

# UPLC-II™

## Universal Power-Line Carrier



## System Manual CU44-VER09

**AMETEK®**  
POWER INSTRUMENTS

AMETEK Power Instruments  
4050 N.W. 121st Avenue  
Coral Springs, FL 33065  
1-800-785-7274  
+1-954-344-9822  
[www.ametekpower.com](http://www.ametekpower.com)

March 2023

Ordering Information	<b>1</b>
Product Description	<b>2</b>
Applications	<b>3</b>
Test Equipment, Maintenance & Troubleshooting	<b>4</b>
Installation/Commissioning Procedure	<b>5</b>
Testing Facilities	<b>6</b>
Communication Protocols	<b>7</b>
Appendices & Index	<b>A</b>

# **UPLC-II™**

## **System Manual**

### **Table of Contents**

---

## ESD Warning!

***YOU MUST BE PROPERLY GROUNDED, TO PREVENT DAMAGE FROM STATIC ELECTRICITY, BEFORE HANDLING ANY AND ALL MODULES OR EQUIPMENT FROM AMETEK.***

*All semiconductor components can be **damaged** by the discharge of static electricity. Be sure to observe all Electrostatic Discharge (ESD) precautions when handling modules or individual components.*



**IMPORTANT**

**W**e recommend that you become acquainted with the information in this manual before energizing your UPLC-II™ system. Failure to do so may result in injury to personnel or damage to the equipment, and may affect the equipment warranty. If you mount the carrier set in a cabinet, it must be bolted to the floor or otherwise secured before you swing out the equipment, to prevent the installation from tipping over.

You should not remove or insert printed circuit modules while the UPLC-II™ is energized. Failure to observe this precaution can result in undesired tripping output and can cause component damage.

AMETEK does not assume liability arising out of the application or use of any product or circuit described herein. AMETEK reserves the right to make changes to any products herein to improve reliability, function or design. Specifications and information herein are subject to change without notice. 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 you desire further information regarding a particular installation, operation, or maintenance of equipment, please contact your local AMETEK representative.

Copyright © AMETEK

ALL RIGHTS RESERVED

AMETEK does not convey any license under its patent rights nor the rights of others.

## Preface

### Scope

This manual describes the functions and features of the *Universal Power-Line Carrier*. It is intended primarily for use by engineers and technicians involved in the installation, alignment, operation, and maintenance of the *UPLC-II™*. (The majority of which also applies to the *UPLC™*.)

### Equipment Identification

The *UPLC-II™* equipment is identified by the 11-digit Catalog Number on the label inside the front door or alternatively in the front display when pressing the SET button.

### Warranty

Our standard warranty extends for 5 years after shipment. For all repaired modules or advance replacements, the standard warranty is 1 year or the remaining warranty time, whichever is longer. Damage clearly caused by improper application, repair, or handling of the equipment will void the warranty.

### Equipment Return & Repair Procedure

To return equipment for repair or replacement:

1. Call your AMETEK representative at **1-800-785-7274 (or 954-344-9822)**.
2. Request an **RMA number** for proper authorization and credit.
3. Carefully pack the equipment you are returning.

Repair work is done most satisfactorily at the factory. When returning any equipment, pack it in the original shipping containers if possible. Be sure to use anti-static material when packing the equipment. Any damage due to improperly packed items will be charged to the customer, even when under warranty.

4. Make sure you include your return address and the RMA number on the package.
5. Ship the package(s) to:

**AMETEK**  
**4050 NW 121st Avenue**  
**Coral Springs, FL USA 33065**



Chapter/Topic	Page No.
<b>1. Ordering Information</b> .....	<b>1-1</b>
UPLC-II™ Catalog Number Digits Explanation .....	1-3
<b>2. Product Description</b> .....	<b>2-1</b>
2.1 Specifications .....	2-1
2.2 Standard Nomenclature .....	2-5
2.3 UPLC-II™ Chassis .....	2-5
2.4 UPLC-II™ Modules .....	2-5
2.4.1 Power Supply Module .....	2-10
2.4.2 Power Amp Module .....	2-12
2.4.3 Display Module .....	2-14
2.4.4 Input/Output (I/O) Module .....	2-16
2.4.5 Transceiver Module .....	2-18
2.4.6 Ethernet Module .....	2-20
2.5 UPLC-II™ Functional Description .....	2-24
2.5.1 Keying Input Logic .....	2-25
2.5.2 Receiver Output Logic.....	2-29
<b>3. Applications</b> .....	<b>3-1</b>
3.1 ON/OFF Mode Protective Relay Applications .....	3-1
3.1.1 Directional-Comparison Blocking (DCB).....	3-1
3.1.2 Phase-Comparison Blocking .....	3-1
3.2 ON/OFF Mode Special Considerations .....	3-7
3.2.1 Multi-Terminal Lines.....	3-7
3.2.2 Phase Comparison .....	3-7
3.2.3 Hybrids/Series LC Unit .....	3-7
3.2.4 Interfacing to Electromechanical Relays.....	3-7
3.2.5 External Booster Amplifiers .....	3-8
3.3 ON/OFF Mode Typical Wiring/Connections .....	3-8
3.4 ON/OFF Mode Alarms .....	3-15
3.5 FSK Mode Protective Relay Applications .....	3-17
3.5.1 Directional Comparison Unblocking (DCUB) .....	3-17
3.5.2 Permissive Overreaching Transfer Trip Systems .....	3-19
3.5.3 Permissive and Non-Permissive Underreaching Transfer Trip Systems.....	3-19
3.5.4 Dual Phase Comparison Unblocking Systems .....	3-19
3.5.5 Segregated Phase Comparison System .....	3-22
3.6 FSK Mode Direct Transfer-Trip (DTT) Systems .....	3-27
3.6.1 Transformer Protection .....	3-27
3.6.2 Shunt Reactor Protection .....	3-27
3.6.3 Remote Breaker-Failure Protection.....	3-27
3.6.4 Direct Transfer Trip Channel Considerations .....	3-28
3.7 FSK Mode Special Considerations.....	3-29
3.7.1 3-Freq. Systems .....	3-30
3.7.2 4-Freq. Systems .....	3-30
3.7.3 Directional Comparison Unblocking (2-Frequency).....	3-30
3.7.4 Transfer Trip: Overreaching, Underreaching or Direct (2-Frequency).....	3-31
3.7.5 Phase Comparison Unblocking: Dual or Segregated (2-Frequency) .....	3-31
3.7.6 Three-Terminal Line Applications.....	3-31
3.7.7 External Booster Amplifier .....	3-31
3.7.8 Unidirectional DTT Receiver-Only Application .....	3-31
3.8 FSK Mode Typical Wiring/Connections .....	3-32

Chapter/Topic	Page No.
3.9 FSK Mode Alarms .....	3-40
3.10 Hybrid Applications .....	3-42
3.10.1 Examples .....	3-43
<b>4. Test Equipment, Maintenance &amp; Troubleshooting .....</b>	<b>4-1</b>
Recommended Test Equipment .....	4-1
4.1 Periodic Checks .....	4-2
4.2 Trouble Detection Sequence.....	4-2
4.3 Front Display Alarms .....	4-2
4.4 Transceiver NOVRAM Battery .....	4-4
<b>5. Installation/Commissioning Procedure .....</b>	<b>5-1</b>
Quick Installation Guide.....	5-1
5.1 Introduction.....	5-3
5.1.1 Safety Precautions .....	5-3
5.2 Mounting/Connecting .....	5-3
5.2.1 Mounting .....	5-3
5.2.2 Terminal Block Connections .....	5-3
5.2.3 Equipment Ground.....	5-3
5.2.4 RF Coax Connections .....	5-5
5.2.5 Other Connections .....	5-6
5.3 Hardware Jumper Settings .....	5-6
5.3.1 Backplane (Rear Panel) .....	5-7
5.3.2 I/O Module.....	5-7
5.3.3 Power Supply Module .....	5-8
5.3.4 Aux. Power Supply Module (for driving EM protective relays).....	5-8
5.3.5 Power Amplifier Module .....	5-8
5.4 PC Setup for Communication with the UPLC-II™ .....	5-10
5.4.1 Ethernet Port – PC/UPLC-II™ Setup .....	5-10
5.4.2 Front RS-232 Port – PC Setup .....	5-11
5.5 Logging In.....	5-11
5.5.1 Admin Web Page .....	5-13
5.5.2 User Accounts .....	5-13
5.6 Making/Saving Settings .....	5-14
5.6.1 Loading Settings .....	5-14
5.6.2 Saving Settings .....	5-14
5.6.3 Working vs Temporary Settings .....	5-16
5.7 Settings Pages .....	5-16
5.7.1 General Tab .....	5-17
5.7.2 Logic Tab .....	5-20
5.7.3 Input/Output Tab .....	5-23
5.7.4 Checkback (ON/OFF Mode) or Trip Test (FSK Mode) Tab.....	5-30
5.7.5 RF Configuration Tab .....	5-30
5.7.6 Submit Tab .....	5-30
5.8 Calibration .....	5-31
5.9 SOE Log .....	5-32
5.10 Home Page .....	5-34
5.11 Front Panel .....	5-36
5.11.1 Password Access .....	5-36
5.11.2 Front Panel Display .....	5-36
5.11.3 Set Button Menu .....	5-36

Chapter/Topic	Page No.
5.11.4 Test Button Menu .....	5-37
<b>6. Testing Facilities .....</b>	<b>6-1</b>
Checkback Test Facility (Quick Checklist, if not working).....	6-1
ON/OFF Mode Automatic Checkback (CB) Feature .....	6-1
6.1 General Description .....	6-1
6.2 Checkback (CB) Settings .....	6-2
6.2.1 General Information.....	6-2
6.2.2 Primary Communications Mode .....	6-2
6.2.3 Checkback Test Sequence .....	6-2
6.2.4 Last Remote .....	6-3
6.2.5 Auto tests .....	6-3
6.2.6 Low Power Tests .....	6-3
6.2.7 Retries .....	6-3
6.2.8 Automatic Tests – Time Settings .....	6-3
6.2.9 Optional Carrier Recovery.....	6-4
6.3 Checkback Tester Inputs/Outputs .....	6-6
6.4 Performing Checkback Tests/Functions .....	6-7
6.4.1 Manual Requests from Web Pages .....	6-7
6.4.2 Loopback Test Capability (Turn On Remote Transmitter via the power line) ....	6-7
6.4.3 Remote-Initiated Periodic Tests.....	6-8
6.4.4 Remote-Initiated “Hours of the Day” Tests .....	6-8
6.5 System Troubleshooting with Checkback .....	6-9
FSK Mode Trip Test Feature .....	6-13
6.6 General Description .....	6-13
6.6.1 Two Frequency Applications Real Trip Scenario.....	6-13
6.6.2 Two Frequency Application Checkback Trip Scenario.....	6-13
6.6.3 Three Frequency Applications Checkback Trip Scenario .....	6-13
6.6.4 Trip Test Initiation .....	6-14
6.6.5 Trip Test Pulse .....	6-14
<b>7. Communication Protocols .....</b>	<b>7-1</b>
7.1 DNP 3 .....	7-1
7.1.1 DNP 3 Settings .....	7-1
7.1.2 DNP Binary Inputs (UPLC-II™ Inputs) .....	7-3
7.1.3 DNP Binary Inputs(UPLC-II™ Outputs) .....	7-4
7.1.4 DNP Analog Inputs (UPLC-II™ Analog Values) .....	7-7
7.2 IEC 61850.....	7-8
7.2.1 UPLC-II™ with IEC 61850 .....	7-8
7.2.2 Private GOOSE Subscription Details .....	7-10
7.2.3 Overview .....	7-11
<b>Appendix A: UPLC-II™ Serial Connection - PC Configuration .....</b>	<b>A-1</b>
<b>Appendix B: UPLC-II™ Ethernet Connection - PC Configuration .....</b>	<b>B-1</b>
<b>Appendix C: UPLC-II™ XML File Format .....</b>	<b>C-1</b>
<b>Appendix D: Management User Interface .....</b>	<b>D-1</b>
<b>Appendix E: Sequence of Events (SOE) Listing .....</b>	<b>E-1</b>
<b>Appendix F: Changing the Cat. No. on a UPLC-II™ .....</b>	<b>F-1</b>
<b>Appendix G: Upgrading the firmware in a UPLC-II™ .....</b>	<b>G-1</b>
<b>Index .....</b>	<b>I-1</b>

# 1. Ordering Information

The UPLC-II™ carrier is functionally compatible with earlier type carrier equipment (e.g., KR, TC, TC-10, TC-10A & TC-10B, TCF, TCF-10, TCF-10B, UPLC™) as well as other suppliers' equipment. That is, you may use the UPLC-II™ with these other carrier types at the opposite end of the line.

However, the testing options below are only compatible between UPLC-II™, UPLC™, TC-10B/TCF-10B and UCBS.

- Automatic Checkback Testing Facilities for periodic testing of the carrier channel at programmable intervals (in ON/OFF mode)
- Trip Test Facility (in FSK mode)

You may use the UPLC-II™ carrier set with the following types of relay systems:

- All Directional-Comparison Systems
- Phase-Comparison Systems
- Direct Transfer Trip Systems

The equipment identification number (catalog number) is displayed when you press “set” on the front keypad & is shown on all of the webpages. There is also a decal/sticker on the inside of the front door. The UPLC-II™ catalog number comprises eleven (11) characters, each specifying a particular feature. This number identifies the unit's capabilities, as well as any optional modules installed in the unit. It is electronically stored in the Transceiver module and controls all features by enabling/disabling them in the unit. Features not enabled are “grayed out” on the web pages. The catalog number can be changed with a software key (alphanumeric code) that AMETEK supplies. It is input into the catalog number tab of the Admin page. Some features can be changed at no charge and others add cost.

The table on the following page provides a complete listing of the options for ordering a UPLC-II™, and a sample catalog number. To order one or more UPLC-II™ units, simply identify the features you want for each chassis. For example, – U S 1 N S M 9 A F S X – describes a UPLC-II™ with the following features:

**Chassis:** UPLC-II™

**Configuration:** Single Transceiver Unit

**Power Supply:** 110/125/250 Vdc

**Redundant Power Supply:** None

**Outputs / Logic:** Standard Outputs (7 Solid State & 3 Contacts) / No Special Logic

**Rear Ethernet Ports:** Redundant/Daisy Chain – 2 RJ-45 (10/100 Base T)

**Protocols:** DNP 3.0

**Testing Facilities:** ON/OFF Checkback Test / FSK Trip Test

**Power Amp Features:** Power Amp with frequency selectivity for TX reflected power

**Table 1–1. UPLC-II™ Catalog Numbers**

	Typical Catalog Number	1	2	3	4	5	6	7	8	9	10	11
<b>1 – Base Unit</b>	U	U										
<b>2 – Configuration</b>			S									
Single Transceiver Unit (3RU) w/Single Power Amplifier	S											
Single Transceiver Unit (3RU) w/Dual Power Amplifier <sup>1</sup>	A											
Single Receiver Unit (3RU)	R											
<b>3 – Main Power Supply</b>				1								
48/60 Vdc	4											
110/125/250 Vdc	1											
48/60 Vdc w/Auxiliary Power Supply for 20/200mA Output	8											
110/125/250 Vdc w/Auxiliary Power Supply for 20/200mA Output	2											
<b>4 – Redundant Power Supply<sup>1</sup></b>												
48/60 Vdc	4											
110/125/250 Vdc	1											
48/60 Vdc w/Auxiliary Power Supply for 20/200mA Output	8											
110/125/250 Vdc w/Auxiliary Power Supply for 20/200mA Output	2											
None	N											
<b>5 – Outputs / 4-Freq. Logic</b>												
Std Outputs (7 SS, 3 Contacts)	S											
Std Outputs (7 SS, 3 Contacts) + 4 Trip Duty Contact Outputs	E											
Std Outputs (7 SS, 3 Contacts) + 4-Freq. Logic	T											
Std Outputs (7 SS, 3 Contacts) + 4 Trip Duty Contact Outputs + 4-Freq. Logic	F											
<b>6 – Ethernet Ports</b>												
None (Front Port Present but Non-Functional)	A											
Front = 1 RJ-45, Rear = 2 RJ-45 (10/100 BaseT)	M											
Front = 1 RJ-45, Rear = 2 Fiber ST (100 BaseFX)	P											
Front = 1 RJ-45, Rear = 1 RJ-45 & 1 Fiber ST	R											
<b>7 – Protocols</b>												
No Protocol	7											
IEC 61850 Compliant <sup>2</sup>	8											
DNP3 Compliant	9											
<b>8 – Testing Facilities (ON/OFF Checkback Test / FSK Trip Test)</b>												
Active	A											
None	N											
<b>9 – Power Amp Features</b>												
Power Amp with Frequency Selectivity for Reflected Power	F											
No Power Amp – Receiver Only	X											
<b>10 – Future</b>												
Reserved for Future Options	S											
<b>11 – Future</b>												
Reserved for Future Options	X											

<sup>1</sup>Dual Power Amps requires <sup>2nd</sup> Power Supply <sup>2</sup>Must also select an ethernet option

## **UPLC-II™ Catalog Number Digits Explanation**

### **Digit and Description**

1. Always starts with letter U
2. Configuration
  - Transceiver or Receiver only (RX only eliminates the Power Amp module)
  - Single or dual (redundant) Power Amps
3. Main Power Supply Type (Input voltage and auxiliary Power Supply)
  - 48Vdc
  - 110/125/250 Vdc (also runs off 120Vac)
  - With or without Aux. PS module to drive older EM relays with 20/200mA (Aux output is on TB1/TB2 for putting in series with an output to get the correct current.)
4. Redundant Power Supply – Yes or No
5. Outputs (with or without 4 optional Trip Test Duty relay outputs) – Yes or No / Special Logic (FSK 4-Frequency) – Yes or No  
(This digit specifies 2 different features with one digit)
6. Ethernet Interface Options (Rear Port Connectors)
  - Dual Electrical – RJ-45
  - Dual Fiber – ST
  - One Electrical, RJ-45 / One Fiber, ST
7. Communications Protocol options
  - None, DNP3 or IEC61850
8. Testing Facilities – Yes or No
  - ON/OFF mode = Checkback Test
  - FSK mode = Trip Test (Shift from guard to trip in test mode without real trip output)
9. Power Amp options
  - None, Receiver-only unit
  - Power Amp with Freq. Selectivity for TX Reflected power meter
10. Future place holder
11. Future place holder  
(All UPLC-II™ Catalog numbers end in “SX”)



## 2. Product Description

### 2.1 Specifications

**Table 2–1. Basic Transmit / Receive Specifications**

Basic Industry Specification	Meets or Exceeds requirements of C93.5, ANSI Requirements for Single Function Power-Line Carrier TX/RX Equipment
Frequency Range	30–535 kHz
TX / RX Frequency Resolution	10 Hz Increments
Frequency Stability	±5 Hz
TX / RX Connections	2-Wire or 4-Wire
TX RF Output Impedance	50 Ω, 75 Ω Nominal Unbalanced
TX RF Output Power	10W Max (20W w/optional redundant amp), 0.3W Min
TX Harmonic & Spurious Output	55 dB Below TX Freq. at Rated Full Power
TX Output Variation	±1 dB Over Temp / Volt Range
TX Reflected Power Monitor Accuracy with Interference	±10 %
Modulation Type	ON/OFF (Amplitude Modulation) or FSK (Frequency Shift Keyed), Field Programmable
FSK Frequency Shifts	Programmable ±100, ±250 or ±500 Hz (See 4-Freq. Table Below)
Minimum In-Band SNR for Good Channel Operation	13 dB for FSK, 20 dB for ON/OFF
4-Wire Receiver Input Impedance	> 4 kΩ
RX Signal Level Range (with 15dB Fade Margin)	28 mV (Min.) to 70.7 V (Max.), or –18 dBm (Min.) to +50 dBm (Max.) across 50 Ω
Receiver Sensitivity (Absolute Lowest Level)	5 mV or –33 dBm across 50 Ω
Hot-swappable	Power Supply & Power Amp Only

**Table 2–2. IRIG-B Load Specifications**

Type	Connector	Load	Compatibility	Signal
Modulated	J13	2.5 k Ω Min. (3.5 k Ω Typical)	IRIG-B123	Mod. 1 kHz Sine Wave
TTL (Unmodulated)	J14	3.8 mA Typical at 5 Vdc	IRIG-B003	0–5 V Pulse Train

**Table 2–3. Frequency Specifications for 4-Frequency Special Logic**

TX Keyed State	RX Bandwidth / Shift		Frequency Designation
	600 Hz BW +/- 250 Shift	1,200 Hz BW +/- 500 Shift	
Non-keyed	+83 Hz	+166 Hz	F3
Command A	+249 Hz	+498 Hz	F4
Command B	–83 Hz	–166 Hz	F2
Command A & B	–249 Hz	–498 Hz	F1



**Table 2-4. Output Ratings (All Outputs Non-Wetted & Non-Polarity Sensitive)**

Output (Terminal Block)	Max Current at @ 250 Vdc		N.O. / N.C. Selectable	Nominal Voltage Drop	Voltage Range	Max Operate Time	Max Dropout Time
	Make & Carry Continuous	Make & Carry Short Term					
Power Supply Alarm (TB1 or 2 - 5 & 6)	2 A	N/A	Hardware Jumper (PS)	0 V	15-250 Vdc	15 ms	10 ms
7 Low Level Solid State (TB4 & 5)	0.1 / 1.0 A Hardware Selectable	6 A / 15 ms for 1 A Setting	Software Setting	2.5 V	15-250 Vdc	0.5 ms	0.5 ms
3 Low Level EM Contacts (TB5)	2 A	N/A	Hardware Jumper (I/O)	0 V	15-250 Vdc	15 ms	10 ms
4 Trip Duty EM Contacts (TB6)	14 A	30 A / 200 ms w/duty cycle per ANSI C37.90	Hardware Jumper (I/O)	0.2 V @ < 1 A 7 V @ 30 A	15-250 Vdc	N.O. Contact Closing = 3 ms N.C. Contact Opening = 2 ms	N.O. Contact Opening = 5 ms N.C. Contact Closing = 4 ms

**Table 2-5. Keying Input Ratings  
(All Inputs Current Limited &  
Non-Polarity Sensitive)**

Nominal Input Voltage	Min Keying Voltage	Max Current Draw
15 Vdc	10 Vdc	5 mA
48/60 Vdc	38 Vdc	5 mA
110/125 Vdc	70 Vdc	5 mA
220/250 Vdc	150 Vdc	5 mA

**Table 2–6. Minimum Frequency Spacing**

ON/OFF Applications			
Wide Band	Directional Comparison Relaying		4000 Hz
Narrow Band	Directional Comparison Relaying		2000 Hz
Extreme Wide Band	Phase Comparison Relaying		4000 Hz
FSK Applications			
Narrow Band:	Directional Comparison or DTT	1 way	500 Hz
Narrow Band	Directional Comparison or DTT	2 way	1000 Hz*
Wide Band	Directional Comparison or DTT	1 way	1000 Hz
Wide Band	Directional Comparison or DTT	2 way	2000 Hz*
Wide Band	Dual Comparator Phase Comp.	1 way	1500 Hz
Wide Band	Dual Comparator Phase Comp.	2 way	3000 Hz*
Wide Band	Segregated Phase Comparison	1 way	2000 Hz
Wide Band	(50/60Hz sq wave keying)	2 way	4000 Hz*
Extra Wide Band:	Directional Comparison or DTT	1 way	2000 Hz
Extra Wide Band	Directional Comparison or DTT	2 way	4000 Hz*
Extra Wide Band	Dual Comparator Phase Comp.	1 way	1500 Hz
Extra Wide Band	Dual Comparator Phase Comp.	2 way	3000 Hz
Extra Wide Band	Segregated Phase Comparison	1 way	2000 Hz*
Extra Wide Band	(50/60Hz sq wave keying)	2 way	4000 Hz*

Specifications Notes:

\*An external hybrid or other device offering at least 20 dB rejection of the adjacent channel must be used in the application.

1 way represents transmitter to transmitter or receiver to receiver

2 way represents transmitter to receiver

**Table 2–7. Nominal Receiver Bandwidths & Corresponding Channel Delay\***

Mode	Receiver Bandwidth		Channel Delay
ON/OFF	Narrow Band	600 Hz	2.8 ms
	Wide Band	1200 Hz	2.1 ms
	Extra Wide Band	4000 Hz	1.5 ms
FSK	Narrow Band	300 Hz	7 ms
	Wide Band	600 Hz	6.5 ms
	Extra Wide Band	1200 Hz	4.8 ms

\*NOTE: Channel times are nominal values with a 15 dB RX Margin on a back-to-back system. Times are for solid state outputs and do not include logic trip delay or relay output operation times.

**Table 2–8. Environmental/Surge/Interface Specifications**

Ambient Temperature, range of air	–30 C to +70 C (ANSI C37.90)
Relative Humidity	Up to 95% (non-condensing) at 40 C (for 96 hrs cumulative) (ANSI C93.5)
Altitude	Up to 1500 m (without de-rating), 6000 m with de-rating
Surge Withstand Capability	Per ANSI C37.90.1
1 Minute withstand	IEC 255-5 and C37.90 (500 Vdc class)
Coax, center conductor to ground	3000 V impulse level, 1.2 x 50 µs impulse, per ANSI C93.5
Dielectric	Per ANSI C37.90, 500 Vdc class (3,000 Vdc dielectric withstand), IEC 60255-5
Electrostatic Discharge (ESD)	Per ANSI C37.90.3, IEC 61000-4-2
Radiated Electromagnetic Interference from Transceivers	Per ANSI C37.90.2
Carrier Frequency on dc Input Leads When Transmitting 1 W	20 mV (max.)

**Table 2–9. Input Power Requirements**

Equipment		Nominal Battery Voltage	Permissible Voltage Range Range <sup>1</sup>	Standby <sup>3</sup>	1 Watt Transmit Single	10 Watt Transmit Single
Power Supply	Power Amp					
Single	Single	48/60 Vdc	38 to 76 Vdc	25 watts	35 watts	60 watts
Single	Single	110/125/250 Vdc	88 to 300 Vdc <sup>2</sup>	20 watts	30 watts	66 watts

Notes:

1 Permissible ripple on incoming Vdc = 5%, Maximum allowable frequency of ripple = 120 Hz

2 Unit can also operate with 110–130 Vac input

3 Not transmitting

**Table 2–10. Weight & Dimension Specifications**

Equipment	Net Weight*		Height		Width		Depth		Rack Space
	lbs	Kg	inches	mm	inches	mm	inches	mm	
UPLC-II	21	9.53	5.218	132.54	17.437	444.88	13.26	336.75	3 RU

\* Without redundant Power Supply or Power Amp, each of which adds 1 lb. to the overall weight.

## 2.2 Standard Nomenclature

The standard nomenclature for AMETEK carrier protection equipment is as follows:

- Cabinet** – contains fixed-racks, swing-racks, or open racks
- Rack** – contains one or more chassis (e.g., the UPLC-II™)
- Chassis** – contains several printed circuit boards, called modules (e.g., Power Supply or Transceiver)
- Module/Card/Board** – contains a number of functional circuits (e.g., Oscillator or Microprocessor)
- Circuit** – a complete function on a printed circuit board

## 2.3 UPLC-II™ Chassis

The Front Panel, with the unit's S/N on back of it, requires a screwdriver to open. It is shown in Figure 2–1. See Figure 2–2 for the backplane. The UPLC-II™ chassis specifications (see Figure 2–3) include standard dimensions of:

- Height – 5.25” (133.35 mm), requiring 3 rack units, each measuring 1.75” (44.45 mm)
- Width – 19.00” (482.6 mm) Depth – 13.50” (342.9 mm)

The chassis includes a two-piece metal cover plate on back. The top half of the cover plate is easily removable with 2 or 4 captivated screws fastening it. Loosen screws, pull bottom out then down to remove.

Each chassis is notched for mounting in a standard 19” rack and has adjustable mounting brackets on the sides. It may be flush-mounted against another chassis on top & bottom.

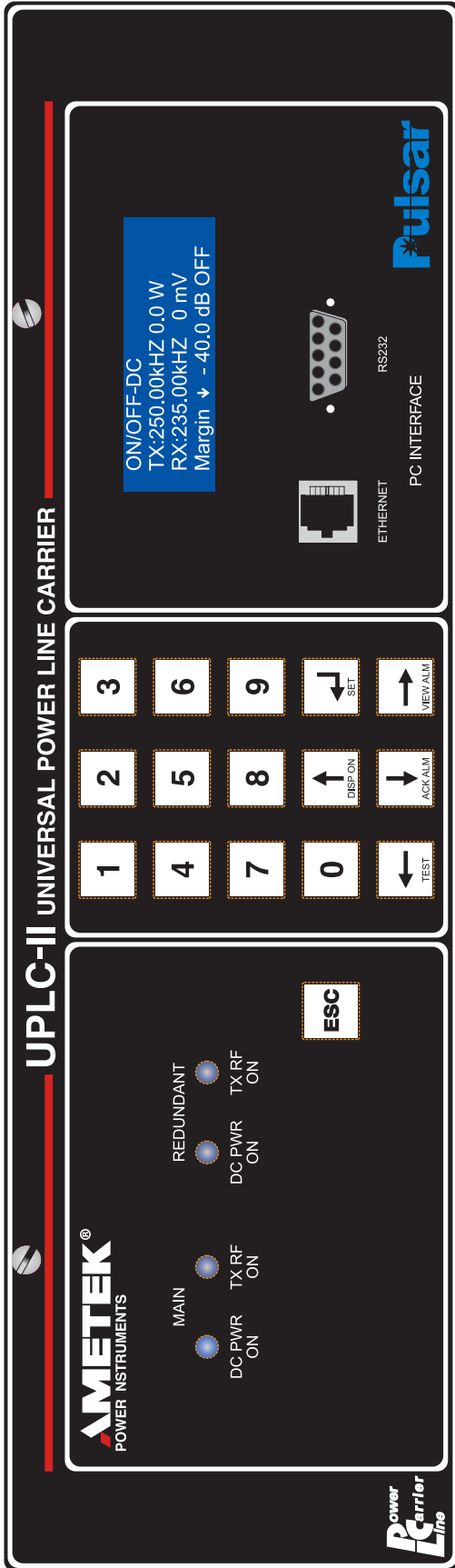
## 2.4 UPLC-II™ Modules

Each module has a white S/N bar code sticker. The basic UPLC-II™ has 7 standard printed circuits boards in a 3RU 19 inch chassis. There are 4 additional boards that may be supplied, based upon the catalog number purchased. The illustration for how these are all interconnected is on Page 2–22.

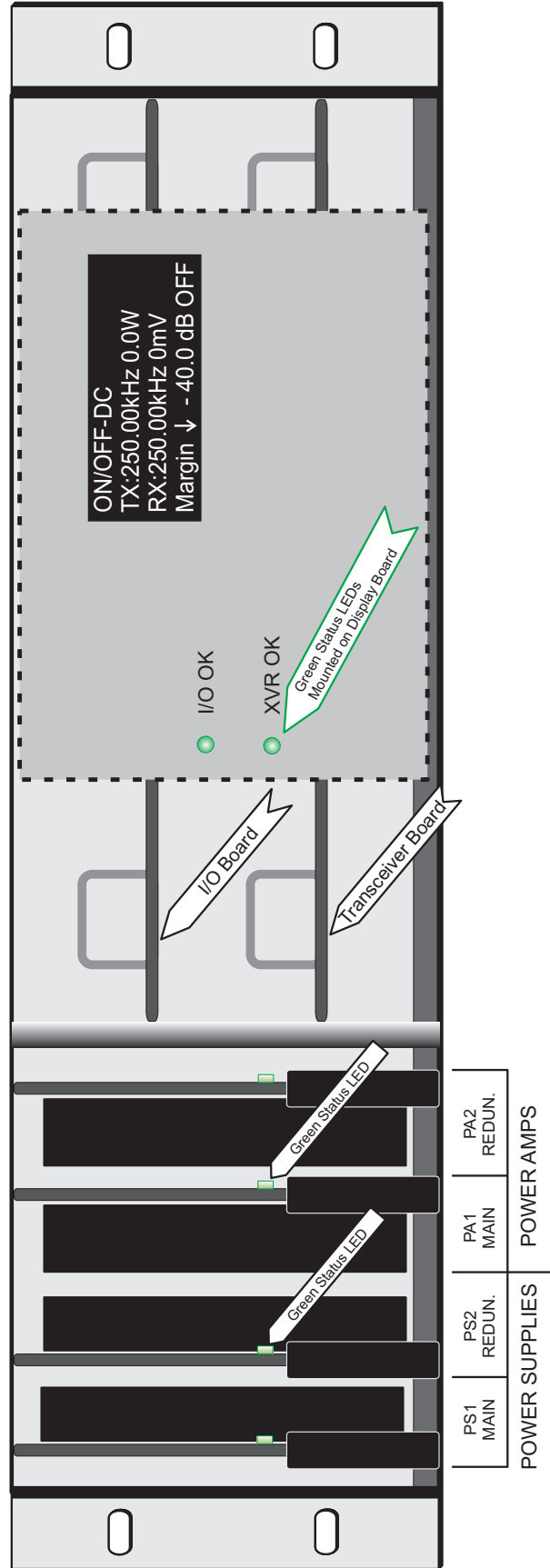
**Table 2–11. UPLC-II™ Modules and Part Numbers**

Name	Part Number
Power Supply (Main / Optional Redundant) 110/125/250 Vdc	CU20-PS1MN-001
Power Supply (Main / Optional Redundant) 48/60 Vdc	CU20-PS1MN-002
Power Supply (Main / Optional Redundant) 110/125/250 Vdc w/Aux. PS	CU20-PS1MN-101
Power Supply (Main / Optional Redundant) 48/60 Vdc w/Aux. PS	CU20-PS1MN-102
Power Amplifier (Main / Optional Redundant)	CU20-PA1MN-002
Display Board	CU20-DP1MN-001
Aux. Display board – w/Ethernet RJ-45 & RS-232 DB9 connectors	CU20-DP1A3-001
Input/Output Board	CU20-IO1MN-001
Transceiver Board	CU20-XVRMN-001
Ethernet Board (Optional) – 2 RJ-45 (10/100 BaseT)	CU20-XVRA5-001
Ethernet Board (Optional) – 2 Fiber ST (100 BaseFX)	CU20-XVRA6-001
Ethernet Board (Optional) – 1 RJ-45 & 1 Fiber ST	CU20-XVRA7-001
Aux. PS (Optional) – for powering 20V, 20 or 200 mA outputs	CU20-PS1A1-001
Motherboard/Backplane	CU20-BP1MN-101
Front Door (without auxiliary door board)	1088-524
Chassis (complete with backplane & front door)	1087-177

Figure 2-1. UPLC-II™ Front View



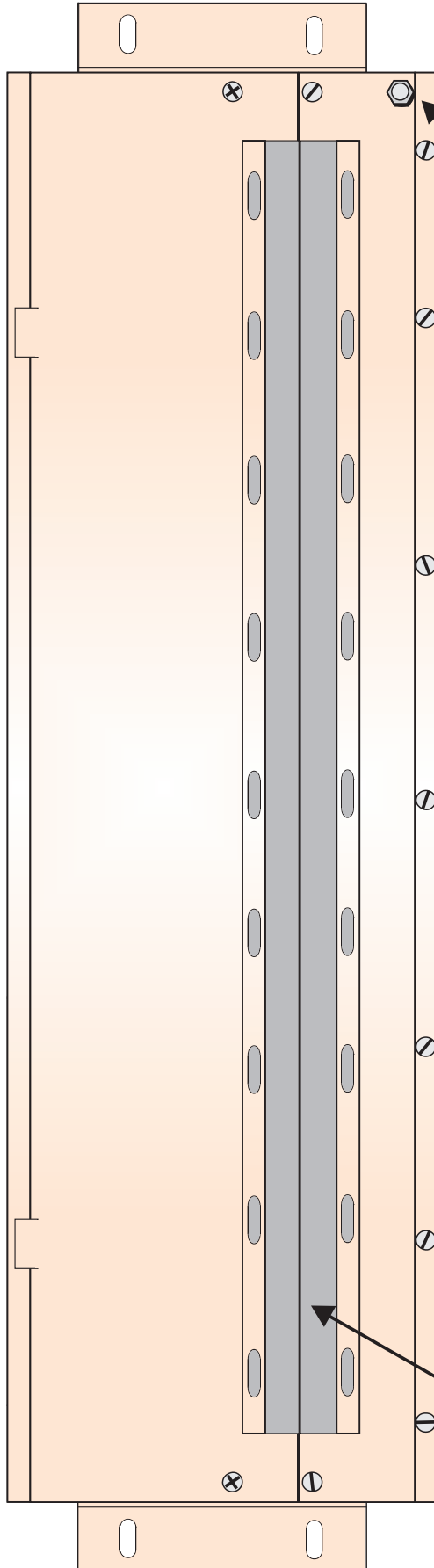
**NOTE:** S/N for the complete UPLC-II™ unit is located on the silver label on rear of front door.



**Chassis with Front Door Open**

**NOTE:** Ethernet board mounted on rear of transceiver board.

Backplane with Metal RF Cover Plate Installed



ChassisGroundStud

RF Gasket Allows Wires to Enter/Exit (Best to Spread Out Wires Along Back)

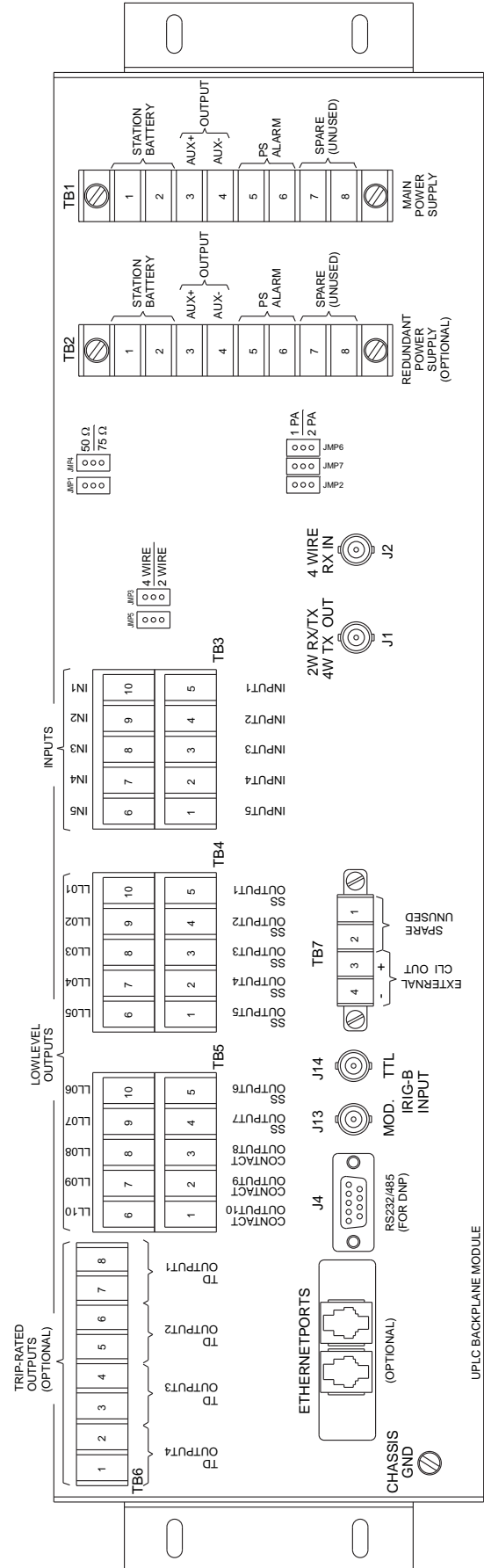
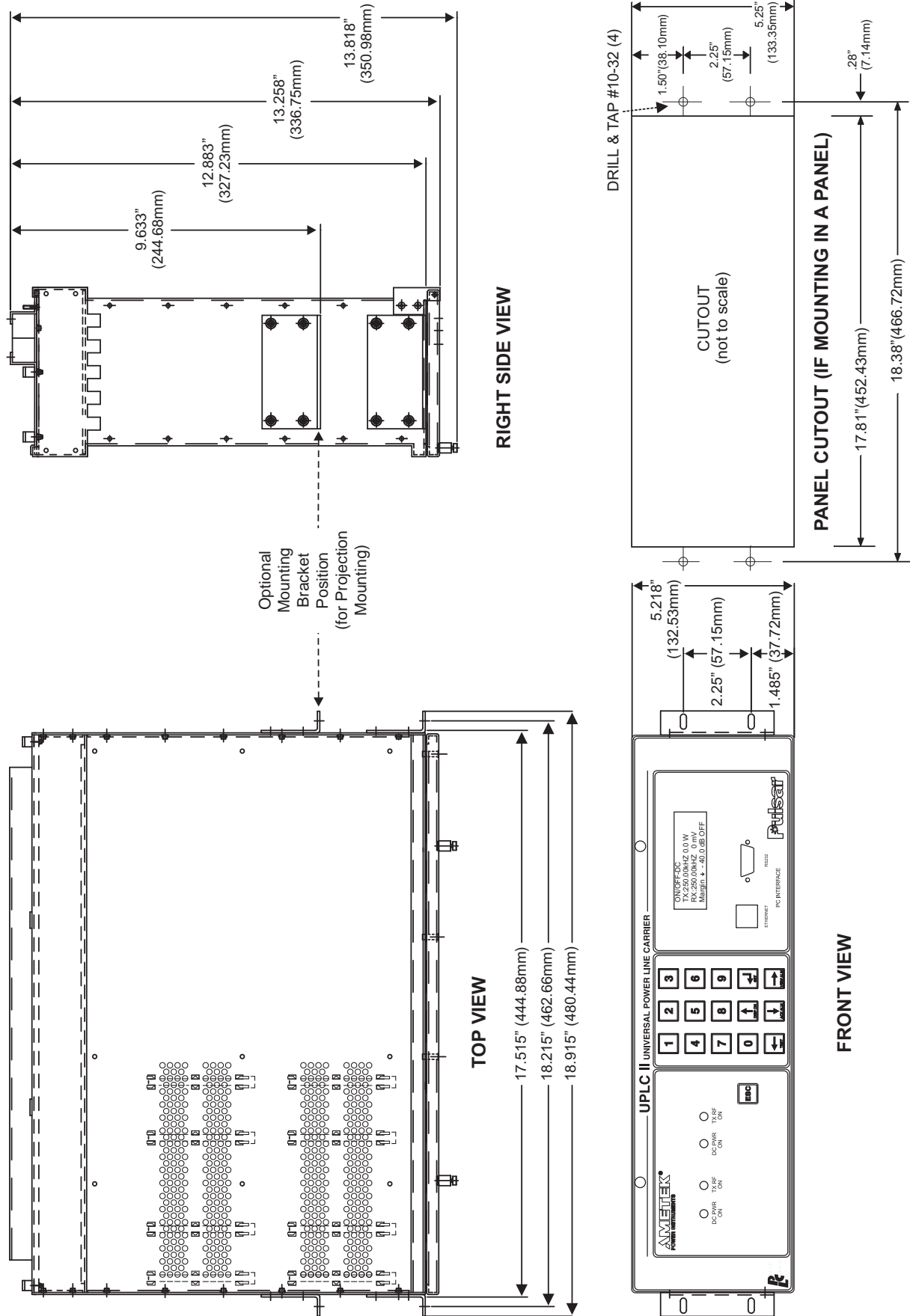


Figure 2-2. UPLC-II™ Rear View with Cover Removed

Figure 2-3. Chassis Dimensions







Description	Part Number	Digit 3 & 4 of UPLC-II Cat. No.
125/250V Power Supply	CU20-PS1MN-001	1
125/250V Power Supply w/ PS Aux	CU20-PS1MN-101	2
48V Power Supply	CU20-PS1MN-002	4
48V Power Supply w/ PS Aux	CU20-PS1MN-102	8

## 2.4.1 Power Supply Module

### Description

The Power Supply (PS) module takes station battery voltage or 120Vac input and converts it into 4 dc output voltages (+/- 16.5V and +/- 6.0V) needed for the UPLC-II™. It mounts into the far left slot of the chassis with the redundant power supply right beside it when used. The two Power Supply modules have separate input terminal blocks and can be run off of different voltages if desired. The Power Supply Module has an alarm relay to indicate failure of the module. This is a “fail-safe” alarm and is therefore energized if the module is functional. The UPLC-II™ was designed without an ON/OFF switch for the Power Supply in order to circumvent a common point of failure. Instead a jumper, J3, is available for keeping the PS in the off state when plugged in if desired. Also, the Power Supply is hot-swappable and may be pulled out to power down the unit.

An optional auxiliary Power Supply daughter board is available for providing an isolated lower voltage output to drive electromechanical relays requiring 20 or 200 mA as well as a 20V output option. This board is soldered onto the main board via headers. When used, it is put in series with one of the UPLC-II™ outputs that connects to an EM protective relay or other device requiring 20/200 mA current or low voltage.

#### Customer interface points:

##### Main board Jumpers/LED/Fuses

- PWR ON/PWR OFF Jumper (J3) – Normally in PWR ON position. Place in PWR OFF position for disabling the Power Supply when it is desired to have the module plugged in with input power applied but have the UPLC-II™ remain powered off.

- PS FAIL Contact Jumper (JMP1/2) – For setting the Power Supply fail alarm contact output on TB1-5 & 6 or TB2-5 & 6 for normally open (N.O.) or normally closed (N.C.)
- PS OK LED (LE1) – Status LED for the PS, when on, it indicates that all 4 dc output voltages are within tolerance and not too low in voltage. This LED has a corresponding virtual LED on the home web page of the UPLC-II™.
- Fuses (F1/F2) – For disconnecting input when drawing too much current due to a failure on the PS.

##### Auxiliary board (low voltage output) Jumpers

- 20/200mA Jumper (JMP1/2) – For choosing 20 or 200 mA for driving EM relays.
- 20V/46V Jumper (JMP3) – For choosing between 20V output versus 46V (20mA) output option.

The jumpers on the auxiliary power supply board need to be set to give the desired output voltage/current per the following:

- 20mA for an EM relay with about 2200 Ω coil resistance: JMP3 = 46V, and JMP1/JMP2 = 46V/20V (20mA).
- 200mA for an EM relay with about 25 Ω coil resistance: JMP3 = setting does not matter, and JMP1/JMP2 = 8V (200mA).
- 20V output for some other applications: JMP3 = 20V, and JMP1/JMP2 = 46V/20V (20mA).

##### Backplane Test Points

- The 4 dc voltage outputs are labeled toward the bottoms of the DIN connector pins close to TB1 & TB2 and can be verified with a meter from the rear of the chassis with the cover off if the “PS OK” LED is off.

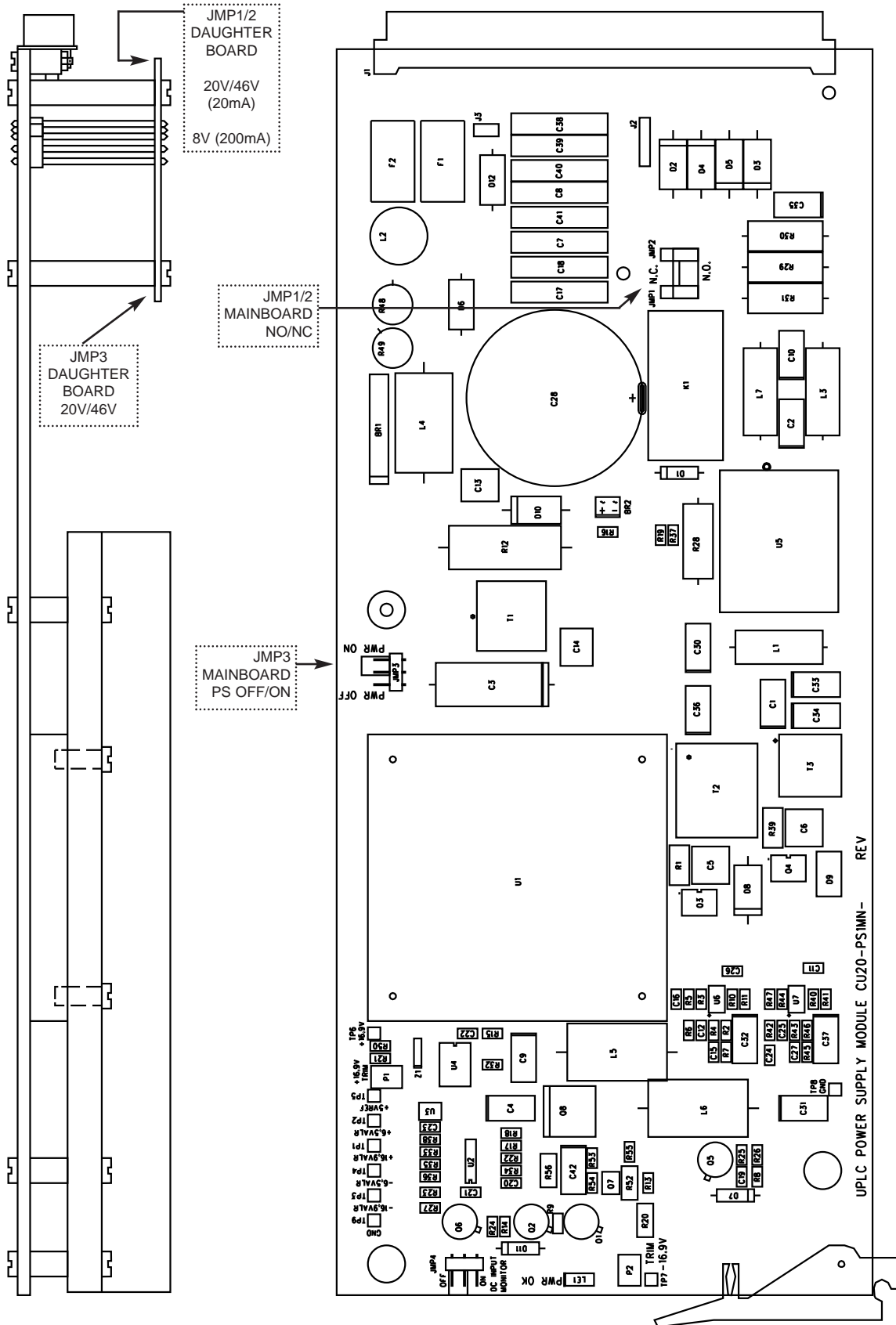


Figure 2-4. Power Supply Component & Jumper Locations

### 2.4.2 Power Amp Module

**Description:**

The Power Amp (PA) input comes from the transmit portion of the Transceiver card and its output goes to the backplane coax connector and boosts the signal level as high as 10W max continuously depending on the software setting. A redundant PA can be plugged into the chassis to give up to 20 W output. There is a transformer, T1, on the backplane that combines the 2 PAs, when used. If one of the 2 PAs fails, the power level drops by 6 dB. So if set for 20 W it would drop to 5 W. The PA contains 2 transmit meters, a Forward Power level meter and a Reflected Power percentage meter. The levels are displayed on the front display as well as the home web page. The forward power level meter only looks at power going out to the coax. It is in a control loop with the Transceiver and automatically adjusts the output power to the correct level when the UPLC-II™'s output level is calibrated. The reflected power meter tracks the TX frequency and only looks at any power coming back into the output of the PA which falls within the narrowband (less than 500 Hz away from the transmit frequency) of the frequency selective circuit of this meter. So this meter reads accurately in the presence of high level interfering signals from transmitters elsewhere on the power line. The PA module is hot-swappable.

Customer interface points:

- PA OK LED (LE1) – Indicates the status of the Power Amp (PA). It monitors that on-board dc voltages are within specifications

Description	Part Number
Power Amp (PA) Module with Freq. Selectivity	CU20-PA1MN-002

and that the PA is actually amplifying the signal as it should. When one of these 2 parameters is bad, the LED goes off.

- PA IN DC (TP11) – A convenient test point for measuring input signal level to the PA from the Transmitter. The level is a dc voltage that is proportional to input signal strength. Normal level is 0.35Vdc for 1W transmit and 1.0Vdc for 10W transmit. Level must be measured between TP11 and the chassis itself as a ground reference.
- FREQ SEL Jumper (JMP1/2) – Normally set to the ON position for UPLC-II™ but if the power amp is put into a UPLC™ this jumper has to be set to the OFF position. It enables the frequency selectivity feature of the reflected power meter in a UPLC-II™.

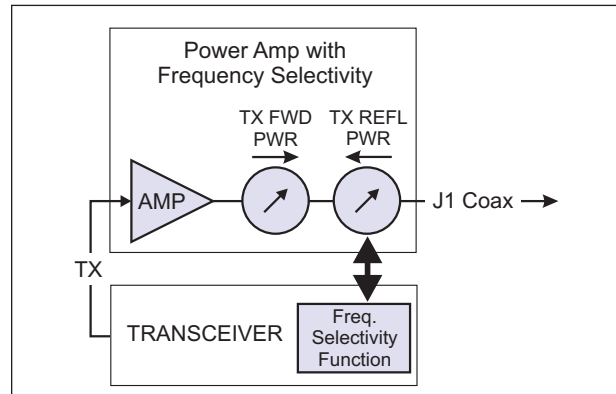


Figure 2–6. Power Amp Block Diagram

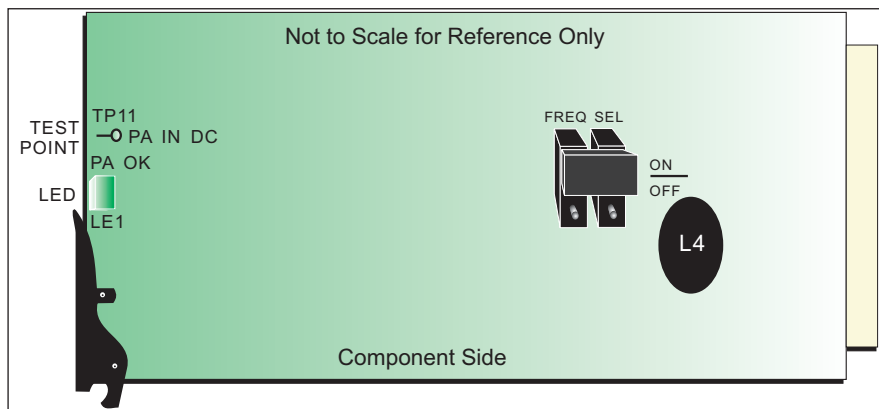


Figure 2–5. Power Amp Jumper Location

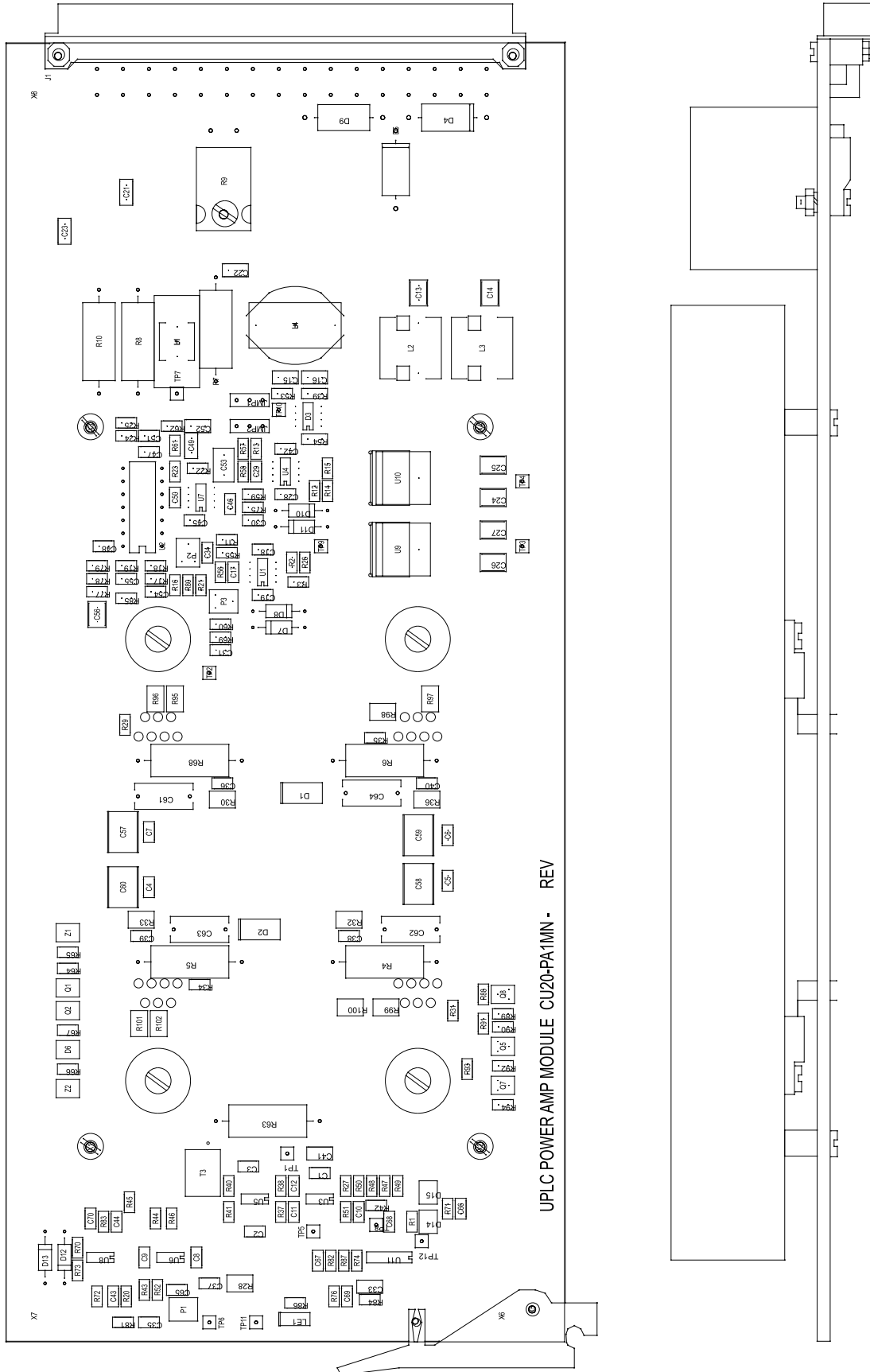


Figure 2-7. Power Amp Module

Description	Part Number
Display Module	CU20-DP1MN-001

### 2.4.3 Display Module

#### Description

The Display Module serves 2 purposes:

- 1) It displays the UPLC-II™ status, settings menu and test menu for front keypad access.
- 2) It interconnects the Transceiver module to the front door keypad/LEDs and to the I/O module.

Four screws hold it in place on its four corners and have to be removed when accessing the Transceiver or I/O boards. These screws are only present to prevent mechanical vibrations, during shipping or earthquakes, from causing the mating connectors to come loose. Care should be taken to not bump the glass display against a hard surface accidentally causing it to crack.

It has larger guide pins in addition to 2 DIN connectors that connect it to the Transceiver and I/O boards. These guide pins allow it to align correctly when connecting to the two horizontal boards

behind it. Firm pressure should be applied to the middle of the board when plugging it back in.

A permanently affixed ribbon cable connects it to the mating connector on the front door auxiliary board. This connector has 2 latches on its sides for unplugging or plugging in the ribbon cable.

Customer interface points:

- XVR OK LED – Indicates Transceiver board is functioning properly. Note: slight flicker of this LED is normal.
- I/O OK LED – Indicates I/O board is functioning properly.
- J1 connector (on back side) – Used only for UPLC™ retrofits when adding a front Ethernet port option. Requires a ribbon cable assy P/N 1088-256 to be plugged into it for interconnecting to a new Ethernet daughter board on the existing old Transceiver board CU50-XVRMN rev 8 or lower.

#### NOTE:

During troubleshooting and to view LEDs on internal boards behind the display board, the UPLC-II™ may be operated without a display board plugged in. But the display board should never be connected or disconnected while powered on.

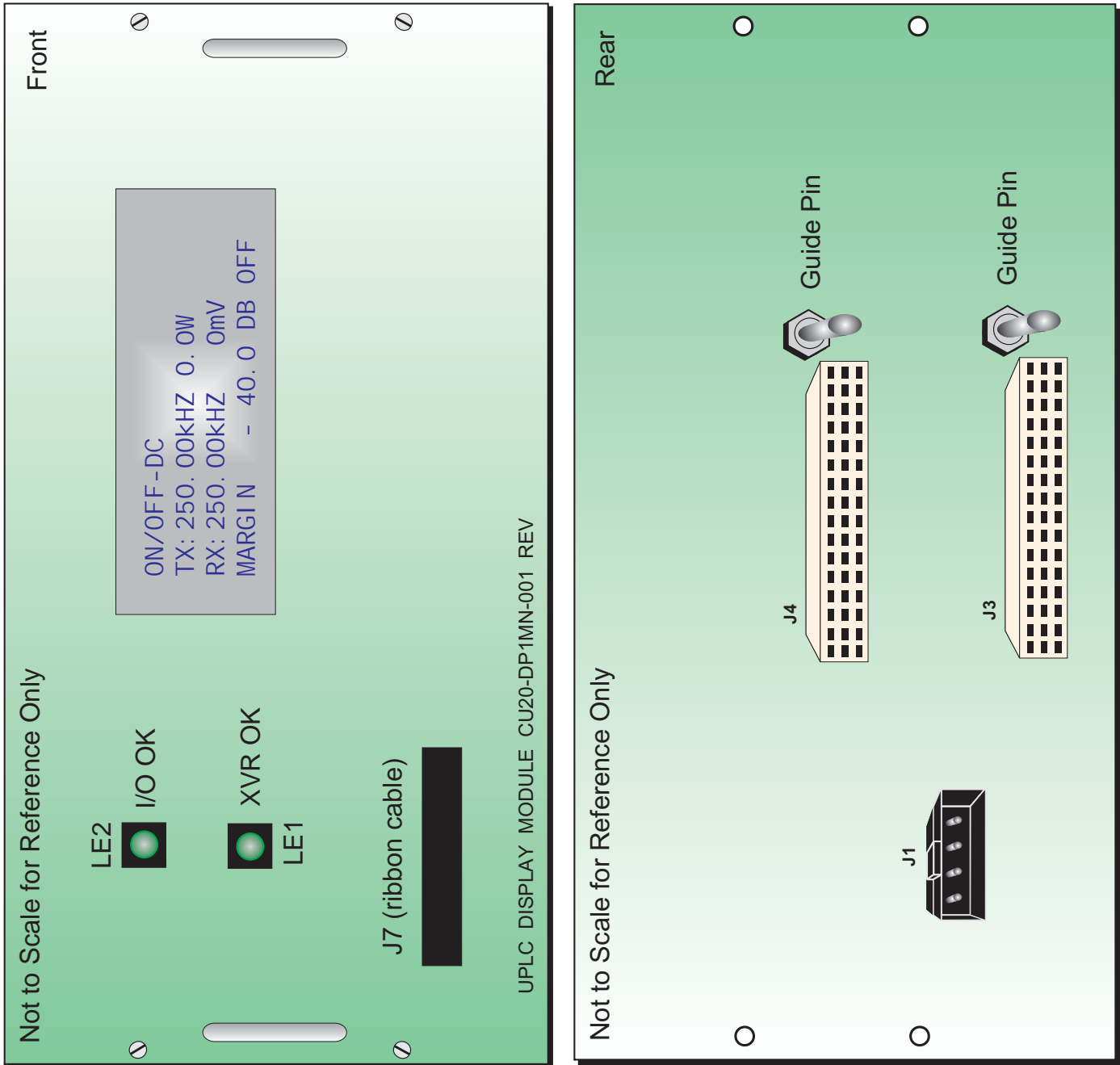


Figure 2–8. Display Board, Rear/Inside & Front/Outside Views

Description	Part Number
Input/Output (I/O) Module	CU20-IO1MN-001

## 2.4.4 Input/Output (I/O) Module

### Description:

The Input/Output (I/O) module interfaces the Transceiver module to all the inputs and outputs on the backplane terminal blocks. All inputs and outputs are non-polarity sensitive. It has several hardware jumpers that require setting before being put into service. All jumpers are “ganged” type jumpers that sense the jumper setting and report it back to the Transceiver processor for displaying status on the web pages. The I/O module mounts in the top right horizontal slot of the chassis behind the front display board. The corresponding I/O OK LED that gives status of this module is located on the display board.

### Customer interface points:

#### Inputs (5 Standard)

There are 5 current-limited inputs that draw 5 mA maximum.

- INPUT 1 – INPUT 5 Voltage Selection jumpers – Choose between 15V, 48V, 125V, and 250V. These are high voltage threshold inputs that require at least greater than half high station battery voltage to operate as long as the correct voltage is chosen.

#### Outputs (10 Standard Low Level)

There are 7 standard low level solid state outputs.

- LL01-LL07 Current Selection jumpers – Choose between 0.1A and 1.0A continuous. Use 0.1A for driving low current loads such as microprocessor relays, and use 1.0A for

devices that draw up to 1A continuous. The 0.1A setting exists because there is a very low leakage current when the output is turned off for the 1.0A setting, especially at 250V input, which could cause a low current device to potentially misoperate. The 1.0A output should also be used when having to interrupt currents that are over 0.25A, as it can interrupt up to 1A currents at 250Vdc, unlike all the other UPLC-II™ outputs which have lower current interrupting capability.

There are 3 standard low level EM contact outputs normally used for low current alarm circuits. Typically, these are used for fail-safe alarming where loss of DC power causes the same alarm also.

- LL08-LL10 Contact Selection jumpers – Choose between N.O./N.C. (Normally Open/Normally Closed)

#### Outputs (4 Extra Optional Trip Duty)

These are able to make and carry up to 30A for 200 msec, which is long enough to trip a breaker directly.

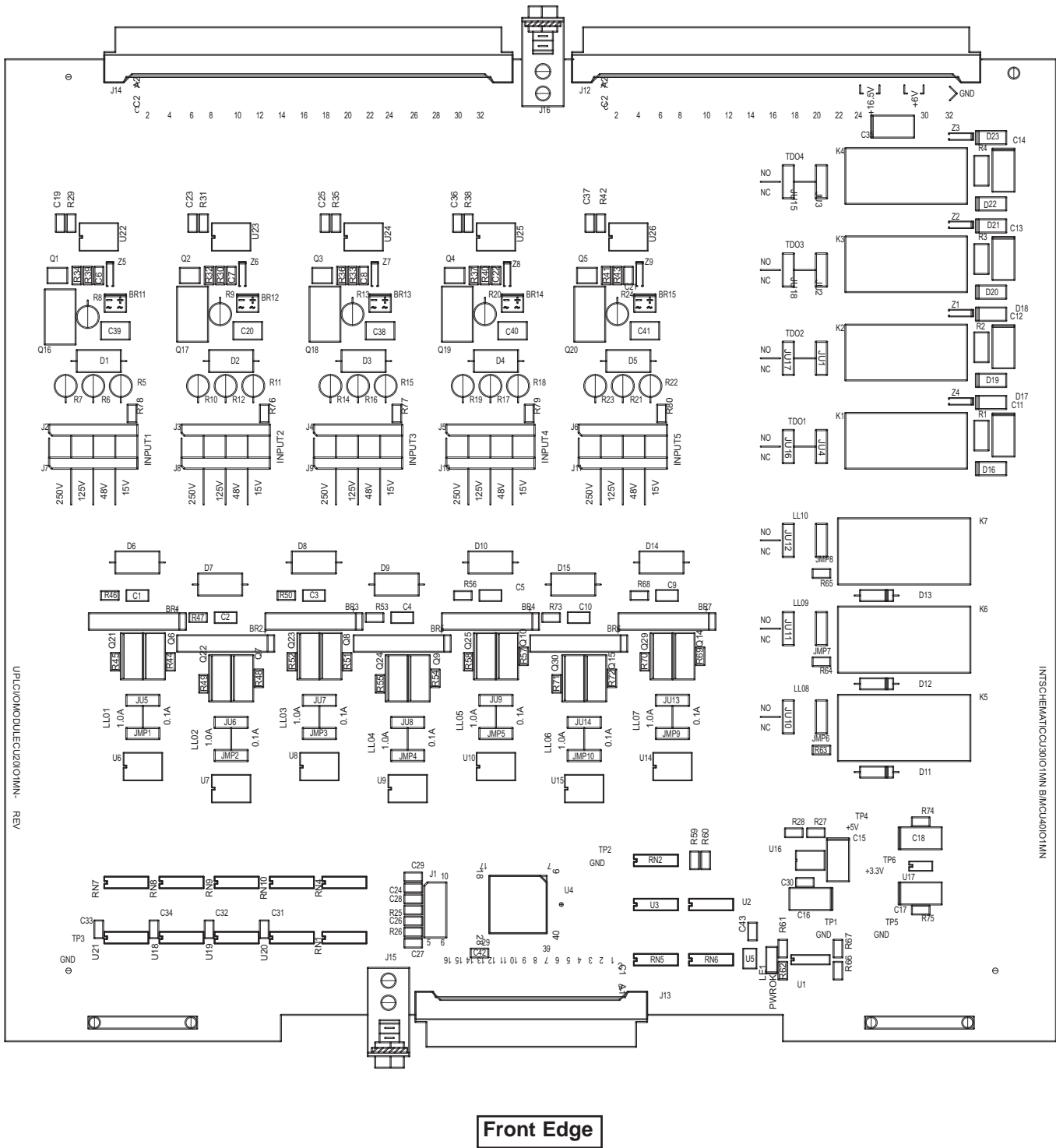
- TD01-TD04 Contact Selection jumpers – Choose between N.O./N.C. (Normally Open/Normally Closed)

#### NOTE:

See the Specifications Tables at the beginning of this chapter for full ratings of inputs and outputs.

**Rear Edge (Plugs into Backplane)**

**2**



**Front Edge**

Figure 2–9. I/O Module Component & Jumper Locations (Rev. 9)



Description	Part Number
Transceiver Module	CU20-XVRMN-001

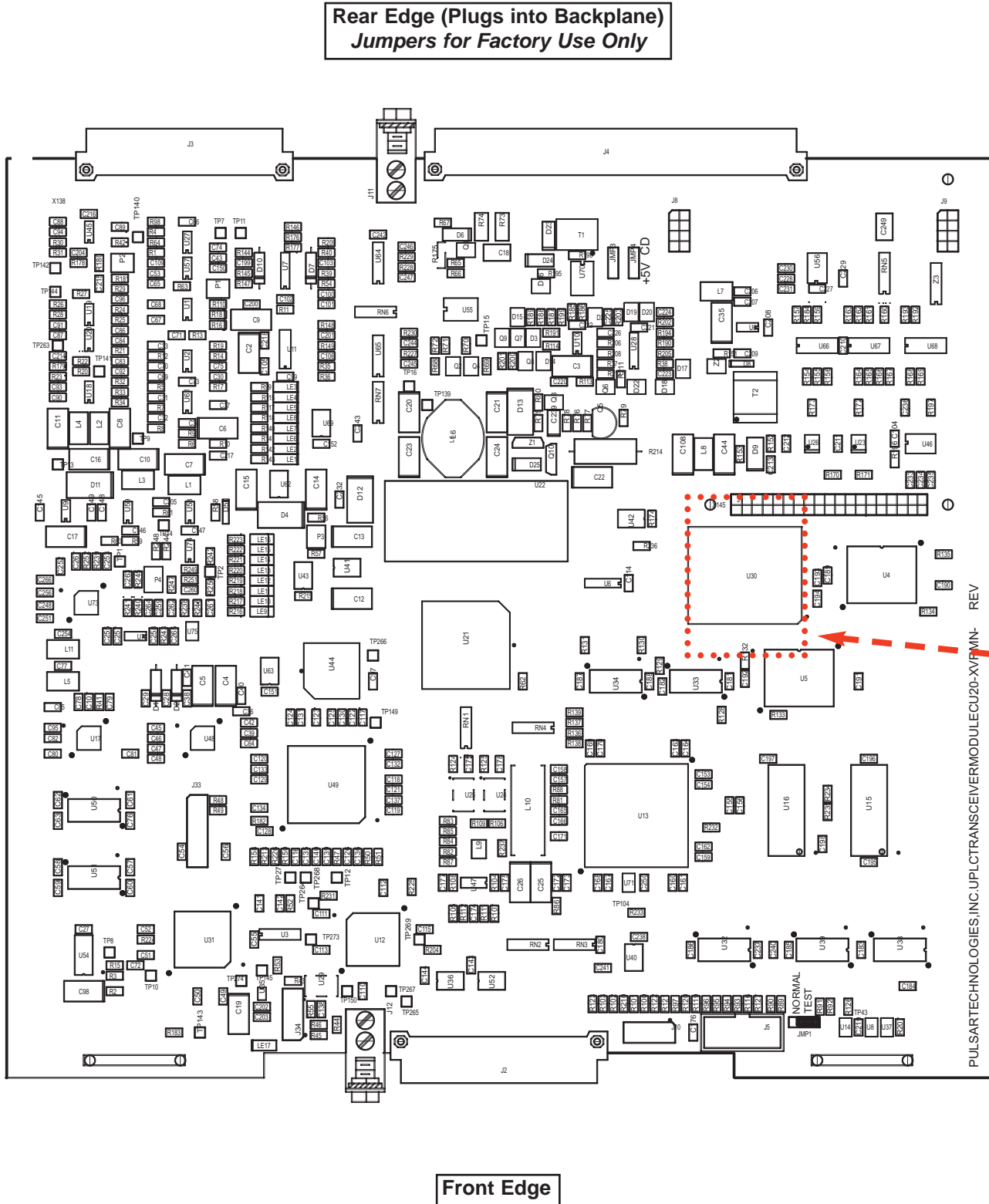
## 2.4.5 Transceiver Module

### Description:

The Transceiver (XCVR) module is the brains of the UPLC-II™ containing both the transmitter and receiver as well as the processing circuitry (Power PC chip), flash memory, NOVRAM, IRIG-B timing, etc. All firmware, settings, SOEs, Catalog/Model number and IP address/MAC address are stored in this module. It mounts in the bottom right horizontal slot of the chassis behind the front display board. The corresponding XVR OK LED that gives status of this module is located on the display board itself. Remember to remove any rear Ethernet connections connected to the optional Ethernet daughter board before removing the Transceiver module from the chassis.

### Customer interface points:

- Battery for NOVRAM (U30) – Normal life is well over 20 years. If you receive a “Battery Failure” event in the SOEs, the NOVRAM battery has expired. It is a Dallas Semiconductor DS9034PCX and is located under the cover on U30. To access use a small flathead screwdriver in the slot on the plastic cover and gently pry the cover off. Replace the battery and snap the cover back on. There are no other user-serviceable items on the board.
- Other LEDs, jumpers, and headers on the board are for factory use only. No jumper positions should be changed.



**2**

**NOVRAM battery is under the cover on U30**

Figure 2-10. Transceiver Component Locations

Description	Part Number	Digit 6 of UPLC-II Cat. No.
Ethernet Module dual RJ-45 electrical	CU20-XVRA5-001	M
Ethernet Module dual ST Fiber	CU20-XVRA6-001	P
Ethernet Module dual 1 RJ-45 elec, 1 ST Fiber	CU20-XVRA7-001	R

### 2.4.6 Ethernet Module

#### Description

The Ethernet module is an optional daughter board that plugs onto the Transceiver board and is attached by 3 screws. If this option is not purchased, then none of the Ethernet ports will be available on the UPLC-II™, although the front port will physically be present, it will not work. The Ethernet board supports 3 Ethernet ports, two on the rear which are part of this board, and one on the front panel. The front port is completely isolated from the 2 rear ports and is intended solely for PC interface. The rear Ethernet ports can be used for PC interface, connection to an Ethernet network, or for other features such as DNP3 or IEC61850 communication.

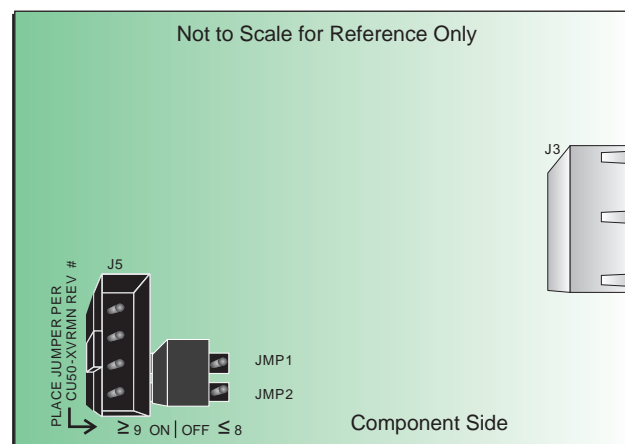
There are 2 modes of operation for the 2 rear ports. This mode of operation is selected on the ADMIN web page of the UPLC-II™. They can operate:

- One as a standby/redundant port for the other. (Default Mode)
- Like Ethernet switch ports allowing daisy chaining of other UPLC™/UPLC-II™s or Ethernet connected devices with itself.

#### Customer interface points:

- Connector (J5) – Only used when placing this board on older style Transceiver boards in UPLCs to add front port Ethernet when doing hardware upgrades. Requires a ribbon cable assembly, part # 1088-256, to be plugged into connector J5 of this Ethernet board with the other end plugged into connector J1 on the back of the front display board. The UPLC-II™ does not need this cable.

- Jumper (JMP1/2) – Always set to the ON (A) position for UPLC-II™s but, if putting this board into a UPLC™ with an older Transceiver PC board CU50-XVRMN *rev 8 or lower*, this jumper has to be set to the OFF (B) position. It works in conjunction with connector J5 above when adding a front Ethernet port to an existing older UPLC™ allowing the older Transceiver board to still be used.
- Ethernet connectors (J3 – RJ45 or U2/U4-Fiber ST) - Located on rear of board and stick out through a rectangular cutout in the back of chassis backplane. The RJ-45 connectors include 2 LEDs that come on solidly when a connection is made. The fiber connectors are designed for interfacing to 1300 nm, 62.5/125 μm multimode fiber cables.



( A | B on some style boards )

**Figure 2–11. Ethernet Module Connectors/Jumpers**

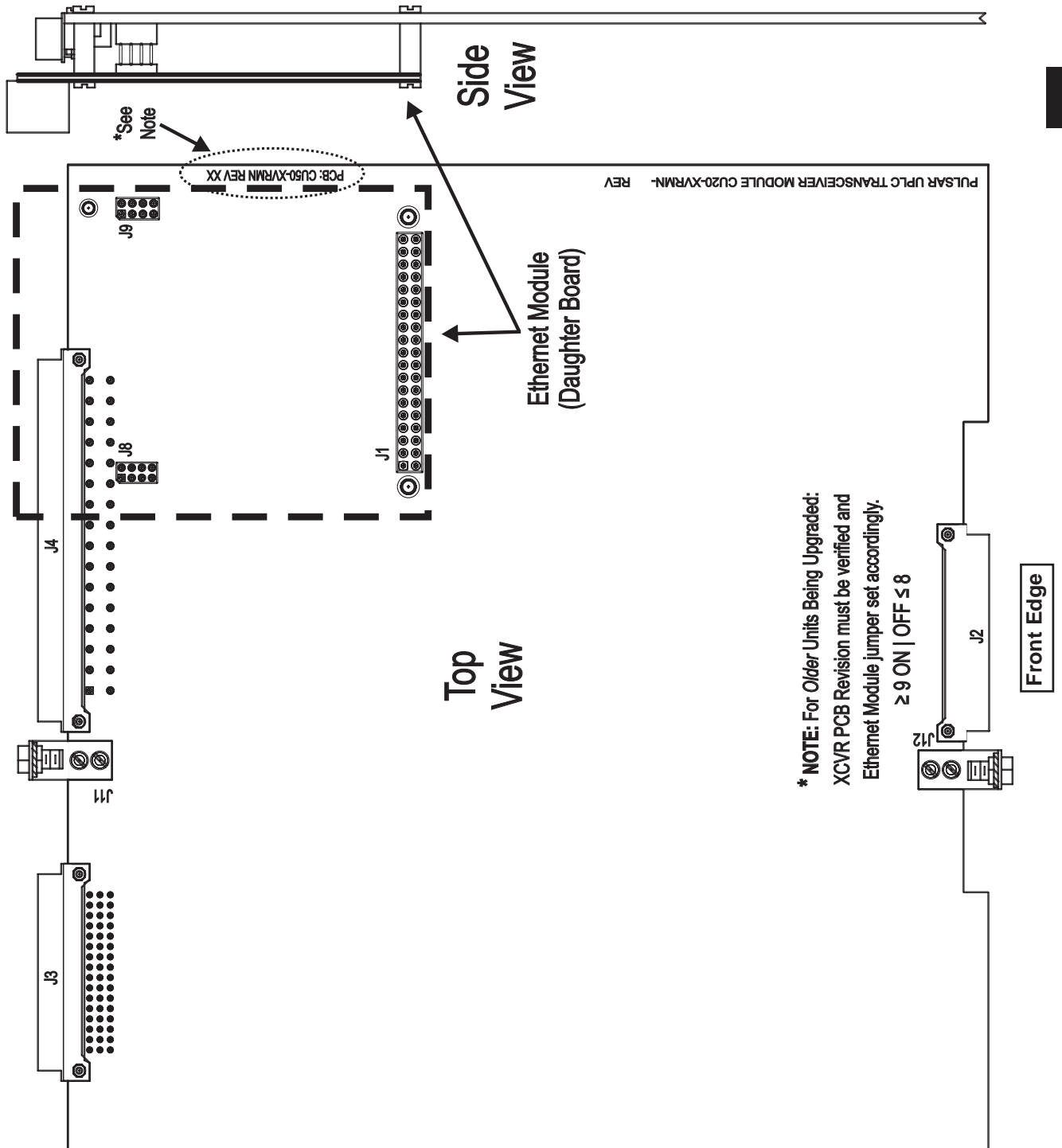
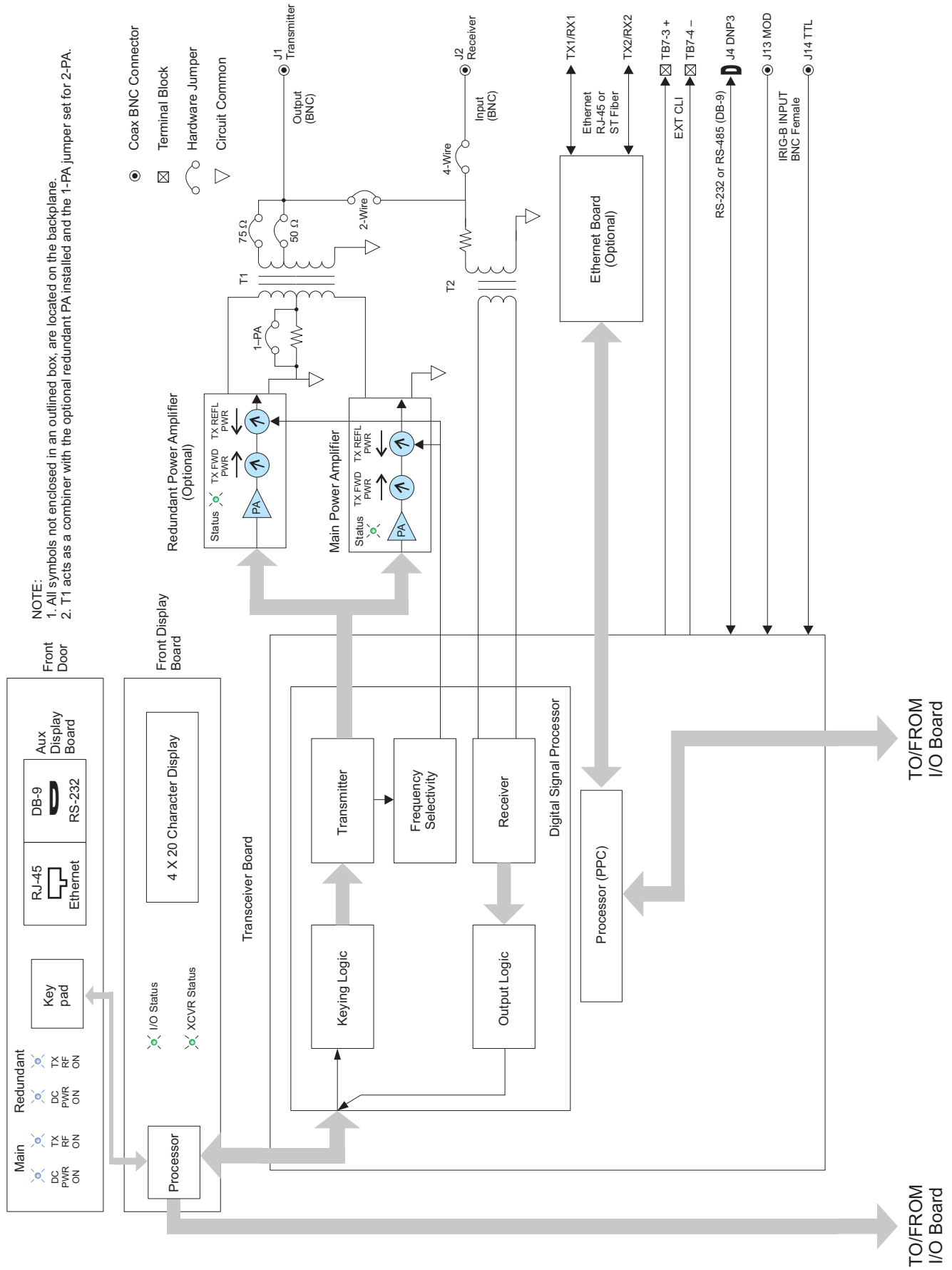


Figure 2–12. Transceiver Module, Ethernet Module Location

**Figure 2-13a. UPLC-II™ Overall Functional Block Diagram**



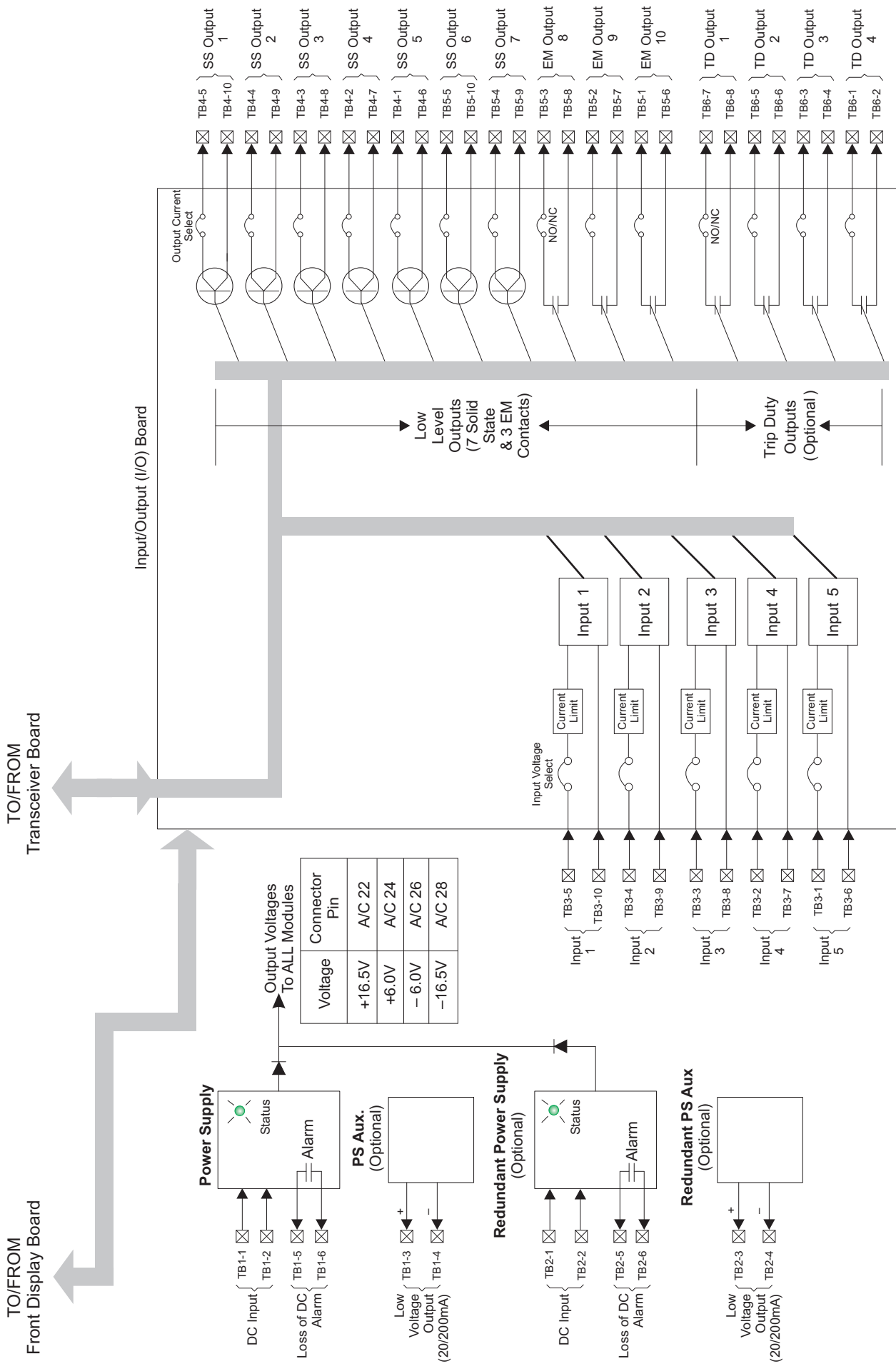


Figure 2-13b. UPLC-II™ Overall Functional Block Diagram

## 2.5 UPLC-II™ Functional Description

The UPLC-II™ was designed to be universal with one unit performing both of the primary modes of operation.

- ON/OFF Mode = amplitude shift keying.
- FSK Mode = frequency shift Keying.

The UPLC-II™ has a transmitter section and a receiver section on the transceiver board. If the unit is purchased as a receive-only system, then only the receiver logic and associated information applies and the Power Amp module is not present. The 2-page block diagram (Fig. 2-13a/b) illustrates the interconnection of the UPLC-II™ hardware.

The transmitter is made up of the keying inputs (on the I/O board), the keying input logic (in the digital signal processing (DSP) firmware on the transceiver board) the power amplifier(s) board and the RF interface circuit (on the motherboard). The state of the keying inputs will determine what output is produced, both frequency and RF power level. For example, an ON/OFF system will be turned on when the START input is asserted. The signal produced will be at the programmed frequency and at the high-level power output. In an FSK system, with no keying input asserted, the GUARD frequency is produced at the low-level power output. When one or more of the keying inputs are asserted, then the appropriate signal will be produced. The following keying tables describe the different combinations available.

The receiver is made up of the RF interface circuit (on the motherboard), input filters, ON/OFF level detector / FSK discriminator, the output logic described herein (in the DSP on the transceiver board), and the associated outputs (on the I/O board). The incoming RF signal is level detected or frequency discriminated according to the programming, and based on the signal received, produces the appropriate output. For ON/OFF systems, the outputs are simple – if the signal is detected (i.e. – the RF signal is the desired frequency and is above the minimum sensitivity), then the receiver output is produced. For FSK systems, it is more complicated and there are several logic choices available.

The FSK logic diagrams at the end of this chapter describe the choices available.

Besides the main function of the UPLC-II™ as a Power-Line carrier channel, there are several other ancillary functions and optional features available.

The processor on the transceiver board handles many of the “housekeeping” functions. It handles the web pages that are served up when connected to a personal computer (pc). The web pages allow you to set up user accounts, make settings, and download settings in either an XML file or a report file. The XML file is used for re-loading settings on a UPLC-II™. Upgrading the firmware and TX/RX calibration are also done via the web pages.

The Sequence of Events (SOEs) reside in the processor on the transceiver board. These track events that occur in the UPLC-II™. They are viewed via the web pages and can be downloaded into a CSV (comma separated values) file format. The I/O programming allows for up to three external events to be fed into the UPLC-II™ SOEs. For example, you can monitor the breaker auxiliary contact position in relationship to keying inputs or receiver outputs. SOEs are stored in non-volatile-random-access memory (NOVRAM) so that they are maintained even when the unit is powered down.

The settings files also reside in the processor on the transceiver board and are stored in NOVRAM. There are three sets of the file stored for redundancy purposes.

Status indication is provided by the four line by 20-character display on the front panel. The basic programming - Channel type, function, TX/RX frequencies/levels, and RX margin are displayed. It also has a 16-button keypad that allows for minor setting changes, testing of the PLC channel, calibration of the transmitter and receiver, and configuration of the Internet Protocol functions. The display turns off automatically 30 minutes after input from the user has stopped. To turn it back on requires pressing the DISP ON button or any other button on the keypad. There is also a front panel ethernet port



(RJ-45) and serial port (DB9 connector) to connect a pc to allow settings, etc through web pages.

Also on the front panel are four blue indicator lights that indicate if the main and optional redundant power supplies and power amplifiers are on.

Each printed circuit board that comprises the UPLC-II™ has a green status LED associated with it. The power supplies and power amplifiers have an LED on the front edge of the printed circuit board that is visible with the front cover down. The Transceiver and Input/Output board have LEDs that are located on the front panel display board, visible with the front cover down. The Ethernet board has green and yellow indicating lights visible from the rear of the unit. If any of these lights are not illuminated, it indicates a problem with that board. There are also 4-character alarm indications on the front panel display when an alarm occurs.

In addition to the standard testing from the front panel, there is also available as a purchased option, integrated testing facilities. When used as an ON/OFF PLC, the channel status is not known until called upon to perform its operation, so therefore could have failed without warning. The UPLC-II™ has an option for performing automatic checkback tests. Please see chapter 6 for details. When used as an FSK, sometimes it is desired to perform a “shift to trip” test from end to end. The trip test feature is available when purchased. Please see chapter 6 for details.

Network protocols are available to allow device-to-device communications. These include DNP3.0 and IEC61850. Please see chapter 7.

### 2.5.1 Keying Input Logic

Depending upon the channel type and function set, different keying logic is selected. Following are tables, which describe the functionality of the keying logic for each channel type and function combination.

### ON/OFF Channels

ON/OFF channels typically are not keyed normally and are keyed on to block tripping for an external fault. A choice is made to give priority to either the stop input or the start input should they both be present at the same time. Typical Directional Comparison and Phase Comparison relaying systems utilize a stop priority; giving the relay system priority to trip vs to not trip, thereby making the system dependable.

Table 2–12 applies to the majority of modern relay systems in service that use the ON/OFF type of PLC channels.

Relay Systems that use the older-style electro-mechanical relays such as ABB/Westinghouse’s KA-4/KD-10 series of relays have one lead that serves the function of both start and stop. Table 2–13 would apply in this situation. Please see chapter 3 for details on how to connect this type of system. The “common start/stop input” box must be checked in order for this table to be applied.

### FSK Channels

FSK channel functions are used for Direct Transfer Tripping Systems or Line Relay Systems. If the DTT/POTT or the Unblocking-2 F selection is set for the function, then Table 2–14 will apply. When the FSK 3-frequency channel is used for both a DTT and Line relaying channel, Table 2–15 will apply. If both the DTT Key and LR key are present, the DTT key will have precedence. If using the FSK channel for Phase Comparison Relaying systems, Table 2–16 will apply. If using the FSK channel for 2 protection channels A & B, where both channels are allowed to trip simultaneously with a fourth frequency shift (unlike the 3-frequency), then Table 2–17 applies.



**Table 2–12. Channel: ON/OFF, function: Directional or Phase Comparison Relaying w/Stop Priority**

START	STOP	LOW LEVEL KEY	TX OUTPUT CONDITION FOR THIS KEYING INPUT STATE
Not Activated	Not Activated	Not Activated	Transmitter off
Not Activated	Not Activated	Activated	Send Low Level Power
Not Activated	Activated	Not Activated	Transmitter off
Not Activated	Activated	Activated	Transmitter off
Activated	Not Activated	Not Activated	Send High Level Power
Activated	Not Activated	Activated	Send High Level Power
Activated	Activated	Not Activated	Transmitter off
Activated	Activated	Activated	Transmitter off

**Table 2–13. Channel: ON/OFF, function: Directional Comparison Relaying with KA-4 type EM Relaying System**

START	STOP	LOW LEVEL KEY	CB TEST INITIATE	TX OUTPUT CONDITION FOR THIS KEYING INPUT STATE
Not Activated	Not Activated	Not Activated	Not Activated	Input States not Likely to Exist
Not Activated	Not Activated	Not Activated	Activated	Input States not Likely to Exist
Not Activated	Not Activated	Activated	Not Activated	Input States not Likely to Exist
Not Activated	Not Activated	Activated	Activated	Input States not Likely to Exist
Not Activated	Activated	Not Activated	Not Activated	TX Off, CB Not Allowed
Not Activated	Activated	Not Activated	Activated	TX Off, CB Not Allowed
Not Activated	Activated	Activated	Not Activated	TX Off, CB Not Allowed
Not Activated	Activated	Activated	Activated	TX Off, CB Not Allowed
Activated	Not Activated	Not Activated	Not Activated	Send High Level Power, CB Not Allowed
Activated	Not Activated	Not Activated	Activated	Send High Level Power, CB Not Allowed
Activated	Not Activated	Activated	Not Activated	Send High Level Power, CB Not Allowed
Activated	Not Activated	Activated	Activated	Send High Level Power, CB Not Allowed
Activated	Activated	Not Activated	Not Activated	Transmitter Off
Activated	Activated	Not Activated	Activated	Transmitter Off, CB Allowed
Activated	Activated	Activated	Not Activated	Send Low Level Power, CB Not Allowed
Activated	Activated	Activated	Activated	Send Low Level Power, CB Not Allowed

**CB = Checkback**

**Table 2–14. Channel: FSK, function: 2 Frequency Directional Comparison Relaying**

TRIP or UB Key	TX POWER OFF	POWER BOOST (52B)	TX OUTPUT CONDITION FOR THIS KEYING INPUT STATE
Not Activated	Not Activated	Not Activated	Send HF at Low Level Power
Not Activated	Not Activated	Activated	Send HF at High Level Power
Not Activated	Activated	Not Activated	Transmitter Output Power off
Not Activated	Activated	Activated	Transmitter Output Power off
Activated	Not Activated	Not Activated	Send LF at High Level Power
Activated	Not Activated	Activated	Send LF at High Level Power
Activated	Activated	Not Activated	Transmitter Output Power Off
Activated	Activated	Activated	Transmitter Output Power Off

2

**Table 2–15. Channel: FSK, function: 3 Frequency, Directional Comparison Relaying**

DTT KEY	LR KEY	TX POWER OFF	POWER BOOST (52B)	TX OUTPUT CONDITION FOR THIS KEYING INPUT STATE
Not Activated	Not Activated	Not Activated	Not Activated	Send CF at Low Level Power
Not Activated	Not Activated	Not Activated	Activated	Send CF at High Level Power
Not Activated	Not Activated	Activated	Not Activated	Transmitter Output Power Off
Not Activated	Not Activated	Activated	Activated	Transmitter Output Power Off
Not Activated	Activated	Not Activated	Not Activated	Send HF at High Level Power
Not Activated	Activated	Not Activated	Activated	Send HF at High Level Power
Not Activated	Activated	Activated	Not Activated	Transmitter Output Power Off
Not Activated	Activated	Activated	Activated	Transmitter Output Power Off
Activated	Not Activated	Not Activated	Not Activated	Send LF at High Level Power
Activated	Not Activated	Not Activated	Activated	Send LF at High Level Power
Activated	Not Activated	Activated	Not Activated	Transmitter Output Power Off
Activated	Not Activated	Activated	Activated	Transmitter Output Power Off
Activated	Activated	Not Activated	Not Activated	Send LF at High Level Power
Activated	Activated	Not Activated	Activated	Send LF at High Level Power
Activated	Activated	Activated	Not Activated	Transmitter Output Power Off
Activated	Activated	Activated	Activated	Transmitter Output Power Off

LF = Low Frequency, CF = Center Frequency, HF = High Frequency

**Table 2–16. Channel: FSK, Function: 2 Frequency Phase Comparison Relaying**

PC Key	TX POWER OFF	POWER BOOST 52B	TX OUTPUT CONDITION FOR THIS KEYING INPUT STATE
Not Activated	Not Activated	Not Activated	Send HF at Low Level Power
Not Activated	Not Activated	Activated	Send HF at High Level Power
Not Activated	Activated	Not Activated	Transmitter Output Power off
Not Activated	Activated	Activated	Transmitter Output Power off
Activated	Not Activated	Not Activated	Send LF at Low Level Power
Activated	Not Activated	Activated	Send LF at High Level Power
Activated	Activated	Not Activated	Transmitter Output Power Off
Activated	Activated	Activated	Transmitter Output Power Off

**Table 2–17. Channel: FSK, Function: 4 Frequency Directional Comparison Relaying**

TRIP A KEY	TRIP B KEY	TX POWER OFF	TX OUTPUT CONDITION FOR THIS KEYING INPUT STATE
Not Activated	Not Activated	Not Activated	Send F3 (Guard) at Low Level Power
Not Activated	Not Activated	Not Activated	Send F3 (Guard) at Low Level Power
Not Activated	Not Activated	Activated	Transmitter Output Power Off
Not Activated	Not Activated	Activated	Transmitter Output Power Off
Not Activated	Activated	Not Activated	Send F2 (Trip B) at High Level Power
Not Activated	Activated	Not Activated	Send F2 (Trip B) at High Level Power
Not Activated	Activated	Activated	Transmitter Output Power Off
Not Activated	Activated	Activated	Transmitter Output Power Off
Activated	Not Activated	Not Activated	Send F4 (Trip A) at High Level Power
Activated	Not Activated	Not Activated	Send F4 (Trip A) at High Level Power
Activated	Not Activated	Activated	Transmitter Output Power Off
Activated	Not Activated	Activated	Transmitter Output Power Off
Activated	Activated	Not Activated	Send F1 (Trip A & B) at High Level Power
Activated	Activated	Not Activated	Send F1 (Trip A & B) at High Level Power
Activated	Activated	Activated	Transmitter Output Power Off
Activated	Activated	Activated	Transmitter Output Power Off

## 2.5.2 Receiver Output Logic

### 2.5.2.1 ON/OFF Receiver Logic/Timers

There is only one logic setting affecting the receiver in an ON/OFF system and that is a blocking output hold timer. Typically it is set to disabled (0 ms) and caution should be taken when using it so that protective relaying logic such as transient blocking is not affected.

### 2.5.2.2 FSK Receiver Output Logic

#### 2-Frequency Directional Comparison Logic

Figure 2–14 illustrates this logic. The logic can be configured for a typical Direct Transfer Trip or Directional Comparison Unblock System. To provide the utmost security, this logic provides for 120ms of guard before trip logic. It requires that after loss of signal, there must be at least 120ms of guard before the system is allowed to trip. This may be disabled or overridden according to system requirements. Details follow. There is also a 120ms trip after guard requirement that requires within 120 ms of losing guard that trip is received, otherwise the channel locks out from tripping.

Hold timers are available for both the trip and guard outputs that can be set from 1 to 100 ms in 1 ms increment or be disabled (0 ms). These timers are on the output side of the logic and therefore only affect the solid state or electromechanical outputs. They have no affect on the functionality of the internal logic.

The pre-trip timer allows for higher security by delaying the trip output by the time set. It is settable from 0 to 30 ms in 1 ms increments. Unblock functions will typically be 2 to 8 ms but DTT functions will typically be on the order of 20 or 30 ms for pre-trip time. This pre-trip time delay is critical to providing security against noise causing a false trip and for every msec added the security increases exponentially.

The logic also provides for line protection of the transmission line when the remote end's breaker is open. Upon receiving a trip signal from the other end for longer than 1000 ms, indicating an open breaker, the logic disables the guard before trip requirement such that if the channel is lost and returns in the trip state, the line relay system will be allowed to trip for a fault. To allow for this scenario,

the guard before trip should be set for “override”. After guard is restored, the logic is reset after 200 ms. Typical line relaying or DTT systems do not disable guard before trip logic. Unblock logic is provided in the UPLC-II™ logic to force a trip on loss of channel. If a fault causes a loss of channel, there is a window setting between 1 and 500 ms that will produce a trip output. A setting of 0 ms will disable this feature. After this time, the channel is locked out from tripping until it receives 120ms of guard. The assertion of the trip output for unblock can be delayed by 1 to 100 ms if desired, with a setting of 0 ms disabling this delay. Typical permissive overreaching transfer trip systems over Power-Line Carrier take advantage of the Unblock Logic and are Directional Comparison Unblock systems. A checkback trip output (meaning trip frequency received) is provided for testing purposes. The checkback trip will always assert anytime a trip is asserted by the logic. However, if a trip frequency is received after a loss of channel (without guard return), then only a checkback trip is asserted, and not an actual trip output.

#### 3-Frequency Directional Comparison Logic

Figure 2–15 illustrates this logic. This logic is similar to the 2-frequency logic except with the addition of logic to handle the Direct Transfer Trip logic separately, in addition to providing for a Directional Comparison Unblock System. The Guard Before Trip and Trip After Guard Logic are duplicated for the DTT portion as well as the Trip hold and Guard hold timers. Note that when the 3-frequency system goes to an Unblock trip, the DTT Guard does not drop out but the Unblock Guard does. Likewise, on a DTT Trip, the Unblock Guard does not dropout but the DTT Guard does.

#### 4-Frequency Directional Comparison Logic

Figure 2–16 illustrates this logic. This logic is like having two independent sets of the 2-Frequency logic. In the 2-Frequency logic there are two inputs to the logic, Guard and Trip. In the 4-Frequency logic, there are four inputs (frequencies) to the logic, Guard (F3), CMD A Trip (F4), CMD B Trip (F2), and CMD A&B Trip (F1). Like in the 3-Frequency logic, a receipt of CMD A Trip does not cause the guard for the CMD B to drop out.

Functional block diagrams for these configurations can be found at the end of this chapter.

### 2.5.2.3 FSK Timers

Following are explanations of all the timers available on the UPLC-II™. Those not available on certain functions are so noted.

#### Pre-Trip Timer

The Pre-Trip Timer does not allow tripping until the trip signal has been present for the time set. This timer is settable from 0 to 30 ms in 1ms increments. A typical application of this timer in Direct Transfer Trip systems is to set it for the maximum delay possible, 20 to 30 ms. Limitations on the critical clearing time of the power system will have a direct impact on this setting. In Directional Comparison/POTT systems, we recommend a minimum setting of 2 ms with 4 ms being typical.

#### Trip Hold Timer

The Trip Hold Timer lets you stretch the trip output. You can set it for 0 to 100 ms or disable (0 ms) it. We recommend that you use the disabled setting in the Unblock/POTT to avoid problems with transient blocking.

#### Guard Hold Timer

The Guard Hold Timer stretches the guard output by the amount you set. You can set it for 1 to 100ms or disable (0ms) it. The disabled setting is appropriate for most applications.

#### Unblock Timer (not available on 2 Frequency DTT/POTT)

The Unblock Timer provides a trip output (LR Trip for 3F) for the time set on loss of channel, which is defined as low level and loss of guard. You can set it for 1 to 500ms in 1 ms increment with 0 ms dis-

abling the feature. The normal setting is 150ms in the Unblock system and disabled for all other applications. This is what differentiates the Unblock system from the POTT.

#### Guard before Trip

With this function set to “on without override”, the logic requires guard to be received for 120 ms before the system is allowed to trip. With it set to “on with override”, the 120 ms guard return is required except where trip has been received for over 1,000 ms; if there is a loss of channel, then the guard is not required prior to tripping. Typically, you would use this where open breaker keying is required.

**NOTE:** Guard must be lost for >120ms for the guard-before-trip timer to be reset. Once you receive guard for 120ms or longer it will trip upon receipt of trip frequency unless guard drops out for >120ms.

#### Unblock Delay Timer (not available on 2 Frequency DTT/POTT)

The Unblock Delay Timer delays the Unblock timer from initiating a trip output on loss of channel; it also delays the low level output. You can set it from 1 to 100 ms or disable it (0 ms).

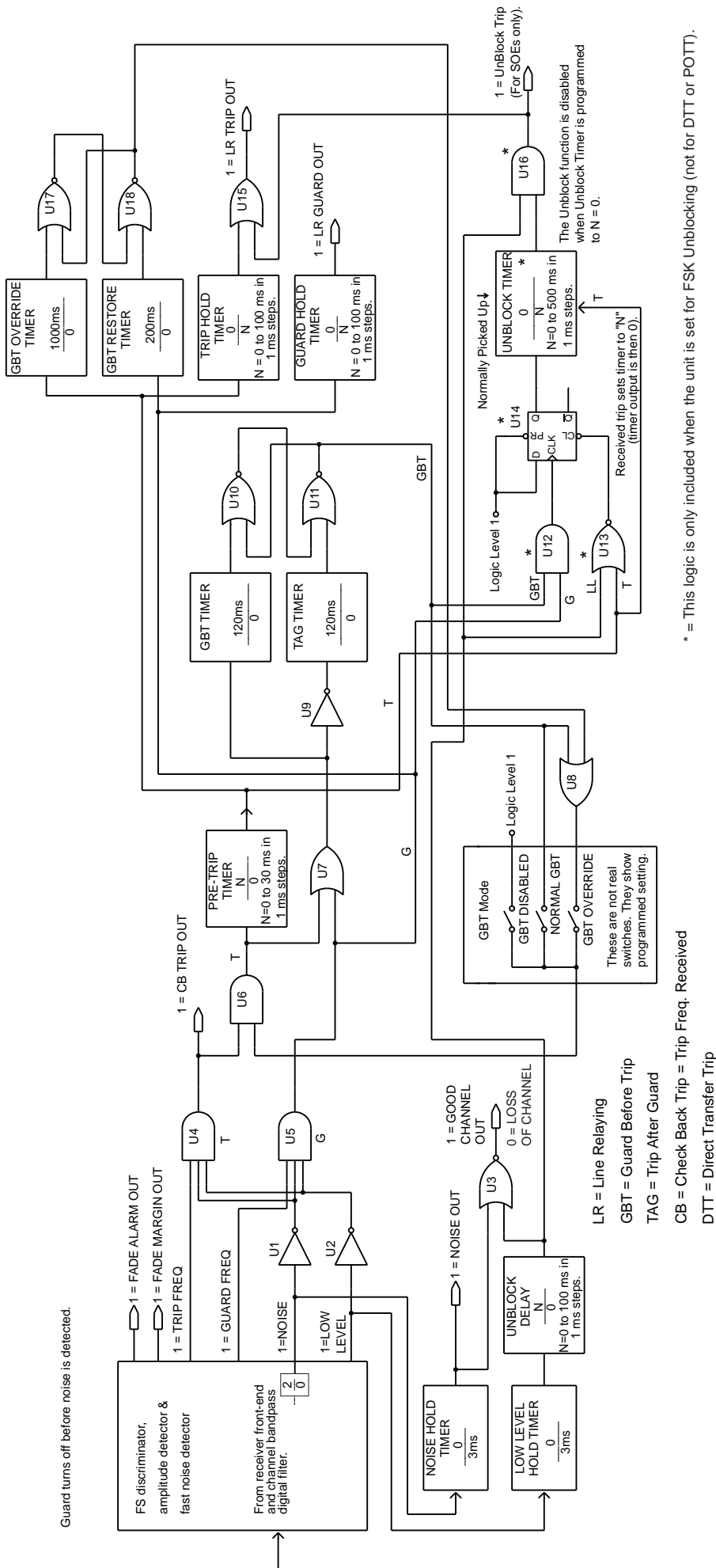
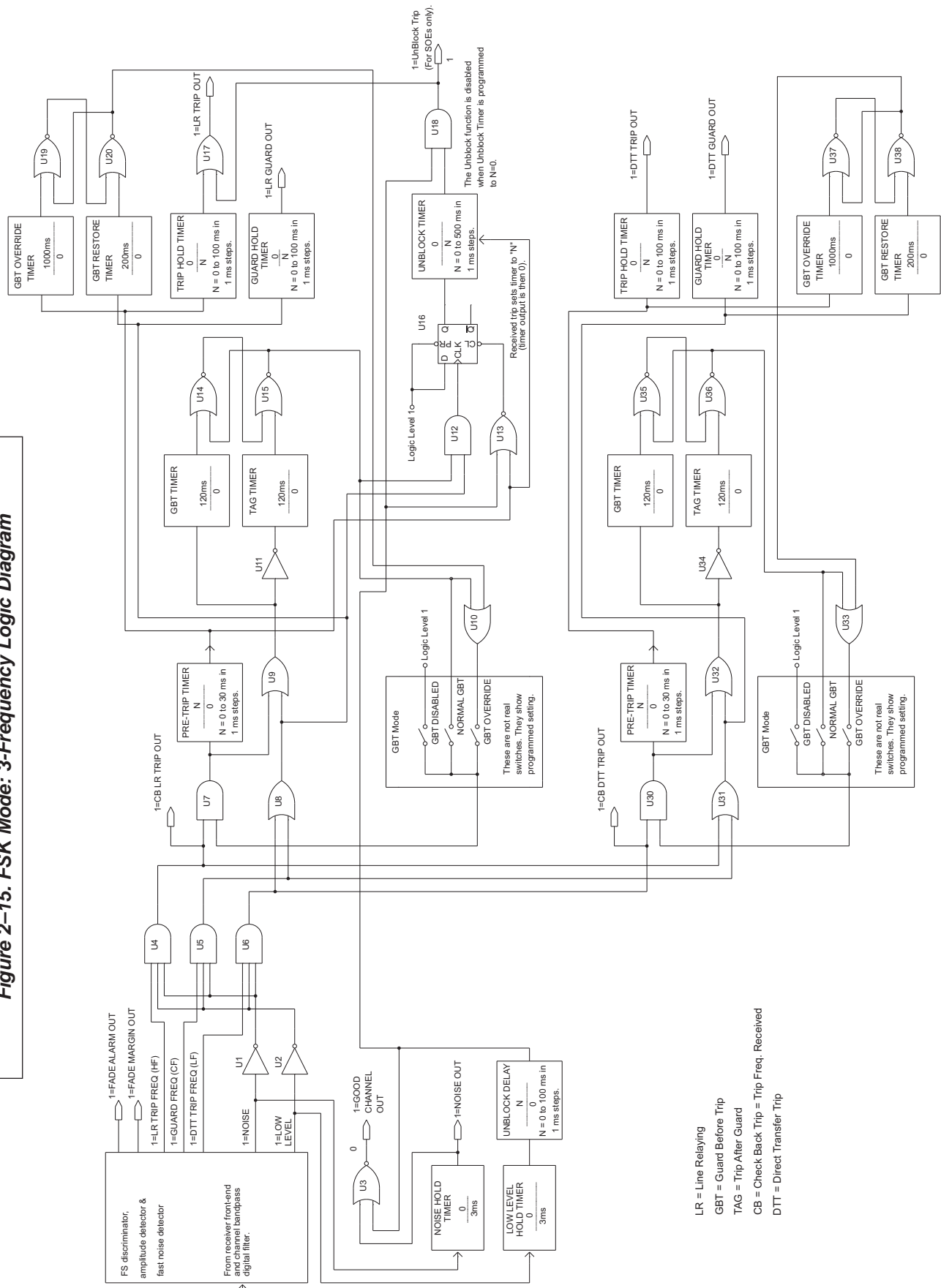
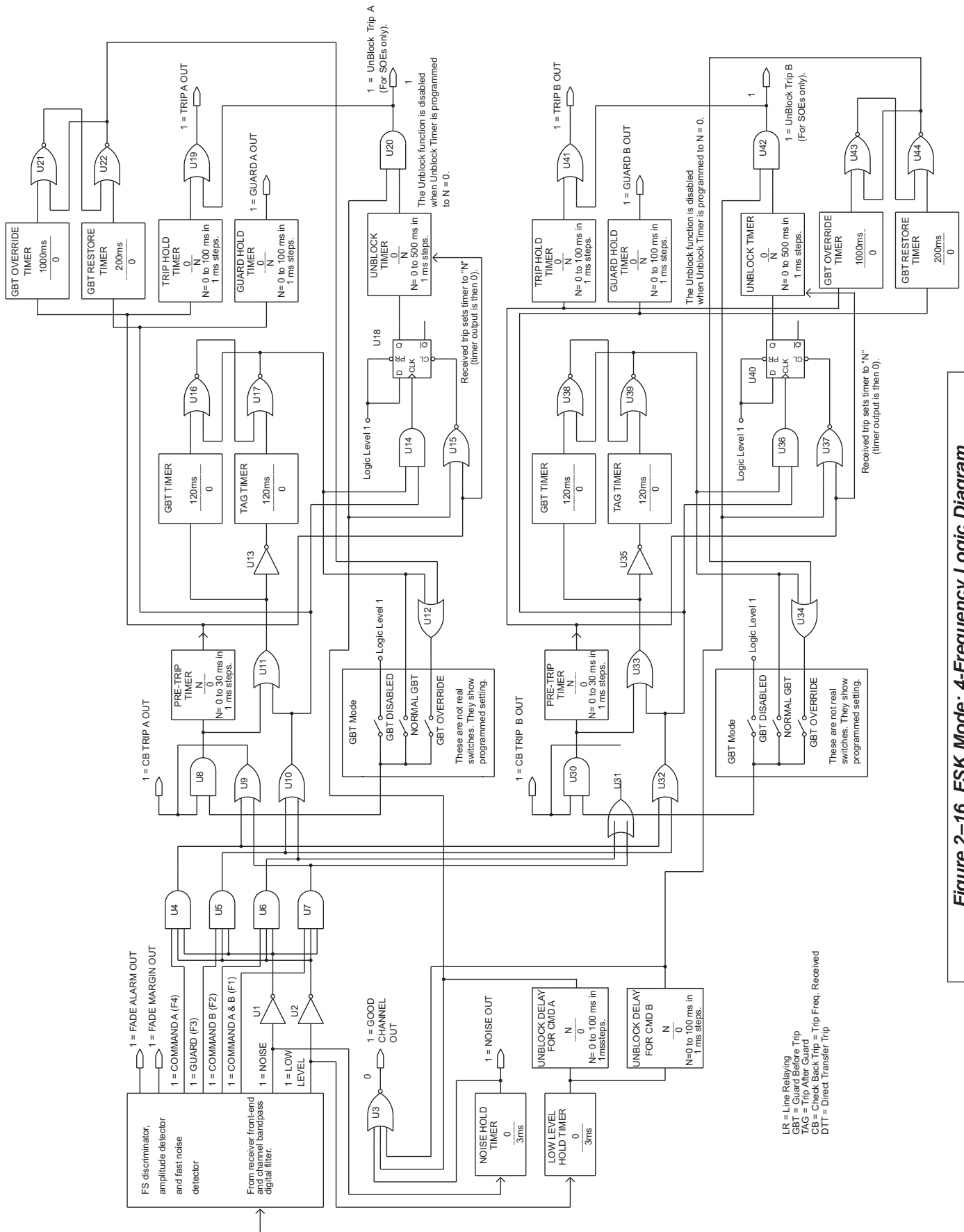


Figure 2-14. FSK Mode: 2-Frequency Logic Diagram

Figure 2-15. FSK Mode: 3-Frequency Logic Diagram



LR = Line Relaying  
 GBT = Guard Before Trip  
 TAG = Trip After Guard  
 CB = Check Back Trip = Trip Freq. Received  
 DTT = Direct Transfer Trip



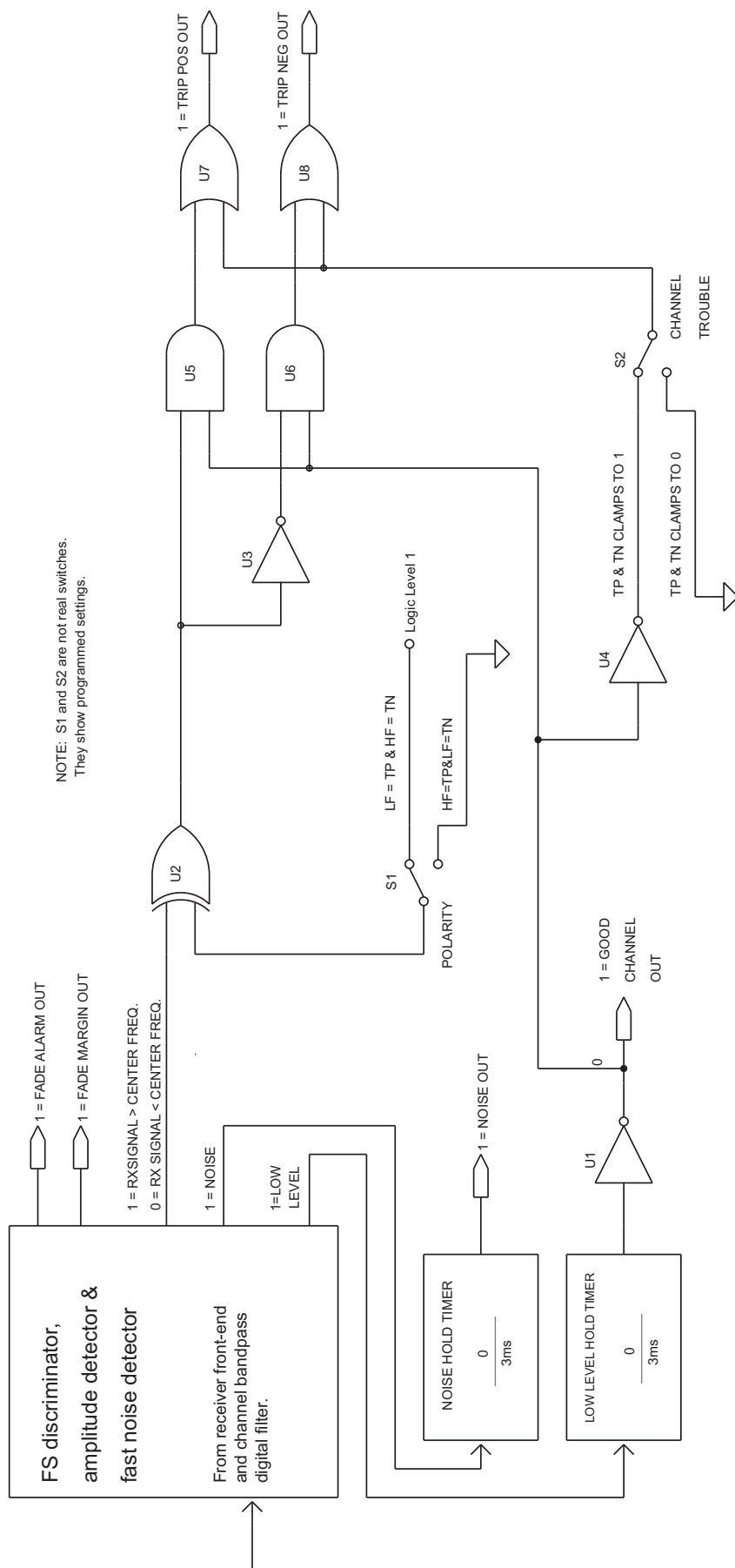
2

Figure 2-16. FSK Mode: 4-Frequency Logic Diagram

LR = Line Relaying  
 GBT = Guard Before Trip  
 TAG = Trip After Guard  
 CB = Check Back Trip = Trip Freq. Received  
 DTT = Direct Transfer Trip



Figure 2-17. FSK Mode: Phase Comparison Logic Diagram



## 3. Applications

### 3.1 ON/OFF Mode Protective Relay Applications

The UPLC-II™ carrier set is particularly suitable for the following types of protective relay systems:

- Directional-Comparison Blocking
- Phase-Comparison Blocking
- Phase-Comparison Blocking, Current Only
- Phase-Comparison Blocking, Distance Supervised

#### 3.1.1 Directional-Comparison Blocking (DCB)

The basic elements for directional-comparison blocking (DCB) systems are shown in Figure 3–1a and Figure 3–1b. At each terminal, the phase and ground trip units (P) must be directional and set to overreach the remote terminal; that is, they must be set to operate for all internal faults. Nominal settings of the distance units are 120 to 150 percent of the line. The start units (S) must reach farther, or be set more sensitively, than the remote trip units. Thus S<sub>1</sub> must be set more sensitively than P<sub>2</sub> or reach farther behind bus G. Likewise, S<sub>2</sub> must be set more sensitively than P<sub>1</sub> or reach farther behind bus H. In any case, the S and P relays should be similar in type. If the trip unit (P) is a directional overcurrent ground relay, the start (S) ground relay should be a similar non-directional overcurrent unit. The same principle applies for the phase relays.

When the UPLC-II™ is set for ON/OFF Power-Line Carrier applications, except for possible aux-

iliary functions, **no signal is normally transmitted**, since the S units operate only during fault conditions.

Operation of the directional-comparison scheme in Figure 3–1a, Figure 3–1b & Table 3–1 is shown for external and internal faults. Subscript 1 indicates relays at station G for breaker 1; subscript 2, relays at station H for breaker 2. (Figure 3–1c shows a solid-state logic version of Figure 3–1b.)

The schemes shown are still widely used for their flexibility and reliability. Since the communication channel is not required for tripping, internal faults that might short and interrupt the channel are not a problem. Over tripping will occur, however, if the channel fails or is not established for external faults within the reach of the trip fault detectors. Since the carrier transmitter is normally OFF, or non-transmitting, channel failure cannot be detected until the system is tested or until an external fault occurs. This limitation can be overcome by using the optional checkback test system with the UPLC-II™ carrier.

A sample schematic for the KA-4 relaying system is shown in Figure 3–5a. A sample schematic for a basic microprocessor relay system is shown in Figure 3–6. Figures 3–7a & 3–7b illustrate some GE EM relay schematics.

#### 3.1.2 Phase-Comparison Blocking

Basic elements of the phase-comparison systems are shown in Figure 3–2. The system uses a composite sequence current network to provide a sin-

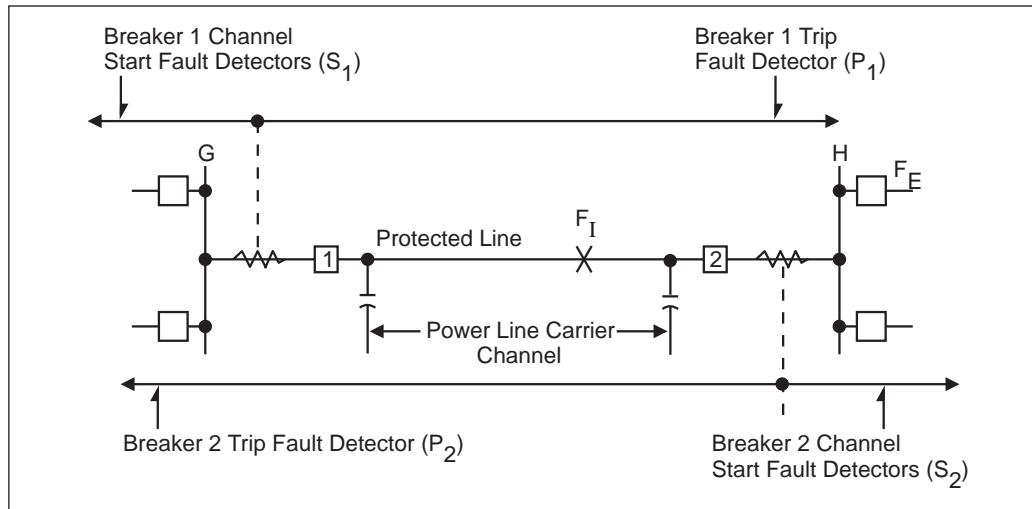


Figure 3-1a. – Basic Elements for directional-comparison blocking systems

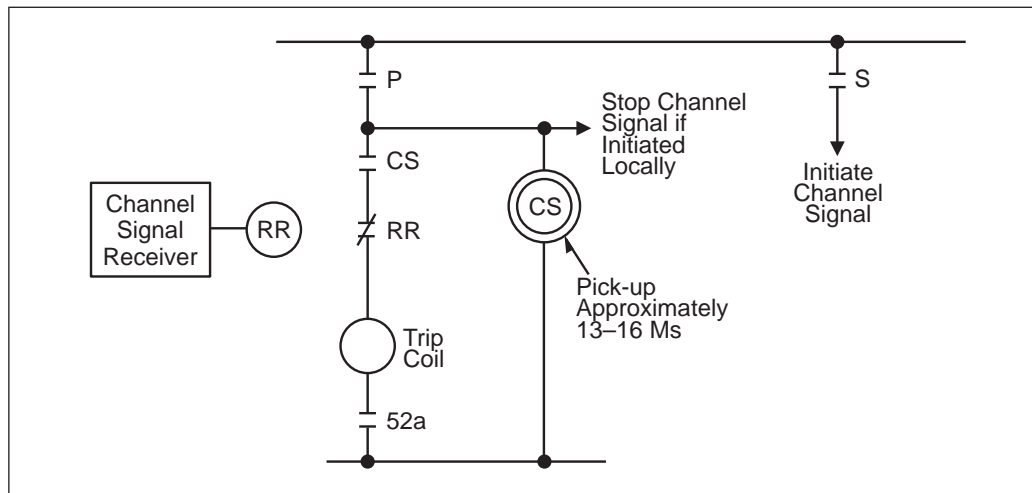


Figure 3-1b. – Contact Logic (per Terminal)

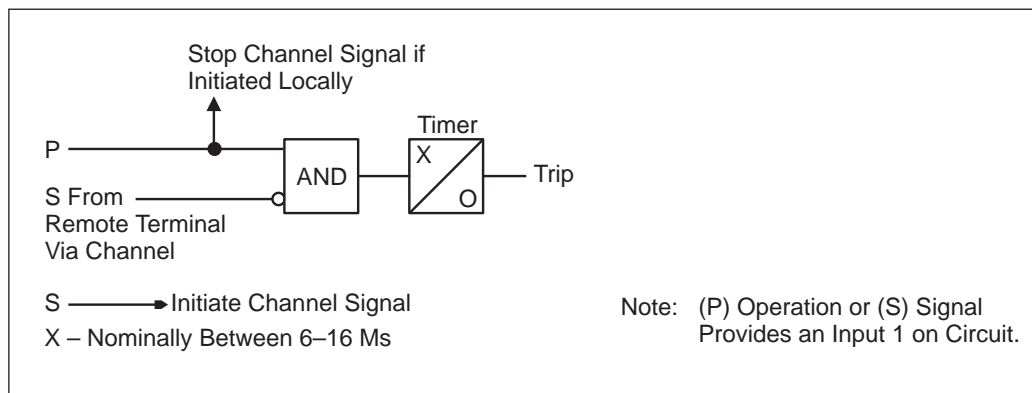


Figure 3-1c. – Solid State Logic (per Terminal)

**Table 3–1. Directional Comparison Blocking Operations for External and Internal Faults**

OPERATION FOR EXTERNAL AND INTERNAL FAULTS		
Type of Fault	Events at Station G	Events at Station H
<p>External (<math>F_E</math>)</p> <p>For external faults, the CS unit or timer x/o assure that a blocking signal is established.</p>	<p><math>P_1</math> operates; <math>S_1</math> does not see fault. Blocking signal received from station H. RR back contacts open (or 1 signal negates AND).</p> <p>No trip.</p>	<p><math>S_2</math> operates to key transmitter. Blocking signal sent to station G. <math>P_2</math> does not see fault.</p> <p>No trip.</p>
<p>Internal (<math>F_I</math>)</p>	<p><math>P_1</math> operates; <math>S_1</math> may or may not operate, but <math>P_1</math> operation prevents transmission of a blocking signal.</p> <p>Breaker 1 tripped.</p>	<p><math>P_2</math> operates, <math>S_2</math> may or may not operate but <math>P_2</math> operation prevents transmission of a blocking signal.</p> <p>Breaker 2 tripped.</p>

\* For external faults, the CS unit or timer x/o assure that a blocking signal is established.

gle-phase voltage output proportional to the positive, negative, and zero sequence current input. Sensitivity to different types of faults depends on the weighting factors or constants designed into the sequence current network. Adjustments to the network are provided.

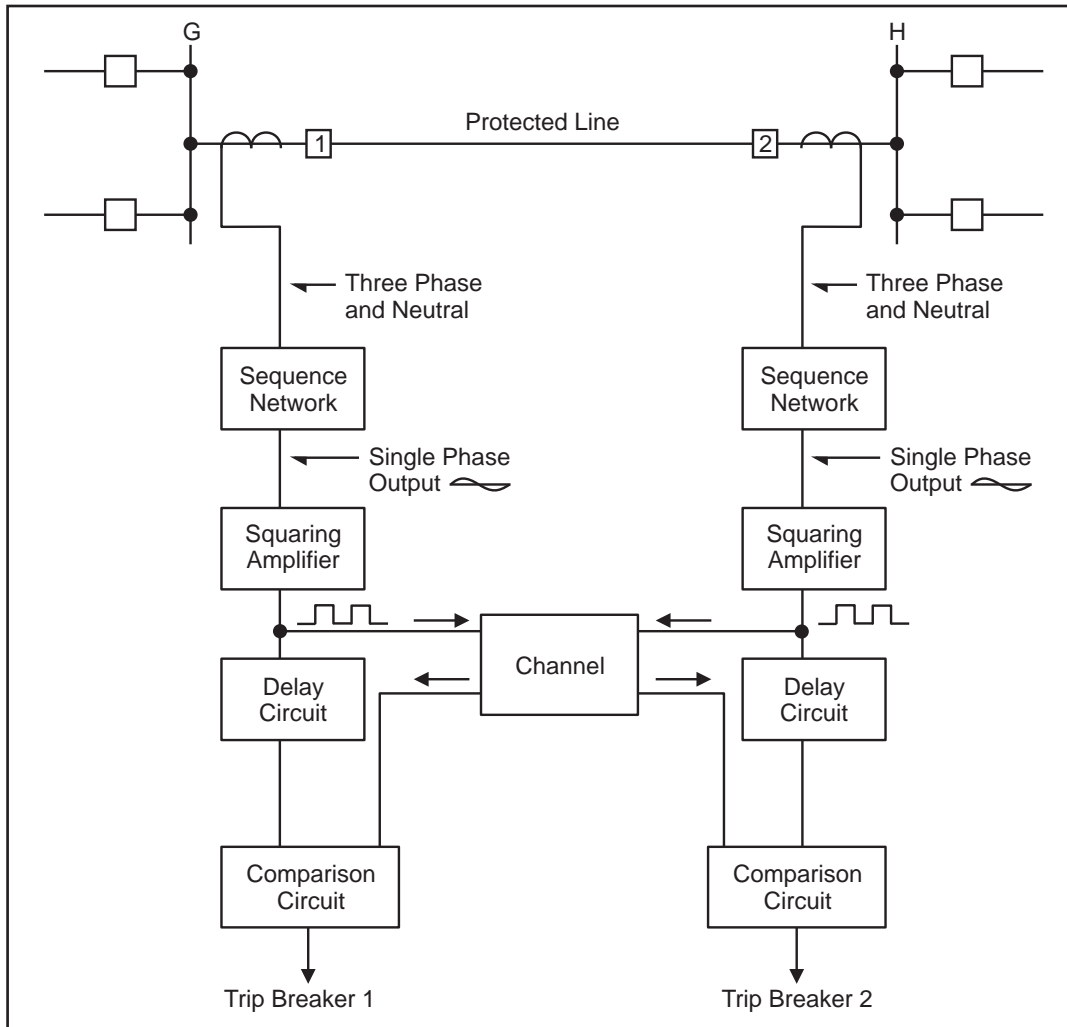
A squaring amplifier in the controlling relay converts the single-phase voltage output to a square wave. The positive voltage portion corresponds to the positive half-cycle of the filter voltage wave and the zero portion corresponds to the negative half-cycle. The square wave is used to key the UPLC-II™, transmitting to the remote terminal. The square wave from the remote terminal is compared to the local square wave, which has been delayed by an amount equal to the absolute channel delay time. This comparison of the local and remote square waves at each terminal determines whether a fault is internal or external.

Fault detectors are used to determine whether a fault has occurred and to supervise tripping. The fault detectors must be overreaching, i.e., set sensitively enough to operate for all internal phase and ground faults.

Because overcurrent fault detectors are normally used, voltage transformers are not required. Such a scheme is current only. Fault detectors should be set above maximum load, yet operate for all internal faults. Distance fault detectors, which require voltage transformers, are used on heavy-loaded or long lines when distance supervision is required.

### 3.1.2.1 Single Phase-Comparison Blocking, Current Only

In the current only system, the UPLC-II™ is used with two overcurrent fault detectors (FD1 and FD2). FD1, the carrier start unit, is set more sensitively than FD2 and permits the local square wave



**Figure 3–2. Phase-Comparison Blocking, Basic Elements**

signal to key the “ON/OFF” carrier transmitter. FD2, set with a higher pickup than FD1, is used to arm the system for tripping. For transmission lines less than 100 miles long, the FD2 pickup is set at 125 percent of FD1. For lines longer than 100 miles, the FD2 pickup is set at 200 percent of FD1. On a three-terminal line, FD2 is set at 250% of FD1, provided the line length between any two breakers is less than 100 miles. Phase-Comparison cannot occur until FD2 operates. The purpose of the two fault detectors is to coordinate the comparison of the local and remote square waves with the keying of the carrier square wave. **The carrier must be started before the comparison is allowed** to ensure that the remote square wave has been received.

The basic operation of the system is shown in Figure 3–3, at the end of this section. FD<sub>1</sub> and FD<sub>2</sub> at both terminals operate for an internal fault (F<sub>I</sub>). The square wave inputs to the AND from the local currents are essentially in phase with those transmitted via the channel from the remote terminal. The local square wave turns the carrier “ON” and “OFF” to provide the square wave receiver output for the remote terminal.

A flip flop is energized if the inputs to the AND continue for 4ms, providing a continuous trip output supervised by FD2 operation. The 4ms correspond to a phase angle difference of 90°, on a 60-Hz base, between the currents at the two terminals. The currents at the two ends of the line may be out of phase by up to 90° and still trip. This is a blocking system, since the receipt of a signal from the channel prevents tripping. The carrier signal, therefore, does not have to be transmitted through the internal fault. No received signal puts a “1” on the AND input. With the remote terminals open, this system provides sensitive instantaneous overcurrent protection for the entire line. As is characteristic of blocking systems, the channel is not required for tripping on internal faults.

For an external fault, such as F<sub>E</sub> in Figure 3–3, blocking is essentially continuous, since the remote wave input to the AND is out-of-phase with the local square wave. The secondary ct currents are essentially out-of-phase for an external fault. The

currents can, however, be in-phase by up to 90° on a 60-Hz base and still block.

### 3.1.2.2 Single Phase-Comparison Blocking, Distance-Supervised

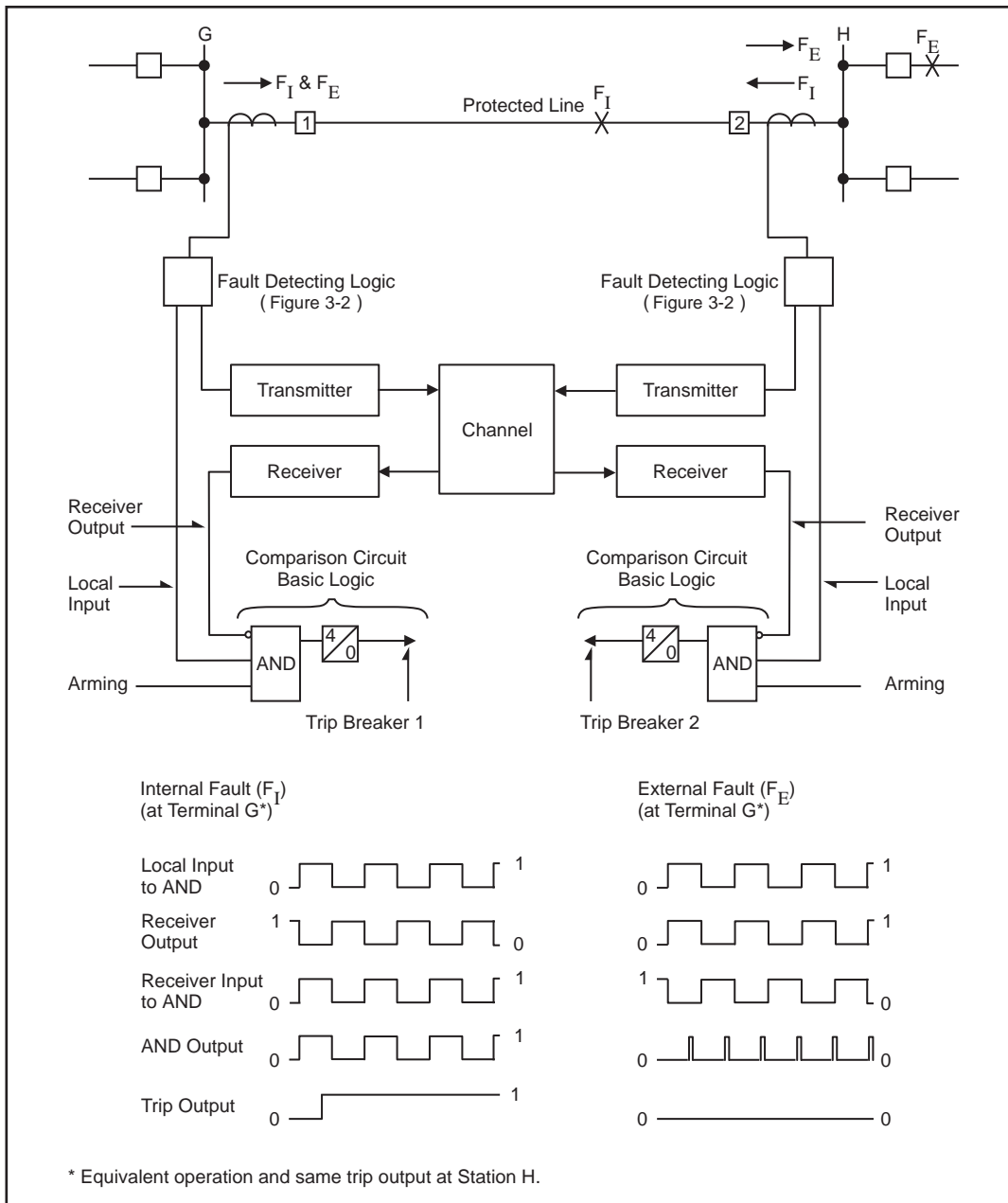
A distance-supervised scheme should be used if the minimum internal three-phase fault current is less than twice the maximum load current. Twice maximum load current allows FD<sub>1</sub> to operate positively on the minimum internal three-phase fault, yet reset when an external fault is followed by a maximum load current flowing through the line. The UPLC-II™ operates in the same manner as when used with the current-only scheme, except for the fault detection and arming techniques.

Two sequence current networks and two distance relays supplement the two overcurrent fault detectors.

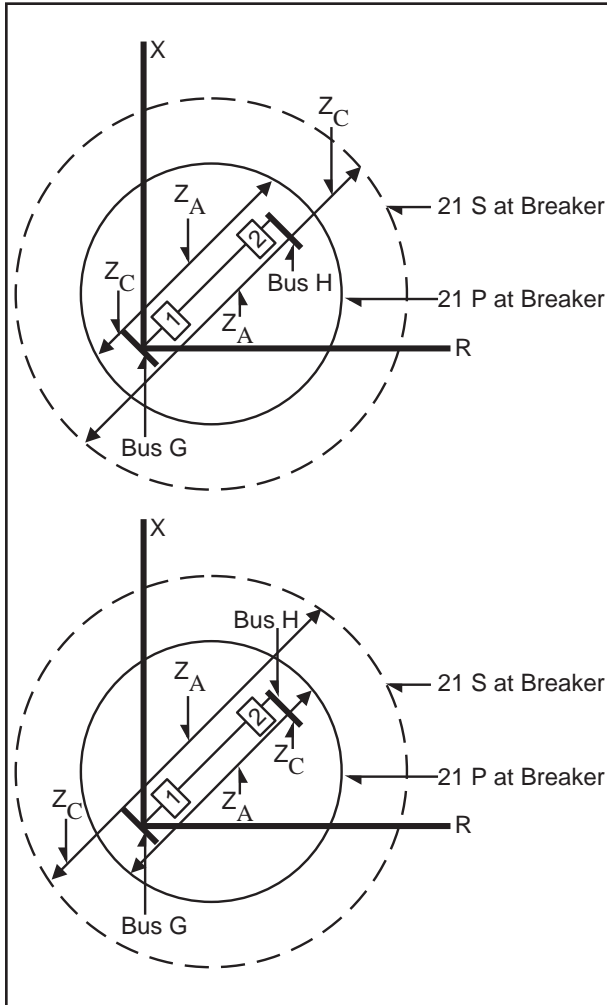
One sequence current network responds only to negative and zero sequence currents, detecting all phase-to-phase and ground faults (but not three-phase faults). The output of this adjustable network operates the conventional overcurrent FD<sub>1</sub> and FD<sub>2</sub> fault detectors. The two distance relays operate only for three-phase faults. Thus, FD<sub>2</sub> provides the arming function for all unbalanced phase and ground faults, through the adjustable filter, and one of the distance relays (21P) provides arming for all three-phase faults.

The second and non-adjustable sequence current network operates through the squaring amplifier, providing the local square wave and the carrier-keyed square wave required for phase comparison. This signal is keyed by FD<sub>1</sub> and the second distance relay (21S) to provide the carrier start functions. This second network responds to positive, negative, and zero sequence currents. Separate networks provide greater sensitivity: with phase-to-phase faults, for example, more than twice the sensitivity is gained.

The setting coordination of FD<sub>1</sub> and FD<sub>2</sub> overcurrent units is the same as for the current-only system. Settings for the two three-phase distance units are shown in Figure 3–4. Both 21S and 21P distance relays must be set to overreach both the local and remote terminal buses; 21S must be set further than 21P, as shown.



**Figure 3-3.**  
**Single Phase-Comparison Blocking, Current Only Operation**



**Figure 3-4. Single Phase-Comparison Blocking, Distance-Supervised Operation**

### 3.2 ON/OFF Mode Special Considerations

#### 3.2.1 Multi-Terminal Lines

Because the UPLC-II™ is ON/OFF modulated, only one frequency ( $f_C$ ) is required for line protection. When applied to **three terminal lines**, phase cancellation will occur when two or more transmitters are keyed simultaneously at the same frequency. To prevent this, you should offset transmitters TX frequencies by  $\pm 100$  Hz. The three frequencies should be:

- $f_C$
- $f_C - 100$  Hz
- $f_C + 100$  Hz

The three receivers' frequencies should all be set to  $f_C$ . If there is some scenario where both ends of a 2-terminal line could be keyed simultaneously, the same applies, but you only need to offset one transmitter by  $\pm 100$  Hz. The UPLC-II™ does not have an adjustable filter or hybrid attached to the output of the transmitter.

#### 3.2.2 Phase Comparison

If you are using the UPLC-II™ in an ON/OFF application where no other Power-Line Carrier equipment is attached to the power line, then no other devices are required. **However, in the application of Single Comparator Phase Comparison relaying, the UPLC-II™ is to be operated in the four-wire mode, with an external skewed hybrid between the transmitter and receiver.**

#### 3.2.3 Hybrids/Series LC Unit

If you are applying the carrier set with other transmitters, coupled through the same tuning equipment, you must apply a hybrid or a series LC unit to the transmitter output to isolate the other transmitters from the UPLC-II™ transmitter. This will avoid the problems of intermodulation distortion. We suggest that you use a hybrid if the frequency spacing between all transmitters is within the bandwidth of the hybrid (usually 6%). Check the manufacturers instructions for the actual spacing limitations of the hybrid you are using. If you cannot use a hybrid, then you may use a series LC unit to isolate the transmitters. In this case, the transmitters must have spacing such that the LC you are using will attenuate the external frequencies by at least 20 dB (if the other frequency is a 10 W transmitter), and 30 dB (if the other frequency is a 100 W transmitter).

#### 3.2.4 Interfacing to Electromechanical Relays

You may need to make special connections/settings for connecting to the inputs of the UPLC-II™, but you definitely will need to do this for connecting to its outputs.

Your connections should be per what is shown in Figures 3-5a,b,c.



For the relay's outputs to the UPLC-II™ inputs, if and only if you have one output from your relay that does both carrier start/stop instead of a separate carrier start and carrier stop output coming from your EM relay, then the following conditions must be met. (Otherwise you would ignore the following steps for your application and use the standard connections/settings for the UPLC-II™ carrier start/stop input.)

1. Both carrier start and carrier stop inputs (Input 1 & 2) need to have the physical jumper on the I/O module set for 48 V if you are using a 125 V station battery (use one position below the station battery voltage).
2. On the web page settings, under the "LOGIC" tab you must have PRIORITY set for STOP and the box *enabled* for COMMON START/STOP KEYING INPUT.
3. On the "INPUTS" tab both carrier start and carrier stop inputs must be set for application of voltage.

Figure 3–5b includes a table that shows the voltages that actually get applied to the UPLC-II™ with the KA4 common start/stop lead setup and how the UPLC-II™ inputs respond.

For the relay's inputs to the UPLC-II™ outputs, you need a power source with voltage less than station battery to drive the lower impedance of the EM relay coils, which normally only require either 20 or 200 mA. The UPLC-II™ has an optional auxiliary power supply output, which is a daughter board on the Power Supply module. This polarity sensitive output comes out on TB1 & TB2 on terminals 3(+) and 4(-). It needs to be connected in series with one of the UPLC-II™ outputs for supplying the correct voltage/current to the EM relay when the output activates.

The two ganged jumpers on the auxiliary power supply board need to be set to give you the desired output voltage/current per the following:

20 mA for EM relay with 2200 Ω coil resistance (JMP3 = 46 V, and JMP1/JMP2 = 46 V/20 V (20 mA)).

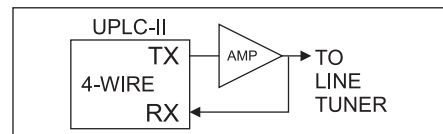
200 mA for EM relay with 25 Ω coil resistance (JMP3 = setting does not matter, and JMP1/JMP2 = 8 V (200 mA)).

20 V is for some other low voltage applications (JMP3 = 20 V, and JMP1/JMP2 = 46 V/20 V (20 mA)).

After setting the jumpers when you plug the power supply module back in the UPLC-II™, then it is ready to output voltage/current on TB1-3 (+) and TB1-4 (-) for the main Power Supply and TB2-3 (+) and TB2-4 (-) if there is a redundant Power Supply with the auxiliary board.

### 3.2.5 External Booster Amplifiers

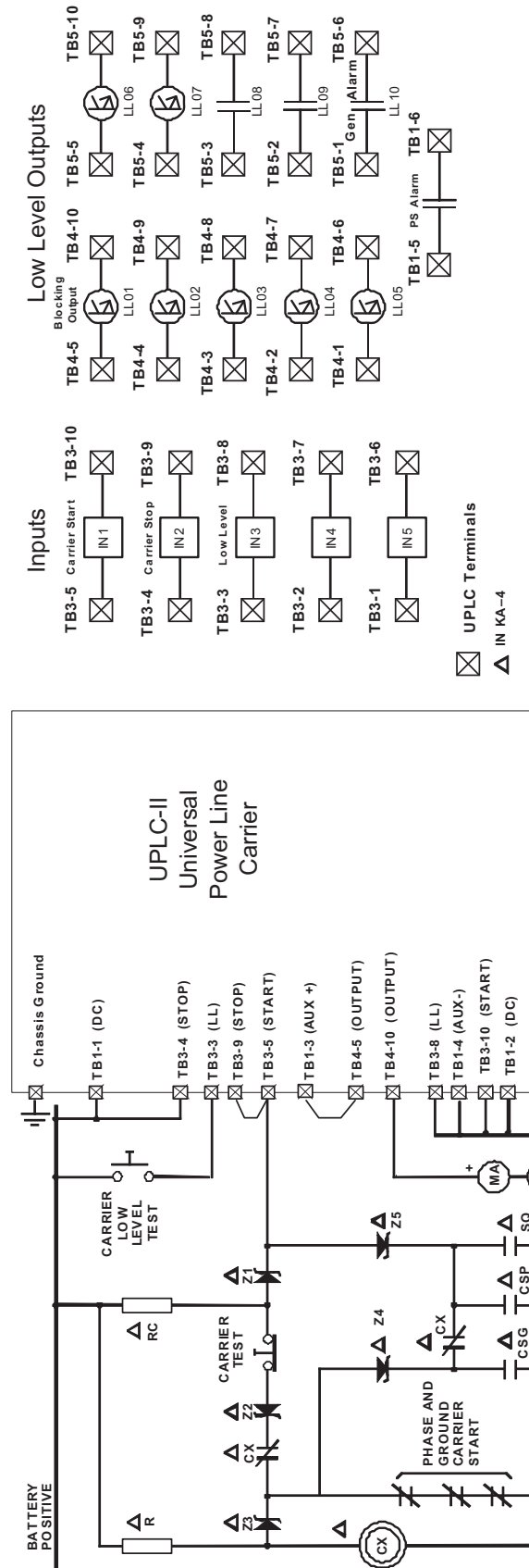
When using an external booster 50 W or 100 W amplifier, for high attenuation power-line applications, make sure the UPLC-II™ backplane 2-wire/4-wire jumper is set for 4-wire. *This is critical to avoid causing damage to the amplifier.* The usual connection is shown. The transmit output power of the UPLC-II™ will need to be set lower than normal depending on the particular external amplifier used.



**DCB Application w/External Booster Amplifier.**

## 3.3 ON/OFF Mode Typical Wiring/Connections

Common wiring/connection diagrams for ON/OFF applications can be found on the following pages.



**Notes:**

1. Some schemes may not have carrier continuation (CX).
2. All contacts are link selectable for Normally Open (NO) or Normally Closed (NC).

**Figure 3-5a. ON/OFF Mode, DCB With KA-4 EM Relay - Connections**

Figure 3-5b. ON/OFF Mode, DCB With KA-4 EM Relay - Volt Levels/Settings

Conditions of UPLC-II inputs for use with KA4 electromechanical relay (Stop Priority)			
Condition	Carrier Start	Carrier Stop	Both start & stop
Voltage across Stop Input	15V	125V	62.5V
Voltage across Start Input	110V	0V	62.5V
Result	Start Carrier	Stop Carrier	Stop Carrier*

\*But allows checkback or low level test.

Programming / Jumper Table

Module	Function	Software Selection	Hardware Selection	Label on board	Recommendation
Backplane	Coax Setting	2 wire/4 wire	2 wire/4 wire	JMP3/JMP5	2 Wire
	# of PAs	1 PA/2PA	1 PA/2PA	JMP2/JMP6	Per factory
Power Supply	Coax Impedance	50 Ω/75 Ω	50 Ω/75 Ω	JMP1/JMP4	50 Ω *
	Power	PwrOn/ PwrOff	PwrOn/ PwrOff	JMP3	PwrOn
Aux Power Supply	Alarm Contact	NO/NC	NO/NC	JMP1/JMP2	Per Engineering
	Holding current	20 mA/200 mA	20 mA/200 mA	8V(200 mA) or 46/20V(20 mA)	JMP1/JMP2 Per carrier relay requirement (JMP3 is used only for 46/20V outputs when JMP1/JMP2 is in 46/20V position)
Logic	Common Start/Stop Keying Input	Enable			
Input/Output					
Input 1	Carrier Start	Application of Voltage	15/48/125/250 Vdc	Input 1	Set to voltage setting one step below station battery, ie - 125 Vdc battery, use 48 volt jumper
Input 2	Carrier S top	Application of voltage	15/48/125/250 Vdc	Input 2	Set to voltage setting one step below station battery, ie - 125 Vdc battery, use 48 volt jumper
Input 3	Low Level Key	Application of voltage	15/48/125/250 Vdc	Input 3	Per Engineering
Input 4			15/48/12 5/250 Vdc	Input 4	Per Engineering
Input 5			15/48/125/250 Vdc	Input 5	Per Engineering
LL Output 1	Blocking Output	(NO)	0.1/1.0 A	LL01	1.0 A
LL Output 2			0.1/1.0 A	LL02	Per Engineering
LL Output 3			0.1/1.0 A	LL03	Per Engineering
LL Output 4			0.1/1.0 A	LL04	Per Engineering
LL Output 5			0.1/1.0 A	LL05	Per Engineering
LL Output 6			0.1/1.0 A	LL06	Per Engineering
LL Output 7			0.1/1.0 A	LL07	Per Engineering
LL Output 8			NO/NC	LL08	Per Engineering
LL Output 9			NO/NC	LL09	Per Engineering
LL Output 10	General Alarm		NO/NC	LL10	Per Engineering

\* Or per engineering's recommendation

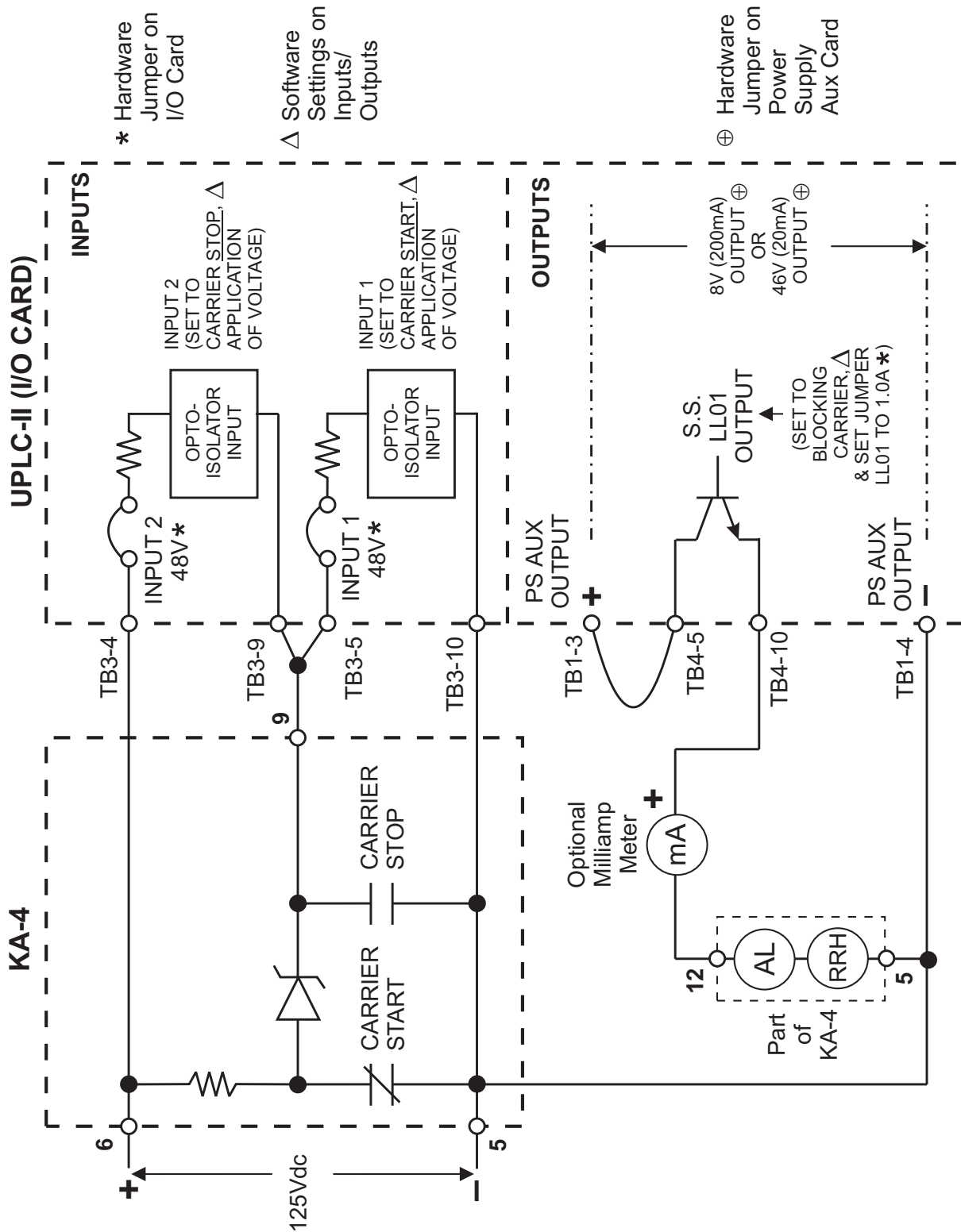
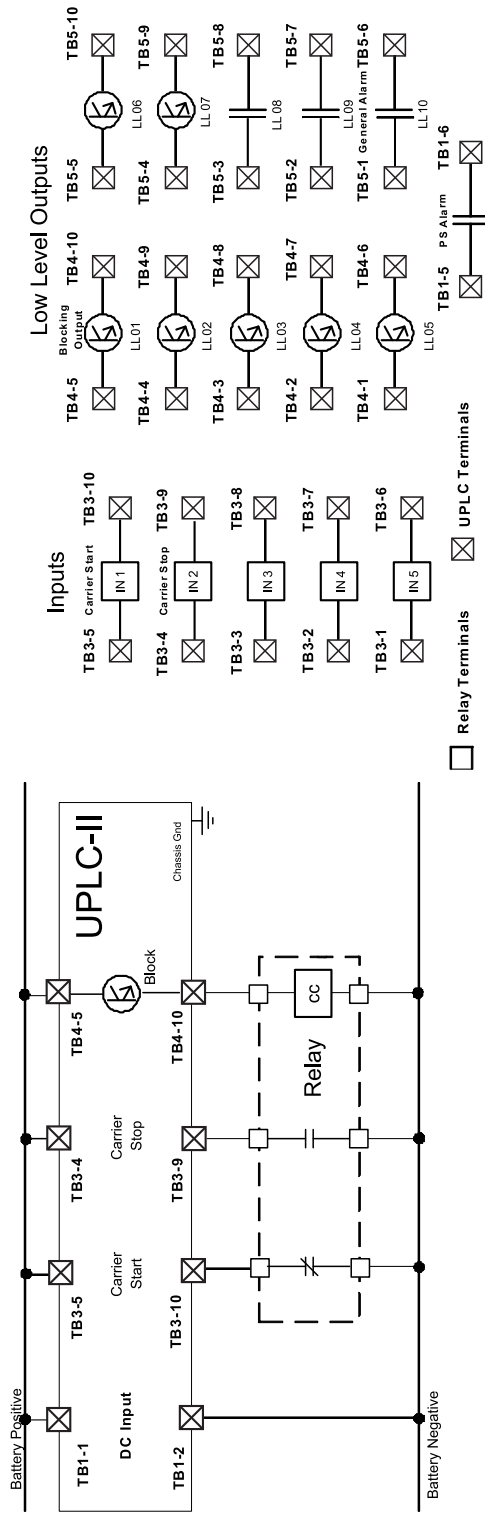


Figure 3-5c. ON/OFF Mode, DCB with KA-4 EM Relay  
Functional Block Diagram (Common Start/Stop Lead for 125Vdc)

Figure 3-6. ON/OFF Mode, DCB with Microprocessor Relay – Connections/Settings



NOTES:  
1 - All contacts are link selectable for normally open or closed.

Jumper Table

Module	Function	Software Selection	Hardware Selection	Label on board	Recommendation
Backplane	Coax Setting	----	2 wire/4 wire	JMP3/JMP5	2 Wire
	# of PAs	----	1 PA/2PA	JMP2/6/7	Per factory
	Coax Impedance	----	50 Ω/75 Ω	JMP1/JMP4	50 Ω *
Power Supply	Power	----	PwrOn/PwrOff	JMP3	PwrOn
	Alarm Contact	----	NO/NC	JMP1/JMP2	Per Engineering
Input/Output					
Input 1	Carrier Start	Removal of Voltage	15/48/125/250 Vdc	Input 1	Station Battery
Input 2	Carrier Stop	Application of Voltage	15/48/125/250 Vdc	Input 2	Station Battery
Input 3	(not used)		15/48/125/250 Vdc	Input 3	Per Engineering
Input 4	(not used)		15/48/125/250 Vdc	Input 4	Per Engineering
Input 5	(not used)		15/48/125/250 Vdc	Input 5	Per Engineering
LL Output 1	Blocking (Carrier Received)	----	0.1/1.0 A	LL01	0.1 A
LL Output 2	(not used)	----	0.1/1.0 A	LL02	Per Engineering
LL Output 3	(not used)	----	0.1/1.0 A	LL03	Per Engineering
LL Output 4	(not used)	----	0.1/1.0 A	LL04	Per Engineering
LL Output 5	(not used)	----	0.1/1.0 A	LL05	Per Engineering
LL Output 6	(not used)	----	0.1/1.0 A	LL06	Per Engineering
LL Output 7	(not used)	----	0.1/1.0 A	LL07	Per Engineering
LL Output 8	(not used)	----	NO/NC	LL08	Per Engineering
LL Output 9	(not used)	----	NO/NC	LL09	Per Engineering
LL Output 10	General Alarm	----	NO/NC	LL10	Per Engineering

\* On per engineering's recommendation

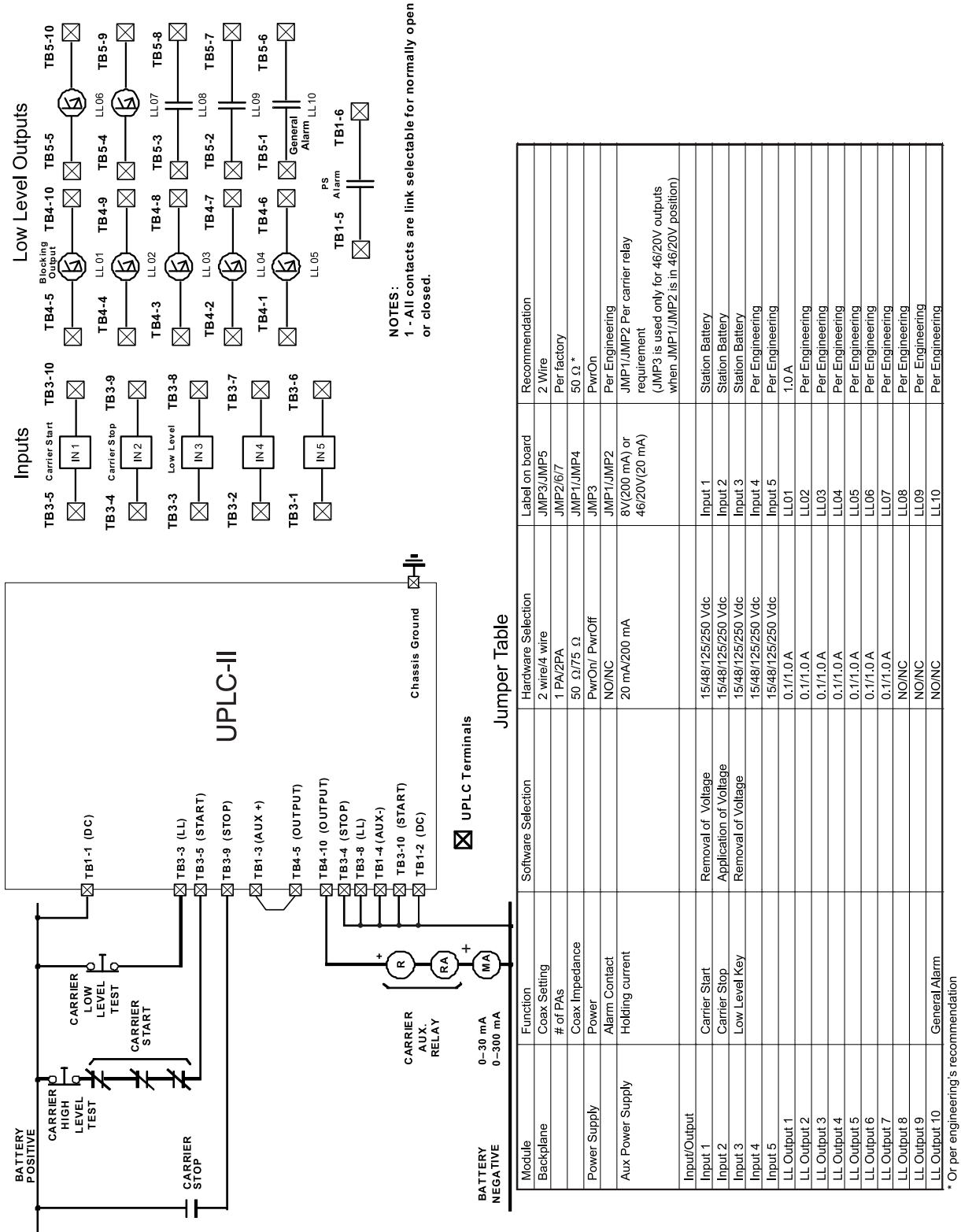
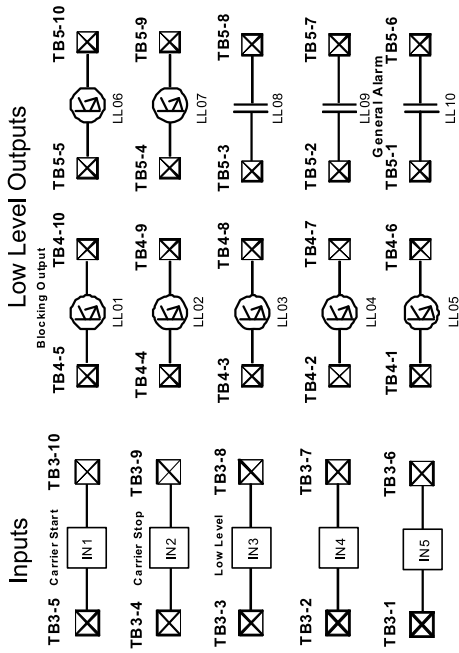
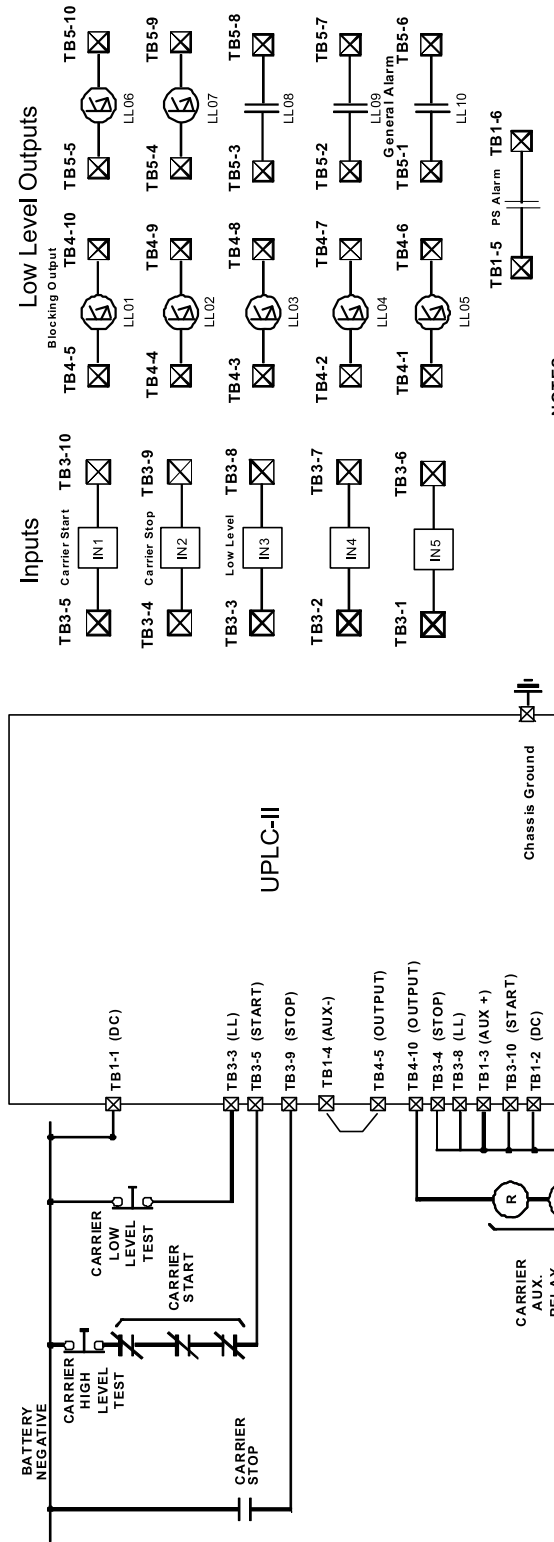


Figure 3-7a. ON/OFF Mode, DCB with GE type EM Relays – Connections/Settings

**Figure 3-7b. ON/OFF Mode, DCB with GE Type EM Relays (Opposite Battery Polarity – Connections/Settings)**



**NOTES:**  
1 - All contacts are link selectable for normally open or closed.

**GE Type EM Relays with UPLC**

**Jumper Table**

Module	Function	Software Selection	Hardware Selection	Label on board	Recommendation
Backplane	Coax Setting		2 wires/4 wire	JMP3/JMP5	2 Wire
	# of PAs		1 PA/2PA	JMP2/6/7	Per factory
Power Supply	Coax Impedance		50 Ω/75 Ω	JMP1/JMP4	50 Ω *
	Power		PwrOn/ PwrOff	JMP3	PwrOn
Aux Power Supply	Alarm Contact		NO/NC	JMP1/JMP2	Per Engineering
	Holding current		20 mA/200 mA	8V(200 mA) or 46/20V(20 mA)	JMP1/JMP2 Per carrier relay requirement (JMP3 is used only for 46/20V outputs when JMP1/JMP2 is in 46/20V position)
Input/Output	Input 1	Carrier Start	15/48/125/250 Vdc	Input 1	Station Battery
	Input 2	Carrier Stop	15/48/125/250 Vdc	Input 2	Station Battery
	Input 3	Low Level Key	15/48/125/250 Vdc	Input 3	Station Battery
	Input 4	Blocking	15/48/125/250 Vdc	Input 4	Per Engineering
	LL Output 1		NO	LL01	Per Engineering
	LL Output 2		0.1/1.0 A	LL02	1.0 A
	LL Output 3		0.1/1.0 A	LL03	Per Engineering
	LL Output 4		0.1/1.0 A	LL04	Per Engineering
	LL Output 5		0.1/1.0 A	LL05	Per Engineering
	LL Output 6		0.1/1.0 A	LL06	Per Engineering
LL Output 7		0.1/1.0 A	LL07	Per Engineering	
LL Output 8		NO/NC	LL08	Per Engineering	
LL Output 9		NO/NC	LL09	Per Engineering	
LL Output 10	General Alarm	NO	NO/NC	LL10	Per Engineering

\* Or per engineering's recommendation

### 3.4 ON/OFF Mode Alarms

The following tables show alarms for ON/OFF Mode.

**Table 3–2.**  
**Hardware Fixed Alarm (from Power Supply Board)**  
**All Modes**

PS Hardware Failure Alarm for All UPLC-II™ Units		
<b>Alarm Reason:</b>	One of the PS outputs is too low in voltage	
<b>Alarm Name: (Available Outputs)</b>	Power Supply Alarm Output (TB1-5 & 6)**	
	De-Energized State	
<b>Contact Type:</b>	<b>N.O. Contact</b>	<b>N.C. Contact</b>
<b>UPLC-II™ Condition</b>		
PS Good	Closed	Open
PS Bad	Open	Closed
**For the Redundant Power Supply, use TB2-5 & 6		

3

**Table 3–3.**  
**Software Programmable Alarms/(Outputs from I/O Board)**  
**ON/OFF Mode**

Hardware Failure Alarm for All UPLC-II™ Units		
<b>Alarm Reason:</b>	Hardware health of at least one card is bad	
<b>Alarm Name: (Available Outputs)</b>	General Alarm Output (LL08 – LL10)	
	De-Energized State	
<b>Contact Type:</b>	<b>N.O. Contact</b>	<b>N.C. Contact</b>
<b>UPLC-II™ Condition</b>		
All OK	Closed	Open
Hardware Failure	Open	Closed
Loss of DC Power	Open	Closed



**Table 3–3 Continued:  
Software Programmable Alarms/(Outputs from I/O Board)  
ON/OFF Mode**

Transmit Monitor for ON/OFF Units Only		
<b>Output Reason:</b>	TX signal level is $\geq$ TX low level setting	
<b>Output Name: (Available Outputs)</b>	Main RF Output (LL01 – LL10)	
	<b>De-energized State</b>	
<b>Output Type:</b>	<b>N.O. Output</b>	<b>N.C. Output</b>
<b>UPLC-II™ Condition</b>		
Transmit ON	Closed	Open
Transmit OFF	Open	Closed

TX / RX Alarms for ON/OFF Units with Checkback (CB) Option Only				
<b>Alarm Reason:</b>	UPLC-II™ failed all checkback tests performed at the <b>10 W</b> level		UPLC-II™ failed all checkback tests performed at the <b>1 W</b> level	
<b>Alarm Name: (Available Outputs)</b>	<b>Checkback Major Alarm (LL01 – LL10)</b>		<b>Checkback Minor Alarm (LL01 – LL10)</b>	
	<b>De-energized State</b>		<b>De-energized State</b>	
<b>Output Type:</b>	<b>N.O. Output</b>	<b>N.C. Output</b>	<b>N.O. Output</b>	<b>N.C. Output</b>
<b>UPLC-II™ Condition</b>				
Passed CB Test	Open	Closed	Open	Closed
Failed CB Test	Closed	Open	Closed	Open

*\* If a UPLC-II™ has both Major & Minor Checkback alarms, then that unit is faulty and needs to be checked.*

### 3.5 FSK Mode Protective Relay Applications

The UPLC-II™ carrier set is particularly suitable for the following types of protective relay systems:

- Directional Comparison Unblocking
- Permissive Overreaching Transfer Trip (POTT)
- Permissive Underreaching Transfer Trip (PUTT)
- Dual Phase Comparison Unblocking
- Segregated Phase Comparison Unblocking
- Direct Transfer Trip

#### 3.5.1 Directional Comparison Unblocking (DCUB)

The Directional Comparison Unblocking systems transmit a continuous blocking signal, except during internal faults. The channel is generally a Frequency-Shift Keyed (FSK) Power-Line Carrier. For an internal fault, the FSK transmitter is shifted to the “unblock” frequency. The transmitted power in many applications is normally 1 W, boosted to 10 W during unblock operation.

The frequency-shift channel is monitored continuously to prevent tripping when a loss of channel occurs. The carrier receiver logic is shown in Figure 3–8. Under normal conditions, a block frequency is transmitted and OR-1 has no input. Because AND-1 and AND-2 are not satisfied, OR-2 is not energized. For an internal fault, the block frequency is removed. Assuming that the unblock signal is shorted out by the fault, OR-1 provides a direct input to AND-2 to satisfy its input requirements for 150 ms. AND-2 inputs to OR-2 to oper-

ate the RR or to provide input to the AND shown in Figure 3–8. Without an unblock signal, typically 150 ms is allowed for tripping. After this period, lock out is initiated as one of the inputs to AND-2 is removed. This resets the RR or removes the input to AND. If the unblock signal is received, it inputs directly to OR-2 to energize the RR or to provide input to AND. The unblock signal also removes an input to AND-1 to stop the timer. A channel failure (no block or unblock signal) provides input to AND-1 and, after 150ms, locks out the relaying and triggers an alarm. The operation of the scheme shown in Figure 3–9 is given in Table 3–4 for external and internal faults. The phase and ground trip fault detectors at both stations must operate for all internal faults; that is, they must overreach the remote bus.

The dependability and security of Directional Comparison Unblocking systems make them the most attractive of the protective schemes for transmission lines using Power-Line Carrier channels. Over-tripping is avoided by continuous blocking and continuous channel monitoring. Only an external fault within a certain time delay after channel failure can result in over-tripping. This time is selectable from 0-500ms.

The scheme is most appropriate for two-terminal lines, but is applicable to multi-terminal lines. Separate channels are required between each terminal and the remote terminal(s). A sample schematic is shown in Figure 3–23, near the end of this chapter.

You may conserve frequency spectrum by using a narrow band frequency shift carrier, but at the expense of channel speed.

Another consideration is an open breaker situation. When the remote breaker is open for an extended period of time, the relay system must be able to trip. The remote relay system sends a trip signal when detecting a remote open breaker. If this

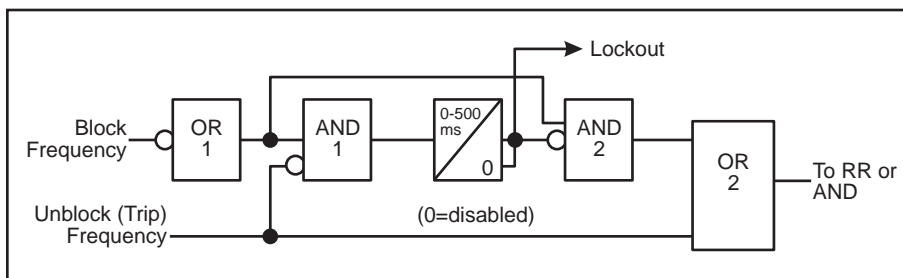


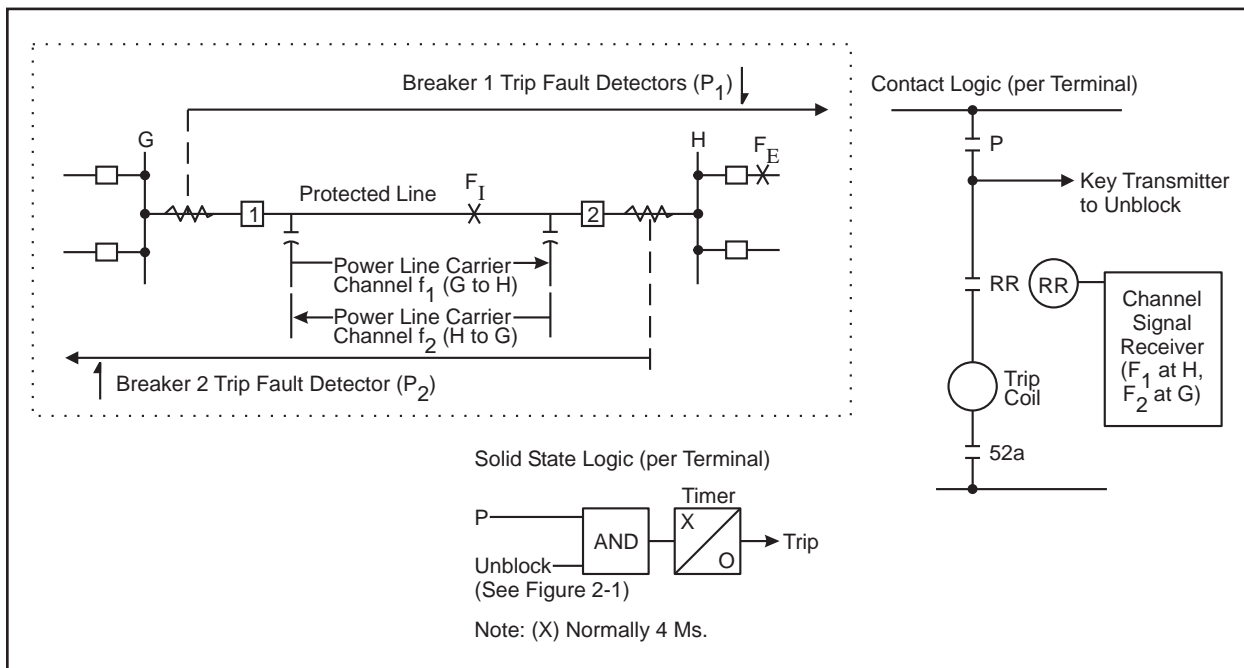
Figure 3–8. Simplified Unblock Receiver Logic

remote signal is received for 1,000 ms (1 sec) or longer, the carrier receiver logic interprets this as an open breaker and allows the local end to trip whenever the local relays detect a fault.

An older system (STU unblock) is shown in Figure 3–25a & 25b, near the end of this chapter.

**Table 3–4. Operation of the Directional Comparison Unblocking Scheme**

OPERATION FOR EXTERNAL AND INTERNAL FAULTS		
Type of Fault	Events at Station G	Events at Station H
External ( $F_E$ )	$P_1$ operates. $f_1$ channel shifts to unblock. $f_2$ channel continues to block. No trip.	$P_2$ does not see fault. Loss of block and/or receipt of unblock ( $f_1$ ) operates RR or inputs AND. No trip.
Internal ( $F_I$ )	$P_1$ operates. $f_1$ channel to unblock. Loss of block and/ or receipt of unblock ( $f_2$ ) operates RR or inputs AND. Trip.	$P_2$ operates. $f_2$ channel shifts to unblock. Loss of block and/or receipt of unblock ( $f_1$ ) operates RR or inputs AND. Trip.



**Figure 3–9. Basic Logic Diagrams for Directional Comparison Unblocking**

### 3.5.2 Permissive Overreaching Transfer Trip Systems

Overreaching transfer trip systems require a channel signal to trip, and are used with a frequency-shift audio tone, modulated on a communication channel (e.g., public or private telephone lines). These systems are generally not used with Power-Line Carriers. There are, however, successful applications of Power-Line Carrier on POTT schemes where parallel lines allow for cross-coupling of the carrier signal.

### 3.5.3 Permissive and Non-Permissive Underreaching Transfer Trip Systems

For overreaching systems, the directional phase and ground trip fault detectors (P) must be set to overlap within the transmission line and not overreach any terminals (see Figure 3–10).

That is, at least one trip fault detector (P) must operate for all internal faults, and none should operate for any external fault. In practice, distance relays are normally required for both ground faults and phase faults, although directional instantaneous ground-overcurrent relays might meet these requirements in some cases.

Though it is the least complex, the non-permissive system is rarely used because of the high potential for false outputs from the channel, which would cause incorrect tripping. If a non-permissive system is used, the channel considerations should be as described later for direct trip systems. The system is made permissive by the additional set of phase and ground overreaching fault detectors (FD), which must operate for all internal faults (see Figure 3–10).

Operation of the underreaching transfer trip scheme shown in Figure 3–10 is described in Table 3–5 for external and internal faults.

Because the trip fault detectors (P) do not operate for external faults, underreaching transfer trip systems do not require external fault-clearing coordi-

nation circuits (transient blocking) and are, therefore, inherently simpler than any of the other schemes. You obtain maximum security if you use additional permissive fault detectors. These schemes also provide minimum operating times for many faults that are tripped directly, without using the channel.

### 3.5.4 Dual Phase Comparison Unblocking Systems

Dual comparison systems require a duplex channel: one frequency for each line terminal. The UPLC-II™ frequency-shift channel equipment is available for this purpose; normally used in an unblocking system. Continuous channel monitoring is also provided, because either a trip positive or trip negative carrier signal is always transmitted.

The transmitter is keyed to its trip positive frequency when the square wave from the filter goes positive, and is keyed to its trip negative frequency when the square wave is at zero. There are two outputs at the receiver: the trip positive output is a square wave that goes positive when a trip positive frequency is received; the trip negative output goes positive when a trip negative frequency is received.

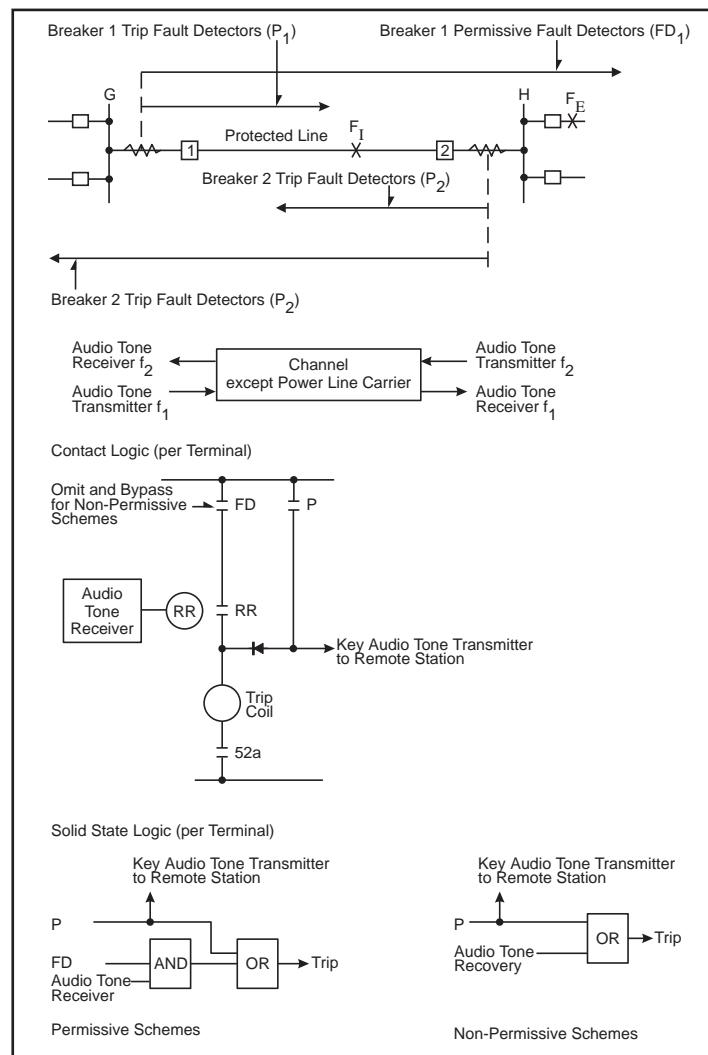
The basic operation of the Dual Phase Comparison system is shown in Figure 3–11. For internal faults, the single phase outputs of the sequence current networks are essentially in phase, although such output represents currents 180° apart in the power system. The network output goes through a squaring amplifier that keys the frequency shift transmitter. An adjustable delay circuit delays the local square wave by a time equal to the channel delay time.

The network output is then used to develop two complementary square waves. One wave, which has a positive state during the positive half-cycle of the sequence current network, is compared with

**Table 3–5. Operation of the Underreaching Transfer Trip Scheme**

OPERATION FOR EXTERNAL AND INTERNAL FAULTS		
Type of Fault	Events at Station G	Events at Station H
External ( $F_E$ )	$P_1$ does not operate. No channel signal sent to H. No trip.	$P_2$ does not operate. No channel signal sent to G. No trip.
Internal ( $F_I$ ) (Fault near station H)	$P_1$ does not operate. No channel signal sent to H. †(FD <sub>1</sub> operates). Transfer-trip ( $f_2$ ) from station H operates RR or inputs to AND (or OR if non-permissive). Trip.	$P_2$ operates and trips directly. Transfer-trip signal keyed to station G. †(FD <sub>2</sub> operates). Trip.

† Omitted in non-permissive systems.



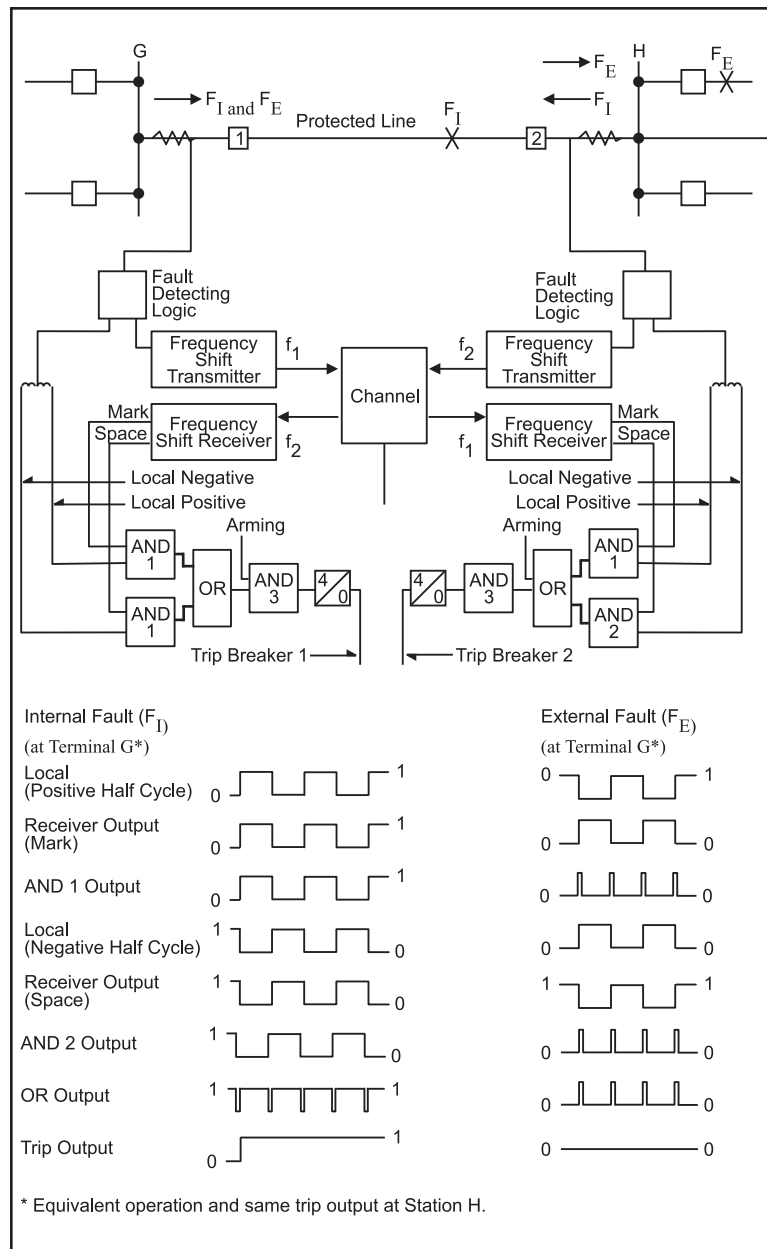
**Figure 3–10. Basic Logic Diagrams for Underreaching Transfer Trip Systems**

the receiver's trip positive output. The other wave, which has positive output during the negative half-cycle of the sequence current network, is compared to the receiver's trip neg. output in a second comparison circuit.

On internal faults, the positive half-cycle of the local square wave lines up with the received trip positive output to provide an AND-1 output. On the negative half-cycle, this local square wave lines up with the received trip negative output to provide an AND-2 output. If an arming signal is received ( $FD_2$  and/or 21P) and either AND-1 or AND-2 output exists for 4ms, an input to the trip flip flop initiates breaker tripping. The same operation occurs at both terminals, tripping breakers 1 and 2 simultaneously on either half-cycle of fault current.

For tripping, both the trip positive and trip negative frequencies must be transmitted through the internal fault via Power-Line Carrier channels. If these frequencies are not received, the receiver detects a loss of channel and clamps both outputs to a continuous positive state. This loss of channel enables both comparison circuits, allowing the system to trip on the local square wave input only. After 150ms, the system output clamps these to the zero state. At this point, the system cannot trip and is locked out. An alarm indicates loss of channel.

For external faults, the reversal of current at one end shifts the square waves essentially 180°. As a result, neither AND-1 nor AND-2 has the sustained output required to operate the 4ms timer. No trip occurs at either line terminal.



**Figure 3-11. Basic Operation of the Dual Phase Comparison Pilot Relaying System**



### 3.5.5 Segregated Phase Comparison System

The Segregated Phase Comparison system has been developed to improve pilot relay protection, particularly for the long EHV series capacitor-compensated transmission lines. Long EHV series capacitor-compensated lines are a source of significant transients during the fault period. Under these circumstances, sequence current networks designed to operate at normal system frequency may present a problem. The experience with these Phase Comparison systems has, however, been remarkably good. Directional Comparison systems, on the other hand, are subject to mis-operation on series capacitor-compensated lines, particularly if the capacitor gaps do not short the capacitors on faults. Segregated phase comparison systems, which are current-only, are independent of the following phenomena:

- Power system frequency and wave form
- Effects of impedance unbalance between the power system phase circuits.
- Maximum load/minimum fault current margin.

The segregated phase comparison system can be divided into two types: a two-subsystem scheme and a three-subsystem scheme. In the two-subsystem scheme, one subsystem operates from delta current ( $I_a-I_b$ ) for all multi-phase faults, and a ground ( $3I_0$ ) current subsystem operates for all ground faults. The three-subsystem scheme has a subsystem for each phase ( $I_a$ ,  $I_b$ , and  $I_c$ ). Each subsystem consists of one channel (UPLC-II™) and one Phase Comparison relay.

Both segregated Phase Comparison systems incorporate “offset keying”, enabling them to trip for internal high-resistance ground faults and internal faults with outfeed at one terminal. No other system can clear these types of faults without extra logic or channels. On a 500 kV line with a 2,000:5 current transformer ratio, for example,

the three-subsystem scheme will operate for ground-fault resistances up to about 100  $\Omega$  primary impedance. Under the same conditions, the two-subsystem scheme will operate up to about 200  $\Omega$  primary fault resistance.

The two-subsystem package is suitable for all applications except single-pole tripping, where the three-subsystem package must be applied. The basic operation of the scheme is illustrated in Figure 3–12. Each current is fed through a noninductive resistor, supplying a voltage output to the squaring amplifier (SA) that is exactly proportional to the primary currents. The output of these amplifiers is used to key the individual channels and, through the local delay timers (LDT), to provide the local square waves for comparison. The timers are adjustable between 2 and 20ms to compensate for the delay time of the channel. This digital delay circuit translates the pulse train independently of the pulse width ratio, in contrast to the ac phase angle shift used in the other systems. The ac phase shift delay uses frequency-dependent components, which are accurate only at system frequency and can “ring” during transient conditions.

The square wave comparison is made independently for each current in the separate subsystems. Separate channels are required for each of the subsystems. One of the comparison circuits is shown in simplified form in Figure 3–13. In this dual comparison circuit, AND-P is used for the positive half-cycles and AND-N for the negative half-cycles. As shown in Figure 3–13, the received positive square wave corresponds to a “1” input to AND-P, and the received negative square wave to a “0” input, negated to “1”, into AND-N. Except for this variation, operation is as shown by the square wave blocks in the lower half of Figure 3–11.

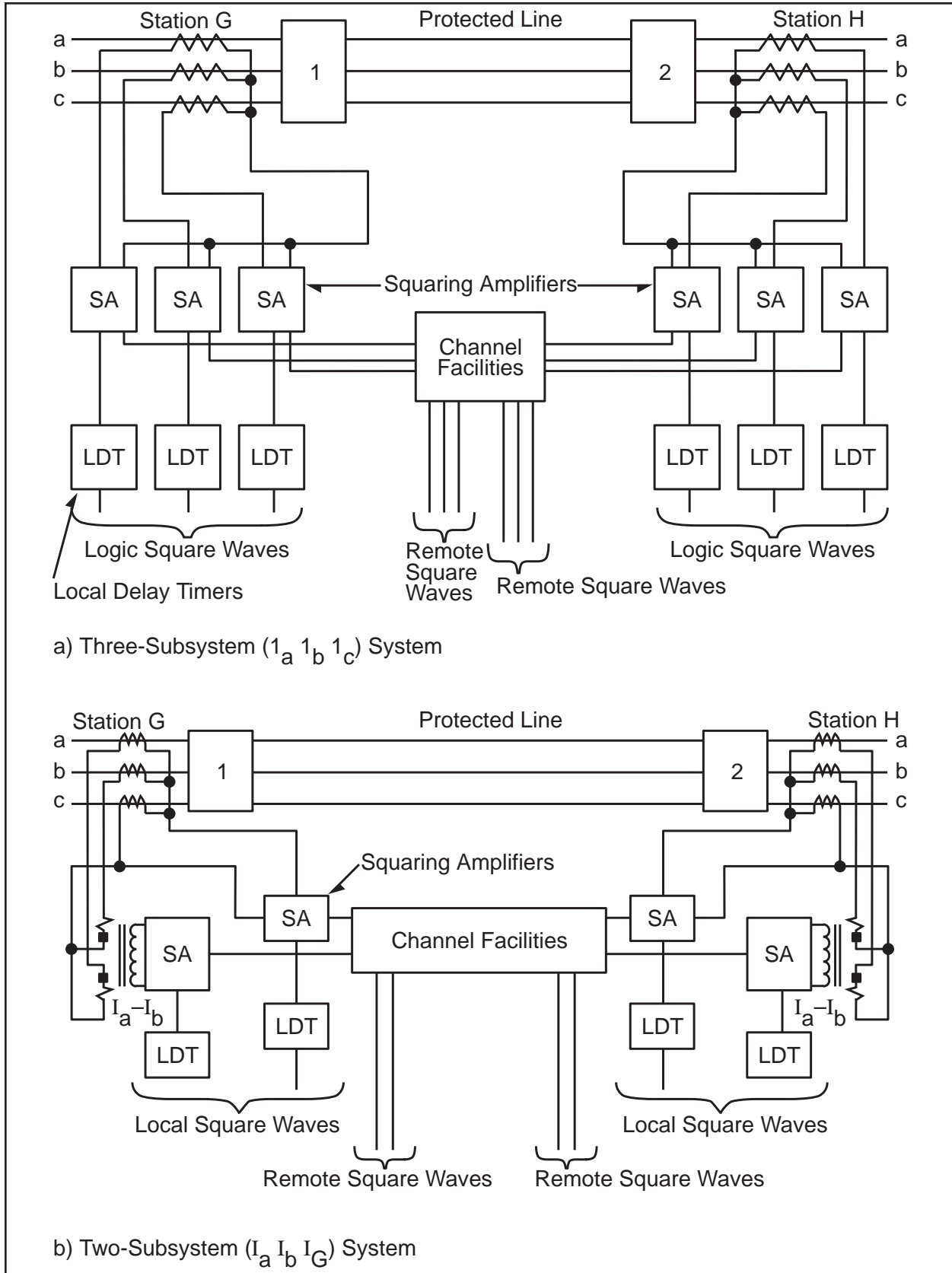


Figure 3-12. Basic Segregated Phase Comparison Systems



To generate the local and keying square waves, conventional phase comparison systems use thresholds equivalent to (or very near) the zero axis. As a result, an internal fault with outfeed looks like an external fault to those systems (see Figure 3–14). The offset keying technique permits the relay system to trip for internal faults with outfeed current out at one terminal. While the outfeed condition is very unusual, it presents difficult problems to the great majority of pilot relaying systems when it does occur. Outfeed can occur in any of the following cases:

- Series-capacitor-compensated parallel lines.
- Weak-feed or zero-feed applications, particularly with heavy through load.
- Some multi-terminal applications.
- Series-compensated (line-end compensation) line with a source inductive reactance smaller than series capacitor reactance.
- Some single-line-to-ground faults, occurring simultaneously with an open conductor, where the fault is on one side of the open conductor.
- Some single-line-to-ground faults with high fault resistance and heavy through load (such conditions can cause outfeed only in the faulted phase current, not in the ground subsystem).

The offset keying technique allows the relay system to work like a true current differential scheme. The scheme takes advantage of the fact that, for the outfeed condition, the current into the line is greater in magnitude than the current out of the line for the internal fault.

This relationship is illustrated in Figure 3–14, where  $I_G$  equals  $I_F$  plus  $I_H$ . While the two terminal

currents may have any angular relationship with one another, most outfeed conditions display a nearly out-of-phase relationship. The out-of-phase condition illustrated is the most difficult case for phase comparison, as well as the most common outfeed condition.

In the offset keying technique, the keying threshold is displaced in the positive direction, away from the zero axis. The local square wave thresholds are displaced negatively. To maintain security, the local thresholds are separated from each other, providing “nesting” during external faults. Typical settings are shown in Figure 3–15.

Figure 3–16 illustrates the square wave characteristics of offset keying for normal internal faults, external faults, and internal faults with outfeed.

The segregated Phase Comparison scheme incorporates a high degree of security. Its design is based on extensive field experience and the model line tests for the very long, series capacitor-compensated EHV lines.

Output trip signals are supervised by an arming input and a number of security checks (see Figure 3–14). Phase arming is performed by a current rate-of-change detector that responds to sudden increases, decreases, or angular shifts in current. It operates on current changes of 0.5 A or more, with an operating time of 2 ms. Ground arming is 3I magnitude—typically 0.8 A secondary.

Security checks to comparison AND (see Figure 3–14) include (1) low channel signal blocking, (2) lockout for sustained low channel signal, (3) channel noise clamp, and (4) receive guard block. For the phase subsystems, a trip signal occurs if comparison AND has an output for more than 3ms (4ms for the ground subsystem).

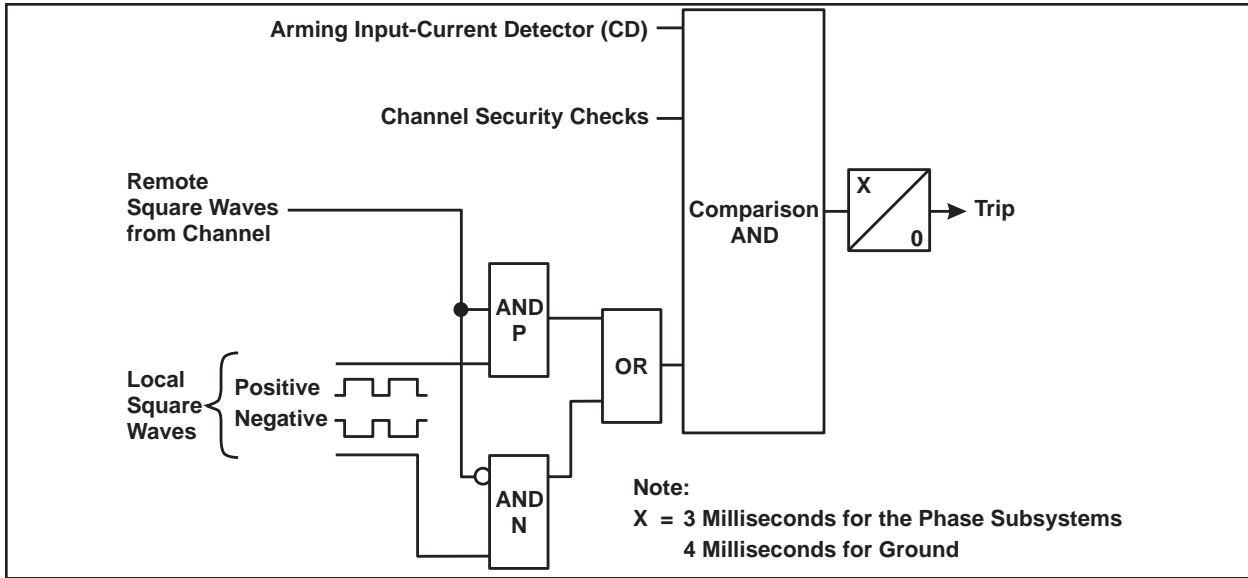


Figure 3-13. Basic Operation of the Segregated Phase Comparison System

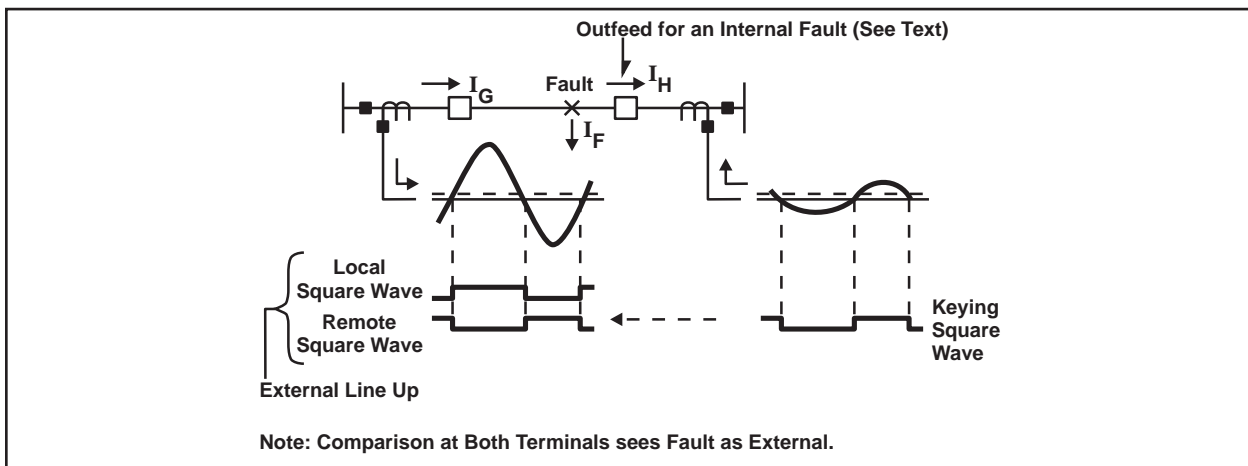


Figure 3-14. Conventional Phase Comparison Response to an Outfeed Condition Block Tripping

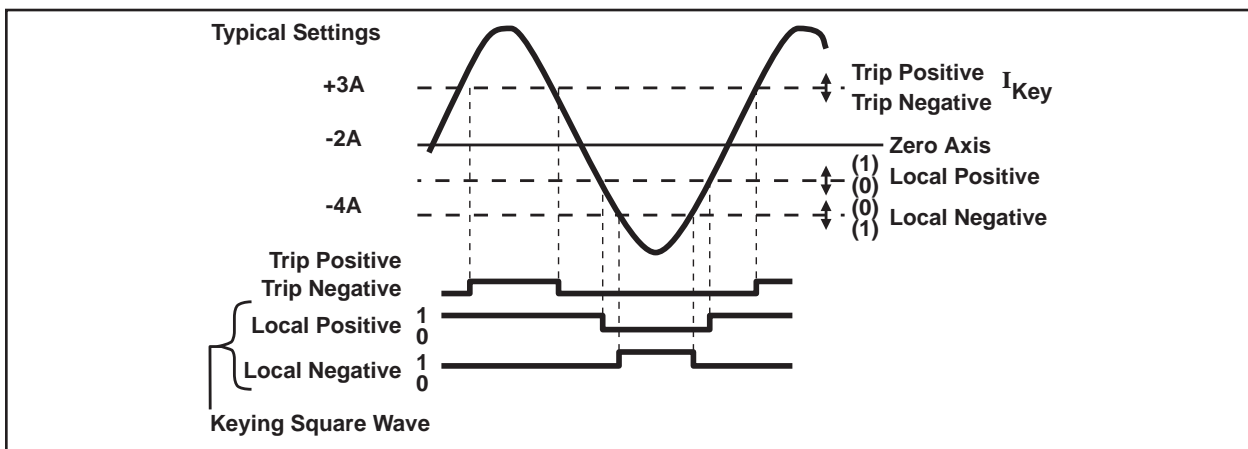
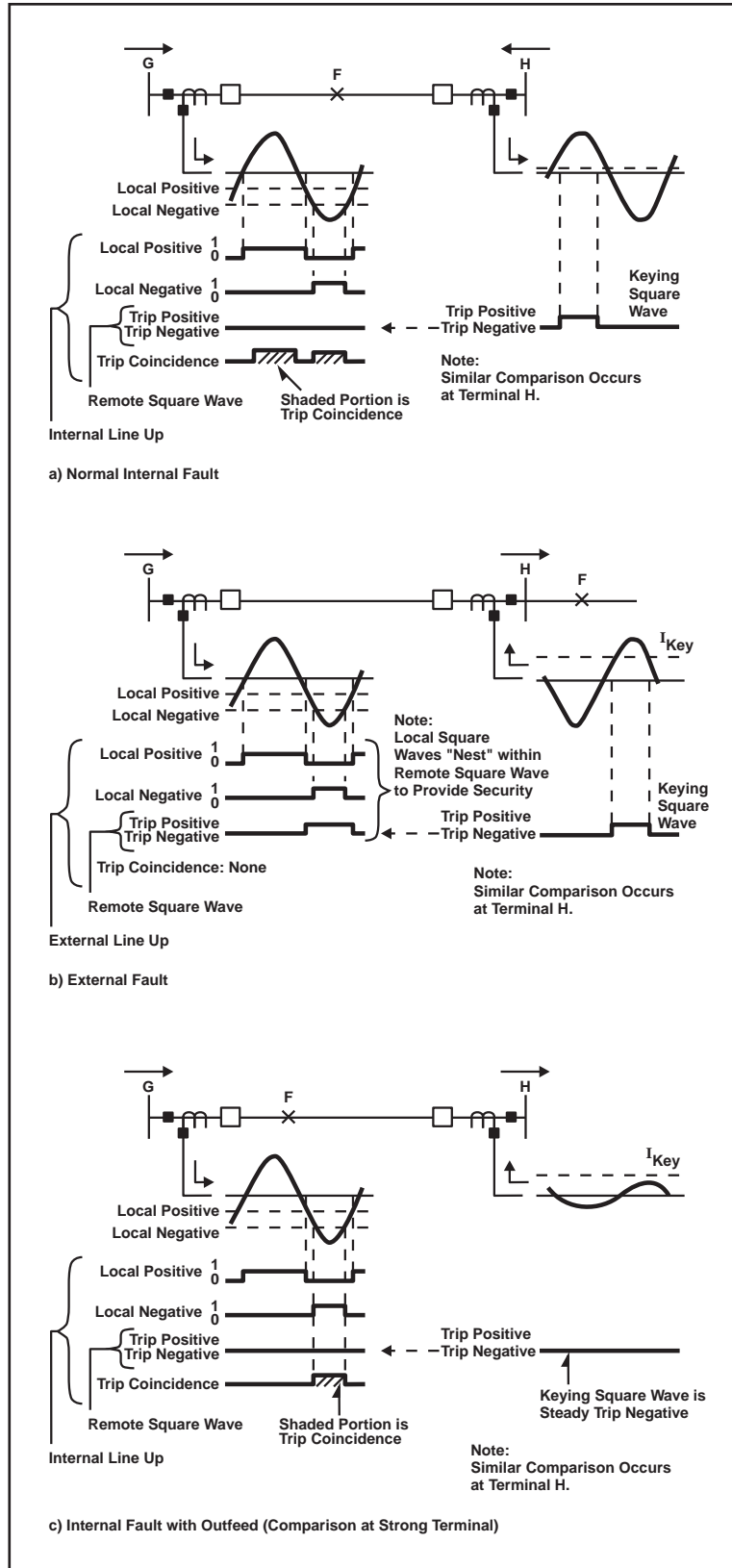


Figure 3-15. Typical Threshold Setting for Offset Keying



**Figure 3-16. Response of Segregated Phase Comparison System with Offset Keying**

### 3.6 FSK Mode Direct Transfer-Trip (DTT) Systems

Direct transfer-trip systems provide circuit-breaker tripping at remote or receiver terminals, without any supervision by fault detectors. The most important consideration in a direct transfer-trip system is the type of channel applied. The communications equipment must carry the total burden of system security and dependability.

Direct transfer-trip systems are applied for:

- Line protection with non-permissive under-reaching transfer-trip systems.
- Transformer protection where there is no circuit breaker between the transformer and transmission line.
- Shunt reactor protection.
- Remote breaker failure protection.

A sample schematic is shown in figure 3-26, near the end of the chapter.

#### 3.6.1 Transformer Protection

A typical transformer protection scheme is illustrated in Figure 3-17. A direct trip channel is keyed to the trip state when the transformer protective relays operate. The received trip signal will then trip the remote end breaker and lock out reclosing.

Although it is no longer widely used, you may use a ground switch operated by the transformer protective relays for transformer protection. In this technique, a ground fault is initiated on the transmission line at G, providing adequate fault current for the ground relays at H to

trip the breaker at H. This system is slower but is widely used on lower voltage systems and is fairly simple and straightforward. It does not require any secure communication medium between G and H. For this type of application, the ground relays at H can be set to operate for 100 percent of the line and not overreach to bus G.

While a single switch on one phase is normally applied, you may use a double switch on two phases to initiate a double-phase-to-ground fault. In the latter case, both phase and ground relays can operate to ensure redundancy. Fault grounding is not applicable to all systems because of high short-circuit capacity.

#### 3.6.2 Shunt Reactor Protection

Shunt reactors are frequently used on HV and EHV lines. These line reactors are connected on the line side of the circuit breakers (Fig. 3-18). A remote trip channel is thus required for a fault in the shunt reactor.

#### 3.6.3 Remote Breaker-Failure Protection

A remote breaker-failure system is necessary where a multi-breaker bus, such as a breaker-and-a-half or ring bus scheme, is applied at a transmission line terminal. A direct transfer-trip system will be a part of the remote breaker-failure protection.

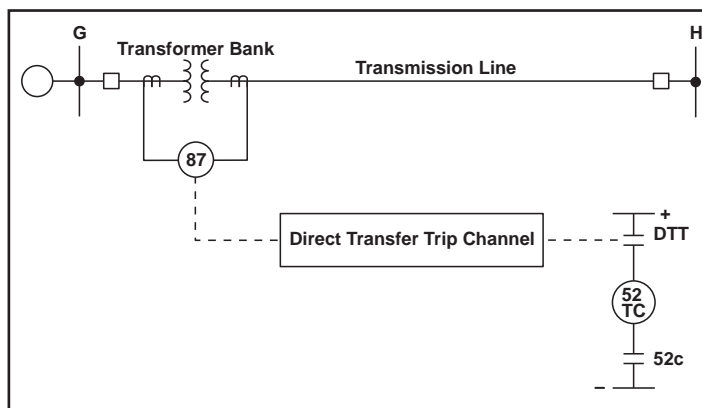


Figure 3-17. Direct Transfer Trip for Transformer Protection

### 3.6.4 Direct Transfer Trip Channel Considerations

The channel and its terminal equipment are major factors in the proper operation of the direct transfer-trip system. The DTT channel must neither fail to provide a correct trip signal nor provide a false signal.

While other types of modulation are possible, FSK equipment offers the best compromise between noise rejection capability and equipment complexity. Two frequencies are usually transmitted in an FSK system: the “guard” frequency is transmitted during non-trip conditions and the “trip” frequency is transmitted when a breaker trip is required. Because a signal is always present, the FSK system will allow the channel to be continuously monitored. Continuous channel monitoring is necessary in a direct trip system, because breaker tripping is not supervised by any local relays.

As noise in the channel increases, a point is reached where there is a high probability of false tripping. The level of noise at which the channel becomes unreliable must be determined by tests. Signal-to-noise ratio monitors must then be included with any direct trip channel, to block possible false tripping. It is important, however, not to get the noise monitors any more sensitive than required, since their operation will prevent tripping.

There are three important aspects to the application of FSK channels to direct trip systems: channel bandwidth, dual channel systems, and channel protection.

Although faults should be cleared in the shortest possible time, speed is not the only criterion for selecting equipment. *It is important to use the narrowest bandwidth equipment possible.* A wide bandwidth channel may give the desired speed, but more noise enters the system. Thus, the channel will block tripping sooner than a narrower bandwidth channel with the same received signal level. A wideband channel will consequently not be as dependable as a narrower channel under equal receive-level conditions.

A dual channel system is recommended for direct trip applications. Two FSK channels should be used in series, so that both must trip before the breaker is tripped. Many tests have indicated that dual channels improve the security of the direct trip system by several orders of magnitude. Use of a dual channel system has very little effect on dependability, even if both channels are on the same transmission medium.

If you want to increase the dependability, you can modify the dual channel transfer trip scheme to allow a single channel trip when there is failure of the other channel. A typical Dual Channel Throwover to Single Channel Scheme is illustrated in Figures 3–19 & 3–20.

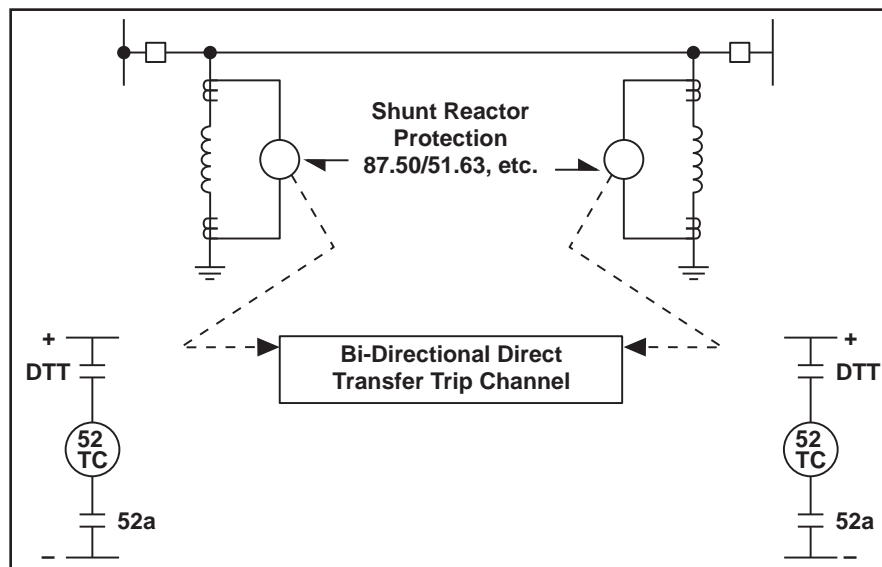
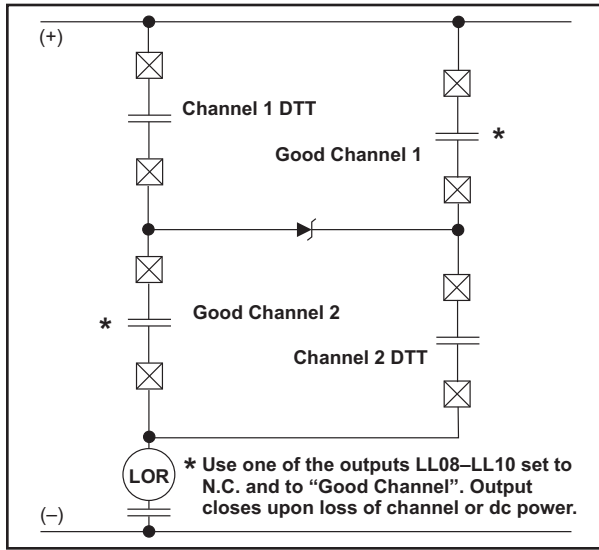
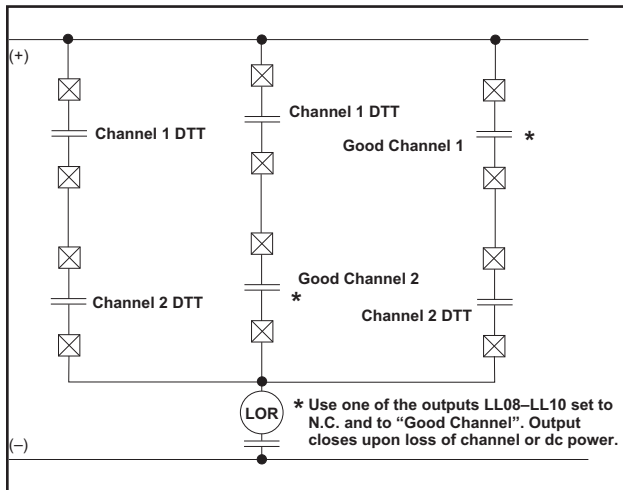


Figure 3–18. Direct Transfer Trip for Shunt Reactor Protection



**Figure 3-19.**  
**Dual Channel Direct Transfer Trip with Throwover to Single Channel**



**Figure 3-20.**  
**Dual Channel Direct Transfer Trip with Throwover to Single Channel**

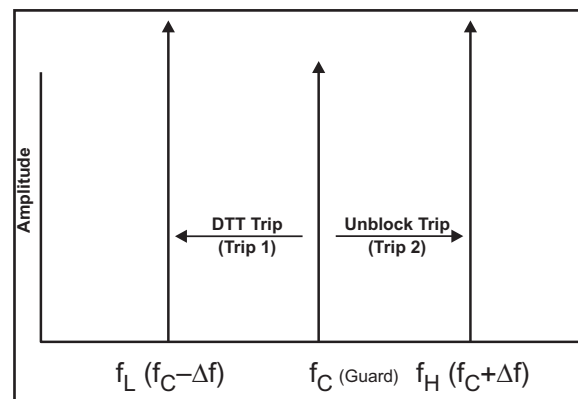
### 3.7 FSK Mode Special Considerations

The UPLC-II™ frequency-shift equipment can operate in either the two- or three-frequency mode. The three basic frequencies are as follows (see Figure 3-21):

- $f_C$  Center frequency
- $f_H$  High-frequency, is a frequency shift ( $\Delta f$ ) above  $f_C$
- $f_L$  Low-frequency, is a frequency shift ( $\Delta f$ ) below  $f_C$

The value of  $\Delta f$  depends on the bandwidth of the UPLC-II™ set. For a bandwidth of 1200 Hz,  $\Delta f$  is 500 Hz. A bandwidth of 300 Hz yields a  $\Delta f$  of 100 Hz, while the 600 Hz bandwidth  $\Delta f$  can be either 250 or 100 Hz. The center channel frequency ( $f_C$ ) can vary from 30 to 535 kHz (in .01 kHz steps).

In the two-frequency systems, only  $f_H$  and  $f_L$  are used. The two frequencies function differently and take on different labels when operating with the different types of protective relay systems.



**Figure 3-21. UPLC-II™ 3-Frequency System**

### 3.7.1 3-Freq. Systems

The UPLC-II™ also provides for three-frequency system applications (Fig. 3–21), e.g., Directional Comparison Unblocking with Direct Transfer Trip, or Permissive Overreaching Transfer Trip with Direct Transfer Trip. All three frequencies are closely-controlled discrete frequencies within the equivalent spacing of a single wideband or extra wideband channel. In applying a three-frequency system, the Direct Transfer Trip keying inputs shifts the channel low (i.e., –250 Hz for 600 Hz bandwidth) and the unblock key shifts the channel high (i.e., +250 Hz for 600 Hz bandwidth).

See figure 3-27, near the end of this chapter, for a sample schematic.

### 3.7.2 4-Freq. Systems

The UPLC-II™ can be purchased with the option of setting it for a four-frequency system (Fig. 3–22). The purpose is to use one PLC channel to perform two independent trips. It is similar to the three-frequency system but is able to key two relaying inputs simultaneously, where as with the three-frequency system, if both inputs are keyed simultaneously, only the DTT frequency is output.

Four frequencies are utilized within either a 600Hz bandwidth or a 1200Hz bandwidth system. For frequencies, refer to the specifications in chap. 2.

Bandwidth/Shift can be 600Hz, +/- 250Hz or 1,200Hz +/- 500Hz. The receiver is able to discriminate between these four frequencies and provide the necessary input to the logic portion.

The logic is two sets of the full unblock logic. This allows you to select either command function, DTT or Unblock. Should both inputs be keyed simultaneously, the frequency that is sent will engage both Trip A and Trip B outputs.

The trip test feature is not available in the four-frequency system.

### 3.7.3 Directional Comparison Unblocking (2-Frequency)

The higher frequency ( $f_H$ ), or “Guard” frequency, is transmitted continually as a blocking-type signal during normal conditions, to indicate that the channel is operative and to prevent remote relay tripping when external faults occur.

For a fault sensed by the local overreaching pilot relay, the transmitter is frequency-shifted to a low frequency ( $f_L$ ), called “Unblock” frequency. The transmitted power is normally 1 W, boosted to 10 W for the “Unblock” operation.

The Directional Comparison Unblocking system will generally use the wide band, wide shift (600 Hz BW, ±250 Hz Shift) UPLC-II™ setting. Also, the most common power output level used will be the 1 watt block and 10 watt trip. The type of carrier applied with this scheme may be varied from the normal for special circumstances, e.g., when matching the new UPLC-II™ equipment at one end of the line with the older TCF, TCF-10, TCF-10A or TCF-10B equipment at the other end. In this case, you must apply the wide band, narrow shift carrier (600 Hz BW, ±100 Hz Shift) to match the older carrier characteristics.

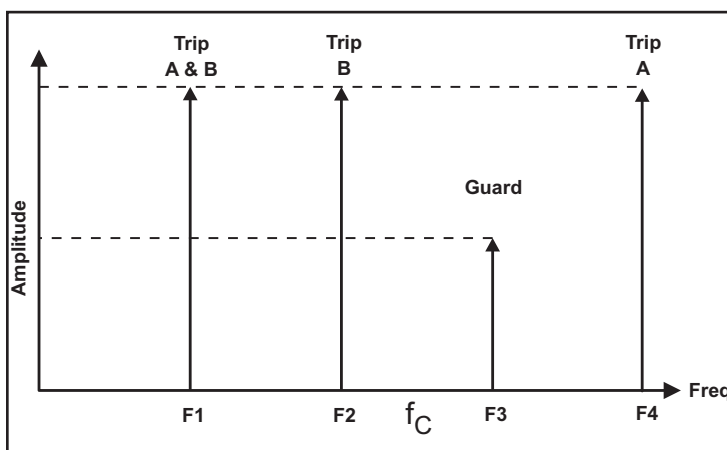


Figure 3–22. UPLC-II™ 4-Frequency System



### 3.7.4 Transfer Trip: Overreaching, Underreaching or Direct (2-Frequency)

The higher frequency ( $f_H$ ), or “Guard” frequency, is transmitted continually during normal conditions. For a fault sensed by the overreaching (or underreaching) pilot relay, the transmitter is shifted to the low frequency ( $f_L$ ), called “Trip” frequency.

When using the UPLC-II™ or any permissive overreaching or underreaching line relay system, you can apply any bandwidth setting. However, the best all around setting to use will be the wide band, wide shift (600 Hz BW, **±250 Hz** Shift) equipment. If frequency spacing between other Power-Line Carrier units is not an issue and relay speed is critical, you may apply the extra wide band (1200 Hz, **±500 Hz** Shift) equipment. Security against noise causing a false trip is also increased some with the extra-wide band, but increasing RX pre-trip delay has the largest improvement on security. In any of these systems, the usual power level combination will be 1 W for guard and 10 W for the trip signal.

### 3.7.5 Phase Comparison Unblocking: Dual or Segregated (2-Frequency)

Phase Comparison relays use square wave signals for operation. The transmitter is keyed to a “Trip Positive” frequency when the relay square wave goes positive, and is keyed to a “Trip-Negative” frequency when the relay square wave is at zero. The Trip Positive frequency is frequency-shifted below  $f_C$ ; the “Trip Negative” frequency is frequency-shifted above  $f_C$ . Either frequency can function as a trip or block, depending on the local square wave.

For Phase Comparison systems, you can use only the wide band with wide shift or extra wide band UPLC-II™. In the interest of conserving spectrum, the wide band, wide shift channel is most common. However, if speed is important, you may apply the extra wide band set. The most often

applied power level will be 10 watts for both “Trip-Positive” and “Trip-Negative”.

### 3.7.6 Three-Terminal Line Applications

When a three terminal line protection requires Power-Line Carrier equipment, each terminal must have one transmitter and 2 receivers, since each terminal must receive a signal from each of the 2 other ends of the line. Fig. 3–24 is a representation of the transmitter/receiver complement required to implement a single function. Hybrids or other isolation devices are required between transmitters and transmitters to receivers. See the hybrid section, at the end of the chapter, for details.

### 3.7.7 External Booster Amplifier

When using an external booster 50 W or 100 W amplifier, for high attenuation power-line applications, make sure the UPLC-II™ backplane 2-wire/4-wire jumper is set for 4-wire. *This is critical to avoid causing damage to the amplifier.* Normally a skewed hybrid is used to combine the booster amplifier’s TX output and the UPLC-II™ RX input onto a common coax. The transmit output power of the UPLC-II™ will need to be set lower than normal depending on the particular external amplifier used.

### 3.7.8 Unidirectional DTT Receiver-Only Application

When there is only one or more UPLC-II™ receiver-only chassis and nothing else connected directly to a line tuner, then a 50Ω load should be added at the receiver’s input using a BNC coax T-connector as shown. This is because the UPLC-II™ receiver is high impedance as compared to its transmitter which is 50Ω. So to terminate the line tuner properly, a single 50Ω load should be bridged across the receiver’s input. This also applies to a 2-frequency line tuner where one of the tuner’s inputs goes only to receivers. However, this does not apply to bi-directional applications where a skewed hybrid is used to separate the TX & RX. That is because the skewed hybrid has a built-in 50Ω termination across its RX port that



serves as this 50Ω load. We recommend a 50Ω 10W or higher wattage load be used. A couple of possible 50Ω load manufacturer’s part numbers include Opek #DL-60 and DX Engineering #DL30A. Additionally a UHF-female to BNC-female adapter is needed for connecting the 50Ω load to the T-connector.

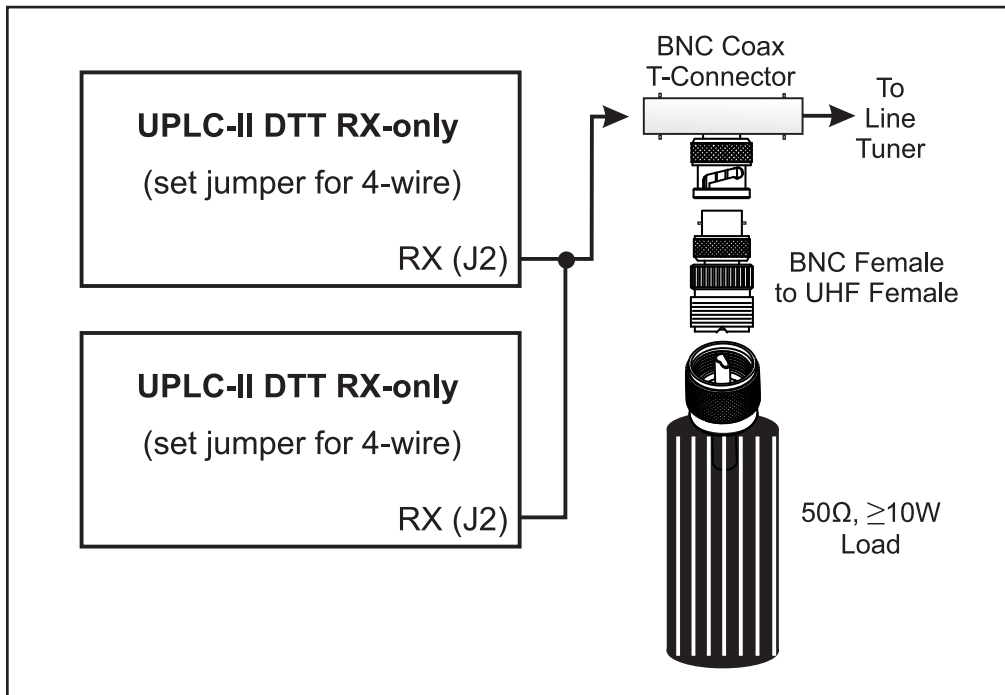


Figure 3–23. Unidirectional DTT Receiver-Only Application

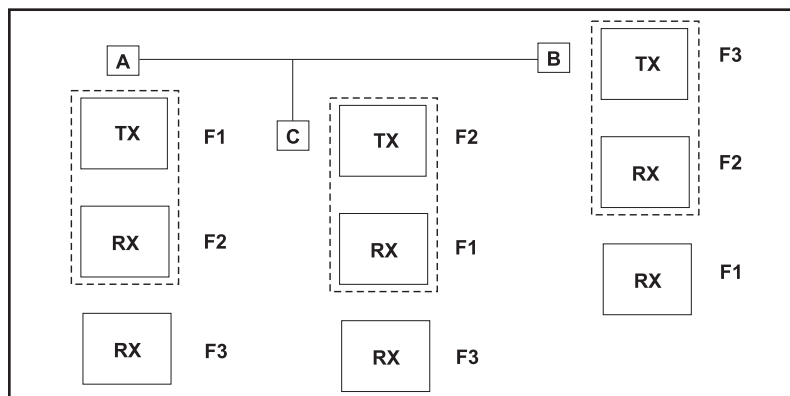


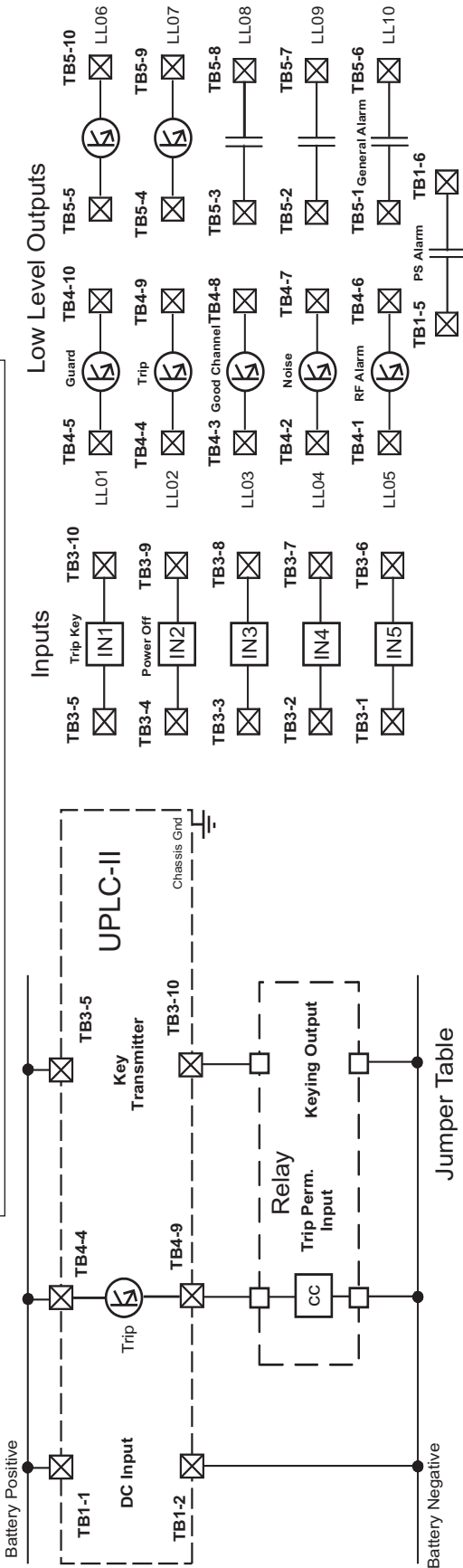
Figure 3–24. FSK Three Terminal Line Application

### 3.8 FSK Mode Typical Wiring/Connections

Common wiring/connection diagrams for FSK applications can be found on the following pages.

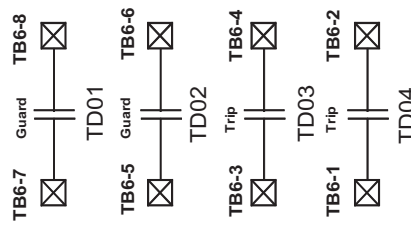


Figure 3-25. FSK Mode, 2-Frequency, Unblock - Connections/Settings



Module	Function	Software Selection	Hardware Selection	Label	Recommendation
Backplane	Coax Setting		2 wire/4 wire	JMP3/JMP5	4 wire
	# of PAs		1 PA/2PA	JMP2/6/7	Per factory
	Coax Impedance		50/75 ohms	JMP1/JMP4	50 ohms*
Power Supply	Power		PwrOn/PwrOff	JMP3	PwrOn
	Alarm Contact		NO/NC	JMP1/JMP2	Per engineering
Input/Output	Input 1		15/48/125/250 Vdc	Input 1	Station Battery
	Input 2		15/48/125/250 Vdc	Input 2	Per engineering
	Input 3		15/48/125/250 Vdc	Input 3	Per engineering
	Input 4		15/48/125/250 Vdc	Input 4	Per engineering
	Input 5		15/48/125/250 Vdc	Input 5	Per engineering
LL Output 1	Guard		0.1/1.0 A	LL01	Per engineering
LL Output 2	Trip		0.1/1.0 A	LL02	0.1A
LL Output 3	Good Channel		0.1/1.0 A	LL03	Per engineering
LL Output 4	Noise		0.1/1.0 A	LL04	Per engineering
LL Output 5	RF Alarm		0.1/1.0 A	LL05	Per engineering
LL Output 6			0.1/1.0 A	LL06	Per engineering
LL Output 7			0.1/1.0 A	LL07	Per engineering
LL Output 8			NO/NC	LL08	Per engineering
LL Output 9			NO/NC	LL09	Per engineering
LL Output 10	General Alarm		NO/NC	LL10	Per engineering
TD Output 1	Guard		NO/NC	TD01	Per engineering
TD Output 2	Guard		NO/NC	TD02	NO
TD Output 3	Trip		NO/NC	TD03	Per engineering
TD Output 4	Trip		NO/NC	TD04	Per engineering

Trip Duty Outputs



Note: All contacts are link selectable for normally open or closed.

- UPLC Terminals
- Relay Terminals

\* Or per engineering's recommendation

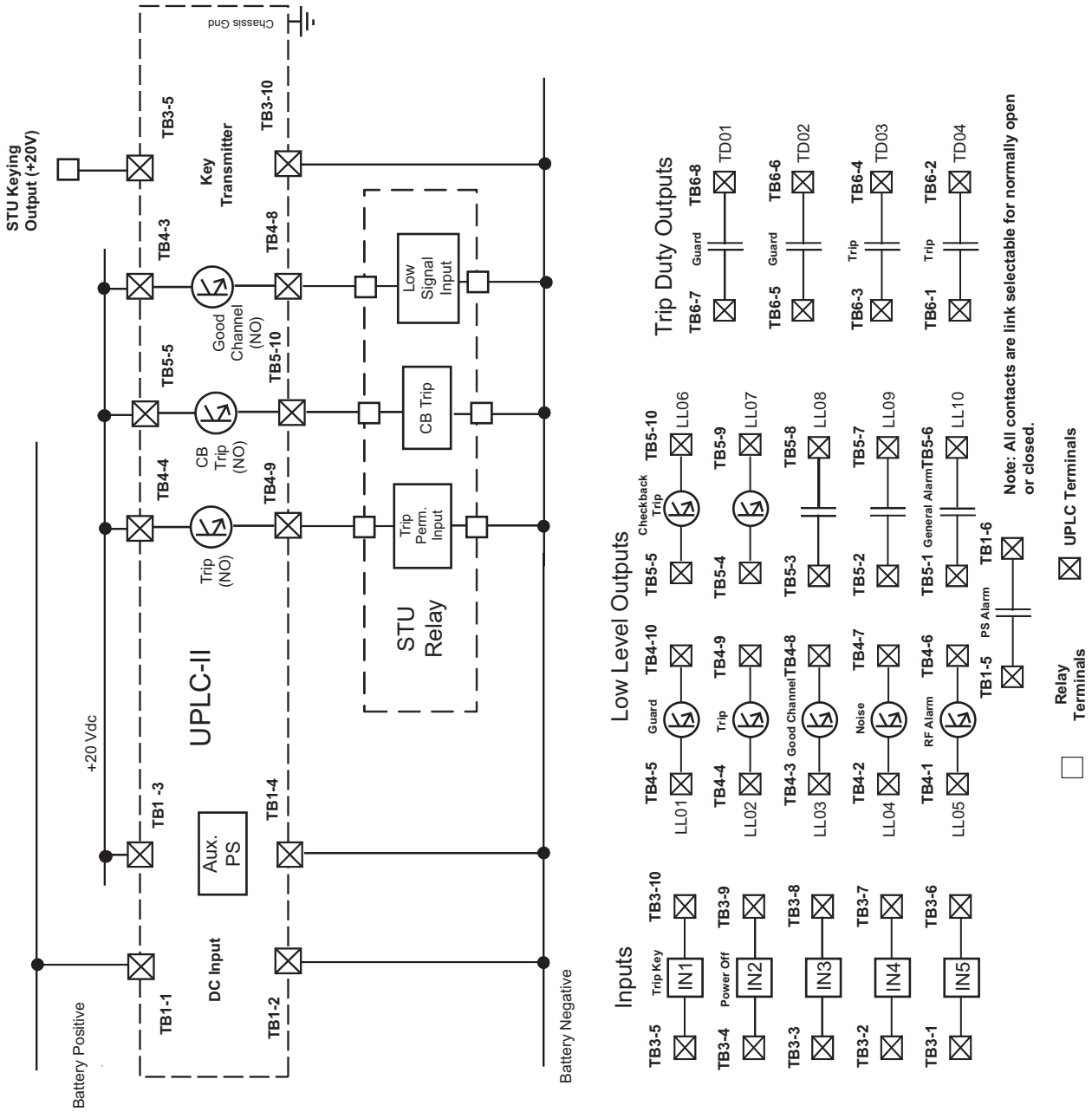


Figure 3-26a. FSK Mode, 2-Frequency, Unblock with STU Relay System - Connections

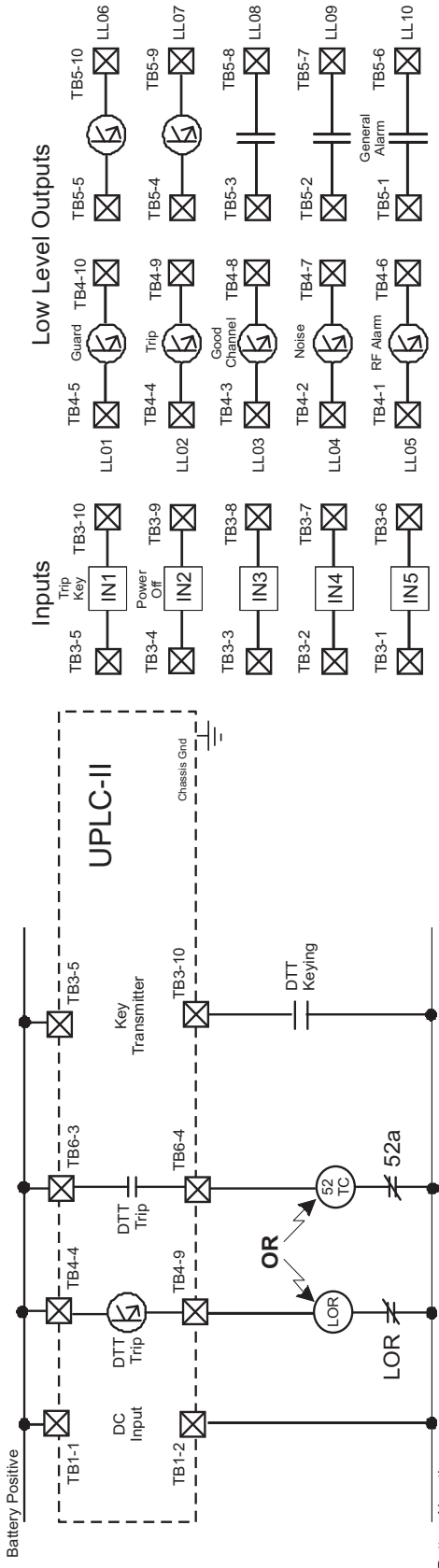
**Figure 3–26b. FSK Mode, 2-Frequency, Unblock with STU Relay System - Settings**

Programming / Jumper Table

Module	Function	Software Selection	Hardware Selection	Label	Recommendation
Backplane	Coax Setting		2 wire/4 wire	JMP3/JMP5	4 wire
	# of PAs		1 PA/2PA	JMP2/6/7	Per factory
	Coax Impedance		50 Ω/75 Ω	JMP1/JMP4	50 Ω *
Power Supply	Power		PwrOn/PwrOff	JMP3	PwrOn
	Alarm Contact		NO/NC	JMP1/JMP2	Per Engineering
Aux PS				JMP1/JMP2	46/20V
				JMP3	20V
<b>Input/Output</b>					
Input 1	Trip Key	Application of Voltage	15/48/125/250 Vdc	Input 1	15V
Input 2	Power Off	Removal of Voltage	15/48/125/250 Vdc	Input 2	Per Engineering
Input 3			15/48/125/250 Vdc	Input 3	Per Engineering
Input 4			15/48/125/250 Vdc	Input 4	Per Engineering
Input 5			15/48/125/250 Vdc	Input 5	Per Engineering
LL Output 1	Guard		0.1/1.0A	LL01	Per Engineering
LL Output 2	Trip	NO	0.1/1.0A	LL02	0.1 A
LL Output 3	Good Channel	NO	0.1/1.0A	LL03	0.1 A
LL Output 4	Noise		0.1/1.0A	LL04	Per Engineering
LL Output 5	RF Alarm		0.1/1.0A	LL05	Per Engineering
LL Output 6	Checkback Trip	NO	0.1/1.0A	LL06	0.1 A
LL Output 7			0.1/1.0A	LL07	Per Engineering
LL Output 8			NO/NC	LL08	Per Engineering
LL Output 9			NO/NC	LL09	Per Engineering
LL Output 10	General Alarm		NO/NC	LL10	Per Engineering
TD Output 1	Guard		NO/NC	TD01	Per Engineering
TD Output 2	Guard		NO/NC	TD02	Per Engineering
TD Output 3	Trip		NO/NC	TD03	Per Engineering
TD Output 4	Trip		NO/NC	TD04	Per Engineering

\* Or per engineering's recommendation

Note: UPLC-II™ programmed for 2F-Unblock Standard Configuration. If used opposite a TCF/TCF-10/TCF-10A, the transmitter and receiver shift needs to be 100 Hz.



**Low Level Outputs**

**Inputs**

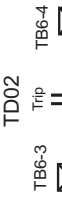
**Jumper Table**

Module	Function	Software Selection	Hardware Selection	Label	Recommendation
Backplane	Coax Setting	2 wire/4 wire	JMP3/JMP5		4 wire
	# of PAs	1 PA/2PA	JMP2/6/7		Per factory
Power Supply	Coax Impedance	50/75 ohms	JMP1/JMP4		50 ohms*
	Power	PwrOn/PwrOff	JMP3		PwrOn
Input/Output	Alarm Contact	NO/NC	JMP1/JMP2		Per engineering
	Trip key	Application of Voltage	Input 1		Station Battery
Input 1	Power Off	Application of Voltage	Input 2		Per engineering
	Input 3	Application of Voltage	Input 3		Per engineering
	Input 4	Application of Voltage	Input 4		Per engineering
	Input 5	Application of Voltage	Input 5		Per engineering
	LL Output 1	Guard	0.1/1.0 A	LL01	
LL Output 2	Trip	0.1/1.0 A	LL02		1.0A
	Good Channel	0.1/1.0 A	LL03		Per engineering
	Noise	0.1/1.0 A	LL04		Per engineering
	RF Alarm	0.1/1.0 A	LL05		Per engineering
LL Output 6	LL Output 7	0.1/1.0 A	LL06		Per engineering
	LL Output 8	0.1/1.0 A	LL07		Per engineering
	LL Output 9	NO/NC	LL08		Per engineering
	LL Output 10	NO/NC	LL09		Per engineering
TD Output 1	General Alarm	NO/NC	TD01		Per engineering
	Guard	NO/NC	TD02		Per engineering
	Guard	NO/NC	TD03		Per engineering
	Trip	NO/NC	TD04		NO
TD Output 4	Trip	NO/NC	TD04		Per engineering

\* Or per engineering's recommendation



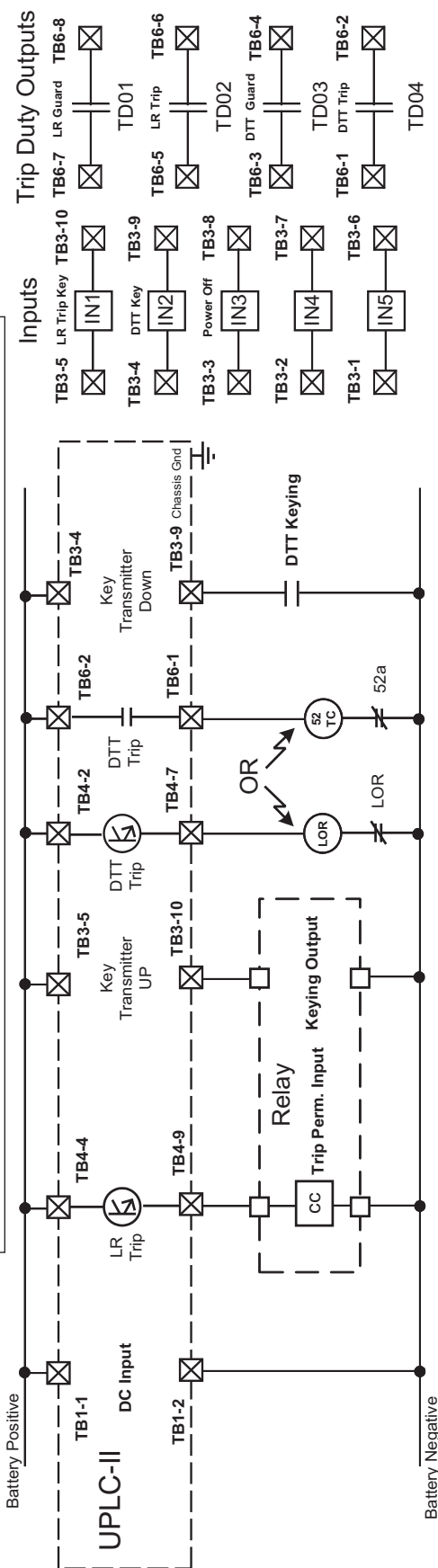
**Trip Duty Outputs**



Note: All contacts are link selectable for normally open or closed.

Figure 3-27. FSK Mode, 2-Frequency, DTT (Single Channel Transceiver) - Connections/Settings

Figure 3-28. FSK Mode, 3-Frequency, (Unblock & DTT) - Connections/Settings



Jumper Table

Module	Function	Software Selection	Hardware Selection	Label	Recommendation
Backplane	Coax Setting	JMP3/JMP5	2 wire/4 wire	JMP3/JMP5	4 wire
	# of PAs	JMP2/6/7	1 PA/2PA	JMP2/6/7	Per factory
Power Supply	Coax Impedance	JMP1/JMP4	50 Ω/75 Ω	JMP1/JMP4	50 Ω *
	Power	JMP3	PwrOn/PwrOff	JMP3	PwrOn
Alarm Contact	Alarm Contact	JMP1/JMP2	NO/NC	JMP1/JMP2	Per engineering
	Input/Output				Station Battery
Input 1	LR Trip key		Application of Voltage	Input 1	Per engineering
Input 2	DTT Key		Application of Voltage	Input 2	Per engineering
Input 3	Power Off		Application of Voltage	Input 3	Per engineering
Input 4			Application of Voltage	Input 4	Per engineering
Input 5			Application of Voltage	Input 5	Per engineering
LL Output 1	LR Guard	TB4-5 + 10	0.1/1.0 A	LL01	Per engineering
LL Output 2	LR Trip	TB4-4 + 9	0.1/1.0 A	LL02	0.1 A
LL Output 3	DTT Guard	TB4-3 + 8	0.1/1.0 A	LL03	Per engineering
LL Output 4	DTT Trip	TB4-2 + 7	0.1/1.0 A	LL04	1.0 A
LL Output 5	Good Channel	TB4-1 + 6	0.1/1.0 A	LL05	Per engineering
LL Output 6	Noise	TB5-5 + 10	0.1/1.0 A	LL06	Per engineering
LL Output 7	TX Shift High	TB5-4 + 9	0.1/1.0 A	LL07	Per engineering
LL Output 8	TX Shift Lo	TB5-3 + 8	NO/NC	LL08	Per engineering
LL Output 9	RF Alarm	TB5-2 + 7	NO/NC	LL09	Per engineering
LL Output 10	General Alarm	TB5-1 + 6	NO/NC	LL10	Per engineering
TD Output 1	LR Guard	TB6-7 + 8	NO/NC	TD01	NO
TD Output 2	LR Trip	TB6-5 + 6	NO/NC	TD02	NO
TD Output 3	DTT Guard	TB6-3 + 4	NO/NC	TD03	NO
TD Output 4	DTT Trip	TB6-1 + 2	NO/NC	TD04	NO

\* Or per engineering's recommendation

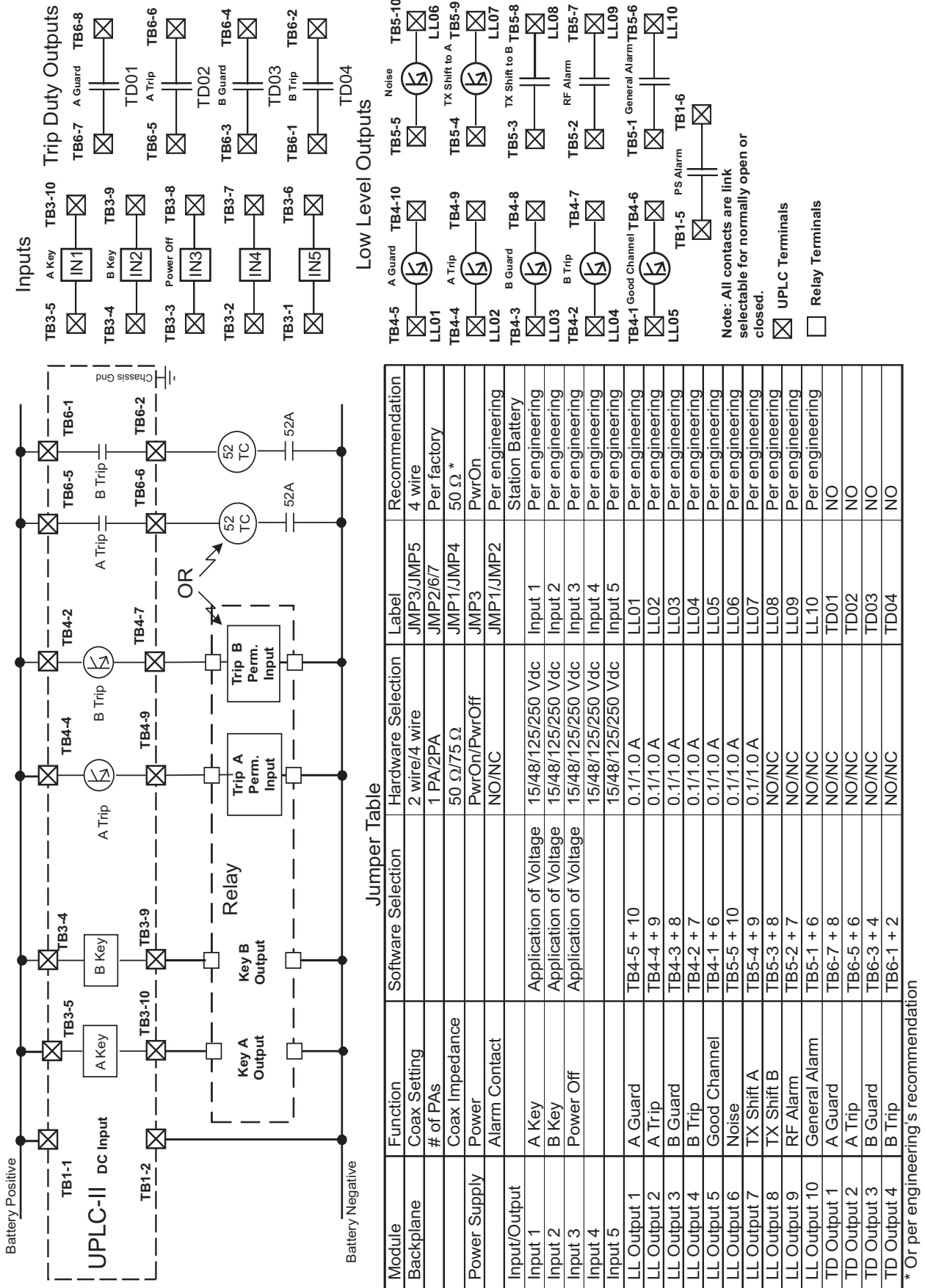


Figure 3-29. FSK Mode, 4-Frequency, (Unblock & DTT) - Connections/Settings



### 3.9 FSK Mode Alarms

The following tables show alarms for FSK mode.

**Table 3–6.**  
**Hardware Fixed Alarm (from Power Supply Board)**  
**All Modes**

Hardware Failure Alarm for All UPLC-II™ Units		
<b>Alarm Reason:</b>	One of the PS outputs is too low in voltage	
<b>Alarm Name: (Available Outputs)</b>	Power Supply Alarm Output (TB1-5 & 6)**	
	De-Energized State	
<b>Contact Type:</b>	<b>N.O. Contact</b>	<b>N.C. Contact</b>
<b>UPLC-II™ Condition</b>		
PS Good	Closed	Open
PS Bad	Open	Closed
**For the Redundant Power Supply, use TB2-5 & 6		

**Table 3–7.**  
**Software Programmable Alarms/(Outputs from I/O Board)**  
**FSK Mode**

Hardware Failure Alarm for All UPLC-II™ Units		
<b>Alarm Reason:</b>	Hardware health of at least one card is bad	
<b>Alarm Name: (Available Outputs)</b>	General Alarm Output (LL08 – LL10)	
	De-Energized State	
<b>Contact Type:</b>	<b>N.O. Contact</b>	<b>N.C. Contact</b>
<b>UPLC-II™ Condition</b>		
All OK	Closed	Open
Hardware Failure	Open	Closed
Loss of DC Power	Open	Closed

**Table 3–7 Continued:**  
**Software Programmable Alarms/(Outputs from I/O Board)**  
**FSK Mode**

Transmit Alarm for FSK Units Only		
<b>Alarm Reason:</b>	TX signal level is $\geq$ TX low level setting	
<b>Alarm Name: (Available Outputs)</b>	Main RF Output (LL01 – LL10)	
	De-Energized State	
<b>Output Type:</b>	N.O. Output	N.C. Output
<b>UPLC-II™ Condition</b>		
Transmit ON	Closed	Open
Transmit OFF	Open	Closed

Receive Alarms for FSK Units Only				
<b>Alarm Reason:</b>	Early Warning alarm, RX signal level has dropped below settable Fade Alarm threshold		Receiver stopped working, RX signal has dropped below Fade Margin or RX Freq. too far off	
<b>Alarm Name: (Available Outputs)</b>	Fade Alarm Output (LL01 – LL10)		Good Channel Output (LL01 – LL10)	
	De-Energized State		De-Energized State	
<b>Output Type:</b>	N.O. Output	N.C. Output	N.O. Output	N.C. Output
<b>UPLC-II™ Condition</b>				
RX Signal Normal	Open	Closed	Closed	Open
RX Signal Low	Closed	Open	Open	Closed
Loss of DC Power	Open	Closed	Open	Closed

*\* Fade alarm is not fail-safe and has a different state for the alarm condition vs loss of DC power. Also Good Channel output must be used on outputs LL08-LL10 in order to be fail-safe as shown in this table.*

**Table 3–8. Hybrid Options**

Description	2-RU Type (Old Style)		1-RU Type (New Style)	
	Type	Part No.	Type	Part No.
Balanced Resistive Hybrid	H1RB	6266D72G05	Balanced	CH20-BALMN-001
Balanced Resistive Hybrid (40W)	H1RB-40	6266D72G07		
Skewed Hybrid (50Ω) with terminating resistor	H1SB-R	1609C45G03	Skewed	CH20-SKWMN-001
Balanced Reactance Hybrid	H3XB	6266D71G03	Not available as 1-RU	
19" panel for mounting 3 Hybrids	2-RU	670B695H01		
19" Chassis for Mounting 4 Hybrids			1-RU	1088-780

*For more details, please refer to the Hybrids System manual.*

### 3.10 Hybrid Applications

The table shows the type of Hybrids and their associated part numbers. The purpose of the hybrid is to enable the connection of two or more transmitters together on one coaxial cable without causing intermodulation distortion due to the signal from one transmitter affecting the output stages of the other transmitter. Hybrids are also required between transmitters and receivers, depending on the application. The hybrid circuits can, of course, cause large losses in the carrier path and must be used appropriately. High/low-pass and band-pass networks may also be used, in some applications, to isolate carrier equipment from each other. A summary of some of the more important application rules are given below:

1. All Ametek/Pulsar ON/OFF Carrier systems are designed to have their TX & RX bridged directly together in 2-wire mode without hybrids.
2. A Balanced Hybrid should always be used if combining 2 Transmitters. Never use a Skewed hybrid for this application.
3. A Skewed Hybrid will give 3 dB less TX loss and thus a 3 dB improvement in signal to noise ratio so it is the recommended hybrid for combining a FSK carrier set TX & RX together.
4. Hybrids should be arranged with the lesser losses in the transmitter path and the greater

losses in the receiver path to provide more transmitter signal levels onto the power line.

5. ON/OFF DCB Carrier systems should be arranged with less losses than FSK systems when combining together with hybrids where possible, as they need higher signal/noise ratios than FSK systems.
6. If possible, transmitters used for common applications should be arranged for equal attenuation. For example, it is ideal to have Dual channel DTT Transmitters combined through the same balanced hybrid.

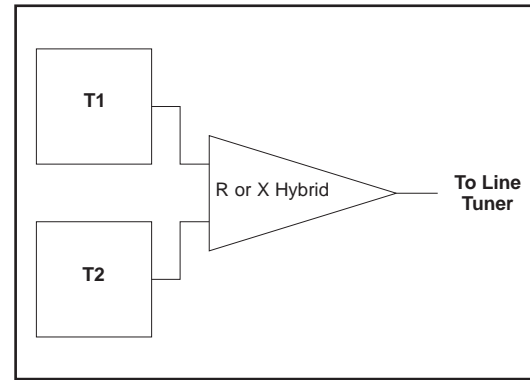
#### Specific Rules for Reactance Hybrids Only:

1. When applying transmitters to balanced reactive Hybrids, the frequency spacing between the widest spaced transmitters is about 4% for frequencies below 50 kHz and 6% for frequencies above 50 kHz. If this rule is not followed then the Hybrid cannot be adjusted to provide the best possible isolation between all transmitters.
2. When applying transmitters and receivers to a balanced reactive Hybrid the frequency spacing between the transmitter group and receiver group is of no concern; however, all the transmitter frequencies must meet the frequency spacing rule above. This rule is based on receivers with high input impedance.

### 3.10.1 Examples

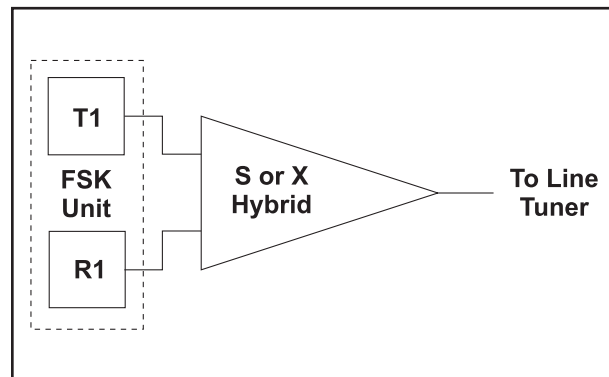
Following are several figures that illustrate possible hybrid applications. A short description of each follows.

In these illustrations, Balanced (resistive) Hybrids are denoted as R Hybrids, Balanced Reactive Hybrids as X Hybrids and Skewed Hybrids as S Hybrids. Fig. 3–30 illustrates two transmitters being combined onto a single coax cable for connection to a line tuner. This would be a typical application for a dual channel, uni-directional trip system. The receive end of the system would not require a hybrid so that the receivers would be tied together via a T-connector and coax cable before connection into the line tuner. However, a single 50 Ω non-inductive resistive load should be bridged across the high impedance receivers to terminate the line tuner because there is no 50 Ω output transmitter also present.



**Figure 3–30. Hybrid Connections – Two Transmitters**

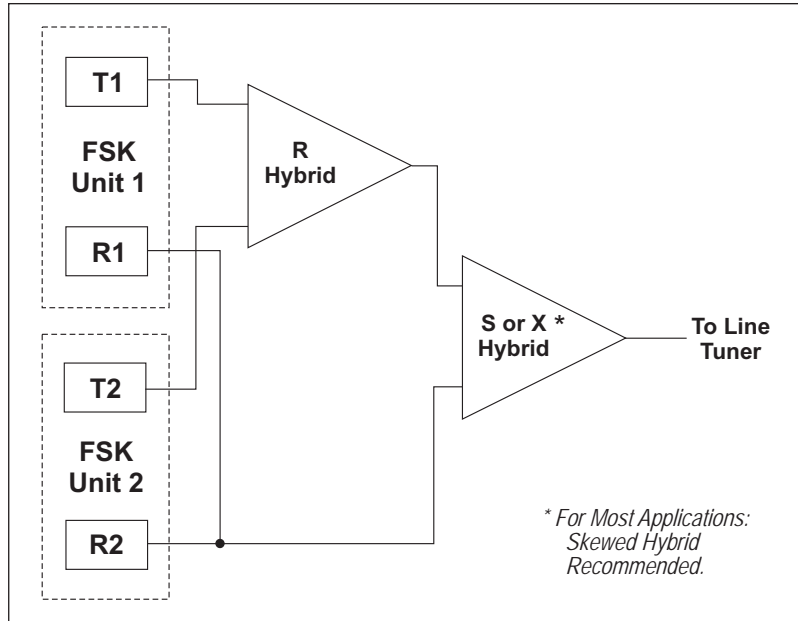
When only one transmitter and one receiver are required as in a single channel bi-directional transfer trip system or a directional comparison unblocking system Fig. 3–31 can be applied. A skewed hybrid may be used in place of the reactive hybrid (X hybrid). The skewed hybrid has a designated transmit port and receive port.



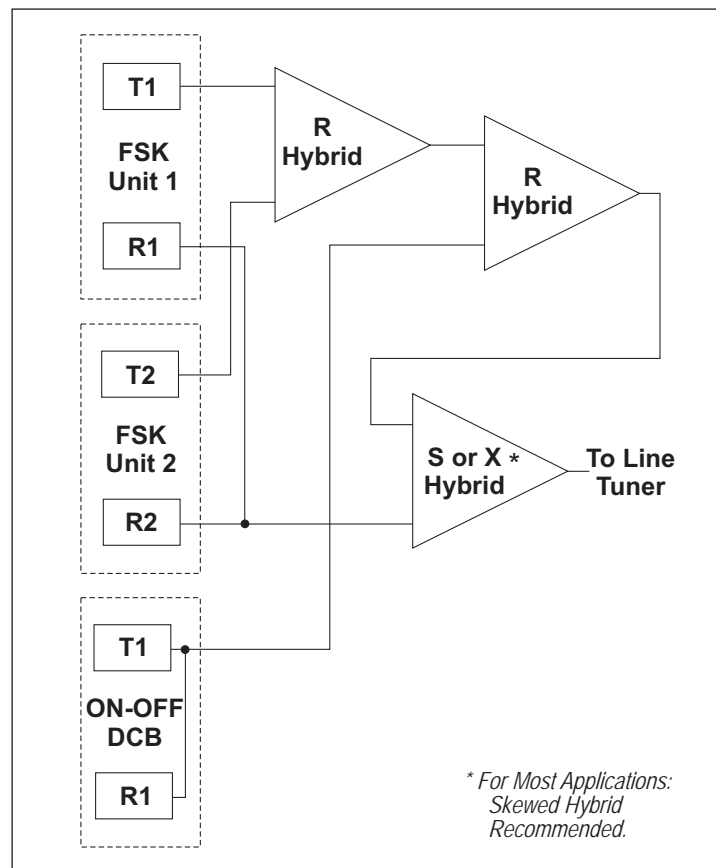
**Figure 3–31. Hybrid Connections – Single Bi-Directional Channel**

When two transmitters and two receivers are being applied to a single coax cable, as in a dual channel bi-directional direct transfer trip system, Fig. 3–32 is appropriate.

When combining a DCB blocking carrier with a dual channel bi-directional DTT, Fig 3–33 is appropriate. The setup gives less hybrid loss for the ON/OFF DCB vs the FSK DTT, because the ON/OFF DCB requires a better signal/noise ratio.



**Figure 3–32. Hybrid Connections – Dual Bi-Directional Channel**



**Figure 3–33. Hybrid Connections – DCB with Dual Bi-Directional DTT**

## 4. Test Equipment, Maintenance & Troubleshooting

### Recommended Test Equipment

Table 4–1 shows the equipment used to test, service and verify your UPLC-II™ unit.

**Table 4–1. Recommended Test Equipment**

Equipment	Application
<b>High-Impedance Frequency Selective Level Meter</b> 1 kHz to 1 MHz <ul style="list-style-type: none"> <li>• PowerComm Solutions PCA-4125</li> <li>• Signal Crafters Model 110</li> <li>• Spectrum Analyzer</li> </ul>	Checking TX/RX Levels Checking Noise Levels
<b>Reflected Power Meter</b> <ul style="list-style-type: none"> <li>• Signal Crafters Model 70</li> <li>• PowerComm Solutions PCA-4125</li> </ul>	Adjusting Line Tuner to Match UPLC-II™ Output Impedance
<b>Signal Generator</b> <ul style="list-style-type: none"> <li>• Signal Crafters Model 90 or 110</li> <li>• PowerComm Solutions PCA-4125</li> </ul>	For Setting RX Sensitivity when no Remote TX is Available
<b>Non-Inductive Resistor</b> , 50 or 75Ω <ul style="list-style-type: none"> <li>• Opek DL-60: 50Ω, 20W Load <sup>1</sup></li> <li>• DX Engineering DL30A: 50Ω, 15W Load <sup>1</sup></li> </ul> Loads Also Included in the Following Equipment <ul style="list-style-type: none"> <li>• PowerComm Solutions PCA-4125: 50Ω, 18W Input</li> <li>• PowerComm Solutions Model 630: 50Ω, 25W Load</li> <li>• Signal Crafters Model 70: 50Ω, 50W Load</li> </ul>	Transmitter Termination (For Calibration)



### CAUTION

*We recommend that the user of this equipment become thoroughly acquainted with the information in these instructions before energizing the UPLC-II™ and associated assemblies. You should not remove or insert printed circuit modules while the UPLC-II™ is energized<sup>2</sup>. All integrated circuits used on the modules are sensitive to and can be damaged by the discharge of static electricity. You should always observe electrostatic discharge precautions when handling modules or individual components. Failure to observe these precautions can result in component damage.*

<sup>1</sup> Requires a UHF Female to BNC Female Adapter to Interface Directly to the UPLC-II™.

<sup>2</sup> Except for Power Amp and Power Supply Modules, which are hot-swappable.

## 4.1 Periodic Checks

Every 12 months, take the following readings on the UPLC-II™. These values can also be accessed via the optional DNP3 protocol with SCADA.

- Transmitted Power Output
- TX Reflected Power
- Receive Level
- Receive Margin

Additionally, we recommend, inspecting, cleaning & re-adjusting any air spark gaps or replacing damaged gas tubes in the channel such as in the tuners and CCVTs.

We recommend that you keep a *log book* as a visible record of periodic checks, as well as a source for indicating any gradual degradation in a unit's performance.

## 4.2 Trouble Detection Sequence

### 1. Check front door LEDs

DC Power On: Illuminated if Power Supply is functioning.

TX RF ON: Illuminated when transmitting.

### 2. Front Display Spinner

Verify “spinning bar” is rotating. If it stops for longer than a few seconds then the software is locked up.

### 3. Front Display (Fig. 4–1) or Home page checks (Fig. 4–2)

Verify no alarms on front display or web pages. See next section.

Verify receiver fade margin of +15 dB +/- 3 dB when far end transmitter is keyed. (assuming default setting of 15 dB was used.)

Verify transmit and receive levels are as expected.

Press “Test” button on front key pad & verify % Reflected Power (or use home page), when transmitting.

### 4. Module status LEDs

Open front door and verify green status LEDs are illuminated. (One on Power supply, one on Power Amp and two on Display board).

### 5. Front Panel I/O Test

Use keypad I/O Test in Test menu for checking inputs/outputs & running tests.

### 6. SOEs

Download SOE Events from each end of the system & look for problems or send to AMETEK for analysis.

### 7. Report File

Download settings “report” file from each end of the system & send to AMETEK for analysis. This is a good “as left” document that contains all software/hardware settings as well as TX/RX levels.

### 8. Timing Input

To best coordinate SOE's from different units, we recommend using the IRIG-B synchronized timing input.

## 4.3 Front Display Alarms

### Hardware Failure Alarms

- GENA - General Alarm
- PS1 - Power Supply Main Alarm
- PS2 - Power Supply Redundant Alarm
- PA1 - Power Amp Main Alarm
- PA2 - Power Amp Redundant Alarm
- TRBD - Transmitter/Receiver Board Alarm
- IOBD - Input/Output Board Alarm
- DSPL - Display Board Alarm

### Signal Level Alarms

- FDAL - Fade Alarm
- LOLV - Low Level
- GSDL - Goose Signal Data Loss



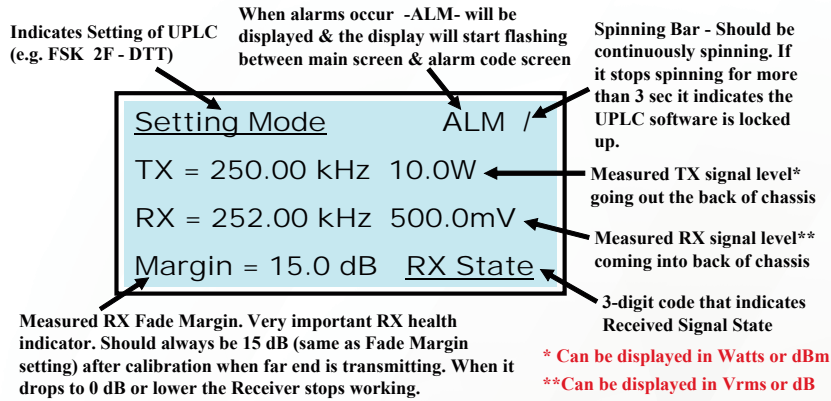


Figure 4-1. Front Panel Display Descriptions

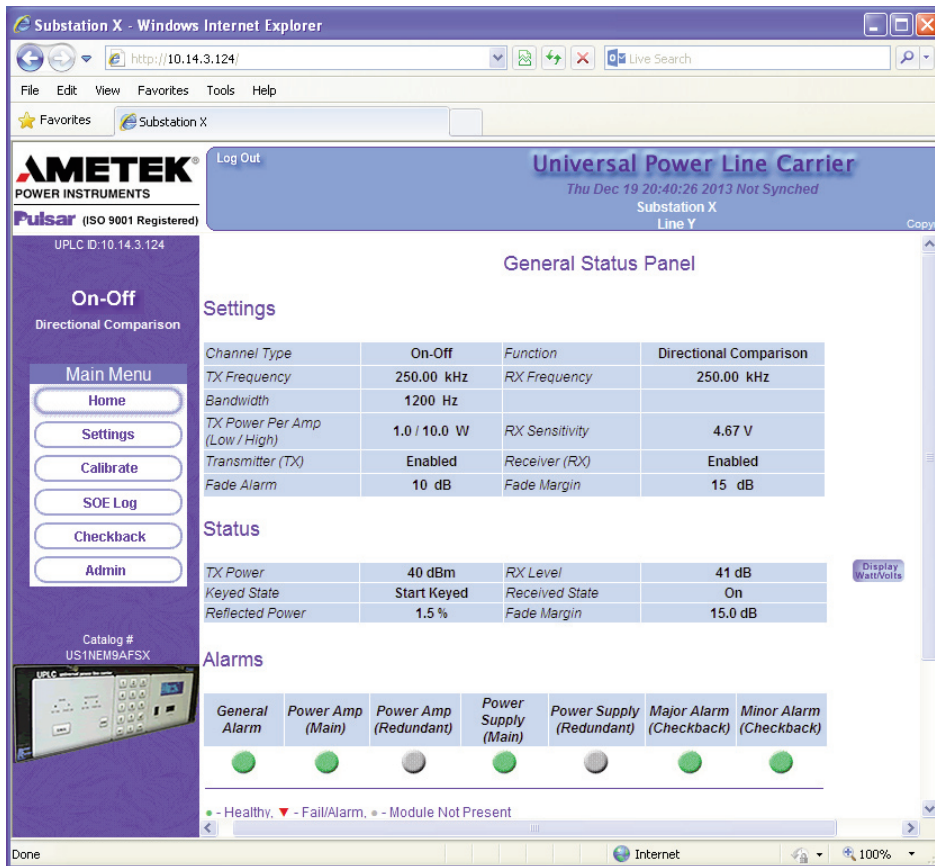


Figure 4-2. Example of the Home Page (ON/OFF Mode)



## ON/OFF Checkback Alarms

- CBMJ - Checkback Major Alarm
- CBMN - Checkback Minor Alarm
- RECO - Checkback in Recovery Alarm

## FSK Mode Only Alarms

- LOLV - Low Level Output
- NOIS - Noise

#### **4.4 Transceiver NOVRAM Battery**

A SOE “Battery Failure” event indicates that the Transceiver board’s NOVRAM battery has expired. The battery is a *Dallas Semiconductor DS9034PCX*. Some events may be lost if this battery expires. It supplies power to an event buffer. Typical life is greater than 20 years.

Replacement consists of removing the plastic cover from U30 on the Transceiver board. You will need to gently pry it off with a small flathead screwdriver by inserting the screwdriver into the rectangular slot. Replace the battery (observing the polarity) and snap the plastic cover back onto U30.

**NOTE**

**It is highly recommended that you do not try to repair or modify individual boards in the field. Call customer service for an RMA number. 800-785-7274 or +1954-344-9822.**

## 5. Installation/Commissioning Procedure

### Quick Installation Guide

1. Physically mount the unit per Chapter 2. (Page 2–8)
2. Wire the unit per your engineering documents or typical schemes as shown in Chapter 3.
3. Set hardware jumpers on I/O Module, Power Supply Module & Backplane. (Page 5–7)
4. Set up your laptop PC for communicating with the unit. (Page 5–10)
  - Ethernet port requires setting static IP address (Direct or LAN connection).
  - RS-232 port requires setting up a modem connection and static IP address.
5. Power up the unit.

(There is no power switch, simply plug Power Supply module in or out to turn power on or off.)
6. Connect to the unit via one of these ports: (Page 5–10)
  - Direct Ethernet (Front or Rear) or LAN Ethernet (Rear only)
  - RS-232 (Front)
7. Log in first time as user = administrator, password = pulsar. Enter new user as a “super user” with privileges of “admin” + “user”. Log out & back in as the new super user. (Page 5–11)
8. Make software settings in the unit via one of the following two methods & submit. (Page 5–14)
  - a. Upload previously made company standard XML software file, on Load/Save Tab of Settings web page. Then modify as needed.
  - b. Use standard configurations on Load/Save Tab of Settings web page. Then modify as needed.
9. Calibrate the unit for incoming RX level. TX level is already calibrated to 1W/10W into a 50Ω load before shipping. (Page 5–31)
10. Document, by saving, the XML file and report file on Load/Save Tab of Settings web page. (Page 5–14)
11. Verify correct operation by looking at the TX/RX levels, RX Margin, TX reflected power on the front display or Home web page. Check LEDs on front door are correctly illuminated. (Pages 5–35, 5–36)



## 5.1 Introduction

The Universal Power-Line Carrier (UPLC-II™) equipment has been designed to provide the user with an ease of installation that has never before been attainable in Power-Line Carrier equipment. The UPLC-II™ can be fully calibrated without the need for any instruments. It also provides the ease of software programmability for most of its functions, through the use of an internet browser. Thus, there is no need to install special software on the computer to configure the UPLC-II™. This section describes the simple process that is needed to connect, configure and calibrate the Universal Power Line Carrier (UPLC-II™).

### 5.1.1 Safety Precautions

Please review this installation information thoroughly before making any connections to the UPLC-II™. *Unless you are thoroughly familiar with the hazards involved in handling high voltage equipment, you should not handle the UPLC-II™ or connect any external apparatus.*

## 5.2 Mounting/Connecting

### 5.2.1 Mounting

The UPLC-II™ unit is 3 RU tall and 13.5” deep and is designed to be mounted in a standard 19” wide panel. It can be flush or projection mounted by moving the mounting brackets to the appropriate location. Refer to Chapter 2 for more details.

### 5.2.2 Terminal Block Connections

Permanent connections are made from the rear of the chassis on the UPLC-II™ backplane. Tables 5–1 & 5–2a/b list all the terminal block connection points. The terminal blocks can accept up to a 14 AWG wire with an AMP #320561, #320619 or

#50881 or equivalent, ring lug installed on the end. See the Terminal Block Hardware Specifications table that follows. All power supply, input & output connections are not polarity sensitive except as noted in the tables. Some typical wiring connections to relay systems are shown in Chapter 3.

If there are any UPLC-II™ wires coming to or from the switchyard other than the coax, they should be shielded twisted pair to reduce transients to below the Surge Withstand Capability of ANSI C37.90.1.

The UPLC-II™ backplane is concealed with a 2-piece metal cover that is divided into a top and bottom section, with an RF foam gasket between the two sections. Remove only the top section for making all necessary connections. All outgoing wire will rest between the RF foam gasket. Do not bundle the wire where it comes through the RF gasket. Spread the wire in one layer across the total width of the gasket. The foam gasket is conductive and is tied to chassis ground.

If maximum isolation is needed to prevent other devices’ high level RF signals from affecting the UPLC-II™, then the metal cover must be used.

### 5.2.3 Equipment Ground

In addition to the UPLC-II™ chassis ground connection that is made through the cabinet or rack, a ground connection screw is provided on the backplane and on the lower right corner of the back cover. (See Figure 2–2.) Only one of these two chassis ground screws needs to have a wire connection to earth ground at the UPLC-II™ cabinet location. It is best to use a #10 ga. or larger wire, that is short & direct with no sharp bends in the wire, for this connection.

**Table 5–1. Terminal Block Hardware Specifications**

Terminal Block Designators	Description	Screw Size	Screw Head Type	Max. Torque	Distance Between Barriers	Wire Size Range
TB1, TB2, TB6	Single Row for DC Power & Trip Duty Outputs	#6-32	Philips/Slotted	9 lb-in	0.26” (6.6mm)	#14-22
TB3–TB5	Dual Row for Keying Inputs & Std. Low Level Outputs	#6-32	Philips/Slotted	12 lb-in	0.26” (6.6mm)	#14-22
TB7	Single Row for External CLI Output	#3-48	Philips/Slotted	4 lb-in	0.20” (5.08mm)	#18-30

**Note:**

ALL inputs and outputs are non-polarity sensitive, except for the Power Supply Auxiliary output and the external CLI output.

**Table 5–2a. Terminal Block Input Connections \***

Inputs	Terminal Block
Main Power Supply Input	TB1-1 & 2
Redundant Power Supply Input	TB2-1 & 2
Keying Input 1	TB3-5 & 10
Keying Input 2	TB3-4 & 9
Keying Input 3	TB3-3 & 8
Keying Input 4	TB3-2 & 7
Keying Input 5	TB3-1 & 6

**Table 5–2b. Terminal Block Output Connections**

LL Outputs-1A Transistor *	Terminal Block
SS Output 1 (LL01)	TB4-5 & 10
SS Output 2 (LL02)	TB4-4 & 9
SS Output 3 (LL03)	TB4-3 & 8
SS Output 4 (LL04)	TB4-2 & 7
SS Output 5 (LL05)	TB4-1 & 6
SS Output 6 (LL06)	TB5-5 & 10
SS Output 7 (LL07)	TB5-4 & 9
LL Outputs-0.25A Contact *	Terminal Block
EM Output 8 (LL08)	TB5-3 & 8
EM Output 9 (LL09)	TB5-2 & 7
EM Output 10 (LL10)	TB5-1 & 6

Optional Trip Duty Contacts *	
EM Output 1 (TD01)	TB6-7 & 8
EM Output 2 (TD02)	TB6-5 & 6
EM Output 3 (TD03)	TB6-3 & 4
EM Output 4 (TD04)	TB6-1 & 2
Power Supply Alarms/Outputs	Terminal Block
Main PS*	TB1-5 & 6
Redundant PS* (Opt.)	TB2-5 & 6
Opt. PS Aux.** <sup>1</sup>	TB1-3(+) & 4(-)
Opt. Red. PS Aux.** <sup>1</sup>	TB2-3(+) & 4(-)
Other Outputs	
External CLI**	TB7-3(+) & 4(-)

\* **Non-Polarity Sensitive**  
 \*\* **Polarity Sensitive**  
<sup>1</sup> **For Driving Older EM Relays**

### 5.2.4 RF Coax Connections

The RF connections to the chassis are made using the J1 and J2 female BNC connectors. The cable used to make this connection must be a 50 Ω or 75 Ω coax cable, depending on the line tuner input impedance. A knife switch is sometimes placed in the rear of the cabinet housing the UPLC-II™ in order to service it.

If the carrier is set for *two-wire* mode: both the TX and RX would go through J1. If the carrier is set for *four-wire* mode: J1 = TX output & J2 = RX input.

#### 5.2.4.1 Coaxial Cable for RF Connections


A coaxial cable is required for a shielded, low-loss, path between the UPLC-II™ and the Line Tuner (in the switchyard).

The type of coaxial cable we recommend is RG-213/U (50 Ω, 29.5 pf/foot):

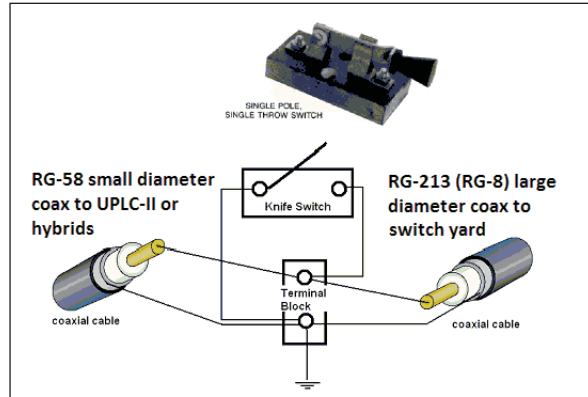
- #12AWG, (7-strand of #21AWG) copper center conductor
- Polyethylene insulator
- Copper shield
- Vinyl jacket (nominal O.D. 0.405 inch)

We also recommend changing from RG-213 cable to the smaller diameter RG-58 coax cable at a terminal block once entering the cabinet. Alternately, you can connect directly to a hybrid or some device with a UHF type connector that can accept the RG-213 coax. The inputs of the hybrid would then be connected with RG-58 coax.

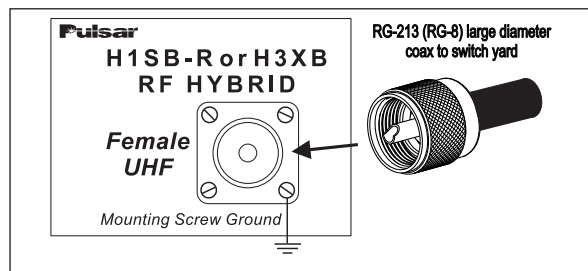
If the coaxial cable is to connect to related cabinets enroute to the switchyard, you should connect the RG-58 cable from J1 or J2, of the UPLC-II™, to the related cabinets, and RG-213 from the cabinets to the switchyard. Keep the coaxial cable as short as possible and ground the outer braid of the coax only at the end connected to the UPLC-II™ and not at the line tuner end.

 **CAUTION**

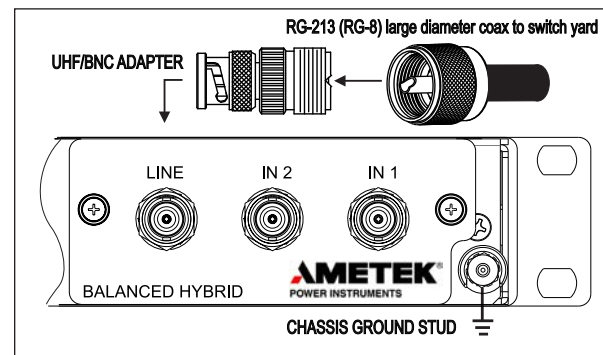
*The UPLC-II™ does not ground the coax shield. It must be externally grounded to prevent surge-related failure to the UPLC-II™.*




**Figure 5-1. Coax Connections (ground at terminal block)**



**Figure 5-2a. Coax Connections (ground at old style 2RU hybrid)**



**Figure 5-2b. Coax Connections (ground at 1RU hybrid)**

 **CAUTION**

**NEVER DISCONNECT THE CARRIER LEAD-IN BETWEEN THE LINE TUNER AND THE COUPLING CAPACITOR UNLESS THE LOW POTENTIAL END OF THE COUPLING CAPACITOR IS GROUNDED. BEFORE DISCONNECTING THE CARRIER LEAD-IN CONDUCTORS, CLOSE THE GROUNDING SWITCH AT THE BASE OF THE COUPLING CAPACITOR. IF THIS GROUND IS NOT PROVIDED, DANGEROUS VOLTAGES CAN BUILD UP BETWEEN THE LINE TUNER AND COUPLING CAPACITOR.**



In order to ground the coax braid (shield), you can use an intermediate terminal block (Fig. 5–1), a UHF connector mounting screw on the old style 2RU hybrid (Fig. 5–2a) or ground stud on 1RU hybrid chassis (Fig. 5–2b).

### 5.2.5 Other Connections

All the other connections to the UPLC-II™ are for alarm and information purposes. These inputs and outputs are listed here for reference purposes. Depending on the options ordered, these outputs may or may not be present. These will be listed from left to right looking at the rear of the chassis.

#### 5.2.5.1 Ethernet Connectors

Ethernet Ports: (TX1, RX1 & TX2, RX2) Depending on options ordered, these connections may be electrical RJ-45 or fiber ST connectors. The RJ-45 connectors include 2 LEDs that come on solidly when a connection is made. The fiber connectors are designed for interfacing to 1300 nm, 62.5/125 μm multimode fiber cables.

#### 5.2.5.2 Protocols Connector

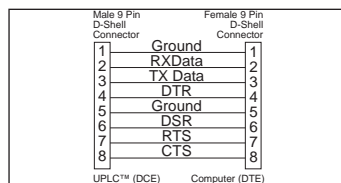
Please refer to Chapter 7, “Communication Protocols” for more details.

9-Pin D shell Connector (J4): This connector is for a permanent connection, which provides RS232 or RS485 access to the unit for the DNP3 communication protocol.

RS-232: (see figure below)

RS-485: pins 2 & 8 (TX +/-)  
pins 3 & 7 (RX +/-)

The rear Ethernet ports, listed above, can also be used for DNP3 and/or IEC 61850 communications. The front Ethernet port is not available for protocol communications.



Standard RS-232 Extension Cable

#### 5.2.5.3 IRIG-B Input

BNC Connectors (J13 & J14): These connectors are for the IRIG-B input. J13 is the input for a modulat-

ed IRIG-B signal and J14 is the input for a TTL Unmodulated IRIG-B signal. **Only one of these inputs should be used, not both at the same time.**

**NOTE:** No setup is required for IRIG-B. Simply connect to the correct coax connector to match your source.

#### 5.2.5.4 CLI (Carrier Level Indicator) Output

TB7-3(+) & TB7-4(-): These two terminals provide an output that tracks the RX fade margin level. It can be connected to an external voltage transducer which can then connect to SCADA to remotely read the receiver’s margin, if desired. It requires an external source of 10–300 Vdc be applied in series with it. (Calibration of this output can be done through the front key pad or the web browser calibration page.)

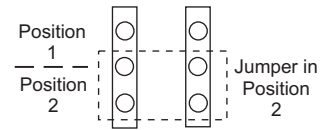
#### 5.2.5.5 Power Supply Outputs

- TB1-3(+) & TB1-4(-): Main power supply Auxiliary output for feeding 20 mA or 200 mA to an electromechanical auxiliary blocking relay such as a KA-4 or SCA carrier auxiliary relay.
- TB1-5 & TB1-6: Main power supply failure alarm dry contact.
- TB2-3(+) & TB2-4(-): Redundant power supply Auxiliary output for feeding 20 mA or 200 mA to an electromechanical auxiliary blocking relay such as a KA-4 or SCA carrier auxiliary relay.
- TB2-5 & TB2-6: Redundant power supply failure alarm dry contact.

### 5.3 Hardware Jumper Settings

Some of the settings on the UPLC-II™ require the use of a hardware jumper. These are settings, which involve selections being made on circuits that are in surge sensitive areas. The jumpers are dual jumpers because one side is the actual jumper setting and the other is the sensing side. The microprocessor can then look at the sensing side and report the physical jumper setting on the web pages and in the settings download file, without having to open the unit to view them. Although it looks like two separate jumpers for each selection, it is really a ganged jumper.

Care should be used to make sure the jumper is always connected to the correct 4 pins.



An explanation of jumper positions, on different boards within the UPLC-II™, is provided here. However, for more detailed information such as jumper location on particular boards, please refer to chapter 2.

The display board and its 4 screws must be removed to access the I/O Module jumpers. These screws only hold the board mechanically. The unit may be operated without them if desired.

### 5.3.1 Backplane (Rear Panel)

JMP 1/4 – 50 or 75Ω: Selects transmitter output impedance

JMP 3/5 – 2 or 4 wire: Sets RF coax connection

If set to 2-wire, then the transmitter and receiver are on a common coax on the rear (J1), as in most ON/OFF applications. If set to 4-wire, then the transmitter outputs on coax connector J1 and the receiver input is on coax connector J2, as in all FSK applications and a few ON/OFF applications (e.g. when using an external amplifier).

JMP 2/6/7: 1 or 2 Power Amplifiers. Set according to the number of power amplifiers present.

### 5.3.2 I/O Module

INPUT 1 }  
 INPUT 2 } 15V, 48V, 125V or 250V: Inputs are set according to keying voltage for the given input.  
 INPUT 3 } This jumper establishes the minimum keying threshold voltage which is greater than  
 INPUT 4 } half station battery voltage to prevent accidental keying.  
 INPUT 5 }

LL01 }  
 LL02 } 1.0A/0.1A: Low level solid state outputs are set according to load level. This jumper sets the  
 LL03 } solid state output current capability. Microprocessor relay inputs should be set for 0.1A.  
 LL04 } Greater loads should use the 1.0A setting such as modern lockout relays. As the heavy  
 LL05 } duty transistors in the solid state outputs leak very small currents, the 0.1A setting totally  
 LL06 } prevents this phenomenon from accidentally turning on the low current inputs of a micro-  
 LL07 } processor relay or other low current device.

LL08 }  
 LL09 } NO/NC: Low Level contact outputs are set according to desired position when a relay coil is  
 LL10 } de-energized. When not energized, the contact will be NO (Normally Open) or NC  
 (Normally Closed).

TD01 }  
 TD02 } NO/NC: Trip Duty contact outputs are set according to desired position when a relay coil is  
 TD03 } de-energized. When not energized the contact will be NO (Normally Open) or NC  
 TD04 } (Normally Closed).



### 5.3.3 Power Supply Module

JMP1/JMP2: NO/NC Selects the contact position when the relay coil is de-energized. This relay coil is fail-safe and energized when the power supply is functional. Therefore set the contact to NO if you want the contact to open for alarm or NC if you want the contact to close for alarm.

JMP3: PWR ON/PWR OFF allows for de-energizing the module when inserted into the chassis with DC power applied. Normally set to PWR ON.

### 5.3.4 Aux. Power Supply Module (for driving EM protective relays)

JMP1/JMP2: 46V (20mA) / 20V or 8V (200mA) - allows you to select either a 20mA or 200mA capable source for use with carrier auxiliary relays such as KA-4 (ABB relay).

JMP3: 46V/20V - if JMP1/2 is in the (46V/20V) position, this allows selection between the 46V or 20V option. The 46V option is used for 20mA carrier auxiliary relays such as KA-4 (ABB relay). The 20V option is used for solid state relay systems such as ABB's STU or SKAU relay systems.

**Note:** This jumper setting doesn't matter when JMP1/JMP2 is set for 8V/200mA.

### 5.3.5 Power Amplifier Module

JMP1/JMP2: (Frequency Select ON/OFF) - Always set for ON in a UPLC-II™. This enables the frequency selectivity capability for the built-in TX reflected power meter, so that this meter reads only its own TX frequency. It is unaffected by other transmit signals coming into it.

For older UPLC units without the supporting hardware, this jumper allows the Power Amp to be used in them without a problem by setting to OFF.

Hardware Jumper Settings Worksheet (Shipping Defaults shown with a √)

Module	Jumper	Selection	Description	
<b>Backplane</b>	JMP1/4	<input checked="" type="checkbox"/> 50Ω <input type="checkbox"/> 75Ω	J1-TX Impedance	
	JMP3/5	<input checked="" type="checkbox"/> 2-wire <input type="checkbox"/> 4-wire	TX/RX Connect	
	JMP2/6/7	<input checked="" type="checkbox"/> 1-PA <input type="checkbox"/> 2-PA	Single/Dual PA	
<b>I/O Module</b>	INPUT 1	<input type="checkbox"/> 15V <input type="checkbox"/> 48V <input checked="" type="checkbox"/> 125V <input type="checkbox"/> 250V	Keying Voltage ↓	
	INPUT 2	<input type="checkbox"/> 15V <input type="checkbox"/> 48V <input checked="" type="checkbox"/> 125V <input type="checkbox"/> 250V		
	INPUT 3	<input type="checkbox"/> 15V <input type="checkbox"/> 48V <input checked="" type="checkbox"/> 125V <input type="checkbox"/> 250V		
	INPUT 4	<input type="checkbox"/> 15V <input type="checkbox"/> 48V <input checked="" type="checkbox"/> 125V <input type="checkbox"/> 250V		
	INPUT 5	<input type="checkbox"/> 15V <input type="checkbox"/> 48V <input checked="" type="checkbox"/> 125V <input type="checkbox"/> 250V		
	Output ↓	LL01	<input type="checkbox"/> 0.1A <input checked="" type="checkbox"/> 1.0A	Max. Current ↓
		LL02	<input type="checkbox"/> 0.1A <input checked="" type="checkbox"/> 1.0A	
		LL03	<input type="checkbox"/> 0.1A <input checked="" type="checkbox"/> 1.0A	
		LL04	<input type="checkbox"/> 0.1A <input checked="" type="checkbox"/> 1.0A	
		LL05	<input type="checkbox"/> 0.1A <input checked="" type="checkbox"/> 1.0A	
		LL06	<input type="checkbox"/> 0.1A <input checked="" type="checkbox"/> 1.0A	
		LL07	<input type="checkbox"/> 0.1A <input checked="" type="checkbox"/> 1.0A	
		LL08	<input checked="" type="checkbox"/> NO <input type="checkbox"/> NC	
		LL09	<input type="checkbox"/> NO <input checked="" type="checkbox"/> NC	
		LL10	<input type="checkbox"/> NO <input checked="" type="checkbox"/> NC	
optional	TD01	<input checked="" type="checkbox"/> NO <input type="checkbox"/> NC	Contact NO/NC ↓	
optional	TD02	<input checked="" type="checkbox"/> NO <input type="checkbox"/> NC		
optional	TD03	<input checked="" type="checkbox"/> NO <input type="checkbox"/> NC		
optional	TD04	<input checked="" type="checkbox"/> NO <input type="checkbox"/> NC		
<b>Power Supply</b>	JMP1/2	<input type="checkbox"/> NO <input checked="" type="checkbox"/> NC	PS Alarm Contact	
	JMP3	<input checked="" type="checkbox"/> PWR ON <input type="checkbox"/> PWR OFF	PS Enable/Disable	
<b>Aux. PS</b> (Optional for EM Relay Interface)	JMP1/2	<input type="checkbox"/> 46V(20mA)/20V <b>or</b> <input checked="" type="checkbox"/> 8V(200mA)	20mA or 200mA source, or 20V	
	JMP3	<input checked="" type="checkbox"/> 46V(20mA) <b>or</b> <input type="checkbox"/> 20V	20mA or 20V	
<b>Power Amp</b>	JMP1/2	<input checked="" type="checkbox"/> ON <b>or</b> <input type="checkbox"/> OFF	TX Refl. Power	
	Freq. Sel.		Freq. Selectivity	

## 5.4 PC Setup for Communication with the UPLC-II™

PC to UPLC-II™ communication is established;

1. Via front or rear Ethernet ports directly through an Ethernet cable. (may use either cross-over or straight-through cable, as it automatically detects the cable)
2. Via rear Ethernet ports through a router/switch over private Ethernet network.
3. Via front RS-232 port.

All require making some one-time settings on your PC. The Ethernet port connection is the easiest to set up and operates 100X faster than the RS-232 port. So when possible, this is the best port to use. The UPLC-II™ Ethernet ports all have one common IP address. Only one port at a time can be accessed for viewing web pages. (Port 80 is the Ethernet internal socket port number used for accessing the units via the web pages.)

### NOTE

The “PING” command is disabled in the UPLC-II™. And can not be used.

### 5.4.1 Ethernet Port – PC/UPLC-II™ Setup

**Note:** The front Ethernet port, although always mounted on the front door, will only be operational if you ordered the Ethernet option. This option is a small auxiliary board that mounts on the Transceiver board. See the Ethernet board section in Chapter 2 for details.

The default UPLC-II™ IP address when shipped is 192.168.0.10 and can only be changed by accessing the unit through its front panel keypad. The IP address will need to be changed when putting the UPLC-II™ on a corporate LAN to match up with that system. Otherwise, if just accessing directly with a laptop, without being on a corporate LAN, then you can just use the default IP address.

#### 5.4.1.1 Changing the UPLC-II™ Default IP Address (when needed)

**Note:** On the front keypad, the SET button is the same as an “enter” key and must be pressed after

entering a value usually. The ESC (Escape) key is used to back out of menus.



1. Using the front keypad, press the SET button. You will be prompted for the password (default is “4050”) to enter using the keypad. (Also displayed below the prompt will be the 11-digit UPLC-II™ electronic catalog number.)
2. Press “2” = menu choice “Configure”.
3. Press “2” = menu choice “IP Address”.
4. Press the SET button and then it will allow you to edit the IP address by entering the four 3-digit number groups separated by periods. Use the keypad numbers and forward/back arrow scroll keys to modify as needed. Press the SET button again to enter.
5. Scroll down to change the default Gateway to match with the IP address with the last digits of the gateway address usually being “001”.
6. The Mask default of 255.255.255.0 should normally not need to be changed.
7. After entering, press the ESC key to escape out of the menu and to automatically save the settings.

#### 5.4.1.2 PC Setup – Direct Ethernet Connection

A static IP address must be set up on your computer to directly connect to the UPLC-II™ as all computers are by default set to automatically assign an IP address. The IP address of your computer needs to be manually assigned to be on the same subnet as the UPLC-II™, but with a different IP address. For example, if the UPLC-II™ has the IP address of 192.168.0.10 then your computer’s IP address can be set for 192.168.0.9 or any other number not ending in 10 with the same subnet. The procedure for changing your computer’s IP address is dependent on the type of computer operating system being used. See Appendix B.

### 5.4.1.3 PC Setup – Ethernet Connection via Router/Switch

The IP address of the UPLC-II™ must match the subnet of the Ethernet network (LAN) which usually means changing the IP address of the UPLC-II™ from its default, as explained previously. Also you must change your computer's IP address which is dependent on the type of computer operating system being used. See Appendix B.

### 5.4.2 Front RS-232 Port – PC Setup

The UPLC-II™ front panel is a DCE serial port. Since most computer serial ports are DTE devices, a standard straight through serial cable may be used to connect the UPLC-II™ to a computer via the serial port. If the device you are connecting to is a DCE device, use a null modem cable.

Connecting your computer to the UPLC-II™

1. After initially powering up the unit, wait approx. 1 min. prior to accessing the unit.
2. Connect a straight-thru serial cable between your computer serial port and the front serial port on the UPLC-II™.
3. Either double click the connection icon you placed on your desktop from the configuration procedure in Appendix A or double click the “My Computer” icon on your desktop.
4. Under My Computer double click on “My Network Places” icon and then double click on “view network connections.”
5. Then double click on the direct connection you set up from the procedure in Appendix A to talk to the UPLC-II™.
6. The connection window will pop up. Leave the user name and password blank. Click on the “Connect” button.
7. You may see a dialog box pop up that says “dialing...” and this is ok. Then you will see “Verifying username and password.....” After that you will see “Registering your computer on the network...” The dialog box will go away and you will get confirmation that you are connected. Should you get a 777 error after “dialing”, close the window and restart the direct connection. Do not “redial”.

8. Now open Internet Explorer. In the address bar enter http://100.100.100.100 and then hit Return. You will then be asked for a user-name and password. An example of the login screen is shown below.

## 5.5 Logging In

After your PC is set up, open a web browser window and enter the correct IP address into the address bar. Any browser should work but if web pages are cosmetically incorrect then try putting the browser into compatibility view for best viewing. The following login window should pop up within seconds after entering the IP address.



If this is the first time logging into a UPLC-II™, enter the default user name and password shown below.

- Default user name = *administrator*
- Default password = *pulsar*

#### NOTE:

**Only one person (except for Management user) can access the UPLC-II™ at a time. If the keypad is being used and in a menu it will also limit what someone logging in via the web pages can do.**

This will take you to the UPLC-II™ Home page.

#### NOTE

**Refreshing any web page will automatically return you to the UPLC-II™ home page.**

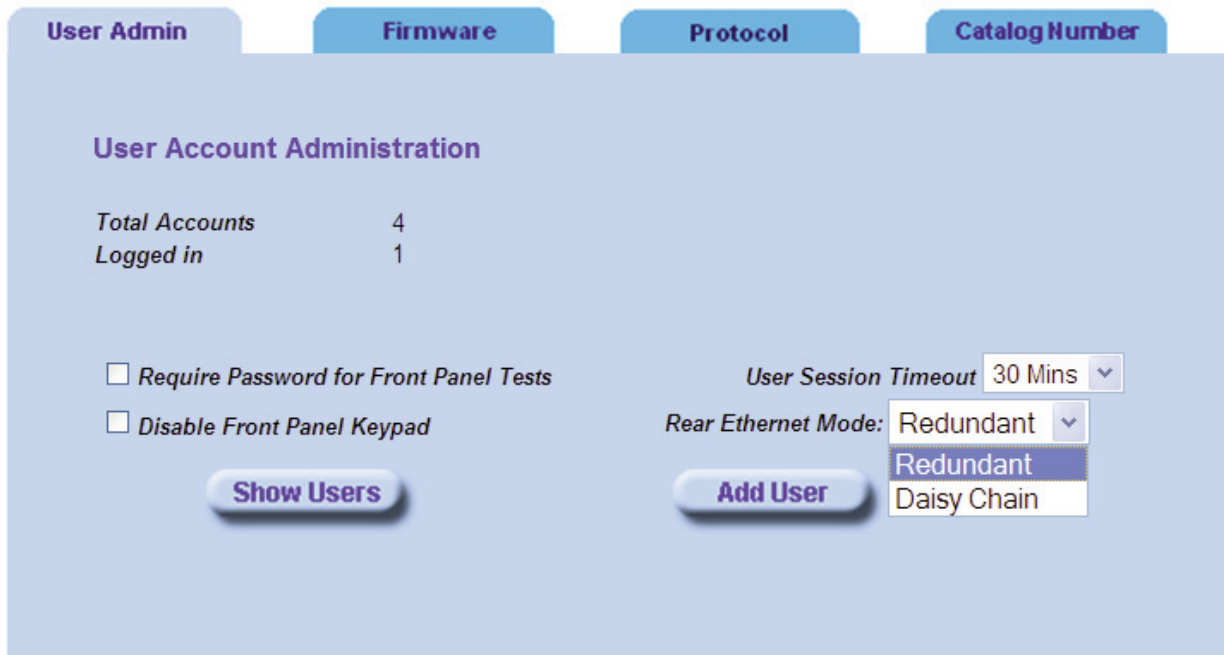


Figure 5–3. Example of the User Admin Tab on the Admin page

**NOTE:**  
Any items selected on the User Admin tab are submitted automatically without doing anything else.

**CAUTION**  
A DEFAULT USER NAME “adminis-  
trator” AND A DEFAULT PASS-  
WORD SET TO “pulsar” HAS BEEN  
PROVIDED WHEN THE UNIT IS  
SHIPPED. IT IS YOUR RESPONSI-  
BILITY TO CHANGE THE DEFAULT  
PASSWORD TO SOMETHING DIF-  
FERENT TO ENSURE THE SECURI-  
TY OF YOUR UPLC-II™. AMETEK  
IS NOT RESPONSIBLE FOR THE  
SECURITY OF THE SYSTEM.

- Additional items on the User Admin Tab that can be set include:*
- Setting a password requirement to enter the front keypad TEST menu (The Settings menu always requires a password, but the TEST menu can be set for either with or without a password requirement.)
  - Disabling the front panel keypad if desired for security reasons (The keypad only has a numerical password and if a stronger password is required then it can be disabled and later turned on by logging in to the web pages with a strong password.)
  - Web browser session timeout period, 5–30 mins (This is how long it will be before a user will be automatically logged out when on any web page and not interacting with the page. The exception is the Home page as it has no time out. If accidentally disconnecting without logging out first, this timeout is also how long you must wait to be allowed re-entry without power cycling the unit.)
  - Dual rear Ethernet ports can be redundant or daisy chain mode. (The redundant mode means that if one rear port fails, it will switch over to the other in a few seconds if you have a second network. The daisy chain mode allows you to connect to a close-by second Ethernet enabled device using the UPLC-II™ as a switch rather than running a separate long cable to it. These modes do not apply to the front Ethernet port which is completely isolated from the rear ports.)

Table 5–3. Authority Level Matrix

Level (Privilege)	Add / Change User Accts	Upgrade Firmware	Setting Changes	TX / RX Calibrate	Up / Down Load Files	View Only	Remote Access*
Guest						X	
User			X	X	X		
Admin	X	X					
Superuser (Admin+ User)	X	X	X	X	X		
Management	X						X

\* Via URL Commands

### 5.5.1 Admin Web Page

Once logged in, initially you will need to set yourself up as a “super user” by clicking on the Admin button in the main menu. Then you can click on the Add User button as shown in Figure 5–3.

Next you add a new user name and enter the password twice and give yourself the privileges of *User* and *Administrator* for your “super user” login. Passwords (case sensitive) can be any combination of up to 8 characters, i.e. upper/lower case letters, numbers and special characters (*no spaces allowed*). User names share the same attributes but can be up to 30 characters. Spaces will be automatically deleted and should not be used.

Then click on the Log Out text in the top left of the screen to exit, so you can log back in as the newly created “super user”.

When you log back into the UPLC-II™ as a super user, you will have full access to all its features and can now make settings.

**NOTE:**

If you have other tabs open in a browser, it will save your log-in credentials and automatically log into the UPLC-II™ using the last used credentials. To prevent this you need to completely close all open browser windows/tabs and then open a new browser window to log in with your new credentials.

### 5.5.2 User Accounts

User accounts allow limited access to the maintenance and setting of the UPLC-II™. This is required security to prevent unauthorized access. Up to 10 accounts are allowed with the “management” account being limited to one account.

There are *five* levels of access allowed through the user account. The UPLC-II™ is provided from the factory with only one administrator level account.

The “administrator” can only assign user accounts and upgrade firmware.

The “guest” level can only view, and cannot make any changes.

The “user” level has the ability to make setting changes, calibrate the unit and download files such as the SOEs and settings.

The fourth level is the “super user”, which is the combination of the administrator level and the

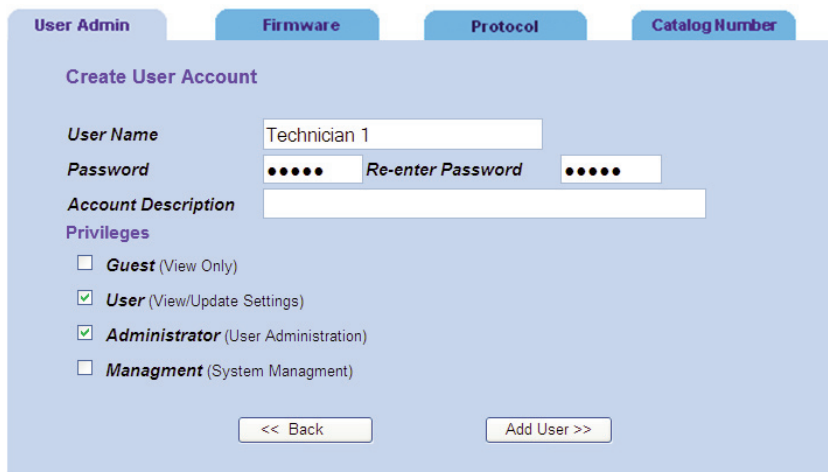
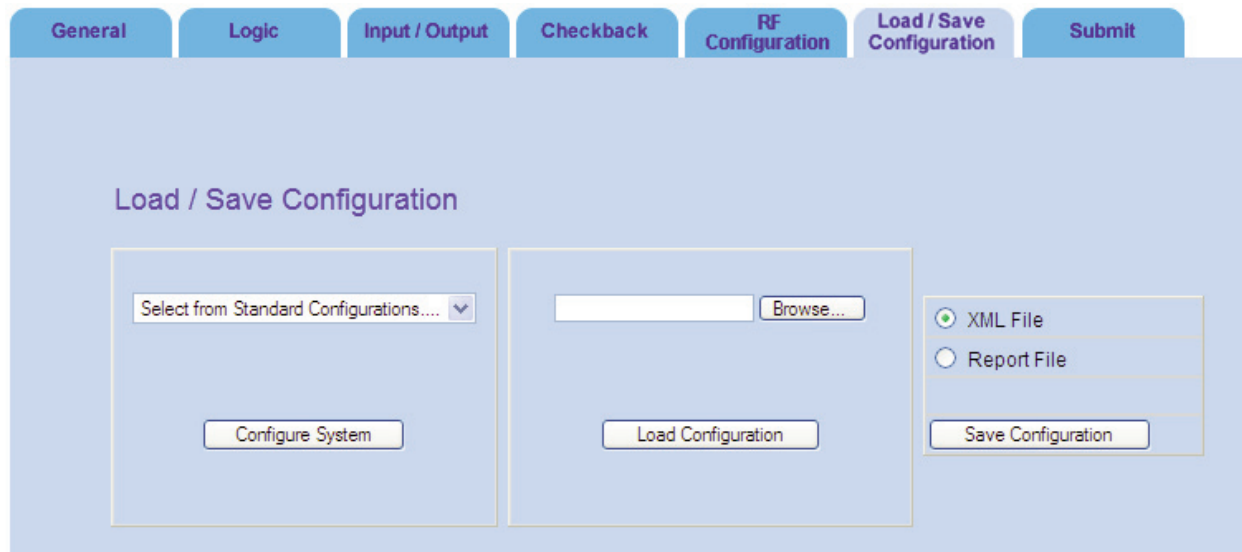


Fig. 5–4. Example of Creating a Super User on the User Admin Tab





**Figure 5–5. Example of Load/Save Configuration Tab on the Settings Page**

user level. To Select super user level, check both the user and administrator level boxes.

The fifth level is the “Management” user and is intended for an IT administrator (see Appendix D).

## 5.6 Making/Saving Settings

It is always best *first* to go to the Load/Save Tab of the Settings button web page when making settings, see Figure 5–5. It is recommended to make and save your own company standard settings files for various configurations (ON/OFF DCB, FSK DTT, FSK UB etc.) when connected to a UPLC-II™ and then upload these files into a new UPLC-II™.

### 5.6.1 Loading Settings

- If starting from scratch with entering settings, then choose from the default configurations already in the UPLC-II™.

ON/OFF Directional Comparison

ON/OFF Phase Comparison

FSK 2-Freq. Unblocking, DTT, POTT

FSK 3-Frequency

FSK 4-Frequency

FSK Phase Comparison

Click on the “configure system” button and next click on the Submit Tab and the submit button to save these settings. This loads default settings that are close to what would normally be needed and these can then be modified as needed and resubmitted.

- To Upload a previously stored settings file just click on the “Choose File” button and browse to where it is located and click on Load Configuration. Then usually you only need to modify frequencies, station/line name, checkback test address (if enabled), then submit settings assuming the input/output connections stay the same.

### 5.6.2 Saving Settings

- To Save software settings for re-use later in case something happens to your Transceiver board, click on XML File and Save Configuration. This stores all the software settings in a format that can be loaded into another UPLC-II™. Enter the name you want to call this configuration file, and add an XML extension. It is required that the saved file have an XML extension in order to upload it to a unit. The UPLC-II™ does not automatically do this for you.

In addition to the XML file, you may save a report file that is more readable. A sample is provided here:

Software Revision: 4.01	Trip Duty Outputs
Unit IP: 10.14.3.52	1. Selection: LR Guard NC Contact
MAC Address: 00:07:5E:00:20:1C	2. Selection: LR Trip NC Contact
Catalog Number: US1NEM9AFSX	3. Selection: DTT Guard NC Contact
Date/Time: Fri Sep 19 14:30:30 2014	4. Selection: DTT Trip NC Contact
System ID (Major): Substation X	Power Supply Alarms Contacts
System ID (Minor): Line Y	Main Power Supply Normally Closed
	Redundant Power Supply: Not Installed
General Settings	Low Level Outputs
Channel Type: FSK	1. Selection: LR Guard
Function: 3-Frequency	De-energized State: NO
Rear Ethernet Mode: Redundant	Action: Normal
Transmit Frequency: 250.00 kHz	Max Load: 1.0A
Receive Frequency: 252.00 kHz	2. Selection: LR Trip
TX Shift-Bandwidth: 600 ± 250	De-energized State: NO
RX Shift-Bandwidth: 600 ± 250	Action: Normal
RF coax connection: 4 Wire	Max Load: 1.0A
RF Impedance: 50 Ohms	3. Selection: DTT Guard
Transmit Power Low: 1.0 W	De-energized State: NO
Transmit Power High: 10.0 W	Action: Normal
RX Sensitivity: 118.1 mV	Max Load: 1.0A
Fade Alarm: 10 dB	4. Selection: DTT Trip
Fade Margin: 15 dB	De-energized State: NO
Reflected Power Alarm: 15 %	Action: Normal
Transmitter: Enabled	Max Load: 1.0A
Receiver: Enabled	5. Selection: Fade Alarm
Current margin: 15.0 dB	De-energized State: NO
Current receive level: 9 dB	Action: Normal
Current transmit power: 30 dBm	Max Load: 1.0A
Current reflected power: 0.0%	6. Selection: Good Channel
Session Time Out: 30 Min.	De-energized State: NO
	Action: Normal
Logic Settings	Max Load: 1.0A
CB Trip Test: Enabled	7. Selection: TX Shift Low
Line Relay Settings	De-energized State: NO
Pre-Trip Delay: 4 ms	Action: Normal
Trip Hold: 0 ms	Max Load: 1.0A
Guard Hold: 0 ms	8. Selection: Reflected Power
Unblock Timer: 150 ms	De-energized State: NO
Unblock Delay: 10 ms	Action: Normal
Guard Before Trip: Required	9. Selection: Main RF Output
Direct Transfer Trip Settings	De-energized State: NO
Pre-Trip Delay: 30 ms	Action: Normal
Trip Hold: 0 ms	10. Selection: General Alarm
Guard Hold: 0 ms	De-energized State: NC
Guard Before Trip: Required	Action: Normal
Input Output Settings	Trip Test Settings
Inputs	Auto Test: On
1. Hold: 0.0 ms	Trip Test Type: CB Trip
Selection: LR Key	Trip Test Type: Periodic
Active State: Application of Voltage	Trip Test Hours: 6:00
Voltage: 125	Trip Test Hours: 12:00
2. Hold: 0.0 ms	Trip Test Hours: 18:00
Selection: DTT Key	Trip Test Hours: 0:00
Active State: Application of Voltage	Trip Test Period: 72
Voltage: 125	Options
3. Hold: 0.0 ms	Configuration: Single Transceiver
Selection: Power Off	Power Supply: 110/125/250 Vdc
Active State: Application of Voltage	Redn. Power Supply: None
Voltage: 125	Outputs: Standard Outputs w/ Trip Duty
4. Hold: 0.0 ms	Logic: Standard
Selection: Trip Test	Ethernet Ports (Rear): Redundant/Daisy
Active State: Application of Voltage	Chain 2 RJ-
Voltage: 125	45(10/100 BaseT)
5. Hold: 0.0 ms	Protocols: DNP 3.0
Selection: SOE Event 1	Front Port: Ethernet / RS-232
Active State: Application of Voltage	Testing: ON-OFF CB Test / FSK Trip Test
Voltage: 125	Power Amp Features: Improved Power Amp w/
	Freq Selectivity for Refl Power



- To Make an “as-left” document that records all software settings, hardware jumper settings, firmware version, catalog number, current TX and RX signal level, receiver sensitivity setting, etc, then choose Report File and click on Save Configuration. This stores all this information into a simple text file.

If a pop up “save to location” window does not appear this means your browser settings are preventing this. To get around this usually you can first hold down the CTRL key on your computer before clicking on the "Save Configuration" button and keep the CTRL key down until you see a pop-up window asking where you want to save your settings file. Then you can release the CTRL key and continue as normal. See note below for how to change IE settings to prevent this so you don't have to hold down the CTRL key.

**NOTE:**

If the Download dialog box doesn't appear, disable all pop-up blockers or add the UPLC-II™'s IP address to the trusted sites and check the following setting. Click on the “Tools” button, which should be in the upper right hand corner of the Explorer window. Then in the drop down menu, click on “Internet Options.” In the Internet Options dialog box, click on the “Security” Tab and then click on the “Custom Level...” button at the bottom. Scroll down the list until you find a heading called “Downloads.” Make sure the selection “Automatic prompting for file downloads” is enabled. If not enabled, click on the radio button. Likewise, “File download” should be enabled. If you can't enable these buttons, see your system administrator.

### 5.6.3 Working vs Temporary Settings

The UPLC-II™ stores its configuration in two sets: *Working* and *Temporary*.

The Working set is nonvolatile, and will be saved even if the unit is turned off. It holds the actual settings the UPLC- II™ uses for operation.

The Temporary set is a volatile set that's lost if the unit is turned off. Except when you're editing settings, these two sets are identical.

The Home page shows some of the Working settings, while the Settings pages show the Temporary

copy of these settings. All settings are changed from the Settings pages and any changes you make will only affect the Temporary settings. The Working settings won't be changed unless you specifically "submit" your changes on the Submit page. Having two copies of settings allows you to change the UPLC-II™'s settings while it continues to operate as normal on your bench or on-line in the field.

You can also use the UPLC-II™ to help you create a configuration file for future use with another UPLC-II™. Edit the Temporary set as usual to create the alternative settings. Then, rather than submitting these settings, "Save" them. If you are just saving the settings, it is a good idea to discard the settings after saving them to a file. You can discard the Temporary settings by going to the submit page and clicking on the discard button. If you don't do this, clicking on the “logout” button will also cause the Temporary settings to be discarded. If you don't logout, the unit will discard all temporary setting changes after an hour of no activity on the serial or Ethernet ports.

Any time you've made at least one settings change either by manually editing or loading a Configuration file, a red bar stating "Changes Pending" will appear at the top of the page. Once you submit or discard these new settings, it will disappear.

## 5.7 Settings Pages

Once you have loaded either a previously made company standard settings file or a UPLC-II™ standard configuration file on the Load/Save Configuration Tab to get you in the correct general area, then you can modify particular settings to satisfy your specific installation needs. When you click on the “Settings” button on the left menu bar you will be presented with the settings tabs for the UPLC-II™. These settings pages change depending on the mode you are in (e.g. ON/OFF DCB, FSK 2F DTT etc.). Note the tabs at the top of the white area, General, Logic, Input/Output, etc.. These tabs are where all the settings are made to the UPLC-II™. Some tabs have multiple pages underneath them that are revealed when you click on buttons on that particular tab. The tab that is seen first is the

General Settings for the connected unit. The bold items are the set items which can be changed. The settings shown in blue are actual hardware jumper settings, which are sensed and can not be changed in the software.

**NOTE:**

Once any settings on a web page are made you must always click on the “Continue” button, if not, you will lose these settings changes. You will then automatically be directed to the next successive screen for the settings. And if you had made any changes on the last page you will see a narrow red bar appear at the top of the window that has the words “Changes Pending” in it. This indicates that settings changes have been made and have not been sent to the UPLC-II™ yet. If you shut down your computer at this point you will lose these settings.

If the user account you have used to log into the UPLC-II™ is set to “User” rights then you will see a “Change Settings” button below the Current Settings table on the web page. If you do not see this button then your user account does not have rights to make changes to the settings and you can only view the settings. You must then logon with a user name that has rights to make changes if you desire to change the settings.

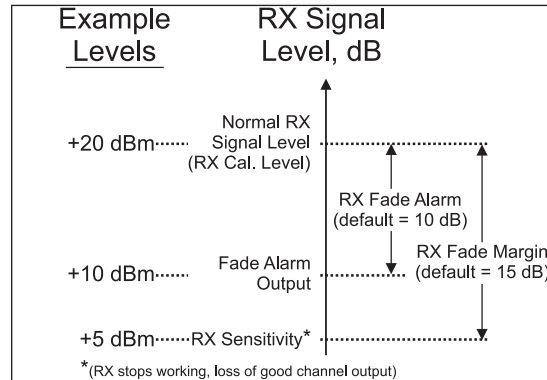
**5.7.1 General Tab**

When you click on the change settings button on the General settings page (Fig. 5–6 & 5–7), you will see the first items that need to be selected. At the top, is the System ID1 and System ID2 Setting. These two boxes allow you put an identification you want the unit to show in the Title bar of the web pages. One suggestion here might be to identify the substation name with the line name and breaker number that the carrier set’s associated relaying is connected to.

The last item to select is the most important. That is, do you want this unit to be a Frequency Shift Keyed (FSK) or ON/OFF type? This setting will affect all the other settings you are presented on the next pages.

On the second screen of the General Settings Tab you will see more items to set. These items depend on whether ON/OFF or FSK is selected. See Table 5–4 and Table 5–5 for the setting options that appear.

The RX sensitivity setting is not input directly but is a level automatically calculated when the receiver is calibrated. It is the minimum level at which the receiver will work. It is equal to the fade margin dB amount below the RX level at which the last calibration was done. The RX fade alarm setting gives an early warning alarm output when the RX signal drops by the dB level to which it was set. But the RX fade margin is the dB drop level at which the receiver stops working. Therefore the RX fade alarm is always set for a lower dB amount than the RX fade margin. See the following figure.



**RX Fade Alarm & Fade Margin**

If the unit is a Transceiver, it can also be set to TX only or RX only if desired. Changing this setting does erase all the I/O selections requiring them to be selected.

The TX Reflected Power Alarm setting is the only setting that can’t be accurately set before communicating with the UPLC-II™. The reason being is that the TX reflected power level is dependent on the line tuner in the substation yard being adjusted first so you know at what value to set the alarm threshold. Once the line tuner has been adjusted for minimum TX reflected power then the TX Reflected Power Alarm should be set to approx. 15% higher than this measured value shown on the Home page in the Status section. This is to prevent nuisance alarms and SOEs. There is no way to turn these SOEs off.

This concludes the General settings on the unit. When complete, click on the “Continue” button and you will be taken to the Logic Tab.

General
Logic
Input / Output
Checkback
RF Configuration
Load/Save Configuration
Submit

### General Settings 1

System ID1 :

System ID2 :

Channel Type :

Function:

Note: If Channel Type or Function are changed, all settings are reset to the Standard Configuration for the above combination. Please review all settings before submitting them.

Note: You must click Continue to make changes on this page effective.

**Figure 5–6. Example of The General (Settings 1) Tab on the Settings Page (ON/OFF Mode)**

General
Logic
Input / Output
Trip Test
RF Configuration
Load/Save Configuration
Submit

### General Settings 2

System ID1 : Substation X      System ID2 : Line Y

Channel Type : FSK      Function : 3-Frequency

TX Frequency <sup>~</sup>	<input type="text" value="250.00"/> kHz	RX Frequency <sup>~</sup>	<input type="text" value="252.00"/> kHz
TX Bandwidth-Shift	<input type="text" value="600 ± 250"/> Hz	RX Bandwidth-Shift	<input type="text" value="600 ± 250"/> Hz
RF Coax Connection	4 Wire	TX Impedance	50 Ω
TX Power (Low / High) <sup>~</sup>	<input type="text" value="1.0"/> / <input type="text" value="10.0"/> W	RX Sensitivity Setting	26.9 mV
Fade Alarm <sup>~</sup>	<input type="text" value="10"/> dB	Fade Margin <sup>~</sup>	<input type="text" value="15"/> dB
TX Reflected Power Alarm <sup>~</sup>	<input type="text" value="15"/> %	<input checked="" type="radio"/> Transceiver <input type="radio"/> Transmit Only <input type="radio"/> Receive Only	

Note: You must click Continue to make changes on this page effective.

**Figure 5–7. Example of The General (Settings 2) Tab on the Settings Page (FSK Mode)**

**Table 5–4. General Settings  
(ON/OFF Mode)**

	Selection	Steps
Function	Directional or Phase Comparison	N/A
TX Frequency	30 to 535 kHz	10 Hz
RX Frequency	30 to 535 kHz	10 Hz
Bandwidth	600, 1200 or 4,000 Hz	N/A
TX Power <sup>1</sup>	Low Power / High Power (0.3 to 10 W)	0.1 W
(RX) Fade Alarm	1 to 25 dB	1 dB
(RX) Fade Margin	1 to 25 dB	1 dB

**Table 5–5. General Settings  
(FSK Mode)**

	Selection	Steps
Function	Phase Comparison, Unblocking-2F POTT/DTT-2, 3 or 4 Frequency	N/A
TX Frequency	30 to 535 kHz	10 Hz
RX Frequency	30 to 535 kHz	10 Hz
Frequency Bandwidth/Shift	300 Hz ± 100 Hz 600 Hz ± 100 Hz 600 Hz ± 250 Hz <sup>2</sup> 1200 Hz ± 250 Hz <sup>4</sup> 1200 Hz ± 500 Hz <sup>2</sup>	N/A
TX Power <sup>1</sup>	Low Power (Guard Freq.) / High Power (Trip Freq.) - (0.3 to 10 W)	0.1 W
(RX) Fade Alarm	1 to 25 dB	1 dB
(RX) Fade Margin	1 to 25 dB	1 dB
TX Reflected <sup>3</sup> Power Alarm	0 – 100%	1%

<sup>1</sup> For units with a redundant Power Amp module, the TX power is for only one Power Amp. So for a 1W/10W setting the total TX power is twice this setting or 2W/20W.

<sup>2</sup> For 3-frequency mode, these are the only two frequency bandwidths & shifts available. Also 4-frequency mode uses special shifts (refer to page 2-1).

<sup>3</sup> Normally this should be set to about 15% higher than the actual measured value on the Home page to avoid nuisance alarms & SOEs.

<sup>4</sup> The 1200Hz BW ± 250 Hz shift is used primarily for matching up with older systems at the opposite end of the line.

### 5.7.2 Logic Tab

See Fig. 5–8 (ON/OFF Mode) & 5–9 (FSK Mode). In the logic settings all the time selections are changed in increments of 1 ms. The others are similar. See Chapter 2 for definitions of the various logic settings.

ON/OFF Directional Comparison & Phase Comparison Logic settings are shown in Table 5–6.

**Caution should be taken when considering setting receiver dropout delay to anything other than 0 ms. Applying a setting of 1 – 150 ms can adversely affect relaying logic such as transient blocking logic.**

FSK Logic settings for the different functions are shown in Tables 5–7 through 5–11. Note that GBT=Guard Before Trip.

When you have completed the logic settings click the “Continue” button.

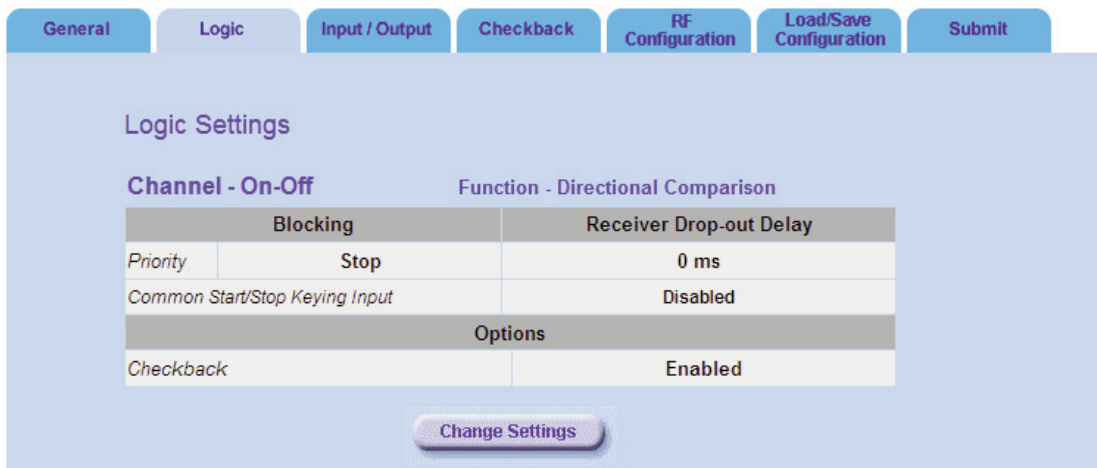


Figure 5–8. Example of The Logic Tab on the Settings Page (ON/OFF Mode)

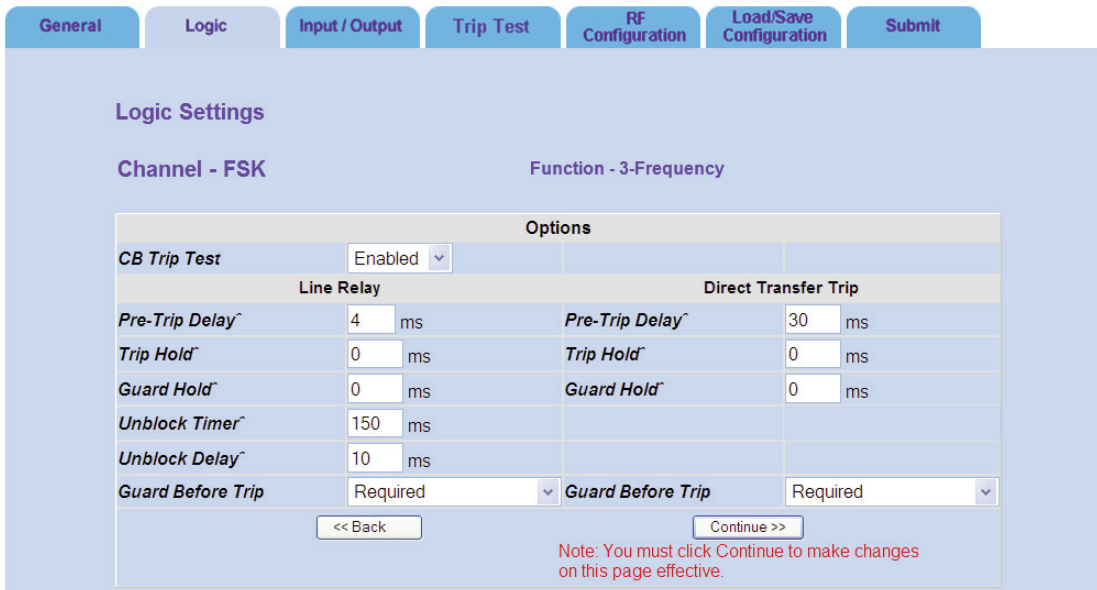


Figure 5–9. Example of The Logic Tab on the Settings Page (FSK Mode)

**Table 5–6. Logic Settings for ON/OFF  
(Directional Comparison & Phase Comparison)**

<b>Blocking</b>		<b>Receiver Drop-out Delay</b>	
Priority	Start or Stop	0 to 150 ms	
Common Start/Stop (KA-4)		Enabled or Disabled	
<b>Options</b>			
Checkback		Enabled or Disabled	

**Table 5–7. Logic Settings for Phase Comparison (FSK Mode)**

Receiver Logic			
Channel Trouble	TP & TN Clamps to “1”	Polarity	HF = TP & LF = TN
	TP & TN Clamps to “0”		LF = TP & HF = TN

5

**Table 5–8. Logic Settings for 2F Unblock (FSK Mode)**

Options			
Trip Test	Enabled or Disabled		
Receiver Logic			
Pre-Trip Delay*	0 to 30 ms	Guard Hold	0 to 100 ms
Trip Hold	0 to 100 ms	Guard Before Trip	None, GBT or GBT with Override
Unblock Timer	0 to 500 ms	Unblock Delay	0 to 100 ms

**Table 5–9. Logic Settings for 2F POTT/DTT (FSK Mode)**

Options			
Trip Test	Enabled or Disabled		
Receiver Logic			
Pre-Trip Delay*	0 to 30 ms	Guard Hold	0 to 100 ms
Trip Hold	0 to 100 ms	Guard Before Trip	None, GBT or GBT with Override

\* For every msec of pre-trip delay you add, the security, against noise causing a false trip, increases exponentially.

- UB & POTT: A min of 2-4 msec is recommended.
- DTT: The time delay should be as long as the critical stability of your system can tolerate, at least 10 msec min.



**Table 5–10. Logic Settings for 3-Frequency (FSK Mode)**

Options			
Trip Test	Enabled or Disabled		
Receiver Logic			
LR Pre-Trip Delay*	0 to 30 ms	DTT Pre-Trip Delay*	0 to 30 ms
LR Trip Hold	0 to 100 ms	DTT Trip Hold	0 to 100 ms
LR Guard Hold	0 to 100 ms	DTT Guard Hold	0 to 100 ms
LR Unblock Timer	0 to 500 ms		
LR Unblock Delay	0 to 100 ms		
LR Guard Before Trip	None, GBT or GBT w/Override	DTT Guard Before Trip	None, GBT or GBT w/Override

LR = Line Relaying

**Table 5–11. Logic Settings for 4-Frequency (FSK Mode)**

Receiver Logic			
Cmd A Pre-Trip Delay*	0 - 30 ms	Cmd B Pre-Trip Delay*	0 - 30 ms
Cmd A Trip Hold	0 - 100 ms	Cmd B Trip Hold	0 - 100 ms
Cmd A Guard Hold	0 - 100 ms	Cmd B Guard Hold	0 - 100 ms
Cmd A Unblock Timer	0 - 500 ms	Cmd B Unblock Time	0 - 500ms
Cmd A Unblock Delay	0 - 100 ms	Cmd B Unblock Delay	0 - 100ms
Cmd A Guard Before Trip	None, GBT or GBT w/Override	Cmd B Guard Before Trip	None, GBT or GBT w/Override

\* For every msec of pre-trip delay you add, the security, against noise causing a false trip, increases exponentially.

- UB & POTT: A min of 2-4 msec is recommended.
- DTT: The time delay should be as long as the critical stability of your system can tolerate, at least 10 msec min.

### 5.7.3 Input/Output Tab

#### 5.7.3.1 Inputs (Fig. 5–10)

There are five inputs on the UPLC-II™. Each input can be set with a contact bounce time of 0–8 ms, any of several selection choices, and if the input is active for voltage applied or removed.

**CAUTION**

*If you are considering setting any contact bounce time please keep in mind that any time other than 0ms will affect the security of your system. If any time is set and you get a very short input of 100µs or less, the input will be held for the total contact bounce time. It may be wiser to let the input follow whatever is coming in and let the receiver respond accordingly.*

The input selection choice varies depending on the channel type and function setting. Table 5–12 shows the various input selection choices for different channel type and function selections. Of course, there is always the choice of “Not Used.” You do not have to program all inputs just the ones you need.

Tables 5–13 & 5–14 show the definitions of the inputs depending on whether the unit is in ON/OFF or FSK mode.

There are 3 inputs that allow an external event to be recorded as an SOE and time tagged by the UPLC-II™. The inputs’ names are SOE Event 1, 2, & 3 and they have the same SOE name in the sequence of events file.

In FSK mode the (TX) Power Off input turns off the transmitter so neither guard nor trip can be sent. It is typically used for testing purposes.

After you have programmed all the inputs needed click on the “Continue” button and you will be taken to the Trip Duty Contact output programming functions, if your UPLC-II™ has this option. If not you will be taken to the Low Level output settings page. First let’s take a look at the Trip Duty Outputs.



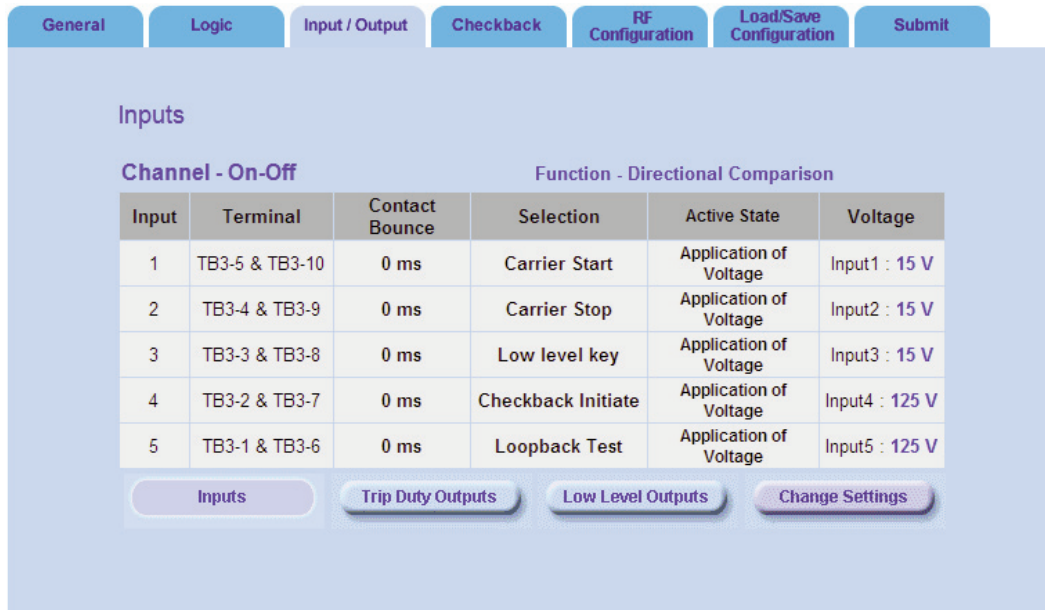


Figure 5–10. Example of the Inputs on the I/O Tab on the Settings Page (ON/OFF Mode)

Table 5–12. Input Selection Choices

ON/OFF		FSK				
Directional Comparison	Phase Comparison	Unblocking-2F	Phase Comparison	POTT/DTT-2F	3-Freq.	4-Freq.
Carrier Start	Carrier Start	UB Key	PC Key	Trip Key	LR Key	A Key
Carrier Stop	Carrier Stop	(TX) Power Off	Boost (52B)	(TX) Power Off	DTT Key	B Key
Low Level Key	Low Level Key	Trip Test	SOE Event 1	Trip Test	(TX) Power Off	(TX) Power Off
Checkback Alarm Reset	Checkback Alm Reset	Disable Trip Test	SOE Event 2	Disable Trip Test	Trip Test	Boost (52B)
Checkback Initiate	Checkback Initiate	Boost (52B)	SOE Event 3	Boost (52B)	Disable Trip Test	SOE Event 1
SOE Event 1	SOE Event 1	SOE Event 1		SOE Event 1	Boost (52B)	SOE Event 2
SOE Event 2	SOE Event 2	SOE Event 2		SOE Event 2	SOE Event 1	SOE Event 3
SOE Event 3	SOE Event 3	SOE Event 3		SOE Event 3	SOE Event 2	
Loopback Test Initiate	Loopback Test Initiate				SOE Event 3	

LR = Line Relaying (POTT or UB) UB = Unblock PC = Phase Comparison

**Table 5–13. (ON/OFF Mode) Input/Output Descriptions**

Input Name	TX or RX	Action When Input Applied
Carrier Start	TX	TX carrier keyed on to high level setting (10W) default)
Carrier Stop	TX	TX carrier keyed off
Low Level Key	TX	TX carrier keyed on to low level setting (1W default)
SOE Event 1/2/3	Both	Causes Event 1/2/3 to be recorded in SOE log
CB (Checkback) Inputs	Both	"See Chapter 6, Table 6–2."
Output Name	TX or RX	Active State
General Alarm	Both	Any major hardware failure occurs
Reflected Power	TX	TX % reflected power above threshold setting
Main RF Output	TX	TX level above 0.3W on Main Power Amp
Redundant RF Output	TX	TX level above 0.3W on Redundant Power Amp
Fade Alarm <sup>1</sup>	RX	RX level below alarm threshold setting since last RX calibration
Blocking Output <sup>2</sup>	RX	Carrier received and blocking command issued
Carrier Received <sup>2</sup>	RX	Carrier received and blocking command issued
CB (Checkback) Outputs	Both	"See Chapter 6, table 6-2."

<sup>1</sup> Fade alarm is actually a RX level **monitor** instead of an alarm in the ON/OFF mode. It should activate when no carrier is transmitted and deactivate when carrier is started.

<sup>2</sup> These 2 outputs are the same, even though they have different names.

**Table 5–14. (FSK Mode) Input/Output Descriptions**

Input Name	TX or RX	Action When Input Applied
Trip Key	TX	TX keyed to Trip Frequency
UB Key	TX	TX keyed to Unblock Trip Frequency
DTT Key	TX	TX keyed to Direct Transfer Trip Frequency
LR Key	TX	TX keyed to Line Relay (POTT/UB) Trip Freq.
A Key	TX	TX keyed to Channel "A" Trip Frequency
B Key	TX	TX keyed to Channel "B" Trip Frequency
PC Key	TX	TX keyed for Phase Comparison
Power Off	TX	TX output level shut off, no frequencies transmitted
Boost TX	TX	TX output level increased to high level setting in Phase Comparison mode
Trip Test Inputs	TX	See Chapter 6
SOE Event 1/2/3	Both	Causes "Event 1/2/3" to be recorded in SOE log
Output Name	TX or RX	Active State
General Alarm	Both	Any major hardware failure occurs
Reflected Power	TX	TX % reflected power above threshold setting
Main RF Output	TX	TX level above 0.3W on Main Power Amp
Redundant RF Output	TX	TX level above 0.3W on Redundant Power Amp
TX Shift High	TX	TX keyed to shift high frequency
TX Shift Low	TX	TX keyed to shift low frequency
Fade Alarm	RX	RX level below fade alarm threshold setting since last RX calibration
Good Channel	RX	RX level below fade margin threshold setting since last RX calibration
Noise	RX	RX freq. not recognized, unstable in freq. or high noise relative to valid signal
Guard	RX	Receive Guard Freq. with adequate level & RX logic satisfied
Trip	RX	Receive Trip Frequency with adequate level & RX logic satisfied
Checkback Trip	RX	Receive Trip Frequency with adequate level only (Do not have to receive Guard before Trip)
DTT Guard	RX	Receive DTT Guard Frequency with adequate level & RX logic satisfied
DTT Trip	RX	Receive DTT Trip Frequency with adequate level & RX logic satisfied
DTT Checkback Trip	RX	Receive DTT Trip Frequency with adequate level only (Guard before Trip not required)
LR Guard	RX	3-Freq Receive Line Relay (POTT/UB) Guard Frequency & RX logic satisfied
LR Trip	RX	3-Freq Receive Line Relay (POTT/UB) Trip Freq. & RX logic satisfied
LR Checkback	RX	3-Freq Receive Line Relay (POTT/UB) Trip Freq. with adequate level only (Do not have to receive Guard before Trip)
Trip Negative	RX	Phase comparison negative half cycle frequency received
Trip Positive	RX	Phase comparison positive half cycle frequency received
A or B Guard	RX	4-Freq Receive A or B Guard Freq. with adequate level & RX logic satisfied
A or B Trip	RX	4-Freq Receive A or B Trip Freq. with adequate level & RX logic satisfied
A or B Checkback Trip	RX	4-Freq Receive A or B Trip Freq. with adequate level only (Do not have to receive Guard before Trip)
Trip Test Outputs	Both	See Chapter 6

### 5.7.3.2 Trip Duty Outputs (Fig. 5–11)

There are four trip duty relay outputs enabled on the UPLC-II™, if this option is ordered. The trip duty relay programmable selections are shown in Table 5–15. There are hardware jumpers to select for either a normally open or normally closed contact. Although these output contacts can trip a breaker directly (30 A for 200 msec), they can only interrupt 0.5 A at 125 Vdc.

### 5.7.3.3 Low Level Outputs (Fig. 5–12)

There are ten Low Level outputs available to be programmed to various output functions. Seven of these outputs are isolated transistor outputs that can be set for either 0.1 A or 1.0 A output. It is recommended to use the 0.1 A selection if your load is less than 0.1 A, such as, for micro-processor based relay inputs. The reason for this is to prevent any possibility of leakage current especially at 250 V station battery. (In the 0.1 A setting the high power transistors that leak very small currents are jumpered out.) Three of these low level outputs are electromechanical relays. There are hardware jumpers to select for either a normally open or normally closed contact. These contacts have a 0.5 A interrupt rating at 125 Vdc. All ten of these outputs may be programmed to one of several functions or to a not used state. The available output functions are shown in Table 5–16.

If you want a UPLC-II™ alarm output to be fail-safe, you have to use one of the 3 low level EM contact outputs (Outputs LL08–LL10). By fail-safe, that means the output will alarm for the set condition and also for loss of dc power to the UPLC-II™.

**NOTE:**

**LL01 – LL07 outputs are transistor switches and if normally closed is selected, the transistor is energized when that output is inactive. Due to this, the transistor will de-energize and open the output if the power is turned off. If a normally closed state during power off is needed then select a normally closed contact for a low-level relay outputs LL08 – LL10.**

All the low level outputs, LL01-LL10, can be set for an action of normal or pulsed.

- Normal action: output active as long as condition exists
- Pulsed action: output pulses on for 5sec then stops, no matter long long the condition exists

Tables 5–13 & 5–14 show the definitions of all the outputs depending on whether the unit is set in ON/OFF or FSK mode.

For monitoring the overall hardware health of the UPLC-II™, it is recommended the General Alarm output be used. This alarm output is a fail-safe alarm. That is, the General Alarm is normally energized and drops out when any major hardware failure occurs on any board. The following specific conditions cause a general alarm.

- Power Supply low output voltage
- Power Amp low dc voltage or reduced amplification
- I/O major parameter bad
- Transceiver major parameter bad
- GSDL (Goose Signal Data Loss)

See Chapter 3 alarm tables for available TX/RX level alarms not covered by the General Alarm. These tables show what causes the alarms and whether the output is closed or open when the alarm is active.

**NOTE:**

**Power Supply alarm output: separate/not shown on web page as it's a direct hardware fail alarm to the PS terminal blocks (TB1 & TB2). It will also cause a General Alarm output.**

Two RX alarm outputs, which are illustrated in section 5.7.1 earlier, deserve special mention for clarity. They are the RX Fade Alarm and RX Good Channel outputs available in the FSK mode. The Good Channel Alarm is dependent on the RX fade margin setting to which the receiver is calibrated. When calibrating a receiver, you establish how much signal degradation (signal fade margin) is tolerable, usually either 15 or 20 dB. This allows the unit to keep working when a condition causes extra loss such as bad weather or aging/minor failure of components in the overall system. When the RX level degrades past the RX fade margin threshold then the Good Channel output drops out for the loss of channel condition.

The RX Fade Alarm is set to activate before the Good Channel output drops out and to be an early warning that the signal level is dropping before a complete loss of channel occurs.

The RX Fade Alarm output is also available in the ON/OFF mode. However, because this alarm output picks up only when the receiver is receiving an RF signal, it is really not an “alarm” in this mode but rather only an indication of receipt of signal when the far end TX is turned on.

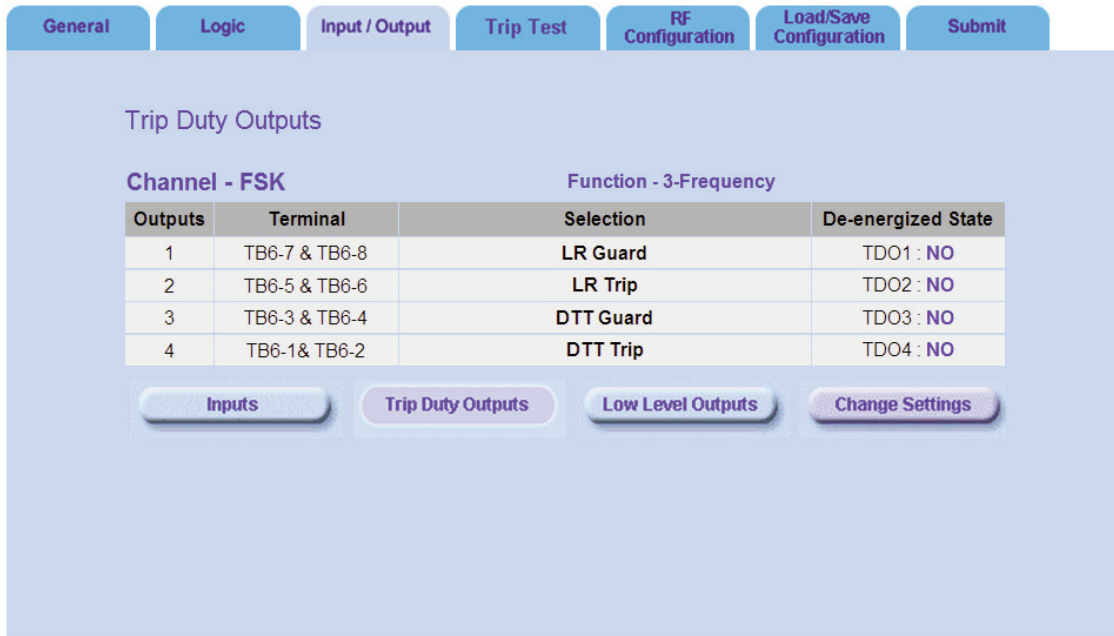


Figure 5–11. Example of the Trip Duty Outputs on the I/O Tab on the Settings Page (FSK Mode)

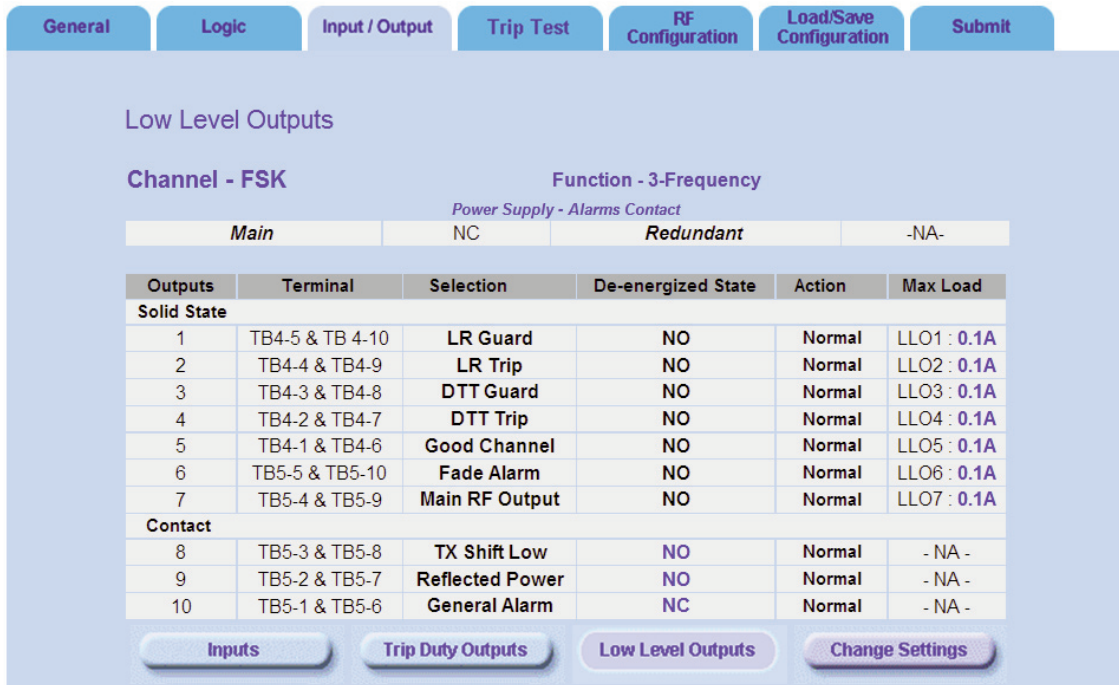


Figure 5–12. Example of the Low Level Outputs on the I/O Tab on the Settings Page (FSK Mode)

**Table 5–15. Trip Duty Output Programmable Selections**

ON/OFF	FSK			
Directional Comparison	Unblocking-2F	POTT/DTT-2F	3-Frequency	4-Frequency
Blocking	Guard	Guard	LR Guard	A Guard
Fade Alarm	Trip	Trip	LR Trip	A Trip
			DTT Guard	B Guard
			DTT Trip	B Trip

**Table 5–16. Low Level Output Programmable Selections**

ON/OFF		FSK			
Directional Comparison	Phase Comparison	Phase Comparison	2F-UB, POTT or DTT	3-Frequency	4-Frequency
General Alarm <sup>1</sup>	General Alarm <sup>1</sup>	General Alarm <sup>1</sup>	General Alarm <sup>1</sup>	General Alarm <sup>1</sup>	General Alarm <sup>1</sup>
(TX) Reflected Power	(TX) Reflected Power	(TX) Reflected Pwr	(TX) Reflected Pwr	(TX) Reflected Pwr	(TX)Reflected Pwr
(TX) Main RF Output	(TX) Main RF Output	(TX) Main RF Output	(TX) Main RF Output	(TX) Main RF Output	(TX) Main RF Output
(TX) Red. RF Output	(TX) Red. RF Output	(TX) Red. RF Output	(TX) Red. RF Output	(TX) Red. RF Output	(TX) Red. RF Output
Fade Alarm (RX)	Fade Alarm (RX)	TX Shift High	TX Shift High	TX Shift High	TX Shift to A
Blocking Output (RX)	Blocking Output (RX)	TX Shift Low	TX Shift Low	TX Shift Low	TX Shift to B
Carrier Rec. Block (RX)	Carrier Rec. Block (RX)	Fade Alarm (RX)	Fade Alarm (RX)	Fade Alarm (RX)	Fade Alarm (RX)
CB Off <sup>2</sup>	CB Off <sup>2</sup>	Good Chan. (RX)	Good Chan. (RX)	Good Chan. (RX)	Good Chan. (RX)
CB Passed <sup>2</sup>	CB Passed <sup>2</sup>	Noise (RX)	Noise (RX)	Noise (RX)	Noise (RX)
CB Major Alarm <sup>2</sup>	CB Major Alarm <sup>2</sup>	Trip Neg. (RX)	Guard (RX)	DTT Guard (RX)	A Guard (RX)
CB Minor Alarm <sup>2</sup>	CB Minor Alarm <sup>2</sup>	Trip Pos. (RX)	Trip (RX)	DTT Trip (RX)	A Trip (RX)
CB Delayed Alarm <sup>2</sup>	CB Delayed Alarm <sup>2</sup>		CB Trip (RX)	DTT CB Trip (RX)	A CB Trip (RX)
CB Carrier Recovered <sup>2</sup>	CB Carrier Recovered <sup>2</sup>		Trip Test Failed	LR Guard (RX)	B Guard (RX)
CB In Recovery Mode <sup>2</sup>	CB In Recovery Mode <sup>2</sup>		Trip Testing	LR Trip (RX)	B Trip (RX)
CB Test in Progress <sup>2</sup>	CB Test in Progress <sup>2</sup>			LR CB Trip (RX)	B CB Trip (RX)
CB Auto Tests Disabled <sup>2</sup>	CB Auto Tests Disabled <sup>2</sup>			Trip Test Failed	
				Trip Testing	

(TX) = Transmit – end output type (RX) = Receive – end output type

<sup>1</sup> Only Available on LL Outputs 8-10

<sup>2</sup> Checkback (CB) Testing Option Only



### 5.7.4 Checkback (ON/OFF Mode) or Trip Test (FSK Mode) Tab

This is the testing facilities tab that only shows up if you have a UPLC-II™ catalog # ending in “AFSX”, where the “A” enables testing. The details for this optional settings tab are shown in Chapter 6.

### 5.7.5 RF Configuration Tab

This is just a graphical representation of how the TX and RX are connected together based on the backplane 2W/4W and 1-PA/2-PA jumper settings. It also shows current jumper settings of the 3 backplane jumpers. There are no settings to make on this tab.

### 5.7.6 Submit Tab

On the Submit Tab (Fig. 5–13), you can either choose to submit the settings to the UPLC-II™ or you can discard the settings. Select the “Submit Changes” button to send the new settings to the UPLC-II™.

The Submit Tab is also where you can set the system time and date. This will be the time used to time tag the Sequence of Events. Therefore, use the time that is common practice in your company for time tagging events, such as standard local time or GMT. If IRIG-B is connected to the unit the month, day, hour, minute and second will be set to GMT by the IRIG-B signal. The user must set the year, even with IRIG-B connected. The time and date are submitted separately from all the other settings.

At this point you have completed the settings on the UPLC-II™. As described here we progressed through the settings from beginning to end as if we were dealing with a new installation. However, you may go into the settings and map another input or output or change an existing one without going through the whole procedure. All you do is make the settings change you want then click on the Submit Tab and then click the “Submit Changes” button. Thus after a UPLC-II™ is configured, it is easy to make a couple of needed changes.

The only time your settings will be cleared and you will have to go through all the settings tabs, is when you change the channel type or the function.

We have covered the entire setup of the UPLC-II™ Power-Line Carrier set. By using the web pages in a standard browser and providing a controlled workflow, the set up of the unit has been greatly simplified. That is, by only presenting the user with the menu selections needed based on previous menu selections, this eliminates confusion and lessens the chance for an error in setup. Since many protection-system security and dependability problems relate to system setup issues, we feel this controlled workflow process will have the overall affect of improving the protection-system reliability where UPLC-II™ is applied.

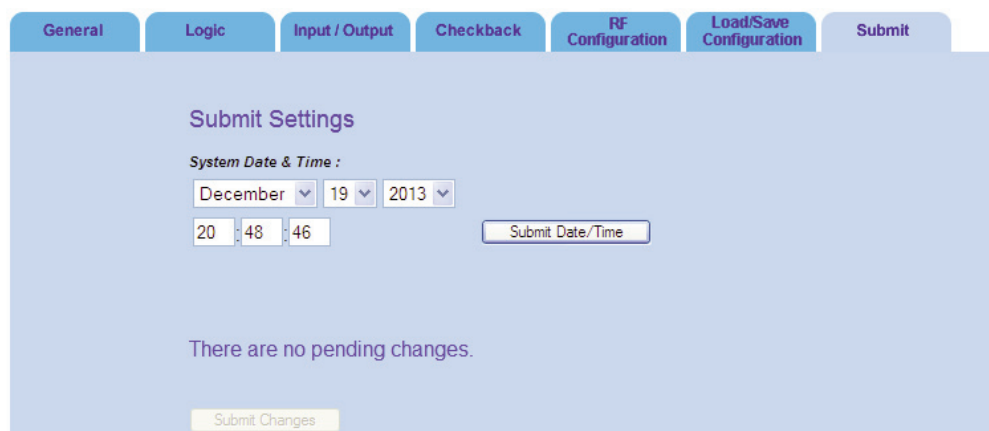


Figure 5–13. Example of the Submit Tab on the Settings Page

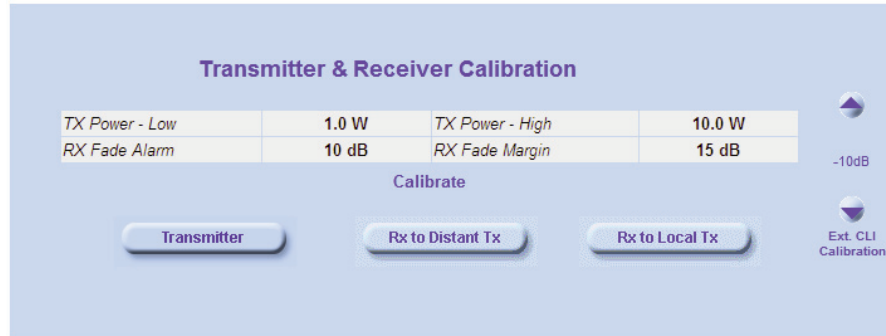


Figure 5–14. Example of the Calibrate Page (ON/OFF Mode)

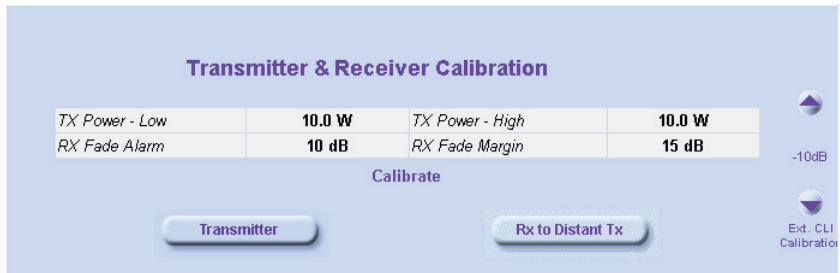


Figure 5–15. Example of the Calibrate Page (FSK Mode)

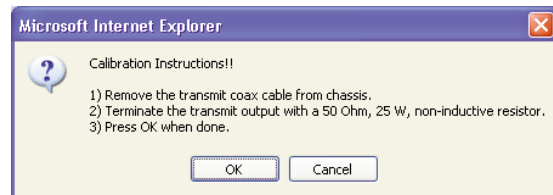
## 5.8 Calibration

**NOTE:** If you change the TX level setting, then the UPLC-II™ will not change to the new TX level until *after* TX calibration. TX calibration actually stores the new TX level into memory. See Figs. 5–14 & 15. Now that the settings have been submitted to the UPLC-II™, the transmitter and receiver levels must be calibrated.

The table in the middle of this web page shows the values that will be used to calibrate the transmitter and receiver. In the case shown in the Figures above, the transmitter will be calibrated to 1 W low power and 10 W high power. The receiver will be calibrated for a 10 dB fade alarm and the fade margin will be set to 15 dB.

You must start by calibrating the transmitters at all line terminals first. If you have not changed the default TX power levels of 1W (low) / 10W (high), then you do not need to calibrate the transmitter because the factory always calibrates at these levels before shipping. If you need to calibrate the transmitter, you will need a 50/75Ω non-inductive resistor, depending on the TX output impedance setting. This resistor must be able to handle at least 10 W of power for a brief period of time. It is suggested to

use a 25 W, 50/75Ω non-inductive resistor. First turn off the power and then remove the transmitter coax from the rear of the chassis. Then connect the 25 W, 50/75Ω non-inductive resistor to the transmitter output coax connector J1. Now turn the UPLC-II™ power back on. The transmitter may be calibrated by selecting the “Transmitter” button on the calibration web page. When you select the transmitter button the following dialog box will pop up.



### Calibration Instructions Dialog Box

Click the OK button in the dialog box. The transmitter will now be calibrated to the low and high power settings. The web page and the display on the front panel will show the calibration progress.

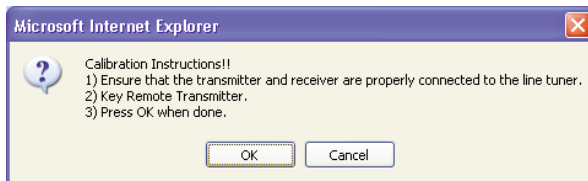
After the transmitter is calibrated, turn off the unit and remove the load. Then reconnect the coaxial cable that goes to the line tuner and turn the transmitter power on. The transmitters at all line termi-



nals must be calibrated in the same manner before continuing. Also, the line tuners and line traps at all line terminals must be tuned. The line tuner must be tuned for minimum TX reflected power at the appropriate TX frequency.

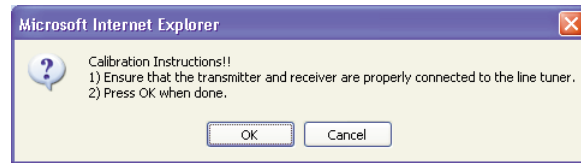
**NOTE:** If the TX reflected power is  $\geq 5\%$  or so when connected to the line tuner, then the TX level will appear higher if the line tuner's impedance is higher than  $50\Omega$  and it will appear lower if the line tuner's impedance is  $< 50\Omega$ . Do not recalibrate because of this.

After the above steps are completed at all terminals, the receivers may be calibrated. The transmitter at the remote end of the line must be transmitting guard in the case of an FSK channel type or keyed on to the normal blocking level in the case of an ON/OFF channel type. Now select the "RX to Remote TX" button on the calibrate web page. When this button is selected the following dialog box will appear.



**Calibration Instructions Dialog Box**

If things are set up as instructed then click on the OK button. The web page and the display on the front panel will show the calibration progress. If the channel type is FSK then this will complete the calibration of the UPLC-II™. If the channel type is ON/OFF then one more step is needed to complete the process. Figure 5–14 shows the calibration web page for the ON/OFF channel type. Note that there is one extra button on the calibration web page for an ON/OFF channel type. This is the "RX to Local TX" button. In an ON/OFF channel type, the receiver must be calibrated to the signal it receives from the remote transmitter and also the signal it sees from the local transmitter, since both are on the same frequency. To complete the calibration click the "RX to Local TX" button. **The remote transmitter must be off.** The following dialog box will pop up.



**Calibration Instructions Dialog Box**

Click the OK button and the local TX will automatically be keyed on. The web page and the display on the front panel will show the RX calibration progress.

This completes the calibration process for the UPLC-II™. With the settings made and the unit calibrated you are now ready to go through your normal end-to-end testing of the system to ready it for service.

## 5.9 SOE Log

See Fig. 5–16. The Sequence of Events (SOE) logs will show the history of the events that have occurred to the unit. Many different events are time-tagged and listed in the SOE Log. Appendix E lists the events per the configuration. All the events in the log, except for one, are time tagged to the nearest 1ms. The "Power off" event is time tagged to the nearest 1 second. The unit can store as many as 4096 events. After 4096 events are stored then the oldest ones will be erased as new ones are added. When the web page is first opened you will see the 15 most current events. You can obtain older events by clicking on the "Next" button. When you click the Next button you will be presented with the next oldest 15 events. If you click the "Back" button you will be presented with the next 15 later (in time) events. Thus, by using the Next and Back buttons you can scroll through the events 15 events at a time. A quick way to get to the oldest set of 15 events is to click the "Bottom" button, and in the same fashion you can go to the latest set of 15 events by clicking on the "Top" button.

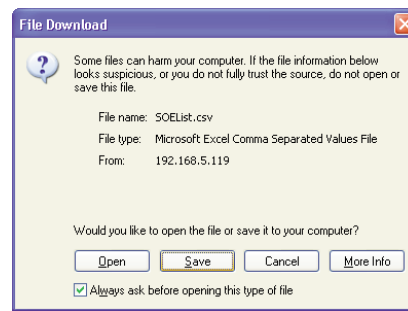
You may also filter the events if you wish. By placing your cursor over the filter events at the top of the web page, you will get a pull down menu as shown in Figure 5–16. You may filter by Event Number Date/Time or Types (of events). There is also a "Clear All Filters" command on this drop down list. When you set up a filter it will be remembered when you display events until it is cleared. So

Filter Events		Events		Abort Query	
By Event Numbers		Go To Event			
By Date/Time		Download Events			
By Types		Clear Events			
Clear Filters					
<b>Sequence of Events</b>					
Event #	Date	Time	Type / Description		
1	09/11/2014	18:10:03.870	Receiver calibrated to distant transmitter		
2	09/11/2014	18:09:47.801	Received carrier block, 930 mV		
3	09/11/2014	18:09:35.910	Receiver calibrated to local transmitter		
4	09/11/2014	18:09:23.702	Local transmitter calibrated		
5	09/11/2014	18:08:56.033	Technician1 logged in		
6	09/11/2014	18:08:46.353	Technician1 logged out		
7	09/11/2014	18:08:06.503	Events cleared		

Figure 5–16. Example of the SOE Page

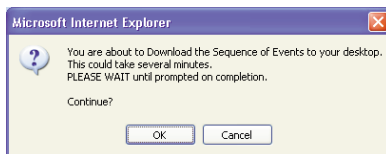
it is important to remember to clear event filters when you are done. That way the next person accessing the unit will be able to see all events.

The quickest way to view all SOEs is to download the list of events to a comma-delimited file (.csv) that can be used in most any spreadsheet application. If a filter is in place at the time of the download then that filter is used to download only those events. Events can be downloaded by moving the cursor to the area at the top of the screen labeled Events. A pull down menu will appear. Then select download events and the following dialog box appears.



File Download Dialog Box

Now click the Save button and you will be presented with the opportunity to change the name of the file and the storage location on your local computer. After the file is saved click on Continue.



Download Dialog Box

This is just warning you that there may be a large number of events in the unit and it may take a few minutes to download. However, for most modern computers this will take less than 1 minute. Click OK and the download will start. After the download is complete the following Dialog box appears.

You may also clear all the events in the unit by moving your cursor over the events pull down menu and clicking Clear Events. You will be presented with a dialog box giving you a chance to cancel. Click OK to clear events.

## CAUTION

**ONCE YOU CLICK "CLEARING SOE LOG OK", ALL EVENTS WILL BE CLEARED FROM THE UNIT AND IT'S IRREVERSIBLE. AMETEK RECOMMENDS NOT CLEARING EVENTS AFTER THE UNIT IS IN SERVICE.**

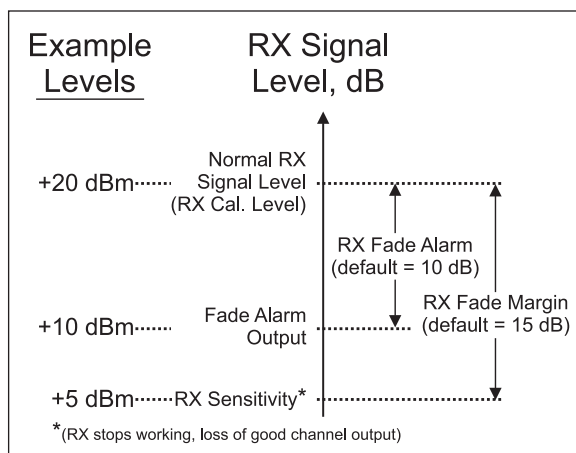
Remember that when you are viewing the SOE web page, it is not being refreshed on an automatic basis. If you want to see if any new events have occurred since you last pulled up the web page click on the little refresh oval to the right of the web page screen. Do not click on the normal browser refresh button in the top menu line. If you do you will be sent to the UPLC-II™ Home page.

### 5.10 Home Page

The home page (Fig. 5–17) shows the general status and settings of the unit at the time the home page was requested by your browser, as well as other information. In the main blue bar at the top of the page is the date and time when the web page was requested as well as the status of whether or not the unit is time synched to an IRIG-B signal. In addition, two title lines which identify the unit to which you are connected are shown, provided this text string has been set. The main blue bar on the left of the screen shows the IP address of the unit connected, the current configuration it is set for and the catalog number of the unit at the bottom. Also it shows all the menu buttons from which you can choose based on the user log-in & configuration setting. Following are the 3 main sections to the home page.

#### 1. Settings Table

- Shows the fixed basic settings (complete settings are viewed on settings pages) which only change if you change the settings
- Shows RX sensitivity which changes only after each calibration of the receiver to the remote transmitter. This is the minimum level at which the RX will work. (See the following table for RX sensitivity levels corresponding to certain RX levels at which calibration was performed. The following figure provides an explanation of RX Sensitivity, Fade Alarm, and Fade Margin.)



#### RX Fade Alarm & Fade Margin

#### 2. Status Table \*

- Shows actual measured TX / RX levels (Note: The RX level is only accurate after calibration of the receiver.)
- Shows Keyed State of TX and RX Signal State
- Shows actual measured TX Reflected Power percentage and RX fade margin, which should always be equal to the Fade Margin setting above in the Settings Table after RX calibration.
- “Display Watt/Volts” (or dBm/db) button to the right allows for changing the units displayed for these measured values

#### 3. Alarm LEDs \* (Green circle = Healthy, Red triangle = Fail/Alarm, Grey circle = Option not present)

- Shows General Alarm indicating overall hardware health for the entire unit.
- Shows specific alarms for Power Amp & Power Supply modules.
- Shows 2 other configuration specific alarms

\*This information is updated about every 15 sec or when the browser window is manually refreshed.

Table 5–17. RX Level vs RX Sensitivity

RX Level (dBm) When Calibrated	RX Level (V) When Calibrated	RX Sensitivity with 15 dB Fade Margin (V)	RX Sensitivity with 20 dB Fade Margin (V)
+40	22.36 V	3.84 V	2.24 V
+35	13.24 V	2.34 V	1.32 V
+30	7.05 V	1.27 V	705 mV
+25	3.98 V	650 mV	398 mV
+20	2.24 V	397 mV	224 mV
+15	1.26 V	205 mV	126 mV
+10	707 mV	113 mV	70.7 mV
+5	398 mV	65 mV	39.8 mV
0	224 mV	37 mV	22.4 mV
-5	126 mV	21 mV	12.6 mV
-10	70.7 mV	12 mV	7.1 mV
-15	39.7 mV	6.7 mV	4.0 mV

5

**AMETEK**  
POWER INSTRUMENTS  
Pulsar (ISO 9001 Registered)  
UPLC ID:10.14.3.124

Log Out  
**Universal Power Line Carrier**  
Thu Dec 19 20:40:26 2013 Not Synched  
Substation X  
Line Y

**On-Off**  
Directional Comparison

**Main Menu**

- Home
- Settings
- Calibrate
- SOE Log
- Checkback
- Admin

Catalog #  
US1NEM9AFSX

**General Status Panel**

**Settings**

Channel Type	On-Off	Function	Directional Comparison
TX Frequency	250.00 kHz	RX Frequency	250.00 kHz
Bandwidth	1200 Hz		
TX Power Per Amp (Low / High)	1.0 / 10.0 W	RX Sensitivity	4.67 V
Transmitter (TX)	Enabled	Receiver (RX)	Enabled
Fade Alarm	10 dB	Fade Margin	15 dB

**Status**

TX Power	40 dBm	RX Level	41 dB
Keyed State	Start Keyed	Received State	On
Reflected Power	1.5 %	Fade Margin	15.0 dB

Display Watt/Volts

**Alarms**

General Alarm	Power Amp (Main)	Power Amp (Redundant)	Power Supply (Main)	Power Supply (Redundant)	Major Alarm (Checkback)	Minor Alarm (Checkback)
●	●	●	●	●	●	●

● - Healthy, ▼ - Fail/Alarm, ● - Module Not Present

Figure 5–17. Example of the Home Page

### 5.11 Front Panel

Limited access is available through the front panel interface of the UPLC-II™. There are 2 menus available using the “SET” or “TEST” button.

Besides these 2 menus, you may view alarms, acknowledge alarms and turn on the display after it has self-extinguished.

- To turn on the display, press any key.
- To view Alarms, press the “RIGHT” arrow.
- To acknowledge alarms, press the “DOWN” arrow.

#### 5.11.1 Password Access

A password is required to make any changes to settings via the SET button menu but by default it is not required for the TEST button menu unless set to “required” on the Admin web page. The default password is 4050. Front panel passwords can be four to nine numeric characters. The front panel password may be changed. However, it can only be changed using the front panel. To disable all front panel access, see Admin page (Fig. 5–3).

#### 5.11.2 Front Panel Display

The display (Fig. 5–18) goes into sleep mode after a few minutes of inaction. Press any key to wake it up. In the upper right corner an alarm state indication can occur. If it does, the display will alternate between the main screen and the alarm code screen. See Troubleshooting in Chapter 4 for a list of the 3

or 4-letter alarm codes. Also in the lower right corner are 3-letter RX state codes shown below.

#### ON/OFF Mode

- BLK Blocking signal received
- OFF No signal received

#### FSK Mode

	LOC	Loss of Channel
	NOI	Noise detected
	GRD	Guard
	CBT	Checkback Trip
	TRP	Trip
3F Only	CB1	Checkback Line Relay trip
	CB2	Checkback DTT trip
	LRT	Line Relay Trip (same as UB or POTT trip)
	DTT	DTT Trip
4F Only	TPA	Trip A
	TPB	Trip B
	TAB	Trip A and B

#### 5.11.3 Set Button Menu

The “Set” button menu (Fig. 5–19) changes depending on the configuration mode setting (ON/OFF, FSK-2F, etc.). Pressing “SET” also displays the 11-digit catalog number of the UPLC-II™ and prompts for the password. Once entering the password, limited functionality is available as shown in the following menu tree. This menu must be accessed to view or change the IP address.

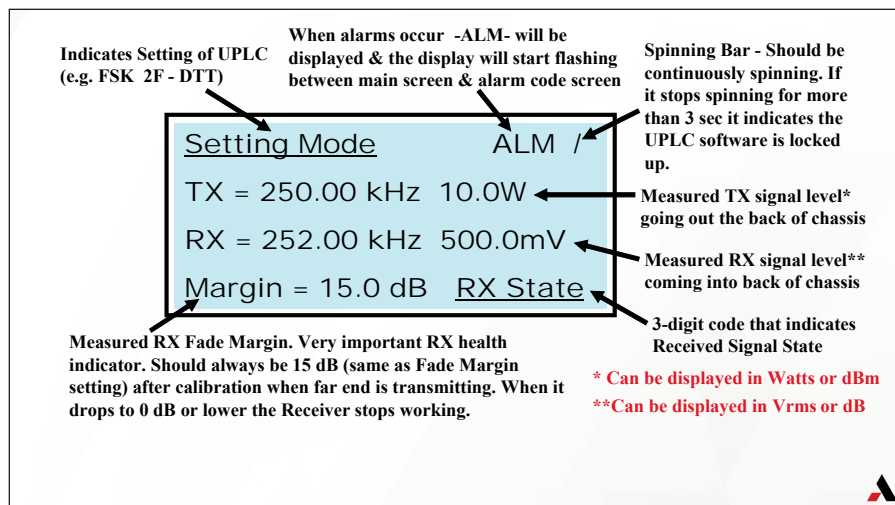


Figure 5–18. UPLC-II™ Front Panel Display



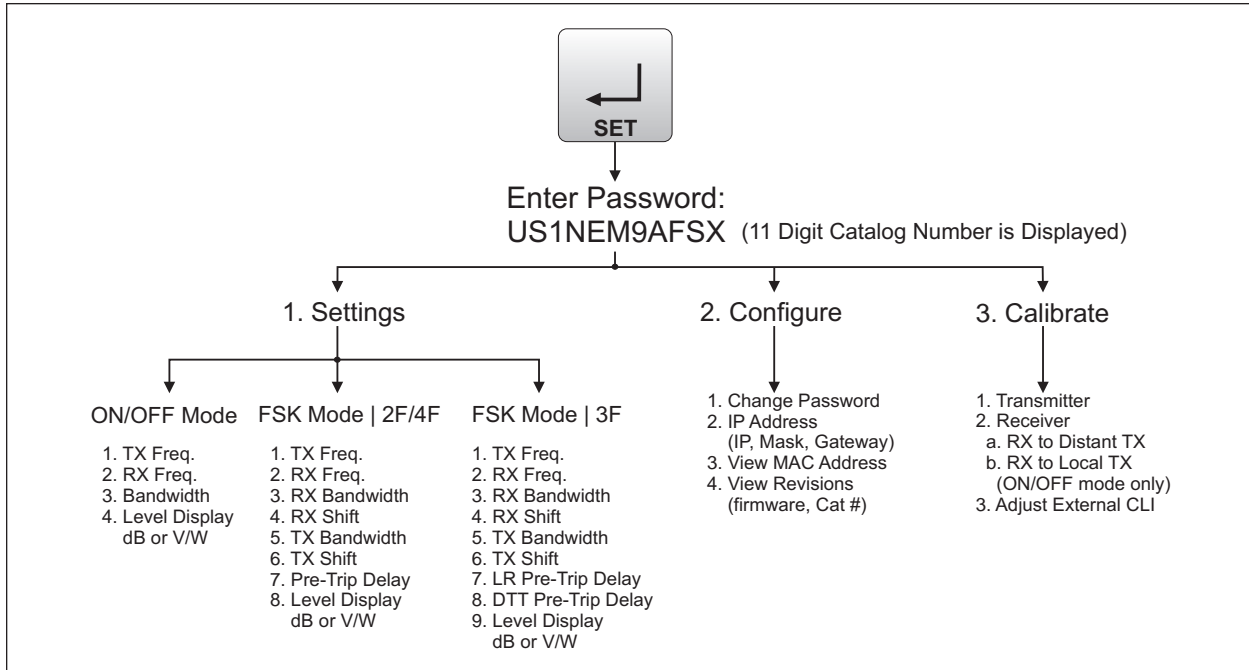


Figure 5–19. UPLC-II™ SET Button Menu (ON/OFF & FSK)

**5.11.4 Test Button Menu**

See Figs. 5–20, 21, 22. Pressing the TEST or Left arrow allows you to test the functionality of the unit. It also shows the TX reflected power percentage on the top line above the TEST menu. This TEST menu can be password-protected if desired (see Figure 5–3).

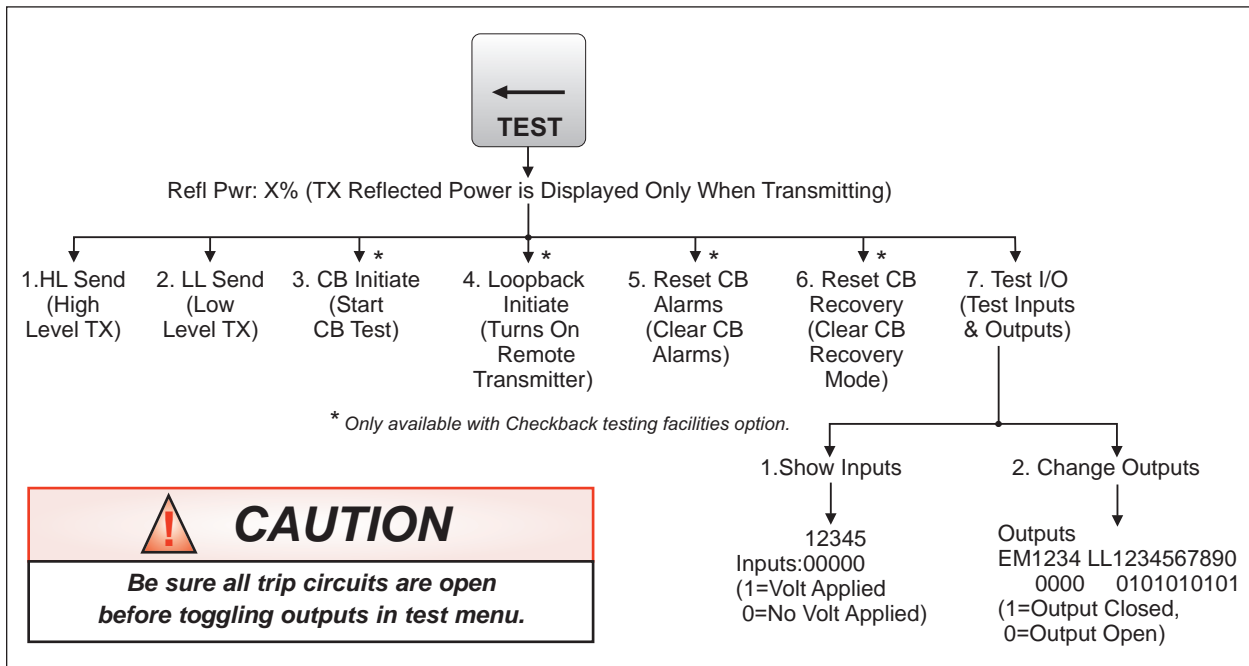


Figure 5–20. UPLC-II™ TEST Button Menu (ON/OFF Mode Only)

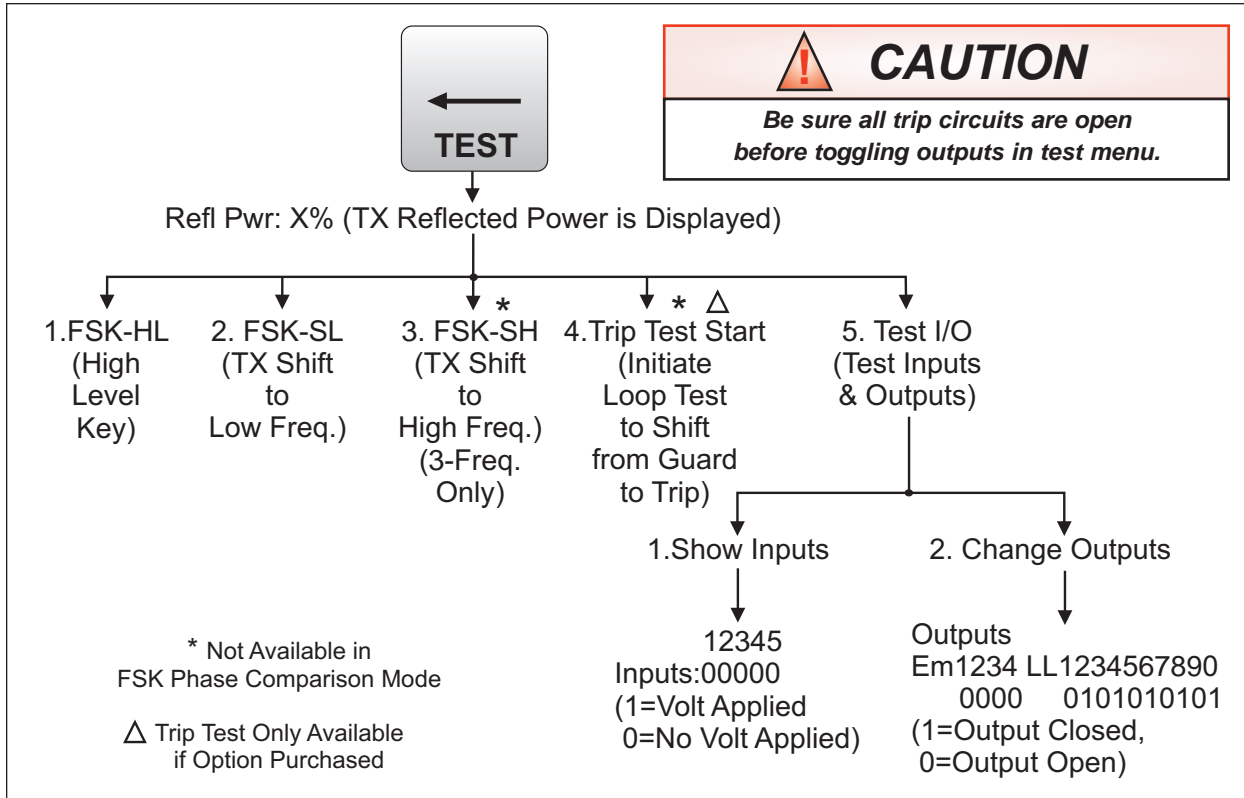


Figure 5–21. UPLC-II™ TEST Button Menu (FSK: 2-Freq, 3-Freq & Phase Comparison)

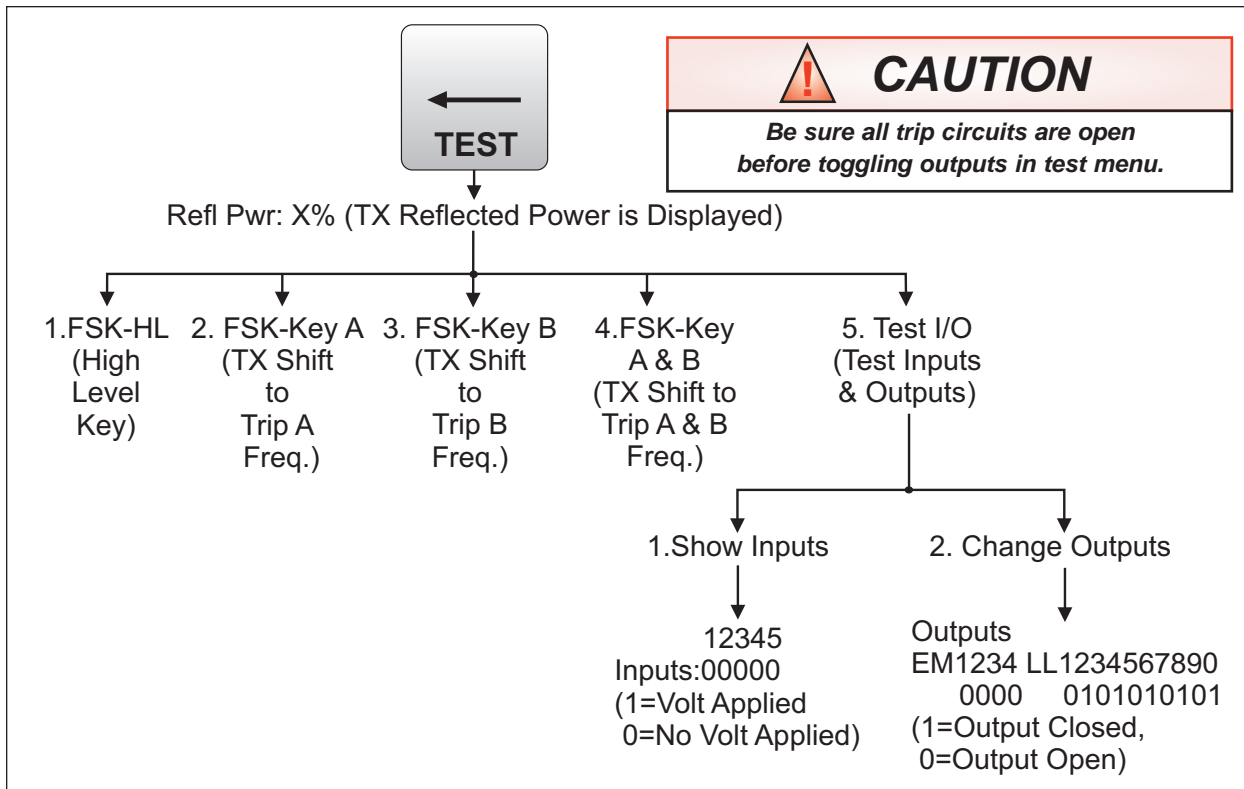


Figure 5–22. UPLC-II™ TEST Button Menu (FSK 4-Frequency Only)

## 6. Testing Facilities

An optional test capability for the UPLC-II™, if purchased, is available to perform manual or automatic testing. The same capability does two different functions depending on whether the UPLC-II™ is in ON/OFF or FSK mode.

For ON/OFF mode, because the system is not transmitting most of the time, there is a need to periodically verify that the Transmitter and Receiver are functional. This is accomplished in the UPLC-II™ with a Checkback (CB) Tester that does a periodic test to each Transmitter and Receiver in the system.

For FSK mode the system is always transmitting and receiving a Guard frequency, but very rarely is the frequency shifted to Trip. For customers that want to verify their system will shift to trip when called upon to do so, the UPLC-II™ has an FSK Trip Test feature. It uses the guard-before-trip logic and sends a trip frequency loop test without causing a real Trip output.

Testing is always over ridden by protective relaying operation.

### **ON/OFF Mode Automatic Checkback (CB) Feature**

#### **6.1 General Description**

The Checkback Tester is an AMETEK proprietary test because there is no industry standard for checkback tests. This means that all Power-Line Carriers communicating with the UPLC-II™ Checkback Tester must be able to run an AMETEK type of checkback test. The following AMETEK products are compatible with the UPLC-II™ Checkback Tester:

- Another UPLC-II™ with checkback test option
- UPLC with Checkback test option
- TC-10B with a Universal Checkback module
- Any other Power-Line Carrier with a Universal Checkback Standalone UCBS Tester connected to it

6

#### **Checkback Test Facility (Quick Checklist, if not working)**

1. Verify that you calibrated all Receivers properly. RX margin measured value (bottom line on display) should be the default of 15dB, or whatever RX margin setting was chosen, when keying either distant or local transmitter.

Each Receiver stores 2 settings – for Distant Transmitter and Local Transmitter.

2. Check UPLC-II™ settings:

- “Logic” Tab Settings

CHECKBACK	Set to ENABLED
COMMON START/STOP KEYING INPUT	Set to DISABLED (Unless Interfacing with EM Relay, KA-4 or Equivalent)

- “Checkback” Tab Settings:

- > Last Remote = number of remotes in your system (for a 2-terminal line = 1)
- > Verify that the Checkback settings are the same in all UPLC™ units, (also TC-10B or UCBS–Standalone Checkbacks), except for the address (Master, Remote 1, Remote 2 etc.)

3. Verify that no STOP or START carrier is applied to the UPLC-II™ inputs.



A normal checkback test consists of one unit addressed as the master sending a test to 1 or more units addressed as remotes and those units responding back to the master. To accomplish this, a unique time period carrier ON pulse or multiple pulses are sent which the other units recognize as a test. These pulses are sent in the same way as when a blocking carrier signal is sent but it is their precise time period and/or pulse pattern that identifies them as a test. All checkback testing is immediately shut down if there is a carrier start or stop input to the UPLC-II™ coming from a protective relay due to the way the UPLC-II™ keying logic is designed.

## 6.2 Checkback (CB) Settings

### 6.2.1 General Information

The general rule for Checkback settings is to set all units in a system with the same settings except each unit will have a different module address (master, remote # 1, remote #2, etc.). This should be followed for optimum results. Which unit is master or remote is really not critical, except that it is recommended to make the UPLC-II™ the master with mixed systems that have other non-UPLC™ units. Also if IRIG-B is only being used at one UPLC™ for time stamping, then make that location the master and the other non-IRIG-B units can be synchronized to it if desired.

### 6.2.2 Primary Communications Mode

The primary communication mode of the checkback relates to the speed and capability of the checkback test.

In the coded mode the test operates at approximately 60 bits per second with the carrier being pulsed on and off as fast as 1/60th of a second depending on the data stream. This has been found to be a very reliable communication speed.

In the timed mode, however, it operates much slower with the carrier being pulsed on for a 5, 10, or 15 sec time period depending on whether the master, remote #1 or remote #2 are being talked to, respectively. The timed mode is very reliable and in general this extra reliability is not needed. We only recommend setting the "Primary

Communication" to the timed mode for systems that are very noisy or where blocking output SOEs filling a protective relay's buffer is an issue.

The recommended setting is to use the "Primary Communication" set to "Coded" and the "Fallback Timed Mode" set to "Enabled" so if the coded mode fails to have a successful test it first tries a timed mode test before giving any alarms.

Even with the "Primary Communication" set to the timed mode, the checkback will still be operating in coded mode for sending commands (i.e. getting settings, checking events, etc.) other than doing the actual checkback tests, because if these commands were sent in the timed mode it would take several hours to process a command. Also two features are not available in the timed mode due to the reduction in data that can be sent. First, you do not get a successful checkback test output at the opposite end of where you initiated the test, only at the local end. And secondly the remote checkback only responds with high level tests regardless of whether high level or low level tests were sent to it.

### 6.2.3 Checkback Test Sequence

The normal sequence of events for a successful checkback test is that the master end sends out coded signal pulses from the local Transmitter to the remote end Receiver first. At the remote end, the signal is received by its Receiver and the checkback software tells the Transmitter to respond with a different set of coded signal pulses. The local Receiver at the master end then receives this checkback signal and indicates a successful test at the master end. If set in the "coded" primary communication mode, it then sends an acknowledgement to the remote end and the remote end indicates a successful test also. If you have a 3-terminal line and initiate a test at the Master, then the Master will communicate to Remote #1 and then to Remote #2. If you initiate a test at either Remote, then the Remote will first communicate to the Master and then to the other Remote.

With an unsuccessful test, the master end will send the initial test, then "X" number of retry tests, then (if "fallback to timed mode" is enabled) run a much slower pulse "timed" mode test before final-

ly giving a checkback major or minor alarm. So there would normally be at least 4 attempts to have a successful test, when the number of retries is set to 2, before getting any alarms. These tests would be run at both low level and high level if "Low Power Tests" are enabled with low power tests being run first. All this gives security against noise on the line or some temporary condition causing a false alarm. Major alarms occur for high power test failures and minor alarms occur for low power test failures.

### 6.2.4 Last Remote

Your network may contain more than two checkback terminals (i.e., one master and one remote). Among other things, this setting lets the unit know the final address to which it needs to send a checkback test request. If the primary communication mode is set to "timed", you can have up to four (4) remotes. If it is set to "coded", you can have up to 10 remotes.

### 6.2.5 Auto tests

Automatic checkback tests can be enabled or disabled. Normally, you would probably want them to be enabled. But if, for example, you are installing a new checkback system, you might want to disable automatic checkback tests until all units are in place. When auto tests are disabled at a unit, it does not issue checkback tests unless manually commanded by you, the user. In addition, the master unit does not issue the automatic clock update at around 12:30 AM. In other words, no unit sends any command, unless you specifically command it.

### 6.2.6 Low Power Tests

Here, you can enable or disable the low power setting during checkback tests. When enabled, all checkback tests initiated by this unit are first performed on low power, then high power. When disabled, only the high-power test is performed, except when in recovery mode during which time only low power tests are run.

### 6.2.7 Retries

During noisy line conditions, remote messages may contain errors that cannot be fixed at the destination

module. With this setting, you can specify the maximum number of times you want the module to automatically resend a message (retries). The valid range is zero (0) to 5 (times).

### 6.2.8 Automatic Tests – Time Settings

The time setting specifies how you want automatic checkback tests to be performed. You have two options:

1. Checkback Hours of the Day
2. Checkback Period

Option 1 – Automatic checkback tests are performed at your four user-specified times. These might be, say, 6:00, 12:00, 17:00, and 23:00.

Option 2 – Automatic tests are performed every so many hours, for example, every eight (8) hours.

When you set the time setting to "Hours of the Day" the master initiates a checkback test at each of these times. You can set these times only to the nearest hour, using a 24-hour format. The master actually executes a test five minutes after the hour (e.g. 4:05). This delay provides some "wiggle" room to compensate for unsynchronized checkback clocks. Remotes that have their Interval Types set to "Hours of the Day" also use these times to initiate their own checkback tests, if they do not hear from the master within a grace period. The grace period is ten minutes after the hour for remote #1, fifteen minutes for remote #2, and so on.

If you do not want to use all four times, say you are only interested in one test per day, you can simply set all of the times equal to one another. For example, you could set time #1 – #4 to 08 to perform a test at 8am every day.

When the Time Setting is set to "Checkback Period" and three tests per day are desired without caring about the time of day when they occurred, you could set this time to 8 hours. The Master attempts periodic checkback tests at exactly this time, in this case eight hours since the last test. Remotes have a grace period before they, too, attempt a checkback test, if they have not heard from the master. For example, remote #1 would do a checkback test after eight hours and five minutes, if it did not receive a checkback test from another unit.

If the current time setting is Checkback Period, this means that the “Hours of the Day” times are disabled and checkback tests occur according to the periodic interval (e.g., in the above example, every 8 hours).

When you set "Hours of the Day", these times become active and the Periodic time is inactive.

### 6.2.9 Optional Carrier Recovery

In general, if settings are set for at least 2 retries & fall back to timed mode, there is very good security against a noise burst causing a false checkback alarm. However “Carrier Recovery mode” is an ultra reliable way to verify that any checkback test failures were legitimate hardware failures and were not caused by an extended noise burst. It works together with the “delayed alarm output” when enabled. The unit starts "carrier recovery mode"

after a failed checkback test. In carrier recovery mode, the "master" only (not the “remote”) initiates a checkback test using a more frequent user interval, for example, every 15 minutes. After three consecutive successful checkback tests, the "master" reverts to normal operation and sets the "successful carrier recovery” output. If three successful consecutive checkback tests fail, the “delayed alarm” output is set. Remotes in carrier recovery mode suspend all checkback tests and wait until they receive three good checkback tests from the "master". At that time they also resume normal operation. When in recovery mode, the unit shows a “reco” alarm on the front display to indicate this state. Also note that while in recovery mode only low power checkback tests are sent, regardless of whether you have low power tests disabled or not. This ensures line conditions are good before resuming normal operation.

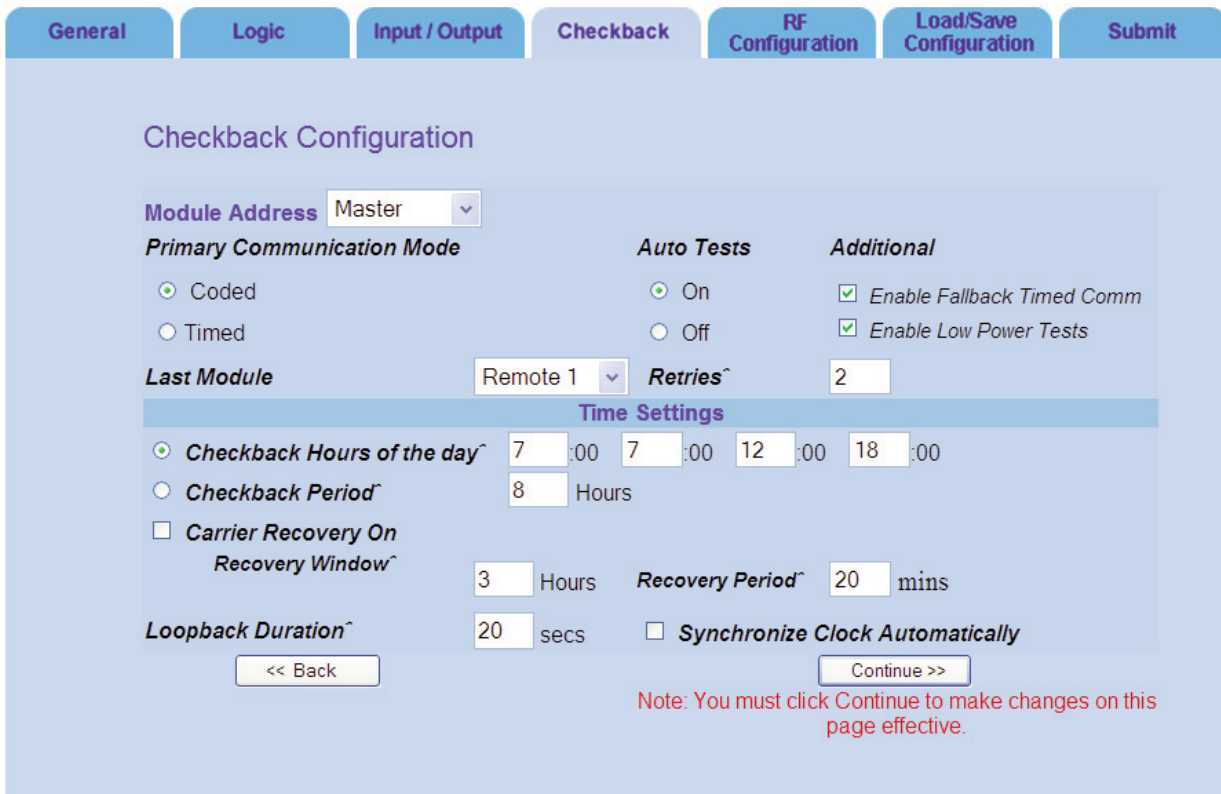


Figure 6–1. Example of the Checkback Tab on the Settings Page (ON/OFF Mode)

**Table 6–1. Checkback (CB) Settings**

Checkback Setting Name	Selections	Description	Typical Setting
<b>Module Address</b>	Master, Remote 1–10	Set each unit's address that controls which unit will initiate the tests in automatic mode. (Master = addr 0).	As appropriate
<b>Primary Communication Mode</b>	Coded or Timed	How fast and how many pulses will be sent during the test (coded = pulses at up to 60 bps, timed = 1 pulse with minimum pulse width of 5 sec).	Coded
<b>Last Module</b>	Remote 1–10 (coded mode) Remote 1–4 (timed mode)	Specify how many total remotes are in your system.	For 2-terminal system = Remote 1, for 3-terminal system = Remote 2
<b>Auto Tests</b>	On or Off	Set ON for regular testing, and if enabled, recovery mode tests to run automatically.	On
<b>Retries</b>	0–5	If the initial test fails, number of additional tests to perform before allowing alarms.	2
<b>Enable Fallback Timed Comm</b>	Enabled or Disabled	If Primary Communication Mode is set to coded, then when enabled this will run an additional "timed" long pulse test before giving any alarm outputs.	Enabled
<b>Enable Low Power Tests</b>	Enabled or Disabled	When enabled, run tests not only at high power but also at low power to check for RX margin.	Enabled
<b>Checkback Hours of the day *</b>	From 1 to 4 times per day at a specific hour (military 24 hour time)	Run automatic tests at up to 4 specific times during the day.	Enabled and all 4 times set to a particular hour of the day for once/day test
<b>Checkback Period*</b>	1–99 hours	Run automatic tests at this time interval.	Disabled
<b>Carrier Recovery On **</b>	Yes or No	After a checkback test failure, this is an ultra secure mode to verify the system is really bad, which works with the Checkback Delayed Alarm output. Multiple tests are run in a sped-up mode to verify system is bad.	Off
<b>Recovery Window **</b>	1–24 hours	After a checkback test failure, this is the time window in which 3 consecutive good tests have to be received to recover and have no Checkback Delayed Alarm output.	When used, set to 3 hrs
<b>Recovery Period **</b>	5–60 minutes	Time between the recovery mode sped up tests.	When used, set to 20 min
<b>Loopback Duration</b>	4–60 seconds	When a "Loopback" test is run it turns on the remote Transmitter for this amount of time to allow measurement of receive signal.	20 seconds
<b>Synchronize Clock Automatically</b>	Enabled or Disabled	Synchronizes the remotes' clocks with the master's clock once per day at 12:30AM.	Enabled, if IRIG-B not used

\* Choose between these 2 checkback timing modes for either a specific hour of the day or a particular time interval.

\*\* **Blue Cells:** These settings all work together when using the carrier recovery mode option.

### 6.3 Checkback Tester Inputs/Outputs

Table 6–2 lists all the inputs and outputs available for the checkback test option. All 3 inputs are meant to be momentarily pulsed on and should not have a continuous input applied. You can program the alarm outputs to seal or just momentarily toggle when an alarm occurs. When you select sealed operation, the alarm outputs stay in their active, or energized, states as long as the alarm exists. If you select momentary, the outputs go to their active states for only five seconds, then return to their previous states. For example, assume alarms are set to momentary action and the major alarm active state is closed. Normally this output is open. When a major alarm occurs, the MAJOR ALARM output closes for five seconds then opens again. The MAJOR ALARM output does not change (again) when the major alarm is cleared.

**Table 6–2. Checkback (CB) Inputs/Outputs**

Inputs	
Menu Selection	Description
Checkback Initiate <sup>1</sup>	Pulsing this input initiates a checkback test & resets Major/Minor Alarms.
Checkback Reset <sup>2</sup>	Pulsing this input resets all checkback alarms & recovery mode.
Loopback Test <sup>1</sup>	Pulsing this input initiates a loopback test to turn on the remote transmitter for “X” seconds per setting.
Outputs	
Menu Selection	Description
CB Off	Activates when all checkback tests are completely disabled in settings.
CB Passed	Activates & latches after successful checkback test.
CB Major Alarm	Activates & latches when failing a high-power test.
CB Minor Alarm	Activates & latches when failing a low-power test.
CB Delayed Alarm	Activates & latches when failing to recover from the auto recovery mode before the recovery windows expires.
CB Carrier Recovered	Momentarily activates for 1 second after a successful recovery before the recovery window expires.
CB In Recovery Mode	Activates in recovery mode. (Note: Goes into recovery mode after failing CB hi-power test).
CB Test In Progress	Activates at end that initiates checkback test during the whole checkback test, but activates after a few seconds during checkback test at remote end.
CB Auto Tests Disabled	Activates when automatic checkback tests are disabled in settings.

<sup>1</sup> Input must be applied for  $\geq 15$  msec.

<sup>2</sup> Input must be applied for  $\geq 2.0$  sec.



## 6.4 Performing Checkback Tests/Functions

The Checkback system's primary function is to perform checkback tests, verifying that your carrier communication path is operating. You can perform checkback tests in several ways:

- Manual request from the front panel test menu
- Manual request from the checkback page
- Manual request from an external source via an input set for “Checkback Initiate”
- Automatic test
- Automatic carrier recovery test
- Automatic remote-initiated tests

The Checkback system also does other secondary functions such as turning on remote transmitters and getting data from distant UPLC-II™ units.

### 6.4.1 Manual Requests from Web Pages

By clicking on the left-hand navigator “Checkback” button and using the 3 pull-down menus, you can do the following:

- A. Tests
  1. Run manual checkback test

2. Run loopback test to turn on remote transmitter only

#### B. Clear Module

1. Clear recovery mode  
(also clears all alarms)
2. Clear alarms
3. Clear checkback events counts

#### C. Checkback (Communications)

1. Update status of web page
2. Connect to distant UPLC-II™ to view;
  - Home page
  - Settings
  - Partial SOE Log

### 6.4.2 Loopback Test Capability (Turn On Remote Transmitter via the power line)

You can command a distant Automatic checkback system to key its carrier for a specified duration (e.g., 30 seconds), giving you time to measure your local receiver's level. This is called loopback tests in the UPLC-II™ and they are always performed at both high and low power. If loopback duration is set to 30 seconds, the carrier is first keyed on high power for 30 seconds, then low power for 30 seconds.

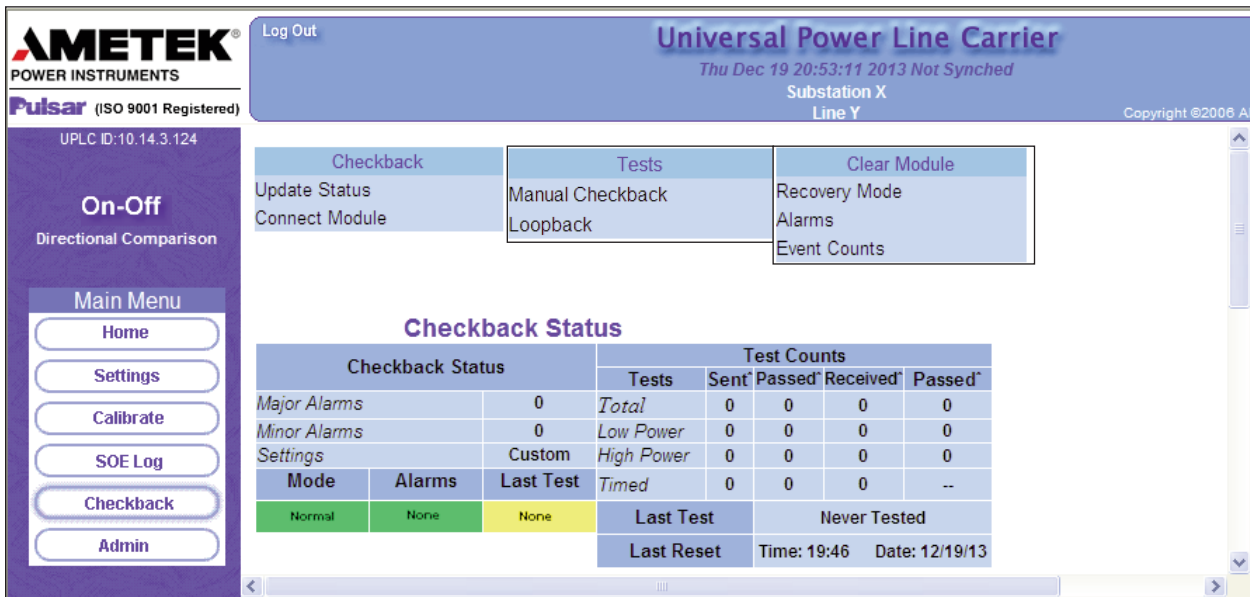


Figure 6–2. Example of the Checkback Page (ON/OFF Mode)

If you have a 3-terminal line or more terminals, a pop-up box will appear after clicking on loopback test so you can choose to which unit you want to do a loopback. (Note: The front panel TEST button menu only allows a loopback test between Master & Remote1)

### 6.4.3 Remote-Initiated Periodic Tests

If the master fails to send a test or is late, then a remote initiates its own checkback test. You can always manually request a test via the Web page or Front Panel test menu on the remote UPLC-II™. But the remote automatically does a checkback test if it detects the master is late. When a remote is set to do automatic periodic tests, it determines the master is late if it does not receive a checkback request within the user period plus some delay, or grace period. For remote #1, this grace period is five minutes.

For example, let's say your remote is set for automatic periodic testing, with a period of eight hours. If it does not receive a checkback test within eight hours and five minutes, it executes a checkback test. If this test is successful, both the master and the remote's periodic timers are restarted at roughly the same time, and the master takes over for subsequent checkback tests, if both units are set for the same periodic interval. The periodic timer starts as soon as the unit is powered, so that one will have a head start on the others. After the first successful checkback test, all the periodic timers in the network are synchronized, and the master initiates any future tests.

If you have more than one remote in your system, each has its own unique grace period. Remote #1 waits five (5) minutes, remote #2 waits 10 minutes, remote #3 waits 15 minutes, and so on.

For example, if neither remote #1 nor the master has initiated a checkback test for the interval plus 10 minutes, remote #2 executes a test.

For this scheme to work properly, it is important to keep all the settings similar. If the master is set for automatic periodic testing, all remotes should also be set this way. If not, you may have more checkback tests occurring than you would expect at equally unexpected times.

### 6.4.4 Remote-Initiated “Hours of the Day” Tests

Just as with remote-initiated periodic testing, remotes set to “Hours of the Day” testing initiate their own checkback tests if the master does not do a test in time. The “grace” period is longer for this mode: user time + 10 minutes for remote #1, user time + 15 minutes for remote #2, etc. That allows this scheme to work even when there is up to five minutes difference between the checkback units' clocks.

For automatic timed testing, the clocks in the master and the remotes should be fairly close.

You can enable the automatic clock synchronization feature to keep your clocks synchronized. When enabled, the master synchronizes all remote clocks to its own time starting at 12:30 a.m. In practice, the synchronization is rough, within about +/- 2 seconds, but that is sufficiently accurate for timed checkback testing.



## 6.5 System Troubleshooting with Checkback

You can identify and solve many checkback network problems by examining the major and minor alarms. If low power checkback tests are enabled in addition to high power tests, the major and minor alarms work like this:

- If a unit fails only the low power test, it sets the minor alarm
- If a unit fails the high power test, it sets the major alarm
- If a unit fails the high power test and can not receive its own messages, it sets both major and minor alarms

Armed with this information, you can usually identify a failed unit or line problem. The System

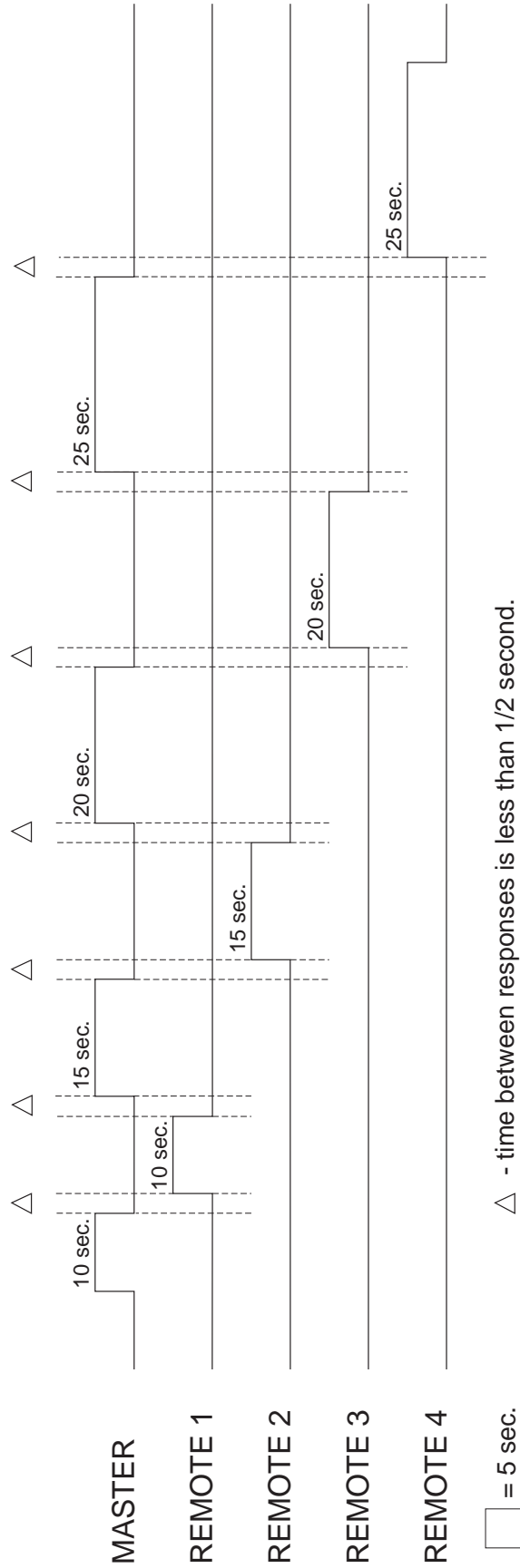
Troubleshooting table lists all combinations for a two-unit system and the probable situation.

To get the complete picture, you must wait long enough for all remotes to initiate their own checkback tests. For example, if the master has a major alarm, but the remote has no alarms, you can not determine if it failed to receive the command due to a bad line or because its receiver failed. By waiting for the remote to initiate a checkback, you can tell if it is the line (major alarm) or the unit (both alarms). Some customers use a N.O. Major alarm and a N.O. Minor alarm output in series to give a “local” alarm so they can know which end of the line has a problem. Both Major & Minor alarms occurring on one UPLC-II™ means that this particular UPLC-II™ in the system is bad.

**Table 6–3. System Troubleshooting**

ALARMS				Probable Situation
Master Module		Remote Module		
Major	Minor	Major	Minor	
clear	clear	clear	clear	All OK
clear	clear	clear	set	Weak/noisy line
clear	clear	set	clear	Master or line failed
clear	clear	set	set	Remote failed
clear	set	clear	clear	Weak/noisy line
clear	set	clear	set	Weak/noisy line
clear	set	set	clear	Weak/noisy line or master failed
clear	set	set	set	Remote failed
set	clear	clear	clear	Remote or line failed
set	clear	clear	set	Remote or line failed
set	clear	set	clear	Line failed
set	clear	set	set	Remote failed
set	set	clear	clear	Master failed
set	set	clear	set	Master failed
set	set	set	clear	Master failed
set	set	set	set	Master and remote failed

Figure 6-3. Timed Checkback Sequence (Master Initiation)



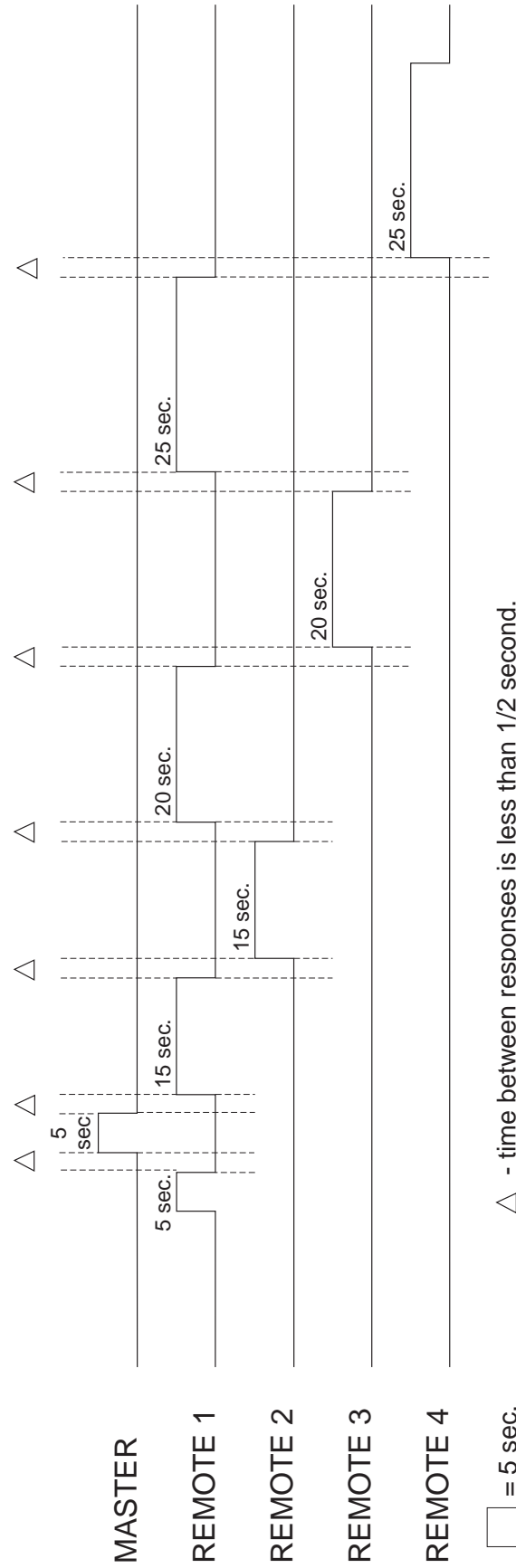
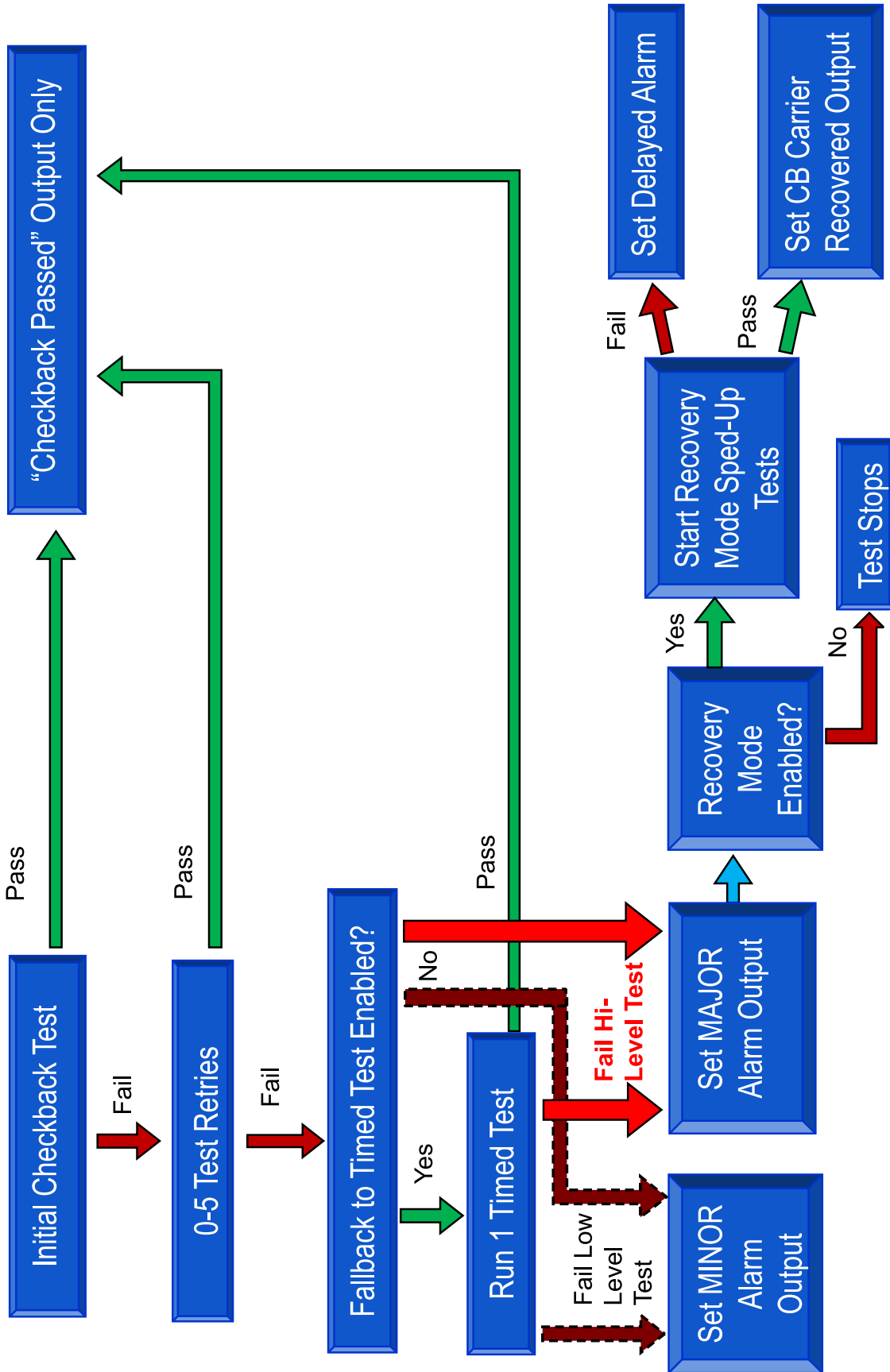


Figure 6-4. Timed Checkback Sequence (Remote 1 Initiation)

Figure 6-5. Checkback Test Sequence



## FSK Mode Trip Test Feature

Trip Test Inputs/Outputs, Web pages and timing diagrams are at the end of the chapter.

### 6.6 General Description

The optional Trip Test is designed to test FSK two-frequency or three-frequency mode and is compatible with the TCF-10B's Trip Test option. Two transmitters with trip test, one at each end of the line, are needed to perform this testing function.

Trip testing will only work on 2-terminal lines and is not functional on 3-terminal lines or more.

The Trip Test can be used to functionally test the transmitters and receivers at both ends of a two terminal line with having only a person at one end.

The Trip Test on the UPLC-II™ works in conjunction with the local receiver as well as the remote receiver and transmitter to test the ability of the system to shift the transmitter to the trip frequency and receive the trip frequency at the opposite end.

For 2-frequency FSK systems, the trip test can be set for a “real” trip or a “checkback” trip. The “real” trip will produce an output of the receiver logic TRIP. A “Checkback” Trip setting will provide only a checkback trip output from the receiver logic, which can be used to pick up an auxiliary relay or indicating light. Only the “checkback” trip setting can be used for 3-frequency systems.

#### 6.6.1 Two Frequency Applications Real Trip Scenario

Please refer to the timing diagrams at the end of the chapter.

In this application, the local end, at which you initiate a Trip Test, will receive a real TRIP as well as a CHECKBACK TRIP, but the remote end will only produce a CHECKBACK TRIP. When using this application the end that initiates the trip would have to be disconnected from the trip relays.

When a trip test is initiated, the local transmitter shuts down for 2 seconds. The remote end receiver will see this as a loss of channel. After 2 seconds, the local transmitter then keys to the trip fre-



## CAUTION

- If the unit is set for a real trip, then caution should be taken to open the trip circuit path so as not to mistakenly trip out a breaker or lockout relay on a Direct Transfer Trip system.
- The required logic must be set for “GUARD BEFORE TRIP”.

quency for 2 seconds. The remote end recognizes this as a Trip Test command and the remote receiver will then produce a CHECKBACK TRIP and key the remote transmitter to the trip frequency for 2 seconds. The local end receiver sees that as a REAL TRIP and produces a TRIP and CHECKBACK TRIP output.

#### 6.6.2 Two Frequency Application Checkback Trip Scenario

In this application, both the local and remote ends shift to “checkback” trip. No trip outputs have to be disconnected.

When a trip test is initiated, the local transmitter shuts down for 1.5 seconds. The remote end receiver will see this as a loss of channel. After 1.5 seconds, the local transmitter then keys to the trip frequency for 0.5 second. The remote end recognizes this as a Trip Test command and the remote receiver will then produce a CHECKBACK TRIP and shut down the remote transmitter for 2 seconds. The remote transmitter is then keyed to the trip frequency for 0.5 second. This in turn produces a loss of channel and CHECKBACK TRIP (without a real TRIP) at the local end.

#### 6.6.3 Three Frequency Applications Checkback Trip Scenario

In this application, both the local and remote ends shift to “checkback” trip. No trip outputs have to be disconnected. Both trips, DTT & LR (unblock/POTT) are tested. DTT is low frequency and LR (unblock/POTT) trip is high frequency.

When a trip test is initiated, the local transmitter shuts down for 1.5 seconds. The remote end receiver will see this as a loss of channel. After 1.5 seconds, the local transmitter then keys to the lower trip frequency for 0.5 second. The remote end recognizes this as a Trip test command and the remote receiver will then produce a CHECK-

BACK TRIP1 and shuts down the remote transmitter for 2 seconds. The remote transmitter is then keyed to the lower trip frequency for 0.5 second. This in turn produces a loss of channel and DTT CHECKBACK TRIP (without a TRIP) at the local end's receiver. Then the system needs to check for the LR TRIP function. In a similar way, the local end will send a LR CHECKBACK TRIP to the remote and the remote receives and then returns a LR CHECKBACK TRIP to the local receiver.

### 6.6.4 Trip Test Initiation

You initiate a trip test sequence by front panel testing, web page request or asserting the trip test initiate input (if programmed).

### 6.6.5 Trip Test Pulse

This optional feature is used to verify that the actual Trip Key input is operating by applying a 0.1 sec pulse to it at the beginning of the Trip Test. This pulse is prevented from causing an actual Trip Key during the test and is used only to verify the input is good. This feature is only enabled when an output is set to "Trip Test Pulse".

**Table 6–4. Trip Test Inputs / Outputs**

Inputs	
Menu Selection	Description
Trip Test	Pulsing this input initiates a Trip Test.
Disable Trip Test	When activated the Trip Test is shut down.
Outputs	
Menu Selection	Description
Trip Test Failed	Activates and latches when the Trip Test fails.
Trip Testing	Trip Test in progress. Activates at end that initiates Trip Test during the whole test, but activates after a few seconds at remote end.
Trip Test Pulse	When selected, this activates a special Trip Test mode requiring this output to be externally wired to the input which is set for keying Trip. If the pulse is not received at the beginning of the test then the Trip Test fails. Used to verify Trip Key input circuit is good.

**Trip Test Configuration**

**Channel - FSK**                      **Function - DTT - 2F**

**Auto Tests**                       On     Off

**Trip Test Type**                       CB Trip     Real Trip

**Time Settings**

**Trip Test Hours of the day**    08 :00 08 :00 14 :00 0 :00

**Trip Test Period**                      24 Hour(s)

Note: You must click Continue to make changes on this page effective.

Figure 6–6. Example of Trip Test Tab on the Settings Page (FSK Mode)

**FSK**  
3-Frequency

**Main Menu**

- 
- 
- 
- 
- 
- 

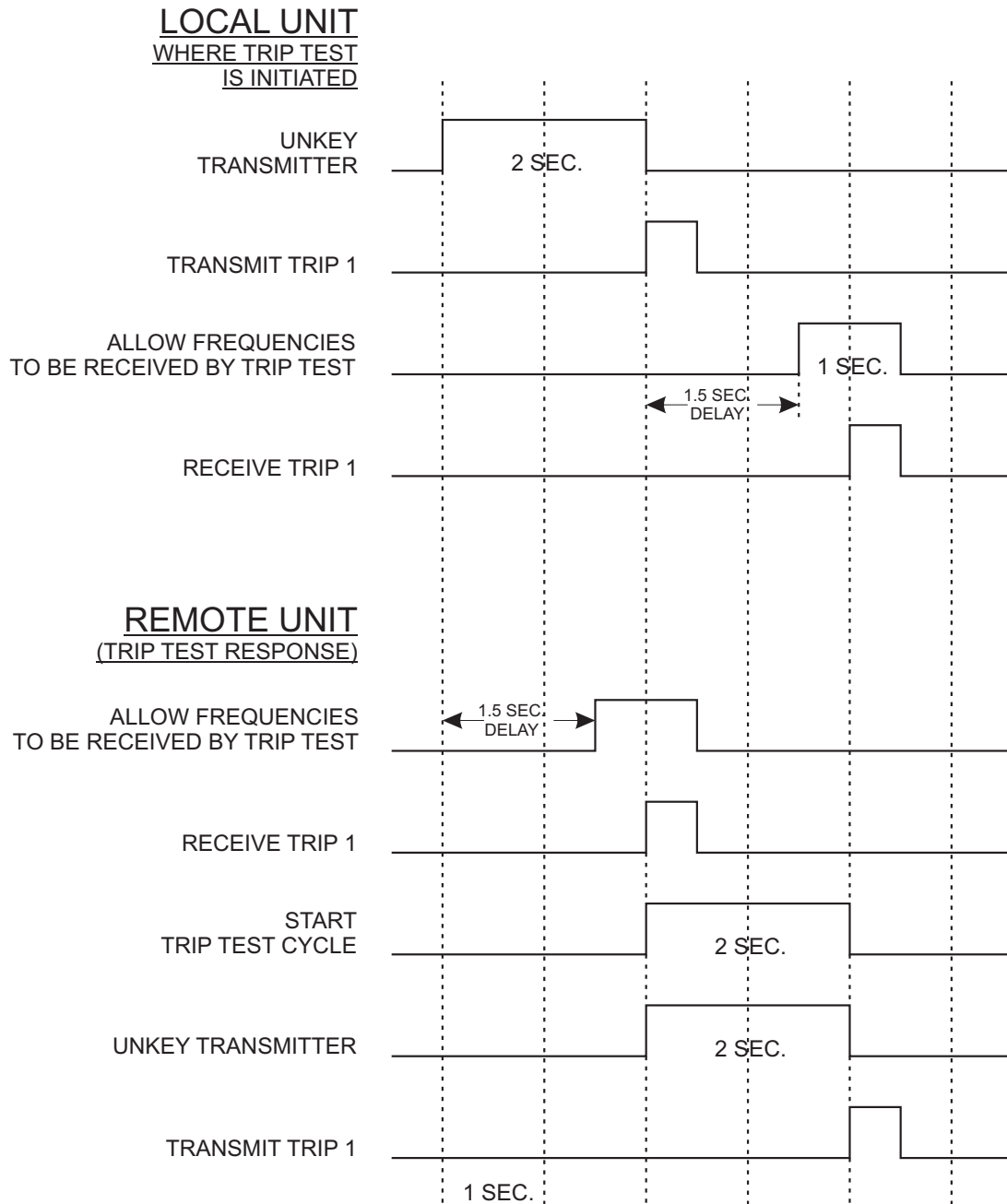
Perform Trip Test

Test Counts			
Sent	Passed	Last Test Sent	Total Received
6	1	Fail	297

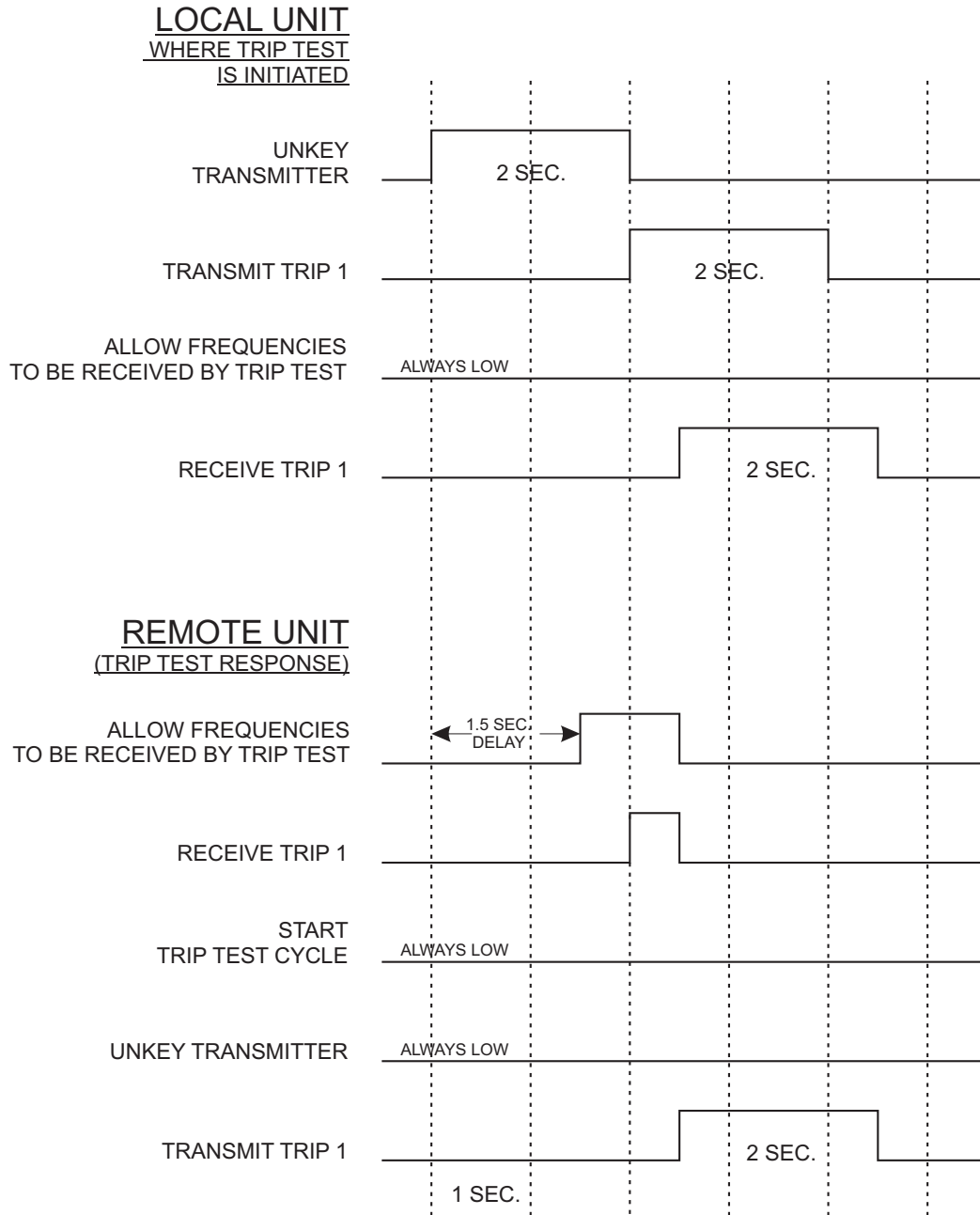
<b>Last Test Sent:</b>	Time: 18:28:34	Date: 2/20/14
<b>Last Reset:</b>	Time: 22:02:02	Date: 2/7/14
<b>Alarms:</b>	Alarm ON	

Figure 6–7. Example of Trip Test Page (FSK Mode)

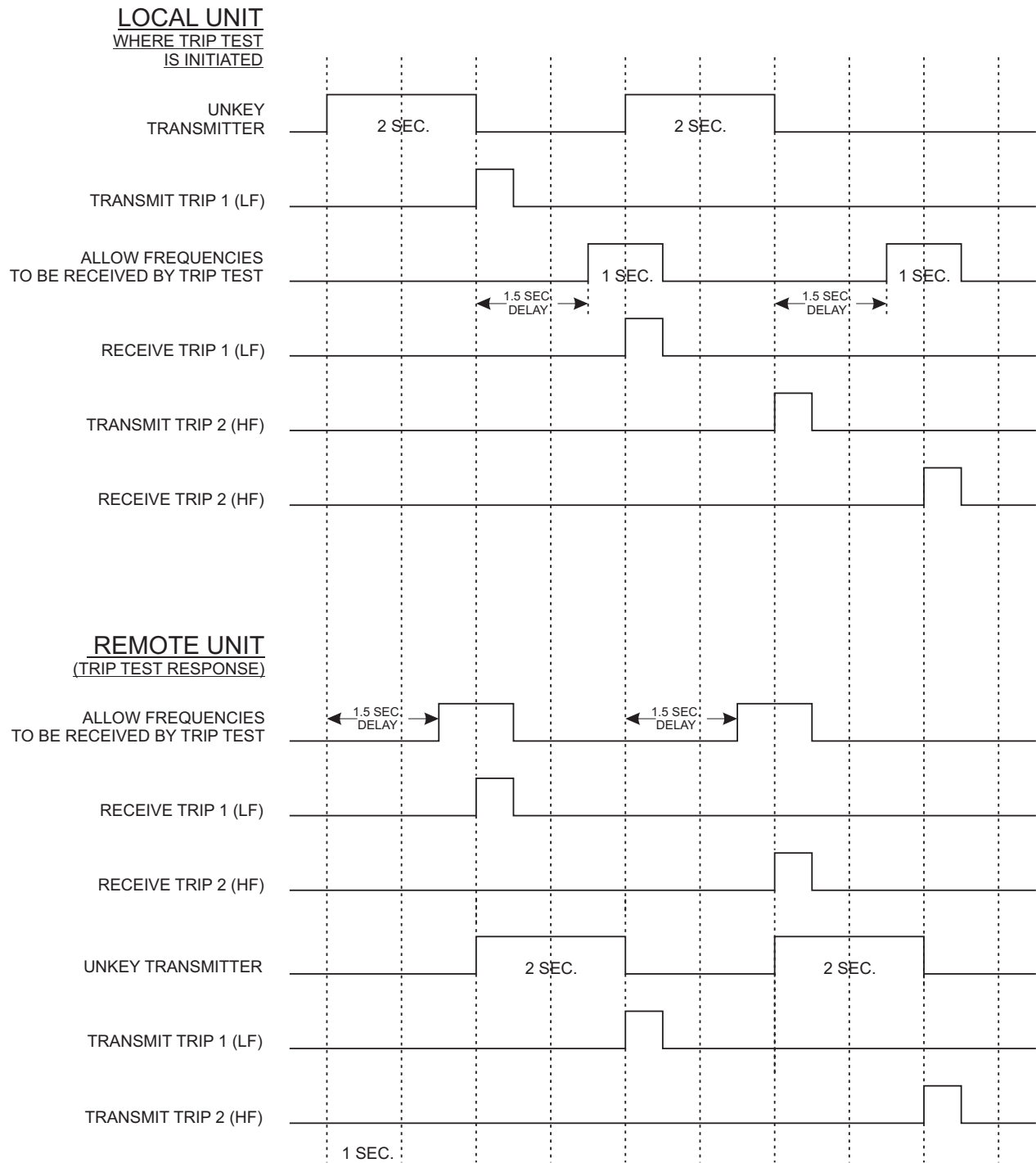




**Figure 6–8. Trip Test 2-Frequency Checkback Trip Timing Diagram**



**Figure 6–9. Trip Test 2-Frequency Real Trip Timing Diagram**



**Figure 6–10. Trip Test 3-Frequency Checkback Trip Timing Diagram**

# 7. Communication Protocols

The UPLC-II™ is available with separate protocols. The Distributed Network Protocol, DNP 3; and the IEC61850 object oriented standard.

## 7.1 DNP 3

The UPLC-II™ can communicate via DNP 3 using one of the following ports/standards.

- Std. rear 9-pin D-sub connector (J4) via RS-232\* (Use Std. Straight-through 9-pin Serial Cable, Male to Female)
- Standard rear 9-pin D-sub connector (J4) via RS-485 (TX- = pin#2, TX+ = pin#8, RX- = pin#3, RX+ = pin#7)
- Optional rear Ethernet connector (TX1/RX1 or TX2/RX2) via TCP/IP-UDP

The account holder must have “User” privileges to set the DNP communications.

The UPLC-II™ DNP communications works in a slave mode as an outstation device and supports level 1 & 2 of the DNP 3 protocol. A DNP device profile can be generated by downloading the UplcDnpCfg.xml file into a folder with the appropriate DNP device profile xsd, xsx & xslt files (2009) and then opening the UplcDnpCfg.xml file.

### 7.1.1 DNP 3 Settings

#### 7.1.1.1 Main DNP Web Page Settings

The following settings must be made on the main DNP page.

- 1) Click on the Admin button in the left task bar.
- 2) Next, click on the Protocol Tab.

\* Terminal Emulator Program Settings:  
Data Bits/Per Word = 8  
Stop Bits = 1  
Parity = None  
Flow Control/Handshake = None

3) Finally, click on the DNP Tab.

If the physical layer is set to RS-232 or RS-485 mode, a Baud rate must be chosen. For the TCP/IP-UDP mode, an IP port must be chosen.

Physical Layer = RS-232 or RS-485

- Baud = 2400, 4800, 9600, 19200, 38400 or 115200

Physical layer = TCP/IP-UDP

- IP Port = 20000 (default) or 49152–65535
- UPLC-II™ DNP address = 1–65519
- Link Layer Confirm = Never, Multi or Always
- Unsolicited Responses = Disabled or Enabled

If “Unsolicited Responses” is enabled, the following additional settings must be made.

- Master DNP Address = 1–65519
- Confirmation Timeout (secs) = 1–60
- Number of Retries = 1–5 or indefinite

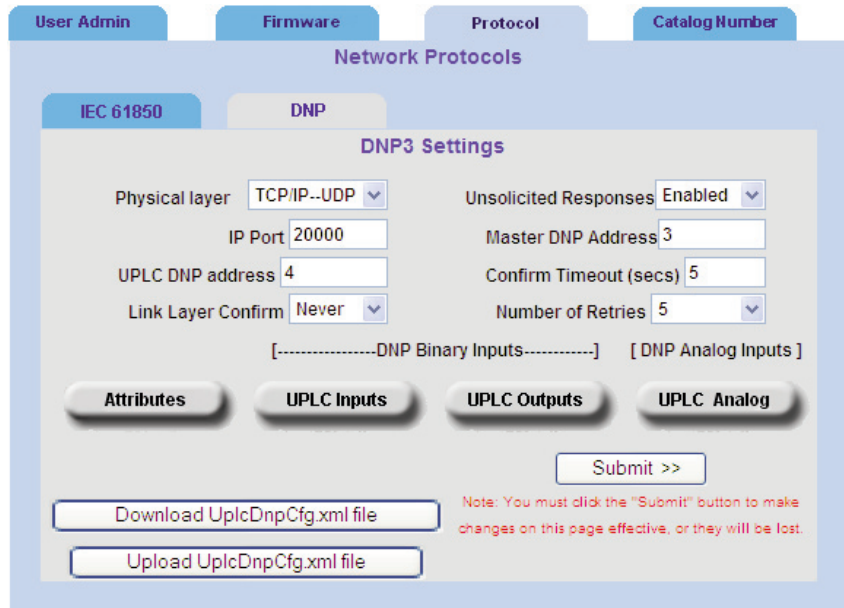


Figure 7–1. DNP Page (Admin > Protocol > DNP)

### 7.1.1.2 Secondary DNP Web Page Settings (Setting Up Data Points)

The UPLC-II™ sends only Binary Inputs and Analog Inputs to an RTU or SCADA master station. There are no DNP Outputs accepted by the UPLC-II™ from an RTU or SCADA master station. All points are programmable as to whether they will be included in a particular class poll and also to what variation (type of value) will be returned in the poll. All points can be set to a Class of “off” if the point is not valid for the selected UPLC-II™ function. All binary points in the UPLC-II™ report a value of 0 when “off” and a value of 1 when “on”.

A separate pop-up window/page appears when you click on each of the 4 buttons at the bottom of the main DNP page. Only one pop-up page can be displayed at a time. Pop-up pages should be closed after viewing or changing. To close the page, you must either click “Submit”, to send the changes to the UPLC-II™, or click the “X” in the upper right corner of the page if there are no changes.

Basic information regarding the UPLC-II™ is located on the Attributes page. The following attributes, in green cells, can be edited.

- User-Assigned Location Name
- User-Assigned ID Code Number
- User-Assigned Name for Outstation

For the 3 DNP Input Web pages,

- 1) “UPLC-II™ Inputs” (Binary)
- 2) “UPLC-II™ Outputs” (Binary)
- 3) “UPLC-II™ Analog” (Analog)

the following settings must be made in the pop-up Web pages.

- Event/Static Data Class = Off, 0–3
- Description = Long Character String that User Can Enter Describing the DNP Input
- Default Variation for Static Data = 1–3 (1-5 for Analog Inputs only)
- Default Variation for Event Data = 1–3 (1-5 for Analog Inputs only)

Please refer to the following figures.

**NOTE**  
You Can Double Click in Green Cells to Edit.

Variation	Dnp Type	Value
242	Device manufacturer’s software version string	3.06.09
243	Device manufacturer’s hardware version string	Rev 9
245	User-assigned location name or code string	Substation XX
246	User-assigned ID code/number string	Panel XX
247	User-assigned name string for the outstation	UPLC XX
248	Device serial number string	00075E000F17
249	DNP subset level and conformance	DNP3 Level 2
250	Device manufacturer’s product name and model	UPLC Model US1NSC5ANSX
252	Device manufacturer’s name string	Ametek Power Instruments, Inc.

**Figure 7–2.**  
**UPLC-II™ DNP Attributes Page**  
(Admin > Protocol > DNP > Attributes)

### 7.1.2 DNP Binary Inputs (UPLC-II™ Inputs)

The UPLC-II™ has five physical binary inputs that can be assigned numerous functions chosen from a selection menu. The following tables include all possible input selections for the UPLC-II™ ON/OFF and FSK modes. Since there are only five inputs and many possible selections, at any given

time some of these selections will be unassigned or not used. The on-line bits of these unassigned selections will be set to zero.

**Table 7-1. UPLC-II™ Inputs – DNP Points (ON/OFF Mode)**

Point	Name	Setting Mode	Definition
0	Carrier Start Key	All ON/OFF Modes	Carrier Start Input has been Keyed
1	Carrier Stop Key	All ON/OFF Modes	Carrier Stop Input has been Keyed
2	Low Level Key	All ON/OFF Modes	Low Level Keying Input has been Keyed
3	CB Alarm Reset	Checkback Option Only	Checkback Alarms have been Reset
4	CB Test Initiate	Checkback Option Only	Checkback Test has been Initiated
5	Loop Test Initiate	Checkback Option Only	Loop Back Test has been Initiated
6	User SOE 1 Key	All ON/OFF Modes	SOE Event 1 Input has been Keyed
7	User SOE 2 Key	All ON/OFF Modes	SOE Event 2 Input has been Keyed
8	User SOE 3 Key	All ON/OFF Modes	SOE Event 3 Input has been Keyed
9	High Power Key	All ON/OFF Modes	High Power Level has been Keyed
10	Low Power Key	All ON/OFF Modes	Low Power Level has been Keyed

7

Point Index	Name	Event/Static Data Class	UPLC function for which point is valid	Description	Default Variation for Static Data	Default Variation for Event Data
0	Carrier Start Key	1	All On-Off Modes	Example: Carrier started by Relay XX	1	1
1	Carrier Stop Key	1	All On-Off Modes		1	1
2	Low Level Key	2	All On-Off Modes		1	1
3	CB Alarm Reset	Off	Checkback option only		2	2
4	CB Test Initiate	Off	Checkback option only		3	3
5	Loop Test Initiate	Off	Checkback option only		1	1
6	User SOE 1 Key	3	All On-Off Modes		1	1
7	User SOE 2 Key	3	All On-Off Modes		1	1
8	User SOE 3 Key	3	All On-Off Modes		1	1
9	High Power Key	1	All On-Off Modes		1	1
10	Low Power Key	1	All On-Off Modes		1	1

**Figure 7-3. DNP Binary Inputs / UPLC-II™ Inputs Settings Page (Admin > Protocol > DNP > UPLC-II™ Inputs)**

**Table 7-2.**  
**UPLC-II™ Inputs – DNP Points**  
**(FSK Mode)**

Point	Name	Setting Mode	Definition
0	3F DTT Trip Key	3-Freq. Only	DTT Trip Input Keyed (for 3-Freq. Mode)
1	LR Trip Key	2 or 3-Freq.	Line Relaying Trip Input Keyed (Unblock/2F, UB/POTT/3F)
2	TX Power Off Key	All FSK Modes	TX RF Power Off Input Keyed (Turns TX Off for Test)
3	TX Pwr Boost Key	All FSK Modes	Power Boost Input has been Keyed
4	User SOE 1 Key	All FSK Modes	SOE Event 1 Input has been Keyed
5	User SOE 2 Key	All FSK Modes	SOE Event 2 Input has been Keyed
6	User SOE 3 Key	All FSK Modes	SOE Event 3 Input has been Keyed
7	PC Key	Phase Comp.	Phase Comparison Input has been Keyed
8	Trip A Key	4-Freq. Only	Trip Channel A Input has been Keyed
9	Trip B Key	4-Freq. Only	Trip Channel B Input has been Keyed
10	Initiate Trip Test	Testing Only Option Enabled	Trip Test Input has been Keyed (for Testing Purposes Only)
11	2F DTT/POTT Trip Key	2-Freq. Only	DTT Trip of POTT Trip Input has been Keyed
12	TX Keyed Off	All FSK Modes	Transmit Keyed Off

### 7.1.3 DNP Binary Inputs (UPLC-II™ Outputs)

The UPLC-II™ has 10 or 14 binary outputs, depending on the model. Like UPLC-II™ inputs, you can assign these outputs in numerous ways. The following tables include all possible output selections for the UPLC-II™ ON/OFF and FSK modes. Since there are more selections than outputs, at any given time some of these selections will be unassigned and their on-line bits will be set to zero.



**Table 7–3. DNP Binary Outputs – UPLC-II™ Outputs (ON/OFF Mode)**

Point	Name	Setting Mode	Definition
11	General Failure	All ON/OFF	A Hardware Failure in the UPLC-II™
12	RX Signal Off	All ON/OFF	Received Level Dropped Below Fade Alarm Setting (Active Unless Block Signal Received)
13	TX Refl Pwr Alarm	All ON/OFF	% Reflected Power has Exceeded Alarm Threshold Setting
14	RX Block Out	All ON/OFF	Carrier Block Output has Occurred
15	RX Carrier Out	All ON/OFF	Carrier Receive Output has Occurred
16	TX Main RF On	All ON/OFF	TX Level on Main Power Amp >0.5W
17	TX Redundant RF On	All ON/OFF*	TX Level on Redundant Power Amp >0.5W
18	Main PA Alarm	All ON/OFF	Main Power Amp has Failed
19	Redundant PA Alarm	All ON/OFF*	Redundant Power Amp has Failed
20	Main PS Alarm	All ON/OFF	Main Power Supply has Failed
21	Redundant PS Alarm	All ON/OFF*	Redundant Power Supply has Failed
22	CB Major Alarm	CB Option*	Failure of High Level Checkback Test
23	CB Minor Alarm	CB Option*	Failure of Low Level Checkback Test
24	CB Delayed Alarm	CB Option*	Failure to Exit Recovery Mode
25	CB Test Passed	CB Option*	Successful Checkback Test
26	CB Test in Progress	CB Option*	Checkback Test in Progress
27	CB in Recovery	CB Option*	Failed Hi-Level Test and is In Recovery Mode
28	CB Recovered	CB Option*	Successfully Recovered from a CB Test Failure, No Delayed Alarm
29	Auto CB Tests Off	CB Option*	Automatic CB Tests Have Been Turned Off

\* = Available only if the redundant module or Checkback option is present.

Point Index	Name	Event/Static Data Class	UPLC function for which point is valid	Description	Default Variation for Static Data	Default Variation for Event Data
11	General Failure	1	All On-Off Modes	Example: UPLC XX in Panel XX has failed.	1	1
12	RX Signal Off	Off	All On-Off Modes		2	2
13	TX Refl Pwr Alarm	2	All On-Off Modes		3	3
14	RX Block Out	2	All On-Off Modes		1	1
15	RX Carrier Out	2	All On-Off Modes		1	1
16	TX Main RF On	2	All On-Off Modes		1	1
17	TX Redundant RF On	2	All On-Off Modes - If Present		1	1
18	Main PA Alarm	2	All On-Off Modes		1	1
19	Redundant PA Alarm	2	All On-Off Modes - If Present		1	1
20	Main PS Alarm	2	All On-Off Modes		1	1

**Figure 7–4. DNP Binary Inputs / UPLC™ Outputs Settings Page (Admin > Protocol > DNP > UPLC-II™ Outputs)**

Table 7-4. UPLC-II™ Outputs – DNP Points (FSK Mode)

Point	Name	Setting Mode	Definition
13	General Failure	All FSK	Hardware Failure in the UPLC™
14	RX Fade Alarm	All FSK	Rec. Level has Dropped Below Fade Alarm Setting
15	RX Noise Alarm	All FSK	Noise Alarm has Occurred
16	RX Good Chanel	All FSK	Channel Good (Rec. Signal Level & Freq. OK)
17	TX Refl Pwr Alarm	All FSK	% Refl Power Exceeded Alarm Threshold Setting
18	TX Main RF On	All FSK	TX Level on Main Power Amp Above 0.5W
19	TX Red. RF On	All FSK	TX Level on Redundant Power Amp Above 0.5W
20	Main PA Alarm	All FSK	Main Power Amp has Failed
21	Red. PA Alarm	All FSK	Redundant Power Amp has Failed
22	Main PS Alarm	All FSK	Main Power Supply has Failed
23	Red. PS Alarm	All FSK	Redundant Power Supply has Failed
24	Trip 1 Out	Non-PC FSK	Trip 1 Output Present (LF Trip for 2F, Line Relay Trip for 3F, Trip A for 4F)
25	Trip 2 Out	3F/4F Only	Trip 2 Output Present (DTT Trip for 3F, Trip B for 4F)
26	Guard 1 Out	Non-PC FSK	Guard 1 Output Present (HF Guard for 2F LR Guard for 3F, Guard A for 4F)
27	Guard 2 Out	3F/4F Only	Guard 2 Output Pres. (DTT Guard/3F, Guard B/4F)
28	CB Trip 1 Out	Non-PC FSK	Checkback Trip 1 Output Present (Rec. Trip 1 Freq.)
29	CB Trip 2 Out	3F/4F Only	Checkback Trip 2 Output Present (Rec. Trip 2 Freq.)
30	Trip Pos. Out	Phase Comp.	Trip Positive Output Present
31	Trip Neg. Out	Phase Comp.	Trip Negative Output Present
32	TX Shift High Freq	All FSK	Transmit Freq. Commanded to Shift High in Freq.
33	TX Shift Low Freq	All FSK	Transmit Freq. Commanded to Shift Low in Freq.
34	TX Shift Ch A Trip	4 Freq. Only	TX Freq. Keyed to Chan A Trip Freq. (F4)
35	TX Shift Ch B Trip	4 Freq. Only	TX Freq. Keyed to Chan B Trip Freq. (F2)
36	TX Shift ChAB Trip	4 Freq. Only	TX Freq. Keyed to Chan A/B Trip Freq. (F1)

### 7.1.4 DNP Analog Inputs (UPLC-II™ Analog Values)

The UPLC-II™ has 4 analog UPLC™ measured values that can be set to be read via DNP.

**Table 7–5.**  
**UPLC-II™ Analog Values**  
**(All Modes)**

Point	Name	Definition
0	TX Signal Level	Measured Transmit Signal Level to Coax
1	RX Signal Level	Measured Receive Signal Level from Coax
2	RX Fade Margin	Measured dB RX Margin – Amount Signal can Fade & Still Work
3	Percent Reflected Power	Measured % Reflected Power for TX

7

Point Index	Name	Event/Static Data Class	UPLC function for which point is valid	Description	Default Variation for Static Data	Default Variation for Event Data
0	TX Signal Level	2	All	Example: UPLC XX 's transmit level	2	2
1	RX Signal Level	0	All		5	1
2	RX Fade Margin	Off	All		2	2
3	Percent Reflected Power	3	All		2	5

**Figure 7–5.**  
**DNP Analog Inputs / UPLC-II™ Analog Values Settings Page**  
**(Admin > Protocol > DNP > UPLC-II™ Analog)**

## 7.2 IEC 61850

### 7.2.1 UPLC-II™ with IEC 61850

IEC 61850 is the industry’s standard for peer to peer communications within a substation. Data is transmitted over an Ethernet network in the substation, eliminating much of the wiring between devices that has historically been used to interconnect them. The UPLC-II™ is used as a pilot channel with transmission line relaying and major equipment breaker protection. Since IEC 61850 protocol allows for interconnecting the devices within the substation without the usual wiring, this eliminates the labor and cost associated with physical wiring. Since a template may be created for all the different devices, and copied for each project, this also eliminates the human factor in wiring errors from panel to panel.

It is not a point-to-point system but a multicast system whereby a message is generated by the UPLC-II™ to which the other devices in the substation subscribe. A new message is sent when there is a change to one of the data items and is repetitiously sent at increasing intervals until another data change occurs. Likewise, the devices and elements the UPLC-II™ has been programmed to subscribe to will produce these messages and the UPLC-II™ will respond accordingly. These messages can be a variety of functions, such as:

- Permission to trip or a block input for pilot relaying
- Request to initiate a checkback test function
- Alarm output
- Measured value such as transmitted power out or received level.

Some specifics to be aware of:

1. The LNodeType id is “ZPLC” and the InClass is “ZPLC”.
2. The user will need to assign:
  - UPLC-II™ IEC name (the generic name the subscribing unit may use to identify the subscribed device)
  - Choose to enable the digital and/or analog GOOSE:

- MAC address (the destination address for the UPLC™ GOOSE message)  
Required to be of the form 01-0C-CD-xx-xx-xx, with the first 3 fields always 01-0C-CD-
- APPID
- VLAN Priority
- GSE Control appID

These will need to be correct for the UPLC-II™ to subscribe to other devices to properly detect and process the information.

Figure 7–6 shows the GOOSE definitions page.

The .cid file will need to be uploaded to the UPLC-II™. This is temporarily created manually. It must be named “api\_uplc.cid”. Reboot is required after file upload. AMETEK will assist any customer with their configuration.

The UPLC-II™ uses the “private subscription” section of the standard, since there are not standard object definitions at this time. A sample file is available from your local AMETEK sales representative.

What’s available?

#### Settings:

- ChannelType
- RelayingFunction
- TransmitterFrequency
- ReceiverFrequency
- ONOFFBandwidth
- FSKTransmitterBandwidth
- FSKReceiverBandwidth
- FSKTransmitterShift
- FSKReceiverShift
- TransmitterHighPower
- TransmitterLowPower

#### GOOSE Outputs and Alarms:

The outputs are divided into “high speed” and “slow speed” GOOSE messaging. The outputs that

are direct protective functions are interpreted and transmitted immediately (less than 1 ms) while those that are not direct protective functions are transmitted after a time period of approximately 5 ms to see if a high speed output change occurs prior to the time period. Should a high speed element change, then the message is transmitted immediately. These are outputted via the same “GOOSE” message. The only difference is the processing time. The high speed GOOSE outputs are bolded in the “Output” list below. The other outputs (as listed in Alarms) are slow speed GOOSE elements.

**Alarms**

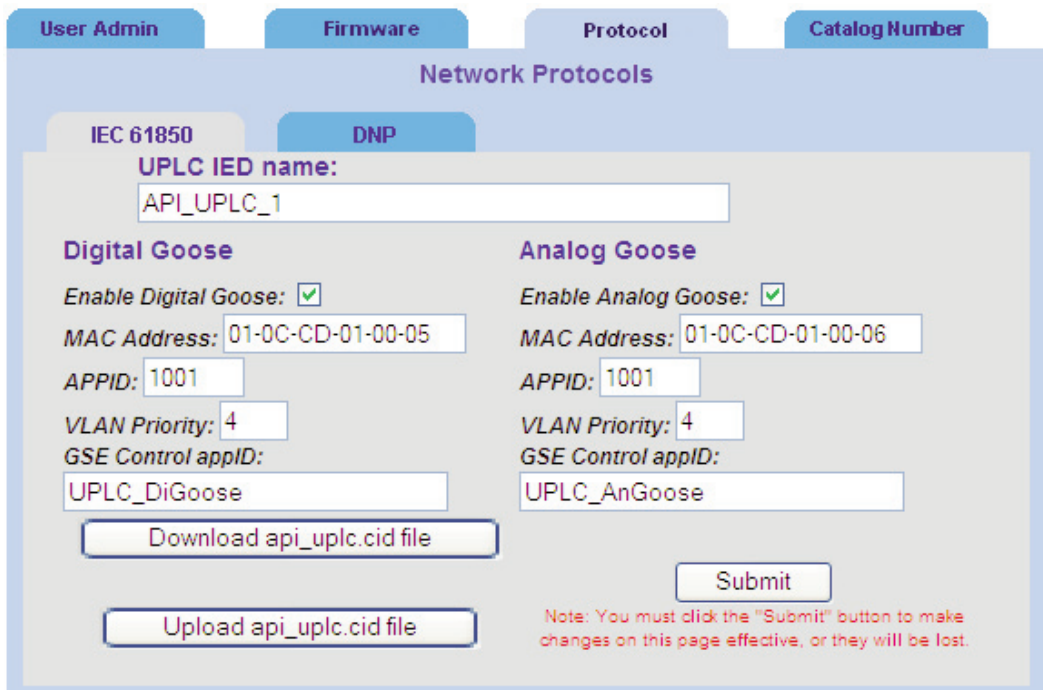
These are the data items available from the UPLC-II™ to indicate functionality/health of the device. These are non-protection based functions.

- GeneralFail
- ReflectedPowerAlarm
- TransmitterKeyedState
- ReceivedState
- PowerAmpOneAlarm
- PowerAmpTwoAlarm
- FSKLowLevel

- ONOFFCheckbackMajorAlarm
- ONOFFCheckbackMinorAlarm
- ONOFFCheckbackInRecovery
- ONOFFCheckbackAutoOff
- ONOFFCheckbackRecovered
- ONOFFCheckbackDelayedAlarm
- ONOFFCheckbackPassed
- ONOFFCheckbackOff
- ONOFFCheckbackInProgress
- ONOFFFadeAlarm
- PowerSupplyOneAlarm
- PowerSupplyTwoAlarm
- FSKFadeMarginAlarm
- FSKFadeAlarm
- FSKShiftLowFrequency

**NOTE**

For loss of goose signal data, a general alarm output will occur and there will be a GSDL alarm code on the front display.



**Figure 7–6. GOOSE Definitions Page**  
(Admin > Protocol > IEC 61850)

FSKShiftHighFrequency  
RF Output

## Outputs

These are the protection based outputs and therefore the “high” speed GOOSE data items.

FSKTripOne  
FSKGuardOne  
FSKTripTwo  
FSKGuardTwo  
FSKGoodChannel  
FSKNoise  
FSKCheckBackTripOne  
FSKCheckBackTripTwo  
FSKTripPositive  
FSKTripNegative  
ONOFFBlockingOutput

## Control

These data items allow the user to program functions for testing in the UPLC™.

ONOFFCheckbackInitiate  
ONOFFLoopback  
FSKTripTestInitiate  
FSKTripTestDisable  
FSKTripTestReset

## Subscribed data:

These are the data items that the UPLC-II™ will subscribe (listen) to. The data items must be identified in the CID file just as shown below. The remote device labeling can be anything the user desires. The position of the data item in the list is what determines the function, not the label.

ONOFFCarrierStart  
ONOFFCarrierStop  
ONOFFLowLevelKey  
ONOFFCheckbackReset  
ONOFFCheckbackInitiate  
ONOFFLoopBack

FSK52BKey  
FSKTripKey  
FSKLRKey  
FSKDTTKey  
FSKAkey  
FSKBBKey  
FSKPowerOff  
FSKTripTestInitiate  
FSKTripTestDisable  
FSKTripTestReset

## Measured Values:

These are analog values continuously sent via the analog GOOSE. These values can be used for reporting functions as needed by the user.

TransmitPowerLevel  
TransmitPowerdB  
ReceiveLevel  
ReceiveLeveldB  
Margin  
MarginPercent  
ReflectedPower

## 7.2.2 Private GOOSE Subscription Details

This section outlines the method by which the UPLC-II™ subscribes to and assigns functions to IEC 61850 GOOSE messages. The method of defining the GOOSE message that the UPLC-II™ uses is the IEC 61850 Private Data type. This section also describes the functions that can be assigned to incoming data.

Please note that the definition of “GOOSE” message within this section follows the definition of GOOSE messaging in IEC 61850 part 8, and should not be confused with UCA GOOSE messages (known as GSSE in IEC61850). You are encouraged to obtain a copy of the standard.

It is assumed that you are somewhat familiar with GOOSE messaging and the IEC 61850 standards. It is also assumed that you are familiar with the idea of configuration files using the Substation



Configuration Language (SCL), and the definitions of .ICD and .CID as device description files.

### 7.2.3 Overview

The UPLC-II™ is capable of using the Configured IED Description file as a means of defining the communications parameters and the data of GOOSE Messages that the user needs the UPLC-II™ to “listen” to and perform functions based upon the data received. This definition of the Goose message is accomplished by using an IEC private data block containing the information in a structured manner. The private data block is contained within the UPLC-II™’s .cid file, and can be edited to produce the desired data to function mapping.

When editing the .cid file, you should use a non-formatting editor such as Windows® Notepad, or if a formatting editor is used then be sure to save the file as a plain ASCII text file. The SCL interpreter is sensitive to embedded formatting characters, or ANSI escape sequences. If the .CID file contains these characters the file will not load.

Figure 7–7 shows an example of the UPLC-II™ <Private /> GOOSE subscription block.

The color coding is as follows:

Green – The <Private> </Private> block as described in the IEC61850 section “Private parts”

Blue – The UPLC-II™ private definition of a “GooseSubscription”.

Proper XML and IEC formatting require the use of a “Private namespace” denoted by the eapi: prefix, and an opening item paired with a closing item. i.e. <eapi:GooseSubscription>..... </eapi:GooseSubscription>. Note that all IEC definitions ARE case sensitive. The GooseSubscription contains the communication parameters, and the IEC data that uniquely identify the incoming GOOSE. Due to publication formatting, this line has been split into multiple lines, but in the actual .cid file, it is one long line.

Orange – order sensitive multiple definitions that correspond with the data order of the incoming GOOSE message.

These definitions allow the UPLC-II™ to call functions based upon the incoming data value. Note that the number of definitions MUST correspond to the number of data items contained in the received GOOSE message, EXACTLY. For example, if the GOOSE message contains 6 items, then there MUST be 6 definitions. This is true regardless if the

```

<Private type="AMETEK_GooseSubscription">
  <eapi:GooseSubscription iedName="SEL_421_1" IdInst="CFG" cbName="Conf" datSet="PLC"
  confRev="1" mAddr="01-0C-CD-01-00-02" maxTime="500" vlanPriority="4" appId="SEL_421_1"
  goCbRef="SEL_421_1CFG/LLN0$GO$PLC" datSetRef="SEL_421_1CFG/LLN0$PLC">
    <eapi:GooseRxEntry gooseData="FSKTripTestDisable" type="Bool" />
    <eapi:GooseRxEntry gooseData="ONOFFCarrierStart" type="Bool" />
    <eapi:GooseRxEntry gooseData="ONOFFCarrierStop" type="Bool" />
    <eapi:GooseRxEntry gooseData="ONOFFCheckbackReset" type="Bool" />
    <eapi:GooseRxEntry gooseData="UPLCNoFunction" type="Bool" />
    <eapi:GooseRxEntry gooseData="UPLCNoFunction" type="Bool" />
  </eapi:GooseSubscription>
</Private>

```

**Figure 7–7.**  
**Example GOOSE Subscription Block**



data is to be used by the UPLC-II™ as an input to the function or if the UPLC-II™ is to ignore the data. The null function “UPLCNoFunction” is provided for the purpose of ignoring the value from the perspective of the UPLC-II™.

The GOOSE subscription private data MUST be defined within the <IED>...</IED> section of the .cid file.

Below are the detailed descriptions and definitions for each of the above sections.

### IEC Private Parts

The IEC allows for the use of extensions within the .CID file. These extensions are for manufacturers’ use, and are not standardized as to the content. The unique identification of the private data objects is accomplished by using XML namespaces. A full description of this is beyond the scope of this manual. For further education you are referred to the XML standards available at [www.w3.org](http://www.w3.org) and the IEC 61850 standards.

### The UPLC-II™ GooseSubscription Definition

The UPLC-II™ GooseSubscription contains attributes that define the IEEE 802.1Q vlan information and the IEC 61850 information that uniquely identify the incoming GOOSE message. The need for the identification is to allow the UPLC-II™ to reject GOOSE messages at the various layers of the protocol.

From the example above:

```
<eapi:GooseSubscription iedName="SEL_421_1"
ldInst="CFG" cbName="Conf" datSet="PLC"
confRev="1" mAddr="01-0C-CD-01-00-02"
maxTime="500" vlanPriority="4"
a p p I d = " S E L _ 4 2 1 _ 1 "
goCbRef="SEL_421_1CFG/LLN0$GO$PLC"
datSetRef="SEL_421_1CFG/LLN0$PLC">
```

### GooseSubscription Attributes:

iedName

This is the name of the sending IED.

ldInst

The identifier of the <GSE/> protocol communication definition. Also contained in the data definition per data item within the <FCDA/> for each.

cbName

The control block name of the issuing GOOSE messages’ control block.

datSet

The data set name of the data contained within the issuing GOOSE message.

confRev

The configuration revision contained within the control block of the issuing message.

mAddr

The GOOSE messages’ destination address.

maxTime

Maximum time to live in milliseconds.

vlanPriority

The 802.1Q vlan priority level.

appId

The appId assigned to the GOOSE message by the <GSEControl /> block.

goCbRef

The IEC61850 address of the GOOSE control.

datSetRef

The IEC61850 address of the data set.

### The UPLC-II™ GooseRXEntry Definitions

When GOOSE messages are defined in an IEDs’ .cid file they consist of three separate “parts”. In the <Communication/> block there is the <GSE /> definition, which defines the destination address (“MAC address”), the APPID and the VLAN-PRIORITY. In the <IED> <AccessPoint> <Server><LDevice><LN0> block, there are two definitions that contribute to the GOOSE message:

The <DataSet> and the <GSEControl>.

The <GSEControl> creates an instance in the server that allows for control of the GOOSE messaging from the IEC 61850 client-server access.

The <DataSet> contains a list of data entries each known as <FCDA>. These entries form the content of the GOOSE message. The number of entries and the order of the data are defined by the IEC 61850 variables contained within the <FCDA>s.

You are encouraged to seek the relevant sections of the standards for further information regarding GOOSE message definitions.

For the purposes of this section, it is necessary to determine the number of entries in the GOOSE message subscription, what type they are, and the order the entries are in.

For each entry in the GOOSE message there MUST be a corresponding entry in the UPLC-II™ GooseSubscription block. Both the order and the number of entries must be exact.

Note: The UPLC-II™ at this time is only capable of receiving BOOLEAN entries from a GOOSE message.

As an example, suppose that IED “OaklandPark” is issuing a GOOSE message containing the following:

```
<Communication>
  < SubNetwork name="W01" type="8-MMS">
    <ConnectedAP iedName="OaklandPark" apName="S1">
      <GSE IdInst="C1" cbName="TripControl" >
        <Address>
          <P type="MAC-Address">01-0C-CD-01-00-01</P>
          <P type="APPID">1001</P>
          <P type="VLAN-PRIORITY">4</P>
        </Address>
        <MaxTime unit="s" multiplier="m">500</MaxTime>
      </GSE>
    </ConnectedAP>
  </SubNetwork>
</Communications>
```

(The above example is edited to show only the items that are needed to define the UPLC-II™ GOOSE subscription. In an actual .cid file, there will be more blocks between <ConnectedAP> and </ConnectedAP> defining the systems’ OSI addressing, and optionally other interfaces, such as serial, and possibly other GOOSE messages.)

Further, suppose that IED “OaklandPark” has the following located in the <IED> section:

(For clarity, there are line breaks between the <FCDA> entries. Normally this is not done within the file. Also, the <FCDA> entries are contained in one line, however due to the limitations of the width of this section, the entry wraps around. The same wrap around occurs in the <GSEControl>)

```
<IED name="OaklandPark">
...(Services are defined here)
<AccessPoint name="S1">
  <Server>
    <LDevice desc="description" inst="C1">
      <LN0 desc="description" lnType="LN0" lnClass="LLN0" inst="">
        <DataSet name=" TripControlData" desc="Goose Trip Control Data">
          <FCDA IdInst="C1" lnClass="LLN1" lnInst="1" doName="TripOne" daName="stVal" fc="ST" />
          <FCDA IdInst="C1" lnClass=" LLN1" lnInst="1" doName="TripTwo" daName="stVal" fc="ST" />
          <FCDA IdInst="C1" lnClass=" LLN1" lnInst="1" doName="52B" daName="stVal" fc="ST" />
          <FCDA IdInst="C1" lnClass=" LLN1" lnInst="1" doName="DisableTx" daName="stVal" fc="ST" />
          <FCDA IdInst="C1" lnClass=" LLN1" lnInst="1" doName="TripTestStart" daName="stVal" fc="ST" />
        </DataSet>
        <GSEControl name=" TripControl" confRev="1" appId="TripControlappID" dataSet="TripControlData" desc="Station Trip Control"/>
      </LN0>
    </LDevice>
  </Server>
</AccessPoint>
</IED>
```

Using the data above, the UPLC-II™ Goose subscription can be constructed:

```
<Private type="Ametek GooseSubscription">
  <eapi:GooseSubscription iedName=" OaklandPark " IdInst="CFG" cbName="TripControl " dataSet=" TripControlData " confRev ="1" mAddr="01-0C-CD-01-00-01" maxTime="500" vlanPriority="4" appId=" TripControlappID " goCbRef="OaklandParkC1/LLN0$GO$TripControl" dataSetRef="OaklandParkC1/LLN0$TripControlData">
    <eapi:GooseRxEntry gooseData="FSKTripKey" type="Bool"/>
    <eapi:GooseRxEntry gooseData="FSKTripKey" type="Bool"/>
    <eapi:GooseRxEntry gooseData="FSK52BKey" type="Bool"/>
```

```
.....<eapi:GooseRxEntry      gooseData="FSKTripTestInitiate"
      type="Bool"/>
      <eapi:GooseRxEntry      gooseData="FSKPowerOff" type="Bool"/>
</eapi:GooseSubscription/>
</Private>
```

(The `gooseData="xxxxx"` map the incoming GOOSE bits to UPLC-II™ input functions. These keywords and definitions are in the next section.)

Note that there are 5 GOOSE entries in the example. The number of GOOSE entries MUST agree with the GOOSE message and the GOOSE subscription, otherwise the GOOSE message will be rejected by the UPLC-II™.

### UPLC-II™ GOOSE subscription input functions

The UPLC-II™ provides the following input functions for mapping to incoming GOOSE data. Note that these functions are positive logic (1 = TRUE).

#### ONOFFCarrierStart

Turn on the transmitter in AM mode only.

#### ONOFFCarrierStop

Turn off the transmitter in AM mode only. The priority of these items is set in the UPLC-II™ logic settings.

#### ONOFFLowLevelKey

Turn on transmitter at the low power setting.

#### ONOFFCheckbackReset

Clear all checkback alarms.

#### ONOFFCheckbackInitiate

Start a checkback test. Progress and results can be monitored via the UPLC-II™ output GOOSE.

#### ONOFFLoopBack

Start a loopback test.

#### FSK52BKey

Boost the transmitter to high power in FSK mode.

#### FSKTripKey

Key the transmitter to Trip in FSK.

#### FSKLRKey

Key the transmitter to LR Trip in FSK 3F and 4F function only.

#### FSKDTTKey

Key the transmitter to DTT Trip in FSK 3F and 4F function only.

#### FSKAKey

Key the transmitter to A in FSK 4F mode only.

#### FSKBKey

Key the transmitter to B in FSK 4F mode only.

#### FSKPowerOff

Turn off the transmitter.

#### FSKTripTestInitiate

Start a trip test.

#### FSKTripTestDisable

Disable trip tests system wide.

#### FSKTripTestReset

Reset trip test alarms.

#### UPLCNoFunction

Do nothing.

Notes:

1. The ONOFF prefix means the function will operate in ON/OFF mode only. FSK prefix means that the function will operate in FSK mode only.
2. Some functions are used in specific relaying functions only. For example, FSKAKey and FSKBkey will operate in FSK 4 Frequency mode only.
3. These functions may be overridden by local settings. For example, if the UPLC-II™ logic setting checkback is disabled, then the OFFCheckbackInitiate will have no effect. All inputs and logic settings must allow for the function to operate.
4. ONOFFCheckbackInitiate, ONOFFLoopback, FSKTripTestInitiate all operate on a transition from a logic FALSE (Input value '0') to a logic TRUE (Input value '1'). The tests will operate then finish. For the test to be initiated again, the input MUST return to FALSE, then TRUE. If a test is in progress and the input changes state from TRUE, to FALSE, then TRUE again,

there will be no effect. i.e. the test inputs are not “queued” in the time dimension.

5. The function UPLCNoFunction is provided as a place holder so that the UPLC™ can ignore bits in the incoming GOOSE message at the user’s discretion.
6. All of these inputs are type=”Bool” which is short for BOOLEAN as defined by IEC 61850.

### Downloading, modifying, and uploading the api\_uplc.cid data file

(It is assumed that you are familiar with the UPLC-II™ web page interface. If not, please refer to Chapter 5 for details.)

The UPLC-II™, when enabled for IEC 61850 protocol, has the ability to generate an api\_uplc.cid file on the tab located under Admin->Protocol>IEC 61850 (See Figure 7–6).

The settings on this page (Fig. 7–8) allow you to change the parameters of the UPLC-II™ 61850

operation regarding the GOOSE messages produced by the UPLC-II™. To obtain a copy of the UPLC-II™ api\_uplc.cid file, click the button “Download UPLC .CID file”. The browser interface will prompt you to save the api\_uplc.cid file to your local hard drive.

You then may edit the api\_uplc.cid file to construct a GOOSE Subscription.

The default api\_uplc.cid file contains a sample GOOSE Subscription block that may be edited. Be sure to use a non-formatting text editor such as Windows® Notepad, or a programming editor.

Figure 8–8 shows the api\_uplc.cid file with the yellow line indicating the start of the GOOSE Subscription block. Due to rapid development, the actual api\_uplc.cid file may be slightly different than shown. Also note that in this editor lines do not wrap, so the attributes of the GOOSE subscription are not all shown.

You can now make changes to the GOOSE subscription data.

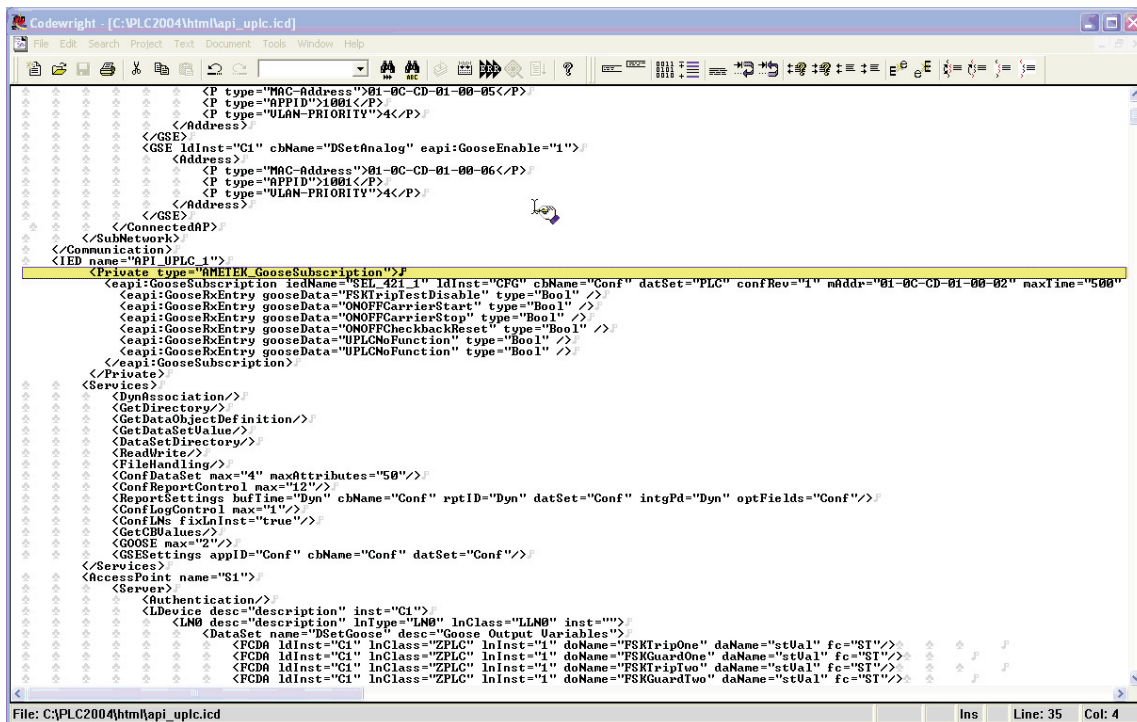


Figure 7–8.  
UPLC-II™ .cid File





## Appendix A: UPLC-II™ Serial Connection - PC Configuration

### Windows 7

1. If you are using an RS-232 to USB converter, make sure the drivers for the converter are installed and that they use a com port that does not change each time your computer is rebooted.
2. Click the “Start” button in the lower left hand corner of the screen.
3. Then click on the “Control Panel” button in the right hand panel to open the Control Panel.
4. **Note:** This write-up assumes your are using the control panel in the classic view.
5. Select the “Phone & Modem” button in the Control Panel.
6. Select the “Modems” Tab in the Phone & Modem window.
7. Then click the “Add” button and this will open the Add Hardware Wizard.
8. Click on the check box that says “Don’t detect my modem; I will select it from a list.” Then click on the “Next” button.
9. In the box labeled Manufacturer, select “(Standard Modem Types)” and under models on the right, select “Communications cable between two computers” then click on the “Next” button.
10. Now select the serial port number that you will use to communicate to the UPLC-II™. Then click the “Next” button.
11. After a brief period of time, you should now see a box that says, “your modem has been set up successfully”. Then click on the “Finish” button. After a short delay you should then see the connection appear in the Modem Tab of the “Phones and Modem” window.
12. Now click on the new modem connection to highlight it. A “Properties” button should

#### General Notes

This process needs to be done only once per computer.

The User must have Administrator privileges to set this up.

Proceed to Item #1.

appear

at the bottom of the window. Click on this “Properties” button, and wait for the properties window to open.

13. When the properties window opens, click on “Change Settings” at the bottom of the window.
14. Wait for a new properties window to open. Then click on the “Modem” Tab and select the Maximum Port Speed pull down menu. Select a port speed of 115200. Then click on the “OK” button.
15. Now click the “OK” button to close the Phone & Modem window.
16. Now you have to set up the network connection. This is done by opening the Control Panel again and clicking on the Network and Sharing Center Icon.
17. When the Network and Sharing Center window opens, click on “Set up a new connection or network” of the window under the heading, Change your networking settings.
18. When the Choose a connection option window opens, just click on “Setup a dial-up connection”. And then click the “Next” button.
19. If you have more than one modem connected, you will get a popup box that asks “Which modem do you want to use?” Choose the one that says “Communications cable between two computers.” If you only have one connection, you may not see this popup box and will go directly to step 20.
20. In the Dial-up phone number box, type any number. A suggestion might be to type a 1.
21. In the box labeled, Connection Name, enter a name for the connection, that you will rec-


- ognize. A suggestion might be UPLC-II Serial Connection. Then click the “Connect” button. It will attempt to dial the connection. Wait until it times out and you get a box that says, Connection failed with error 777. In this box you will have two choices. Select the “Set up the connection anyway” choice.
22. You will now get a box that says “The connection to the Internet is ready to use.” Click the “Close” button in this box. The computer will take you back to the Network and Sharing center window. At this point click on the choice, “Connect to a network”. A new box will pop up which lists the connections available. You should see the new connection with the name you selected. Move the mouse to that connection and right click, then select Properties.
  23. In the Connect using: you should see the words “Communication cable between two computers (COMX)” device. Where COMX is the COM port you had set up before. For most computers this will be COM1. Click on it to select it. At this point select the move down to the dummy phone number you put in and remove it.
  24. Now click on the “Configure” button below the box in the previous step. The “Modem Configuration” window pops up. Be sure the Maximum speed is set to 115200 bps. Also make sure the “Enable hardware flow control” box is checked. Now click the “OK” button.
  25. Now click on the “Options” Tab. Uncheck the “Prompt for name and password, certificate, etc.” box. Also uncheck the “Prompt for phone number” box.
  26. Click on the box labeled “PPP Settings.” The only box that should be checked is “Enable LCP extensions.” Uncheck all others.
  27. Click the Networking Tab of the Properties window. Then highlight Internet Protocol Version 4 (TCP/IPv4), and then click on the “Properties” button.
  28. Select the radio button titled “Use the following IP address:” and then enter 100.100.100.101 in the IP address location. Then click on the “OK” button.
  29. Click the “OK” button
  30. You are now ready to connect to the UPLC-II™ Front Panel.

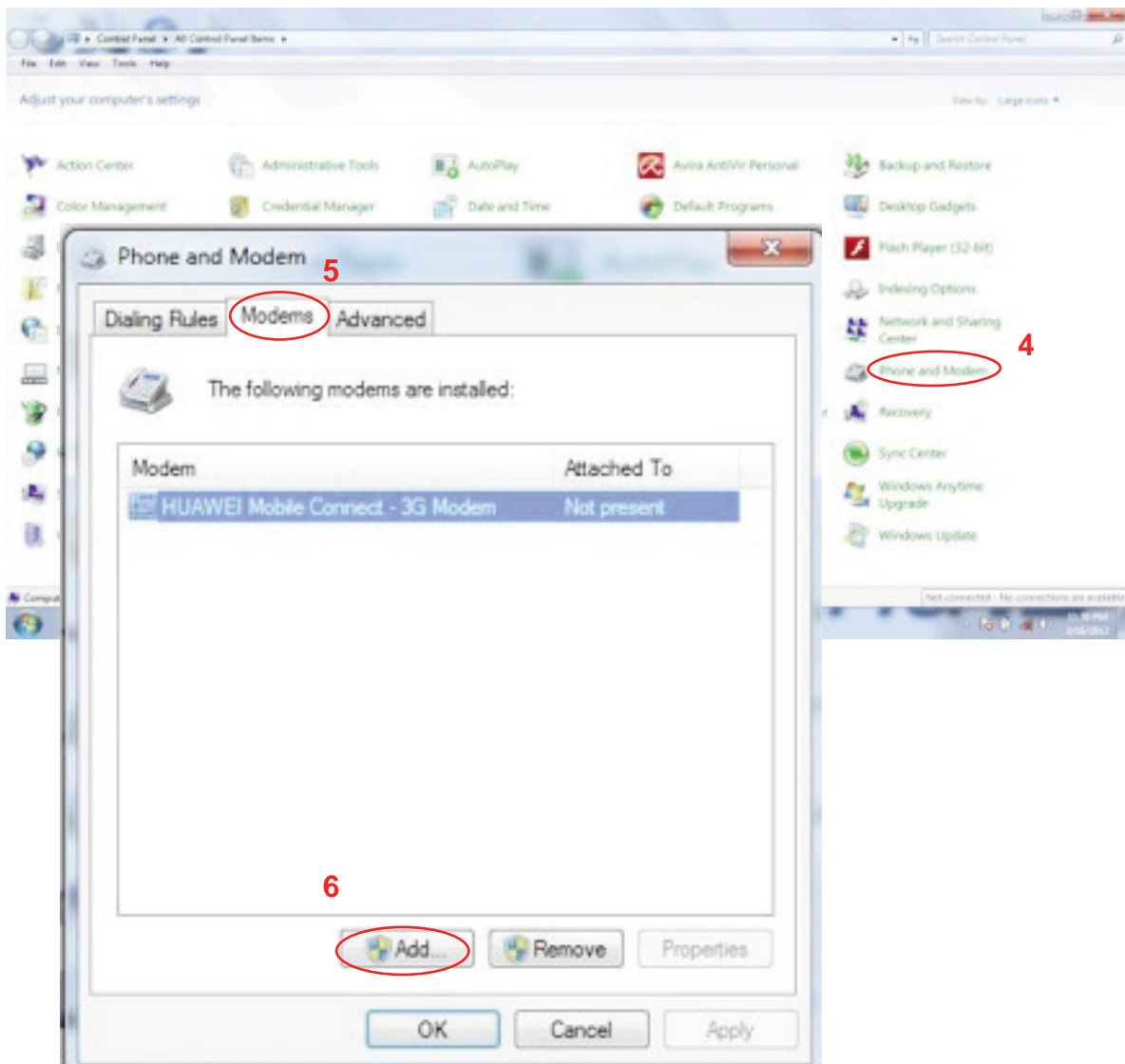
This completes the Windows 7 setup process.



### RS-232 Setup for Windows 10

You must have Administrator privileges to do this.

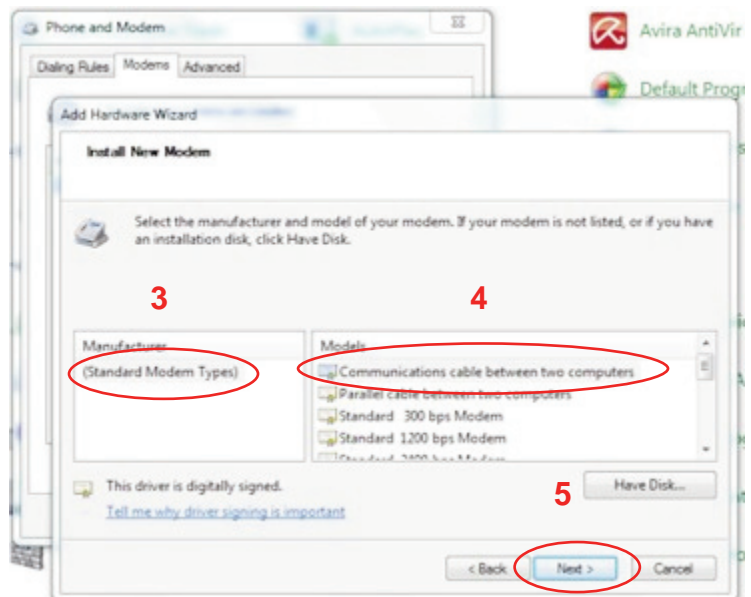
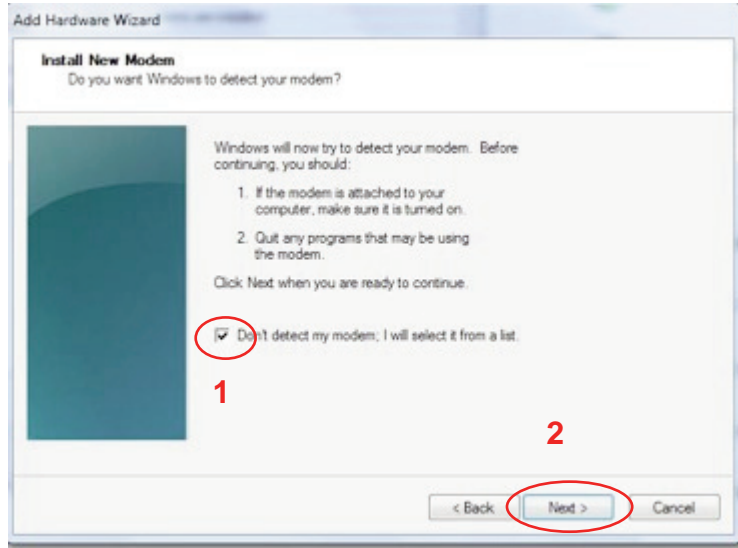
1. Connect the serial cable from your PC to the UPLC-II.
2. Click “Start”. 
3. Select Control Panel.
4. Click on Phone and Modem.
5. Select the Modems tab.
6. Click the “Add” button.

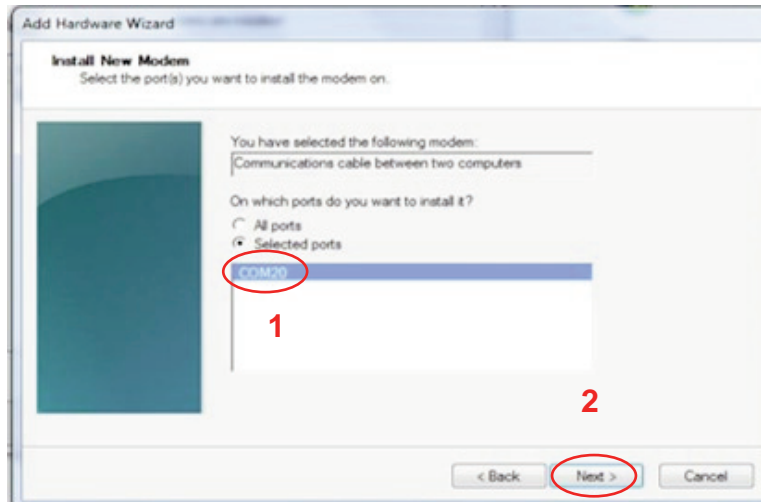


**A**

### Setup for Windows 10

1. Check the box “Don’t detect my modem”...
2. Click “Next”. (The following window takes a few seconds to pop up).
3. Select “Standard Modem Types”.
4. Select “Communication cable between two computers”.
5. Click “Next”.





1. Select the serial port to communicate to the UPLC-II.
2. Click “Next”.

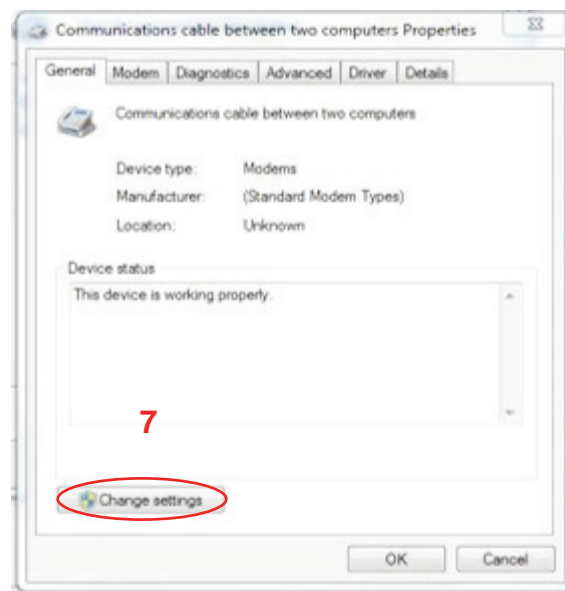
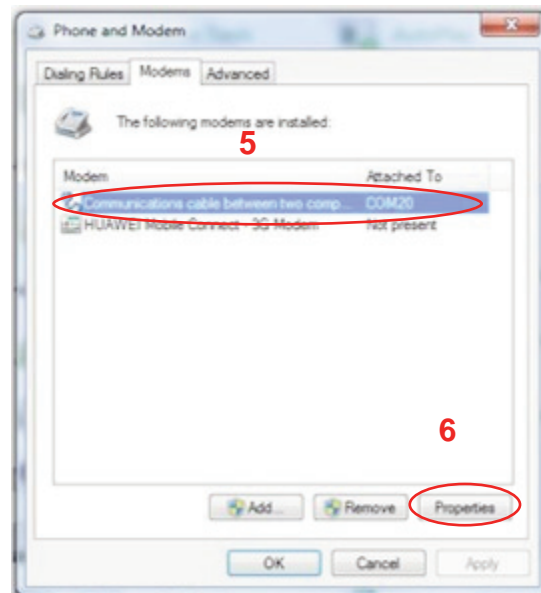
**General Notes**

If you will be using a USB to DB9 adapter cable, then the COM port would have been shown when you plugged it in and Windows recognized it.

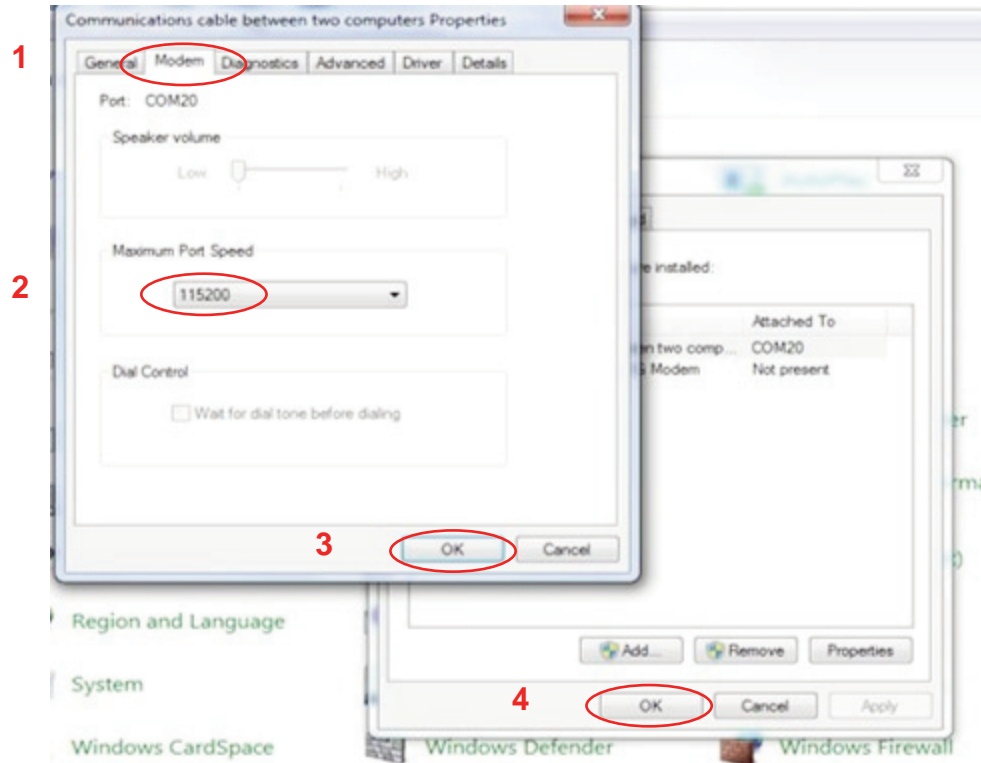
You can also open Device Manager and look under “Ports (Com & LPT)” to see the COM port number. That would be the COM port you need to select now.

Shortly after, you should see “your modem has been set up successfully.”

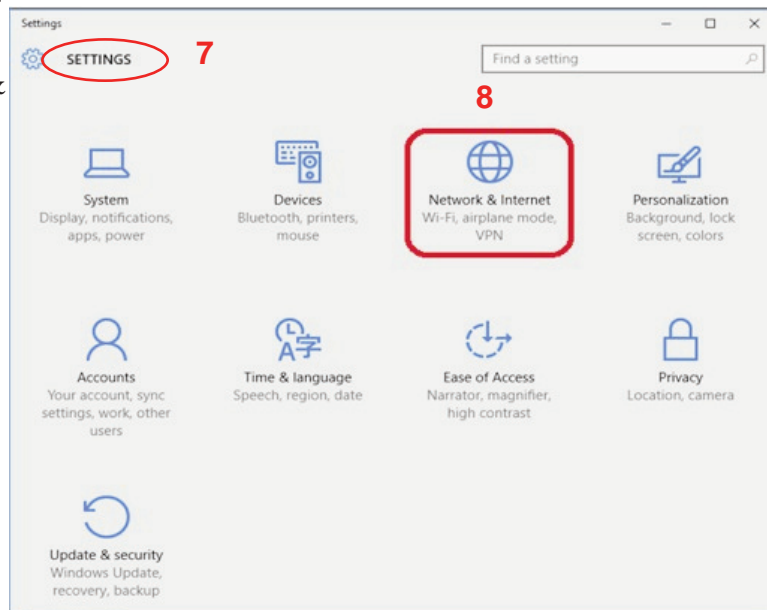
3. In the next window, click “Finish”.
4. Shortly after (<15sec) you should see the connection appear in the Modem tab of the “Phone and Modem” window.
5. Select the new connection.
6. Click “Properties”.
7. Click “Change settings”.



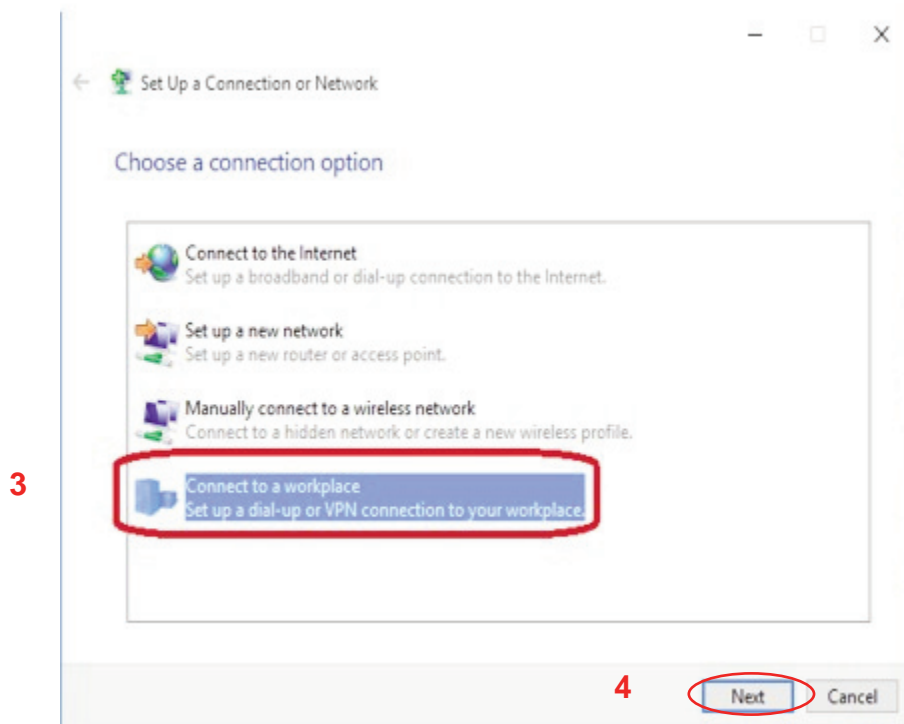
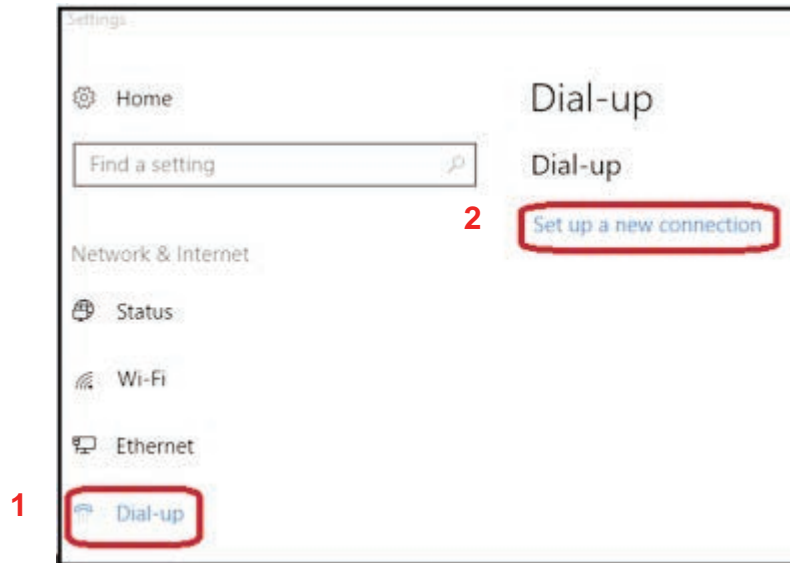
**A**



1. Click on the Modem tab.
2. Set the maximum port speed for 115200.
3. Click “OK”.
4. Click “OK” in the Phone and Modem window.
5. Next, set up a network connection.
6. Right click the “Start” button.
7. Select Settings.
8. Then select Network & Internet.

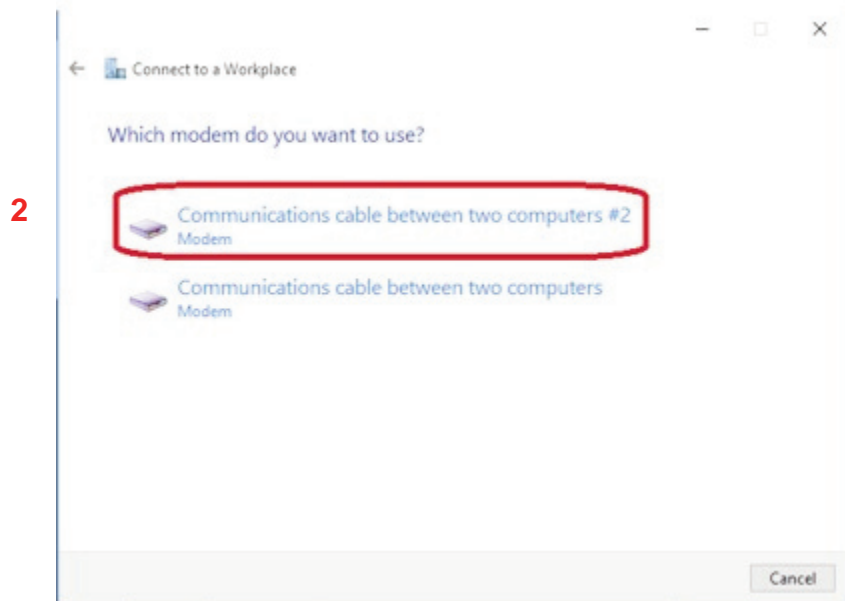
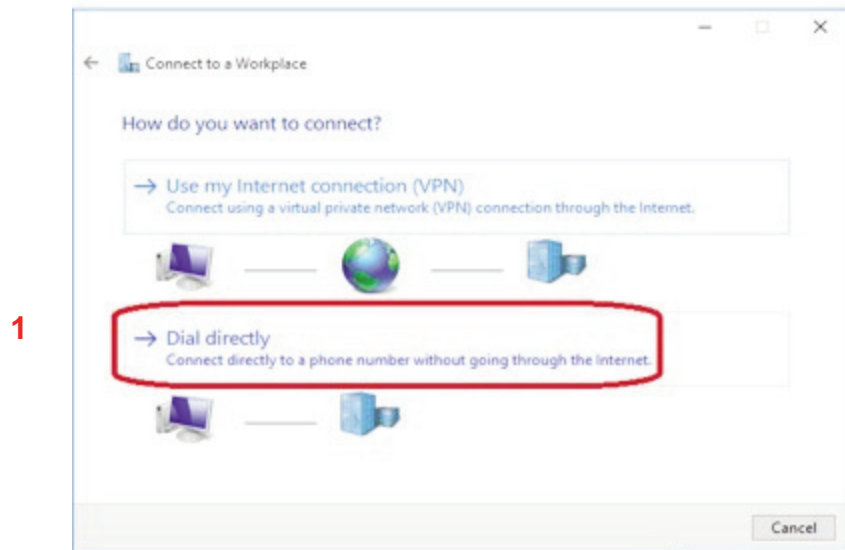


1. Select Dial-up.
2. Then Set up a new connection.
3. In the pop-up window, select Connect to a workplace.
4. Click “Next”.

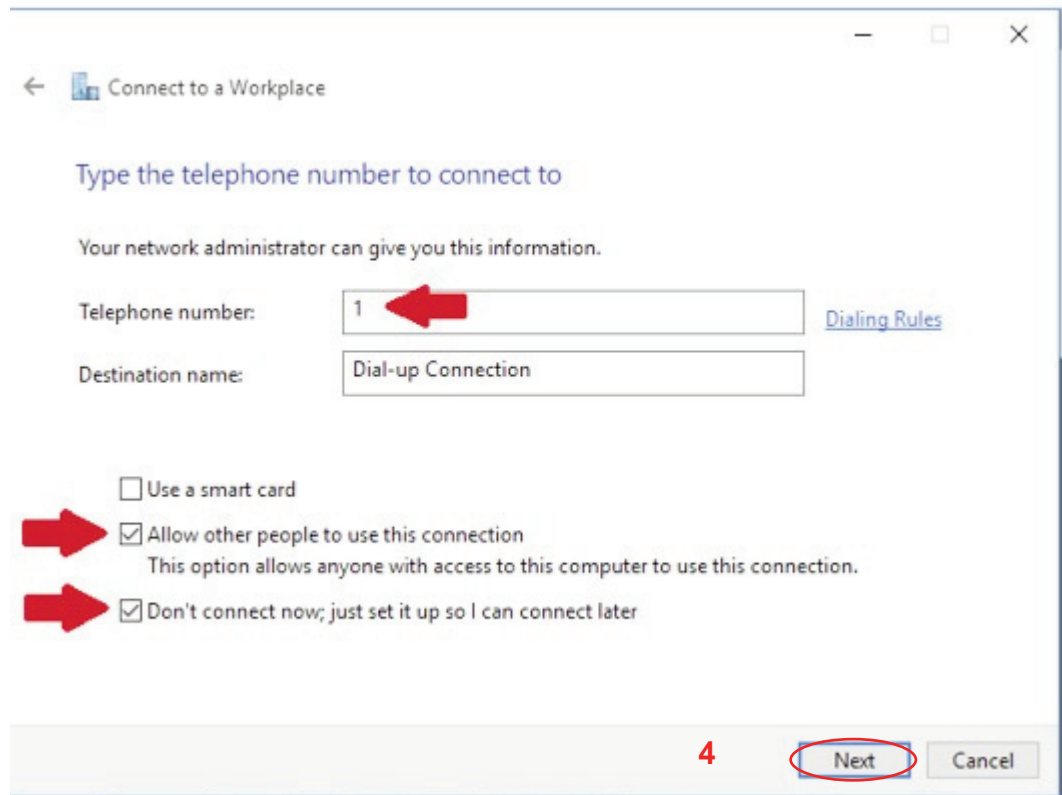


A

1. Select Dial directly.
2. In the pop-up window, select the top of the list choice, “Communications cable between two computers...” as this will be your new connection.



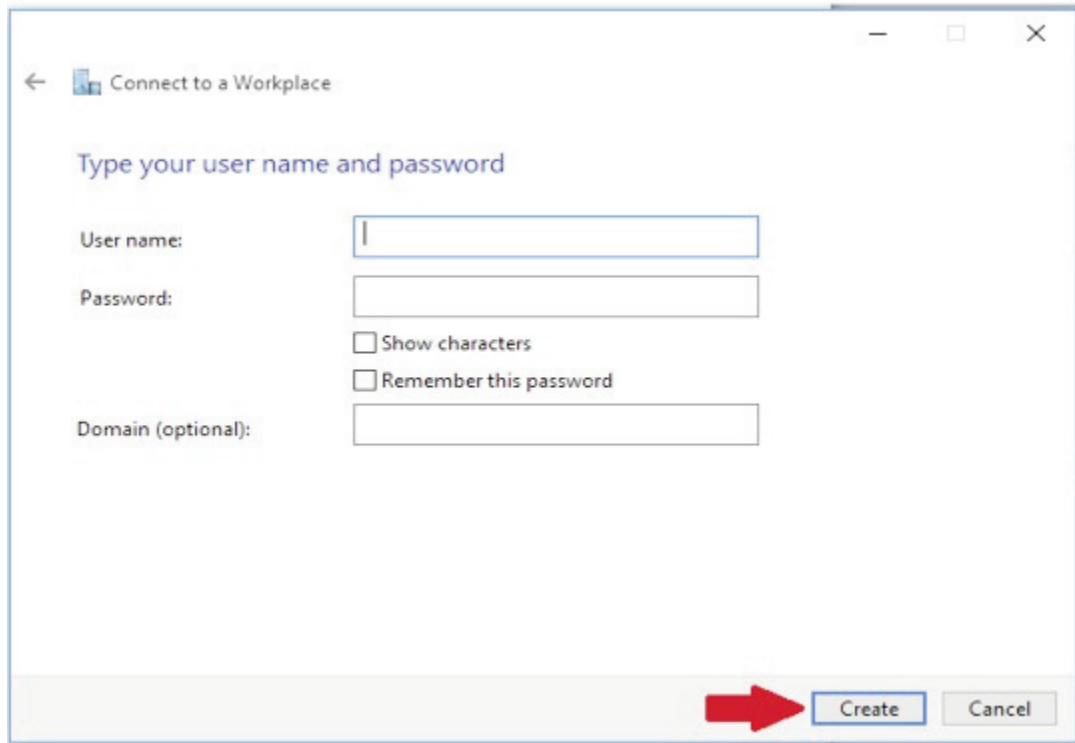
1. In the Telephone number field, type any number. A “1” is suggested.
2. In the Destination name field, enter a recognizable name, such as UPLC-II Serial Connect.
3. Check the 2 bottom boxes.
4. Click “Next”.



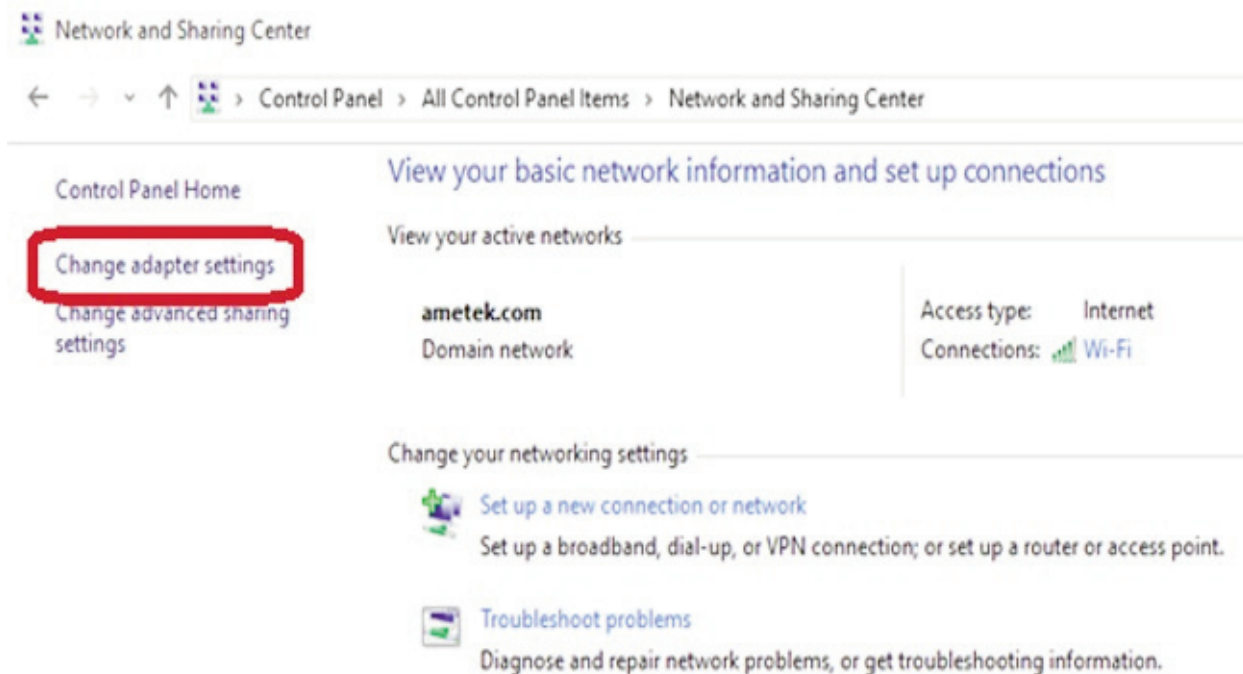
A



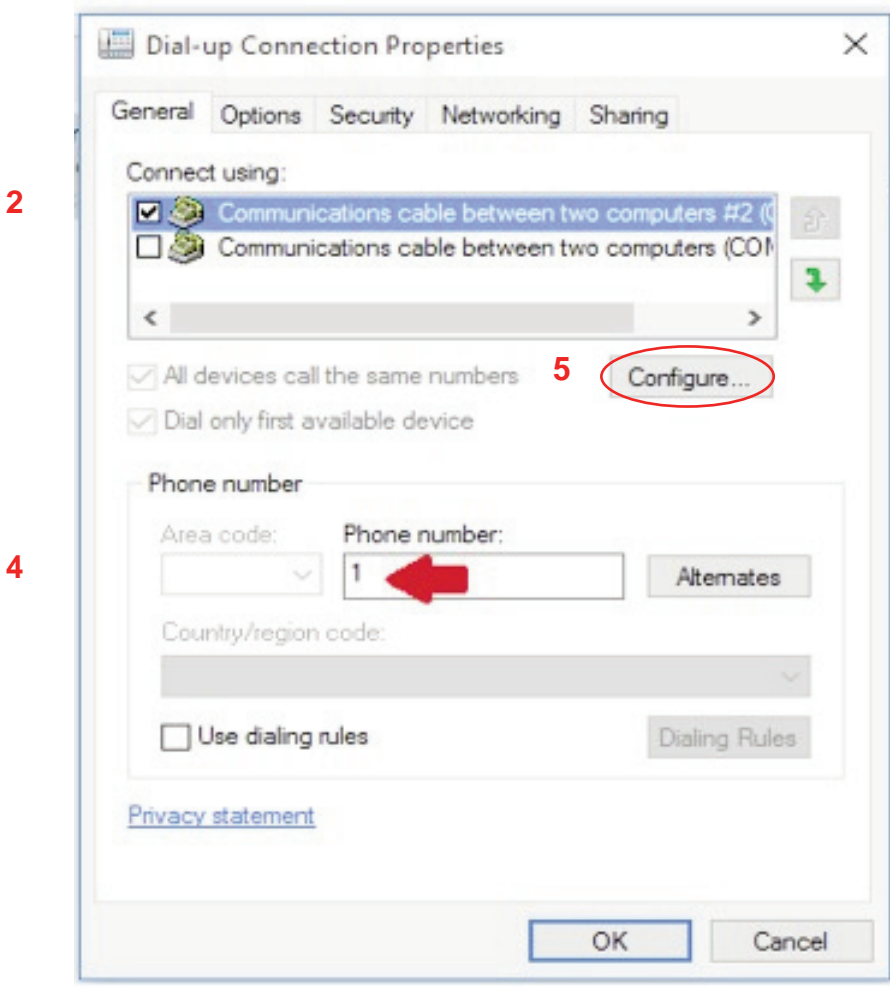
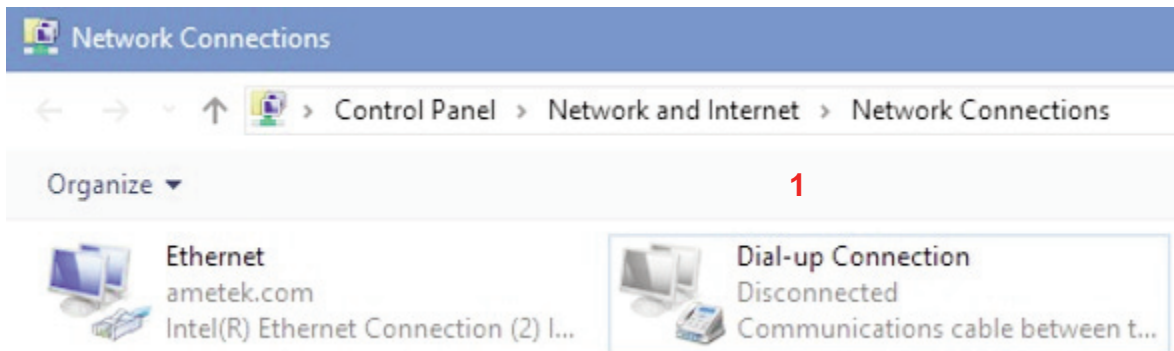
1. Click on the “Create” button but leave user name and password blank.
2. Click “OK” in the Phone and modem window if necessary.



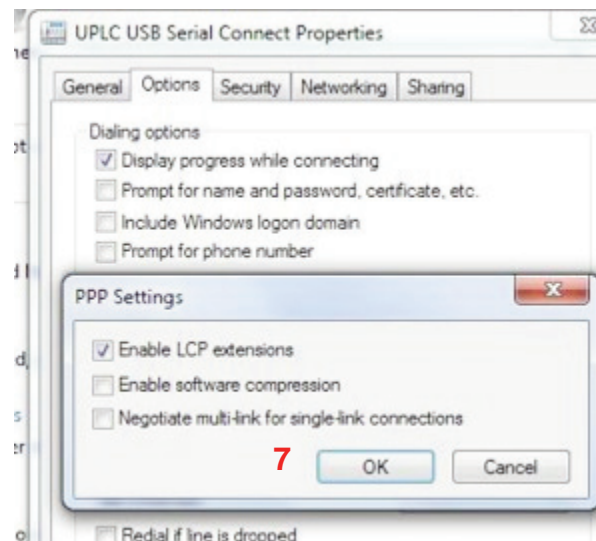
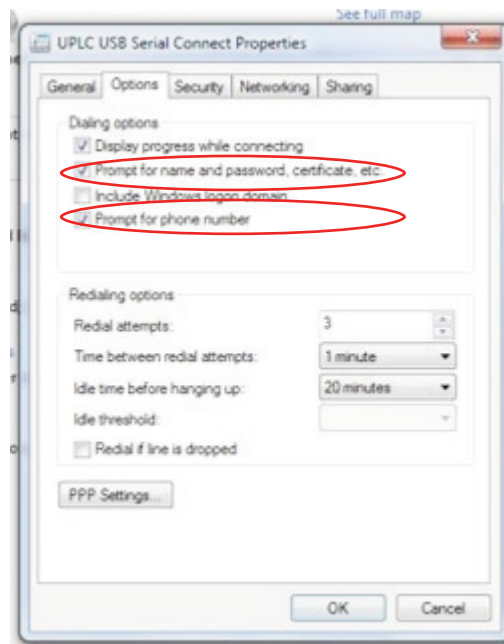
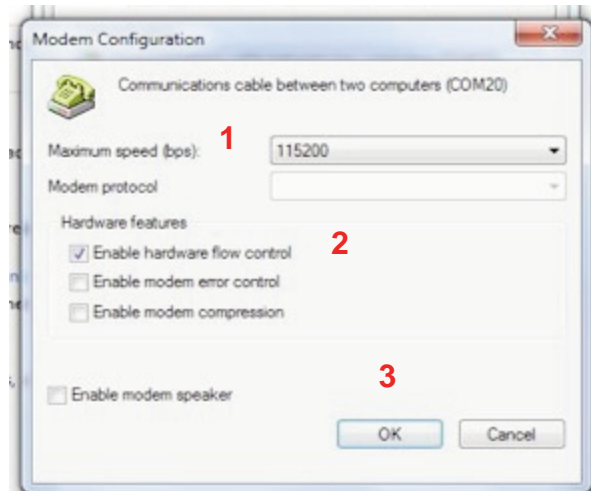
Next go to the Network and Sharing Center.  
Click on Change adapter settings.



1. Right click on the new Dial-up connection you just created and select Properties.
2. Verify the correct Comm port in the “Connect using” box.
3. You should see “Communications cable between two computers (COM#). Which should be the COM port number you just created. Select it.
4. In this window, clear the sample phone number (1).
5. Click “Configure”.

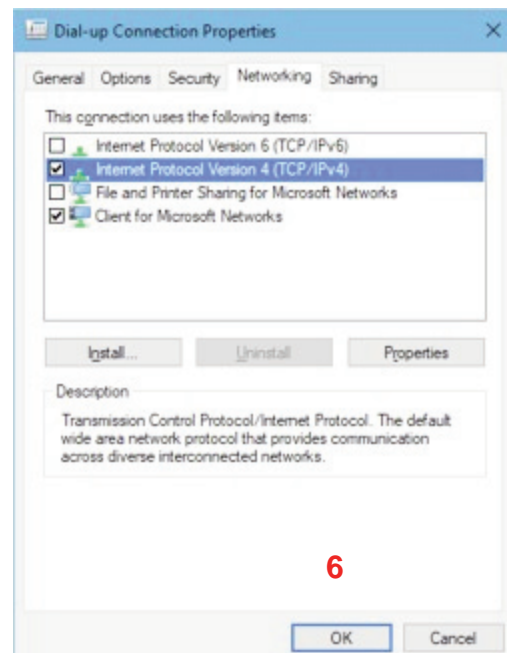
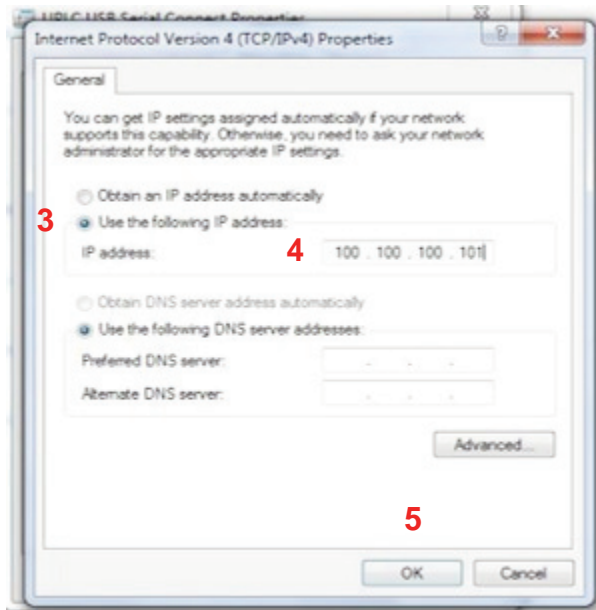
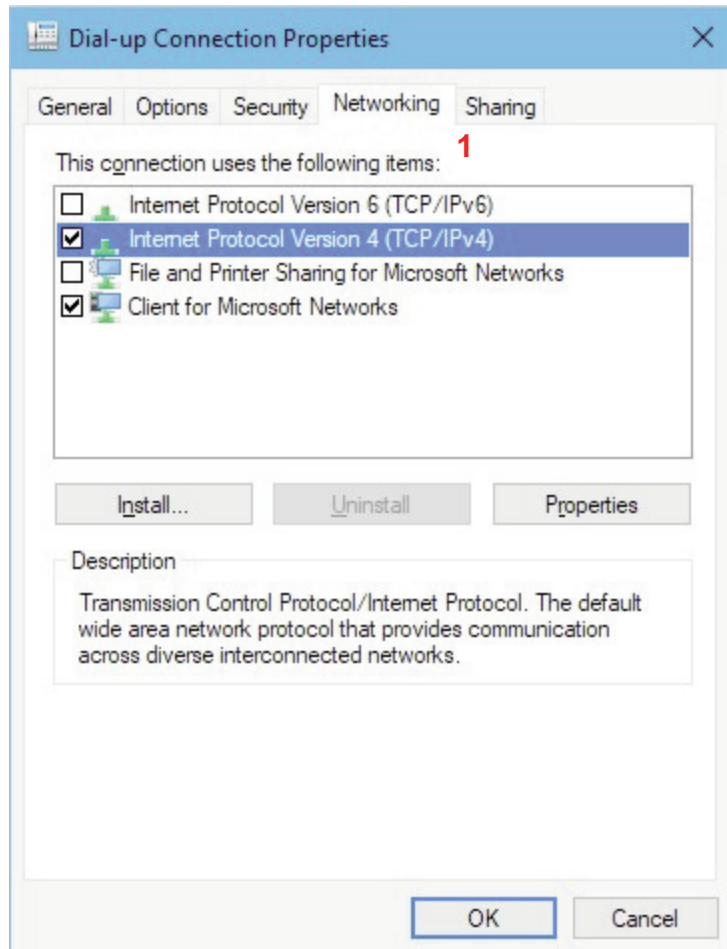


1. Make sure the maximum speed is set to 115200 bps.
2. Enable hardware flow control should be the only checked box.
3. Click “OK”.
4. In the Options tab, uncheck:  
 Prompt for name and password..... etc.  
 Prompt for phone number.
5. Click the “PPP Settings” button.
6. Check Enable LCP extensions, uncheck all others.
7. Click “OK”.



1. Under the Networking tab, uncheck “Internet Protocol Version 6”. Leave the other two checked.
2. Select the TCP/IPv4 and click Properties.
3. Click Use the following IP address.
4. Enter 100.100.100.101.
5. Click “OK”
6. Then “OK” again.

This completes the Windows 10, UPLC-II, serial port communications setup process.



**A**

## Connecting to the UPLC-II with this Serial Port

1. Connect your serial cable to the serial port selected as COMX or if using a USB to serial converter connect the USB end to a USB port on your computer.
2. Then connect the other end of the cable to the UPLC-II™.
3. Either select the connections icon on the system tray if you have one, or open the Network and Sharing Center.
4. If you selected the network connections icon from the system tray, the “Connections are available” dialog box will appear. Skip to step 6.
5. If you opened the Network and Sharing Center, click on “Connect to a network” under the Change your networking settings. This will pop up the same “Connections are available” dialog box as in step 4.
6. Click on the connection that has the name you used for the UPLC-II™. Then click on the “Connect” button.
7. Several Dialog boxes will pop up and disappear. Some will be slow and some will be very fast. The last one will say “Connected.”
8. If you want, you may select the network connection icon in the system tray and under the UPLC connection, the word *connected* will appear.
9. Now open internet explorer and in the URL box, type “http://100.100.100.100/” and press return. At this point, the UPLC II™ password box will pop up. Type in the UPLC II™ username and password that has been setup for your use.
10. The home screen for the UPLC II™ should now appear after a short delay.
11. Do the work you need to do.
12. When you have completed your work, *do not disconnect the serial cable from your computer*. At this point, instead, click on the Log out in the upper left hand corner of the home screen.

13. Click “OK” to the dialog box that appears. Then click “yes” to the Question, “Do you want to close internet explorer.” *Do not unplug the serial cable from your computer or the UPLC-II™ until you complete step 14.*
14. Next, click the network icon in the system tray and click on the UPLC II™ connection, then click on the Disconnect box.

This completes your connection session with the UPLC-II™.

**Warning:** If you do not perform steps 12, 13 and 14 before disconnecting your computer, on UPLC II™ versions 2.05 and less, you will have to reboot the UPLC-II™ before you will be able to connect again. On versions greater than 2.05, you will not have to reboot but you will have to wait before you can reconnect again by the amount set in the time-out setting on the administration page (30 minutes by default).

## Troubleshooting

If you get a warning (777) or no connection at all, try the following.

Power cycle the UPLC-II (if allowed).

Reboot your PC.

Attempt to log in again.

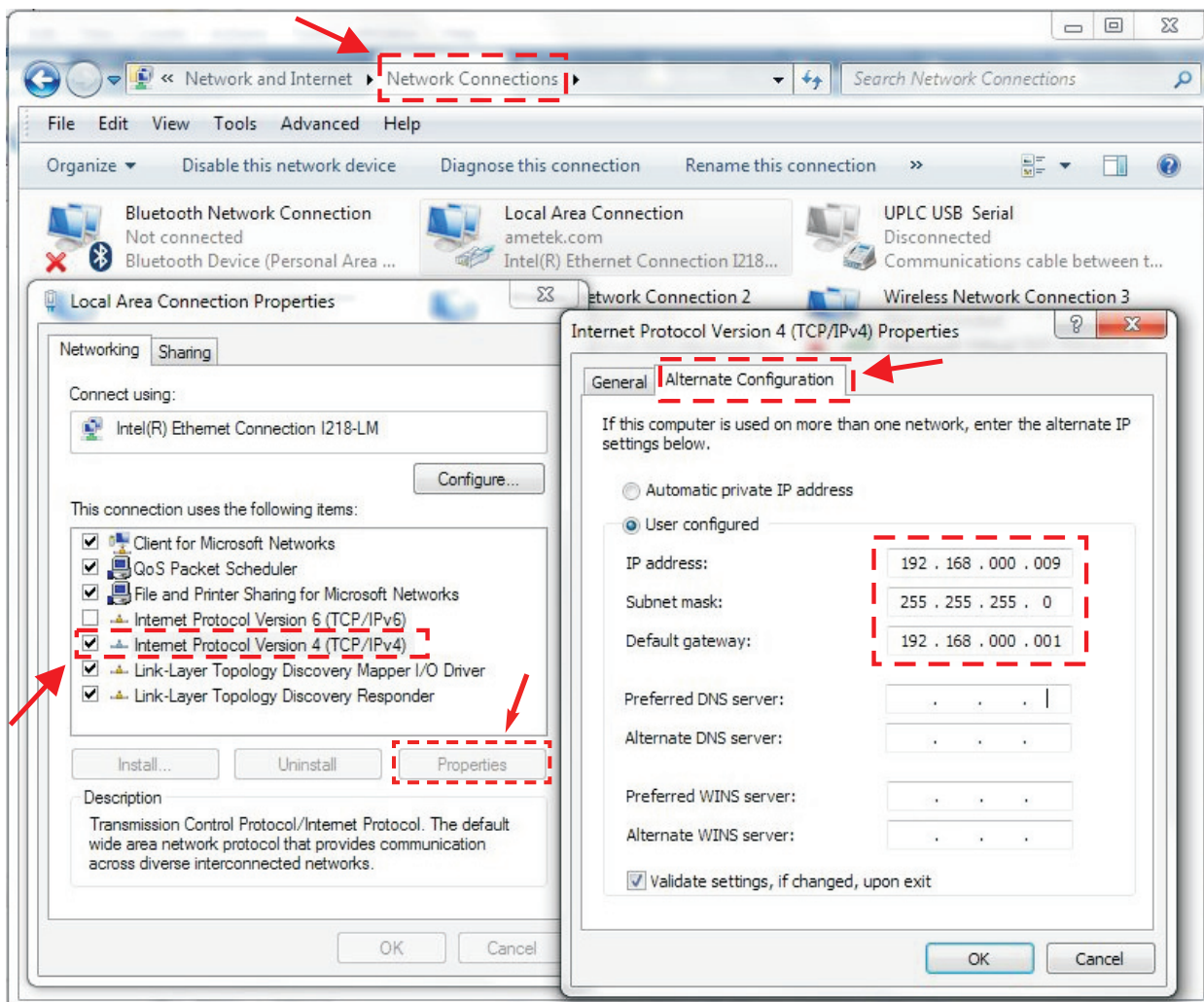
If you did not disconnect from the webpage correctly, then you could be timed out for 30 minutes by default.

If that does not work, then a step was missed or the COM port assigned is incorrect. Typically the Baud rate will not take in the Network setup. It should be 115200.



## Appendix B: UPLC-II™ Ethernet Connection - PC Configuration

1. Locate Network Connections on your PC. (See Figure below)
2. Locate the Ethernet connection to modify, then right click on it and choose Properties.
3. Click on “Internet Protocol Version 4 (TCP/IPv4).
4. Click the Properties button.
5. In either the “Alternate” or “General” tab select “User Configured”.
6. Enter a static IP address with last group of 3 digits different from the UPLC-II™ IP address.
7. If on a LAN also set the subnet mask and default gateway.



**B**

**Network and Internet Connections**





## Appendix C: UPLC-II™ XML File Format

Here is an example of a configuration file downloaded from the UPLC-II™. This is an XML file. The file can be checked with any common XML tools to see if it conforms to XML format rules. It can be edited in any standard text-editing program, however you must be certain not to change any of the XML required format. If you are going to edit the file in a text editor it is important that you understand the format requirements of an XML file.

The file has a main section <UPLC-II™>, also called the 'root node'. The main section encompasses three major sub-sections;

- <genset> - General Settings
- <logset> - Logic Settings
- <ioset> - Input/Output Settings

The Inputs/Outputs settings also has a three minor sub-sections;

- <inputs> - Inputs
- <tdoutputs> - Trip Duty Outputs
- <lloutputs> - Low Level Outputs

These sections encompass the entire configuration for the UPLC-II™. Typically this file should be system generated to avoid any typographic and syntax errors. Rather than starting from scratch, it's easier to download from the UPLC-II™ and create a configuration file first, then edit that before uploading it back to the UPLC-II™. After uploading you should review the changes on the settings pages to ensure they're correct before locking them in by submitting. The XML configuration file can be loaded into any text editor and the data can be changed. We recommend you familiarize yourself with the nuances of the eXtensible Markup Language (XML Files), prior to attempting any changes to the data in the file. Be careful not to change any file formatting or the file will not load properly.

Following, is an example of the downloaded XML file. The data in the example file is shown in bold for instructional purposes only.

NOTE: It will not and should not be in bold in the downloaded or uploaded file.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!--UPLC-II Configuration for 10.14.3.127 as of
Mon Sep 10 11:17:50 2007-->
<UPLC-II>
  <system>
    <ppc_version>2.00</ppc_version>
  </system>
  <genset>
    <id_line0>System ID text string
    1</id_line0>
    <id_line1>System ID text string
    2</id_line1>
    <chan_type>1</chan_type> // AM - 0 FSK
    - 1
    <functn>1</functn>
    <tx_freq>250.00</tx_freq>
    <rx_freq>252.00</rx_freq>
    <txbwshift mode="FSK">2</txbwshift>
    <rxbwshift mode="FSK">2</rxbwshift>
    <tx_low>1.0</tx_low>
    <tx_hi>10.0</tx_hi>
    <fade_alarm>10</fade_alarm>
    <fade_margin>15</fade_margin>
    <reflpwr>15</reflpwr>

    <shift_up_to_trip_tx>0</shift_up_to_trip_
    tx>

    <shift_up_to_trip_rx>0</shift_up_to_trip_
    rx>
    <tx_rx_enable>3</tx_rx_enable>
  </genset>
  <logset>
    <voice>1</voice>
    <ptt_delay1>2</ptt_delay>
    <trip_hold1>0</trip_hold1>
    <guard_hold1>0</guard_hold1>
    <ptt_delay2>30</ptt_delay2>
    <trip_hold2>35</trip_hold2>
    <guard_hold2>40</guard_hold2>
    <unblock_time1>0</unblock_time1>
    <unblock_delay1>0</unblock_delay1>
    <ttu0>2</ttu0>
    <guard_t0>2</guard_t0>
```



```

</logset>
<ioset>
<inputs>
<in1_hold>0</in1_hold>
<in1_selection>1</in1_selection>
<in1_active_state>0</in1_active_state>
<in2_hold>0</in2_hold>
<in2_selection>2</in2_selection>
<in2_active_state>0</in2_active_state>
<in3_hold>0</in3_hold>
<in3_selection>0</in3_selection>
<in3_active_state>0</in3_active_state>
<in4_hold>0</in4_hold>
<in4_selection>0</in4_selection>
<in4_active_state>0</in4_active_state>
<in5_hold>0</in5_hold>
<in5_selection>0</in5_selection>
<in5_active_state>0</in5_active_state>
</inputs>
<tdoutputs>
<em1_selection>0</em1_selection>
<em2_selection>0</em2_selection>
<em3_selection>0</em3_selection>
<em4_selection>0</em4_selection>
</tdoutputs>
<lloutputs>
<prog1_selection>1</prog1_selection>
<prog1_active>0</prog1_active>
<prog1_action>0</prog1_action>
<prog2_selection>2</prog2_selection>
<prog2_active>0</prog2_active>
<prog2_action>0</prog2_action>
<prog3_selection>6</prog3_selection>
<prog3_active>0</prog3_active>
<prog3_action>0</prog3_action>
<prog4_selection>7</prog4_selection>
<prog4_active>0</prog4_active>
<prog4_action>0</prog4_action>
<prog5_selection>0</prog5_selection>
<prog5_active>0</prog5_active>
<prog5_action>0</prog5_action>
<prog6_selection>10</prog6_selection>
<prog6_active>0</prog6_active>
<prog6_action>0</prog6_action>
<prog7_selection>4</prog7_selection>
<prog7_active>0</prog7_active>
<prog7_action>0</prog7_action>
<prog8_selection>0</prog8_selection>

```

```

<prog8_action>0</prog8_action>
<prog9_selection>0</prog9_selection>
<prog9_action>0</prog9_action>
<prog10_selection>12</prog10_selection>
<prog10_action>0</prog10_action>
</lloutputs>
</ioset>
</UPLC-II>

```

### Configuration File Modification(Firmware Ver. 3.00 and later)

System identifies the firmware version and can not be changed.

```

<system>
<ppc version>3.02</ppc version>

```

#### General Settings <genset>

##### System Identification

```

<id_line0>System Identification Line I</id_line0>
<id_line1>System Identification Line II</id_line1>

```

These two lines are 40 characters free form text. You are free to enter any text here to identify the system.

##### Channel

```

<chan_type>1</chan_type>

```

This indicates the channel type and is a single digit value.

- 0 - Configures the system to operate in AM or otherwise called ON/OFF mode
- 1 - Configures the system for operation in FSK Mode

##### Function

```

<functn>1</functn>

```

Function allows you to choose the function type. This is a number between 0 & 3 depending on the choice of mode.

If the Channel is configured for AM Mode, you can choose from the following types:

- 0 – Phase Comparison
- 1 – Directional Comparison

If the Channel is configured for FSK Mode, you can choose from the following types:

- 0 – Phase Comparison
- 1 – Unblocking-2Frequency
- 2 – DTT-2Frequency
- 3 - POTT 2-Frequency
- 4 - 3-Frequency
- 5 - 4-Frequency

TX & RX Frequency

<tx\_freq>**250.35**</tx\_freq>  
<rx\_freq>**252.55**</rx\_freq>

These are the transmit and the receive frequencies within the range of 30 to 530 kHz in steps of 0.01 kHz, e.g. 250.55 is 250.55 kHz.

Bandwidth and Shift

Bandwidth & shift is specified as a single digit number:

- ON/OFF Mode
- <bandwidth>**1**</bandwidth>
- 1 – Sets the bandwidth to 600 Hz.
  - 2 – Sets the bandwidth to 1200 Hz.
  - 3 – Sets the bandwidth to 4000 Hz.
- FSK Mode
- <txbwshift mode="FSK">**2**</txbwshift>  
<rxbwshift mode="FSK">**2**</rxbwshift>

This is called the TX Bandwidth-Shift & RX Bandwidth-Shift

- 0 – Sets the bandwidth-shift to 300±100 Hz.
- 1 – Sets the bandwidth-shift to 600±100 Hz.
- 2 – Sets the bandwidth-shift to 600±250 Hz.
- 3 – Sets the bandwidth-shift to 1200±250 Hz.
- 4 – Sets the bandwidth-shift to 1200±500 Hz.

FSK - 3 & 4-Frequency has only

- 0 – Sets the bandwidth-shift to 600±250 Hz.
- 1 – Sets the bandwidth-shift to 1200±500 Hz.

Tx Power

<tx\_low>**1.5**</tx\_low>  
<tx\_hi>**9.5**</tx\_hi>

The tx\_hi and tx\_low values must be between 1 & 10 W in steps of 0.1 W, with tx\_low smaller than tx\_hi, e.g. 1.5 specifies 1.5 W.

Fade Alarm

<fade\_alarm>**10**</fade\_alarm>

Fade Alarm is between 1 & 25 dB

Fade Margin

<fade\_margin>**15**</fade\_margin>

Fade Margin is between 1 & 25 dB

Reflected Power

<reflpwr>**15**</reflpwr>

Reflected power is 1 to 100% in 1% increments

Shift Up to Trip

<shift\_up\_to\_trip\_tx>**0**</shift\_up\_to\_trip\_tx>

0–sets the transmitter to see a shift down to trip signal

1–sets the transmitter to see a shift up to trip signal

<shift\_up\_to\_trip\_rx>**0**</shift\_up\_to\_trip\_rx>

0–sets the receiver to see a shift down to trip signal

1–sets the receiver to see a shift up to trip signal

Transmit/Receive Enable

<tx\_rx\_enable>**3**</tx\_rx\_enable>

3–Both transmitter and receiver enabled

2–Receive only (transmitter is disabled)

1–Transmit only (receiver is disabled)

**Logic Settings <logset>**

Pre-trip Delay (Valid for FSK Mode Only)

<ptt\_delay>**30**</ptt\_delay>

Pre-trip Delay is 0 – 30 ms in 1 ms steps.

Trip Hold (Valid for FSK Mode Only)

<trip\_hold>**10**</trip\_hold>

Trip Hold is 0 – 100 ms in 1 ms steps.

Guard Hold (Valid for FSK Mode Only)

<guard\_hold>**15**</guard\_hold>

Guard Hold is 0 – 100 ms in 1 ms steps.



Pre-trip Delay (Valid for FSK Mode Only)

<ptt3\_delay>**30**</ptt3\_delay>

Pre-trip Delay is 0 – 30 ms in 1 ms steps.

Trip Hold (Valid for FSK Mode Only)

<trip3\_hold>**35**</trip3\_hold>

Trip Hold is 0 – 100 ms in 1 ms steps.

Guard Hold (Valid for FSK Mode Only)

<guard3\_hold>**40**</guard3\_hold>

Guard Hold is 0 – 100 ms in 1 ms steps.

Unblock Time (Valid for FSK Mode Only)

<unblock\_time>**20**</unblock\_time>

Unblock Time is 0 – 500 ms in 1 ms steps.

Unblock Delay (Valid for FSK Mode Only)

<unblock\_delay>**25**</unblock\_delay>

Unblock Delay is a number between the range of 0 – 100 ms.

RCVR Drop Delay (Valid for AM Mode Only)

<fade\_drop\_delay>**0**</fade\_drop\_delay>

RCVR Drop Delay is 0 – 15 ms in 1 ms steps

Trip Test (Valid for FSK Mode Only)

<ttu0>**1**</ttu0>

Trip Test is a single digit value. Only 1 or 2 is valid:

1 – Disabled

2 – Enabled

Guard Before Trip (Valid for FSK Mode Only)

<guard\_t0>**2**</guard\_t0>

Guard Before Trip is a single digit value between 1 & 3:

1 – Not Required

2 – Required

3 – Required But With Override

Blocking Priority (Valid for AM Mode Only)

<blk\_pri0>**1**</blk\_pri0>

Blocking Priority is a single digit value:

1 – Stop

2 – Start

Common Start/Stop Keying (Valid for AM Mode Only)

<ka4>**0**</ka4>

This is a single digit value. Only 0 or 1 is valid:

0 – disabled

1 – enabled

Checkback (Valid for AM Mode Only)

<checkback0>**0**</checkback0>

Checkback is a single digit value. Only 0 or 1 is valid:

0 – Checkback Disabled

1 – Checkback Enabled

**Input/Outputs <ioset>**

Inputs

Contact Bounce

<in1\_hold>**1**</in1\_hold>

Contact Bounce is between 0 to 15. Each unit denotes 0.5 ms. As an example, 8 would be equal to 4ms.

Selection

<in1\_selection>**1**</in1\_selection>

Selection is a number between 0 & 8 or 9 depending on the mode:

FSK

FSK-UB, FSK-DTT, FSK-POTT

0 – Not Used

1 – UB Key

2 – Power Off

3 – Trip Test

4 – Disable Trip Test

5 – 52B

6 – SOE Event 1

7 – SOE Event 2

8 – SOE Event 3

FSK-3 Freq

0 – Not Used

1 – LR Key

- 2 – DTT Key
- 3 – Power Off
- 4 – Trip Test
- 5 – Disable Trip Test
- 6 – 52B
- 7 – SOE Event 1
- 8 – SOE Event 2
- 9 – SOE Event 3
- FSK-4 Freq
- 0 – Not Used
- 1 – UB Key
- 2 – Power Off
- 3 – Trip Test
- 4 – 52B
- 5 – SOE Event 1
- 6 – SOE Event 2
- 7 – SOE Event 3
- AM
- 0 – Not Used
- 1 – Carrier Start
- 2 – Carrier Stop
- 3 – Low Level Key
- 4 – Checkback Reset
- 5 – Checkback Initiate
- 6 – SOE Event 1
- 7 – SOE Event 2
- 8 – SOE Event 3
- 9 – Loopback Test
- AM RX Only
- 0 – Not Used
- 1 – SOE Event 1
- 2 – SOE Event 2
- 3 – SOE Event 3

Active State

<in1\_active\_state>0</in1\_active\_state>

Active State is a single digit value. Only 0 or 1 is valid:

- 0 – Application of Voltage
- 1 – Removal of Voltage

Trip Duty Outputs

Selection

<em1\_selection>1</em1\_selection>

Trip Duty Outputs is a single digit value between 0 & 2

FSK

- 0 – Not Used
- 1 – Guard
- 2 – Trip

AM

- 0 – Not Used
- 1 – Blocking Output
- 2 – Fade Alarm

Low Level Outputs

Selection

<prog1\_selection>1</prog1\_selection>

Low Level Outputs is a single or double-digit value between 0 & 11 or 16 depending on the mode:

FSK

Phase Comparison

- 0 – Not used
- 1 – Trip Negative
- 2 – Trip positive
- 3 – Reflected Power
- 4 – Main RF Output
- 5 – Redundant RF Output
- 6 – Good Channel
- 7 – Noise
- 8 – Fade Alarm
- 9 – TX Shift High
- 10 – TX Shift Low
- 11 – General Failure

2F-Unblocking & 2F-POTT/DTT

- 0 – Not used
- 1 – Guard



- 2 – Trip
- 3 – Reflected Power
- 4 – Main RF Output
- 5 – Redundant RF Output
- 6 – Good Channel
- 7 – Noise
- 8 – Fade Alarm
- 9 – TX Shift High
- 10 – TX Shift Low
- 11 – Checkback Trip
- 12 – Trip Test Failed
- 13 – Trip Test in Progress
- 14 – Trip Test Pulse
- 15 – General Failure

3-Frequency

- 0 – Not used
- 1 – LR Guard
- 2 – LR Trip
- 3 – Reflected Power
- 4 – Main RF Output
- 5 – Redundant RF Output
- 6 – Good Channel
- 7 – Noise
- 8 – Fade Alarm
- 9 – TX Shift High
- 10 – TX Shift Low
- 11 – LR Checkback Trip
- 12 DTT Guard
- 13 DTT Trip
- 14 DTT Checkback Trip
- 15 – Trip Test Failed
- 16 – Trip Test in Progress
- 17. – Trip Test Pulse
- 18 – General Failure

4-Frequency

- 0 – Not used
- 1 – A Guard

- 2 – A Trip
- 3 – Reflected Power
- 4 – Main RF Output
- 5 – Redundant RF Output
- 6 – Good Channel
- 7 – Noise
- 8 – Fade Alarm
- 9 – TX Shift to A
- 10 – TX Shift to B
- 11 – A Checkback Trip
- 12 B Guard
- 13 B Trip
- 14 B Checkback Trip
- 15 – General Failure

AM

- 0 – Not used
  - 1 – Blocking Output
  - 2 – Fade Alarm
  - 3 – Reverse Power
  - 4 – Main RF Output
  - 5 – Redundant RF Output
  - 6 – CB Off
  - 7 – CB Passed
  - 8 – Carrier Received
  - 9 – CB Major Alarm
  - 10 – CB Minor Alarm
  - 11 – CB Delayed Alarm
  - 12 – CB Carrier Recovered
  - 13 – CB In Recovery Mode
  - 14 – CB Test In Progress
  - 15 – CB Auto Test Disabled
  - 16 – General Alarm
- <prog1\_active>0</prog1\_active>

Low level active state is a single digit value, only a 1 or 0 is valid.

- 0 - Normally Open
- 1 - Normally Closed

<prog1\_action>0</prog1\_action>

Low level action state is a single digit value, only a 1 or 0 is valid.

0 - Normal

1 - PULSED (on for 5 sec.)

NOTE: General Alarm is a valid option only for the EM Outputs.

De-Energized State

<em1\_selection>1</em1\_selection>

De-energized State is a single digit value:

0 – Normally Open

1 – Normally Closed

### Checkback Configuration <checkback>

#### Module Address

<address>0</address>

Module Address is a number between 0 and 10. 0 being the Master and 1-10 are Remote Modules

#### Primary Communication Mode

<prim\_comm>1</prim\_comm>

Primary Communication mode is a single digit value. Only 0 or 1 is valid:

1 – Coded Communication Mode

0 – Timed Communication Mode

#### Auto Tests

<auto\_test>1</auto\_test>

Auto tests is a single digit value. Only 0 or 1 is valid:

1 – Auto Tests On

0 – Auto Tests Off

#### Fallback Communication Mode

<fallback>0</fallback>

Fallback Communication Mode is a single digit value. Only 0 or 1 is valid:

1 – Enable Fall back Communication

0 – Disable Fall back Communication

#### Low Power Tests

<low\_pwr>0</low\_pwr>

Low Power Tests is a single digit value. Only 0 or 1 is valid:

1 – Enable Low Power Tests

0 – Disable Low Power Tests

#### Last Module

<last\_rem>1</last\_rem>

Last Module is between 1 and 10; up to ten Remote Modules can be assigned.

#### Retries

<retries>4</retries>

Retries is 0 – 15, indicating, up to 15 retries are allowed.

#### Interval Type

<int\_type>0</int\_type>

Interval type is a single digit value. Only 0 or 1 is valid:

1 – Checkback Hours of the day

0 – Periodic checkback select

#### Hours Of The Day

(Valid only when ‘Hours of the Day’ is selected)

<time1>5</time1>

<time2>10</time2>

<time3>15</time3>

<time4>20</time4>

Hours of the day 0 – 23 in a 24 hour clock format. This indicates the hours of the day checkback needs to run.

#### Checkback Period

(Valid only when ‘Checkback Period’ is selected)

<test\_period>8</test\_period>

Periodic Checkback is 0 – 99. This indicates the number of hours to wait before the next Checkback test will run.

#### Carrier Recovery

<reco\_enab>0</reco\_enab>

Carrier Recovery is a single digit value. Only 0 or 1 is valid:

1 – Enable Carrier Recovery



0 – Disable Carrier Recovery

#### Recovery Window

<recovery\_time>**10**</recovery\_time>

Recovery Window is a number between the range of 0 – 24 hours. It specifies how long a UPLC-II™ will be in Recovery Mode before indicating a Delayed Alarm.

#### Recovery Period

<reco\_time>**30**</reco\_time>

Recovery Period number between the range of 5 – 60 minutes. It specifies the time between Master initiated Checkback tests when the UPLC-II™ is in Recovery Mode.

#### Loopback Duration

<loop\_time>**10**</loop\_time>

Loopback Duration is 4 – 60 seconds. It specifies how long a UPLC-II™ will key its transmitter at high and low power during a Loopback test.

#### Synchronize Clock Automatically

<sync\_enab>**1**</sync\_enab>

Synchronize Clock Automatically is a single digit value. Only 0 or 1 is valid:

- 1 – Enable Automatic Synchronization
- 0 – Disable Automatic Synchronization

## Appendix D: Management User Interface

### Introduction

The Universal Power Line Carrier device is network enabled allowing access to the settings and measured values via standard network interfaces and protocols. The UPLC-II contains a web server and allows a user to administer, configure, and view the near real-time status of the system while in operation. An authenticated user can use a standard browser to view and change the configuration of the system.

In addition to the web server interface, the UPLC can support either IEC61850 or DNP protocols for automated operation in the substation.

Prior to the UPLC-II management interface the only way to perform administrative changes was through the web server interface. Because of the new requirements requiring system operators to periodically change user passwords, it can be a time consuming task to access all the UPLC-IIs in the sub-stations as it currently requires a user to log in via a browser, make the changes and apply them on a unit by unit basis.

This interface provides a more automated method to make management changes to the UPLC-II that is:

1. Not HTML based
2. Provide services that are not necessarily supported by DNP or IEC61850
3. Management oriented – similar to Administrative functionality
4. Uses the standard TCP/IP port 80 and HTTP for transport control.

A key feature of this management interface is that it is automation friendly. This means it does not use graphics and the response data is in clear text for easier parsing by an automated user agent. In addition, responses from the UPLC are delivered in XML format, allowing for easier parsing by the requesting agent.

The following services are supported:

1. Retrieve the user list on the UPLC-II.

2. Verify that a user/password combination is a valid user on the system.
3. Create a user account on the system.
4. Change the password of an already existing user.
5. Delete a user from the user list on the system.
6. Retrieve the UPLC-II settings in XML format.

In order to allow a user agent to perform these services, it is necessary to create a “management” user. This user type is the only type of user that can access the management interface. It is necessary for a user agent to be authenticated on the UPLC-II before the interface will respond.

### Creating a Management User (Fig. D–1)

Creating a management user is similar to creating any other user on the UPLC-II. A user becomes a management user through the use of permission settings presented on the Admin >Add User web page.

**Note:** Only Administrators or Super Users can create new user accounts on this page.

Once created, a management user is displayed in the normal user list, but with a “Management” role.

A management user differs from any other user role (e.g. permissions) on the UPLC-II in the following ways:

1. Only management users can access the management services.
2. A management user is not restricted from accessing the UPLC-II if another user is logged in.
3. A management user cannot access the web pages.
4. There can only be one management user in a given UPLC-II.

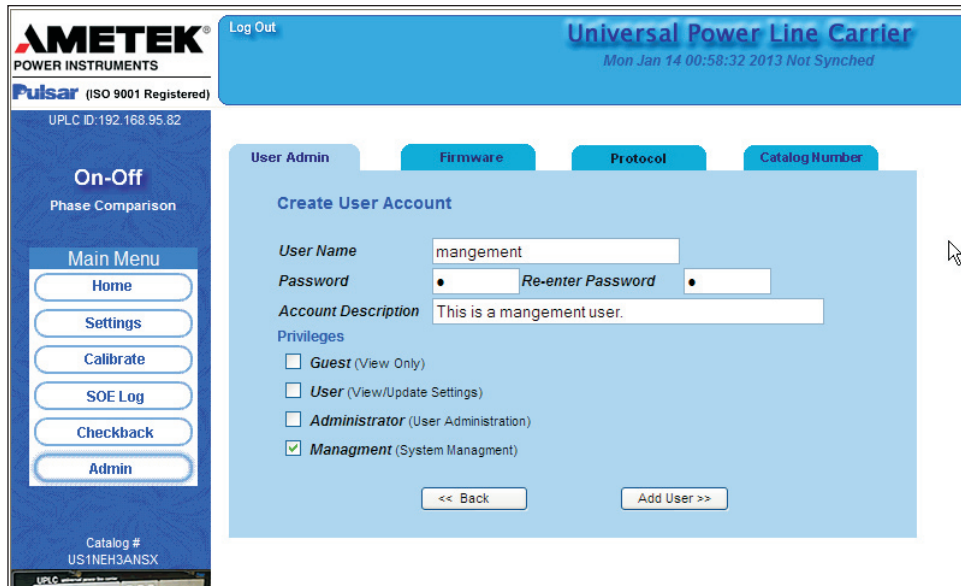


Figure D–1. Creating a Management User

## Basics of Management Services

The main purpose of the management user is to be able to access web services on the UPLC-II directly, rather than go through interactive graphically oriented web pages to accomplish tasks.

The web services are built around the basic HTTP interface. For those services requiring parameters, the parameters are added to the request URL in a HTTP query string. This means that appended to the URL separated by a ? are a series of name/value pairs that become the parameters (the input data) to the service.

For more information on query strings, please see [http://en.wikipedia.org/wiki/Query\\_string](http://en.wikipedia.org/wiki/Query_string)

Following are the web services implemented on the current version of UPLC-II firmware and descriptions for use.

In the following descriptions, the form represents the input as typed into a web browser.

Since the UPLC-II system enforces basic authorization for access to these services, it is necessary to supply the management users' credentials when using the browser as the access device.

For automated user agents, it is possible to establish a connection to the UPLC and access the service

directly, supplying the credentials as part of the get request as "Authorization: Basic <uuencoded credentials>".

The user credentials are in the form username:password, and then encoded.

The form of the get request aside from the addition of Basic Authorization is beyond the scope of this document. All required parameters for the get request must be included.

**Note:** The following examples are derived from using Internet Explorer to access the management interface. This is done for clarity. The design of this interface allows access from other user agents such as .NET or other programmatic interfaces.

## Authentication

For all management interface accesses, the request must include the username and password of the management user as part of the request.

If the username and password are not included as part of the request, or the username and password are not correct, the UPLC-II returns the standard HTTP 1.1 message: "401 Unauthorized - User authentication is required."

**Note** that this response is not formatted in xml as it is part of the HTTP implementation on the UPLC-II and such responses are standardized per rfc2616.

See <http://www.w3.org/Protocols/> and in particular <http://www.w3.org/Protocols/rfc2616/rfc2616-sec10.html>

## Management Services/Commands

### 1. Get User List (Fig. D-2)

Form: (*italicized bold text* is specific customer input data)

[http://uplc\\_ip\\_address/manage\\_get\\_user\\_list.htm](http://uplc_ip_address/manage_get_user_list.htm)

Returns: The current user list stored on the UPLC-II unit. Errors: None.

### 2. Verify User (Figs. D-3 to D-6)

Verify if a given user exists on the target system by supplying the user name and password of the user.

Form: (*italicized bold text* is specific customer input data)

[http://uplc\\_ip\\_address/manage\\_verify\\_user.htm?username=\*user name\*&password=\*user password\*](http://uplc_ip_address/manage_verify_user.htm?username=user_name&password=user_password)

Returns Fig. D-3.

TRUE if user exists in the user list AND the password is correct

Screen shot (sample user with username “b” and password of “b” shown)

**Warning:** Please note that using this service via a browser requires that the username and password must be typed in clear text. Be sure to clear the browser cache if using this service via a browser.

Errors:

If Password is not correct, see Fig. D-4.

If user doesn't exist, see Fig. D-5.

If the parameters in the query string do not exist, or do not have the correct syntax, see Fig. D-6.

**D**

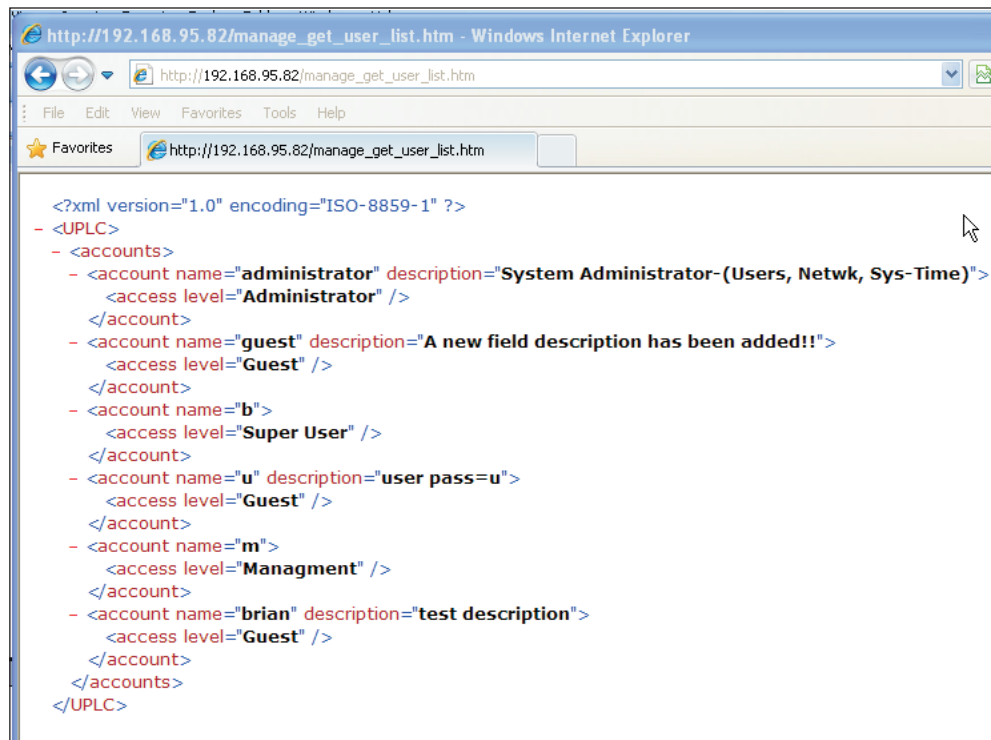
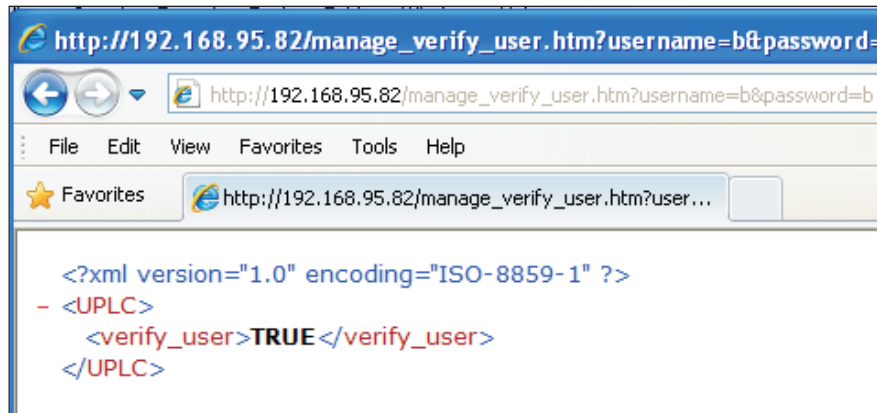
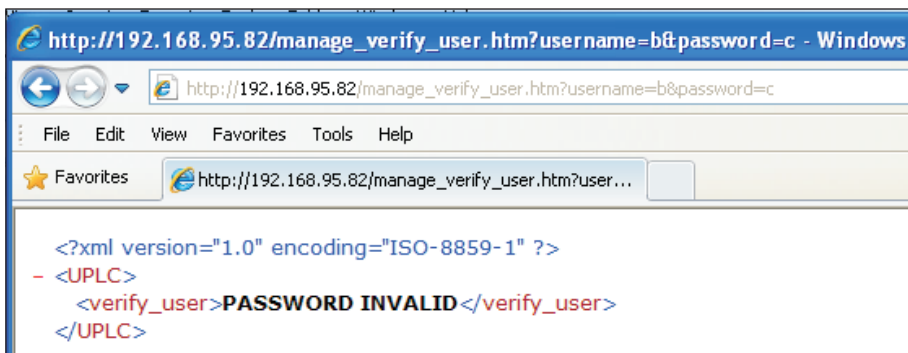


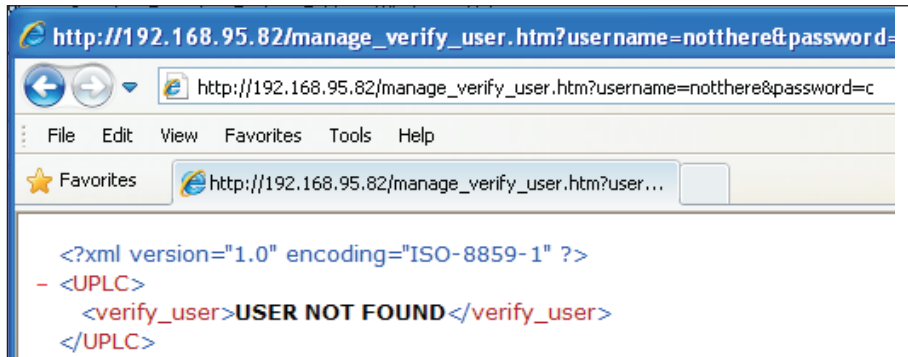
Figure D-2. Get User List



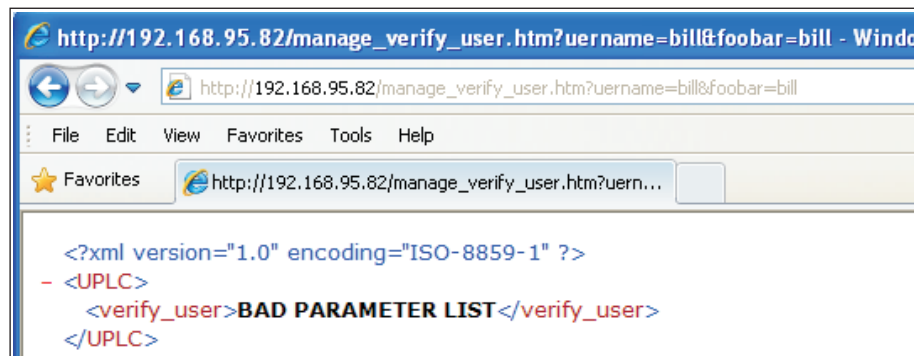
**Figure D-3. Verify User – Successful Return**



**Figure D-4. Verify User – Incorrect Password**



**Figure D-5. Verify User – Invalid User**



**Figure D-6. Verify User – Invalid Parameter List**

### 3. Create New User (Fig. D-7 to D-10)

Create a new user on the target UPLC-II.

Form: (*italicized bold text* is specific customer input data)

[http://uplcipaddress/manage\\_create\\_user.htm?username=newman&password=n&permissions=GUEST&description=test](http://uplcipaddress/manage_create_user.htm?username=newman&password=n&permissions=GUEST&description=test)

(The command above creates a new user on the UPLC-II with a user name of “newman” and a password of “n”, as a GUEST user and an optional description of “test”.)

Allowed user permissions values (must be exact):

- GUEST
- USER
- ADMINISTRATOR
- SUPERUSER

**Note:** The management user interface is restricted to one management user in the UPLC-II. Therefore, it

is not possible to create a management user using this interface.

For the parameters “username” and “password”, the length of the value is restricted to 32 characters. Any excess characters are truncated.

For the parameter “description”, the length of the value is restricted to 100 characters.

**Warning:** Please note that using this service via a browser requires that the username and password must be typed in clear text. Be sure to clear the browser cache if using this service via a browser.

Verification of the new user creation via the normal web interface returns Fig. D-8.

To create a new user, it is required that the parameters “username”, “password” and “permissions” are supplied. The parameter “description” is optional and may be omitted.

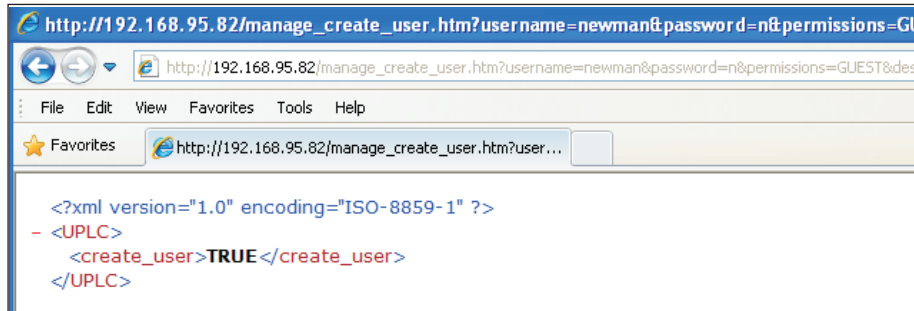


Figure D-7. Create User – Verification Return

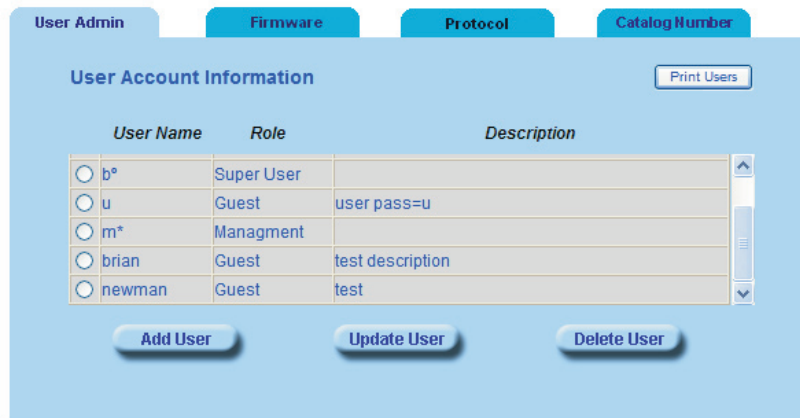
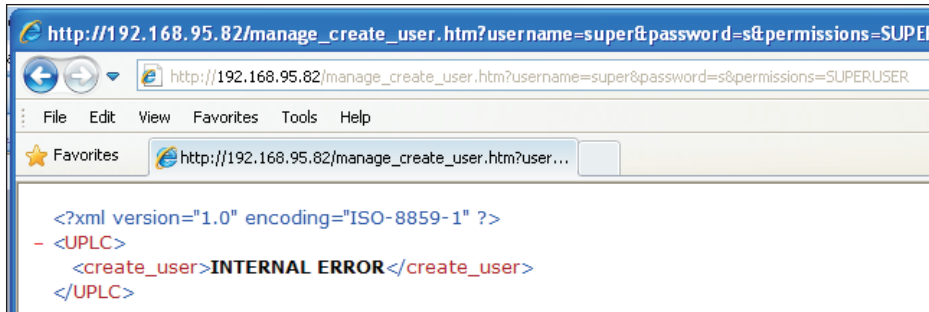
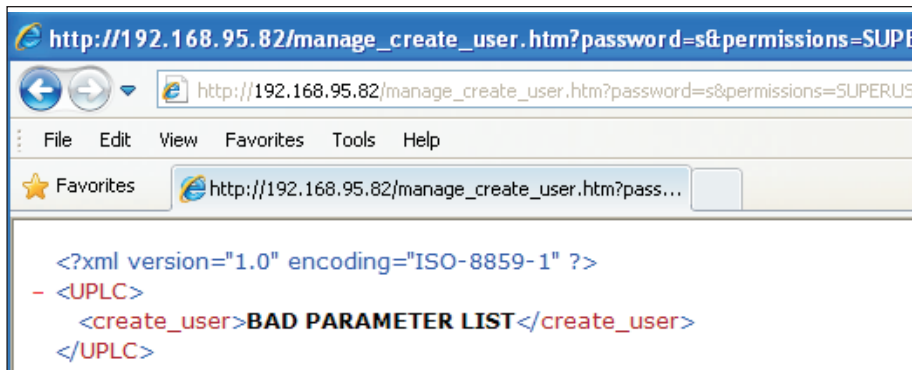


Figure D-8. Create New User



**Figure D–9. Create User – User Already Exists Error**



**Figure D–10. Create User – Parameters Not Supplied Error**

Errors:

If user to be created already exists (Fig. D–9).

If all of the required parameters are not supplied or incorrect in some way (Fig. D–10).



#### 4. Change Password for Existing User

Form: (*italicized bold text* is specific customer input data)

[http://uplciaddress>/manage\\_change\\_password.htm?username=newman&password=newpassword](http://uplciaddress>/manage_change_password.htm?username=newman&password=newpassword)

**Warning:** Please note that using this service via a browser requires that the username and password must be typed in clear text. Be sure to clear the browser cache if using this service via a browser.

Successful return (Fig. D–11) Errors:

User does not exist (Fig. D–12)

Bad parameter list (Fig. D–13)

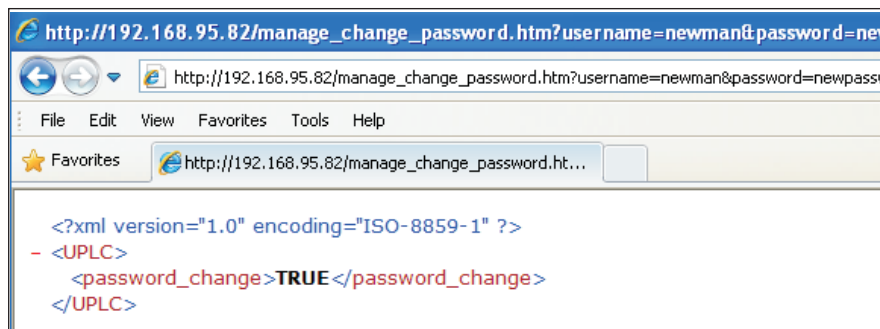


Figure D–11. Change Password – Successful Return

D

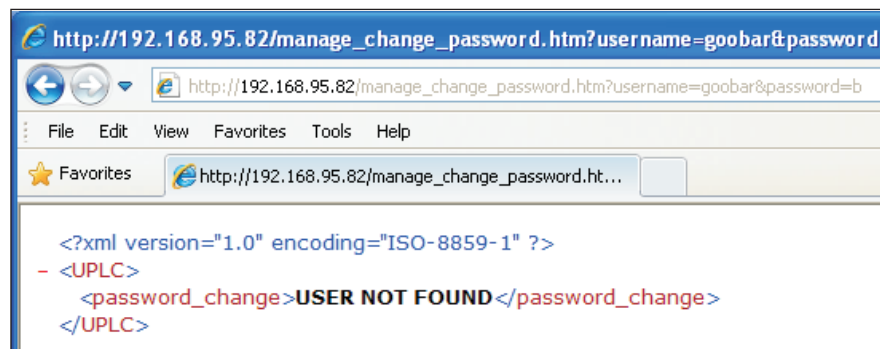


Figure D–12. Change Password – User Does Not Exist

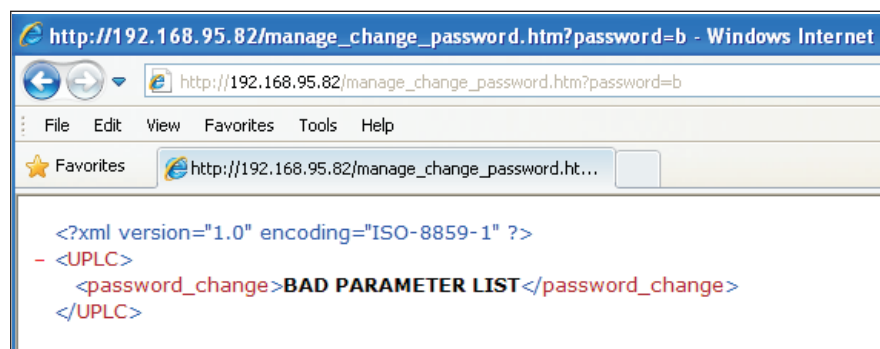


Figure D–13. Change Password – Bad Parameter Error

## 5. Delete User

The user account in the UPLC-II that matches the username will be removed.

Form: (*italicized bold text* is specific customer input data)

[http://uplcipaddress>/manage\\_delete\\_user.htm?username=user name to be removed](http://uplcipaddress>/manage_delete_user.htm?username=user name to be removed)

Successful return (Fig. D–14).

Note: upon success, the user name is returned as well for verification.

Errors:

Incorrectly formed request (Fig. D–15).

A user matching the supplied name is not in the UPLC-II list of accounts (Fig. D–16)

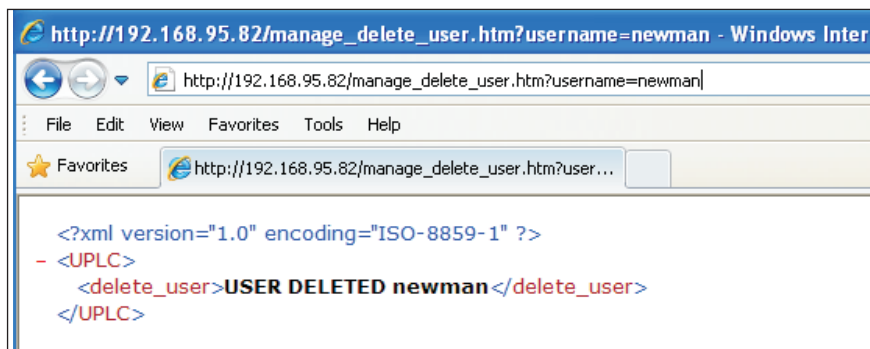


Figure D–14. Delete User – Successful Return

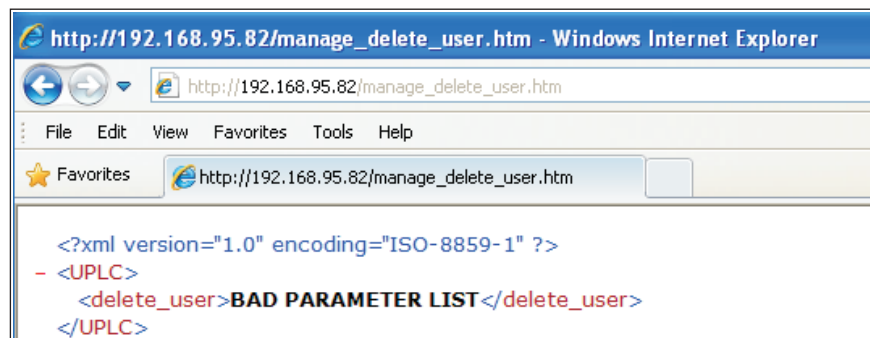


Figure D–15. Delete User – Bad Parameter Error

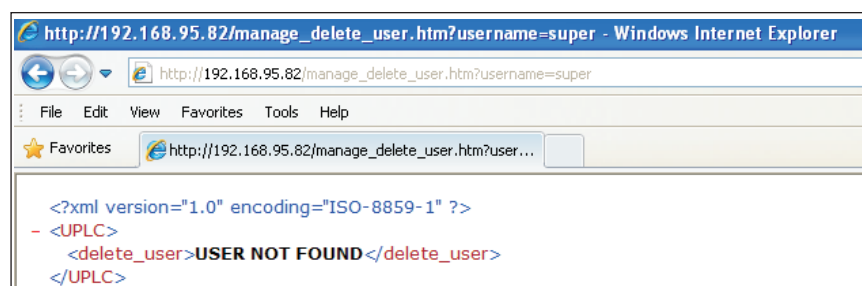


Figure D–16. Delete User – User Not Found Error

## 6. Get UPLC-II Settings

This returns the UPLC-II settings in xml format. Form: [http://uplcipaddress>/manage\\_get\\_uplc\\_set.htm](http://uplcipaddress>/manage_get_uplc_set.htm)  
See XML report at the end of this appendix. Errors: None

```

<?xml version="1.0" encoding="ISO-8859-1" ?>
<!-- UPLC Configuration for 10.14.3.124 as of Tue May 06 22:35:04 2014 -->
<!-- Catalog Number US1NEM9AFSX Mac Address 00:07:5E:00:10:12 -->
- <UPLC>
- <system>
  <ppc_version>4.01</ppc_version>
</system>
- <genset>
  <id_line0>Substation X</id_line0>
  <id_line1>Line Y</id_line1>
  <rear_ethernet_mode>0</rear_ethernet_mode>
  <chan_type>1</chan_type>
  <functn>1</functn>
  <tx_freq>250.00</tx_freq>
  <rx_freq>252.00</rx_freq>
  <txbwshift mode="FSK">2</txbwshift>
  <rxbwshift mode="FSK">2</rxbwshift>
  <tx_low>1.0</tx_low>
  <tx_hi>10.0</tx_hi>
  <fade_alarm>10</fade_alarm>
  <fade_margin>20</fade_margin>
  <reflpwr>15</reflpwr>
  <shift_up_to_trip_tx>0</shift_up_to_trip_tx>
  <shift_up_to_trip_rx>0</shift_up_to_trip_rx>
  <tx_rx_enable>3</tx_rx_enable>
</genset>
- <logset>
  <ptt_delay1>4</ptt_delay1>
  <trip_hold1>0</trip_hold1>
  <guard_hold1>0</guard_hold1>
  <ptt_delay2>30</ptt_delay2>
  <trip_hold2>35</trip_hold2>
  <guard_hold2>40</guard_hold2>
  <unblock_time1>150</unblock_time1>
  <unblock_delay1>20</unblock_delay1>
  <ttu0>1</ttu0>
  <guard_t0>3</guard_t0>
</logset>

```

D

Figure D–17. Get UPLC-II™ Settings – Settings XML Report

```

- <ioset>
- <inputs>
  <in1_hold>0</in1_hold>
  <in1_selection>0</in1_selection>
  <in1_active_state>0</in1_active_state>
  <in2_hold>0</in2_hold>
  <in2_selection>0</in2_selection>
  <in2_active_state>0</in2_active_state>
  <in3_hold>0</in3_hold>
  <in3_selection>0</in3_selection>
  <in3_active_state>0</in3_active_state>
  <in4_hold>0</in4_hold>
  <in4_selection>0</in4_selection>
  <in4_active_state>0</in4_active_state>
  <in5_hold>0</in5_hold>
  <in5_selection>0</in5_selection>
  <in5_active_state>0</in5_active_state>
</inputs>
- <tdoutputs>
  <em1_selection>0</em1_selection>
  <em2_selection>0</em2_selection>
  <em3_selection>0</em3_selection>
  <em4_selection>0</em4_selection>
</tdoutputs>
- <lloutputs>
  <prog1_selection>0</prog1_selection>
  <prog1_active>0</prog1_active>
  <prog1_action>0</prog1_action>
  <prog2_selection>0</prog2_selection>
  <prog2_active>0</prog2_active>
  <prog2_action>0</prog2_action>
  <prog3_selection>0</prog3_selection>
  <prog3_active>0</prog3_active>
  <prog3_action>0</prog3_action>
  <prog4_selection>0</prog4_selection>
  <prog4_active>0</prog4_active>
  <prog4_action>0</prog4_action>
  <prog5_selection>0</prog5_selection>
  <prog5_active>0</prog5_active>
  <prog5_action>0</prog5_action>
  <prog6_selection>0</prog6_selection>
  <prog6_active>0</prog6_active>
  <prog6_action>0</prog6_action>
  <prog7_selection>0</prog7_selection>
  <prog7_active>0</prog7_active>
  <prog7_action>0</prog7_action>
  <prog8_selection>0</prog8_selection>
  <prog8_action>0</prog8_action>
  <prog9_selection>0</prog9_selection>
  <prog9_action>0</prog9_action>
  <prog10_selection>0</prog10_selection>
  <prog10_action>0</prog10_action>
</lloutputs>
</ioset>
- <trip_test>
  <ttype>0</ttype>
  <auto_test>0</auto_test>
  <int_type>0</int_type>
  <time1>6</time1>
  <time2>12</time2>
  <time3>18</time3>
  <time4>0</time4>
  <test_period>8</test_period>
</trip_test>
</UPLC>

```

**Figure D–17. (cont'd) Get UPLC-II™ Settings – Settings XML Report**

## Appendix E: Sequence of Events (SOE) Listing

### Access Events

<User name> Logged off  
<User name> Logged on  
Front panel logoff  
Front panel logon  
User logged in  
User logged out

### Hardware Events

DC power down  
DC power up  
General alarm  
General alarm reset  
I/O board failed  
I/O board restored  
Main power supply failed  
Main power supply restored  
Main TX power low  
Main TX power OK  
Novram settings restored from flash memory of <Date>  
Power amp failed  
Power amp restored  
Redundant power amp failed  
Redundant power amp restored  
Redundant power supply failed  
Redundant power supply restored  
Redundant TX power low  
Redundant TX power OK  
Battery Failure

### Firmware Events

All UPLC™ settings initialized to default values  
DSP checksum mismatch  
Ethernet settings restored from flash memory  
Ethernet settings restored from flash memory of <Date>  
Ethernet settings set to default values  
SOE file system repaired  
Software Watchdog reset occurred (x)  
Events cleared

**Calibration Events**

Local transmitter calibrated  
Local transmitter failed calibration  
Receiver calibrated to distant transmitter  
Receiver calibrated to local transmitter  
Receiver failed distant transmitter calibration  
Receiver failed local transmitter calibration

**LAN Communications Events**

Ethernet interface 1 not detected  
Ethernet interface 2 not detected  
Ethernet link lost  
Ethernet link restored  
Redundant ethernet link lost  
Redundant ethernet link restored

**Administration Events**

<User name>: User account deleted from the system  
<User name>: User account modified  
New user added to the system  
Settings changed by <User name>  
Settings changed via front panel  
Settings file uploaded to the system

**Events Caused by External Stimulus**

IRIG signal acquired  
IRIG signal lost  
User event 1 - reset  
User event 1 - set  
User event 2 - reset  
User event 2 - set  
User event 3 - reset  
User event 3 - set

**System Events in All Modes*****Receiver Functions***

Fade alarm off  
Fade alarm on

***Transmitter Functions***

RF powered off  
RF powered on

**System Events for ON/OFF Mode*****Receiver Functions***

Carrier off

Carrier on

***Transmitter Functions***

Low level key

Low level key reset

TX start key

TX start key reset

TX stop key

TX stop key reset

**Checkback Events**

<current module name> received timed CB  
<current module name> sent high power CB to <module name>;  
<current module name> sent low power CB to <module name>  
<current module name> failed <module name>'s high power coded test  
<current module name> failed <module name>'s low power coded test  
<current module name> passed <module name>'s high power CB  
<current module name> passed <module name>'s low power CB  
<current module name> passed <module name>'s high power coded CB  
<current module name> passed <module name>'s low power coded CB  
<current module name> received <module name>'s high power coded CB  
<current module name> received <module name>'s low power coded CB  
<Current Module Name> received timed CB  
<current module name> sent high power coded CB to <module name>;  
<current module name> sent high power timed CB to <module name>;  
<current module name> sent low power coded CB to <module name>;  
<current module name> sent low power timed CB to <module name>;  
<module name> Alarms cleared  
<module name> Checkback event counts cleared  
<module name> failed high power CB  
<module name> failed low power CB  
<module name> failed high power coded CB  
<module name> failed high power timed CB to <module name>;  
<module name> failed low power coded CB  
<module name> failed low power timed CB to <module name>;  
<module name> passed high power coded CB  
<module name> Passed high power test



<module name> passed high power timed CB to <module name>;  
<module name> passed low power coded CB  
<module name> Passed low power test  
<module name> passed low power timed CB to <module name>;  
Auto checkback tests disabled  
Auto checkback tests enabled  
Carrier recovered  
CB Alarms Cleared  
CB event counts cleared  
Communications error  
Delayed alarm reset  
Delayed alarm set  
Local carrier failed  
Major alarm cleared  
Major alarm set  
Minor alarm cleared  
Minor alarm set  
Remote <module number> requested CB  
Starting carrier recovery mode

## System Events for FSK Mode

### *Receiver Functions*

Channel lost  
Channel restored  
Noise detected  
Noise reset

### *Transmitter Functions*

Boost key reset  
Boost key set

## 2-Frequency DTT/POTT/Unblock

### *Receiver Functions*

Guard  
Loss of guard  
Trip  
Trip reset  
Unblock trip  
Unblock trip reset

### *Transmitter Functions*

Trip key

Trip key reset

### 3-Frequency Mode

#### *Receiver Functions*

DTT guard  
Loss of DTT guard  
DTT trip  
DTT trip reset  
LR guard  
Loss of LR guard  
LR trip  
LR trip reset

#### *Transmitter Functions*

LR trip key  
LR trip key reset  
DTT trip key  
DTT trip key reset

### Phase Comparison

#### *Receiver Functions*

Trip negative off  
Trip negative on  
Trip positive off  
Trip positive on

#### *Transmitter Functions*

PC Key Off  
PC key on

### Trip Test Events

Failed Trip Test  
Passed Trip Test  
Received CB Trip Test request  
Received real Trip Test request  
Request CB Trip Test  
Request real Trip Test

### 4-Frequency Mode

#### *Receiver Functions*

Trip A  
Trip A Reset  
Loss of Guard A

Guard A  
Loss of Guard B  
Guard B  
Unblock A  
Unblock A Reset  
Unblock B  
Unblock B Reset  
Both Trip A & B  
Both Trip A & B Reset  
Guard A & B  
Guard A & B Reset

#### *Transmitter Functions*

A key  
B key  
A & B key



## Appendix F: Changing the Cat. No. on a UPLC-II™

1. Login to the UPLC-II™ with either the administrator or superuser account. (Default administrator login is “administrator” and password is “pulsar”.)
2. On the left-hand side navigator, click on “Admin”. This should take you to a page with four tabs across the top.
3. Select the “Catalog Number” Tab. You will see a “Submit Key” box at the bottom with a field in which to type in the provided hexadecimal key code(s) to update the catalog number. These codes are MAC address specific. The MAC address of the UPLC-II™ you are logged into is shown at the top of the screen.
4. Locate the appropriate key code for the MAC address and insert the key code in the box provided. If you have an electronic copy of the key codes, you can copy and paste the key code into the box to help eliminate errors.
5. Hit the “Submit Key” to start the process to update the catalog number. You will see a description of the catalog number you are about to install. It should read as shown in Figure 42, with the exception of the receive-only chassis or dual-power-amp chassis, which will change appropriately.
6. Should you get a message to contact Pulsar Sales, you may have used the wrong key code with the MAC address you are trying to update. Re-check the key code and the MAC address and try again.
7. Click the “Continue” button.
8. You will receive a message window about logging out from the UPLC-II™ and rebooting it. Click “OK” to continue.
9. The system will reboot and the UPLC-II™ is now updated. Settings should not have changed during this process but a quick check would be in order.

You have completed the update.

The screenshot shows the 'System Configuration' page with the 'Catalog Number' tab selected. The page lists various system parameters and their current values. At the bottom, there is a text input field for entering a key code and a 'Submit Key' button.

System Configuration	Value
Mac Address	00 07 5E 00 10 12
Catalog No.	US1NEM9AFSX
Configuration	Single Transceiver
Main Power Supply	110/125/250 Vdc
Redn. Power Supply	None
Outputs	Standard Outputs w/ Trip Duty
Logic	Standard
Ethernet Ports (rear)	Redundant/Daisy Chain 2 RJ-45(10/100 BaseT)
Protocols	DNP 3.0
Front Port	Ethernet / RS-232
Testing	ON-OFF Checkback Test / FSK Trip Test
Power Amp Features	Improved Power Amp with Freq Selectivity for Refl Power

Submit Key

UPLC-II™ Catalog Number Update



## Appendix G: Upgrading the firmware in a UPLC-II™

**NOTE: Never downgrade to a lower firmware version.**

### General Firmware Upgrade Procedure

(Specific instructions for a particular firmware version are provided with each firmware release on the [www.ametekpower.com](http://www.ametekpower.com) website.)

Cautions when upgrading to later firmware versions:

- Protection system must be out of service and all trip circuits opened, in order to upgrade the firmware.
- Reconfirm all settings and calibrations prior to putting back in service.
- Upgrading from previous firmware versions usually will revert the settings to the factory default of an ON/OFF unit. You will need to then reload your settings.
- If the transceiver board hardware revision is less than revision 7, please contact the factory for a replacement board. The revision can be identified on the administration page under the “Firmware” tab when you are connected to the unit or through the front panel keypad SET button menu (Configure/View Revisions).
- Check what version of Internet Explorer you are using before starting to upgrade. If using IE9 or higher then you must be in ‘compatibility view’ to avoid issues. IE8 and older versions will work fine.

### Upgrade Process

1. Log in using the Ethernet port (faster port) or RS-232 (slower port) on the UPLC-II™ with an administrator or super-user account. See chapter 5 for details.
2. If not previously done, save the settings configuration file as a “xml” file (remembering to add the .xml extension to the file name) and as a “report” file (.txt). The SOE file (.csv) may also be saved if desired.

[NOTE: If you do not get a pop up window asking you where to save this file, then try continuously holding down the control key (CTRL) before clicking the “save configuration” button and keeping it held down until the window pops up, then release the key.]

3. Take the UPLC-II™ system out of service by powering it down, removing the coax from the rear of the chassis and loading the transmitter output (J1) with a 50 or 75 ohm non-inductive resistor, whichever is the applicable load. Power the unit back up.
4. Two files make up the upgrade process if updating from Version 2.0x to later versions. The code loader (UPLCL1\_5.mem) file must be uploaded to the UPLC-II™ unit first. (If updating from Version 3.0x or higher the code loader file is not required, so skip to step 7). This will prepare the unit to accept the actual firmware file (UPLCVx\_xx.mem). Copy these two files to a directory on the computer that you will be using for upgrading the UPLC-II™.
5. Log back onto the system as in step 1 prior. On the left hand side of the web page, click on “Admin”. This will take you to the administration page. Click on the tab labeled “Firmware”. There you will see a browse button for locating the needed files. Click on the button and navigate to where you have stored the files in Step 4. Select the code loader file (UPLCL1\_5.mem), then click on “update code”. The system will go through several steps. **DO NOT TURN UNIT OFF** during this process. Click on the Continue and OK button, when prompted to do so in order to continue the process. When complete, the UPLC-II™ front panel will display the words “CODE LOADER” to indicate that it is non-functional and ready to be updated to latest firmware.

6. Close the browser and log back onto the system as in step 1.
7. You will be directed to the firmware update page automatically. (If you have skipped step 5 and 6, then Log into the system as in Step 1 before continuing with this step.) On the left hand side of the web page, click on “Admin”. This will direct you to the administration page. Click on the tab labeled “Firmware.” There you will see a browse button for locating the needed files. Click on the button and navigate to where you have stored the files in Step 4. Select the firmware file (UPLCVx\_xx.mem), then click on “update code”. The system will go through several steps. Hit “continue” and OK when prompted.



Figure G–1

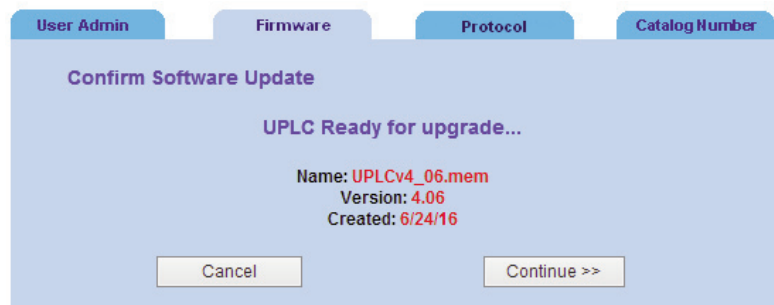


Figure G–2

8. If the unit does not see new code as shown in Figure 1, and you have waited at least 10 minutes, cycle the power and try again. Once the unit sees the new code, it will check several files (as shown in Figure G–1) and prepare the unit for upgrading.
9. At that point you should see a web page similar to Figure G–2.

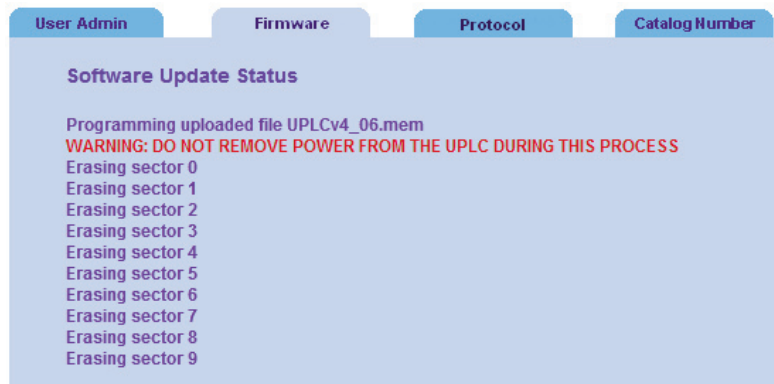


Figure G–3

10. After you have hit the “continue” button, DO NOT TURN THE UNIT OFF during this process. You should see something like Figure G–3.
11. Reload the settings files saved in Step 2. Reconfirm the desired settings. The Trip Duty outputs may need to be reprogrammed according to the desired settings. Recalibrate the transmitter & receiver per chapter 5.



4-Frequency .....2-1, 2-33, 3-30, 3-39

**A**

Alarms, Checkback .....6-9  
 Alarms, Fade Alarm .....3-41, 5-17, 5-34  
 Alarms, Fail Safe .....5-27  
 Alarms, Front Panel .....4-2  
 Alarms, FSK Mode .....3-40  
 Alarms, General .....5-27  
 Alarms, Good Channel .....3-41  
 Alarms, Main RF Output .....3-41  
 Alarms, ON/OFF Mode .....3-15

**B**

Backplane .....2-5, 2-7, 5-3, 5-7  
 Battery, NOVRAM .....2-18  
 Binary Inputs .....7-3  
 Block Diagram .....2-22, 2-23  
 Blocking (DCB) System .....3-1

**C**

Calibration .....5-31  
 Catalog Number, Explanation .....1-3  
 Catalog Number, Location .....1-1  
 Channel Delay .....2-3  
 Chassis .....2-5  
 Chassis Dimensions .....2-8  
 Checkback .....6-1  
 Checkback, Clock Sync .....6-5  
 Checkback, Coded Test .....6-2, 6-5  
 Checkback, Delayed Alarm ....6-4, 6-5, 6-6  
 Checkback, Loopback Test .....6-7  
 Checkback, Major Alarm .....6-3, 6-6  
 Checkback, Minor Alarm .....6-3, 6-6  
 Checkback, Recovery Mode .....6-4, 6-5  
 Checkback, Sequence .....6-2  
 Checkback, Timed Test .....6-2, 6-5  
 Coax Cable .....5-5  
 Computer (PC), RS-232 .....5-11  
 Computer (PC), Setup .....5-10  
 Computer, Windows 10 .....A-3  
 Computer, Windows 7 .....A-1  
 Configuration File .....5-14  
 Connections .....5-3, 5-4, 5-5, 5-6  
 Connections, ON/OFF .....3-8

**D**

Direct Transfer Trip (DTT) 3-28, 3-29, 3-37

Directional Comparison Blocking (DCB) 3-1  
 Display Board (Module) .....2-14  
 DNP3 .....7-1  
 Downloads, Report File .....5-15  
 Downloads, Settings .....5-14  
 Downloads, SOE's .....5-33  
 Downloads, XML File .....5-14  
 DTT Unidirectional App .....3-31

**E**

Electromechanical Relay 3-9, 3-10, 3-11, 3-13, 3-14  
 Ethernet Board (Module) .....2-20  
 Ethernet Cable .....5-10  
 Ethernet, IP Address .....5-10

**F**

Fade Alarm .....3-41, 5-17, 5-34  
 Fade Margin .....5-17, 5-34  
 Firmware, Version .....5-16, 5-36  
 Frequency Spacing .....2-3  
 Frequency Specifications .....2-1  
 Front Display Alarm Codes .....4-2  
 Front Display RX States .....5-36  
 Front Door .....2-6  
 Front Panel, Parameters .....5-36  
 Front Panel, Password .....5-36  
 Front Panel, Set Menu .....5-36  
 Front Panel, Test Menu .....5-37

**G**

GOOSE .....7-8

**H**

Hot Swappable .....2-1  
 Hybrids .....3-42

**I**

IEC61850 .....7-8  
 Input/Output (I/O) Board (Module) .....2-16  
 Inputs, Settings .....5-23  
 Inputs, Specifications .....2-2  
 IRIG-B .....2-1, 5-6

**J**

Jumpers .....5-6  
 Jumpers, As Shipped .....5-9

**K**

Keying Logic .....2-25, 2-26, 2-27, 2-28

**L**

Log In, Ethernet .....5-10  
 Log In, RS-232 .....5-11

**O**

Outputs, EM Contacts (Low Level) ....5-27  
 Outputs, Settings .....5-27  
 Outputs, Solid-State (Low Level) .....5-27  
 Outputs, Specifications .....2-2  
 Outputs, Testing .....5-37  
 Outputs, Trip Duty .....5-27

**P**

Passwords, Front Panel .....5-36  
 Passwords, Web Page .....5-11  
 Phase Comparison, FSK Mode ..2-34, 3-31  
 Phase Comparison, ON/OFF Mode .....3-5  
 Power Amp (PA) .....2-12  
 Power Supply (PS) .....2-10, 5-8

**R**

Receiver Sensitivity .....5-17, 5-34  
 RS-232 5-11

**S**

Settings (Logic), Guard Before Trip ....5-21  
 Settings (Logic), ON/OFF .....5-21  
 Settings (Logic), Pre-Trip Delay .....5-21  
 Settings (Logic), Unblock Timer .....5-21  
 Settings, Downloads .....5-14  
 Spare Modules .....2-5

**T**

Terminal Blocks, Connections .....5-4  
 Terminal Blocks, Lugs .....5-3

Test Equipment, Load Resistor .....4-1  
 Transceiver (XCVR) .....2-18

**U**

Unblock (DCUB) System 3-17, 3-30, 3-31  
 Users, Administrator .....5-13  
 Users, Management User .....5-14, D-1  
 Users, Super User .....5-13