MIR2

Installation and Service Manual

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DEVELOPED BY	GE Security 8985 Town Center Parkway Bradenton, FL 34202 (941) 739-4200
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Content

Important information

Limitation of liability

This product has been designed to meet the requirements of NFPA 72 *National Fire Alarm Code* and UL 864 *Standard for Control Units and Accessories for Fire Alarm Systems.* Installation in accordance with this manual, applicable codes, and the instructions of the authority having jurisdiction is mandatory. GE Security shall not under any circumstances be liable for any incidental or consequential damages arising from loss of property or other damages or losses owing to the failure of GE Security products beyond the cost of repair or replacement of any defective products. GE Security reserves the right to make product improvements and change product specifications at any time.

While every precaution has been taken during the preparation of this manual to ensure the accuracy of its contents, GE Security assumes no responsibility for errors or omissions.

FCC warning

This equipment can generate and radiate radio frequency energy. If this equipment is not installed in accordance with this manual, it may cause interference to radio communications. This equipment has been tested and found to comply within the limits for Class A computing devices pursuant to Subpart B of Part 15 of the FCC Rules. These rules are designed to provide reasonable protection against such interference when this equipment is operated in a commercial environment. Operation of this equipment is likely to cause interference, in which case the user at his own expense, is required to take whatever measures may be required to correct the interference.

FCC information

1. The dialer complies with Part 68 of the FCC rules. The Dialer's FCC registration number and the Ringer Equivalence Number (REN) are on the back of the dialer. This information must be provided to the telephone company, if requested.
2. An FCC compliant telephone cord and modular plug cord is supplied with the dialer. The dialer is designed to be connected to the telephone network using the supplied cord and an RJ31X or RJ38X jack, which must also comply with FCC Part 68 rules.

3. The REN is used to determine the quantity of devices which may be connected to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of RENs should not exceed five (5). To be certain the number of devices that may be connected to a line, as determined by the total RENs, contact the local telephone company.
4. If the dialer causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. If advance notice isn't practical, the telephone company will notify you as soon as possible. You will also be advised of your right to file a complaint with the FCC, if you believe it is necessary.
5. The telephone company may make changes in it's facilities, equipment, operations, or procedures that could affect the operation of the dialer. If this happens, the telephone company will provide advance notice in order for you to make necessary modifications to maintain uninterrupted service.
6. If trouble is experienced with the dialer, for repair or warranty information, contact GE Security, 6411 Parkland Drive, Sarasota, Florida, USA 34243 Telephone: 1-800-655-4497. If the dialer is causing harm to the telephone network, the telephone company may request you disconnect the dialer until the problem is resolved.
7. No repairs may be performed on the dialer by the user.
8. The dialer cannot be used on public coin phone or party line service provided by the telephone company.

UL 864 9th edition requirements

NOTICE TO USERS, INSTALLERS, AUTHORITIES HAVING JURISDICTION, AND OTHER INVOLVED PARTIES

This product incorporates field-programmable software. In order for the product to comply with the requirements in the Standard for Control Units and Accessories for Fire Alarm Systems, UL 864, certain programming features or options must be limited to specific values or not used at all as indicated below.

Programmable feature or option	Permitted in UL 864? (Y/N)	Possible settings	Settings permitted in UL 864
2-DACT Settings - Mode (single line or dual line dialer)	Y	Single Line DACT Dual Line DACT	Single Line DACT [1] Dual Line DACT
2-DACT: Ground Fault (telephone line is supervised for ground faults)	Y	No Yes	Yes
4-state alarm IDC	N	In Signature module configuration, personality code 18 is unavailable.	N/A
AC Power Delay	Y	None 30 minutes 1 hour 6 hour 12 hour 24 hour	1 hour
Alarm zone group members	Y	Alarm device type Pull device type Heat device type Verified smoke device type Water flow device type	Alarm device type [5] Pull device type Heat device type Verified smoke device type Water flow device type
AND group members	Y	Alarm device type Pull device type Heat device type Verified smk. device type Water flow device type Alarm zone device type Fire zone device type Matrix group device type	Alarm device type [5] Pull device type Heat device type Verified smk. device type [6] Water flow device type Alarm zone device type Fire zone device type Matrix group device type
Delays (programmed in rules)	Y	0 to 4095 seconds	0 to 4095 seconds [4]
DL2	N	N/A	The DL2 is not compliant, and may not be used.
ISP-96	N	N/A	The ISP-96 is not compliant, and may not be used.

Programmable feature or option	Permitted in UL 864? (Y/N)	Possible settings	Settings permitted in UL 864
MTM	N	N/A	The MTM is not compliant, and may not be used.
Object message routing	Y	All Cabinets No Cabinets User defined routes	All Cabinets No Cabinets [2] User defined routes [3]
SIGA-APS	N	N/A	The SIGA-APS is not compliant, and may not be used.
SIGA-CC1	Y	PC 6 PC26	PC 26
SIGA-MCC1	Y	PC 6 PC26	PC 26

Notes

[1] Allowed only when the supervising station supervises the telephone line and annunciates fault conditions within 200 seconds
[2] Allowed only with monitor device types and switches
[3] Allowed only if user route includes the control panel
[4] Allowed only when setting does not prevent the activation or transmission of alarm or supervisory signals within 10 seconds or trouble signals within 200 seconds
[5] Allowed in alarm zone groups, AND groups, and matrix groups that are used to initiate the release of extinguishing agents or water except when the addressable smoke detector's alarm verification is used.
[6] Allowed only in alarm zone groups, AND groups, and matrix groups that are not used to initiate the release of extinguishing agents or water

Document history

Date	Revision	Reason for change
31MAY95	1.0	Initial Release.
22JAN09	2.0	Moved: All compatibility appendix information to the compatibility list document. Revised: Testing procedures and battery calculations; corrections from markups noted in Rev 5.0. All sections revised to reflect compliance with UL 864, 9th edition. Replaced: “Calculating wire lengths for 24 VDC NACs” with standard NAC calculation text. Added: Notes 2 through 4 to table in “UL 864 NAC signal synchronization.”

The MIR2 library

MIR2 documents

A library of related documents supports the MIR2 product line. Here is a complete list of the MIR2 library:

- *MIR2 Installation and Service Manual* (P/N 270674)
- *MIR2 Network Supplement Manual* (P/N 3100207)
- *MIR2 System Operation Manual* (P/N 270676)
- *MIR2 Installation Sheets* (P/N 3100058)
- *2-SDU Help* (P/N 180902)

Our technical writers constantly update the information in this manual. Your comments during our training classes, technical support phone calls, and field trips improve this document.

Other documents

In addition to documents in the MIR2 library, you may find the following documents useful.

The *Signature Series Intelligent Smoke and Heat Detectors Applications Bulletin* (P/N 270659) provides instructions and illustrations for various arrays of smoke and heat detectors.

The *Signature Series Component Installation Manual* (P/N 270683) supports the installation of the Signature Series detectors and modules.

The *Serial Number Log Book* (P/N 270658) provides a convenient means for recording the serial number of each Signature device installed in the fire alarm system.

The *Speaker Application Guide* (P/N 85000-0033) provides information about the placement and layout of speakers for fire alarm signaling and emergency voice communications.

The *Strobe Applications Guide* (P/N 85000-0049) provides information for the placement and layout of strobes for fire alarm signaling.

The *Microline Turbo Printer Handbook*, by Okidata provides all the necessary information for the maintenance and configuration of the MIR-PRT/S Form Printer. The Okidata handbook comes with the Form Printer.

Chapter 1
Introduction

Summary

Before you begin to use the MIR2 Installation and Service Manual, take some time to familiarize yourself with its layout and conventions. Be familiar also with the agency standards that apply to every fire alarm system.

Content

Manual overview

The *MIR2 Installation and Service Manual* provides an overview of the MIR2 fire alarm system and instructions for its installation, testing, and servicing. This manual also contains compatible device listings and calculations for batteries and wiring.

System overview

The system overview presents the fire alarm system in several variations. The size of the equipment enclosure, the wiring class, and the components installed make up the configuration of the system.

System power-up and testing

The power-up and testing procedures will guide you through the activation and testing of your system in the following progression:

1. Simulate off-normal conditions at the panel.
2. Simulate off-normal conditions at the devices.

The testing procedures conclude with instructions for completing and posting a master copy of the Certificate of Completion.

System service procedures

The servicing of the system entails everything from preventive maintenance practices to troubleshooting difficult problems. Preventive maintenance practices include the proper installation and care of fire alarm components. For example, detectors require periodic cleaning to avoid nuisance alarms. Troubleshooting problems on the system requires an understanding of the system fault messages, which appear on the front panel display.

Calculations

The system wiring requires a calculation to prevent over extension. Worksheets, along with instructions, provide a means for determining the maximum wire length for your fire alarm system. The batteries that power the fire alarm system in the event of a power failure or brownout also require a special set of calculations. A set of worksheets guides you through the calculations for battery ampere-hour requirements.

Special applications

The system requires surge protection from one building to another. The Ditek Surge Protection Module provides the required surge protection.

Some applications require coded signals. The CDR-3 provides march time and unique coded outputs for separate zones.

Documentation conventions

Important notices

Notices throughout this manual inform the reader of practices and conditions, which will affect physical safety, occupant safety, equipment performance, and time consumption. Notices appear as warnings, cautions, and notes.

Warnings

Warnings appear throughout the manual where injury or loss of life may occur through the neglect of safe practices and conditions. Warnings appear in the following format:

WARNING: Testing the system disables the alarm contact. The system will not notify the fire department in the event of a fire alarm condition during a test. See the system administrator for detailed information.

Cautions

Cautions are posted in the manual to prevent damage to the equipment. A typical caution concerns the prevention of electrostatic discharge (ESD). Cautions appear in the following format:

Caution: Observe static-sensitive handling practices.

Notes

Notes instruct the reader to avoid practices or conditions, which may result in wasted time and effort. For example, a download will not work unless the programmer disconnects the printer from the RS-232 port on the MIR2-MCM. Notes appear in the following format:

Note: Disconnect the printer when downloading to the MIR2-MCM.

System parameters

2-LCD keypad entries and fault messages require knowledge of the system parameters.

Keypad entry parameters

To understand the parameters for 2-LCD keypad entries, see *Making keypad entries* in the *MIR2 System Operation Manual*.

Fault message parameters

To understand the parameters for reading fault messages, see *System service procedures* in the *Installation and Service Manual*.

Installation codes and standards

The Signature series fire detection devices are designed to meet the requirements of NFPA 72 and UL 864. Other related codes and standards are listed below.

Information contained in this document is intended to serve as a guide. Installation in accordance with the instruction sheets (provided with Signature Series devices), applicable codes, and the instructions of the Authority Having Jurisdiction is mandatory.

National Fire Protection Association

	National Fire Protection Association (NFPA) 1 Batterymarch Park PO Box 9101 Quincy, MA 02269-9101
NFPA 70	National Electric Code
NFPA 72	National Fire Alarm Code

Underwriters Laboratories, Inc.

	Underwriters Laboratories, Inc. (ULI) 333 Pfingsten Road Northbrook, IL 60062-2096
UL 38	Manually Actuated Signaling Boxes
UL 217	Smoke Detectors, Single and Multiple Station
UL 228	Door Closers/Holders for Fire Protective Signaling Systems
UL 268	Smoke Detectors for Fire Protective Signaling Systems
UL 268A	Smoke Detectors for Duct Applications
UL 346	Waterflow Indicators for Fire Protective Signaling Systems
UL 464	Audible Signaling Appliances
UL 521	Heat Detectors for Fire Protective Signaling Systems
UL 864	Standard for Control Units for Fire Protective Signaling Systems
UL 1481	Power Supplies for Fire Protective Signaling Systems

	Underwriters Laboratories, Inc. (ULI) 333 Pfingsten Road Northbrook, IL 60062-2096
UL 1638	Visual Signaling Appliances
UL 1971	Visual Signaling Appliances

Other requirements

Other requirements that affect the installation of this system include:

- State and local building codes
- Authority having jurisdiction (AHJ)

Chapter 2
System overview

Summary

MIR2 fire alarm systems are configurable to a variety of requirements. Some panels contain only the components necessary for a Signature data loop and the notification appliances. Other panels contain loop expansion, audio, and option modules. MIR2 fire alarm systems are even configurable to a variety of Notification Appliance Circuits.

Content

System overview

Design

The control panel consists of a multiplexed fire alarm system, which supports up to 96 Signature series detectors and 94 Signature series modules on an addressable Signature Data Circuit (SDC). Two hard-wired Notification Appliance Circuits (NACs) are provided for audible and visual devices. An Expander Loop Module may be added to the panel, providing two more NACs and a second SDC, which supports an additional 96 Signature detectors and 94 Signature modules.

The audio sub-system consists of a two-channel audio control center, which provides a microphone, 15 available signal tones, and firefighter paging capability. Audio amplifiers complement the audio system.

Features

MIR2 systems provide:

- Autoprogramming (automatic reconfiguration)
- Advanced power management
- Custom programmability
- Transient-protected field wiring
- User-friendly front panel
- Emergency audio control center
- Firefighter telephone system
- 30 and 50 Watt audio amplifiers
- Optional dead-front construction
- Class A (Style D) Initiating Device Circuits (IDC)
- Class B (Style B) Initiating Device Circuits (IDC)
- Ground fault detection LED
- Monitor mode
- Local and remote power supplies
- Class A (Style Z) Notification Appliance Circuits (NACs)
- Class B (Style Y) Notification Appliance Circuits (NACs)
- Optional supplementary front panel led/switch modules
- Optional expander loop module
- Class A RS-485 external annunciator port
- Class B RS-485 external annunciator port
- Off-premises: Reverse Polarity Module or Dialer
- RS-232 external peripheral device port
- Form C alarm and trouble common control relay contacts
- Form A supervisory common control relay contacts

Table 1: Minimum system requirements

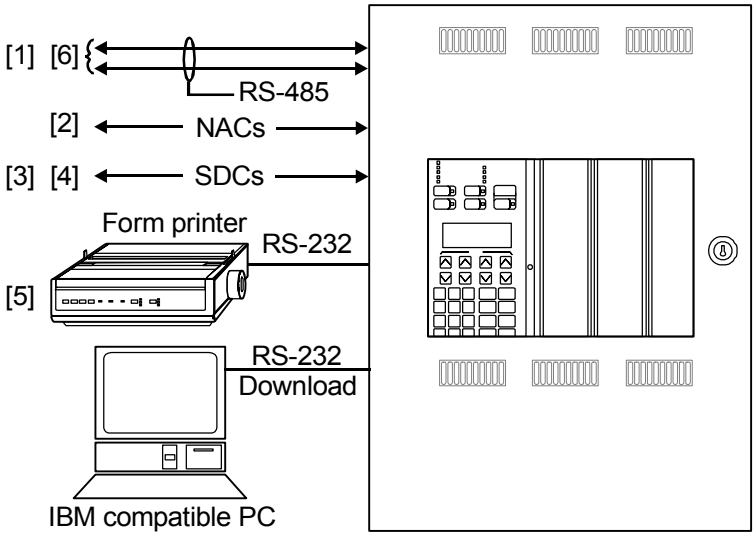
NFPA 72 system classification	Required control equipment	
Protected premises, local	2-WB(S)	Enclosure
	MIR2-MCM	Main Controller Module
	MIR-PPS(/6A)	Primary Power Supply
	2-LCD	LCD Annunciator
	5 Ah batteries, minimum	Battery calculation required
Auxiliary	Add RPM module to protected premises system.	
Remote station	Add RPM or 2-DACT module (dialer) to protected premises system.	
Proprietary protected premises	Connect to a protected premises system. Connect a listed printer with a 120 VAC uninterruptible power supply.	

Control panels

Standard control panels

A standard control panel (Figure 1) includes the following:

- 2-WBS surface mount or 2-WB semi-flush Wallbox
- MIR-PPS/6A Primary Power Supply (6A)
- MIR2-MCM Main Controller Module
- MIR2-LCX Expander Loop Module
- Backup batteries (24 VDC @10 Ah)



Notes

[1] The RS-485 lines support ANN annunciators, 2-LSRA-MIR(-C)s, 2-LCDA(-C)s, and 2-SLCDA(-C)s.

[2] The MIR2-MCM and the MIR2-LCX have two NACs each for a total of four NACs.

[3] The MIR2-MCM and the MIR2-LCX have one SDC each for a total of two SDCs.

[4] See the *Signature Series Component Installation Manual* for information on specific detectors and modules.

[5] Locate the form printer in the same room, within 50 feet of the Main Controller Module.

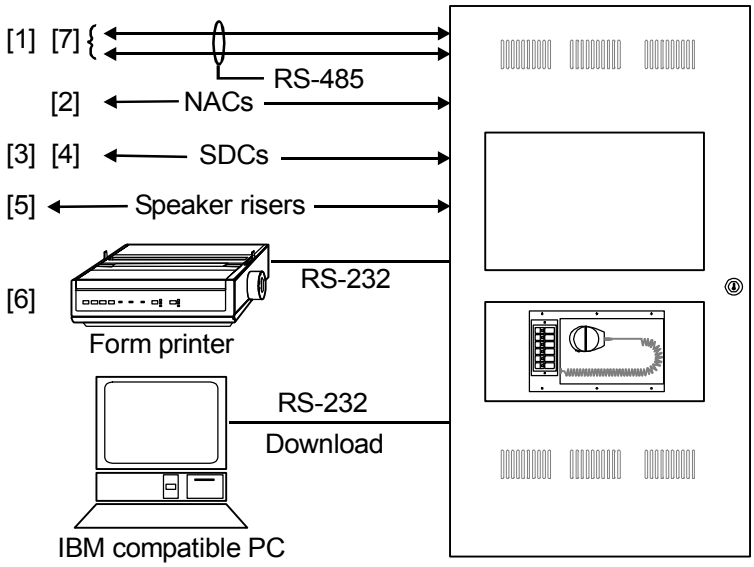
[6] Any wiring that exits one building and enters another requires a Ditek Surge Protector Module at each end. See *Special Applications*, in the Appendix, for more information.

Figure 1: 2-WBS(R) and 2-WB(R) wall boxes

Control panels with audio

A control panel with emergency audio includes the following:

- 2-WB3 (Figure 2) or 2-WB7 (Figure 3)
- MIR-PPS/6A Primary Power Supply
- APSxA/BPSxA Auxiliary / Booster power supply
- MIR2-MCM Main Controller Module
- MIR2-LCX Expander Loop Module
- 2-AAC Audio Control Module
- SIGA-AAXX Amplifiers
- Backup batteries (24 VDC @10 Ah)



Notes

[1] The RS-485 lines support ANN annunciators, 2-LSRA-MIR(-C)s, 2-LCDA(-C)s, and 2-SLCDA(-C)s.

[2] The MIR2-MCM and the MIR2-LCX have two NACs each for a total of four NACs.

[3] The MIR2-MCM and the MIR2-LCX have one SDC each for a total of two SDCs.

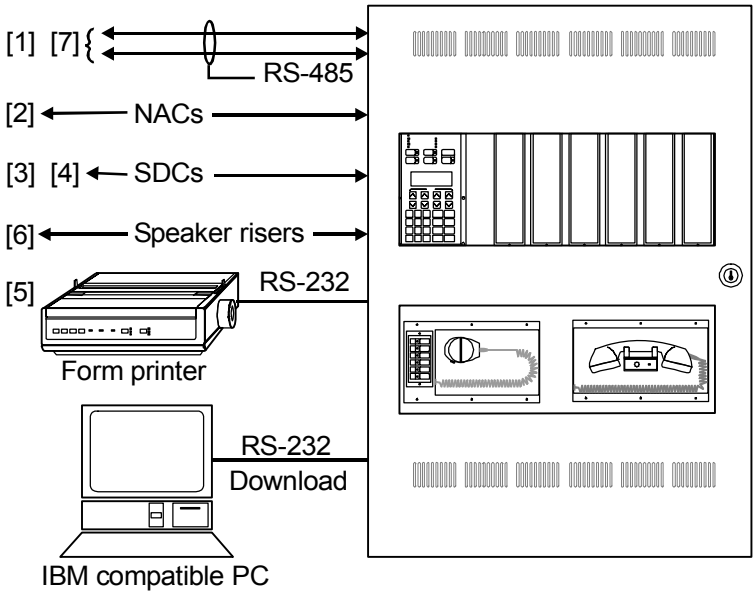
[4] See the *Signature Series Component Installation Manual* for information on specific detectors and modules.

[5] 2-AAC Audio Control Module and SIGA-AAXX amplifiers

[6] Locate the form printer in the same room, within 50 feet of the Main Controller Module.

[7] Any wiring that exits one building and enters another requires a Ditek Surge Protector Module at each end. See *Special Applications*, in the Appendix, for more information.

Figure 2: 2-WB3(R) Wallbox



Notes

[1] The RS-485 lines support ANN annunciators, 2-LSRA-MIR(-C)s, 2-LCDA(-C)s, and 2-SLCDA(-C)s.

[2] The MIR2-MCM and the MIR2-LCX have two NACs each for a total of four NACs.

[3] The MIR2-MCM and the MIR2-LCX have one SDC each for a total of two SDCs.

[4] See the *Signature Series Component Installation Manual* for information on specific detectors and modules.

[5] Locate the form printer in the same room, within 50 feet of the Main Controller Module.

[6] This control panel can support a fifth SIGA-AAXX instead of an extra MCM. The amplifier must have a dedicated output from an APSxA/BPSxA auxiliary/booster power supply.

[7] Any wiring that exits one building and enters another requires a Ditek Surge Protector Module at each end. See *Special Applications*, in the Appendix, for more information.

Figure 3: 2-WB7(R) Wallbox

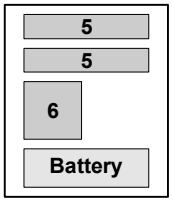
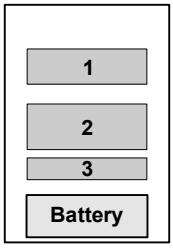
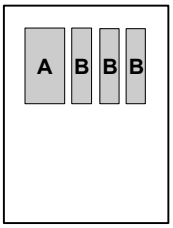
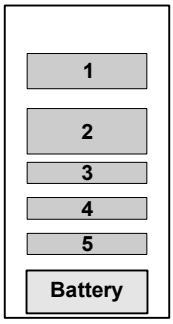
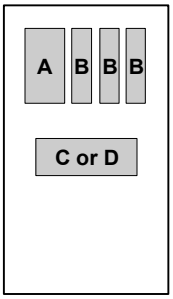
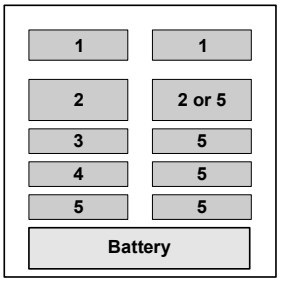
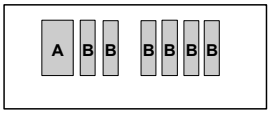
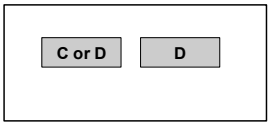
Option modules

Each control panel may house the following option modules:

- CDR-3 Coder
- 2-DACT Dialer
- IOP3A Isolation Module

- 2-CTM City Tie Module
- 2-SMK Smoke Power Module
- GSA-MDM Digital Voice Message Module
- GSA-UIO2R Universal Input/Output Motherboard
- GSA-UIO6(R) Universal Input/Output Motherboard

Figure 4 shows the different locations and combinations of system modules in the wall boxes and inner doors.

Wall boxes		Inner doors	
	APS6A or APS10A		The APS models have no inner doors.
	2-WB or 2-WB(S)		MIR2-WBD(S)
	2-WB3		MIR2-WB3D(R)
	2-WB7 [1]	 	MIR2-WB7D(R) upper half MIR2-WB7D(R) lower half

Wallbox components

ID	Component
1	Primary Power Supply
2	Main Controller Module
3	Expander Loop Module (optional module)
4	Audio Control Module (optional module)
5	Audio Amplifier (up to 5 optional modules)
6	Booster Power Supply

Inner door components

ID	Component
A	Liquid Crystal Display
B	LED/Switch Module
C	Microphone Module
D	Telephone Module

[1] Any combination of components 3, 4, and 5 is legal. Example: 1, 2, 4, 5, and 5 is valid. A fifth SIGA-AAXX in the 2-WB7 requires a dedicated power supply in another cabinet.

Figure 4: Wall boxes and inner doors

NAC configurations

The system supports the following NAC circuits:

- Class B (Figure 5)
- Class A (Figure 6)
- Multiplexed-switched (Figure 7)

Notes

The following notes apply to:

- Figure 5: Typical Class B NAC wiring
- Figure 6: Typical Class A NAC wiring
- Figure 7: Typical multiplexed switched NAC wiring

1. All wiring is one pair of appropriate sized conductors unless otherwise noted. See the wire distance calculations in Appendix A “Calculations” to size the conductors according to their application.
2. If the AUX riser is used for more than one notification zone, install in accordance with the requirements for survivability from attack by fire defined in NFPA 72 *National Fire Alarm Code.*

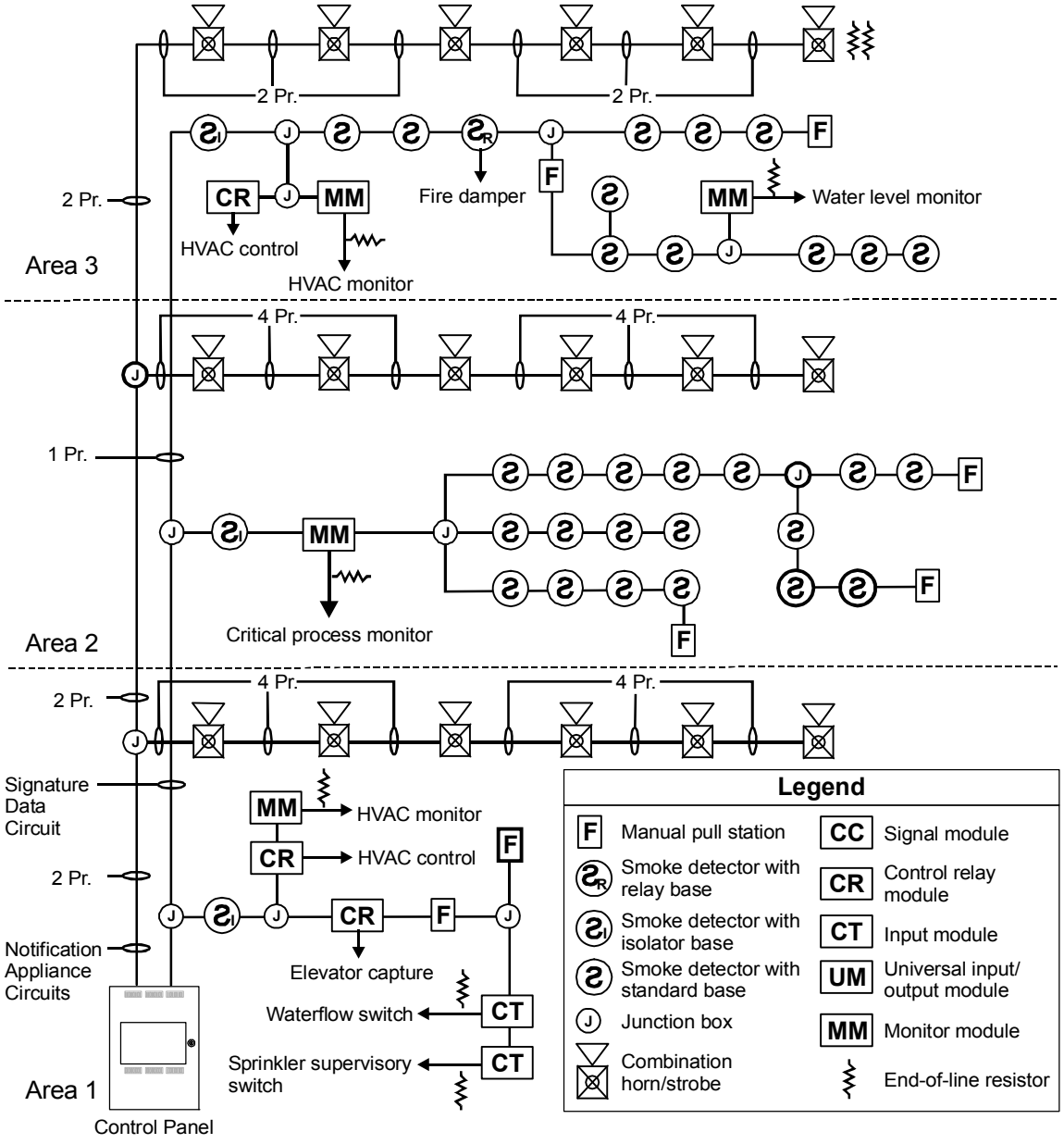


Figure 5: Typical Class B NAC wiring

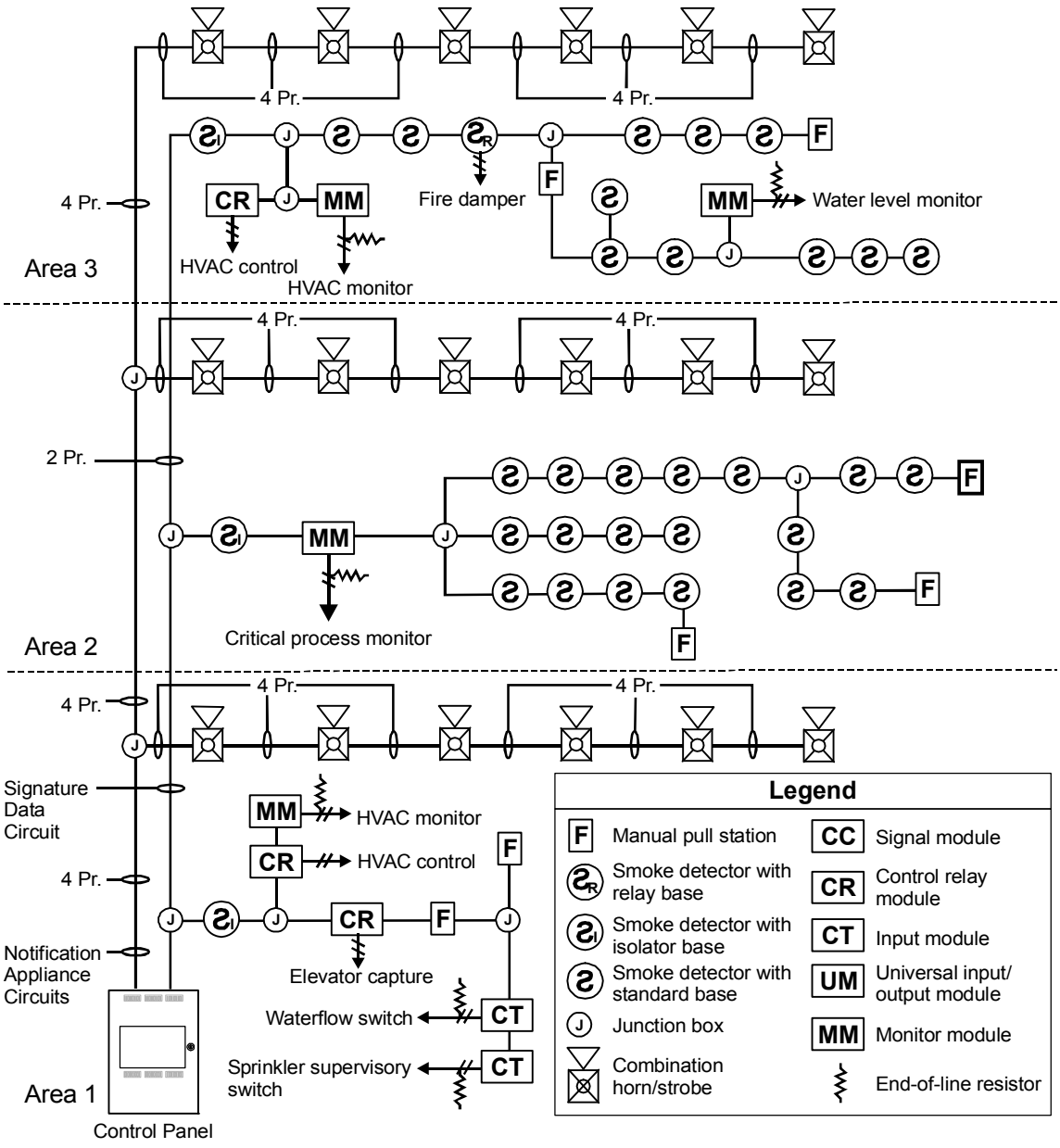


Figure 6: Typical Class A NAC wiring

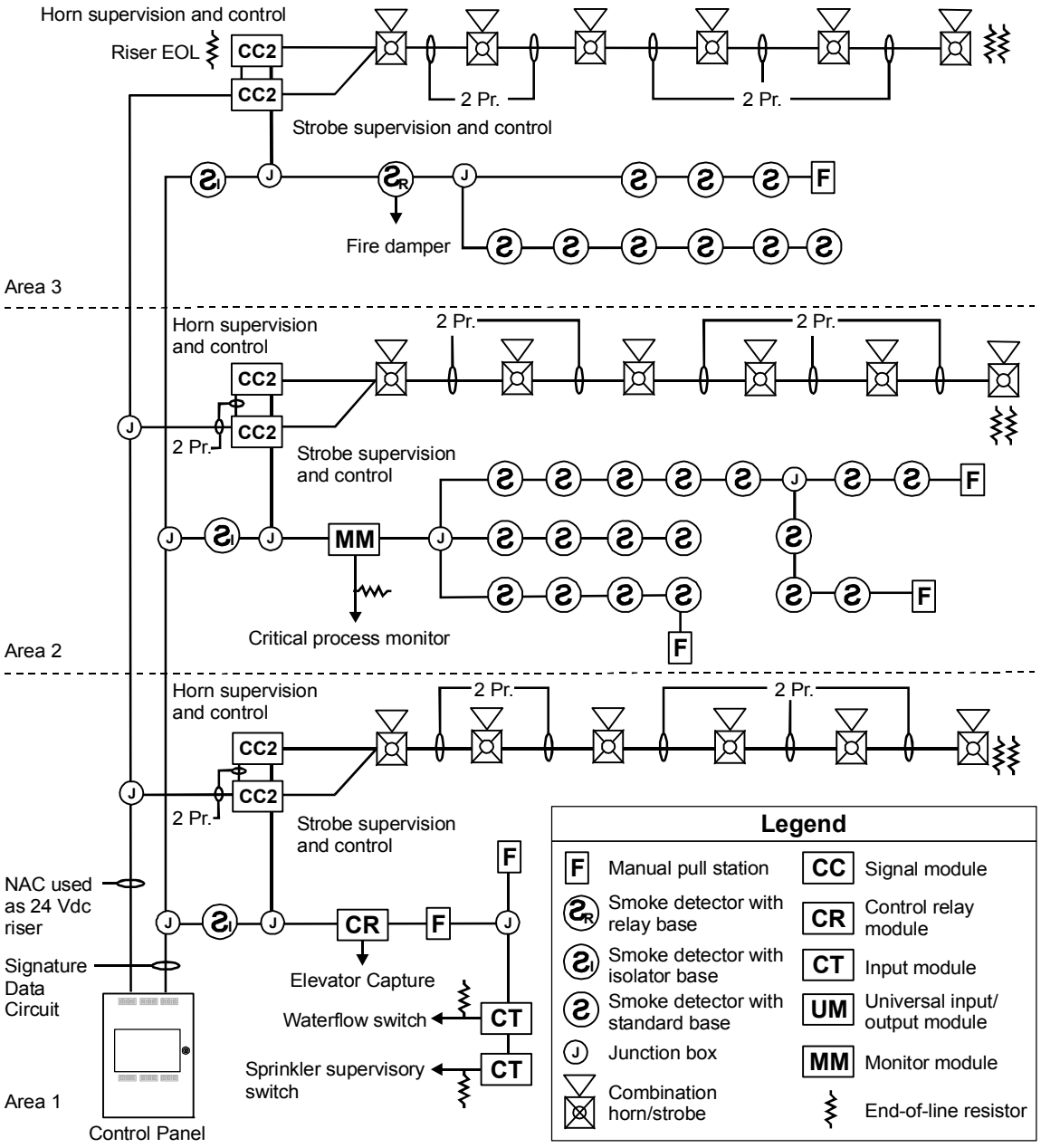


Figure 7: Typical multiplexed switched NAC wiring

Chapter 3
System power-up and testing

Summary

National and local authorities require the testing of every fire alarm installation for initial acceptance and re-acceptance. The procedures in this chapter provide a consistence means of testing the system for acceptance and re-acceptance. The Certificate of Completion, at the end of this chapter, provides a consistent means of documenting the system tests.

Content

Activating the system

WARNING: Observe personal safety while you work with electrical power. Failure to follow these instructions may result in serious injury or loss of life.

Caution: Wire the power supplies and all system components according to the installation sheets that came with them. Failure to follow installation instructions may damage the equipment.

To initialize the system:

1. Disconnect the power supply from the AC power outlet.
2. Check wiring, including batteries, at the power supply.
3. Connect AC power to the power supplies.

The 2-LCD and the system annunciators will initially indicate all off-normal conditions, but they should go away quickly. For persistent problems, see the chapters on *System service procedures* and *Isolating trouble conditions*.

Testing the system

Test all of the components as a system once it has been properly:

- Wired
- Programmed
- Cleared of circuit faults

WARNING: Before you test the system, notify all areas that receive alarm signals that testing is in progress. Inform any off-premises locations that receive alarm and trouble transmissions of the test.

All of the procedures in this chapter apply to initial and re-acceptance testing.

Initial acceptance test

The initial system check verifies that every component of the system is installed and operating according to design. Verification of the system design and installation requires the testing of every aspect of the system. Test results that differ from expected outcomes require corrective action.

Note: Records of all testing and maintenance shall be kept on the protected premises for a period of at least five (5) years.

Re-acceptance test

A complete check of installed field wiring and devices should be made at regular intervals, in accordance with NFPA 72.

Test tools

During the tests you will need to check the wiring for possible open circuits, short circuits, and ground faults. You will also need to simulate different conditions by disconnecting wires or shorting them with a jumper. Any test of the system requires the following tools:

- Slotted screwdriver, insulated
- Digital multimeter
- 12-inch (30.5 cm) jumper lead with alligator clips
- Panel door key

Testing the control panel

Perform the test procedures listed on the equipment installed in each cabinet connected to the system. These procedures will test the installation of the hardware.

Note: Download the system configuration information into the panel, using the 2-SDU, before you begin testing the system.

Before you test any power supply, verify that your system conforms to:

- Accepted installation practices
- Job specifications
- The battery capacity requirements for the application
- Safe routing practices for power-limited and nonpower-limited wires

Testing power supplies

Primary power supply

To test the primary power supplies:

1. Disconnect the batteries.
2. Connect the positive battery terminal to the positive auxiliary output of the power supply to verify that it can sustain its full alarm load without batteries.
3. Disconnect the positive battery terminal from the positive auxiliary output of the power supply.
4. Reconnect the batteries.
5. Disconnect AC power to verify that the 2-LCD annunciates a power supply trouble. The batteries should also sustain the supply's full alarm load.
6. Verify that the battery charger properly charges the batteries connected to 80% capacity within 24 hours.

Auxiliary power supplies

To test the auxiliary supplies:

1. Disconnect the batteries to verify that the power supply can sustain its full alarm load without the batteries connected.
2. Reconnect the batteries.
3. Disconnect AC power to verify that the 2-LCD annunciates a power supply trouble. The batteries should also sustain the supply's full alarm load.

4. Verify that the battery charger properly charges the batteries connected to 80% capacity within 24 hours.

Testing the control functions

Verifying panel components installation

Before you test the panel components, make sure that all:

- Ribbon cables are firmly seated in the proper connectors
- Wiring connections are secure
- Components are installed according to job specifications

Testing the 2-LCD

Before you test the 2-LCD, take some time to verify that the 2-LCD is properly mounted and secure. Also, check the ribbon cable between the 2-LCD and the MIR2-MCM to verify proper seating.

To test the 2-LCD:

1. Make sure that the 2-LCD Power LED is on.
2. Verify the correct date and time on the 2-LCD display.
3. Press the Trouble Silence and Alarm Silence simultaneously to perform the lamp test function.
4. Verify that each function switch performs according to specification.

Note: See the *System Operations Manual* for information about 2-LCD switch functions.

Verifying 2-LCD message queues

WARNING: Before you test the system, notify all areas that receive alarm signals that testing is in progress. Inform any off-premises locations that receive alarm and trouble transmissions of the test.

In this part of the system test, you initiate several off-normal conditions to see how the 2-LCD handles queued messages. The message queue test requires:

- 3 initial alarm tests
- 1 monitor condition test
- 2 trouble condition tests
- 2 supervisory condition tests
- 1 final alarm test

Conducting the initial fire alarm test

Conduct three separate fire alarm tests. During fire alarms, the proper 2-LCD indications include the:

- Sounding of the internal buzzer
- Flashing of the Alarm LED
- Display of a Programmed alarm message

Fire alarms should also cause audible notification appliances to sound and visual notification appliances to flash.

Note: Visual notification appliances will continue to flash after you press the Alarm Silence switch.

To conduct each fire alarm test:

1. Initiate a fire alarm anywhere in the system.
2. Check the 2-LCD for the proper fire alarm indications.
3. Press the Local Silence switch to verify that it silences the panel buzzer, stops the Alarm LED from flashing (but keeps it lit), and turns on the Local Silence LED.
4. Press the Alarm Review switch to verify that you can scroll through all the messages in the alarm queue.
5. Press the Alarm Silence switch to verify that it silences the audible notification appliances and turns on the Alarm Silence LED.

Concluding the initial fire alarm test

Before you conclude the first three fire alarm tests, print a history report from the 2-LCD. Verify that all three fire alarms appear in the history report printout. After you print the history report, clear the fire alarm conditions you introduced for the initial fire alarm tests.

To conclude the initial fire alarm test:

1. Clear the fire alarm conditions you introduced for the initial fire alarm tests.
2. On the 2-LCD, press the Reset switch.

The reset should turn off all:

- 2-LCD indicators clear except the green Power LED
- Audible and visual notification appliances

Conducting the monitor test

Conduct a monitor test. During monitor conditions, the 2-LCD Monitor LED flashes, but the internal buzzer is silent.

To run a monitor condition test:

1. Initiate a monitor condition.
2. Check the 2-LCD for the proper monitor indications.
3. Restore the monitor point.
4. Press the Reset switch at the 2-LCD.

Conducting the trouble tests

Conduct two separate trouble tests. During trouble conditions, the proper 2-LCD indications include the:

- Sounding of the internal buzzer
- Flashing of the Trouble LED
- Display of a programmed trouble message

To conduct each trouble test:

1. Initiate a trouble condition.
2. Check the 2-LCD for the proper trouble indications.
3. Press the Local Silence switch to verify that it silences the buzzer, stops the Trouble LED from flashing (but keeps it lit), and turns on the Local Silence LED.
4. Press the Trouble Review switch to verify that you can scroll through all the messages in the trouble queue.
5. Restore the trouble condition.
6. Press the Reset switch at the 2-LCD.

Conducting the supervisory tests

Conduct two separate supervisory tests. During supervisory conditions, the proper 2-LCD indications include the:

- Sounding of the internal buzzer
- Flashing of the Trouble LED
- Display of a programmed trouble message

To conduct each supervisory test:

1. Initiate an active supervisory condition.
2. Check the 2-LCD for the proper supervisory indications.
3. Press the Local Silence switch to verify that it silences the buzzer, stops the Supervisory LED from flashing (but keeps it lit), and turns on the Local Silence LED.
4. Press the Supervisory Review switch to verify that you can scroll through all the messages in the supervisory queue.
5. Clear the supervisory condition.

6. Press the Reset switch at the 2-LCD.

Conducting the final fire alarm test

Conduct a fourth fire alarm test. Look for the same 2-LCD indications mentioned in the initial fire alarm tests. The fire alarm message should override any other message in the queue.

To conduct the final fire alarm test:

1. Initiate a fire alarm anywhere in the system.
2. Check the 2-LCD for the proper fire alarm indications.
3. Press the Local Silence switch to verify that it silences the panel buzzer, stops the Alarm LED from flashing (but keeps it lit), and turns on the Local Silence LED.
4. Press the Alarm Review switch to verify that you can scroll through all the messages in the alarm queue.
5. Press the Alarm Silence switch to verify that it silences the audible notification appliances and turns on the Alarm Silence LED.
6. Clear the fire alarm condition you introduced.
7. On the 2-LCD, press the Reset switch.

The reset should turn off all:

- 2-LCD indicators clear except the green Power LED
- Audible and visual notification appliances

Testing RS-232 and RS-485 ports

Testing the RS-232 port

This test will verify the operation of peripheral devices connected to the Main Controller Module's RS-232 port.

To test the RS-232 Port:

1. Verify that the baud rate of the peripheral device matches the setting in the 2-SDU.
2. Check the printer operation by generating a system report at the 2-LCD keypad.
3. Check the laptop function by uploading data in the 2-SDU *Communication* menu.

Testing RS-485 ports

Two RS-485 lines (Ch 0 and Ch 1) support the system in a Class B (Style 4) or a Class A (Style 7) configuration. The RS-485 lines support annunciators like 2-LSRA-MIR(-C)s, 2-SLCDA(-C)s, and ANN annunciators.

To test the Class B (Style 4) RS-485 ports:

1. Verify that the 2-LCD indicates normal operations.
2. Use the System Status switch to verify that all connected devices are communicating over the system.
3. Disconnect the RS-485 wiring from the MIR2-MCM.
4. Verify that all the other devices connected to the system appear in the Trouble queue.

To test the Class A (Style 7) RS-485 ports:

1. Verify that the 2-LCD indicates normal operations.
2. Use the System Status switch to verify that all connected devices are communicating over the system.
3. Disconnect the RS-485 wiring from the MIR2-MCM, Ch 0.
4. Verify that the 2-LCD annunciates a communications fault.
5. Repeat step 2 to verify that all connected devices still communicate over the RS-485 lines.

Testing Signature data circuits

The signature data circuit (SDC) consists of Signature series devices connected to the MIR2-MCM on a data circuit. A complete test of the SDC looks at:

- Wiring on the circuit
- Mapping in the 2-SDU
- Messages on the 2-LCD

To verify the proper SDC mapping:

1. Visually inspect the wiring on the SDC to ensure proper wiring practices.
2. In the 2-SDU, map the SDC by uploading device data from the MIR2-MCM.
3. Commit devices on the SDC as required.
4. Download the new data back to the MIR2-MCM and upload it again back into the 2-SDU.
5. In the 2-SDU, open the Signature data map to verify that actual data matches the expected data.

To test the SDC:

1. With no map errors displayed, put an input device on the SDC into the active mode.
2. Verify that the 2-LCD displays the appropriate message.
3. Put the input device into the Trouble mode.
4. Verify that the 2-LCD displays the appropriate Trouble message.

Testing NACs

To test NACs at the 2-LCD:

1. Verify that all components are installed according to the specifications of the job.
2. Activate an output on the 2-LCD.
3. Verify that the devices activate properly.
4. Restore the circuit.
5. Disconnect the circuit or EOL resistor.
6. Verify that the appropriate trouble message appears on the 2-LCD.

To test NACs on site:

1. Verify that all components are installed according to the specifications of the job.
2. Inspect each notification appliance to verify proper operation.
3. Remove one leg of the notification appliance wiring.
4. Verify that the 2-LCD displays the appropriate trouble message.

Testing reverse polarity modules

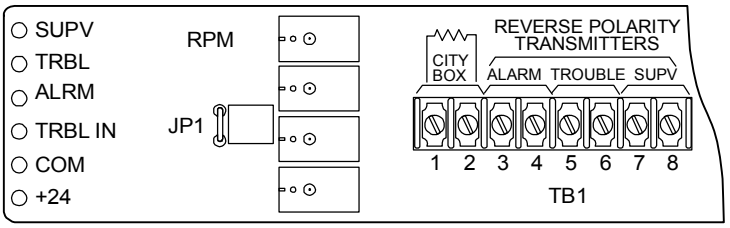


Figure 8: Reverse Polarity Module

Note: See the MIR2-MCM and RPM installation sheets for more details on the RPM.

The Reverse Polarity Module (RPM) supports these configurations:

- Single circuit (old style) configuration
- Three circuit configuration

Each of the configurations requires a different approach to testing the RPM. Before you test the RPM in any configuration, however, you have to ensure that the proper test conditions exist.

To ensure the proper test conditions:

1. Verify the proper wiring of the RPM.
2. If the RPM is connected to a municipal box or central monitoring station, advise the appropriate parties of the upcoming test.

Testing single-circuit (old-style) configuration

To test for trouble conditions:

1. Make sure that JP1 is not installed.
2. With a voltmeter, verify that 20 to 25 VDC sits across TB1-3 (+) and TB1-4 (-).
3. Create a Trouble condition on the panel.
4. With a voltmeter, verify that 0 VDC sits across TB1-3 (+) and TB1-4 (-).
5. Verify that the:
    - Panel's trouble relay activates
    - 2-LCD message queue displays the correct message
    - Municipal receiving station receives a trouble indication

6. Open the circuit wired between TB1-3 and TB1-4.
7. Verify that municipal receiving station receives a trouble indication.

To test for fire alarms:

1. Initiate an active fire alarm.
2. With a voltmeter, verify that 20 to 25 VDC sits across TB1-5 (+) and TB1-6 (-) and look for any polarity change.
3. Verify the receipt of the alarm at the municipal receiving station.

Testing three circuit configuration

To test for trouble conditions:

1. Make sure that JP1 is installed.
2. With a voltmeter, confirm that 20 to 25 VDC (in the correct polarity) sits across the following terminals:
   - TB1-3 (+) and TB1-4 (-)
   - TB1-5 (+) and TB1-6 (-)
   - TB1-7 (+) and TB1-8 (-)
3. Create a Trouble condition on the panel.
4. With a voltmeter, confirm that 20 to 25 VDC sits across TB1-5 (+) and TB1-6 (-).
5. Verify that the:
   - Panel's trouble relay activates
   - 2-LCD message queue displays the correct message
   - Receiving station receives a trouble indication
6. See if the municipal receiving station receives a circuit fault indication when you open the circuit wired between:
   - TB1-3 (+) and TB1-4 (-)
   - TB1-5 (+) and TB1-6 (-)
   - TB1-7 (+) and TB1-8 (-)

To test for fire alarms:

1. Initiate an active fire alarm.
2. With a voltmeter, verify that 20 to 25 VDC sits across TB1-3 (+) and TB1-4 (-) and look for any polarity change.
3. Verify the receipt of the alarm at the municipal receiving station.

To test for supervisory conditions:

1. Initiate a supervisory condition.
2. With a voltmeter, verify that 20 to 25 VDC sits across TB1-7 (+) and TB1-8 (-) and look for any polarity change.
3. Verify the receipt of a supervisory condition at the municipal receiving station.

Testing audio

The audio system includes the following components:

- 2-AAC Audio Controller Module
- SIGA-AAXX Audio Amplifier
- 2-MIC Microphone Module
- 2-TEL Firefighter Telephone

Note: Before any test, check all of the audio components against the job specifications and the installation sheets. Ensure the proper installation and wiring of each component.

WARNING: Inform building occupants of any fire alarm test before you perform it.

Microphone paging test

To test the 2-AAC and the 2-MIC:

1. Disconnect the 2-MIC from the 2-AAC and make sure that the 2-LCD displays the appropriate message.
2. Reconnect the 2-MIC to the 2-AAC.
3. Remove each audio riser from the 2-AAC and make sure that the 2-LCD trouble queue displays the correct message.
4. Reconnect the audio risers.
5. At the 2-MIC, press the Page-to-Alarm switch.
6. At the front panel LED/Switch module, select all floors and issue a page to verify that all locations receive the page.

Firefighter telephone tests

The firefighter telephone test consists of several phases because telephone jacks are distributed throughout the building. In addition, the 2-TEL comes with a 2-TEL option board, which needs its own test.

Note: The GSA-CC1 wired to the 2-TEL should be programmed with a personality code 26.

To test the first firefighter telephone circuit:

1. Take a firefighter telephone off the hook.
2. Plug a firefighter telephone into a firefighter telephone jack.
3. Verify that an incoming call buzzer sounds, and that the appropriate LED lights on the front panel LED/Switch module.

4. Press the Call-in Silence switch and verify that the buzzer silences.
5. Press the appropriate switch on the front panel LED/Switch module to connect the incoming call.
6. Talk over the firefighter telephone connection to verify clear, noise-free communications.

To test the second firefighter telephone circuit:

1. Take a second firefighter telephone, on a different branch circuit, off the hook.
2. Verify that the incoming call buzzer re-sounds, and that the appropriate LED lights on the front panel LED/Switch module.
3. Press the Call-in Silence switch and verify that the buzzer silences.
4. Press the appropriate switch on the front panel LED/Switch module to connect the incoming call.
5. Talk over the firefighter telephone connection to verify clear, noise-free communications.

To test multiple telephone jacks:

1. Connect five firefighter telephones at the same time.
2. Verify that the incoming call buzzer re-sounds, and that the appropriate LEDs light on the front panel LED/Switch module.
3. Press the Call-in Silence switch and verify that the buzzer silences.
4. Press the appropriate switch on the front panel LED/Switch module to connect each incoming call.
5. Talk over the firefighter telephone connection to verify clear, noise-free communications.
6. Disconnect all but one firefighter telephone.

To test the Page by Phone switch:

1. Press the Page by Phone switch on the 2-MIC.
2. At the front panel LED/Switch module, select a page destination.
3. Speak into the telephone still connected to the circuit from the last test.
4. Verify the distribution of the telephone’s audio throughout the facility.

To test the telephone option board:

1. Disconnect each of the telephone risers from the 2-TEL option board.
2. Verify that the 2-LCD displays the appropriate trouble message.
3. Restore the connections.

To test the firefighter telephone jacks:

1. Disconnect each firefighter telephone jack/station.
2. Verify that the 2-LCD trouble queue displays the correct message.
3. Restore the connections.

Amplifier test

The amplifier test will measure the responsiveness of the SIGA-AA30 and SIGA-AA50 amplifiers.

To test the audio amplifiers:

1. Ensure that the wattage of any backup amplifier equals or exceeds the wattage of any primary amplifier it will replace.
2. Create an alarm condition to verify that EVAC signal shows up at the alarm output.
3. Create an amplifier fault to see if the backup amplifier takes over.

To test Class B output configurations:

1. Disconnect the amplifier's audio output wiring.
2. Verify that the 2-LCD trouble queue displays the correct message.
3. Restore the connections.

To test Class A output configurations:

1. Disconnect the amplifier's primary audio output wiring.
2. Verify that the 2-LCD trouble queue displays the correct message.
3. Verify that the amplifier output is available on Class A wiring.
4. Restore the connections.

Testing detectors and modules

These procedures are designed to test the application and programming of detectors, input modules, and output modules for initial approval and re-acceptance.

Note: Download the Signature data circuit (SDC) configuration to the panel from the 2-SDU before you start testing.

Detectors

Signature Series detectors

Signature Series detectors and bases reside on an SDC controlled by a Main Controller Module (MIR2-MCM) or an Expander Loop Module (MIR2-LCX).

To test Signature Series detectors:

1. Ensure that all the detectors are located and mounted according to accepted installation practices and the specifications of the job.
2. Activate each detector individually.
3. Verify that the device initiates the appropriate system responses.
4. Check the 2-LCD for the appropriate circuit type and device location message.
5. Remove the detector from its base.
6. Verify that the 2-LCD displays the appropriate trouble message and location.
7. After you replace the detector, press the Reports switch on the 2-LCD to run a sensitivity report.

If the detector is installed in a relay base, verify that the base's relay function operates according to design. If the detector is installed in an isolator base, verify that the base isolates the required circuit segments.

Conventional detectors

Conventional detectors and bases work in conjunction with GSA-UMs (or GSA-MABs).

Note: Before you test conventional detectors, verify the following:

- A 2-SMK module is installed between the panel power supply and the GSA-UM (or GSA-MAB), terminal 9 (smoke power)

- JP1, on each GSA-UM (or GSA-MAB), jumps pins 1 and 2

To test conventional detectors:

1. Ensure that all the detectors are located and mounted according to accepted installation practices and the specifications of the job.
2. Activate each detector individually.
3. Verify that the GSA-UM (or GSA-MAB) initiates the appropriate system responses.
4. Check the 2-LCD for the appropriate circuit type and device location message.
5. Remove the detector from its base.
6. Verify that the 2-LCD displays the appropriate trouble message and location.

If the detector is installed in a relay base, verify that the base's relay function operates according to design. If the detector is installed in an isolator base, verify that the base isolates the required circuit segments.

Duct detectors

Test duct detectors to verify that they meet the minimum and maximum airflow requirements.

See the following documents for detailed specifications and instructions on Signature Series detectors:

- *Signature Series Technical Reference* (P/N 270144)
- *Signature Series Component Installation Manual* (P/N 270683)
- *Signature Series Intelligent Smoke and Heat Detectors Applications Bulletin* (P/N 270659)

Modules

Input modules

To test input modules

1. Ensure that all the modules are located and mounted according to accepted installation practices and the specifications of the job.
2. Activate each module individually.
3. Verify that the device initiates the appropriate system responses.

4. Check the 2-LCD for the appropriate circuit type and device location message.
5. Open the circuit.
6. Verify that the 2-LCD displays the appropriate trouble message and location.

Output modules

To test output modules:

1. Ensure that all the modules are located and mounted according to accepted installation practices and the specifications of the job.
2. At the 2-LCD, activate each module individually with the Activate Output command.
3. Verify that the device initiates the appropriate system responses.
4. Check the 2-LCD for the appropriate circuit type and device location message.
5. Open the circuit (for supervised output circuits).
6. Verify that the 2-LCD displays the appropriate trouble message and location.

If the output is activated by one or more system inputs, activate these inputs and verify that the output function operates appropriately.

Testing initiating devices

The procedures for testing initiating devices are the same for initial and re-acceptance testing. These procedures test the initiating devices and their programming. Initiating devices include:

- Manual pull stations
- Non-restorable heat detectors
- Restorable heat detectors
- Waterflow switches

Caution: Do not test a nonrestorable heat detector. Nonrestorable heat detectors activate only one time, and require replacement afterwards.

Perform the tests along with the procedures for testing Signature detectors and input modules.

To test manual pull stations:

1. Inspect the initiating device for visual indications of non-conformance.
2. Pull the lever to activate the pull station.
3. Verify that the device initiates the appropriate system responses.
4. Check the 2-LCD for the appropriate circuit type and device location message.
5. Open the circuit.
6. Verify that the 2-LCD displays the appropriate trouble message and location.

To test restorable heat detectors:

1. Inspect the initiating device for visual indications of non-conformance.
2. Activate the detector.
3. Verify that the device initiates the appropriate system responses.
4. Check the 2-LCD message for the appropriate circuit type and device location.
5. Open the circuit.
6. Verify that the 2-LCD displays the appropriate trouble message and location.

To test waterflow switches:

1. Inspect the initiating device for visual indications of non-conformance.
2. Activate the sprinkler test valve.
3. Verify that the device initiates the appropriate system responses.
4. Check the 2-LCD message for the appropriate circuit type and device location.
5. Open the circuit.
6. Verify that the 2-LCD displays the appropriate trouble message and location.

Testing notification appliances

The procedures for testing notification appliances are the same for initial and re-acceptance testing.

These procedures test the notification appliances and their programming. Notification appliances include:

- Visual devices
- Speakers
- Bells
- Horns

The procedures for testing notification appliances are the same for visual and audible devices. Perform the tests along with the procedures for testing Signature detectors and output modules.

To test notification appliances:

1. Inspect the notification appliance for visual indications of non-conformance.
2. Activate the circuit.
3. Verify that all indicating appliances operate according to specification.
4. Open the circuit.
5. Verify that the 2-LCD displays the appropriate trouble message and location.

Filling out a certificate of completion

When you have tested the system and found it to operate satisfactorily, it is time to submit a Certificate of Completion.

Note: Do not use the master copy to report your work.

To fill out a certificate of completion:

1. Reproduce the master copies of the Certificate of Completion on the following pages (Figure 9 and Figure 10).
2. Supply the information requested on the Certificate of Completion.
3. Give the Certificate of Completion to the building representative.

Fire Alarm System Certificate of Completion

Page 1 of 2

Protected Property

Name:

Address:

Representative:

Phone:

Authority Having Jurisdiction:

Address:

Phone:

Certificate of System Installation

This system has been installed in accordance with the NFPA standards listed below, was inspected by _____ on _____ , and includes the devices listed below, and has been in service since _____ .

_____ NFPA 72, Ch 4 5 6 7 8 9 10 (Circle all that apply)
_____ NFPA 70, National Electric Code, Article 760
_____ Manufacturer's Instructions _____ Other (Specify) _____

Certificate of System Operation

All operational features and functions of this system were tested by _____ on _____ and found to be operating properly and in accordance with the requirements of:

_____ NFPA 72, Ch 4 5 6 7 8 9 10 (Circle all that apply)
_____ NFPA 70, National Electric Code, Article 760
_____ Manufacturer's Instructions _____ Other (Specify) _____

Signed: _____ Dated: _____ Organization:

System Software

System Firmware

Installed Revision: _____ Checksum: _____ Date: _____

Application Programming

Initial Program Installation: _____ Date: _____
Revisions & Reasons: _____ Date: _____
_____ Date: _____
_____ Date: _____

Programmed by (name): _____

Date of Programmer's Latest Factory Certification: _____

Data Entry Program Revision Used: _____

Maintenance

Frequency of routine tests and inspections, if other than in accordance with the referenced NFPA standards: _____

System deviations from the referenced standards are: _____

(signed) for Central Station or Alarm Service Company (title) (date)

(signed) for representative of the Authority Having Jurisdiction (title) (date)

Figure 9: Certificate of Completion, Page 1

Fire Alarm System Certificate of Completion

Page 2 of 2

Initiating Devices and Circuits

(indicate quantity)

__ Manual Stations

Automatic Devices

Combination Detectors (circle active sensors.)

__ Smoke Detectors: __ Ion __ Photo __ Ion/Photo/Heat

__ Duct Detectors: __ Ion __ Photo __ Ion/Photo/Heat

__ Waterflow Switches: _____

__ Other (list): _____

Supervisory Devices and Circuits

(indicate quantity)

__ Compulsary Guard's Tour comprised of _____ transmitter stations and _____ intermdediate stations.

Sprinkler System

__ Valve supervisory devices

__ Building temperature points

__ Site Water Temperature Points

__ Site water supply level points:

Electric Fire Pump

__ Fire pump power

__ Fire pump running

__ Phase reversal

Engine Driven Fire Pump

__ Selector in auto position

__ Control panel trouble

__ Transfer switches

__ Engine running

Other Supervisory Function(s) (specify)

__ _____

_____

_____

Notification Appliances & Circuits

Notification Appliance Circuits _____

Type and quantity of installed Notification Appliances

__ Bells __ inch __ Visual Signals Type: _____

__ Speakers __ with audible

__ Horns __ without audible

__ Other: _____

__ Local Annunciator

Signaling Line Circuits

Quantity and Style of connected SLCs, per NFPA 72, Table 6.6.1

__ Quantity ____ Style

System & Service

__ **NFPA 72, Ch. 6 - Protected Premises**
If alarm transmitted off premise, location(s) received: _____

__ **NFPA 72, Ch. 6 - Emergency Voice Alarm Service**
voice/alarm channels: _____ single: __ multiple: __
installed speakers: _____ # speakers per zone: __
telephones/jacks installed: ____

__ **NFPA 72, Ch. 9 - Auxiliary**
Type of connection:
Local Energy:____ Shunt: ____ Parallel Telephone: ____
Location/Phone # for receipt of signals: _____

__ **NFPA 72, Ch. 8 - Remote Station**
Alarm: _____
Supervisory: _____

__ **NFPA 72, Ch. 8 - Proprietary**
If alarms retransmitted off premise, location & phone of receiving organization: _____
Method of alarm retransmission: _____

__ **NFPA 72, Ch. 8 - Central Station**
Prime Contractor: _____
Central Station Location: _____
Method of transmission of alarms to central station:
__ McCulloh __ One-Way Radio
__ Multiplex __ Two-Way Radio
__ Digital Alarm Communicator __ Others: _____
Method of transmission of alarms to public fire service comunications center:
1. _____ 2. _____

Power Supplies

Primary (main)

Nominal Voltage: _____
Current Rating: _____
Overcurrent protection:
Type: _____
Current rating: _____
Location: _____

Secondery (standby)

__ Storage battery
Amp-Hour rating: ____
Calculated for ___ hours of system operation.
__ Dedicated generator
Location of fuel supply:
_____

Emergency or standby system used to backup primary supply

__ Emergency system described in NFPA 70, Article 700
__ Legally required standby system described in NFPA 70, Article 701
__ Optional standby system described in NFPA 70, Article 702, meeting the performance requirements of Article 700 or 701

Figure 10: Certificate of Completion, Page 2

Chapter 4
System service procedures

Summary

If the MIR2 system develops problems, you will see fault codes and error messages at the 2-LCD. You may also see problem indications at the module level. Whenever these events occur, you need a quick reference to guide you to the source of the problem. The tables in this chapter provide the needed quick reference for fault codes and module indicators. You also need a consistent way to report system problems or maintenance activities. The Fire Alarm Trouble And Maintenance Log provides an effective means for reporting maintenance activities.

Content

Recommended maintenance practices

Electrical safeguards

Personal safety

WARNING: Disconnect AC power to the control panel before installing or removing any components. Failure to remove AC power may result in serious injury or loss of life.

Follow the recommendations for the routing of power-limited and nonpower-limited wiring to avoid dangerous confusion of wire types. See the wallbox installation sheets for the details.

Electrostatic precautions

The components of the fire alarm control panel are extremely sensitive to small amounts of static electricity. Make sure you are properly grounded before you handle any module. Provide a static-free storage environment for any module you remove from the control panel.

Wire stripping

Strip 1/4 inch (6.4 mm) from the ends of all wires that connect to the terminal blocks of the module. Exposing more than 1/4 inch of wire may cause a ground fault. Exposing less than 1/4 inch of wire may result in a faulty connection. Observe the wire stripping whenever you perform maintenance on the system or troubleshoot a problem.

Preventive maintenance

There are two standards you need to follow for preventive maintenance. NFPA 72 provides guidance for inspection, testing, and maintenance. The other standard to follow is the authority having jurisdiction for your municipality.

Documenting system service

Document your maintenance activities and any problems that arise on the system. The more documentation you have, the easier it is to track problems on the system. See, *Documenting system service*, at the end of this chapter for a sample maintenance log. Photocopy the sample and use it for system maintenance activities.

Use the Reports menu in the 2-SDU to generate and print reports on the configuration of the system for any changes. When

problems arise on the system, you will have a reliable record for comparison.

System faults

Reading 2-LCD messages

The standalone system provides valuable data to help the technician find and correct problems. Whenever a problem arises, the 2-LCD indicates both audibly and visually that something is wrong. See the *System Operations Manual* for detailed information on the LED indications of the 2-LCD.

The 2-LCD also displays fault messages to locate and identify the problem. Each fault message consists of a 4-digit address. The first two digits represent the panel address. If the panel address is 00, the last two digits will be pseudo-point IDs (01 through 99). If the panel address is 01 through 63, the last two digits will represent the device address (01 through 96). Table 2 lists the system addresses. All devices and accessories connected to the RS-485 circuit have four-digit addresses between 10xx and 63xx.

Table 2: System addressing

Panel address	Function	Device addresses		References
00	Primary Power Supply and system faults Table 7 (MIR-PPS) Table 8 (MIR-PPS/6A)	0001 to 0014 System faults 0015 to 0019 MIR2-MCM faults 0020 to 0024 MIR2-LCX faults 0025 to 0029 2-DACT faults		Table 3
01 and 02	Main Controller Module See *Signature device problems*.	0101 to 0196 Signature detectors 0201 Dedicated NAC (default) 0202 Dedicated NAC (default) 0203 to 0296 Signature modules		
03 and 04	Expander Loop Module See *Signature device problems*.	0301 to 0396 Signature detectors 0401 Dedicated NAC (default) 0402 Dedicated NAC (default) 0403 to 0496 Signature Modules		
05	LED/switch modules 1st module 2nd module 3rd module 4th module 5th module 6th module	LEDs 0501 to 0516 0517 to 0532 0533 to 0548 0549 to 0564 0565 to 0580 0581 to 0596	Switches (0501 to 0508) (0509 to 0516) (0517 to 0524) (0525 to 0532) (0533 to 0540) (0541 to 0548)	Table 14

Table 2: System addressing

Panel address	Function	Device addresses	References
	User-defined switch	0096	
06, 07, 08, 09	Future use		
41,	2-AAC Audio Control Module	4110 to 4115, and 4197	Table 17 Table 18 Table 19 Table 20
42, 43	Not available		

Fault messages also contain pre-programmed descriptions for the conditions or events that prompt them.

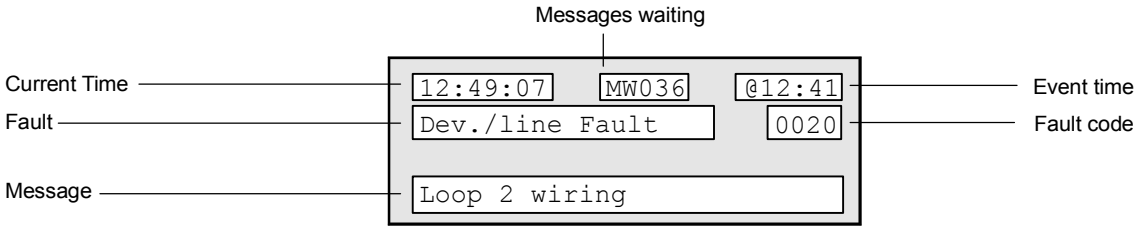


Figure 11: Typical fault message

The message in (Figure 11) indicates that the current time is 12:49 (PM) and the queue contains thirty-six messages. The Expander Loop Module has a short circuit or open on its SDC, which occurred at 12:41. Table 3 provides the meanings of other messages that appear on the 2-LCD.

Table 3: System fault messages

Message	Description
0001 / Short fault, NAC power	Over-current condition at the MIR-PPS(/6A) Primary Power Supply NAC PWR terminal repaired by reducing the NAC current load.
0002 / Short Fault, Smoke or auxiliary power	Over-current condition at the MIR-PPS(/6A) SMK/AUX PWR terminal repaired by reducing the smoke power current load.
0003 / Open Fault, Battery or Wiring	Battery problem on the MIR-PPS(/6A) caused by: Low or missing battery Open battery fuse (F2) Open or poor connection on battery leads

Table 3: System fault messages

Message	Description
0004 / Open fault, MIR-PPS(/6A)	Brownout or loss of AC power caused by an: Input voltage below 85% of rating Open on the AC input fuse (F1)
0005 / Ground Fault, System Ground	Pinched wire between device and electrical box Nicked wire insulation
0006 / Internal Fault	Abnormal internal voltage due to a MIR-PPS(/6A) failure.
0007 / Communications Fault, Local Controller (See Table 10 for LED indications on the MIR2-MCM.)	Main Controller Module (MIR2-MCM) not communicating with the MIR-PPS(/6A), caused by a: Loose or defective ribbon cable* Defective MIR2-MCM * Check J1 on the MIR2-MCM and the MIR-PPS(/6A).
0008 / Communications Fault, Expansion Controller (See Table 11 for LED indications on the MIR2-LCX.)	Expander Loop Module (MIR2-LCX) not communicating with the MIR-PPS(/6A), caused by a: Loose or defective ribbon cable* Defective MIR2-LCX *Check J1 on the MIR2-LCX and the MIR2-MCM.
0009 / Internal Fault, Watch-dog Time-out	Watch-dog timer restart failure: MIR2-MCM failure
0010 / Internal Fault, LCD Display Table 13	Communication failure between the 2-LCD and the MIR2-MCM, caused by a: Loose or defective ribbon cable* Defective 2-LCD *Check J1 on the 2-LCD and J2 on the MIR2-MCM.
0011 / Internal Fault, Local Annunciator	Front panel annunciator module not communicating with the MIR2-MCM
0012 / Internal Fault, Dialer	Fault on dialer module or associated wiring caused by: Improper programming of the dialer Telephone line problems
0013 / Internal fault, printer or external command port (ECP)	Problem on RS-232 port or device caused by: Off-line status of the printer or ECP Incorrect device wiring (Pins 2 and 3 on the printer cable)
0014 / Communication fault, MIR-PPS(/6A)	Communication failure between the MIR2-MCM and the MIR-PPS(/6A), caused by a: Loose or defective ribbon cable* Defective MIR-PPS(/6A) *Check J1 on the MIR-PPS(/6A) and the MIR2-MCM.
0015 / Class A fault, Loop 1 Wiring	Open or short on one path of the MIR2-MCM Signature data circuit (SDC)

Table 3: System fault messages

Message	Description
0016 / Internal Fault, Loop 1 Device Mapping Error	The MIR2-MCM SDC is in the process of mapping the circuit. This fault should clear itself when mapping is complete. Mapping may take up to 30 minutes per circuit.
0017 / Internal Fault, L1 Dev. Personality	A personality code mismatch exists on the MIR2-MCM SDC.
0018 / Internal Fault, Loop 1 autoconfigure	The MIR2-MCM SDC could not properly configure the circuit.
0019 / Internal Fault, Loop 1 Int. Memory	A memory mismatch exists between the actual data from the SDC and the expected data in the MIR2-MCM.
0020 / Class A fault, Expansion Loop	Open or short on one path of the MIR2-LCX SDC.
0021 / Internal Fault, Loop 2 Device Mapping Error	The MIR2-LCX SDC is in the process of mapping the circuit. This fault should clear itself when mapping is complete. Mapping may take up to 30 minutes per circuit.
0022 / Internal Fault, L2 Dev. Personality	A personality code mismatch exists on the MIR2-LCX SDC.
0023 / Internal Fault, Loop 2 autoconfigure	The MIR2-LCX SDC could not properly configure the circuit.
0024 / Internal Fault, Loop 2 Int. Memory	A memory mismatch exists between the actual data from the SDC and the expected data in the MIR2-LCX.
0025 / Dialer Internal Memory Fault (See Table 15.)	An internal error has occurred. Turn the power off and on again. Replace the 2-DACT if the fault remains.
0026 / Dialer Phone Line 1 fault	An electrical fault on telephone line 1 caused by: A bad connection between J1 and the telephone jack An inoperative telephone line Note: The fault may take up to two minutes to clear after the repair.
0027 / Dialer Phone Line 2 fault	An electrical fault on telephone line 2 caused by: A bad connection between J2 and the telephone jack An inoperative telephone line A configuration error* *If the 2-DACT is configured for 1-line operation, this error means J2 is connected to a good phone line. Disconnect the line to clear the error. The fault may take up to two minutes to clear after the repair.
0028 / Call-out Not Completed By Dialer	The dialer reached the maximum number of call attempts. The telephone company has technical problems. The receiver is down.

Table 3: System fault messages

Message	Description
0029 / Dialer manually disabled	The dialer disconnect switch was pressed or: The dialer is new and needs programming The dialer is in the programming mode See the 2-DCU online help for programming instructions on the 2-DACT.
0030 / Test Mode Active	Someone initiated a test by pressing the 2-LCD Test switch. The message will go away when the test ends. See the *System Operation Manual* for more information.
0101 to 0196 - Device/line Fault or Device communications fault	Trouble on Signature detector wired to the MIR2-MCM having an address from 0101 to 0196
0201 and 0202 - Open fault (See Table 12.)	An open on the MIR2-MCM NAC caused by: An incorrect or missing EOL resistor A miswired circuit or intermittent connections A broken conductor
0201 and 0202 - Short fault	MIR2-MCM NAC shorted because of a: Polarized device reversed on the circuit Defective notification appliance Miswired circuit
0203 to 0296, Device/line Fault or Device communications fault	Trouble on a Signature module wired to the MIR2-MCM having an address from 0203 to 0296
0301 to 0396 - Device/line Fault or Device communications fault	Trouble on Signature detector wired to the MIR2-LCX having an address from 0301 to 0396
0401 and 0402 - Open fault	An open on the MIR2-LCX NAC caused by: An incorrect or missing EOL resistor A miswired circuit or intermittent connections A broken conductor
0401 and 0402 - Short fault	MIR2-LCX NAC shorted because of a: Polarized device reversed on the circuit Defective notification appliance Miswired circuit
0403 to 0496 - Device/line fault or Device communications fault	Trouble on Signature module wired to the MIR2-LCX having an address from 0403 to 0496
XX97*	Comm Fault Primary Comm Channel (xx = 10-40 or 44-63)
XX98*	Comm Fault Secondary Comm Channel (xx = 10-40 or 44-63)
XX99*	Internal Fault Card/Supervision (xx = 10-40 or 44-63)
41XX 2-AAC Audio Controller faults	See Table 17

Checking LEDs on the 2-LCD

The 2-LCD also indicates problems with LEDs and an internal buzzer. The internal buzzer provides an audible indication that the system has a problem. Table 4 lists the LEDs to look for when the internal buzzer sounds.

Table 4: System fault messages

Fault	Possible Causes
AC Power LED off	The AC power is off or below 85% of the rated voltage.
TROUBLE LED on	The system has detected a problem with the wiring or a device on the loop. Check the display for more details and look for other lit LEDs.
CPU FAIL LED on	• MIR2-MCM CPU watch-dog time-out • LED/Switch module CPU watch-dog time-out
All LEDs off	The system has had an AC power failure and the batteries below minimum allowable voltage

Another way of finding problems is to look for improper device responses. For example, the disable function fails to disable the desired Signature device or disables another one. An improper device response may result from any of the following conditions:

- Conflicting device types
- Conflicting serial numbers
- An incorrect personality code loaded into a module
- Incorrect country code
- An incorrect jumper setting on a GSA-UM

Check the devices by looking at their LEDs and comparing their serial numbers with the ones configured in the 2-SDU.

Checking system status

A level 1, 2, or 3 password is required to use the 2-LCD status function. Press the STATUS switch to access the status report screen, and follow its instructions (Figure 12).

```
Status Report.
[ent] key scrolls
[del] key terminates
```

Figure 12: Status report screen

Press the ENTER switch a second time to advance the LCD display to the general status screen (Figure 13).

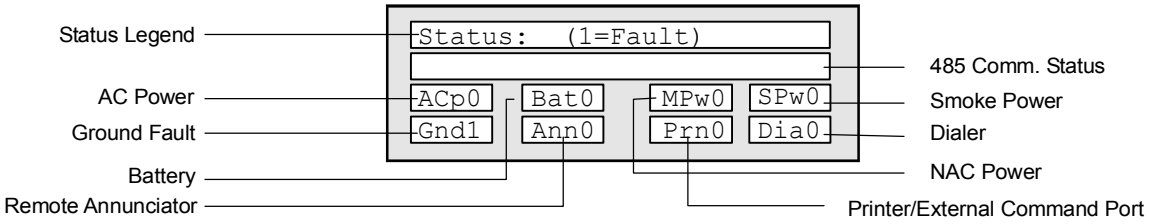


Figure 13: General status screen

The general status screen in Figure 13 indicates a ground fault in the system. Table 5 lists the indications that appear on the general status screen and the events they represent.

Table 5: General status legend

Indication	Event
ACp	AC power
Gnd	Ground fault
Bat	Battery
Ann	Remote annunciator
MPw	NAC power
Prn	Printer
Spw	Smoke power
Dia	Dialer

Press the ENTER switch again to reveal the loop status screens.

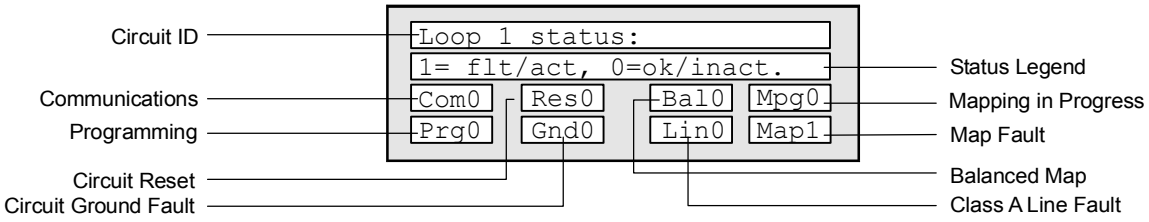


Figure 14: Loop Status Screen

The loop status screen in (Figure 14) shows a map fault on the SDC connected to the Main Controller Module (loop 1). The next loop status screen displays the status of the SDC on the Loop Expander Module. Table 6 lists the indications that appear on the loop status screen the events they represent.

Table 6: Loop status legend

Legend	Cause
Com	Communications fault between loop electronics and Main Controller Module
Res	SDC is resetting
BAL	SDC is balanced
Mpg	SDC is actively mapping
Prg	Writing to Signature memory
Gnd	Ground Fault on SDC
Lin	Class A fault on SDC
Map	Map fault on SDC

Panel modules

MIR-PPS Primary Power Supply

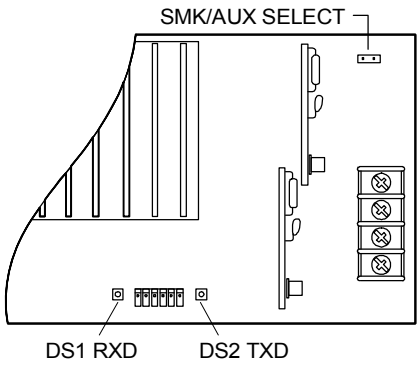


Figure 15: Primary Power Supply

Table 7: Primary Power Supply LEDs

LED	Color	Pattern	Indication
DS1	Amber	Flickering	The MIR-PPS successfully receives data from the MIR2-MCM.
DS2	Amber	Flickering	The MIR-PPS successfully transmits data to the MIR2-MCM.

MIR-PPS/6A 6 Amp Primary Power Supply

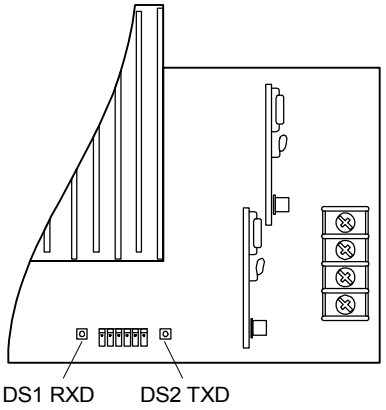


Figure 16: Primary Power Supply (6 Amp)

Table 8: 6 Amp Primary Power Supply LEDs

LED	Color	Pattern	Indication
DS1	Amber	Flickering	The MIR-PPS/6A successfully receives data from the MIR2-MCM.
DS2	Amber	Flickering	The MIR-PPS/6A successfully transmits data to the MIR2-MCM.

Table 9 lists the most common symptoms and causes of primary power supply problems.

Table 9: Primary power supply problems

Problem	Causes
RXD LED (DS1) off (Figure 15 and Figure 16)	A communication failure from the MIR2-MCM, caused by a: Loose or defective ribbon cable* Defective MIR2-MCM *Check J1 on the MIR-PPS(/6A) and the MIR2-MCM
TXD LED (DS2) off (Figure 15 and Figure 16)	A communication failure from the MIR2-MCM, caused by a: Loose or defective ribbon cable* Defective MIR-PPS(/6A) *Check J1 on the MIR-PPS(/6A) and the MIR2-MCM
Voltage low at NAC PWR	An excessive load is causing the MIR-PPS(/6A) to fold back (3.5 A, max for the MIR-PPS; 3.2 A, max for the MIR-PPS/6A).
Voltage low at SMK/AUX PWR	An excessive load is causing the MIR-PPS(/6A) to fold back (1 A max).
4-Wire smoke detectors will not reset	The SMK/AUX SELECT jumper is installed.
Batteries will not charge	The system is in the alarm mode. The 7 Amp battery fuse (F2) is open.
System will not operate on batteries	The batteries are low. The 7 Amp battery fuse (F2) is open. Note: The system automatically turns off when batteries are too low to operate system.
System ground fault	Internal or field wiring is in contact with earth ground The download computer is feeding ground to the panel.

MIR2-MCM Main Controller Module

Note: See the MIR2-MCM installation sheet for detailed drawings and information about terminals, cables, and wiring.

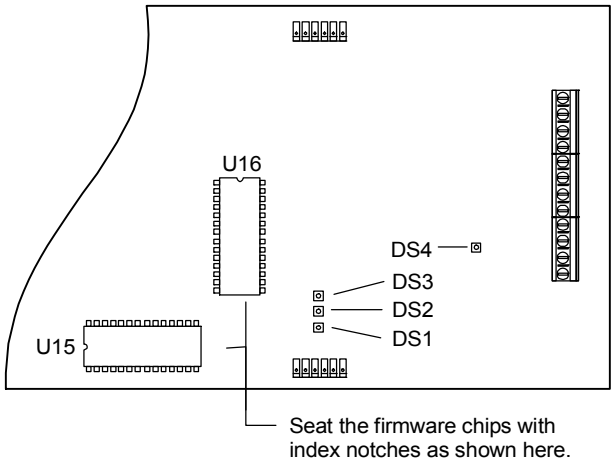


Figure 17: Main Controller Module

Reading MIR2-MCM LEDs

The lower RS-485 LED (Figure 17 and Table 10) should flicker if the RS-485 port circuit has been configured for Class B operation. The lower and upper RS-485 LEDs should flicker if the RS-485 port circuit has been configured for Class A operation.

Table 10: Main Controller Module LEDs

LED	Color	Pattern	Indication
DS1	Green	Flickering	Internal communications normal
DS2	Green	Flickering	RS-485 TX1 active
DS3	Green	Flickering	RS-485 TX0 active
DS4	Green	Flickering	Signature data circuit (SDC) active

Replacing MIR2-MCM firmware chips

Caution: Remove AC and battery power before installing the chip. When handling the chips, observe all anti-static precautions.

The EPROM firmware chips (U15 and U16) may be replaced with upgrade firmware revisions.

To replace U15 and U16:

1. Remove AC and battery power to the Main Controller Module.
2. Ground yourself to prevent electrostatic discharge.

3. Note the position of the index notches on U15 and U16.
4. Remove the old firmware chips.
5. Take the upgrade chips out of the static-protective bag.
6. Seat the upgrade chips with index notches in the same position as the replaced firmware chips.

Substituting Main Controller Modules

You can substitute a dependable MIR2-MCM for a suspect MIR2-MCM, but the substitute MIR2-MCM requires a download from the 2-SDU. The substitute MIR2-MCM does not contain the original map information, which it requires to watch the integrity of the system loop(s). See the 2-SDU Help for complete instructions on uploading and downloading to the MIR2-MCM.

MIR2-LCX Expander Loop Module

Note: See the MIR2-LCX installation sheet for detailed drawings and information about terminals, cables, and wiring.

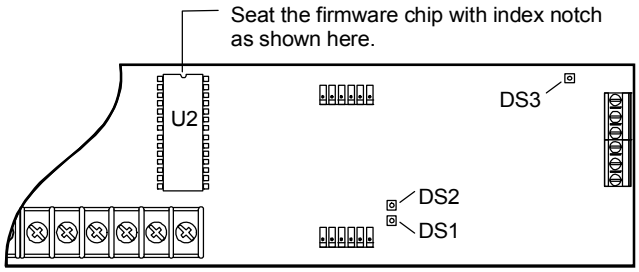


Figure 18: Expander Loop Module

Reading MIR2-LCX LEDs

Table 11: Expander Loop Module LEDs

LED	Color	Pattern	Indication
DS1	Green	Flickering	Internal communications normal (Figure 18)
DS2	Green	Flickering	½ on/off active LED
DS3	Green	Flickering	SDC activity

Replacing MIR2-LCX firmware chips

Caution: Remove AC and battery power before installing the chip. When handling the chips, observe all anti-static precautions.

The EPROM firmware chip (U2) may be replaced with upgrade firmware revisions.

To replace U2:

1. Remove AC and battery power to the Expander Loop Module.
2. Ground yourself to prevent electrostatic discharge.
3. Note the position of the index notch on U2.
4. Remove the old firmware chip.
5. Take the upgrade chip out of the static-protective bag.
6. Seat the upgrade chip with index notch in the same position as the replaced firmware chip.

Substituting the Expander Loop Module

You can substitute a dependable MIR2-LCX for a suspect MIR2-LCX, but the substitute MIR2-LCX requires a download from the 2-SDU. The substitute MIR2-LCX does not contain the original map information, which it requires to watch the integrity of the system loop(s). See the 2-SDU Help for complete instructions on uploading and downloading to the MIR2-LCX.

Table 12: MIR2-MCM/MIR2-LCX problems

Problem	Causes
NAC open	Incorrect or missing EOL resistor Miswired circuit or intermittent connections Broken conductor
NAC shorted	A polarized device reversed on the circuit A defective notification appliance A miswired circuit
NAC ground fault	A pinched wire between device and electrical box Nicked wire insulation
SDC open	Miswired circuit Defective base Broken conductor Device not installed on the circuit Class A configuration: circuit open
SDC shorted and the protection relay keeps on cycling	Miswired circuit Defective base Nicked insulation Class A or B: circuit shorted
SDC ground fault	Pinched wire Nicked insulation Class A: one or both of the two circuits has a fault

Table 12: MIR2-MCM/MIR2-LCX problems

Problem	Causes
RS-232 port inoperative (MIR2-MCM only)	TXD and RXD wires reversed Improper baud rate on the peripheral device Off-line or improperly configured peripheral device
RS-485 port inoperative (MIR2-MCM only)	Positive and negative wires reversed Improper circuit termination Crossed channel 0 and Channel 1 circuits Improper wire type

2-LCD Display Module

Note: See the 2-LCD installation sheet for detailed drawings and information about terminals, cables, and wiring.

Table 13: 2-LCD problems

Problem	Causes
The Power LED is off, no characters appear on the display, and the switches do not work.	No power to the panel Loose or defective ribbon cable between the MIR2-MCM and the MIR-PPS(/6A) Loose or defective ribbon cable between the 2-LCD and the MIR2-MCM Defective 2-LCD Defective MIR2-MCM

LED/Switch Modules

Note: See the LED/Switch module installation sheet for detailed drawings and information about terminals, cables, and wiring.

Table 14: LED/switch module problems

Problem	Possible Causes
The module LEDs, the module switches, and the 2-LCD are inoperative.	No power to the panel Loose or defective ribbon cable between the MIR2-MCM and the MIR-PPS(/6A) Loose or defective ribbon cable between the 2-LCD and the MIR2-MCM Loose or defective ribbon cable between the 2-LCD and the LED/Switch modules Defective 2-LCD Defective MIR2-MCM

Table 14: LED/switch module problems

Problem	Possible Causes
The 2-LCD works, but the LED/Switch modules do not work.	Loose or defective ribbon cable between the 2-LCD and the LED/Switch modules Incorrect setting of the module address switch LED/switch module(s) not defined in the 2-SDU Defective LED/switch module
Module 1 acts like module 2 and module 2 acts like module 1.	Module 1's address switches were set to the module 2's address. Module 2's address switches were set to the module 1's address.

2-DACT Dialer

Note: See the 2-DACT installation sheet for detailed drawings and information about terminals, cables, and wiring.

Verify the following for the 2-DACT:

CMS: central monitoring station

- Incoming receiver phone numbers for the CMS
- Site ID (account) codes
- Proper entry of all information into the dialer

Verify the designed settings stored in your project file. If these are correct, compare the designed settings with the actual settings in the 2-DACT.

To verify information:

1. Start the 2-SDU and open the correct project.
2. Click Tools > Dialer Configuration to start the 2-DCU.
3. Verify the designed settings shown in the 2-DCU window, or click Report > Configuration to view the Configuration Report.
4. Press the Disable button on the 2-DACT to enable communication.
5. Click Communication > Read from DACT to upload the actual settings from the 2-DACT.

   The 2-DCU automatically displays the DACT Difference Report, which highlights differences between the designed and actual settings.

Table 15: 2-DACT Dialer trouble conditions

Problem	Possible Causes
Dialer not communicating with the CMS	Incorrect phone numbers entered in the dialer Incorrect site ID (account) numbers entered in the dialer MIR2-MCM not configured for dialer Long distance prefix (1) not entered in phone number* Incompatible receiver *The long distance prefix is not always required.
Garbage signal received at the CMS	Incorrect protocol selected at receiver Defective dialer module
Telephone line problems	Loop start line not furnished Line wired through PBX board Line voltage less than 10 VDC T-tap on phone line before RJ31X jack Dialer not wired to seize line upon operation

CDR-3 Coder

Note: See the CDR-3 installation sheet for detailed drawings and information about terminals, cables, and wiring.

The Coder trouble contacts close approximately 3 minutes after a CPU failure or a loss of RS-232 communications. The temporal output on TB1-1 and 2 delivers a continuous tone. Table 16 lists the CDR-3 LEDs and the their indications.

Table 16: CDR-3 LED Indications

LED	Color	Description
D1	Red	Bell code relay active
D2	Red	Temporal relay active
D3	Red	Duration relay active
D5	Yellow	Module trouble
D8	Green	Power on

2-AAC Audio Controller Module

Note: See the 2-AAC installation sheet for detailed drawings and information about terminals, cables, and wiring.

Table 17 lists the 2-AAC fault messages that may appear on the 2-LCD.

Table 17: 2-AAC troubles

Problem Link	Possible Causes
4110: 2-AAC pre-amp Ch 1 output	Pre-amp output wiring open, shorted, or incorrect Incorrect or missing EOL resistor
4111: 2-AAC pre-amp Ch 2 output	Pre-amp output wiring open, shorted, or incorrect Incorrect or missing EOL resistor
4114: Channel 1 is not functioning properly.	Incorrect output wiring Incorrect or missing EOL resistor Incorrect setting of dip switches S1 or S2 Incorrect programming of Ch 1
4115: Channel 2 is not functioning properly.	Incorrect output wiring Incorrect or missing EOL resistor Incorrect setting of dip switches S3 or S4 Incorrect programming of Ch 2
4197: The 2-AAC is unresponsive. DS1 is not flashing	Incorrect RS-485 wiring at TB1 Incorrect database definition for the 2-AAC* Power/data cable on J2 loose *Program the 2-AAC as an audio panel at address 41.
Auxiliary 1 input not functioning properly	Incorrect programming for output 4119 Auxiliary source level too low (below 1 VRMS) Incorrect wiring at the auxiliary input (TB4)
Auxiliary 2 input not functioning properly	Incorrect programming of output 4121 Auxiliary source level too low (below 1 VRMS) Incorrect wiring at the auxiliary input (TB4)
Incorrect EVAC and Alert tones	Incorrect setting of switches S1 or S3 EVAC and Alert input or output wiring switched
No pre-announce tone	Dip switches S2 and/or S4 not set to mode 4
The supervisory tone pulses when the system is inactive, and does not detect missing EOL resistors.	Dip switches S2 and/or S4 set to mode 5
Low output level	Driving in excess of 15 amplifiers per channel Short on riser wiring or incorrect EOL value

2-MIC Microphone

Note: See the 2-MIC installation sheet for detailed drawings and information about terminals, cables, and wiring.

The 2-MIC requires the 2-AAC for operation. Table 18 lists the possible causes of a 4112 error on the 2-LCD.

Table 18: 2-MIC troubles

Problem	Causes
4112: 2-MIC trouble	Loose or defective ribbon cable* Loose or open microphone connection to J2 Defective 2-MIC Paging switch pressed in standby condition Incorrect setting of mode 6 on the 2-AAC *Check J1 on the 2-MIC and J1 on the 2-AAC.

2-TEL Firefighter Telephone

Note: See the 2-TEL installation sheet for detailed drawings and information about terminals, cables, and wiring.

Table 19: 2-TEL problems

Problem	Causes
4113: 2-TEL trouble	Improper seating of the 2-TEL option board on the 2-AAC Loose or defective modular cable* Defective 2-TEL Defective 2-TEL option board Open telephone riser wiring Missing or wrong value EOL resistor on telephone riser Incorrect setting of phone supervision jumper *Check the RJ45 connector on the 2-TEL and J2 on the 2-TEL option board.

SIGA-AAXX amplifiers

Note: See the SIGA-AAXX installation sheet for detailed drawings and information about terminals, cables, and wiring.

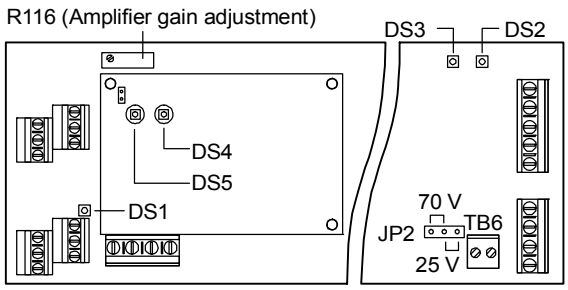


Figure 19: SIGA-AA30 or SIGA-AA50 Audio Amplifier

Reading LEDs

Table 20: SIGA-AAXX LEDs

LED	Color	Pattern	Indication
DS1	Green	Steady	Power amp disabled (Figure 19)
DS2	Yellow	Steady	Backup mode)
DS3	Green	Steady	Amplifier active
DS4	Green	Flashing	Normal communications (daughterboard)
DS5	Red	Flashing	Active condition (daughterboard)

Adjusting amplifier gain

To adjust the amplifier gain:

1. Connect the amplifier to the speaker load.
2. Connect 1 VRMS, 1 kHz tone to the amplifier input.
3. Set JP2 for 25 VRMS or 70 VRMS.
4. Adjust R116 to 25 VRMS or 70 VRMS (Figure 19).

If you use an oscilloscope to adjust levels, set it to the following peak-to-peak voltage levels:

- 25 VRMS: 71 VPP
- 70 VRMS: 200 VPP

Note: The amplifier must be connected to a load to adjust it for the proper gain. If the actual speaker circuit cannot be used, use Table 21 to construct a dummy load. The wattage rating of the dummy load must exceed the output power rating of the amplifier.

Caution: Do not operate the amplifier with the speaker circuit and the dummy load connected at the same time.

Table 21: Amplifier Dummy Load Values

Output Power	25 VRMS Output	70 VRMS Output
30 Watts	20.8 Ω @ 30W	163.3 Ω @ 30 W
50 Watts	12.5 Ω @ 50W	98.0 Ω @ 50 W

To keep the amplifier out of trouble during the gain adjustment:

1. Connect a 47 kΩ EOL resistor across the NAC B output.

2. Connect the dummy load to the NAC A output.

Troubleshooting the amplifiers

Table 22 lists some common problems on the SIGA-AAXX amplifiers and provides some of the causes.

Table 22: Audio amplifier troubleshooting

Problem	Causes
No output	24 VDC power or input signal missing Incorrect wiring of output circuits Improper seating of Daughterboard Incorrect database definition for the amplifier In backup mode with backup amplifier/wiring problem Incorrectly programming of branch circuits Inoperative branch circuit control modules
Backup 1 kHz tone sounding	Incorrect or missing input wiring
Low output	70 VRMS speakers with 25 VRMS jumper setting Overloaded circuit* Gain setting on R116 too low *Too many GSA-CC1s and GSA-CC2s will cause the amplifier to shut down.

Remote alphanumeric annunciators

Note: See the applicable installation sheets of the remote alphanumeric annunciators for detailed drawings and information about terminals, cables, and wiring.

The remote alphanumeric annunciators include the following models:

- 2-LCDA(-C)
- 2-SLCDA(-C)
- 2-LSRA-MIR(-C)

Troubleshooting remote alphanumeric annunciators

Table 23 lists problems common to all of the remote alphanumeric annunciators. The table also lists problems unique to each class of annunciator.

Table 23: Remote alphanumeric annunciator problems

Common problems	Possible causes
Point is displayed without a message	No message for the point in the database Routing set to all messages
No message when change of state initiated	Incorrect setting of the display filter
Incorrect header type but correct message	Wrong type selected for message
LCD display's internal database corrupted	Download process interrupted
2-LCDA(-C) and 2-SLCDA(-C)	Possible cause(s)
Display indicates a fault at the control panel	Mismatched baud rate Faulty connection Improper wiring
Front panel switches inoperative	Key switch in disable position Improper programming of the key switch filter
2-LSRA-MIR(-C)	Possible cause(s)
Garbled characters on the display	Mismatched baud rate
Front panel switches inoperative	Key switch in disable position Improper programming of the key switch filter Password not entered

Printers

MIR-PRT/S(-220) form printer

Note: See the Okidata printer handbook, for detailed technical information about the MIR-PRT/S(-220). The handbook comes with the printer. See the MIR2-MCM installation sheet for wiring the form printer to the Main Controller Module.

RANN-PRT strip printer

Note: See the RANN-PRT (Strip Printer) installation sheet for detailed drawings and information about terminals, cables, FCOM cards, jumper settings, and wiring.

Table 24: Strip printer problems

Problem	Possible causes
Gibberish from printer	Printer baud rate does not match the source's baud rate Printer not defined as a strip printer in the 2-SDU Paper jammed in the printer
Printer not working at all	Printer out of paper 24 VDC off FCOM card incorrectly installed/wired FCOM jumpers incorrectly set
Paper Out LED on	Out of paper Paper Out sensor out of adjustment
Trouble LED on	Internal printer trouble Trouble on a printer downline Trouble on a communications circuit
Light printing	Old ribbon
Paper take-up reel inoperative	Take-up reel On/Off switch (top of take-up reel frame) in the off position

Cleaning detectors

Signature Series detectors require periodic cleaning to ensure reliable performance. The Detector Cleaning Tool, with a conventional vacuum cleaner, provides the means for cleaning the detectors. The tool creates a high velocity vortex scrubbing action around the detector to remove loose dust and debris.

Caution: Disable the detector before you clean it to avoid false alarms.

To clean a Signature Series detector:

1. At the 2-LCD, disable the detector to prevent false alarms.
2. Vacuum cobwebs and other loose objects from the immediate area of the detector.
3. Install the Detector Cleaning Tool on the vacuum hose (Figure 20).
4. Place the Detector Cleaning Tool over the detector head for approximately 1 minute.
5. When the detector is clean, restore it to proper operation.
6. At the 2-LCD, check the detector's sensitivity to verify that it is clean.

Note: See the *System Operations Manual* for instructions on checking detectors sensitivity level.

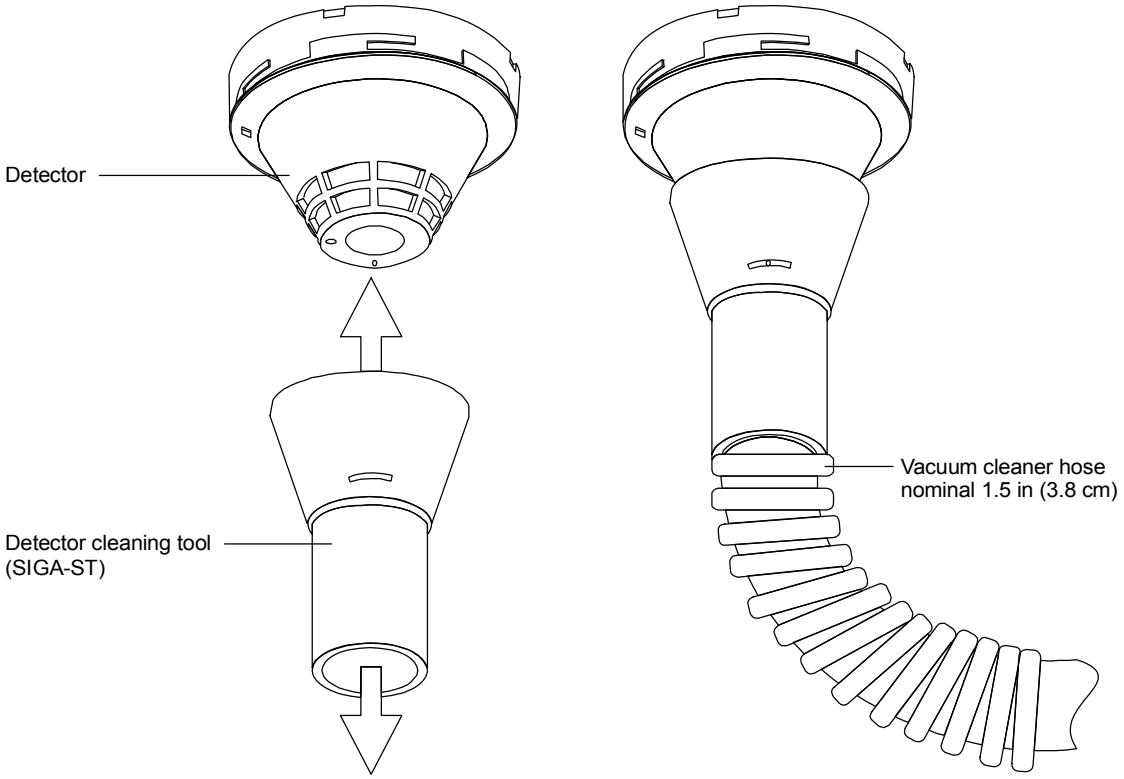


Figure 20: Detector cleaning tool

Fire alarm trouble and maintenance log

Date	Time	Event	Initials

Chapter 5
Isolating trouble conditions

Summary

Sometimes, quick reference tables can only lead you to the general location of a system problem. From there, you have to isolate and locate the cause of the problem. In order to isolate difficult problems, you need to have a systematic approach to troubleshooting long runs of wire. You also need to know how the Signature Series devices behave and how they map under certain conditions.

Content

Isolating device faults

Methods for isolating Signature device faults differ according to the problem. Still, some tools may prove helpful in many situations. An accurate and complete wiring diagram of the Signature data circuit (SDC) will prove useful in all circumstances. The 2-SDU features a mapping tool, which provides valuable information about the condition of each circuit and its devices. You can read about the mapping tool in the 2-SDU help. Your own documentation is another useful tool. Document your maintenance activities and make the records available. If you know the last thing that happened to a device or the system, you may not have to spend a lot of time isolating a problem.

Isolating open circuits

The most common electrical problems with fire alarm systems are open circuits, short circuits, and ground faults (Figure 22). An open circuit disrupts communications on the SDC. Consequently, the 2-LCD will report an open circuit as a communications fault (Figure 21).

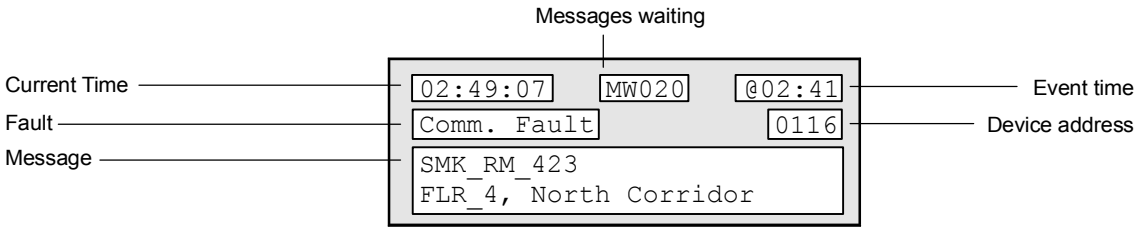


Figure 21: 2-LCD message for an open condition

In a trouble-free SDC, all devices are properly:

- Wired
- Installed
- Programmed
- Maintained

An open on the SDC may indicate:

- A break in the line
- A missing connection
- A loose connection
- A programming error
- A poorly seated detector
- An improper device

A short on the SDC may indicate:

- Reversed wiring
- A defective device
- A faulty wire

A ground fault on the SDC may indicate that the circuit has:

- Multiple ground references
- Nicked wiring
- Pinched wiring
- Mixed wiring types

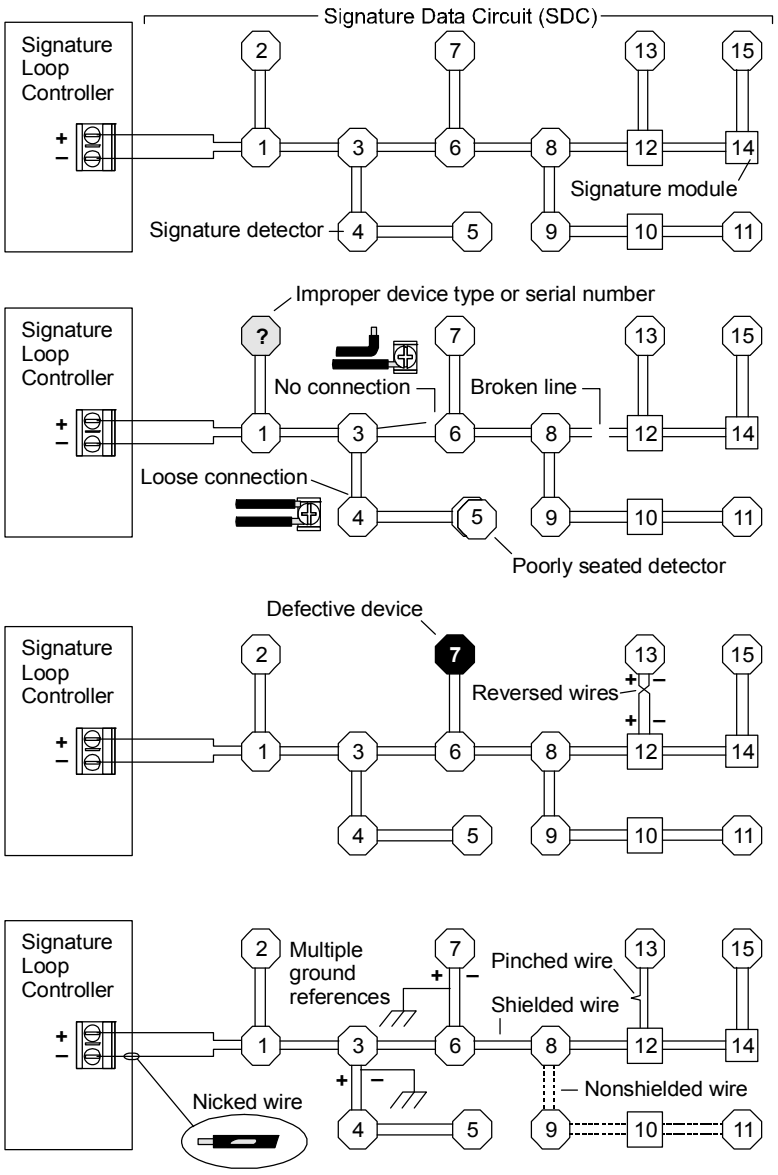


Figure 22: SDC problems

To isolate an open circuit:

1. Read the fault message at the 2-LCD to find out which devices are not communicating.
2. If your company has a maintenance log, check it for any work recently performed on or around the suspect device.
3. Go to the device and examine it for the potential problems of an open condition.
4. Check the device's LEDs for communications activity.

5. Check the serial number of the device against the serial number entered in the *Serial Number Log Book*.
6. Check the 2-SDU for other programming information about the device to see if it matches the one in trouble.

Isolating short circuits

The 2-LCD reports a short circuit as a device/line fault because it may arise from a problem with the line or the device (Figure 23).

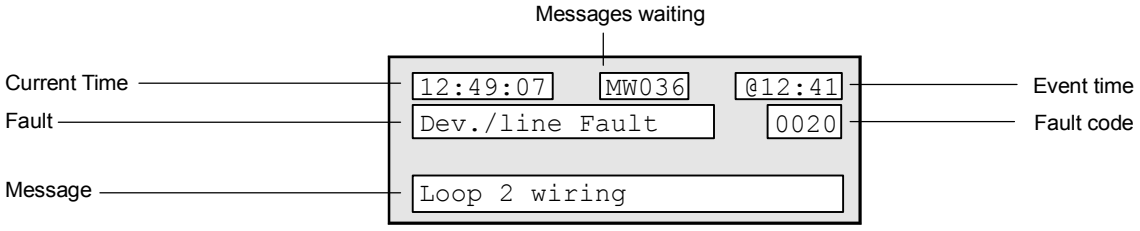


Figure 23: 2-LCD message for a short circuit

The 2-LCD also reports communications faults for every device on the SDC. Listen for the constant clicking of a relay on the primary power supply, which frequently accompanies a short circuit.

Isolating a short circuit requires more patience than isolating an open circuit. The 2-LCD provides indications of a short circuit, but you may have to isolate portions of the circuit to find the cause.

To isolate a short circuit:

1. Look for a device/line fault and several communication faults on the 2-LCD.
2. Listen for a clicking relay at the Primary Power Supply.
3. If your company has a maintenance log, check it for any work recently performed on or around the suspect device.
4. Isolate portions of the SDC to locate the cause (Figure 24).
5. Investigate the problem area for potential wiring or device faults.

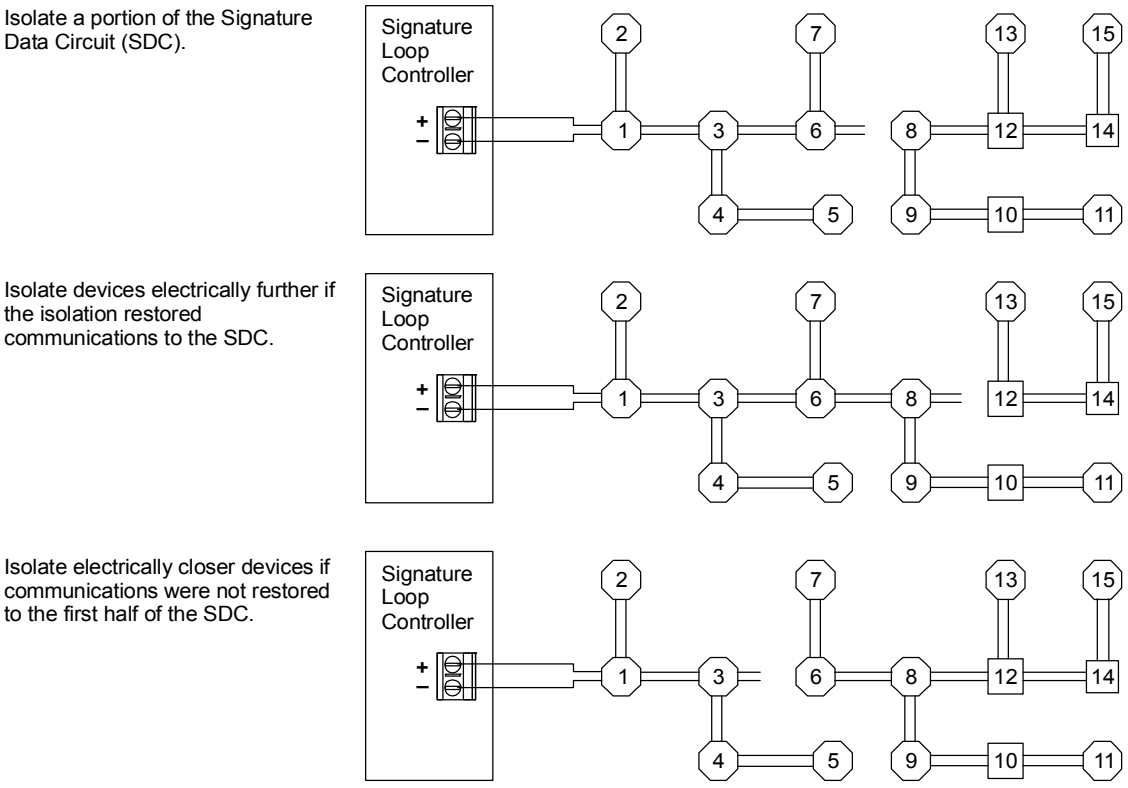


Figure 24: Typical isolation procedure

Isolating ground faults

A ground fault occurs when a device or a line has more than one ground reference. The 2-LCD indicates a ground fault condition for the system and communication faults for every device on the affected SDC (Figure 25).

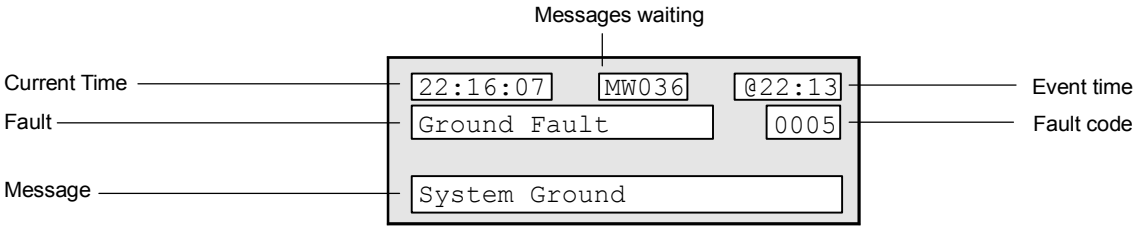


Figure 25: 2-LCD message for a ground fault

As with short circuits, the cause of a ground fault may prove elusive. The isolation procedure for short circuits also applies to ground faults.

To isolate a ground fault:

1. Look for a ground fault and several communication faults on the 2-LCD.
2. If your company has a maintenance log, check it for any work recently performed on or around the suspect device.
3. Isolate portions of the SDC to locate the cause (Figure 24).
4. Investigate the problem area for potential wiring or device faults.

Signature device problems

Signature device LEDs

Signature Series detectors and modules feature LEDs that indicate the status of the device. Table 25 provides a description for each LED color and pattern.

Table 25: Signature device LEDs

LED	Device status
Green flashing	Normal communications
No flashing	No communications
Red flashing	Alarm/Active(either input of dual input modules)
Red and green steady	Standalone Alarm/Active (either input of dual input modules)

Detectors

Incorrect response

A detector may exhibit an incorrect response for the following reasons:

- Incorrect detector address
- Detector not in database
- Incorrect programming of device responses

Trouble condition

A detector may cause a trouble condition for the following reasons:

- Missing or incorrectly wired
- Not in the database
- Ground fault
- Internal fault

Nuisance alarms

A detector may cause nuisance alarms or active conditions under the following conditions:

- Extremely high airflow*
- High ambient smoke
- Defective detector

*High airflow affects ionization detectors.

Modules

Incorrect response

A module may exhibit an incorrect response for the following reasons:

- Wrong location
- Incorrect address
- Missing from the database
- Wrong personality code
- Ground fault on the SDC or negative side of the input/output
- Personality code other than 0 assigned to unused addresses*
- Wrong setting of jumper on dual channel modules*
- 24 VDC for smoke power low or missing*
- Swapped inputs*

Note: *This condition may only affect certain personality codes. See the module installation sheet for specific requirements.

Trouble condition

A module may cause a trouble condition on the host controller under the following circumstances

- Wrong location
- Incorrect address
- Missing from the database
- Ground fault on the SDC or negative side of the input/output
- Output circuit open, short, or incorrectly wired
- Polarized device installed in reverse

Note: An incorrect or missing EOL will also cause some modules to indicate a trouble condition to the host controller. See the module installation sheet for specific requirements.

Nuisance alarm

A module may cause nuisance alarms or active conditions if the:

- Initiating device has a short circuit
- Initiating device was installed wrong
- EOL resistor value is too low

Mapping errors

Several things may cause mapping errors. Figure 26 shows how the 2-LCD displays a mapping error.

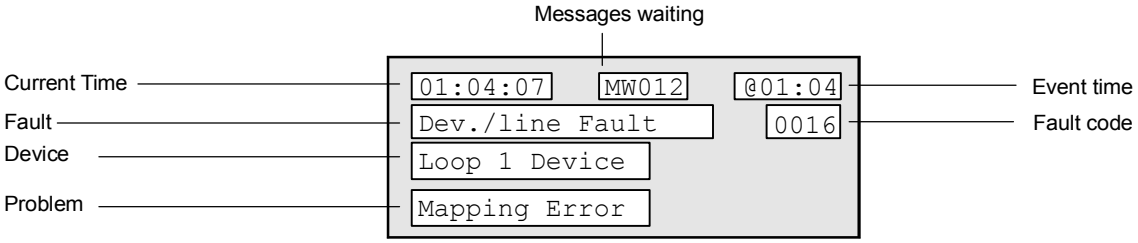


Figure 26: 2-LCD message for a mapping error

To isolate a mapping error:

1. Read the mapping error message on the 2-LCD to determine which loop and device has the mapping error.
2. Check the maintenance log for any work recently performed on the device or panel.
3. Go to the suspect device and examine it for the potential problems of a mapping error.
4. Check the device's LEDs for communications activity.
5. Check the serial number of the device against the serial number entered in the *Serial Number Log Book*.
6. Check the 2-SDU for other programming information about the device to see if it matches the one in trouble.

Table 26: Mapping errors

Problem	Causes
Mapping error	Conflicts between actual and expected data* Loose or defective ribbon cable** Device ID entered incorrectly into database More than 63 T-taps on an SDC Excessive circuit resistance Excessive circuit capacitance *The MIR2-MCM's internal map does not reflect the devices actually installed on the SDC (serial number, personality code, or device type). **Check J5 on the MIR2-MCM and J3 on the MIR2-LCX.
System continues to re-map data circuit	An intermittent connection* A defective device or detector base *The intermittent connection will cause one or more devices to loose then re-establish communication with the MIR2-LCX.

Table 26: Mapping errors

Problem	Causes
Device type error	A discrepancy between the device type recorded on the MIR2-MCM or MIR2-LCX internal map and the device installed on the SDC

Appendix A
Calculations

Summary

If you are designing or installing an MIR2 system, you need some formulas and specifications for the job. This appendix provides formulas for determining maximum wire lengths and battery capacities.

Content

Calculating wire lengths for Signature data circuits

Circuit resistance and capacitance determines the maximum length of a Signature data circuit. Circuit resistance affects the wire length of the longest circuit branch. Circuit capacitance affects the total amount of wire that can be used on the circuit.

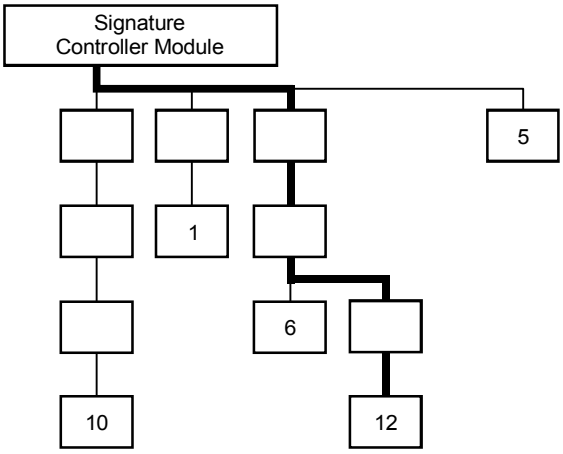
Notes

The design of the Signature data circuit must not exceed either of the two measurements.

There are no restrictions placed on the wiring used for the Signature data circuit. Longer wire runs may be obtained using standard (non-twisted, non-shielded) wire pairs.

Determining the maximum allowable branch length

The maximum branch length is the wire distance measured from the Signature controller module to the last device on the longest circuit path as shown below.



Several factors influence the maximum allowable branch length:

- Wire gauge and type
- Number of Signature detectors and modules installed on the branch
- Number of GSA-UMs configured for 2-wire smoke detectors installed on the branch

Table 27 through Table 30 provide the maximum allowable branch length for any detector, module, GSA-UM, and wire gauge combination. Using the wire distances specified in the tables ensures that the circuit does not exceed the maximum circuit resistance of the Signature data circuit.

Note: To calculate the wire distance with respect to circuit resistance, the tables assume that the circuit is end-loaded (all devices are clustered more towards the end of the circuit) and the circuit uses standard, non-shielded wire.

To determine the maximum allowable length of a Signature data circuit branch:

1. Identify the device located farthest from the Signature controller.
2. Determine the number of Signature detectors, modules, and GSA-UMs configured for 2-wire smokes that lie on the same conductive path between the device identified in step 1 and the Signature controller.
3. Calculate the number of detector and module addresses. Some Signature modules require two addresses.
4. Determine the size of the wire used to construct the circuit.
5. Find the maximum allowable wire distance for the longest branch in the lookup tables as follows:

If no GSA-UMs are installed, use Table 27.

If 1–5 GSA-UMs are installed, use Table 28.

If 6–10 GSA-UMs are installed, use Table 29.

If 11–15 GSA-UMs are installed, use Table 30.

Caution: Install no more than 15 SIGA-UMs (or SIGA-MABs) on each SDC. The addition of a SIGA-IM to the SDC will reduce the maximum to 7 modules.

Table 27: Maximum branch length [1] without GSA-UMs configured for 2-wire smokes

Signature detector addresses	Signature module addresses	18 AWG		16 AWG		14 AWG	
		ft	m	ft	m	ft	m
1–25	0	7437	2267	11815	3601	13157	4010
26–50	0	7038	2145	11180	3408	13157	4010
51–75	0	6638	2023	10545	3214	13157	4010
76–96	0	6302	1921	10012	3052	13157	4010
0	1–25	7267	2215	11544	3519	13157	4010
1–25	1–25	6867	2093	10909	3325	13157	4010
26–50	1–25	6467	1971	10275	3132	13157	4010
51–75	1–25	6068	1849	9640	2938	13157	4010
76–96	1–25	5732	1747	9106	2776	13157	4010
0	26–50	6697	2041	10639	3243	13157	4010
1–25	26–50	6297	1919	10004	3049	13157	4010
26–50	26–50	5897	1798	9369	2856	13157	4010
51–75	26–50	5498	1676	8734	2662	13157	4010
76–96	26–50	5162	1593	8200	2499	13043	3975
0	51–75	5906	1800	9383	2860	13157	4010
1–25	51–75	5250	1600	8340	2542	13157	4010
26–50	51–75	4633	1412	7360	2243	11707	3568
51–75	51–75	4051	1235	6435	1961	10235	3120
76–96	51–75	3585	1093	5695	1736	9058	2761
0	76–94	4323	1318	6867	2093	10923	3329
1–25	76–94	3774	1150	5995	1827	9536	2906
26–50	76–94	3249	990	5162	1573	8210	2503
51–75	76–94	2747	837	4364	1330	6940	2115
76–96	76–94	2340	713	3717	1133	5913	1802

[1] Maximum allowable wire distance using non-twisted, non-shielded wire pairs

Table 28: Maximum branch length [1] with 1–5 GSA-UMs configured for 2-wire smokes

Signature detector addresses	Signature module addresses	18 AWG		16 AWG		14 AWG	
		ft	m	ft	m	ft	m
1–25	0	6778	2066	10768	3282	13157	4010
26–50	0	6131	1869	9741	2969	13157	4010
51–75	0	5501	1677	8739	2664	13157	4010
76–96	0	4982	1519	7915	2413	12589	3837
0	1–25	5353	1632	8504	2592	13157	4010
1–25	1–25	4720	1439	7498	2286	11926	3635
26–50	1–25	4100	1250	6513	1985	10359	3157
51–75	1–25	3491	1064	5546	1691	8821	2689
76–96	1–25	2988	911	4748	1447	7551	2302
0	26–50	3776	1151	5999	1829	9542	2908
1–25	26–50	3153	961	5009	1527	7966	2428
26–50	26–50	2539	774	4034	1230	6416	1956
51–75	26–50	1935	590	3075	937	4890	1491
76–96	26–50	1435	437	2280	695	3626	1105
0	51–75	2491	759	3957	1206	6293	1918
1–25	51–75	1868	569	2967	904	4720	1439
26–50	51–75	1254	382	1992	607	3168	966
51–75	51–75	648	198	1030	314	1638	499
76–96	51–75	145	44	231	70	368	112
0	76–84	2076	633	3298	1005	5245	1599
1–25	76–84	1453	443	2308	703	3670	1119
26–50	76–84	837	255	1330	405	2116	645
51–75	76–84	230	70	366	111	582	177
76–84	76–84	13	4	21	7	34	10

[1] Maximum allowable wire distance using non-twisted, non-shielded wire pairs

Table 29: Maximum branch length [1] with 6–10 GSA-UMs configured for 2-wire smokes

Signature detector addresses	Signature module addresses	18 AWG		16 AWG		14 AWG	
		ft	m	ft	m	ft	m
1–25	0	5045	1538	8015	2443	12748	3886
26–50	0	4494	1370	7139	2176	11355	3461
51–75	0	3950	1204	6275	1913	9981	3042
76–96	0	3499	1066	5559	1694	8841	2695
0	1–25	4106	1252	6523	1988	10375	3162
1–25	1–25	3542	1080	5627	1715	8950	2728
26–50	1–25	2985	910	4742	1445	7542	2299
51–75	1–25	2435	742	3868	1179	6152	1875
76–96	1–25	1978	603	3142	958	4997	1523
0	26–50	2869	874	4557	1389	7248	2209
1–25	26–50	2296	700	3648	1112	5802	1768
26–50	26–50	1730	527	2749	838	4372	1332
51–75	26–50	1170	357	1859	567	2957	901
76–96	26–50	705	215	1120	341	1781	543
0	51–74	1836	560	2917	889	4639	1414
1–25	51–74	1255	382	1993	608	3171	966
26–50	51–74	680	207	1080	329	1717	523
51–75	51–74	110	34	175	53	279	85
76–79	51–74	20	6	31	10	50	15

Maximum allowable wire distance using non-twisted, non-shielded wire pairs

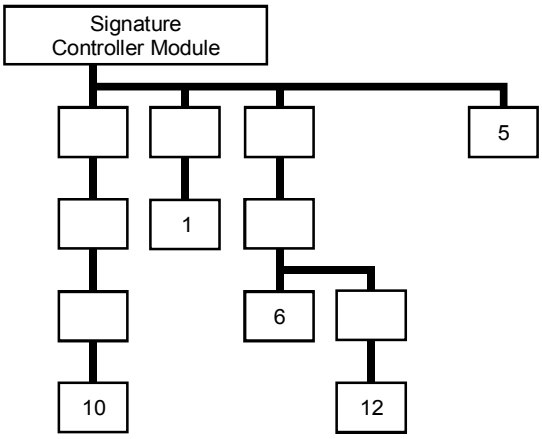
Table 30: Maximum branch length [1] with 11–15 GSA-UMs configured for 2-wire smokes

Signature detector addresses	Signature module addresses	18 AWG		16 AWG		14 AWG	
		ft	m	ft	m	ft	m
1–25	0	3931	1198	6245	1903	9932	3027
26–50	0	3427	1045	5444	1659	8659	2639
51–75	0	2928	892	4651	1418	7397	2255
76–96	0	2511	765	3989	1216	6345	1934
0	1–25	3247	990	5158	1572	8204	2501
1–25	1–25	2722	830	4324	1318	6878	2096
26–50	1–25	2202	671	3498	1066	5563	1696
51–75	1–25	1686	514	2678	816	4259	1298
76–96	1–25	1256	383	1995	608	3173	967
0	26–50	2204	672	3502	1067	5570	1698
1–25	26–50	1664	507	2644	806	4205	1282
26–50	26–50	1129	344	1793	547	2852	869
51–75	26–50	598	182	950	289	1511	460
76–96	26–50	155	47	246	75	392	119
0	51–64	1667	508	2648	807	4212	1284
1–25	51–64	1119	341	1778	542	2828	862
26–50	51–64	576	176	915	279	1456	444
51–75	51–64	37	11	59	18	94	29
76	51–64	16	5	25	8	40	12

[1] Maximum allowable wire distance using non-twisted, non-shielded wire pairs

Determining the total loop length

The total loop length equals the sum length of all the wire segments installed in the data circuit.



The total length of all the cable installed in the Signature data circuit can not exceed the values listed below:

Wire type	14 AWG		16 AWG		18 AWG	
	ft	m	ft	m	ft	m
Twisted pair	13,157	4,010	13,888	4,233	20,000	6,096
Twisted-shielded pair	5,952	1,814	6,098	1,859	8,621	2,628
Non-twisted, non-shielded pair	20,000	6,096	20,000	6,096	20,000	6,096

If the cable manufacturer's data indicates the capacitance per foot of the cable, use Equation 1 to determine the maximum total loop length.

Note: In no case may the total loop length of a Signature data circuit exceed 20,000 feet (6,096 meters).

Equation 1: $Lmax = 500{,}000 / Ccab$

Where:

Lmax = Maximum total cable length in feet

Ccab = Cable capacitance in picofarads per foot

Note: Install Isolator modules at strategic points in the Signature data circuit to limit the effect of an electrical short.

Calculating wire lengths for 24 VDC NACs

Introduction

This topic shows you how to determine the maximum cable length of a notification appliance circuit (NAC) for a given number of appliances.

Two methods are presented: worksheet and equation. The worksheet method is simpler, but your installation must meet the criteria listed on the worksheet. If your installation does not meet these criteria, you need to use the equation method.

The methods given here determine cable lengths that work under all operating conditions. The calculations ensure that the required operating voltage and current will be supplied to all notification appliances. To do this, we assume these two worst-case conditions:

- The voltage at the NAC terminals is the minimum provided by the power supply
- The notification appliances are clustered at the end of the NAC cable

Other, more detailed methods that distribute the appliance load along the NAC cable may indicate that longer cable runs are possible.

What you'll need

Appliance and cable values

Whether you use the worksheet method or the equation method, you'll need to know:

- The minimum operating voltage required for the appliances
- The maximum operating current drawn by each appliance
- The resistance per unit length of the wire used (Ω/ft)

This information can be found on the appliance installation sheets and on the cable specification sheet.

Power supply values

For either method, you'll need some fixed or calculated operating values for your specific power supply. The fixed values are:

- Maximum voltage = 27.1 V
- Source voltage = 20.4 V
- Load factor = 0.17 V/A
- Power type = DC

The *maximum voltage* is the highest voltage measured at the NAC terminals. This value is not used in the calculations, but is given so you can ensure appliance compatibility.

The *source voltage* is the theoretical operating minimum for the power supply, and is calculated as 85% of 24 volts.

The *load factor* is a measure of how the power supply voltage reacts when a load is applied. The load factor measures the voltage drop per ampere of current drawn by the load.

The *power type* reflects the type of power supplied to the NAC terminals at minimum voltage. The current draw of notification appliances can vary substantially with the type of power supplied: full-wave rectified (VFWR) or direct current (VDC). It is important to know the power type at minimum terminal voltage.

You'll need to calculate the following values relating to your power supply and to the NAC circuit current. These are:

- Minimum voltage
- Voltage drop

The *minimum voltage* is the lowest voltage measured at the NAC terminals when the power supply is under the maximum load for that circuit (i.e. for the appliances that constitute the NAC.)

The *voltage drop* is the difference between the minimum voltage and 16 V. This value is for use with the worksheet only.

Worksheet method

Use this worksheet to determine the maximum cable length of a notification appliance circuit for a given number of appliances.

Use this worksheet only if all the appliances are regulated. That is, they must have a minimum operating voltage of 16 V. For other appliances, use the "Equation method."

Worksheet 1: NAC cable length

		NAC1	NAC2	NAC3	NAC4	
Total operating current [1]						A
Load factor	×	0.17	0.17	0.17	0.17	V/A
Load voltage drop	=					V
Source voltage		20.4	20.4	20.4	20.4	V
Load voltage drop	−					V
Minimum voltage	=					V
Regulated appliance voltage	−	16.0	16.0	16.0	16.0	V
Voltage drop [2]	=					V
Total operating current	÷					A
Maximum resistance	=					Ω
Wire resistance (Ω/ft) [3]	÷					
Maximum wire length	=					ft
	÷	2	2	2	2	
Maximum cable length	=					ft

[1] Total of the maximum operating currents for all appliances as specified for DC power. See the appliance installation sheets for operating currents.

[2] This voltage drop is valid for regulated notification appliances only. For special application appliances, see "Equation method," later in this topic.

[3] Use the manufacturer's published wire resistance expressed in ohms per foot. For typical values, see Table 31, later in this topic.

Equation method

Appliance operating voltage and current

Regulated notification appliances have an operating range from 16 V to 33 V. Use 16 V as the minimum appliance voltage when using regulated notification appliances.

When using special application appliances, refer to the installation sheets to determine the minimum appliance voltage required.

What if there are different types of appliances in the NAC, and each type has a different minimum operating voltage? In this case, use the *highest* minimum voltage required by any appliance.

The total current requirement for the appliances will be the sum of the individual maximum currents drawn by each appliance when using DC power. Use the maximum current for the appliance over the 16 V to 33 V range.

If all appliances draw the same maximum current, the total current is the maximum current multiplied by the number of appliances. If different appliance types have different maximum currents, the total current is the sum of the maximum current for each appliance type multiplied by the number of appliances of that type.

Wire resistance

Typical wire resistances are shown in the following table.

Table 31: Typical wire resistances

Wire gauge (AWG)	Resistance 1-strand uncoated copper		Resistance 7-strand uncoated copper	
	Ω per foot	Ω per meter	Ω per foot	Ω per meter
12	0.00193	0.00633	0.00198	0.00649
14	0.00307	0.01007	0.00314	0.01030
16	0.00489	0.01604	0.00499	0.01637
18	0.00777	0.02549	0.00795	0.02608

When performing these calculations, always refer to the actual cable supplier documentation and use the actual Ω/ft (or Ω/m) for the cable being used.

Calculating cable length

To calculate the maximum NAC cable length:

1. Calculate the total current (Itot) as the sum of the maximum operating currents for all the appliances.

   Itot = ΣIa

   Where:
   Ia = appliance maximum current

   See the appliance installation sheets for Ia. Remember to use the maximum operating current specified for DC power.

2. Calculate the minimum voltage (Vm).

   Vm = Vs − (Itot × K)

   Where:
   Vs = source voltage
   Itot = total current (from above)
   K = load factor

   For the power supply, Vs is 20.4 V and K is 0.17 V/A.

3. Calculate the allowable voltage drop (Vd) between the power supply and the appliances.

   Vd = Vm − Va

   Where:
   Vm = minimum voltage (from above)
   Va = appliance minimum voltage

   For regulated notification appliances, Va is 16 V. For special application appliances, Va is the lowest operating voltage specified on the appliance installation sheet.

4. Calculate the maximum resistance (Rmax) for the wire.

   Rmax = Vd / Itot

   Where:
   Vd = voltage drop
   Itot = total current

5. Calculate the maximum length of the cable (Lc), based on the maximum resistance allowed, the resistance of the wire, and the number of wires in the cable (two).

   Lc = (Rmax / Rw) / 2

   Where:
   Rmax = maximum resistance
   Rw = wire resistance factor

Example: You're using regulated notification appliances. Assume that the maximum operating current for each appliance

is 100 mA for DC power, and that 20 appliances will be placed on the NAC. The cable is 12 AWG wire, and the manufacturer specifies a wire resistance factor of 0.002 Ω/ft.

Itot = ΣIa
= 20 × 0.1 A
= 2 A

Vm = Vs − (Itot × K)
= 20.4 V − (2 A × 0.17 V/A)
= 20.4 V − 0.34 V
= 20.06 V

Vd = Vm − Va
= 20.06 V − 16.0 V
= 4.06 V

Rmax = Vd / Itot
= 4.06 V / 2.0 A
= 2.03 Ω

Lc = (Rmax / Rw) / 2
= (2.03 Ω / 0.002 Ω/ft) / 2
= (1015 ft) / 2
= 507.5 ft

So the maximum wire run for this NAC would be 507 ft (rounding down for safety).

Calculating wire lengths for 25 or 70 VRMS NACs

The maximum allowable wire length is the greatest distance from the amplifier to the last speaker on the NAC. The wire pair must have no more than 0.5 dB loss over its entire length. Calculating the maximum allowable wire length using this method ensures that each speaker operates at its full potential. Several factors influence the maximum allowable wire length:

- Wire size
- Output signal level of the amplifier driving the circuit
- Number of speakers installed on the circuit

To calculate the maximum allowable wire length for a 0.5 dB loss, use the following formula:

Equation 2: Lmax = (59.25 × Asig **2)/(Rwire × Lcirc)

Where:

Lmax = Maximum length in feet

Asig = Amplifier output signal level in VRMS (supplied by the amplifier driving the circuit)

Rwire = Resistance rating of the wire per in Ω/1000 ft pair (See Table 31 for examples.)

Lcirc = Circuit load: The total wattage required by the audio circuit

For example, the maximum allowable wire length for an audio circuit consisting of one 40 W (25 VRMS) amplifier, thirty 1 W speakers, and 18-gauge wire equals 95 feet.

94.95 = (59.25 × 25**2)/(13 × 30)

Use Table 32 for amplifiers set for 25 VRMS output. Use Table 33 for amplifiers set for a 70 VRMS output.

Table 32: Maximum allowable length at 25 VRMS, 0.5 dB loss

Wire Size	Circuit load requirement											
	15 W		20 W		30 W		40 W		90 W		120 W	
	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
18 AWG (0.75 sq mm)	190	58	142	43	95	29	71	22	Over max current limit		Over max current limit	
16 AWG (1.0 sq mm)	309	94	231	70	154	47	116	35	51	16	39	12
14 AWG (1.5 sq mm)	475	145	356	109	237	72	178	54	79	24	59	18

Table 32: Maximum allowable length at 25 VRMS, 0.5 dB loss

Wire Size	Circuit load requirement											
	15 W		20 W		30 W		40 W		90 W		120 W	
	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
12 AWG (2.5 sq mm)	772	235	579	176	386	118	289	88	129	39	96	29

Table 33: Maximum allowable length at 70 VRMS, 0.5 dB loss

Wire Size	Circuit load requirement											
	15 W		20 W		30 W		40 W		90 W		120 W	
	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
18 AWG (0.75 sq mm)	1489	454	1117	340	744	227	558	170	248	76	186	57
16 AWG (1.0 sq mm)	2420	738	1815	553	1210	369	907	276	403	123	302	92
14 AWG (1.5 sq mm)	3722	1134	2792	851	1861	567	1396	426	620	189	465	142
12 AWG (2.5 sq mm)	6049	1844	4537	1383	3024	922	2268	691	1008	307	756	230

Calculating wire lengths for addressable analog circuits

Table 34 lists the maximum wire distances allowed for addressable analog circuits.

Notes

Maximum wire resistance can not exceed 50 Ω.
Maximum wire capacitance can not exceed 0.05 μF.

Table 34: Maximum allowable wire distance for addressable analog circuits

Wire gauge	Max loop capacitance	Twisted, nonshielded		Twisted, shielded		Nontwisted, nonshielded	
		ft	m	ft	m	ft	m
18	0.01 μF	4000	1219	1724	525	5000	1524
	0.02 μF	8000	2438	3448	1051	10000	3048
	0.03 μF	12000	3658	5172	1576	15000	4572
	0.04 μF	16000	4877	6896	2102	20000	6096
	0.05 μF	20000	6096	8620	2627	25000	7620
16	0.01 μF	2777	846	1219	372	5000	1524
	0.02 μF	5555	1693	2439	743	10000	3048
	0.03 μF	8333	2540	3658	1115	15000	4572
	0.04 μF	11111	3387	4878	1487	20000	6096
	0.05 μF	13888	4233	6097	1858	25000	7620
14	0.01 μF	2631	802	1190	363	5000	1524
	0.02 μF	5263	1604	2380	725	10000	3048
	0.03 μF	7894	2406	3571	1088	15000	4572
	0.04 μF	10526	3208	4761	1451	20000	6096
	0.05 μF	13157	4010	5952	1814	25000	7620

Determining battery capacity requirements

Complete worksheets 1 through 4 in sequence. See the appropriate installation sheets for device currents.

Worksheet 1 instructions

Use Worksheet 1 to calculate the total standby and alarm currents for Signature Series devices. All Signature Series devices are wired to the Signature Data Circuit (SDC) on the Main Controller Module or the Expander Loop Module.

Caution: Install no more than 15 SIGA-UMs (or SIGA-MABs) on each SDC. The addition of a SIGA-IM to the SDC will reduce the maximum to 7 modules.

Worksheet 2 instructions

Use Worksheet 2 to calculate the total standby and alarm currents for devices remote to the fire alarm control panel.

Worksheet 3 instructions

Use Worksheet 3 to calculate the total standby and alarm currents for system components in the fire alarm control panel. This includes modules powered by the panel's primary power supply or devices wired to the Signature loop controller's:

- RS-485 terminals
- RS-232 terminals
- Relay contacts

Remember to enter the totals from Worksheet 1 and Worksheet 2 in the provided space on Worksheet 3.

Worksheet 4 instructions

Use Worksheet 4 to calculate the ampere-hour (Ah) requirement for your system. Worksheet 4 requires the total standby and the total alarm currents from Worksheet 3.

Caution: Maximum battery capacity must not exceed 26 Ah! The batteries must also sustain the system for five minutes under full alarm conditions.

Worksheet 1: Signature Series devices								**Page____**
Device			**Standby current (mA)**			**Alarm current (mA)**		
Type	**Quantity**		**Per device**		**Total**	**Per device**		**Total**
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
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		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
Signature data loop*		X		=			=	
	Total							

Add 15 mA for each loop that contains at least one SIGA-UM or SIGA-MAB with 2-wire smokes.

Make enough copies of this worksheet to include every type of Signature device in the system.

Worksheet 2: Remote devices								Page____
Device			**Standby current (mA)**			**Alarm current (mA)**		
Type	**Quantity**		**Per device**		**Total**	**Per device**		**Total**
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
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		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
	Total							
Make enough copies of this worksheet to include every type of accessory device in the system.								

Worksheet 3: Fire alarm control panel								
Device			**Standby current (mA)**			**Alarm current (mA)**		
Type	**Quantity**		**Per device**		**Total**	**Per device**		**Total**
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
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		X		=			=	
		X		=			=	
		X		=			=	
		X		=			=	
Worksheet totals								
Total from Worksheet 1 →								
Total from Worksheet 2 →								
Smoke power								
4-wire detectors								
2-MCM →					N/A			0.29
2-LCX →					N/A			0.29
2-wire smoke detectors								
24Vdc notification appliance		→						
Total →								

Worksheet 4: Battery calculations

Project name: _____ Cabinet number: _____ Cabinet label: _____

To calculate the total ampere-hours required for standby operation:

		Example		Your calculation	
1	Enter the total standby current from Worksheet 3.	580	mA		mA
2	Multiply line 1 by 0.0012.	0.696	A		A
3	Enter the required number of standby hours.	24	Hours		Hours
4	Multiply line 2 by line 3 to find the standby ampere-hour (Ah) requirement.	16.70	Ah		Ah

To calculate the total ampere-hours required for alarm operation:

		Example		Your calculation	
1	Enter the total alarm current from Worksheet 3.	2600.5	mA		mA
2	Multiply line1 by 0.00002.	0.05201	A		A
3	Enter the number of required alarm minutes.	5	Minutes		Minutes
4	Multiply line 3 by line 4 to find the alarm Ah requirement.	00.26	Ah		Ah

To calculate the total ampere-hours required for the system:

		Example		Your calculation	
1	Enter the standby Ah requirement.	16.70	Ah		Ah
2	Enter the alarm Ah requirement.	00.26	Ah		Ah
3	Add lines 1 and 2 to find the system's the total Ah requirement.	16.96	Ah		Ah

Appendix B
Special applications

Summary

UL requires synchronization of NACs. The built-in synchronization capabilities of the MIR2 system are listed in this appendix, along with diagrams for typical synchronization applications.

UL also requires that you monitor secondary power sources for loss of AC power. The requirements and appropriate application diagrams are contained in this appendix.

No fire alarm system is safe without surge protection. Each RS-485 line in the system requires a surge protection when it exits one building and enters another. The Ditek Surge Protector Module provides the needed surge protection.

If your building includes several zones, you may need coded outputs for each one. The CDR-3 Bell Coder provides coded fire alarm signals for multiple zones.

Content

UL 864 NAC signal synchronization

Requirements

Table 35 lists the installation requirements for systems that must meet UL 864 NAC signal synchronization requirements.

Table 35: Installation requirements for UL 864 signal synchronization

Circuit	**Installation requirements** [2] [3]
2-AAC audio riser	The 2-AAC audio subsystem uses a single signal source, so audible NACs on the 2-AAC audio riser are synchronized system-wide for voice notification.
NACs on the MIR2-MCM(N)	Visible signals are synchronized for an NAC when you use a Genesis Signal Master synchronization module and Genesis or Enhanced Integrity notification appliances. Visible signals on separate NACs on the MIR2-MCM(N) are not synchronized. Audible synchronization is supported between NACs 1 and 2 on the MIR2-MCM(N). To silence audible appliances separately, use one NAC channel to provide audible and another NAC channel to provide visible power to the NAC. In this configuration, the signal silence function operates as defined in your project. See Figure 27 for typical wiring. Configure the audible notification appliances for temporal or steady output as desired. Visible devices must be configured as steady only.
Signature data circuit (SDC) on the MIR2-MCM(N) module and the MIR2-LCX card	Signals are synchronized for a NAC on the Signature data circuit when you use SIGA-CC1 and SIGA-MCC1 addressable NAC modules, a Genesis Signal Master synchronization module, and Genesis or Enhanced Integrity notification appliances. [1] Separate NACs on the Signature data circuit are not synchronized. See Figure 29 and Figure 30. Configure the audible notification appliances for temporal or steady output as desired.
NACs on the MIR2-LCX card	Audible synchronization is supported between NACs on the MIR2-MCM(N) and NACs on the MIR2-LCX card. J3 on the MIR2-LCX card must be connected to J5 on the MIR2-MCM(N) with a ribbon cable (P/N 250214). NACs on a MIR2-LCX are synchronized as described above for the NACs on the MIR2-MCM(N).
SIGA-CC1, SIGA-MCC1, SIGA-CC1S, and SIGA-MCC1S	Signature CC1 modules do not generate temporal signals, they simply turn the NAC circuit on or off. You must configure the notification appliances for temporal or steady output as desired.

Table 35: Installation requirements for UL 864 signal synchronization

Circuit	Installation requirements [2] [3]
G1M and G1M-RM	The G1M and G1M-RM Genesis Signal Master modules can be used to synchronize NACs consisting of Genesis appliances. These modules can also be used to synchronize visible devices on mixed NACs consisting of Genesis and Enhanced Integrity appliances, but the first appliance must be a Genesis device, and the Genesis Signal Master module must be mounted on this device. [4] Audible devices (horns or strobe/horns) will not audibly synchronize when mixing appliances on the same NAC circuit. G1M-RM Genesis Signal Master modules can be used to synchronize NACs consisting of Enhanced Integrity appliances. The G1M is physically designed to mount to the Genesis electrical connector, and cannot be attached to an Enhanced Integrity device.

[1] You can also use SIGA-UM and SIGA-MAB modules configured as Class B addressable NAC modules (personality code 16.)

[2] If notification appliances are used on the data line for more than one zone, each zone must have isolation so that a break, ground, or wire-to-wire fault will not affect more than one zone.

[3] If any riser is used for more than one notification zone, install it in accordance with the survivability from attack by fire requirements in NFPA 72 National Fire Alarm Code.

[4] Visual synchronization using the G1M or G1M-RM can only be wired Class B (Style Y).

Typical circuits

The circuit diagrams that follow use the term *zone* to indicate *notification zones* as defined in UL 864.

"Notification zone: An area covered by notification appliances that are activated simultaneously."

Figure 27 shows a typical application of the MIR2-MCM(N) module to support a notification zone with audible and visible appliances. In this example, power could be supplied by a MIR-PPS(/6A).

In Figure 27, the zone is configured with separate NAC circuits for audible and visible appliances. NAC 1 is programmed as a visible device type, and NAC 2 as an audible device type. This means that the signal silence function can be configured to silence only the horns.

Separating the visible and audible devices is optional and may not be required for your project. Refer to the Genesis Signal Master installation sheet for additional configurations and wiring details.

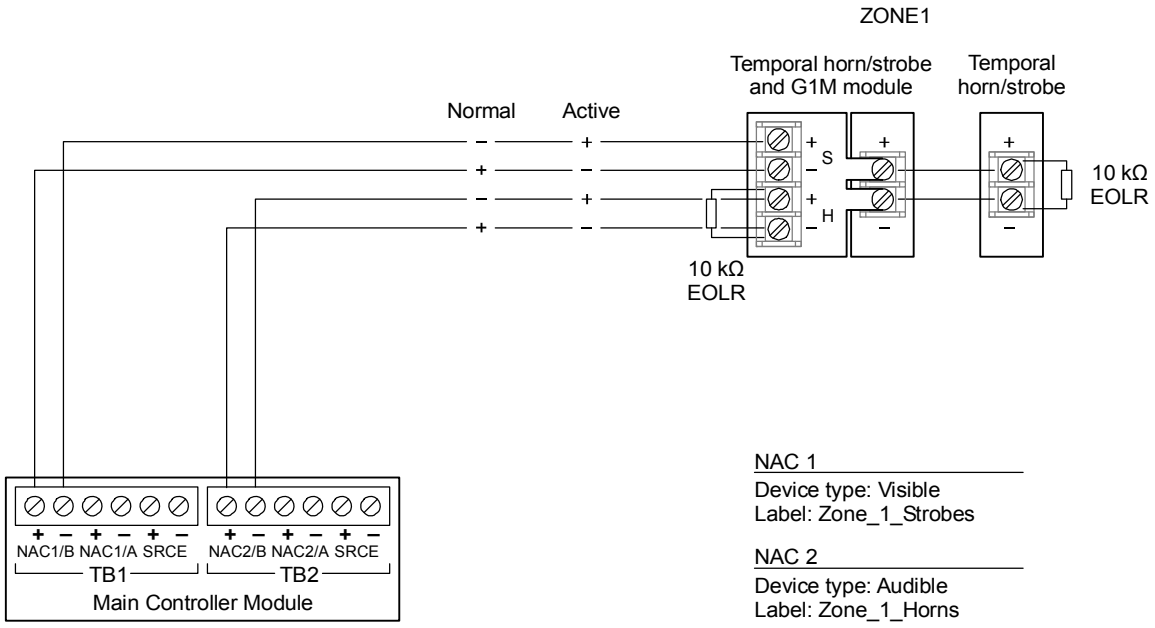


Figure 27: Typical MIR2-MCM(N) NAC wiring

Figure 28 shows a Signature circuit, wired as Class A, and using isolation modules or bases for each IDC and NAC. A separate AUX riser must be used for each NAC.

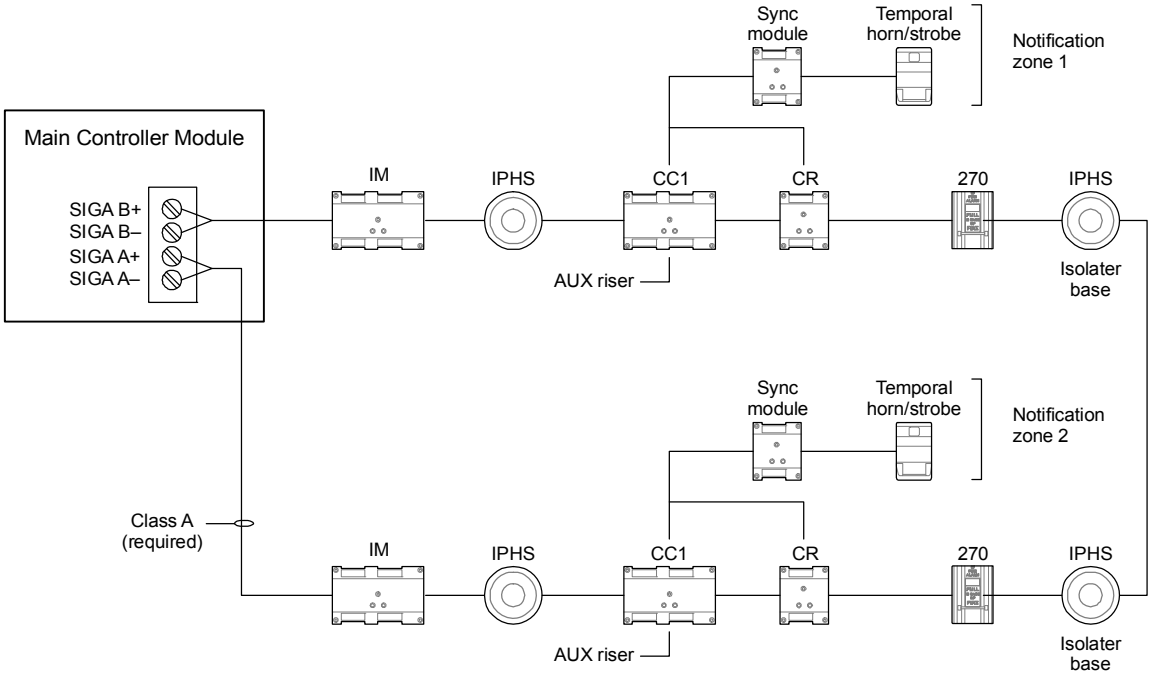


Figure 28: Signature wiring for notification circuit signal synchronization

Figure 29 Shows two NACs on a Signature data circuit. Each NAC is controlled by a SIGA-CC1 module, one for audible appliances, and one for visible appliances. A separate AUX riser must be used for each NAC.

As in Figure 27, this configuration allows the audible appliances to be silenced independently of the visible appliances. This operation is optional, and may or may not be required for your project.

The G1M module provides signal synchronization for the strobe appliances.

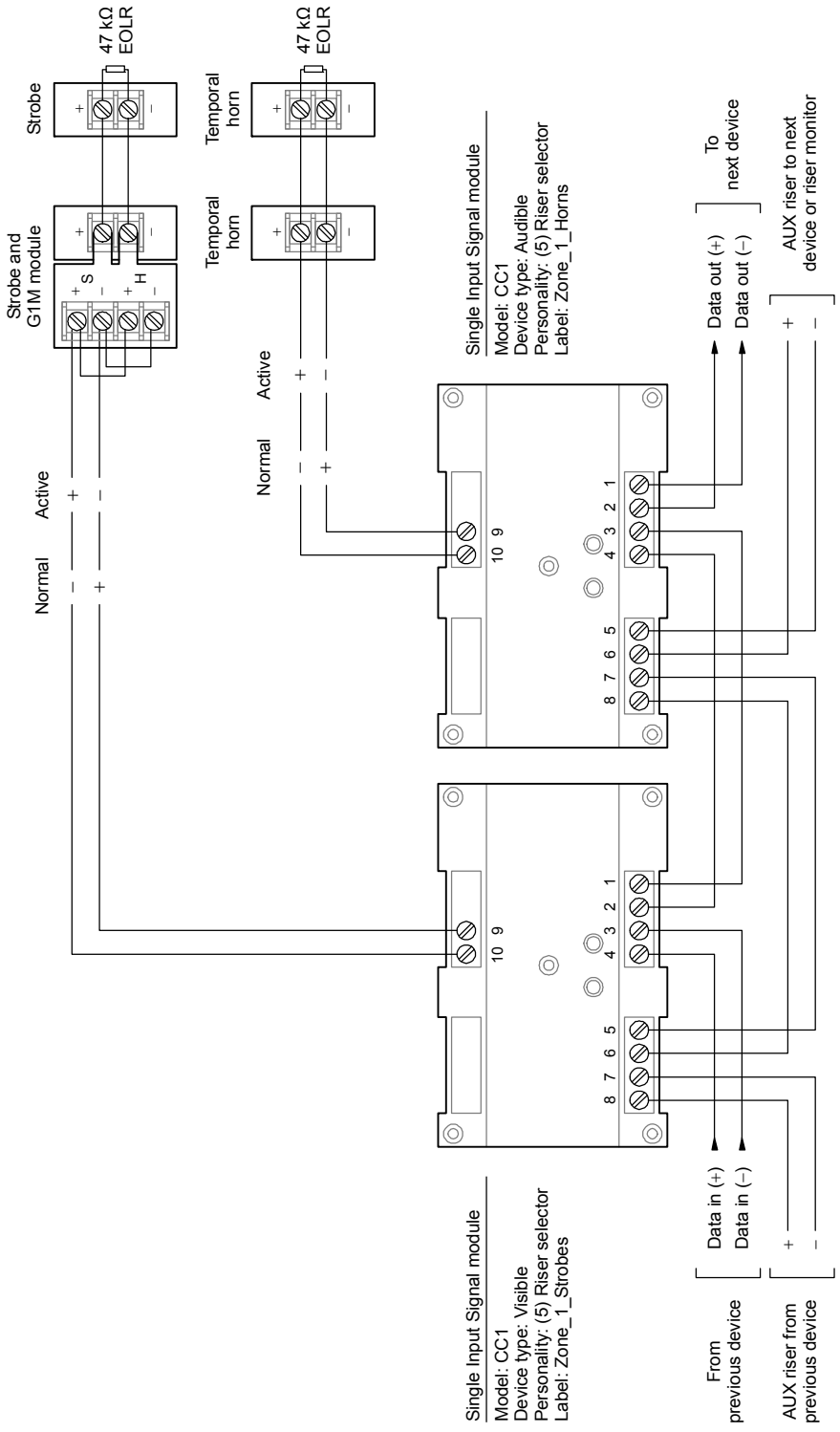


Figure 29: Typical SIGA-CC1 NAC wiring for separate appliance types

Figure 30 shows a single SIGA-CC1 switching an NAC on or off. The G1M module provides signal synchronization for the temporal horn/strobe appliances. A separate AUX riser must be used for each NAC.

As in earlier examples, this circuit allows for independent silencing of the audible appliances. This operation is provided by the SIGA-CR module, which opens or closes the circuit between S+ and H+ on the G1M module. In this case, however, you must program the operation of the SIGA-CR. The project settings for signal silence operation will *not* determine the operation of the audible appliances in this NAC.

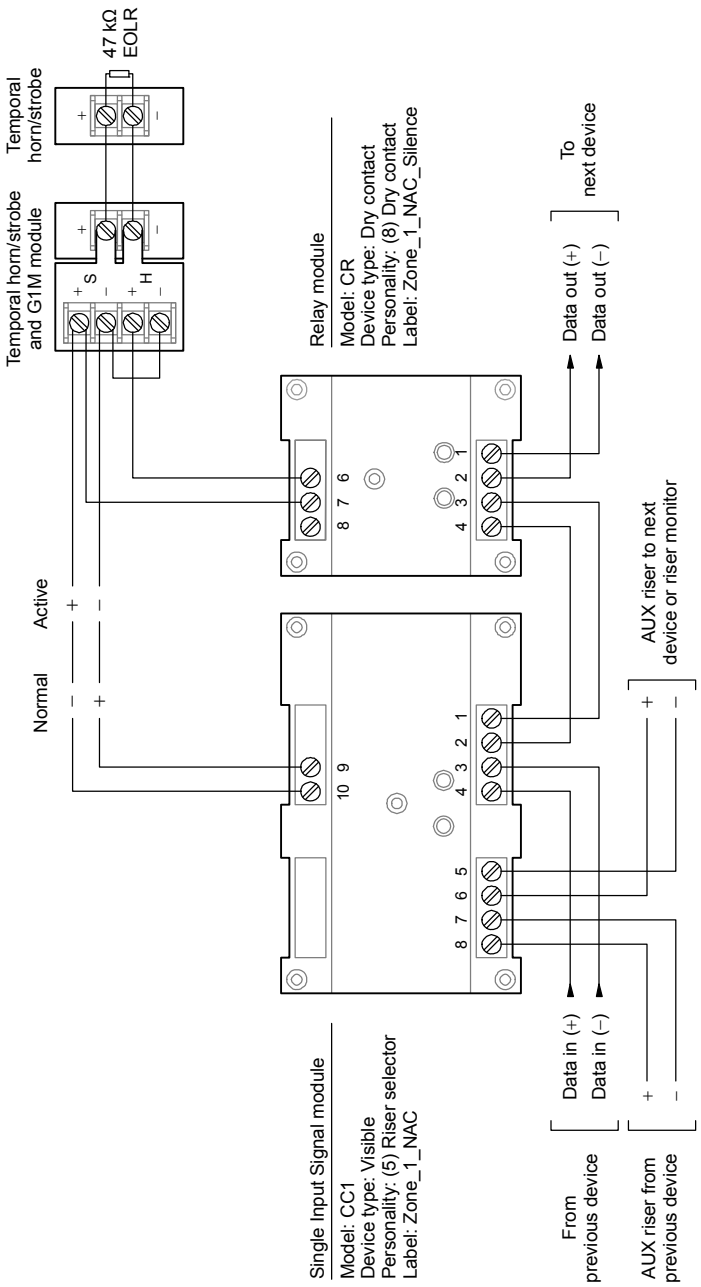


Figure 30: Typical SIGA-CC1 NAC wiring for horn/strobe appliance types

Figure 31 and Figure 33 show an auxiliary/booster power supply being used to power the NAC, to provide synchronization, and to provide horn silence capability. Because the auxiliary/booster supply has the ability to silence the horn circuit, this application can be created using only the Signature loop wiring.

The SIGA-CT1 module monitors the power supply for AC failure. The SIGA-CR module signals the power supply to turn the horns on or off. The SIGA-CC1 module signals the power supply when the system goes into alarm, turning the NAC on.

This application requires a rule, written against the Alarm Silence action. The rule operates the GSA-CR when the Alarm Silence button on the panel is pressed, thus turning off the horns.

Note that the power supply can only synchronize the notification appliances to which it is connected. Separate NACs on the Signature data circuit are not synchronized.

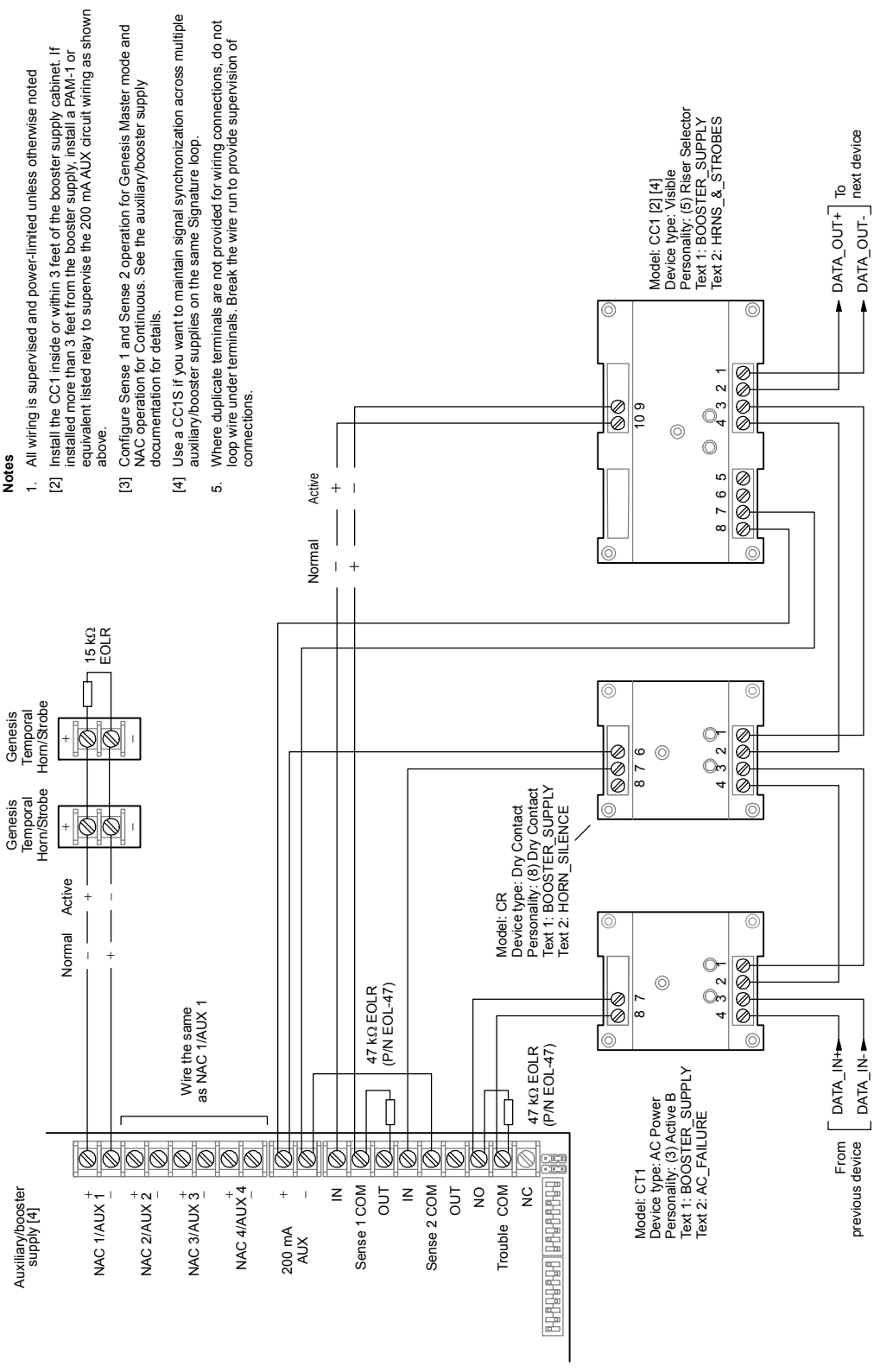


Figure 31: Using an auxiliary/booster supply to provide horn silence capability with two wires

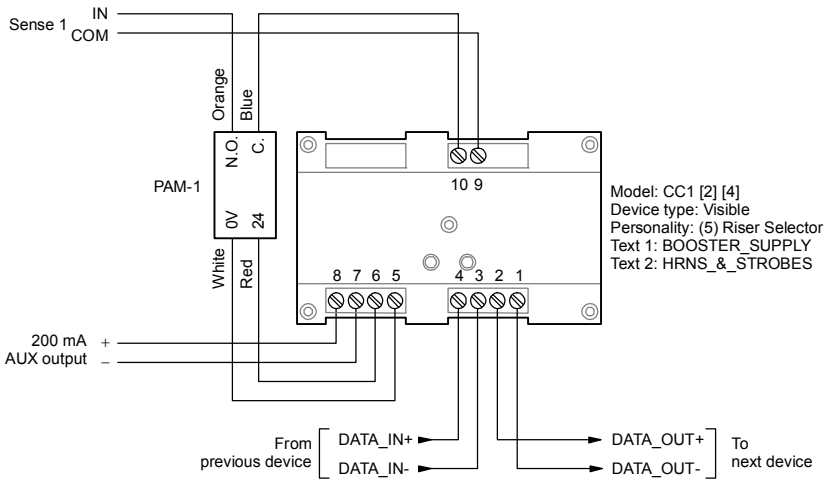


Figure 32: Typical 200 mA AUX supervision circuit

Connecting auxiliary/booster power supplies

UL requires that you monitor secondary power sources for loss of AC power. Upon loss of AC power, the control panel must provide an audible and visible trouble signal. In addition, remote station, central station, and proprietary-type protected premises units must transmit a trouble signal off-premises after a one- to three-hour delay.

To meet UL requirements you need to connect a SIGA-CC1 (or SIGA-CC1S) and a SIGA-CT1 to the booster supply. The SIGA-CC1 is used to activate the booster supply and to signal common troubles. The SIGA-CT1 is used to signal booster supply AC power failures.

Installation

Mount the SIGA-CC1 and SIGA-CT1 inside the booster supply as described in the booster supply's technical documentation and wire them as shown in Figure 33.

Configuration

Booster supply

Set SW2-6 to ON. This configures the booster supply's Trouble relay to close only on loss of AC power. All other booster troubles are signaled through the sense circuits.

Note: In Figure 33, the booster supply is configured so that Sense 1 controls all four NACs. For DIP switch settings for this and other booster supply configurations, refer to the booster supply's technical reference manual.

Signature modules

Configure the Signature modules as described below.

Module	Properties
SIGA-CC1	Model = CC1 Device Type = CommonAlarmOutput Personality = (5) Riser Selector Text 1 = REMOTE_SUPPLY Text 2 = SENSE_1
SIGA-CT1	Model = CT1 Device Type = ACFail Personality = (3) Active B Text 1 = REMOTE_SUPPLY Text 2 = AC_FAILURE

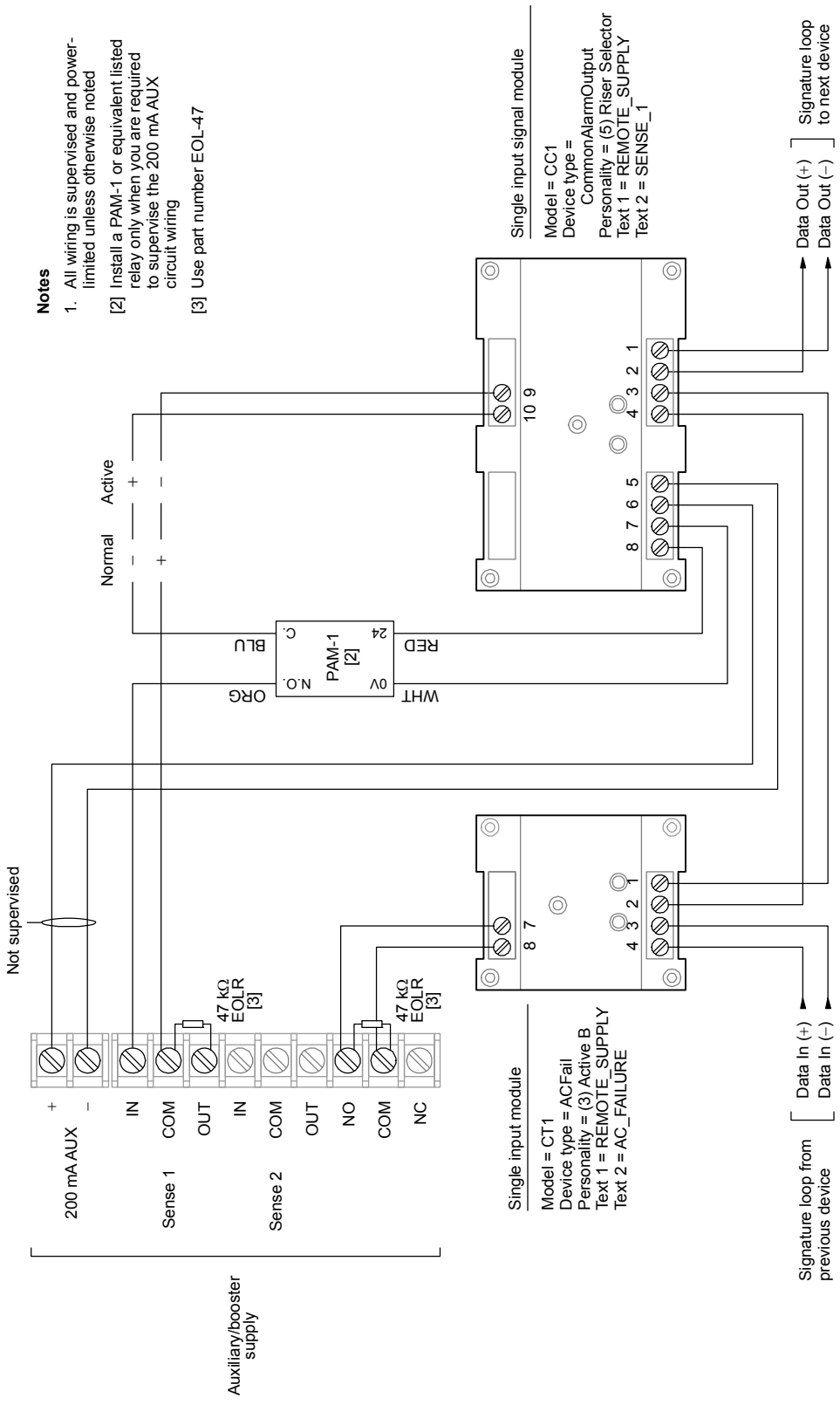


Figure 33: Typical booster power supply wiring

Ditek surge protector module

Description

Any time a wire exits a building and enters another, it must have surge and amperage protection at each end. The Ditek surge protector module (Figure 34) provides protection to circuits, fuses, and wiring. The surge protector is mounted in a standard grounded metal electrical box and comes in a 2, 4, 6, or 8-wire version. The following are part numbers for the Ditek surge protectors:

- 2 Wire Protector: (P/N - DTK-1LVLPSCP)
- 4 Wire Protector: (P/N - DTK-2LVLPSCP)
- 6 Wire Protector: (P/N - DTK-3LVLPSCP)
- 8 Wire Protector: (P/N - DTK-4LVLPSCP)

These surge protectors can be ordered from Ditek at 1720 Starkey Road, Largo, Florida 33771. Ditek also has a toll-free number (1-800-753-2345).

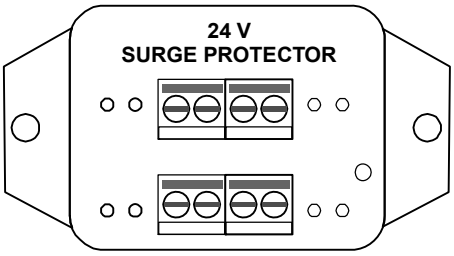


Figure 34: Ditek Surge Protector Module

Wiring the surge protector module

Figure 35 illustrates the typical application for surge protector modules. Wiring must include a surge protector when it exits one building and another surge protector when it enters the next building.

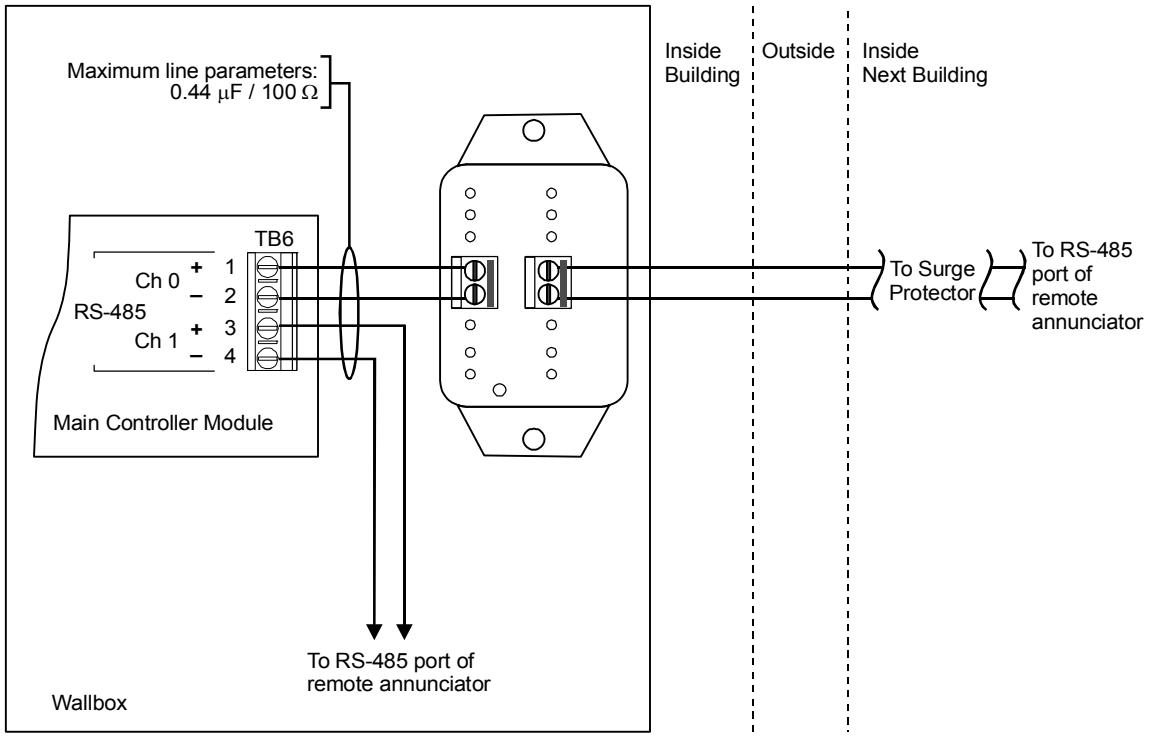


Figure 35: Surge protector wiring

Wiring the CDR-3 Bell Coder

Some applications require coded fire alarm signals. The CDR-3 Bell Coder provides march time or unique coded outputs for separate zones.

Figure 36 illustrates the wiring for a typical coded signal. For this application, you'll need to write a rule that turns off the CC2 when the power supply to the module goes into trouble state.

A sample rule for each set of terminals follows:

```
[AUX1]
TROUBLE LOCALTROUBLE 'SMOKE/AUXILIARY_POWER_1_00' :
   OFF '2-MCM_SIGA-CC2';

[AUX2]
TROUBLE LOCALTROUBLE
'NOTIFICATION_APPLIANCE_POWER_1_00' :
   OFF '2-MCM_SIGA-CC2';
```

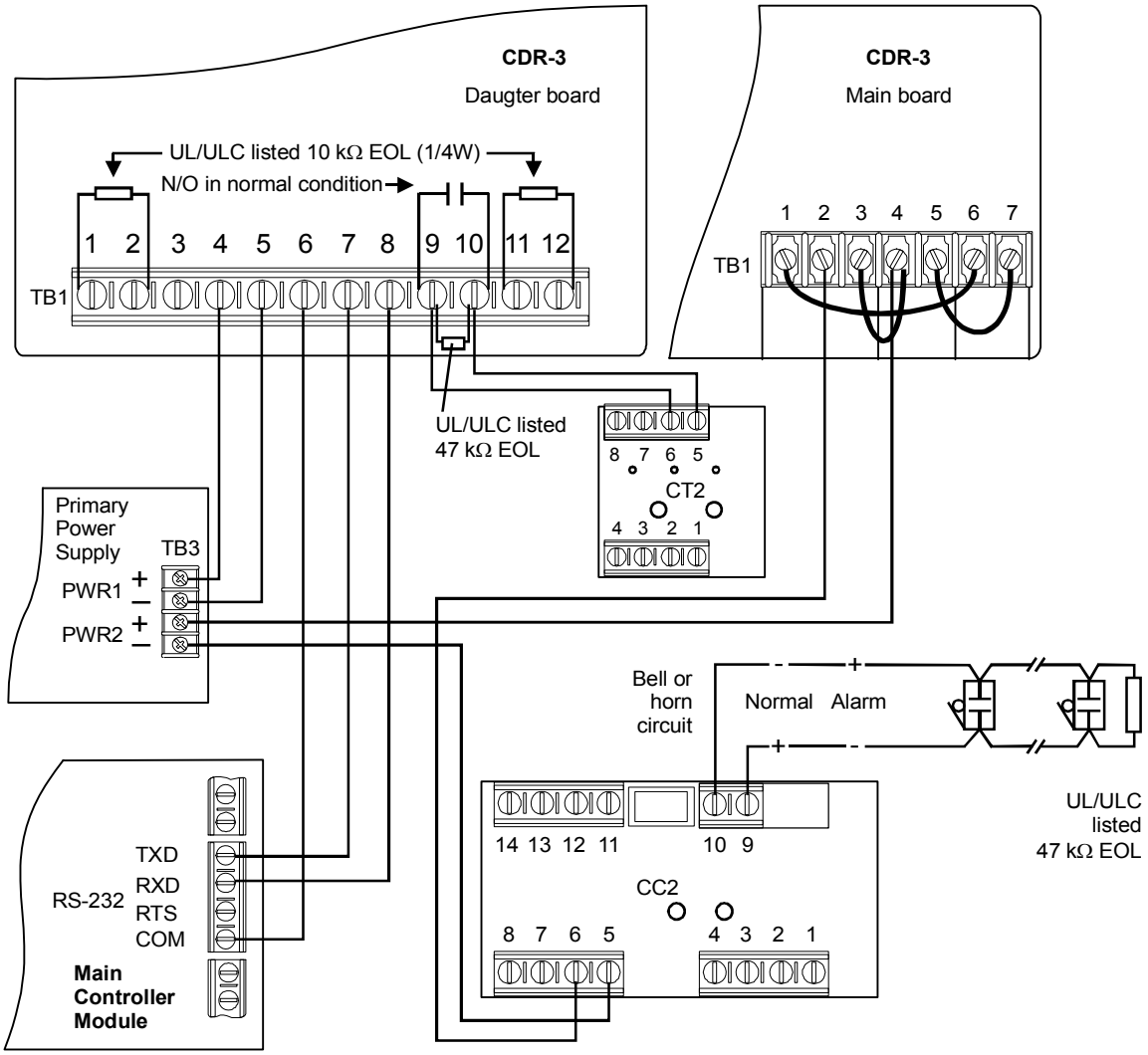
Figure 37 shows how to wire a CDR-3 to an audio circuit.

Figure 38 pictures the wiring of a CDR-3 to NACs on the Main Controller Module.

Note: Table 36 lists the terminal board connector labels. See the CDR-3 installation sheet (P/N 3100023) for more details about the installation, configuration, and specifications of the bell coder.

Table 36: TB1 connector labels

Main board	Label
1-3	DURATION
4, 5	TEMPORL
6, 7	BELL CODE
Daughter board	**Label**
1, 2	TEMPORL TONE
3	EARTH GRND
4	24V
5, 6	COMMON
7	RS232 INPUT
8	PRINT SUPV
9, 10	TRBL OUT
11, 12	CODED TONE



Notes

1. All components except for the bell or horn circuit must be in the same enclosure.
2. The CDR-3 and NAC circuits cannot use the same power terminals

Figure 36: Coded signal wiring

Note: All components must be in the same enclosure.

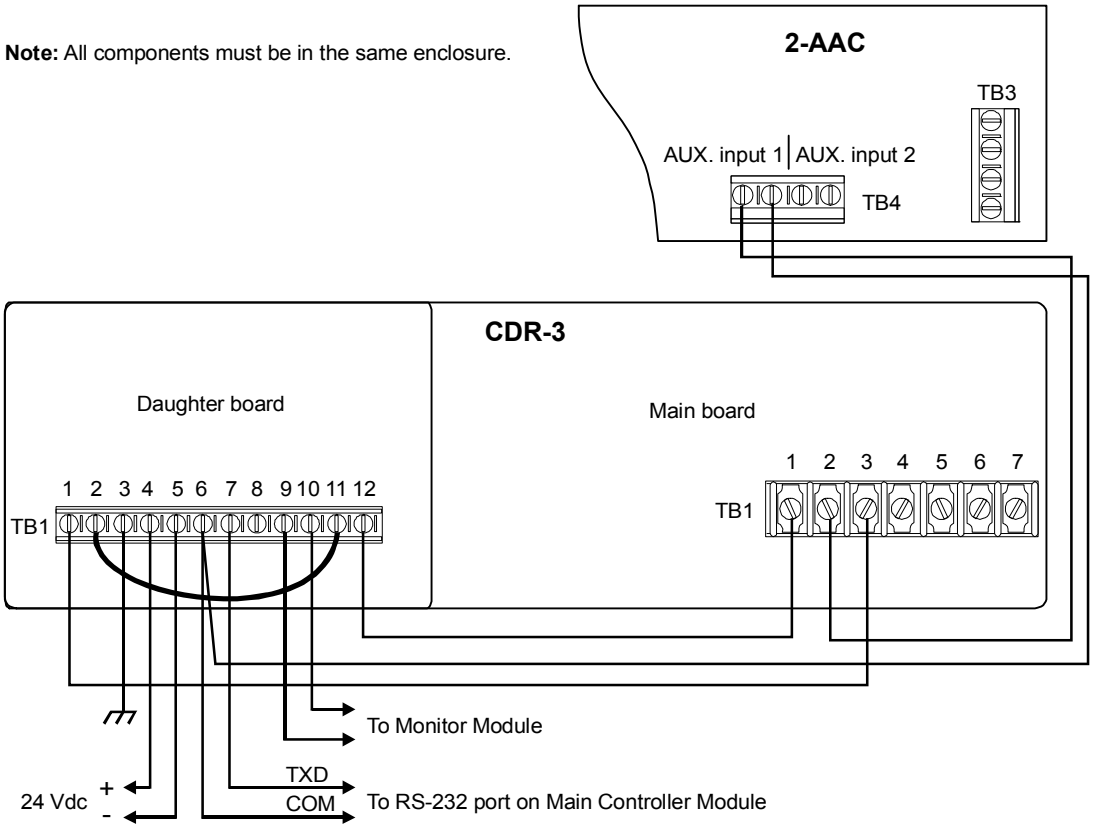


Figure 37: 2-AAC with coded tone auxiliary output

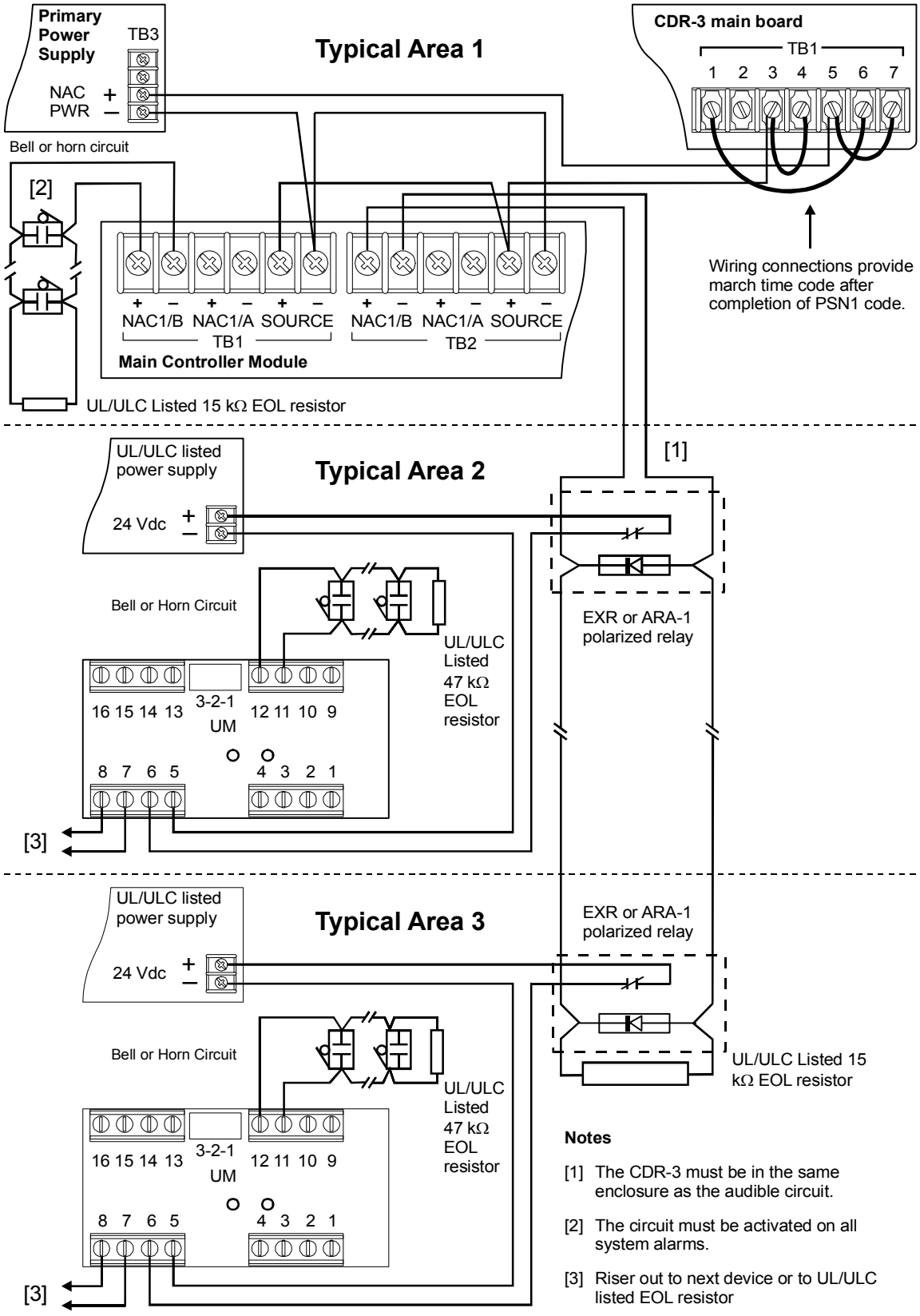


Figure 38: Coded NAC risers

Circuit and cable specifications

Circuit compatibility matrix

Figure 39 lists the restrictions for circuits that occupy the same conduit. Check local codes for additional restrictions.

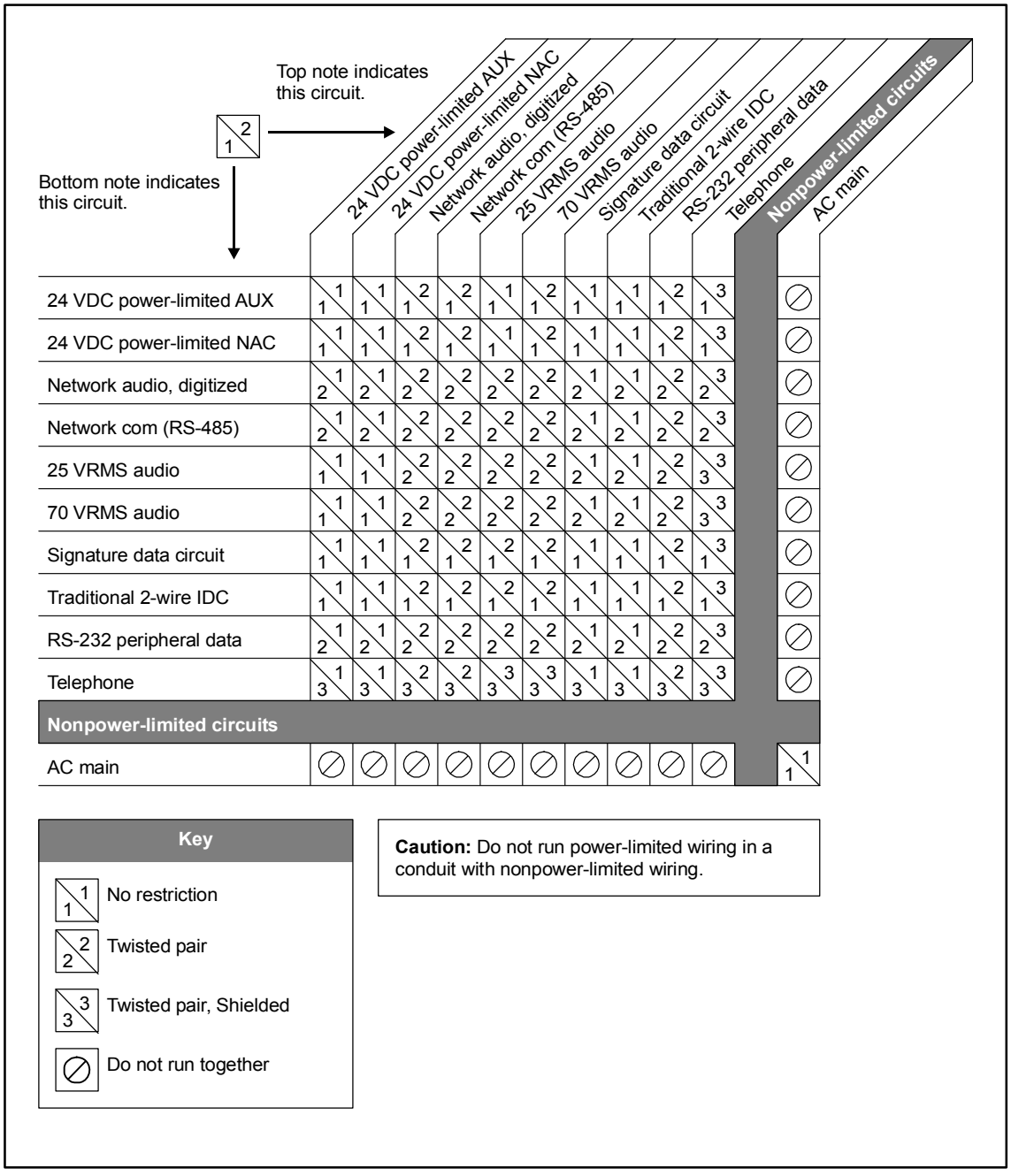


Figure 39: Circuit compatibility matrix

Circuit specifications

Table 37 lists the specifications for each type of power-limited circuit in Figure 39. Table 38 lists the specifications for each type of nonpower-limited circuit in Figure 39.

Table 37: Specifications for power-limited circuits

Circuit	Specifications
24 VDC AUX	Size conductors per acceptable voltage drop.
24 VDC NAC	Size conductors per acceptable voltage drop.
Network audio, digitized	No T-taps Maximum circuit resistance: 90 Ω Maximum circuit capacitance: 0.3 μF
Network com (RS-485)	No T-taps Maximum circuit resistance: 70 Ω Maximum circuit capacitance: 0.07 μF
25 VRMS audio	Size conductors per acceptable voltage drop.
70 VRMS audio	Size conductors per acceptable voltage drop.
Signature data	No T-taps Maximum circuit resistance: 76 Ω Maximum circuit capacitance: 0.5 μF
Traditional 2-wire IDC	Maximum circuit resistance: 100 Ω
RS-232 peripheral data	Maximum length: 50 ft (15.2 m) in the same room as the main controller module if not connected to a modem
Telephone	Maximum distance: 4,000 ft (1,200 m) #18 AWG (0.75 sq mm)

Table 38: Specifications for nonpower-limited circuits

Circuit	Specifications
AC main	230 VAC, 20 A max.

Recommended cable manufacturers

Use the cable manufacturers listed in Table 39.

Table 39: Recommended cable manufacturers

Manufacturer	Address	Telephone/Fax
Atlas Wire & Cable Corp.	133 S. Van Norman Road Montebello, CA 90640	(213) 723-2401
West Penn Wire Corp.	2833 West Chestnut Street P.O. Box 762 Washington, PA 15301	(412) 222-7060

Table 39: Recommended cable manufacturers

Manufacturer	Address	Telephone/Fax
Belden Wire & Cable Corp.	P.O. Box 1980 Richmond, IN 47375	(317) 983-5200
BSCC	233 Florence Street Leominster, MA 01453	(508) 537-9138 (508) 537-8392
Remee Product, Inc.	186 North Main Street Florida, NY 10921	Not listed

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