BETTER, FASTER, AND MORE ECONOMICAL INTEGRATED PROTECTIVE RELAYING AND CONTROL USING DIGITAL BITS AND LOGIC: ADDITIONAL DOCUMENTATION

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XIII. ADDITIONAL DOCUMENTATION

This document is the additional information that consists of:

A. A detailed test procedure, with specific steps for replacing and testing µP-07A and RIO-07B.

B. A device logic diagram for µP-07A.

C. An interdevice logic diagram for Bus 1.

A. µP Relay and RIO Test Procedure

The following is the detailed procedure, with specific steps, that was developed and required for replacing and testing µP-07A and RIO-07B. This procedure is typical of all the procedures developed for each µP relay and RIO in the substation.

RELAY µP-07A – INDEX #1001
and RIO-07B – INDEX #1002

TEST PROCEDURE

Preparation: Use prints **07-93GA-020** and **07-93GAA-020** for reference. You may also need a calculator.

I. Disable Relay

Note that when performing any maintenance or testing on either the µP-07A or RIO-07B, you should always follow this procedure from Section I.

1. Notify the Control Center that the feeder relay µP-07A for Unit-07 at the switching station will be removed from service for testing.
2. Verify that you are about to work on the correct panel and are decommissioning the correct relay.
3. Place Unit-07 in **LOCAL** by momentarily pushing the UNIT-07 {REMOTE/LOCAL} pushbutton on the front of µP-07A (associated amber pushbutton LED should turn ON).
4. Remove cover on FTS1-07B (located inside UNIT-07 cubicle), and open all **ORANGE (output)** test switches.
5. Disconnect (RC1-LP1A-07A) relay communications cable from Port-1 on µP-07A (disconnects PLP-1A from µP-07A).
6. Disconnect (FC1-07A-07B) fiber communications cable from Port-3 on µP-07A (disconnects µP-07A from RIO-07B).
7. Disconnect (SC1-SS1A-07A) SCADA communications cable from Port-2 (disconnects SDP-1A from µP-07A).
8. Open all **BLUE (input)** test switches on FTS1-07B.
9. Remove cover from FTS1-07A (located on the front of Unit-07 cubicle), and open all **BLACK (current)** test switches.
10. Open all **RED (voltage)** test switches on FTS1-07A.
11. Insert isolation test plugs into FTS1-07A and FTS1-07B.

II. Replace Relay

Note: If µP-07A or RIO-07B is not being replaced, go to Section III, General Information.

µP-07A

12. Remove dc fuses from FU-07A fuse block.
13. Disconnect all wirings from the rear of relay µP-07A.
14. Remove and replace the relay (spare or replacement relay should have previously passed an acceptance test).
15. Reconnect all wiring to the rear of relay µP-07A.
16. Verify all wiring on the rear of relay µP-07A.
17. Install dc fuses into FU-07A fuse block.
18. Load relay Setting File µP-07A-1001 into the replacement relay. (Refer to Section III, General Information, for the procedure to upload settings and compare settings from the relay.)
19. Plug the 120 Vac–12 Vac voltage adaptor into a wall receptacle. Connect wire (+V) to Position A and wire (–V) to Position D of the isolation test plug on FTS1-07A. Measure the input voltage across (+V) and (–V) with an accurate multimeter.
20. On the front interface of the relay, push the {ENT} button once, and push the {ESC} button twice. Use the {UP ARROW} to select **METER**, and then press {ENT}. Use the {DOWN ARROW} to select **FUNDAMENTAL METER**, and press {ENT} twice. Verify with a calculator that VA is equal to 120 times (PT ratio) the measured input voltage (± 0.010 kV tolerance). Note that VB and VC should be zero volts.
21. Move wire (+V) from Position A to Position B. Verify that VB is equal to 120 times the measured input voltage (± 0.010 kV tolerance). Note that VA and VC should be zero volts.
22. Move wire (+V) from Position B to Position C. Verify that VC is equal to 120 times the measured input voltage (± 0.010 kV tolerance). Note that VA and VB should be zero volts.
23. Move wire (+V) from Position C back to Position A. Connect wire (+I) to Position F. Connect wire (–I) to

Position E. Verify that IA is equal to 4.8 times the measured input voltage (± 2 A tolerance) at zero degrees (± 2° tolerance). Note that IB and IC should be zero amperes.

24. Move wire (+I) from Position F to Position H. Move wire (–I) from Position E to Position G. Verify that IB is equal to 4.8 times the measured input voltage (± 2 A tolerance) at zero degrees (± 2° tolerance). Note that IA and IC should be zero amperes.
25. Move wire (+I) from Position H to Position J. Move wire (–I) from Position G to Position I. Verify that IC is equal to 4.8 times the measured input voltage (± 2 A tolerance) at zero degrees (± 2° tolerance). Note that IA and IB should be zero amperes. If the value is not what is expected, recheck the wiring, and retest. Otherwise, remove the voltage adapter and associated wires from the isolation test plug in FTS1-07A.
26. Reconnect (FC1-07A-07B) fiber communications cable to Port-3 on µP-07A. Verify that **COMM B FAILED RIO-07B** is not alarming (amber LED is ON when alarming). Connect Jumper-1 across Position B and Position H on the isolation test plug in FTS1-07B (RIO-07B).
27. Log in to the relay µP-07A to clear the Sequential Events Recorder (SER). Refer to Section III for instructions on how to get access to Level 2. Once in Level 2, type in the following command to clear the SER:

    SER CA <Enter>

    The relay will prompt you with the question, "Clear the sequential events recorder for all ports. Are you sure (Y/N)?" Enter **Y** for yes.

    Push the {TRIP} button on the front interface of µP-07A. Push the {ENT} button, and use the {DOWN ARROW} to select **EVENTS**, and then press {ENT} again. Use the {DOWN ARROW} to select **SER Events**, and then press {ENT} again. Look for Relay Word bit **TMB3B ASSERTED**, and write down the stamped time for this word bit. Push the {DOWN ARROW} key, and look for Relay Word bit **PB3 DEASSERTED**, and write down the stamped time for this word bit. Subtract **PB3 DEASSERTED** stamped time from **TMB3B ASSERTED** stamped time. This will be the relay's processing time, which is about 3.002 to 3.005 seconds (minus 3-second time delay allowing the operator to step away from the breaker before it operates). So the relay's actual processing time is from 2 to 5 milliseconds. If the actual processing time exceeds this tolerance, notify the relay engineer.
28. Look for the Relay Word bit **RMB2B ASSERTED**, and write down the stamped time for this word bit. Subtract **TMB3B ASSERTED** stamped time from **RMB2B ASSERTED** stamped time. This will be the communications I/O processing time from µP-07A to RIO-07B and then back to µP-07A, which should be less than 20 milliseconds. If the actual processing time is exceeding the tolerance, notify the relay engineer.
29. Disconnect (FC1-07A-07B) fiber communications cable from Port-3 on µP-07A, and remove Jumper-1 from FTS1-07B.
30. The full functional test is optional. Refer to Section IV for full details.

RIO-07B

31. Remove dc fuses from FU-07B fuse block.
32. Disconnect (FC1-07A-07B) fiber communications cable from RIO-07B.
33. Open KS-07 disconnect switch (located inside UNIT-07 cubicle), which removes the control power, and disconnect all wiring from RIO-07B.
34. Set the new RIO-07B control switches as indicated on print 07-93GA-020.
35. Replace RIO-07B. (Replacement remote I/O should have previously passed an acceptance test.)
36. Reconnect all wiring to RIO-07B.
37. Verify all wiring on RIO-07B with print 07-93GA-020, and close KS-07 disconnect switch (located inside UNIT-07 cubicle), which applies the control power.
38. Install dc fuses in FU-07B fuse block.
39. Connect the provided DB Tester to the new RIO-07B. Turn ON the DB Tester. If, after a few seconds, the **ROK** LED on the tester does not come on, then reverse the fiber connection on the relay.
40. Connect Jumper-1 across Position A and Position F on the isolation test plug in FTS1-07B. Press Button 1 on the tester, and verify that **OUT1** LED and **IN1** LED on RIO-07B turn on. Press Button 1 again, and **OUT1** LED and **IN1** LED on RIO-07B turn off. Relocate Jumper-1 across Position B and Position G on the isolation test plug in FTS1-07B, and connect Jumper-2 across 107PB(TB2) to 07-7B(TB1). Press Button 2 on the tester, and **OUT2** LED and **IN2** LED should turn on. Press Button 2 again, and **OUT2** LED and **IN2** LED turn off. Relocate Jumper-1 across Position C and Position H on the isolation test plug in FTS1-07B, and reconnect Jumper-2 across 107NB(TB2) to 07-9A(TB1). Press Button 3 on the tester, and **OUT3** LED and **IN3** LED should turn on. Press Button 3 again, and **OUT3** LED and **IN3** LED turn off. Relocate Jumper-1 across Position D and Position I on the isolation test plug in FTS1-07B, and reconnect Jumper-2 across 107PB(TB2) to R07B-16(TB2). Press Button 4 on the tester, and **OUT4** LED and **IN4** LED should turn on. Press Button 4 again, and **OUT4** LED and **IN4** LED turn off. Remove Jumper-1 and Jumper-2.
41. Turn OFF the tester, and disconnect it from the relay. Reconnect (FC1-07A-07B) fiber communications cable to RIO-07B.
42. Reconnect (FC1-07A-07B) fiber communications cable to Port-3 of µP-07A. Verify that **COMM B FAILED µP-07B** is not alarming (amber LED is ON when alarming). If it is alarming, wait for about 30 seconds, and then reverse the fiber connection on µP-07B.
43. Connect Jumper-1 across Position B and Position H on the isolation test plug in FTS1-07B (RIO-07B).
44. Log in to the relay µP-07A to clear the SER. Refer to Section III for instructions on how to get access to Level 2. Once in Level 2, type in the following command to clear the SER:

    SER CA <Enter>

45. The relay will prompt you with the question, "Clear the sequential events recorder for all ports. Are you sure (Y/N)?" Enter **Y** for yes. Push the {TRIP} button on

the front interface of relay µP-07A. Push the {ENT} button, and use the {DOWN ARROW} to select **EVENTS**, and then press {ENT} again. Use the {DOWN ARROW} to select **SER Events**, and then press {ENT} again. Look for Relay Word bit **TMB3B ASSERTED**, and write down the stamped time for this word bit. Look for the Relay Word bit **RMB2B ASSERTED**, and write down the stamped time for this word bit. Subtract **TMB3B ASSERTED** stamped time from **RMB2B ASSERTED** stamped time. This will be the communications I/O processing time from µP-07A to RIO-07B and then back to µP-07A, which should be less than 20 milliseconds. If the actual processing time is exceeding the tolerance, notify the relay engineer.

46. The full functional test is optional. Refer to Section IV for full details.

III. General Information

Basic Information: To communicate to µP-07A, you will need to have the associated relay software installed on your laptop, and you will need a NULL MODEM serial cable that will be connected from your laptop's serial port to µP-07A's front port (Port F).

Communication: Once you have opened the software application program (double-click on the icon), click on **Communication** at the top menu toolbar. Select **Parameters** under the drop-down menu of **Communication**. Select the **COMM PORT** that will be used for communication to the relay under the **Device** box. Select 19200 for the baud rate to talk to the relay. Click **OK** when done with all of the parameters for establishing communication to the relay.

To verify if communication is made, click on **Tools**, and select **Terminal** under the drop-down menu. A window will be opened, and if you hit the <Enter> key on your laptop's keyboard, the equal sign = (Level zero (0)) will appear to the left of the screen. There are some helpful common commands at the end of each relay instruction book. It will be very handy to have them while performing the tests.

Access Level 1: To gain access to Level 1, type in the following:

ACC <Enter>

The relay will ask you to enter a password. All passwords must be **CAPITALIZED**.

"Level 1 password" <Enter>

XXXXX is this substation's default password for Level 1.

The software will prompt you with **=>**, which means that you are in Level 1.

Access Level 2: To gain access to Level 2, type in the following:

2AC <Enter>

The relay will ask you to enter the password.

"Level 2 password" <Enter>

XXXX is this substation's default password for Level 2.

=>> means you are in Level 2.

You will have to be in Level 2 in order to modify or change any relay settings. When you are running the automated tests, you will be required to enter settings for certain tests by using **Terminal** from the software. When time is up or expired (depending on relay's setting), the relay will prompt back to Level 0. If you enter the wrong password three consecutive times, the relay will go back to Level 0.

Active Database: Once you have opened the software, click on **File** at the top menu toolbar. Select **Active Database** on the drop-down menu toolbar, and a **Set Active Settings Database** window will pop up. If you have saved the settings file database in **My Documents**, then click on the **My Documents** icon on the left side of the popup window. Once you have located the settings file database, double-click on the file to open it. If you have saved the settings file database somewhere else, then navigate through **My Computer** to find it. Once you have opened the active settings database, click on **File** at the top menu toolbar, select **Open**, and an **Open Settings** box will appear with all of the settings files in the database. Double-click on the file **µP-07A-1001** to open it. Click on **File**, select **Send** to upload the opened settings file into the relay, and a **Setting Group/Classes to Send** window will pop up. Click on the checkbox button (√) to upload everything in the settings file to the relay. If you wish to upload just Group 1 settings, then click on the box in front of Group 1 (not recommended).

Comparing Settings: After you have successfully uploaded the settings file into the relay, close the settings file so that you will not be mixed up with the other settings files. Click on **File** at the menu toolbar, and select **Read** to read the settings from the relay. Next, click on **Edit** at the menu toolbar, and select **Compare** to compare the setting that you have just read from the relay to the setting in your database. Once you have selected the compare feature, a **Compare with Settings** window will appear on the screen. Click on **µP-07A-1001**, and click **OK**. After settings have been compared, a **Compare Setting** window will generate a report. There should not be any differences between the two settings. If there are any differences, a particular setting will show up on the left-side column of the report. If you click on it, it will give you description and detail between the two different settings strings. If differences occur, contact your relay engineer for investigation.

Clearing History and SER: Click on **Tools** on the menu toolbar, and select **Meter and Control**. Please allow a few minutes to open up the window. Once the window is opened, there will be a navigation list on the left side of the screen. Click on **Control Window**, and then click on the **History Clear** button to clear the history record. Click on the **SER Clear** button to clear the SER. Click on the **Mirrored Bits-A Clear** and **Mirrored Bits-B Clear** buttons to clear bits on Channel A and Channel B.

Test Set: Connect the power cord to the test set, and then connect the Ethernet communications cable from the test set to your laptop. Turn on the power to the test set. Minimize all of the other programs. Double-click on the **Test Set** icon. Select the **Open Existing Test Document.** Click on the **My Document** or **My Computer** icon to locate the automation folder where it stored all of the test set automated test files. Once you have located the file **µP-07A-1001**, double-click on the file to open it.

Automation Test: Be certain that you have selected and opened the appropriate file for the specific relay that you are trying to test. Once the file is opened, there will be numerous macros or modules embedded under each file. If there is a green arrow or cross (**+**) in front of each macro, you will need to clear the test results before you can rerun the test again. Click on **Test** at the menu toolbar, and select **Clear All** to clear all test results. Click on **Test** at the menu toolbar, and select **Start/Continue All** to autorun the whole test. If, for some reason, one of the modules failed, the program will ask if you still want it to continue or stop the automation test. Select **Continue** so that the program can finish the rest of the other macros. Once the automation test is done, you can go back to

the macros that had failed earlier by double-clicking on the macro with a red **X** in front of it. Click on **Test** at the top menu toolbar, and select **Clear** at the drop-down menu to clear the particular macro's test result. Rerun the macro again by selecting **Test** at the menu toolbar and clicking on **Start/Continue** to rerun this particular macro.

IV. Functional Test

47. Connect three-phase (4-wires) voltage source from the test set **VOLTAGE OUTPUT** channel labels as follows: 1, 2, 3, N. Connect 1 (Phase A) to FTS1-07A Terminal A. Connect 2 (Phase B) to FTS1-07A Terminal B. Connect 3 (Phase C) to FTS1-07A Terminal C. Connect N to D.
48. Connect three-phase (4-wires) current source from the test set labeled **CURRENT OUTPUT A** channel. Connect 1 to FTS1-07A Terminal F. Connect 2 to FTS1-07A Terminal H. Connect 3 to FTS1-07A Terminal J. Connect N to FTS1-07A Terminal I. From FTS1-07A, install jumper to Terminals E, G, and I together. Parallel **CURRENT OUTPUT A** and **CURRENT OUTPUT B** together.
49. From the test set, locate **BINARY/ANALOG INPUT** channels. These inputs are **POLARITY** sensitive, with red always being positive dc. Connect one pair of test leads from **BINARY/ANALOG INPUT 1** of the test set to the relay's **OUT101** for sensing contact. Terminal A01 is positive dc, so it should be connected to the RED input on **BINARY/ANALOG INPUT 1**.

    Go back to the software, and select the **Software Control Center** icon at the bottom of your laptop's toolbar. Click on **Test** at the top menu toolbar, and select **Start/Continue All**. When selecting this option, the software will go from the beginning to the end of the test.
50. Go back to the relay software, click on **Tools** at the top menu toolbar, and select **Terminal**. Hit the <Enter> key to make sure that you are still in Level 2. Type in the following commands to test the ground time overcurrent pickup:

    SET O OUT101 TERSE

    When the relay prompts you with **OUT101 =?**, type in the following commands:

    51S2

    Type **END** when the relay prompts you to the next line.

    Enter **Y** for the relay to save all of the changes.

    Go back to the test set software, and click the **Continue** button to continue the test.
51. Go back to the relay software, and hit the <Enter> key to make sure that you are still in Level 2. Type in the following commands to test the ground time overcurrent element:

    SET O OUT101 TERSE

    When the relay prompts you with **OUT101 =?**, type in the following commands:

    51S2T

    Type **END** when the relay prompts you to the next line.

    Enter **Y** for the relay to save all of the changes.

    Go back to the test set software, and click the **Continue** button to continue the test.
52. Go back to the relay software, and type in the following commands to test the directional ground instantaneous element:

    SET O OUT101 TERSE

    When the relay prompts you with **OUT101 =?**, type in the following commands:

    67G1

    Type **END** when the relay prompts you to the next line.

    Enter **Y** for the relay to save all of the changes.

    Go back to the test set software, and click the **Continue** button to continue the test.
53. Go back to the relay software, and type in the following commands to test the phase time overcurrent pickup:

    SET O OUT101 TERSE

    When the relay prompts you with **OUT101 =?**, type in the following commands:

    51S1

    Type **END** when the relay prompts you to the next line.

    Enter **Y** for the relay to save all of the changes.

    Go back to the test set software, and click the **Continue** button to continue the test.
54. Go back to the relay software, and type in the following commands to test the phase time overcurrent element:

    SET O OUT101 TERSE

    When the relay prompts you with **OUT101 =?**, type in the following commands:

    51S1T

    Type **END** when the relay prompts you to the next line.

    Enter **Y** for the relay to save all of the changes.

    Go back to the test set software, and click the **Continue** button to continue the test.
55. Go back to the relay software, and type in the following commands to test the directional phase instantaneous element:

    SET O OUT101 TERSE

    When the relay prompts you with **OUT101 =?**, type in the following commands:

    67P1

    Type **END** when the relay prompts you to the next line.

    Enter **Y** for the relay to save all of the changes.

    Go back to the test set software, and click the **Continue** button to continue the test.

Test Report: Once the test is completed, click on **File** at the menu toolbar, and select **Save As**. Each test report should have a unique ID based on the relay's ID tag and a six-digit format of the test date (MM/DD/YY).

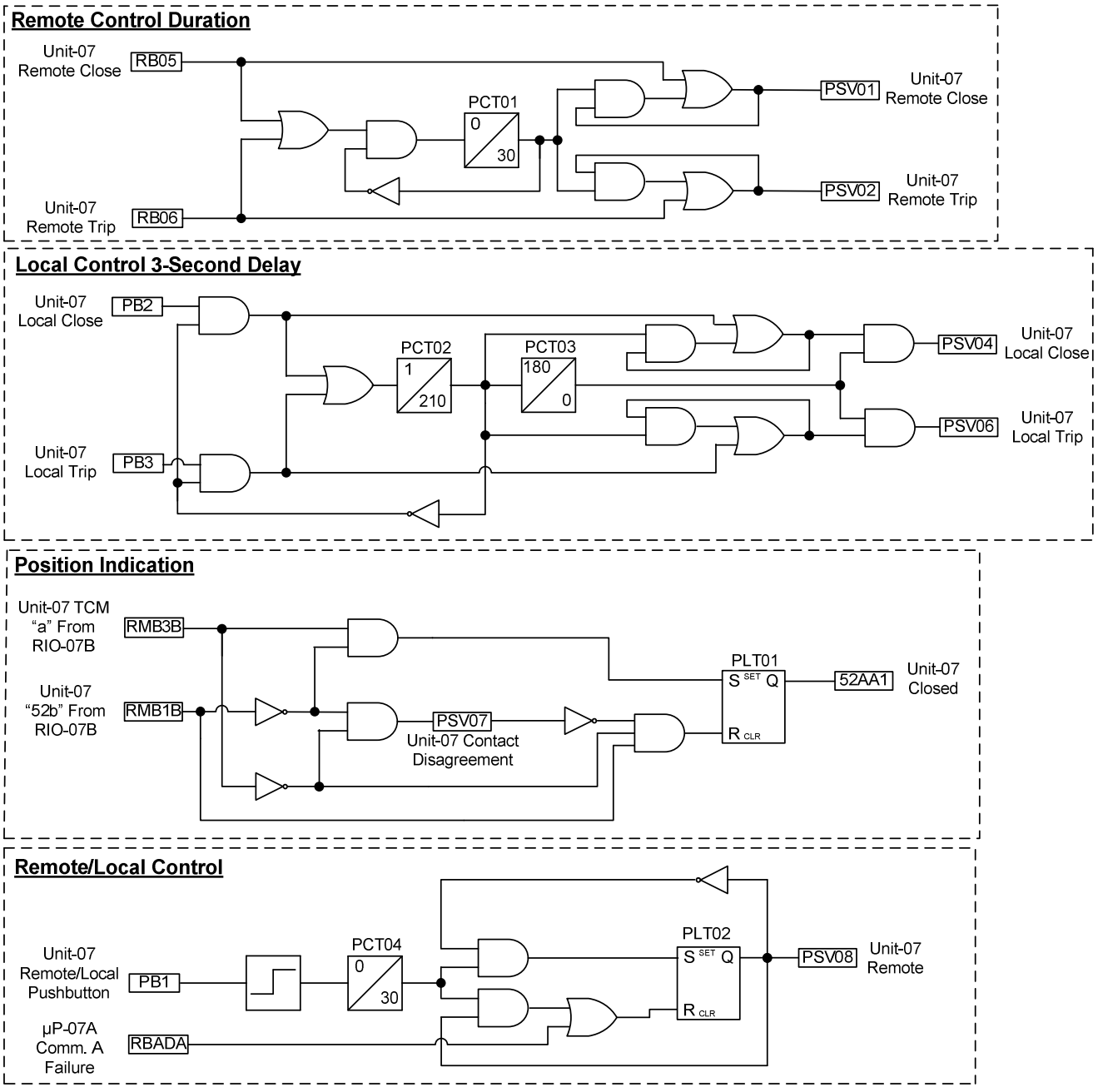
An example for this test report is as follows: **µP-07A-1001-011508**.

Upload Settings: Refer to Section III for information on how to upload settings into the relay (after settings have been modified for testing) and how to clear the history in the relay.

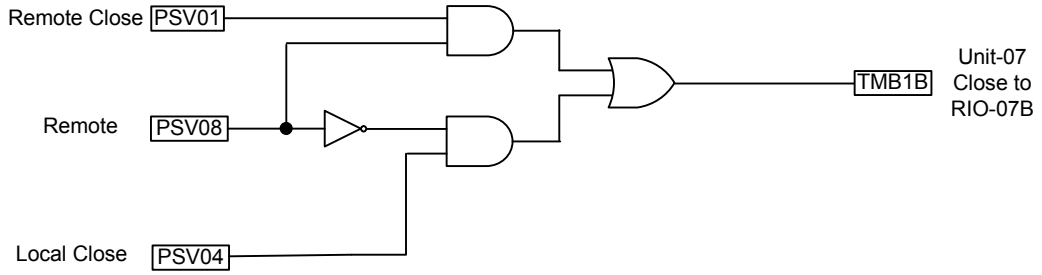
V. Enable Relay

56. Remove the test leads from the relay's **OUT101** sensing contact.
57. Remove isolation test plugs from FTS1-07A and FTS1-07B.
58. Close all **RED (voltage)** test switches on FTS1-07A.
59. Close all **BLACK (current)** test switches on FTS1-07A, and replace cover.
60. Close all **BLUE (input)** test switches on FTS1-07B.
61. Reconnect (SC1-SS1A-07A) SCADA communications cable to Port-2 on µP-07A (reconnects SDP-1A to µP-07A).
62. Reconnect (FC1-07A-07B) fiber communications cable to Port-3 on µP-07A (reconnects µP-07A to RIO-07B).
63. Reconnect (RC1-LP1A-07A) relay communications cable to Port-1 on µP-07A (reconnects PLP-1A to µP-07A).
64. Verify on the front interface of µP-07A that no communications alarms or channels are failed on Comm. A or Comm. B.
65. Press the {TARGET RESET} button on µP-07A, and verify trips are not asserted.
66. Close all **ORANGE (output)** test switches (one at a time), and replace cover on FTS1-07B.
67. Place Unit-07 in **REMOTE** by momentarily pushing the UNIT-07 {REMOTE/LOCAL} pushbutton (associated amber pushbutton LED should turn OFF).
68. Notify the Control Center that the feeder relay µP-07A for Unit-07 at the switching station is back in service.

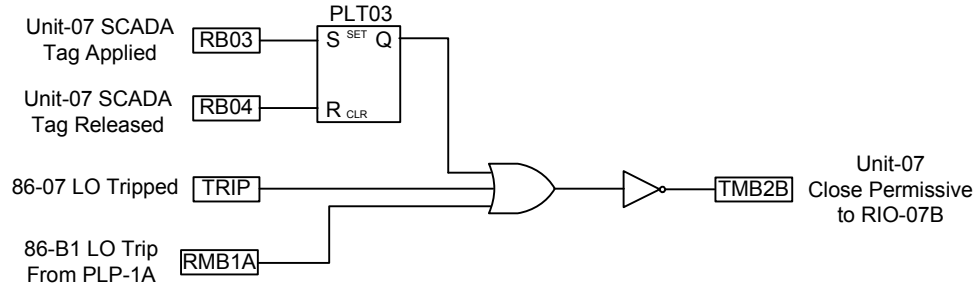
B. Device Logic Diagram for µP-07A



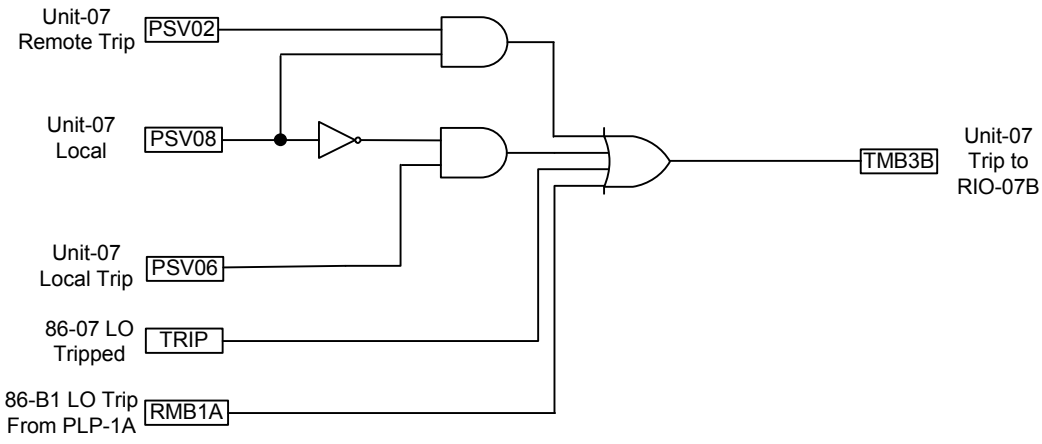
Close Control



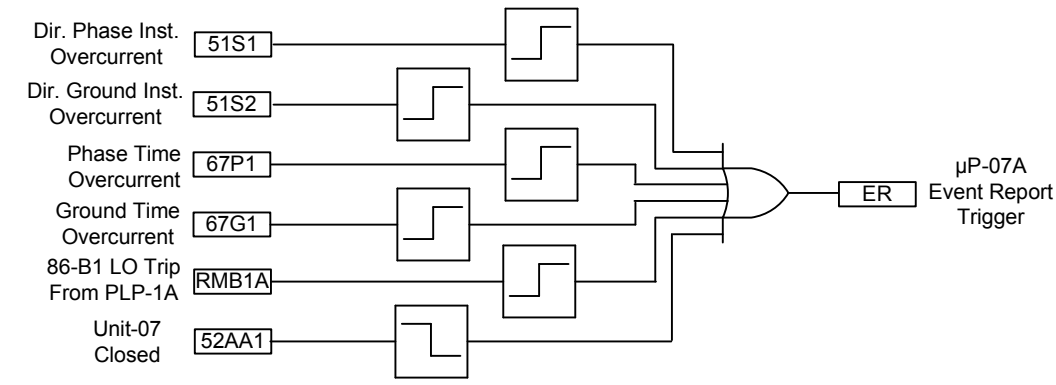
Close Permissive

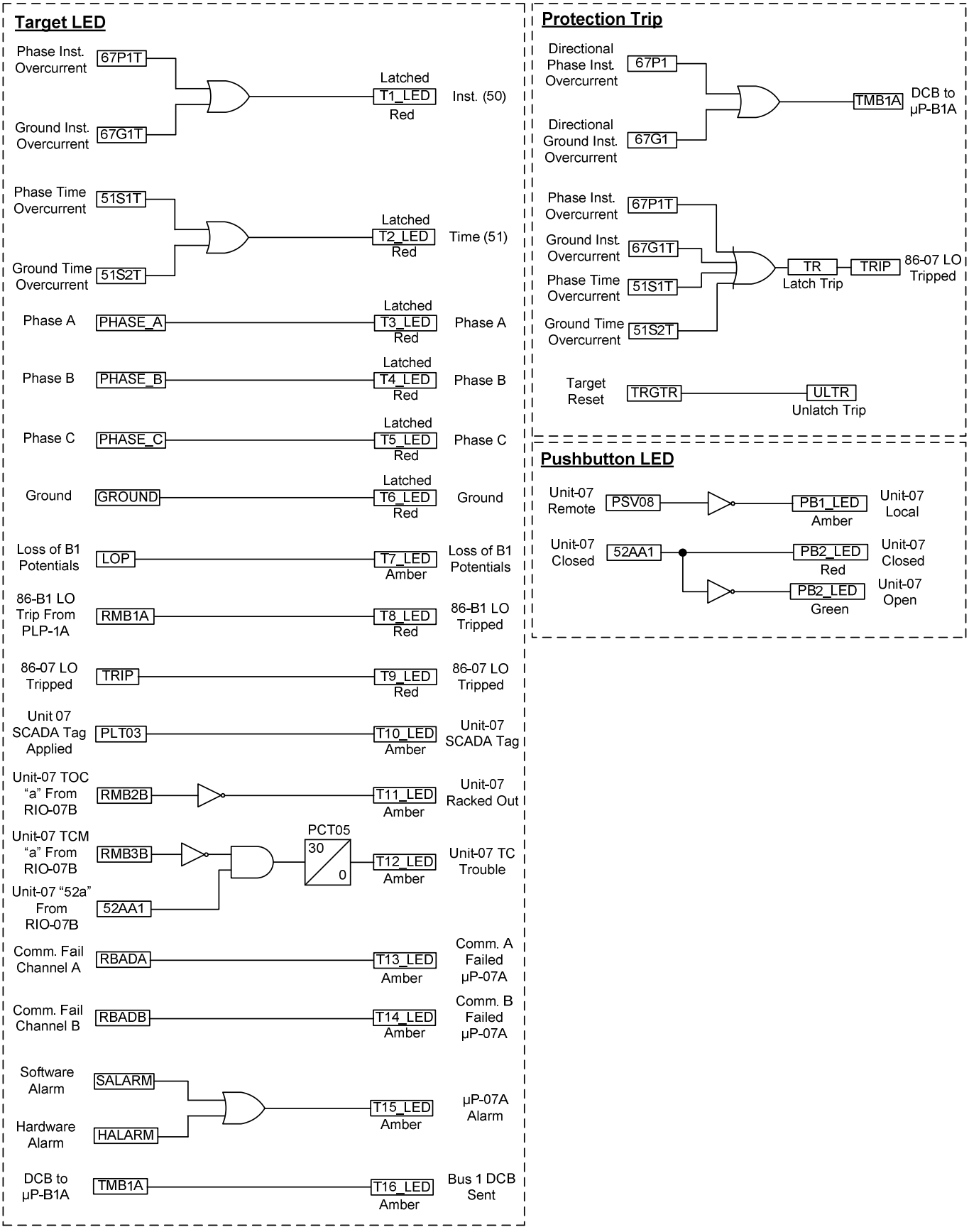


Trip Control

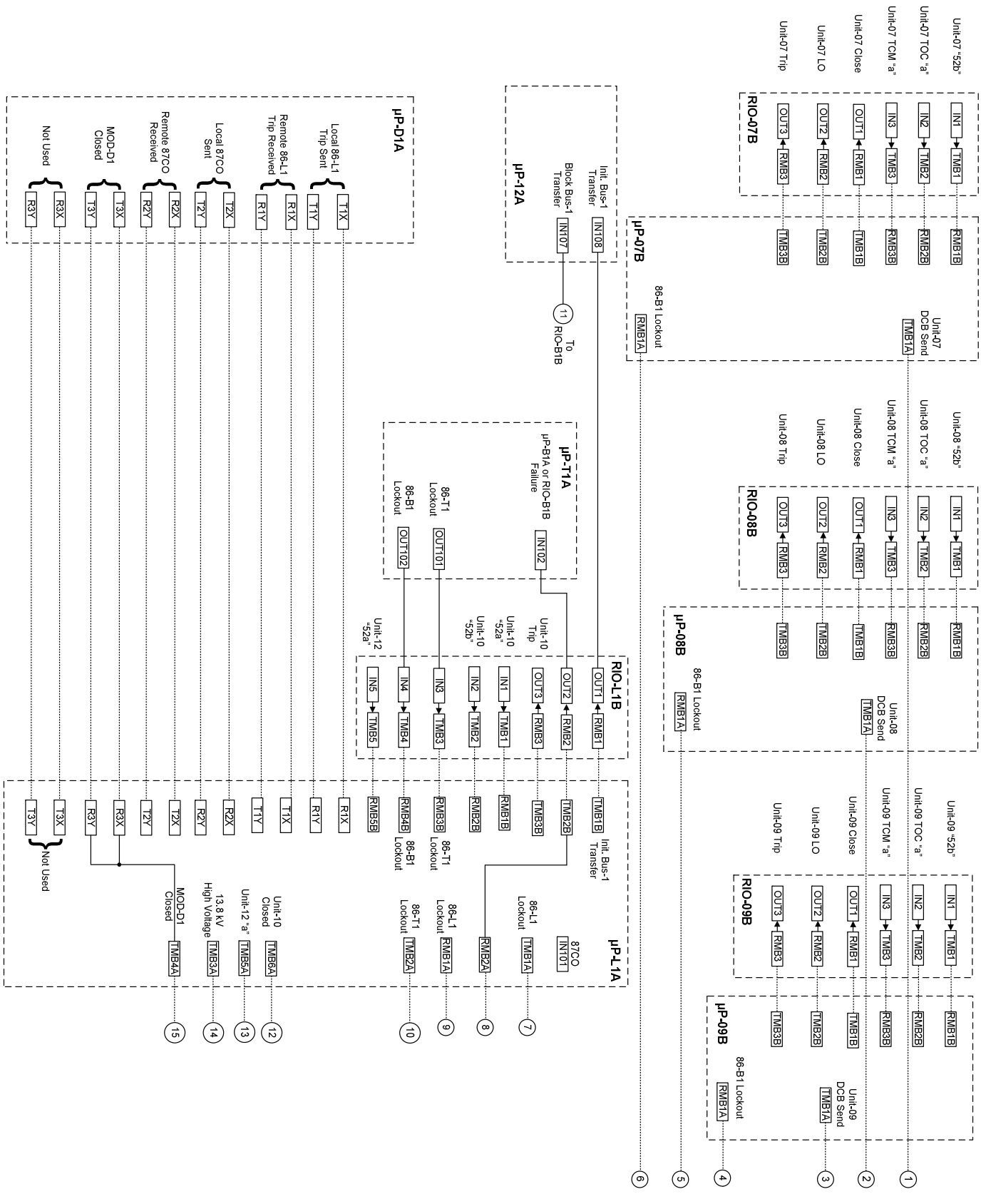


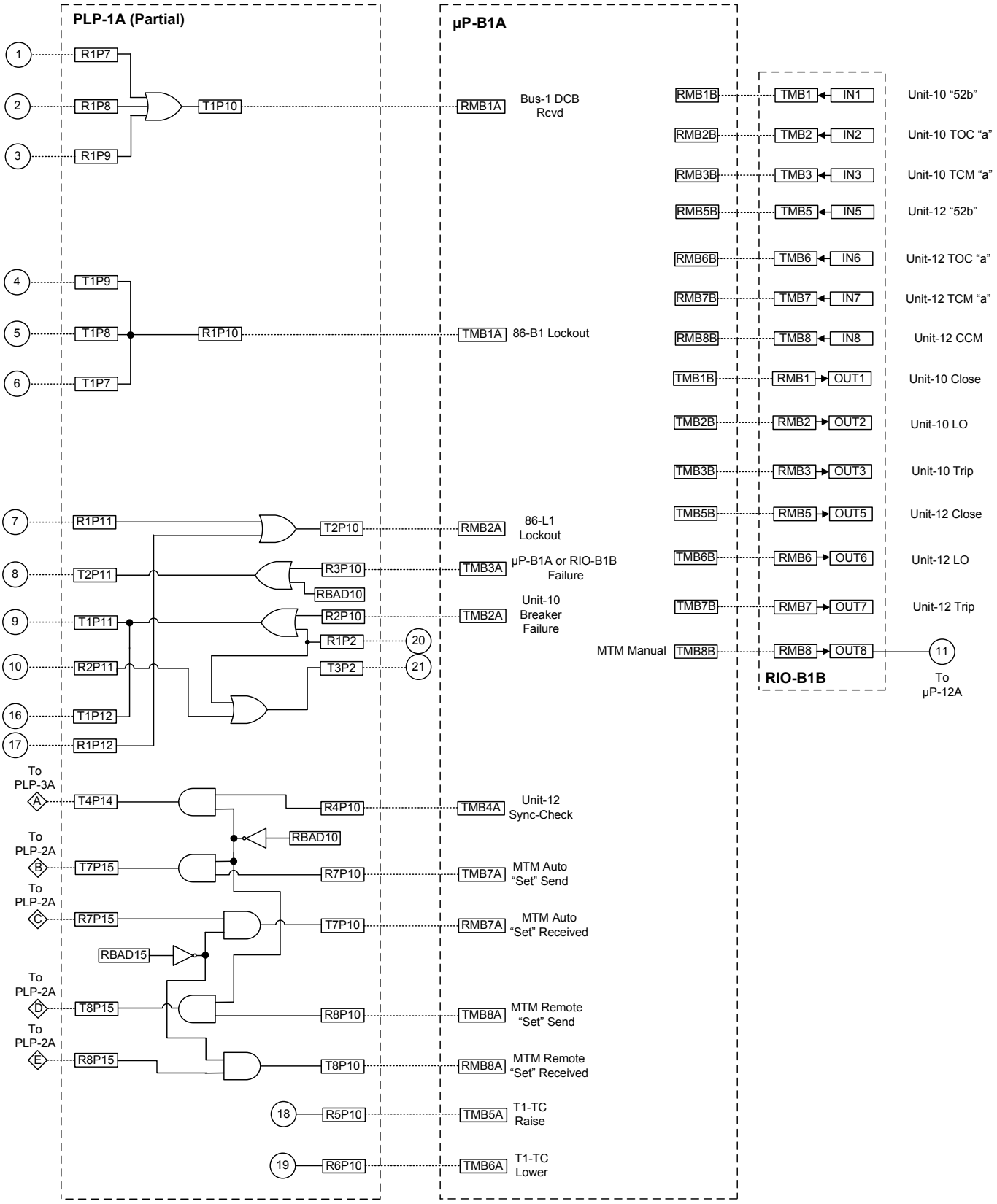
Oscillographic Triggering

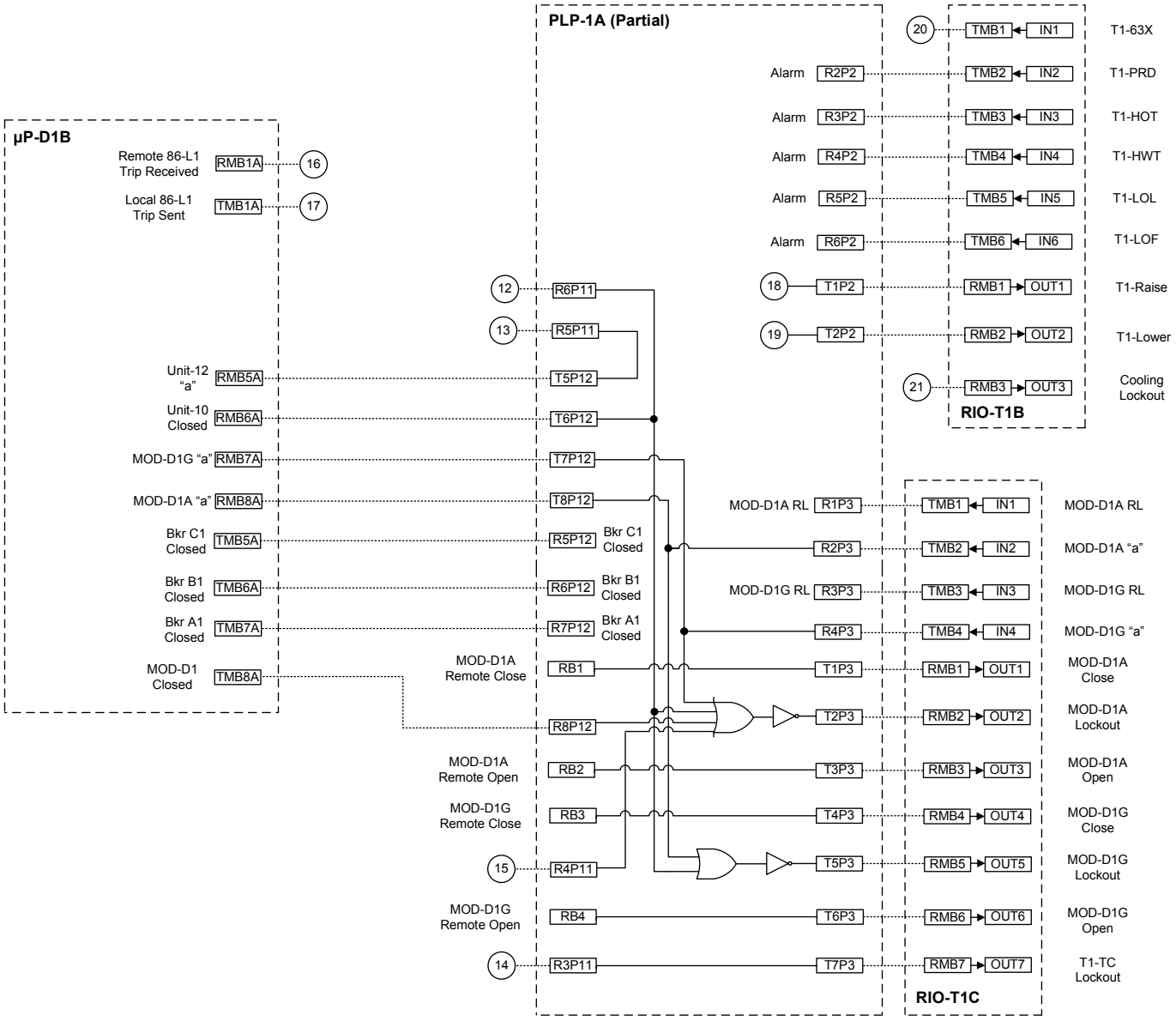



Target LED
Phase Inst. Overcurrent
67P1T
Ground Inst. Overcurrent
67G1T
Latched
T1_LED
Red
Inst. (50)
Phase Time Overcurrent
51S1T
Ground Time Overcurrent
51S2T
Latched
T2_LED
Red
Time (51)
Phase A
PHASE_A
Latched
T3_LED
Red
Phase A
Phase B
PHASE_B
Latched
T4_LED
Red
Phase B
Phase C
PHASE_C
Latched
T5_LED
Red
Phase C
Ground
GROUND
Latched
T6_LED
Red
Ground
Loss of B1 Potentials
LOP
T7_LED
Amber
Loss of B1 Potentials
86-B1 LO Trip From PLP-1A
RMB1A
T8_LED
Red
86-B1 LO Tripped
86-07 LO Tripped
TRIP
T9_LED
Red
86-07 LO Tripped
Unit 07 SCADA Tag Applied
PLT03
T10_LED
Amber
Unit-07 SCADA Tag
Unit-07 TOC "a" From RIO-07B
RMB2B
T11_LED
Amber
Unit-07 Racked Out
Unit-07 TCM "a" From RIO-07B
RMB3B
PCT05
30
0
T12_LED
Amber
Unit-07 TC Trouble
Unit-07 "52a" From RIO-07B
52AA1
Comm. Fail Channel A
RBADA
T13_LED
Amber
Comm. A Failed µP-07A
Comm. Fail Channel B
RBADB
T14_LED
Amber
Comm. B Failed µP-07A
Software Alarm
SALARM
Hardware Alarm
HALARM
T15_LED
Amber
µP-07A Alarm
DCB to µP-B1A
TMB1A
T16_LED
Amber
Bus 1 DCB Sent
Protection Trip
Directional Phase Inst. Overcurrent
67P1
Directional Ground Inst. Overcurrent
67G1
TMB1A
DCB to µP-B1A
Phase Inst. Overcurrent
67P1T
Ground Inst. Overcurrent
67G1T
Phase Time Overcurrent
51S1T
Ground Time Overcurrent
51S2T
TR
Latch Trip
TRIP
86-07 LO Tripped
Target Reset
TRGTR
ULTR
Unlatch Trip
Pushbutton LED
Unit-07 Remote
PSV08
PB1_LED
Amber
Unit-07 Local
Unit-07 Closed
52AA1
PB2_LED
Red
Unit-07 Closed
PB2_LED
Green
Unit-07 Open

C. Interdevice Logic Diagram for Bus 1




PLP-1A (Partial)
μP-B1A
1
2
3
R1P7
R1P8
R1P9
T1P10
RMB1A
Bus-1 DCB Rcvd
4
5
6
T1P9
T1P8
T1P7
R1P10
TMB1A
86-B1 Lockout
7
8
9
10
16
17
R1P11
T2P11
T1P11
R2P11
T1P12
R1P12
T2P10
R3P10
RBAD10
R2P10
R1P2
T3P2
RMB2A
86-L1 Lockout
TMB3A
μP-B1A or RIO-B1B Failure
TMB2A
Unit-10 Breaker Failure
20
21
To PLP-3A
A
T4P14
R4P10
TMB4A
Unit-12 Sync-Check
RBAD10
To PLP-2A
B
T7P15
R7P10
TMB7A
MTM Auto "Set" Send
To PLP-2A
C
R7P15
T7P10
RMB7A
MTM Auto "Set" Received
RBAD15
To PLP-2A
D
T8P15
R8P10
TMB8A
MTM Remote "Set" Send
To PLP-2A
E
R8P15
T8P10
RMB8A
MTM Remote "Set" Received
18
R5P10
TMB5A
T1-TC Raise
19
R6P10
TMB6A
T1-TC Lower
RMB1B
RMB2B
RMB3B
RMB5B
RMB6B
RMB7B
RMB8B
TMB1B
TMB2B
TMB3B
TMB5B
TMB6B
TMB7B
MTM Manual
TMB8B
TMB1
TMB2
TMB3
TMB5
TMB6
TMB7
TMB8
IN1
IN2
IN3
IN5
IN6
IN7
IN8
RMB1
RMB2
RMB3
RMB5
RMB6
RMB7
RMB8
OUT1
OUT2
OUT3
OUT5
OUT6
OUT7
OUT8
RIO-B1B
Unit-10 "52b"
Unit-10 TOC "a"
Unit-10 TCM "a"
Unit-12 "52b"
Unit-12 TOC "a"
Unit-12 TCM "a"
Unit-12 CCM
Unit-10 Close
Unit-10 LO
Unit-10 Trip
Unit-12 Close
Unit-12 LO
Unit-12 Trip
11
To μP-12A



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