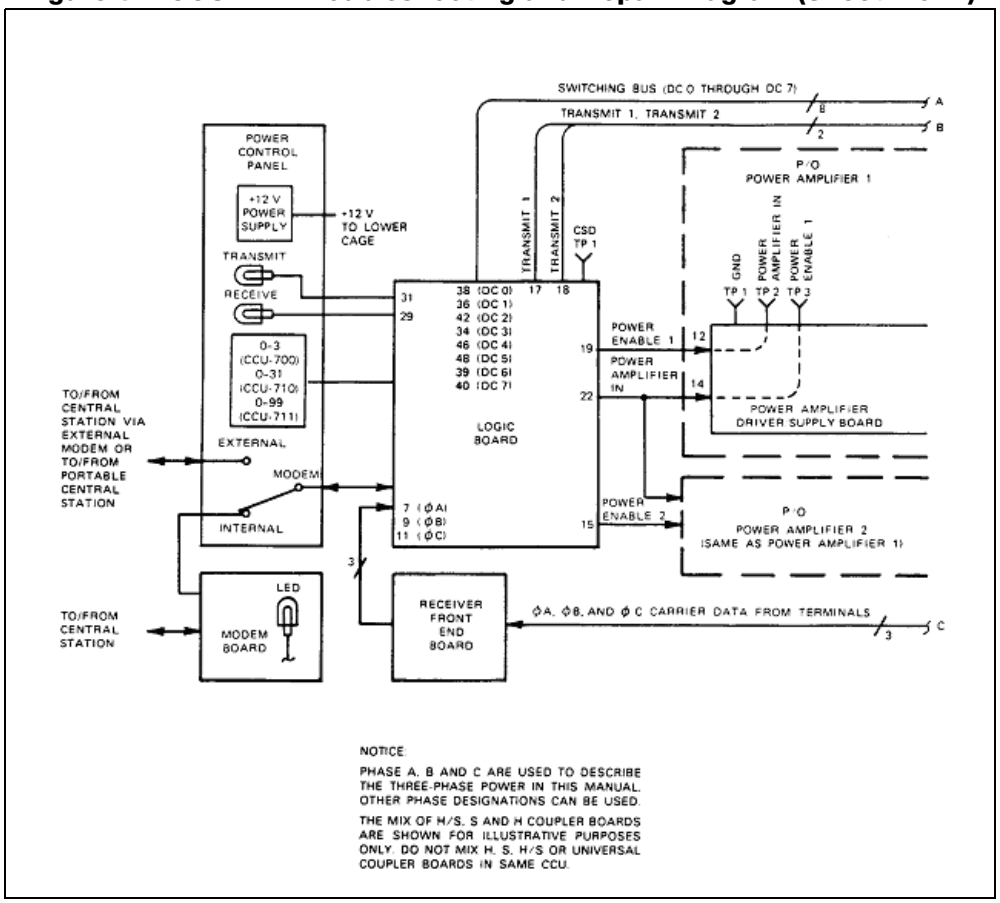
5.2 CCU-711 Removal

To remove the CCU-711:

1. Set the Internal and Auxiliary power switches to the Off position.
2. Remove 120 VAC power from the CCU at the circuit breaker box.
3. Unplug CCU power cord from the electrical power receptacle.

WARNING Before the coax connections to the CCU are disconnected, open the fused-devices associated with the capacitors. Opening the fused-devices isolates the capacitors and CCU from the high voltage distribution bus. Personal injury or death can result if power is not removed from the CCU. Using established utility procedures, open all fused-cutouts associated with the capacitors connected to this CCU. Wait five minutes for the capacitors to discharge before proceeding.

Figure 5.1 CCU-711 Troubleshooting and Repair Diagram (Sheet 1 of 2)

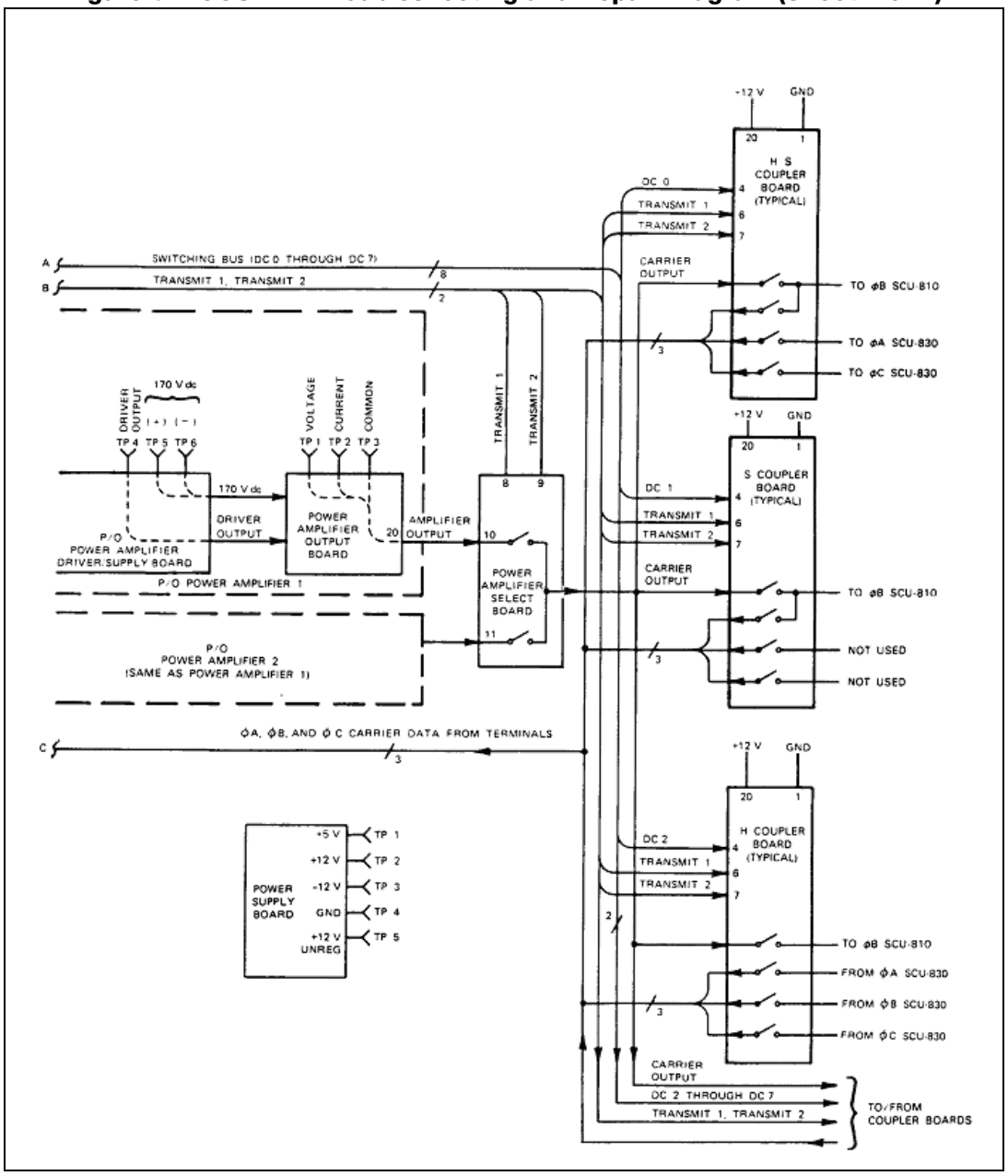


NOTICE

PHASE A, B AND C ARE USED TO DESCRIBE THE THREE-PHASE POWER IN THIS MANUAL. OTHER PHASE DESIGNATIONS CAN BE USED.

THE MIX OF H/S, S AND H COUPLER BOARDS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT MIX H, S, H/S OR UNIVERSAL COUPLER BOARDS IN SAME CCU.

Figure 5.2 CCU-711 Troubleshooting and Repair Diagram (Sheet 2 of 2)



5.3 CCU-711 Troubleshooting Procedures

To prepare the CCU-711 for troubleshooting

1. Verify that the exterior of each PCA and the associated hardware are not damaged and that the fused-device is not blown. If it is damaged, repair the PCA.
2. Make sure that the fused-devices or the remote controlled oil switches (if installed) are closed. If the oil switches are not closed, close them.
3. Open the CCU door and make sure that the CCU controls are set as follows:
   - Address switch: As specified by system implementation plan. Addresses (0-99) are available on the CCU.
   - Modem switch: Internal
   - Internal Power switch: On

If the settings are different, set the controls to the correct settings.

5.3.1 Power Supplies Check

Perform the following steps for CCU-711 power failure:

1. Verify that the following voltages are present on each test point of the power supply board:
   - TP4 GND (use as ground)
   - TP1 +5V
   - TP2 +12V
   - TP3 -12V
   - TP5 +20V (+ 12V un reg)

If any of the above voltages are not present, replace power supply board.

WARNING Exercise caution while making voltage readings. Up to 170 VDC is present at test points TP5 and TP6. Personal injury or death could result if safety precautions are not followed.
In addition, do not allow test point TP5 or TP6 to contact electrical ground in the following step. High voltage is present on both TP5 and TP6; grounding either test point will damage the CCU. Use an ungrounded probe or a floating ground probe when measuring the voltage in the following step.

2. Using an ungrounded probe or floating ground probe, verify that 170 VDC is present between TP5 (+) and TP6 (-) on the power amplifier driver/supply board. If 170 VDC is not present, replace power amplifier driver/supply board.
3. Turn off CCU power and put power amplifier select board on an extender board. Turn on CCU power.
4. Verify that +12V is present between pins 20 (positive) and 1 (negative). If +12V is not present, replace power control module.

5.3.2 Communications Check

Perform the following steps for Yukon Master Station to CCU-711 communication failure:

1. If the Master Station to CCU modem link is the constant carrier type, verify that the CS light on Yukon Master Station modem is continuously lit and that the modem LED on the modem board is continuously lit. If the modem LED is not lit, check for defective LED, if modem LED is not defective, check for defective modem wiring; if modem wiring is not defective, check surge suppressor; if surge suppressor is not defective, replace modem board. If the modem LED is still not lit, check the PC modem transmit pair of the phone line.
2. If the CCU modem card is also set for constant carrier, verify that the CD light on the Yukon Master Station modem is continuously lit. If the LED is not lit, check the receive pair at the modem.
3. If the Master Station to CCU modem link is the keyed carrier type, verify that the modem LED on the modem board lights each time a message is transmitted from the Yukon Master Station. If the LED does not light, check for defective LED; if LED is not defective, check for defective modem wiring; if modem wiring is not defective, check surge suppressor; if surge suppressor is not defective, replace modem board.
4. A telephone butt set is useful for hearing the carrier tones on the line.
5. Check for presence of digital pulse data at TP1 of the logic board each time a message is transmitted from the Yukon Master Station. If data is present, replace logic board. If data is not present, replace modem board.

5.3.3 Power Output Check

Perform the following steps for power output failure on all distribution buses:

1. Check for presence of 5V p-p carrier between TP2 (power amplifier in) and TP1 (ground) of the power driver/supply board for each CCU transmit operation. If carrier is not present, replace logic board.
2. Check for presence of +5V between TP3 (power enable 1 or 2) and TP1 (ground) of the power amplifier driver/supply board for each CCU transmit operation. If +5V is not present, replace logic board.
3. Check for presence of carrier frequency (12.5 or 9.6 kHz), 22V p-p carrier between TP4 (driver output) and TP1 (ground) of power amplifier driver/supply board for each CCU transmit operation. If carrier is present, replace power amplifier output board. If carrier is not present, replace power amplifier driver/supply board.
4. If VOUT is equal to or greater than VOUT previously recorded on the CCU door, and if IOUT is approximately equal to zero, replace power amplifier select board.

5.3.4 Power Coupling Check

Perform the following steps for power coupling failure on some distribution buses:

1. If VOUT is equal to or greater than VOUT recorded inside the CCU door and, if IOUT is low (but not zero) compared to IOUT recorded inside the CCU door, repair PCA.
2. Turn off CCU power and put the coupler board on an extender board.
3. Turn on CCU power.
4. Verify that +5V appears at pin 5 of coupler board for each CCU transmit operation. If +5V is present, replace coupler board. If +5V is not present, replace logic board.
5. Turn off CCU power and remove the extender board.
6. Turn on CCU power.

5.3.5 Two-Way Communication Check

Perform the following procedures for two-way communication failure on all distribution buses:

1. If Receive LED lights when two-way communication is attempted, replace logic board.
2. If Receive LED does not light when two-way communication is attempted, check for defective Receive LED; if LED is not defective, replace.

Index

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