

Quick Reference Guide for the Smart Distributed System Bus



and Troubleshooting Procedures

Quick Reference Guide
for the Smart Distributed
System Bus

Reference Guide

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▲ WARNING

PERSONAL INJURY

- DO NOT USE these products as safety or emergency stop devices, or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.

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Chapter 1

Introduction

Why Should You Read This?

This Reference Guide provides information that will help you install, verify, and troubleshoot your Smart Distributed System network. Use steps outlined in this guide to safeguard your system and equipment from problems that may hinder its operation or even damage components.

Installation Guide Objectives

This publication illustrates and explains how to install a Smart Distributed System network. It covers:

- What you need to successfully complete the installation.
- How to install your physical media and devices.
- How to configure your system.
- How to check and document your system.
- How to troubleshoot after installation.

Where This Guide Fits

The structure of this guide is as follows. In general, you'll find graphics, illustrations, and quick reference steps on left-hand pages while textual descriptions appear on the right.

This chapter, *Introduction*, provides general information about this guide plus a brief introduction to the Smart Distributed System architecture.

We assume that you or someone in your organization has completed a thorough planning phase including needs analysis and system design.

NOTICE

If you don't have a complete system design, refer to *Plan Your Application* on page 85 for a summary of steps you should take before installing your network.

Chapter 2, *Installation*, begins with a summary of the pre-installation planning requirements that go into a complete system design. The remainder of that chapter describes steps required to successfully install the network and all its connected devices. The chapter provides a checklist to get your system working the first time.

Chapter 3, *Troubleshooting Guide*, gives you a process to use to track down the cause of problems.

Chapter 4, *Reference*, brings together key reference material from various documents.

Conventions

This guide includes symbols to identify important information.

▲ WARNING

PERSONAL INJURY

- *Warnings* identify critical information about a process or situation that has the potential to cause component or system damage, economic loss, personal injury, or even death.

Failure to comply with these instructions could result in death or serious injury.

NOTICE

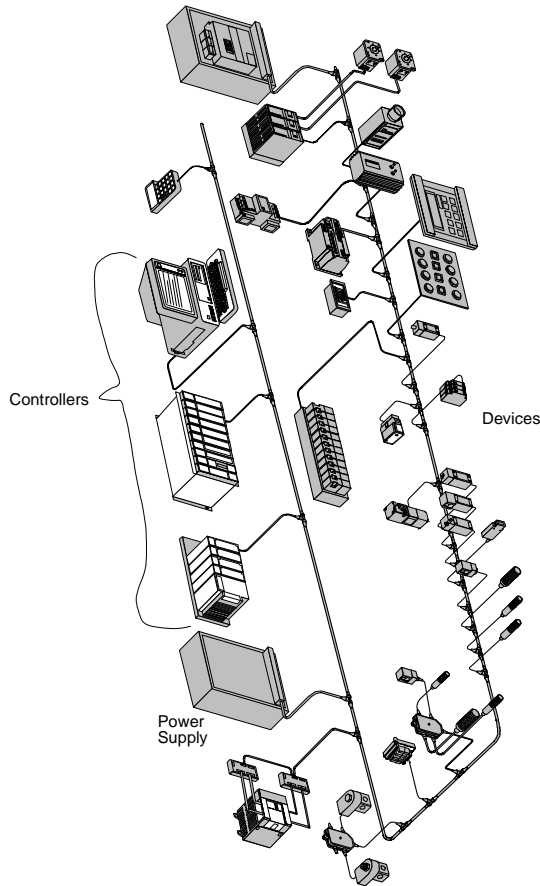
The *Notice* symbol indicates essential information of special interest or importance that will aid in, or simplify job performance.

TIP

Tips identify helpful information about a process, situation, or concept. A tip may also include shortcuts or alternative methods.

Introduction

Introduction



A Smart Distributed System must include:

- A power supply for the bus.
- Separate power supplies for devices when required.
- A controller.
- Smart devices connected directly to the network, or conventional devices connected by I/O interfaces.
- Bus cable.
- Terminating resistors.

What is Smart Distributed System?

Smart Distributed System is a bus system for intelligent sensors and actuators that streamlines installation and makes it easy to get diagnostics. This lets “smart” devices control some functions.

Simplified Installation

Devices communicate over a single 4-wire cable. You don’t have to deal with a jungle of discrete wires. One pair of wires is for communications and the other for system power. You can use quick connect hardware or hardwired connections that meet Smart Distributed System specifications.

Smart Distributed System networks let you standardize, build, and test network components before installation. You can make modular control panels, junction boxes, and most other components, making installation and maintenance quick and easy.

System Diagnostics

Smart Distributed System technology uses Controller Area Network (CAN) protocol for the data link layer. CAN is a full-function protocol that provides message checking and error correction. The Smart Distributed System adds the application layer that provides system diagnostics to ensure communications integrity.

Device Diagnostics

Many Smart Distributed System devices have special diagnostics designed into them. For instance, some photoelectric devices send warning messages when their lens is dirty or they are out of alignment.

Related Publications

Table 1:

For Information About	See Publication
CAN	Bosch V2.0 CAN ISO Standard 11898
Smart Distributed System Physical Layer Specification	GS 052 104

Warranty/Remedy

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Commencing with date of shipment, Honeywell's warranty runs for 18 months. If warranted goods are returned to Honeywell during that period of coverage, Honeywell will repair or replace without charge those items it finds defective. The foregoing is Buyer's sole remedy and is **in lieu of all other warranties, express or implied, including those of merchantability and fitness for particular purpose.**

Sales and Service

Honeywell serves its customers through a worldwide network of sales offices and distributors. Contact a nearby sales office for application assistance, current specifications, pricing, or the name of the nearest authorized distributor.

Or contact:

MICRO SWITCH

Honeywell, Inc.
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Freeport, Illinois 61032
For application assistance:
1-800-537-6945 USA
1-800-737-3360 Canada
1-815-235-6847 International

INTERNET E-MAIL ADDRESS

info@micro.honeywell.com

INTERNET WORLD WIDE WEB ADDRESSES

<http://www.honeywell.com/sensing/>
<http://www.honeywell.com/sensing/sds>

While we provide application assistance for Honeywell products, personally and through our literature, it is up to the customer to determine the suitability of the product in the application.

Reference Guide

Introduction

Chapter 2 Installation

Chapter Objectives

This chapter:

- Shows the three phases of installation and provides detailed steps for each phase.
- Lists tools and supplies you need to install a Smart Distributed System network.
- Explains the steps you must follow to properly and safely install a system.

The Installation Process

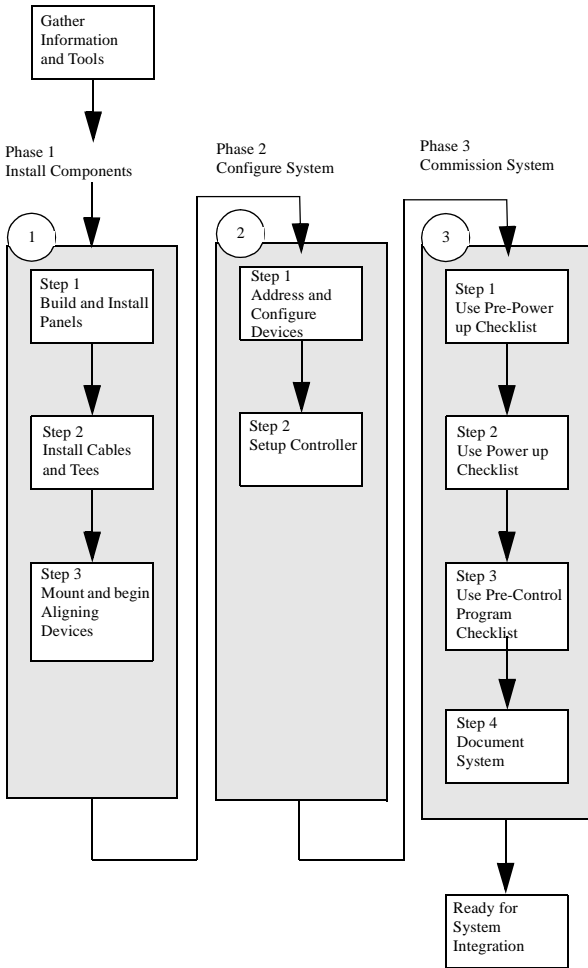
Understand Each Step

1. Gather required data and information to complete a step.

NOTICE

Don't start a step until you've accounted for everything needed to complete the step.

2. Perform each step in sequence.
3. Test your work before continuing.



Installation Planning

- Be familiar with Smart Distributed System technology (see Commonly Used Terms on page 77).
- Be familiar with your application.
- Gather pre-installation system documentation from the system designer.
- Gather manufacturer documentation for all devices.

Pre-Installation Check List

NOTICE

Before you attempt installation, someone in your organization should have completed a thorough plan, needs analysis, and system design. This document assumes that you, or another team of engineers, have completed these pre-installation steps. For reference, your pre-installation plan should include:

- Detailed system and machine layout.
- Detailed bus layout including routing, cable lengths, and device and branch locations.
- Manufacturer's documentation for each device on the bus.
- Detailed list of device power requirements.
- Control panel (power supply) layout and wiring diagram.

NOTICE

If you don't have a complete system design, refer to Plan Your Application on page 85 for a summary of steps you should take before installing your network.

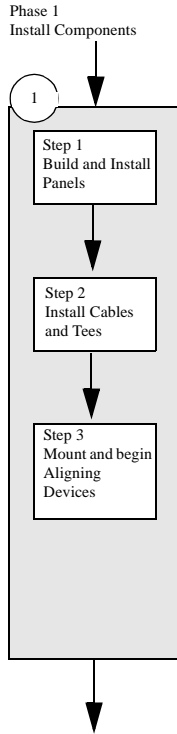
Phase 1 — Install Components

Goal: To install devices, network cable, tees, branches, and other hardware associated with a Smart Distributed System network.

This phase covers three steps:

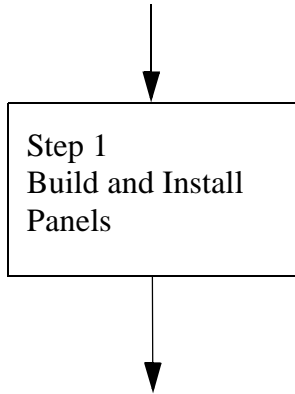
1. Build and install control panels.
2. Install cables and tees.
3. Mount and begin aligning devices.

When completed, you'll be ready to configure devices on the network.



Installation

Installation

**TIP**

Standardize panel construction. This allows you to:

- Do more in the panel shop, and less in the field.
- Decrease time and risk of installation and commissioning.
- Standardize installation and maintenance.
- Install as a unit / replace as a unit.
- Prepare panel off-line - address it; configure it; then install it.
- Repair panel units off-line with no downtime.

Phase 1, Step 1 — Build and Install Panels

GOAL: Provide bus power and control interfaces required by your system.

To install your system, you need:

- Power supply hardware.
- Controller hardware.
- Power consumption data.
- AC power connection.
- Controller/Smart Distributed System interface.
- Programming software (if required).
- Panel layout, materials, and wiring diagrams.
- Installation documentation for panel components (mounting dimensions, connectors, etc.).
- Tools.

When completed, you'll have:

- Properly sized, wired, and located power supplies.
- Operational controller with Smart Distributed System interface.
- Other panels (as required) properly installed.

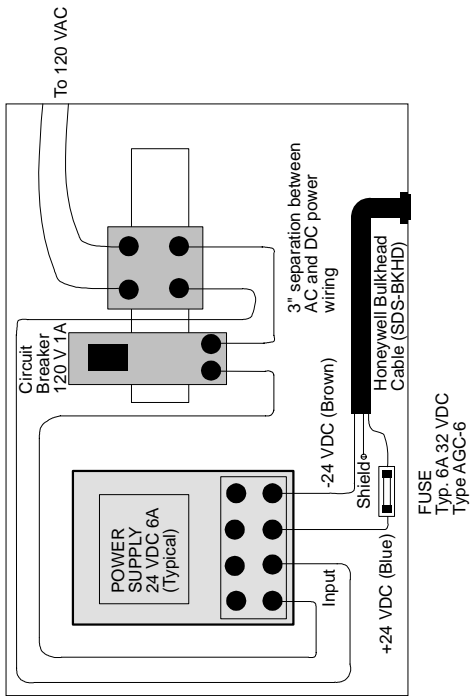
Installation

TIP The fuse protects cabling under normal operating conditions, and helps avoid intermittent problems. It will blow when detecting a “hard short,” which can happen if device wires are accidentally cut.

TIP Attach the shield wire to earth ground in the power supply cabinet.

TIP Clip Exposed shield wire back to the sheathing at each device.

▲ WARNING PERSONAL INJURY
 • Select the power supply, AC wiring, and circuit breaker in accordance all applicable codes and practices.
Failure to comply with these instructions could result in death or serious injury.



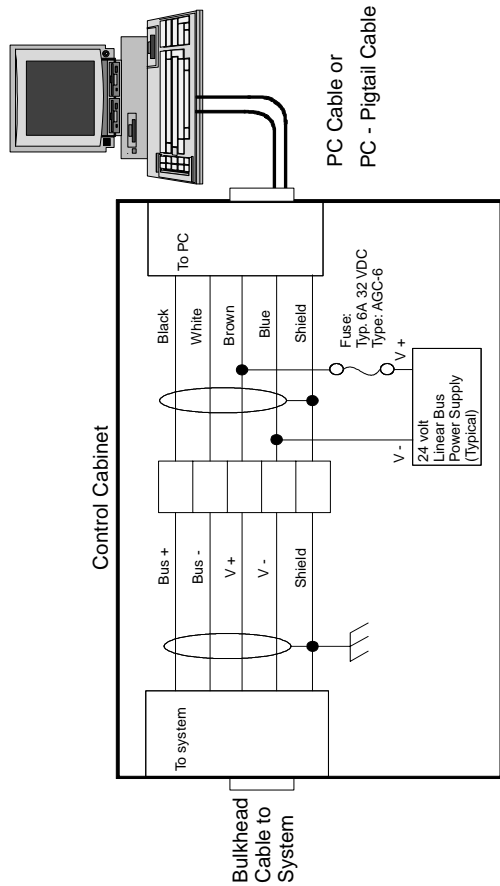
Phase 1, Step 1 Continued

General Guidelines

Please adhere to the following guidelines when designing the layout for your power supply cabinet:

- Keep devices and bus connections as far as possible (minimum of 3 inches) from AC power wiring.
- If bus and AC power wiring must cross, do so at right angles.
- Never run bus and AC power wires parallel to and within 3 inches of each other.
- Use only shielded bus cable inside an accessory cabinet. Both pigtail and bulkhead cables are available from Honeywell. Do not use general purpose unshielded products.
- Maintain maximum shield coverage up to the point of connection.
- Where the bus pair (black and white) and power pair (blue and brown) exit from the shielded cable, keep wires twisted up to the point of termination.
- Connect bus shielding to ground in only one place. Normally this should be in the central control cabinet. Do not connect the shield to ground at any device or accessory wiring cabinet.

Installation

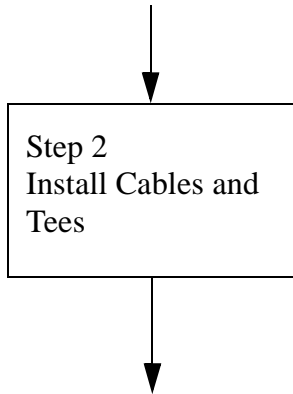


Phase 1, Step 1 Continued

- If possible use a pigtail cable (with strain relief) for the bus-to-enclosure connection. Or use a bulkhead connector mounted on the motor control cabinet side walls. Treat motor control cabinets and other device cabinets as “plug and play” sub-assemblies that you can pre-test and configure in the panel shop, saving time and field wiring costs. Avoid using unnecessary terminal strips, which expose wiring. Exposed wiring may allow electrical noise to enter the system.

Installation

Installation



Three Cabling Schemes:

- “Plug-and-Play” using quick connect cable.
- Hardwiring using conventional bulk cable and terminal blocks.
- Combination using quick connect cables, and pigtails or field terminated connectors for longer trunk sections with no devices, and to connect non Smart Distributed System devices to a branch.

Phase 1, Step 2 — Install Cables and Tees

GOAL: Correctly install trunk and branch cables and tees.

NOTICE

You shouldn't begin installing cables and devices without a completed design. You should have detailed documentation available that shows all cable lengths and device locations.

TIP

Protect exposed skin and eyes as you deem necessary. It is a good idea to protect your hands with gloves since you will be continually hand-tightening plug and play knurled cable connections.

To install your bus cable and tees you need:

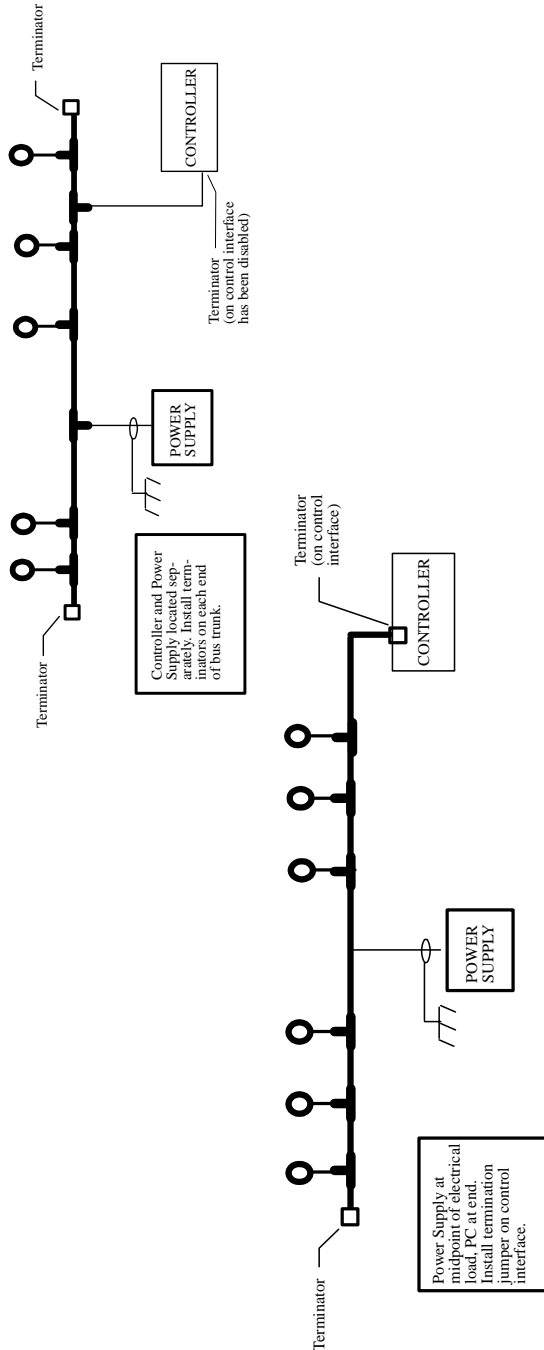
- Detailed layout information showing bus routing and cable lengths with device and branch location.
- All installation hardware, including cables, two terminating resistors, tees, devices, brackets, extra cable, etc.
- Installation instructions for all devices.

When completed, you will have:

- Cables properly routed and terminated, and supported at all device locations.

TIP

Don't connect branch cables to devices until you address the devices and set necessary attributes (after Phase 2, Step 1).



Phase 1, Step 2 Continued

General Guidelines

TIP Run all cable without connecting to devices. This lets you walk through the system with an activator and address devices without having to disconnect cable.

Termination Resistor Rules

NOTICE

Each bus must have two termination resistors — one at each end. Connect the resistors across the + BUS and - BUS conductors. Termination requires 120 Ohm, 1/2 Watt, 2% resistors.

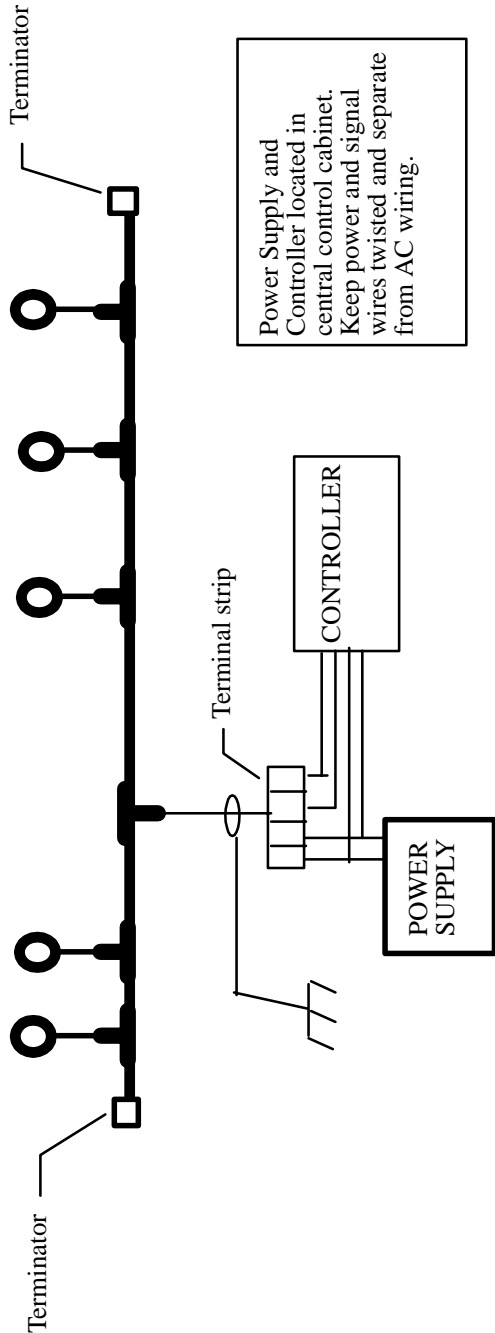
- If you are using hardwire cabling you will need two 120 Ohm, 1/2 Watt, 2% resistors. Use a Termination Cap (SDS-TERM) with plug-and-play cabling systems.
- If the controller is at one end of the bus, you must enable the interface card's internal resistor (if it has one), or add an external resistor.
- If the controller is in the middle of the bus, you must disable the interface card's internal resistor (if it has one), or remove any external resistor.
- The power supply can be located anywhere on the bus.

NOTICE

You must configure each bus as a single trunk. A system can have more than one bus. "Star" layouts are not allowed.

Do not run communication and power cables together in a conduit or cable trough.

Installation



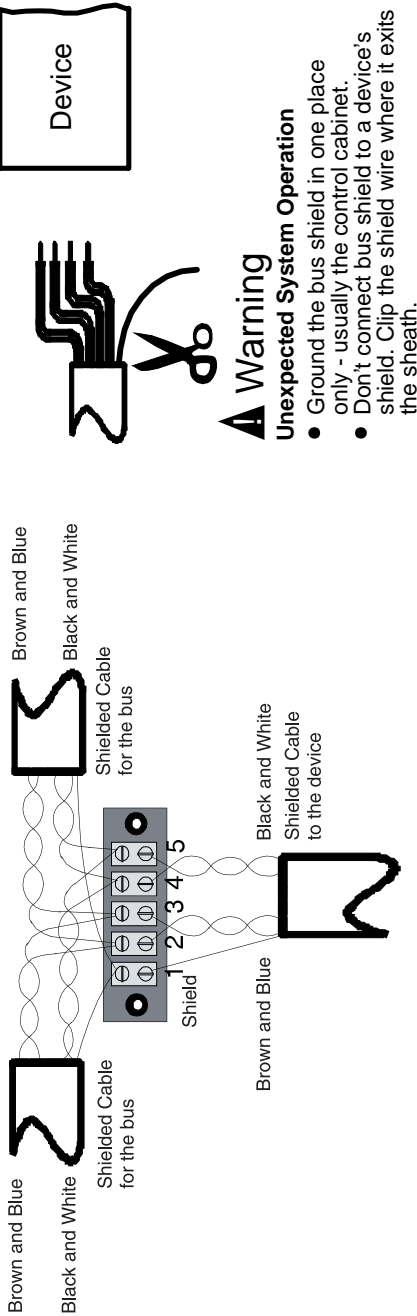
Phase 1, Step 2 Continued

Power Supply Considerations

- TIP** Sum the current requirements for all devices and compare that value to the power supply rating. We recommend a power supply rating twice the bus power requirement.
- TIP** To ensure an even power supply, calculate total current draw and move the supply to the electrical center. The center is different in each application due to varying numbers and types of devices.
- TIP** We recommend using linear power supplies because of their low electrical noise level.
- TIP** Allow for remote control of power supply if it is not located at or near the controller. You must cycle bus power and controller power for proper system initialization.

Installation

Installation



Warning
Unexpected System Operation

- Ground the bus shield in one place only - usually the control cabinet.
- Don't connect bus shield to a device's shield. Clip the shield wire where it exits the sheath.

Failure to comply with these instruction could result in death or serious injury.

1. Shield (Clipped to sheath where exposed at device end)
2. Bus Power (+) Brown
3. Bus Power (-) Blue
4. Bus Communications (Bus +) Black
5. Bus Communications (Bus -) White

Phase 1, Step 2 Continued

Bus Routing With Conventional Wiring

Hardware for hybrid conventional wiring connections include the following:

- 14 and 12 gage, shielded, twisted pair cables for bus power.
- Brand-Rex T-14397, individually shielded, twisted pair cable for the communications bus.
- Terminal blocks (required), conduit, and junction boxes as required.
- 120 Ohm, 1/2 Watt, 2% resistors for the extreme ends of the communications bus.
- Honeywell-approved cable with quick connect molded-on connector at one end for the device, and a conductor pigtail for connection to terminal strip at the other.

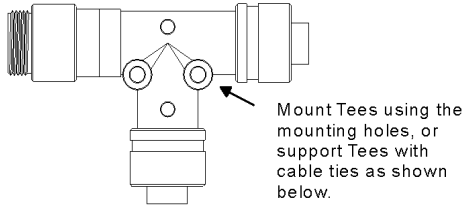
General Guidelines

- The DC power (+V and -V) for the bus should be supplied by a regulated DC power supply. Use 16 or 18 gage wire.

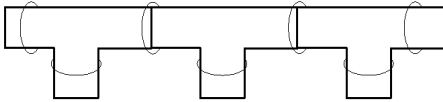
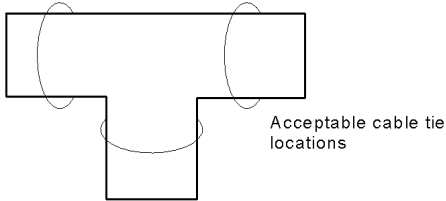
TIP Use a 5-pin mini-bulkhead connector to make the connection inside the controller cabinet.

TIP Use Field Terminatable Connectors to join bulk cable with quick connect cable. This lets you use bulk cable for uninterrupted trunk sections, or eliminate excessive quick connect cable.

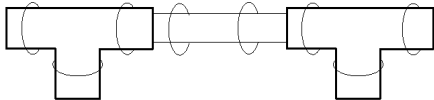
Installation



0.375 in. (4.76 mm) diameter hole for mounting screws



Support multiple tees with cable ties as shown



Use cable ties on cable between tees at least every 24 inches

Proper Ways to Support Tees

Phase 1, Step 2 Continued

Routing the Bus with Quick Connect Cable

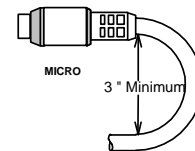
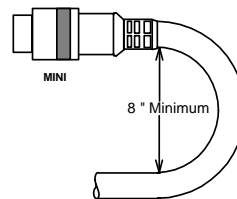
Before starting, verify that you have all required bus hardware. Then:

- Connect bus cable segments with passive tee connectors at each branch.
- Run the bus cable complete with tees to the location of each device.

NOTICE

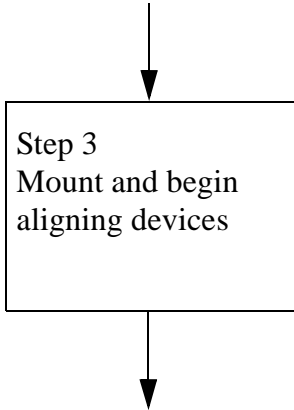
Hand tighten all quick connect cable connections. Do not use pliers.

- Hand-tighten all screw-terminal connections, and be sure that the green ring lines on all plug-and-play connections are visible.
- Run the branch cables, but don't connect them to devices until you've addressed the devices and set necessary attributes.
- Eliminate strain on connectors. To prevent damage to connectors, do not bend mini and micro style cables to a diameter of less than 8" and 3", respectively.



Installation

Installation



NOTICE

Some Smart Distributed System devices have special mounting requirements to ensure proper electrical isolation or device operation. Make sure you carefully review the *Installation Instructions* for each device you intend to use.

What you need:

- All devices.
- Detailed layout information showing device location.
- *Installation Instructions* for each device.
- Mounting brackets and hardware.
- Electrical enclosures if required.
- Tools.

When completed, you'll have:

- Devices mounted in correct location.
- Devices ready for configuration.

Phase 1, Step 3 — Mount and Align Devices

Goal: To save time and ensure correct operation by properly mounting and aligning all devices.

General Guidelines

- Carefully review the *Installation Instructions* packaged with the product for each device.
- Where necessary (e.g., Quad I/O Concentrator), install devices in electrical enclosures.
- Make sure all devices and sensors are physically secure.
- As closely as possible, make sure sensors are properly oriented for proper operation. This is particularly important for optical sensors. You can fine tune the adjustments when you supply power to the bus and devices.



Check devices for proper operation after mounting. You can use the Honeywell Hand-Held Activator for most devices.

NOTICE

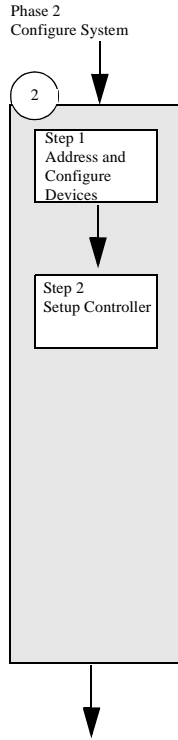
Make sure devices requiring horizontal or vertical orientation are properly installed. Also, verify all required clearances.

NOTICE

Make sure you provide appropriate electrical enclosures or cabinets for unsealed devices.

Installation

Installation



Phase 2 — Configure System

Goal: To provide unique addresses to all devices on the network, set attributes, and test device response. This phase also includes initial configuration of the network controller.

This phase covers two steps:

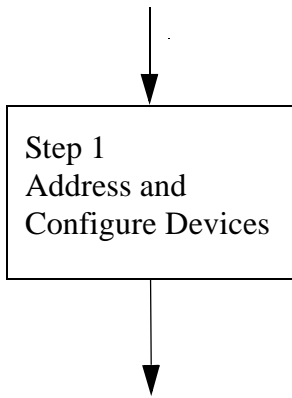
1. Address and configure devices.
2. Setup controller.

When completed, you'll be ready to begin commissioning your system.

NOTICE

Some devices support attributes, which can function as On/Off Delay Timers, NO/NC operation, etc.

You can configure attributes using the Honeywell Hand-Held Activator or a PC with appropriate software. Enable only those attributes required by your application. Refer to the manufacturers installation instructions for this information.



To address and configure your devices, you need:

- Address information for each device.
- Configuration required for each device.
- Hand-Held Activator (or PC and software).
- Installation Instructions for each device to obtain device attribute defaults and determine appropriate settings.
- Address labels.

When completed, you'll have:

- Devices correctly addressed.
- Device attributes set.
- Each device labeled for maintenance.

Phase 2, Step 1 — Address and Configure Devices

Goal: To provide properly addressed and configured devices ready to connect to the Smart Distributed System bus.

General Guidelines

- Begin at one end of the bus and move from device to device.
- Verify that there are no more than 64 Smart Distributed System devices on the bus.

NOTICE

Do not attach more than 64 Smart Distributed System devices (loads) to the bus; this does not include PC or PLC interface connections.

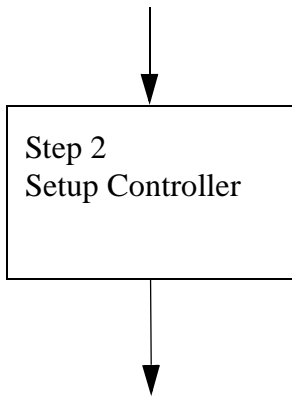
- At each device, use an Activator to program the device address.
- Some devices may require an external source of power when using the Activator.
- Verify device attribute defaults, and change attribute values as required (optional).

NOTICE

Carefully review the *Installation Instructions* packaged with the product for each device to verify that configurable parameters are set for proper operation. **At minimum, each device must have a unique address.**

You can also perform device configuration with a PC, interface card, and various software packages (See page 38).

- After configuring the device, attach it to the installed branch cable.

**NOTICE**

Configuration of control interfaces varies between controllers. Consult the manufacturer's installation instructions for details. You may need special software and/or cable.

Smart Distributed System control interfaces include:

- Honeywell Interface Terminal Strip.
- GE Fanuc/Horner Electric 90/30.
- PLC Direct 405.
- Honeywell VME Interface.
- Siemens S5.
- Honeywell Smart Control^{PC}.
- Honeywell PC 620.

Phase 2, Step 2 — Setup Controller

Goal: To configure controller or PC to access all network devices.

To perform this step you need:

- A functioning controller or PC with a Smart Distributed System interface card.
- I/O address of all devices.
- Attribute settings for all devices.

When completed, you'll be ready to connect devices to the network and begin the commissioning phase.

General Guidelines

Use controller software or the Smart Distributed System Network Manager to define devices.

- Setup I/O address mapping in controller.
- When using Honeywell Smart Control^{PC}, create an SDS.CFG file as specified in the PC Interface Card User's Guide.

NOTICE

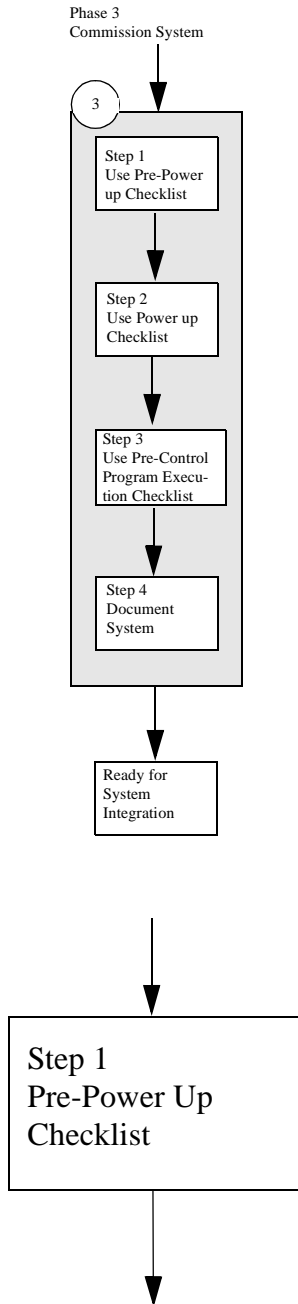
You can begin using Network Manager before applying power to the network, but it is more efficient to defer this step until later for networks connected to a PC.

TIP

You can use a PC and various software applications to check out your bus even if you plan to use a PLC as a controller.

Installation

Installation



Phase 3 — Commission System

GOAL: To commission your system, and to document your system for training, reconfiguration, and reference purposes.

This phase includes four steps:

1. Use pre-power up verification checklist.
2. Use power up verification checklist.
3. Use pre-control program execution checklist.
4. Document system.

When completed, you'll be ready for system integration.

Phase 3, Step 1 — Pre-Power Up Checklist

Goal: Verify correct wiring before applying power.

Use the following check list as an aid to verify your Smart Distributed System installation. This verification helps safeguard your system from problems that may hinder its operation or even damage components.

To perform this task, you need:

- Break-out box (BOB) or access to bus wiring.
- Digital multimeter (DMM).
- Checklist.

TIP Contact Honeywell for information on purchasing or constructing a BOB. This device provides easy access to bus wires for making measurements if you don't already have easy access.

Upon completion of this step, you'll have verified that Smart Distributed System bus power and communications wiring is correctly installed.

Pre-Power Up Checklist

▲ WARNING
UNEXPECTED SYSTEM OPERATION

- Follow all checklist steps completely to aid proper system operation.

Failure to comply with these instructions could result in death or serious injury.

Before Powering You Bus

- Make sure there are no short circuits or reversed wiring in the communication and power lines.
- Use two 120 ohm terminating resistors on the extreme ends of each bus.
- Verify that the resistance across bus positive and negative, while power is off, falls between 50 and 70 ohms.
- Ensure that the bend radius is greater than 8" for mini-sized cables and greater than 3" for micro-sized cables.
- Check the number of loads on the bus (only 64 "smart" devices permitted).
- Hand-tighten all screw-terminal connections and be sure that the green ring lines on all plug-and-play connections are showing.
- Do not install your bus wiring closer than 3 inches to other wiring. Do not place your bus wiring in parallel with power or other system wiring.
- Verify that the:
 - ▶ Shield drain-wire is intact.
 - ▶ Shield drain-wire measures less than 1 ohm to earth-ground.
 - ▶ Shield drain-wire is attached at a single point to control earth-ground start-point.
 - ▶ Shield drain-wire is clipped flush with cable at all devices.
 - ▶ Black-white and brown-white pairs remain twisted and as short as possible.

Phase 3, Step 1 Continued

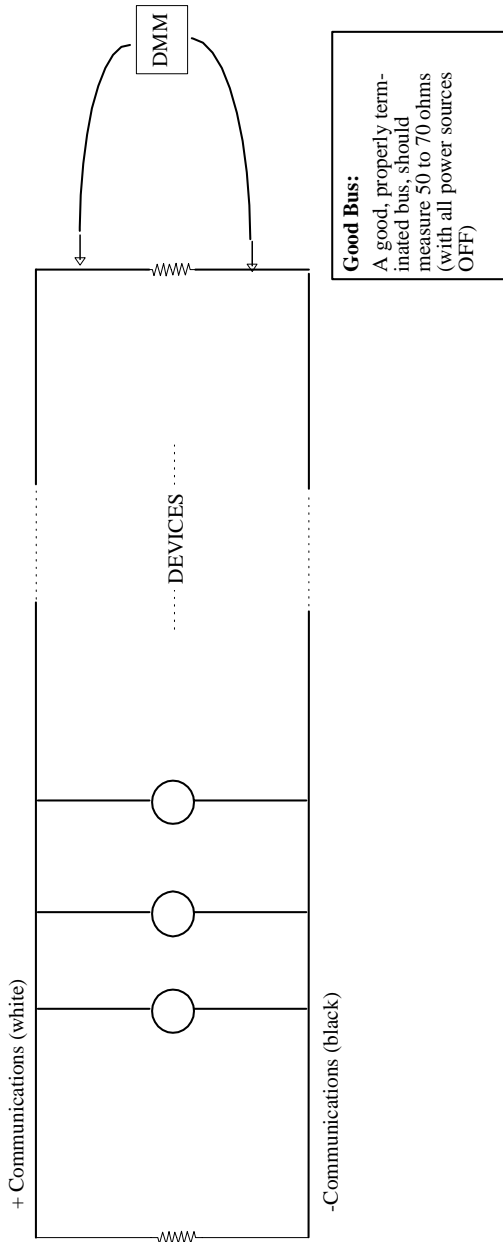
1. Verify that the:
 - Shield drain-wire measures less than 1 ohm to earth-ground.
 - Shield drain-wire is attached at a single point to control earth-ground start-point.
 - Terminating resistors (120 Ohm, 1/2 Watt, 2%) are in place at extreme ends of each bus.
2. For pigtail, bulkhead, or hardwired connections, verify that the:
 - Shield drain-wire is clipped flush where it exits the cable at devices and control panels unless it is the single earth ground point.
 - Black-white and brown-white pairs remain twisted and as short as possible.

Pre-Power Up Checklist by the Numbers

Before powering the bus, we recommend that you:

1. Use a Break-out box and a DMM to look for short circuits and reversed wiring in the communication and power lines.
2. Measure resistance across bus positive and negative while the power is off. The value should fall between 50 and 70 ohms.
 - If the resistance is greater than 60Ω, make sure there is a terminating resistor at each end of the bus. If resistance is less than 60Ω, look for and remove extra terminating resistors. Typical culprits are additional PCs added to the network for debugging.
3. Ensure that all cable and tee supports eliminate stress on cable connections.
4. Verify that the bend radius is greater than 8" for mini-sized cables and 3" for micro-sized cables.

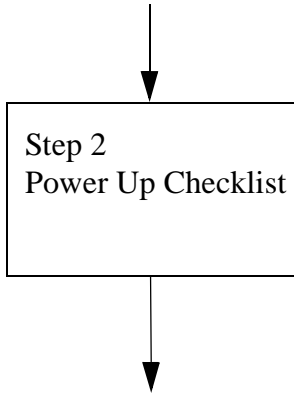
Installation



Phase 3, Step 1 Continued

6. Check the number of loads on the bus.
7. Verify that all screw-terminal connections are tight and that the green ring lines on all plug-and-play connections are showing. Hand-tighten; do not use pliers. Double check field terminated connectors.
8. Practice proper wire isolation. Identify the system's wiring location in relationship to other wiring.
9. For best operation, system wiring should reside as far away as possible from other wiring; the minimum distance is 3". This is especially important when dealing with high voltage, switched load, or electric motor-drive. Do not install bus wiring in parallel with power or other system wiring.

Installation



Power Up Checklist

▲ WARNING
UNEXPECTED SYSTEM OPERATION

- Follow all checklist steps completely to aid proper system operation.

Failure to comply with these instructions could result in death or serious injury.

When Powering Your Bus:

- Use a dedicated power supply.
- Size the power supply correctly.
- Measure the positive and negative voltage at the power supply and each end of the bus. The voltage must fall between 11 and 25 volts DC across the bus and the maximum difference between voltages must be less than the 4 volts.
- Check the number of loads on the bus (64 devices permitted).
- Fine tune alignment on devices where necessary.

Installation

Installation

Phase 3, Step 2 — Power Up Checklist

Goal: A fully functioning Smart Distributed System bus.

Use the checklist as an aid to verify your Smart Distributed System installation. This verification helps safeguard your system from problems that may hinder its operation or even damage components.

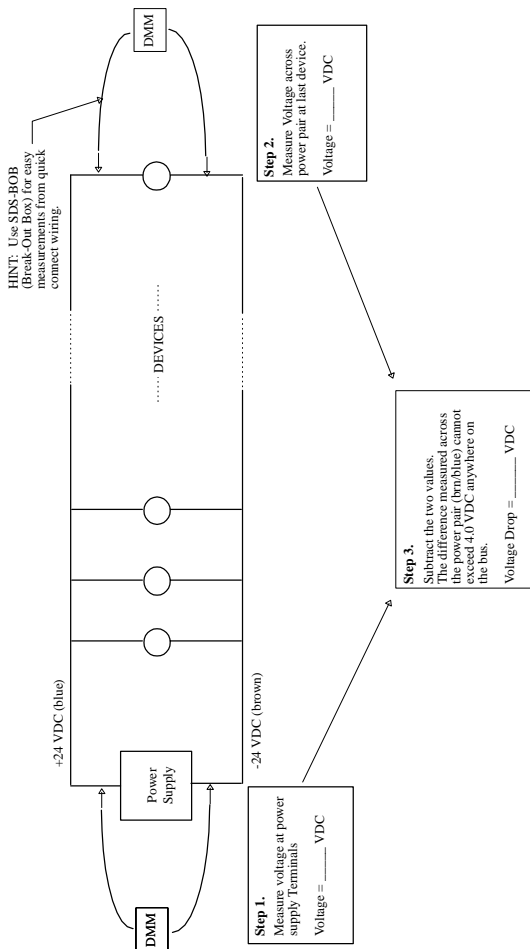
NOTICE

Reversed polarity may result in significant system damage. Be sure to check all power supply connections and bus segments that are hardwired rather than “plug-and-play.”

The bus cannot operate properly without two terminating resistors. Remember, if the host computer resides on either end of the bus, it must have a terminating resistor. You can terminate the host via jumper selection, plug-and-play terminator, or a discrete resistor connected across the black-white wire pair.

To perform this task, you need:

- Break-out box.
- Digital multimeter (DMM).
- Smart Distributed System controller.
- Checklist.



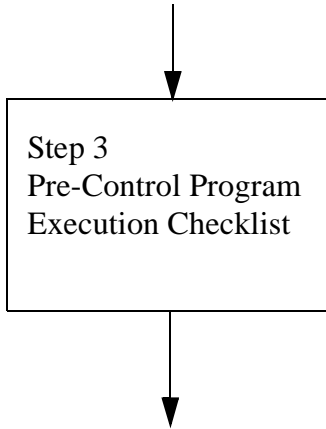
Phase 3, Step 2 Continued

Upon completion of this step, you'll have verified that Smart Distributed System bus power is adequate and correctly applied to the bus.

Power Up Checklist by the Numbers

When powering the bus, we recommend that you:

1. Verify the bus power. Be sure that you:
 - Use a dedicated power supply whenever possible. Do not share the same power source with other systems, such as: PLC I/O, switched loads, or motor drives.
 - Size the power supply correctly. In addition, positive and negative voltage should reach their final value in less than one second upon power-up.
2. Measure the voltage at the power supply terminals and at each end of the bus. Positive to negative voltage must be between 11 and 25 volts DC across the bus. The maximum difference between voltages must be less than 4.0 volts DC.
3. Follow directions for the individual devices to fine tune their alignment. Verify proper operation with a sample target where possible.



Phase 3, Step 3 — Pre-Control Program Execution Checklist

Use the following checklist before attempting to debug your control program. Following these steps may avoid lengthy debug sessions that are the result of simple network problems.

To perform this task, you need:

- Smart Distributed System controller.
- Checklist.

Upon completion of this step, you'll have all devices enrolled and functioning on the Smart Distributed System bus.

Pre-Control Program Execution Checklist by the Numbers

Before running your control program, we recommend that you:

1. Verify correct system start-up. Turn on bus power, then controller power for proper initialization.
2. Verify the presence of all system devices.
3. Verify that all inputs and outputs are operating properly by using the host's "force/sense" feature.
4. Verify that each device's programmable attribute settings are configured properly.
5. Make sure the control interface can properly select bus speed.
6. Set all devices to autobaud.
7. Fine tune alignment on all devices where necessary.
8. Check traffic load. The load must be less than 50%.



Before Executing Your Control Program

- Turn on bus power, then controller power for proper initialization.
- Verify the presence of all system devices.
- Check traffic load. The load must be less than 50%.
- Verify that all inputs and outputs are operating properly.
- Verify each device's programmable attribute settings.
- Make sure the control interface can properly select bus speed.
- Verify that all devices are set to autobaud

Commissioning Checklist Summary

Use this check list as you install your Smart Distributed System bus.

Before Powering Your Bus:

- Make sure there are no short circuits or reversed wiring in the communication and power lines.
- Use two 120 Ohm, 1/2 Watt, 2% terminating resistors on the extreme ends of each bus.
- Verify that the resistance across bus positive and negative, while the power is off, falls between 50 and 70 ohms.
- Ensure that the bend radius is greater than 8" for mini-sized cables and greater than 3" for micro-sized cables.
- Verify:
 - Bus speed is correct.
 - Host baud rate is set to the appropriate value.
 - Bus length (overall and branch length) is within guidelines.
 - Devices are correctly addressed.
- Check the number of loads on the bus (only 64 "smart" devices permitted).
- Hand-tighten all screw-terminal connections and be sure that the green ring lines on all plug-and-play connections are showing.
- Do not install your bus wiring closer than 3" to other wiring. Do not place your bus wiring in parallel with power or other system wiring.
- Verify that the:
 - Shield drain-wire is intact.
 - Shield drain-wire measures less than 1 ohm to earth-ground.
 - Shield drain-wire is attached at a single point to control earth-ground start-point.
 - Shield drain-wire is clipped flush with cable at devices.
 - Black-white and brown-white pairs remain twisted and as short as possible.

Phase 3, Step 4 — Document System

Goal: Fully document system to facilitate system integration and future troubleshooting and system enhancement.

To perform this task, you may need the following:

- Handheld activator.
- Layout with as-installed markups.
- Control software documentation.
- Network Manager software for PC-based applications.

NOTICE

A load of more than 20% on an idle bus may indicate incorrectly configured devices.

Attributes which can impact bus load include (but are not limited to):

- Normally open/normally closed (NO/NC).
- On Delay/Off Delay.
- Batch Count.
- Motion/Jam.
- SPDT Mode.
- Cyclical Timer.
- Unsolicited/Solicited Mode.

NOTICE

An incorrect Unsolicited/Solicited mode setting results in approximately a six second delay in device reaction time.

TIP

Some devices are preset to a fixed baud rate. Activating the autobaud feature on your devices helps ensure that they are set to the correct baud rate at bus initialization.

Reference Guide

Upon completion of this step, you'll be ready to begin system integration.

General Guidelines

Final system documentation should include as-installed:

- Layout showing network cabling, tees, and branches.
- Device location and power requirements.
- Device address and attribute settings.
- Control panel, power supply, and ground location.
- Complete collection of device specification and installation sheets.
- Design documents for custom enclosures or mounting.
- Design documents showing special mounting considerations.

Chapter 3

Troubleshooting Guide

Chapter Objectives

This chapter identifies some common problems and provides steps you can take to isolate and correct the situation.

Network Troubleshooting

The two major causes of I/O network problems are:

- Physical wiring problems.
- Communications errors.

The following symptoms may result:

- Bus fails to initialize properly (“Error 40” with PC Control).
- “Dead Bus.”
- Devices fail to respond to force/sense actions.
- Device operation is erratic, intermittent.
- Network errors are reported (“Missing Node”, “Bus-Off”, “Duplicate Node”).
- Problems are not isolated to specific devices.
- A large number of errors are reported simultaneously.
- System operation is unpredictable, erratic.

To isolate a problem on the network:

Step 1. Visually Inspect Physical Layer

The physical layer includes wiring, cables, tees, connectors, terminators, terminal strips, junction boxes, field-terminated connectors, etc. Look for:

- Physical damage, such as smashed or pinched cables.
- Loose connections.
- Intermittent shorts or open circuits (check FTCs and terminal strips).
- Excessive stress on cable bends, especially where connectors join tees.
- Over-tightened connectors (green line should just be visible).

- Tees not properly mounted or subject to vibration or stress.
- Excessive flexing or vibration of cable during operation.
- Proximity of cable to electrical noise sources, AC power wiring, etc.
- Experience has shown that you can find many bus-related problems by careful visual observation of the physical wiring. Be especially suspicious of physical problems if a problem begins immediately following other maintenance work, equipment relocation, or other actions that may have disturbed the wiring.
- None of the devices are operating properly.

Step 2 - Make Basic Resistance Measurements

Use a DMM connected to a Smart Distributed System Break-out Box (BOB) or where you have direct access to the wires (assume you can use direct wire access anywhere the BOB is mentioned in this document) to measure the following:

1. Remove power to all system components, including the bus, all devices, and controller.
2. Attach the BOB to the network and select “Ohms” range on the DMM. Make the measurements suggested in Table 1 on page 58.

You may need to repeat some of these measurements at various points along the bus as not all problems (such as open circuits) show up everywhere. For example, a loose connection on a screw terminal in a panel may only affect devices that are connected to that panel, even though the rest of the system checks OK.

Table 1:

DMM Negative	DMM Positive	Checking for:	Should be:
WHITE (Bus -)	BLACK (Bus +)	proper bus termination	50-70 ohms
BLUE(V-)	BLACK (Bus +)	power supply shorts	> 1000 ohms
BLUE (V-)	WHITE (Bus -)	wiring shorts	> 100K ohms
BLUE (V-)	BROWN (V+)	wiring shorts	> 100K ohms
BLUE (V-)	YELLOW (Shield)	V- shorted to earth	> 100K ohms
YELLOW (Shield)	Earth Ground	shield continuity	< 1 ohm

Table 2:

DMM Negative	DMM Positive	Checking for:	Should be:
BLUE (V-)	BROWN (V+)	power supply voltage	11-25 volts DC

Table 3:

DMM Negative	DMM Positive	Checking for:	Should be:
BLUE (V-)	BROWN (V+)	power supply ripple	.1 VAC volts DC

Step 3. Check Bus Power Supply

Apply power to the network and measure basic DC voltages. Use DMM set for DC Volts and measure across the power supply terminals. Table 2 on page 58 shows the measurement you should take with acceptable results.

Using the BOB, repeat this measurement at extreme ends (furthest distance) away from the power supply:

- Voltage at power supply: _____ volts.
- Lowest voltage measured at extreme ends of bus: _____ volts.

Subtract the two values. If the difference is greater than 4.0 Volts, the voltage drop is excessive for proper communications. Relocate the power supply to the midpoint of the bus, or reduce the current consumption of the connected devices to correct this problem.

Step 4. Check for Excessive Ripple

With power applied, select AC Volts on the DMM and measure across the power supply (blue-brown pair). Table 3 on page 58 shows the measurement you should take with acceptable results.

- If a power supply has excessive ripple on the DC output, this can interfere with reliable communications. Replace the power supply if you find excessive ripple.
- Other power supply problems may include voltage fold-back or “crowbar” protection, which may indicate an intermittent short in the bus power wiring. Normal troubleshooting methods should identify these problems.

Step 5. Check Auxiliary Power Supply(s)

Some Smart Distributed System devices such as Honeywell “smart” sensors, operate exclusively from the bus power supply. Others, including any device that consumes more than 20-50 ma., require an auxiliary power supply. Problems with auxiliary power supplies may interfere with normal network operation.

Use the DMM to verify proper DC output (and lack of excess ripple) from auxiliary power supplies. Consult your system documentation for correct voltage values.

The above checks should isolate most physical wiring problems to the point where you can identify the defect. It is possible that intermittent or hidden, more obscure network communications problems can remain hidden, but perform these simple checks to “eliminate the obvious” before going on.

TIP If devices are powered from an auxiliary power supply, you must cycle BOTH bus power and Auxiliary power for proper bus initialization. You can accomplish this with a dedicated control line, or by slaving one supply to the other. To ensure correct system start up, apply power to the bus and any auxiliary power supply(s), then apply power to the controller. Since devices wait for the host, timing of power supplies is not critical.

Step 6. Check for Network Communications Problems

Communications may be disrupted by intermittent electrical problems — the kind that are always the most difficult to fix! Because Smart Distributed

System is a very robust communications network designed to work in factory environments, you need to understand how the protocol operates under adverse conditions, and what can cause it to go wrong.

There are three basic types of communications errors commonly reported:

- Bus-off Error — when a device experiences difficulty in communicating and leaves the bus.
- Missing Node Error — when the host does not receive a reply from a device when expected.
- Duplicate Node Error — when two or more devices have incorrectly been given the same network address.

Smart Distributed System Communications Basics:

Smart Distributed System uses the CAN (controller area network) protocol, and sends data over two wires using differential voltages similar to RS 485 in the +/- 2.5 volt range. Due to the high speed involved, a meter or oscilloscope is useless in visualizing what is going on over the network. You need a specialized monitoring tool, along with a basic understanding of how Smart Distributed System works:

- Input devices send messages to the host when an event occurs. The host sends messages to output devices when required by the controller. Messages are only sent when necessary, i.e. only one message will be sent to turn an output on, rather than one message every scan.
- Recipients send an acknowledgment to every message, except initial autobaud test messages and multicast commands.
- Only one device can communicate at any given time. The device’s address determines its

priority in using the network — lower addresses have priority over higher addresses.

- Each message follows strict formatting rules. Any violation of these rules results in an error.
- A normally-operating bus will have very few or zero error frames. Smart Distributed System works with occasional error frames, but when an error frame happens, the message must be re-sent.
- It's impossible to say how many error frames are too many. But a change in the number of error frames is a warning that something has changed.
- Error frames are invisible to control programs. Telltale signs of excessive error frames include sluggish response, missing devices, or bus-off conditions.

What causes error frames?

Each device listens for its own messages. Any interference will cause the device to generate an error frame. For example, if a noise spike overrides the expected voltage during a message, it may cause an error. This is why the proper routing and shielding of bus wiring is so important.

Intermittent electrical connections are another cause of error frames. Unlike conventional wiring, even a very brief open circuit in a bus communications wire will disrupt the message in process and cause an error frame. On a positive note, this means that the presence of error frames is an indication that a hard-to-find electrical intermittent problem is present!

What happens to a device when an error frame occurs?

Because each device listens for its own messages,

it knows if it may have been the cause of the error. The designers of CAN built features into the system to quickly remove any malfunctioning devices from the network, and this is probably what is happening if devices seem to disappear or drop off the bus.

Here's what happens inside a device: When a message is sent, an internal counter advances, and if no errors occur, the counter decrements back to zero. But if an error occurs, the counter is advanced, and if problems continue, the counter eventually reaches a value of 255 — at which point the device goes bus-off and stops trying to communicate. Although all devices see the error frame, only the device that is sending at the time removes itself from the network.

When a device goes bus-off, it seldom means the device is bad, but rather that there is some interference when it is trying to send messages. It may be that some outside interference was persistent enough to interfere with successive messages from the device, forcing it to go bus-off. Another explanation is that electrical noise may be occurring at random times, creating bus-off conditions in random devices. Of course, it is also possible that there is a defect in a device, and by going bus-off, it allows the rest of the network to communicate as designed.

When a bus-off condition occurs, the device first sends a diagnostic message to the host to signal that it is leaving the network. Then the internal microprocessor in the device is reset and tries to re-join the network. If a problem is really persistent, it may do so, only to be forced off the bus again. This can create the symptom of erratic operation of a system which works while the device is present, and fails to work when it is off-bus.

Remember: Bus-off is an indication that the device had difficulty communicating.

What causes Missing Node errors?

When a device is reported as missing, this means the host was unable to communicate with it as expected.

Each host polls each device on the network at a pre-defined interval to make sure all devices are present. For the Honeywell PC Interface Card, this rate is set at 2.5 seconds. If no communication has occurred with a device, the Honeywell PC Interface Card sends a heartbeat message approximately every 2.5 seconds, and if the device fails to respond, it reports a missing node error.

Missing node generally is a clear signal that the device is not electrically present on the bus. However, under extremely heavy bus traffic conditions, it's possible for a missing node error to occur because other devices (with higher priority) prevent the response from being sent. While not common, missing node is sometimes an indication of excessively-high bus traffic, which may be the result of a device with cyclical timer (Attribute 10) enabled, a device that is chattering, or a programming error in the control software which is generating excessive traffic. It will be difficult to detect this condition without some type of bus analyzer.

How to diagnose communications problems:

1. **Look for signs of communications errors.** Each controller is different, for example, in the Honeywell PC Interface Card, the bus-off error is bit 0 of byte 2 in the Device Diagnos-

tic Register. By examining the diagnostic register, you can tell which device is experiencing the error. Examine the device and its bus connections carefully. You may wish to try substituting a new device (properly addressed) to determine if the problem is in the network or device. Other tools, such as SDSTOOLS and the Honeywell Network Manager let you see errors on the network.

2. **Examine the environment for possible causes of communications errors:**
 - EMI or electrical noise from generators, motors, welders, high voltage arcing, battery chargers, hand-held radios, etc. Check the list of case histories on page 75 for suggestions.
 - Electrostatic discharge is a problem unique to some conveyor applications. One technique is to run the conveyor with lights out so you can more readily see arcing ESD. Grounding may be necessary to eliminate ESD.
 - Do problems happen at certain times of day when specific equipment may be in use?
 - Try keeping a log of all communications problems — a trend may emerge over time.
3. **Look for signs of excessive bus traffic.** The Handheld Activator provides a function for measuring bus activity — typical values should be under 50%. Examine the control software and device attributes for potential causes of excessive bus traffic.
 - Attribute 6 should be 0 for unsolicited (event-driven) operation.
 - Some photoelectric sensors can false-trigger on florescent lights, light-curtains, and other sensors, creating excessive traffic.
 - Avoid traffic-generating control software techniques such as reading or clearing diagnostics in every scan.

- Try stopping the control program (but leave the bus running) to see if this reduces bus traffic.
 - Try removing suspect devices (see also *What is Divide and Conquer* page 67).
4. **Make sure there are no duplicate addresses.** If two devices exist with the same address, they will both respond at the same time resulting in error frames. Because both devices have the same priority, this will continue until both devices go bus-off. This process will continue until you resolve the duplicate address problem. (To guard against this, Honeywell's PC control software checks for duplicate node addresses at start-up.) You will have to re-check addresses or remove devices from the bus to determine if duplicate addresses are present.

Step 7. Using Advanced Troubleshooting Techniques

If problems continue, at this point you have three options:

1. Call Honeywell's Customer Response Center at 800-537-6945 in the U.S., (815) 235-6847 elsewhere. An application engineer may be able to provide further assistance or arrange for an appropriate service response.
2. Continue troubleshooting on your own without specialized tools.
3. Continue troubleshooting on your own, but with special bus test equipment.

Option 1:

Unless you are experienced in troubleshooting CAN-based networks, arranging for Honeywell service may be the best option, especially if time is of the essence.

Option 2 or 3:

If you are willing and able to invest more time and effort, you can isolate many problems without special test equipment or outside help. But the most efficient method involves using special purpose tools that will help pinpoint network communications problems. In either case, use a divide and conquer approach to isolate the problem.

What is divide and conquer? Because all devices are connected in parallel, it is necessary to disconnect some devices to isolate the problem to a physical location. Follow these rules during this process:

▲ WARNING
PERSONAL INJURY

- Be sure that troubleshooting activities, which will render parts of the bus inoperative, do not result in unsafe conditions.

Failure to comply with these instructions could result in death or serious injury.

1. Whenever a bus is broken into segments, install a terminator on the segment that is still operational.
2. Depending on the power supply location, you may need to provide power to the bus during troubleshooting work.
3. Remember to put everything back when finished!

Divide and conquer without specialized tools:

1. Remove all power from the network and controller.
2. Break the bus at the midpoint, and install a terminator on the end that is connected to the controller. (If the power supply has been disconnected, you must supply power in some other way).
3. Re-start the controller and observe the results. If the problem is gone, then it must be somewhere in the half that is now disconnected. If the problem persists, it must be in the half that is still connected. Either way, you've just eliminated half of the bus wiring as the possible source of the problem.
4. Remove power again, and restore the original connection.
5. Move halfway from the midpoint (i.e. on the results of step #3) and again break the bus and attach the terminator.
6. Again re-start the controller and observe the results.
7. Continue, successively moving halfway closer each step until the problem is isolated. When the direction of the problem reverses, you know exactly where the problem is located.
8. Continue with normal troubleshooting if needed, or fix the problem by replacing the defective component or device.

This process is the fastest method to isolate a problem. It is also the least disruptive to the system. The biggest weakness is the need to continuously re-start the control system to observe the effect of each change. Another shortcoming of this approach is that it may take a long time to see the effect of each step, especially if the problem is intermittent in nature.

Divide and conquer — with specialized tools:

The process is the same, except specialized equipment makes it easy to see the effect of each step in the troubleshooting process.

In addition to error frames, most communications problems, including duplicate addresses and electrical interference causing bus-off errors, are an indication that there is a problem in the physical wiring. Thus, a tool that can detect error frames greatly simplifies the troubleshooting process.

What specialized tools are available?

The number of tools capable of detecting error frames is relatively small, but includes:

- Honeywell CAN Error Monitor. This is a small, bus-powered portable device which provides an indication of error frames.
- Honeywell SDSMON. This is a PC-based tool, which is meant to run on a laptop computer having a PCMCIA card slot to accept the interface adapter. Software provides for data capture and logging as well as error detection.
- Vector CANalyzer. This is a PC-based high-end CAN network analyzer, which has been customized to display messages. It offers very extensive features and is meant for use by experts.

It is important to note that the Hand-Held Activator, Honeywell PC Interface Card, and all other PC/PLC controller interfaces today do not have the ability to detect error frames.

The best way to select the proper tool for your needs is to consult with an application engineer in the Honeywell Customer Response Center.

How are specialized tools used?

- **Error Monitor:**
 - You can attach the portable Error Monitor to a network anywhere that is convenient (just don't exceed topology limits!), so you can easily see the effect of changes.
 - If a hidden problem exists — such as a loose connection in a plug-and-play tee — you may need to shake, wiggle, or bend a connector while observing the effect on the Error Monitor.
 - The audible alarm of the Error Monitor may be coupled over a radio link.
- **PC-based Tools:**
 - You can configure the PC-based tools to log data for off-line analysis.
 - These tools time-stamp each event in the PC so you can see trends.
 - You can leave PC-based tools connected for long-term, unattended monitoring.
 - The PC provides more data, including number and type of various messages, and timing of messages. You can set it to monitor all, or specific groups of addresses.

Specialized tools will speed the troubleshooting process by identifying error frames that occur as a result of communications problems on the network. It's important to remember that error frames are different than other errors, such as a device error (low gain on a photoeye, for example), or a network error (such as Missing Node). Error frames are an indication of problems at the CAN communications level, and are most often the result of intermittent electrical connections or external electrical noise that is entering the system and interfering with network communications. Review the Installation Guide section on grounding, shielding, and proper wiring practices.

Step 8. Network Management Problems

As an evolving network and standard, some aspects of network behavior are not completely documented, and are implemented differently by different manufacturers.

One example of this is how the host manages a network during start-up or after a power failure. For purpose of illustration, the next section describes how the widely-used Honeywell PC Interface Card behaves.

Network Initialization — Honeywell PC Interface Card

When the network is powered-on, all devices are inhibited from sending messages, awaiting instructions from the host.

The Honeywell PC Interface Card is a self-contained co-processor which supports two buses. The software which runs the card is stored on the PC hard drive and downloaded by a routine called SDSBEGIN. (Consult the PC Interface Users Guide for complete details). Honeywell recommends creation of a configuration file, which will determine that all devices are present and properly configured at start-up, and helps automatic detection of certain types of network errors.

From a network viewpoint, the PC interface card performs two important functions at start-up:

- **Autobaud** - the host allows each device to select the proper network data communications rate.
- **Enrollment** - the host determines the type of device at each address and prepares to communicate with each device.

Note 1 - PC interface card internal diagnostics. These errors should never occur in normal operation.

Note 2 - Watchdog Tripped: Since the PC interface card functions independently of the PC control processor, a Watchdog Timer is implemented to check the linkage between the two systems. Periodically (i.e. every "scan") the driver software executing on the control PC must update a memory location on the PC interface card. If this fails to happen within a preset period of time, the Watchdog Timer Tripped bit is set, and all outputs are forced to the default state, as defined by the driver. Typical options are "Off", and "Hold Last State".

Note 3 - Three different types of errors from the CAN controller are reported. Typically, these errors are indicative of problems in the physical layer, or device(s). "Error-40" also occurs if no devices are found on the network.

Table 4

Bit Position	Binary	Hex	Description	Action
0	0000 0000 0000 0001	00 01	Power	restore bus power
1	0000 0000 0000 0010	00 02	Rx FIFO Overflow ¹	reload or replace card
2	0000 0000 0000 0100	00 04	Tx FIFO Overflow ¹	reload or replace card
3	0000 0000 0000 1000	00 08	IMB FIFO Overflow ¹	reload or replace card
4	0000 0000 0001 0000	00 10	Device Error	read device register
5	0000 0000 0010 0000	00 20	CAN Overrun Status ³	troubleshoot bus
6	0000 0000 0100 0000	00 40	CAN Error Status ³	troubleshoot bus
7	0000 0000 1000 0000	00 80	CAN Bus Status ³	troubleshoot bus
8	0000 0001 0000 0000	01 00	Health Check ¹	reload or replace card
9	0000 0010 0000 0000	02 00	Watchdog Tripped ²	re-start PC control software

At the completion of these tasks, normal operation begins, which includes a 2.5 second heartbeat to all devices.

Typical problems at start-up include:

- Incomplete Enrollment - some or all devices are missing.
- Duplicate node addresses.
- Errors in the Global Diagnostic Register (Refer to Table 4 on page 72).

Using SDSTOOLS.EXE

Honeywell provides a simple DOS-based utility, called SDSTOOLS, with each PC Interface Card. This tool provides a variety of functions that are useful in troubleshooting networks, including:

Function	Command
Start Bus and Enroll all devices	I
View number and type of enrolled devices	G
Write a value to an output device	W
Read the value of an input device	R
Read and write the value of device attributes	A
View the status of all Inputs at once	M
View the status of all Outputs at once	N
Toggle an output in various patterns and rates	Z
Link an Output to an Input for test purposes	U
Select either of two buses from up to six interface cards	B
Stop the PC interface card software	F
Get pertinent device information	T
Change device addresses	Y

Network Initialization - Non-Honeywell

Controllers

Different PC and PLC controllers and the ITS all have various means of initialization and start-up of the bus. All must accomplish Autobaud — although some may look to a configuration file rather than poll the network to enroll devices. Refer to manufacturers data sheets and supporting software for details.

Each controller and programming software package provides basic capabilities to view, force, and sense I/O, and this should provide the basic tools for network troubleshooting.

Problems with the Host:

The Host is subject to hardware failure, like any other electronic assembly. For the Honeywell PC interface card, “Error 100” indicates a major hardware fault and the card must be replaced. “Error 40” will occur if the CAN interface circuitry on the card is defective, preventing the Host from communicating with the rest of the network. “Error 80” and “Error 20” are indications of Error Frames or other communications problems at the Host. Use the *Divide and Conquer* method (see page 67).

Problems with Power Sequencing:

When power is applied, all devices begin looking for a Host, and after initialization, both Host and Devices transition into normal operating mode. Under some conditions, such as momentary power disruptions, electrical storms, etc., the Host and Devices may be in different operating modes. Devices should recover properly, but if problems persist, it may be necessary to cycle power to the network. It should not be necessary to cycle power

or re-boot the Host.

Since Devices will wait for the Host, the timing of power supplies is not critical.

Case Histories

This is a list of some causes of problems that occurred in Smart Distributed Systems bus implementations:

- Terminator with open resistor.
- Break in shield to a device, allowing noise to enter.
- Tees where female contacts had been deformed, creating intermittent connection.
- Excessive power supply ripple and noise from switching power supply.
- Static discharge from conveyor rollers in epoxy-paint insulated frame.
- Be aware of Attribute-6 Solicited/Unsolicited mode. A 2.5 second delay in response time from devices results when Attribute-6 is set to OFF (solicited mode).
- Unexpected operation from devices with “smart” attributes inadvertently enabled.
- “Chattering” photoelectric sensors from florescent lights.
- Excessive bus traffic caused by reading/clearing diagnostics in every scan.
- Errors during Autobaud caused by non-conforming devices.
- Excessive Error Frames due to vibration of loose connections.
- Ground loops caused by multiple-point grounding of the shield wire.
- Noise causing Error Frames due to proximity of Smart Distributed System cables to 440 VAC.

Reference Guide

- Erratic operation of network caused by connecting V- (blue) to earth ground.
- Excessive Error Frames due to use of unshielded non-approved cable in motor panels.
- Shield not connected to earth ground.
- Damage to devices caused by reversing polarity of 24 volt power supply.
- No output from Output device due to incorrect configuration of Mask register.
- No bus operation because Bus + and - leads were reversed in a panel.
- Excessive voltage drop under worst-case conditions disrupted communications.
- Broken internal connection in device.
- Erratic operation caused by connecting diagnostic tool without disabling terminator.
- Damage to devices caused by “Hot Swapping” - breaking the bus trunk with power on.
- Bus power short caused by defective screw-on cap on diagnostic tee.
- Excessive Error Frames after fork-lift ran over bus cable.
- Use of wire-nuts or other poor connecting methods.
- Damage to cables by use as foot-rest, hand-hold, etc.
- Failure of connector as a result of using pliers to over-tighten.
- Communications problems caused by use of unshielded bulkhead cables inside power cabinets.
- Errors when using RS-232 type cable for the Smart Distributed System bus.
- Inability to cycle power to auxiliary power supplies.
- Incorrect Attribute Settings.

Chapter 4

Reference

Chapter Objectives

This chapter:

- Defines commonly used terms that you may encounter in this and other Smart Distributed System documentation.
- Defines Smart Distributed System physical specifications.
- Summarizes correct design methodology to assure successful implementation of a Smart Distributed System.

Commonly Used Terms

This term:	Is defined as:
Attribute	A device value that you can read and/or write.
Branch	The physical cable that connects a device to the trunk, sometimes known as “drop cable.”
Bus	The logical medium within the trunk and branches, connecting network devices and the controller, over which communication takes place.
CAN (Controller Area Network)	A serial data bus for real-time applications. The device network protocol used by Smart Distributed System

CAN chip	A microprocessor that enables a device to communicate as an addressable node on a CAN.
Change-of-state	A concept in CAN message-delivery in which network nodes transmit a message to the controller only when their state changes from on to off or vice versa.
Device	Any I/O product connected, directly or indirectly, to the bus.
Dumb device	Any device without an embedded CAN chip.
Electrical load	Any bus device that draws current from the network power.
Logical address	The numeric value of the upper eight bits of the eleven bit standard CAN identifier, excluding the Smart Distributed System direction bit. This includes identifier bits ID ₉ through ID ₃ defined in Bosch V2.0A CAN Specification. The value range is from 0 to 125. Addresses 126 and 127 are illegal on CAN networks, and should not be used. (See also, <i>User address</i>).
Logical device	A single input or output control element, along with its embedded device(s). Each logical device has a single <i>logical address</i> .

Logical state	The on/off state of an electrical signal or flag.
Multiple binary object	A single-address node, containing multiple I/O, whose message accounts for the state of each I/O point (for example, Multiport).
Multiple embedded object	A single-address node containing multiple I/O. Each I/O point retains a unique “sub-address” which transmits change-of-state data (for example, Quad I/O Concentrator).
Network	All media, connectors, and associated communication elements by which a given set of devices communicate.
Network data	Data that is communicated to and from other devices on the bus. This data relates to the status and condition of an object. This is typically the data required during the execution of a control program.
Network variable	An attribute ID that contains network data.
Node	A physical component connected to the bus via a single CAN interface (i.e. one or more logical devices including the CAN interface).

Object model	A description of behavior or structure that is completely defined by a set of properties (attributes), a set of actions, and a set of events.
Output	Describes the reference of the Smart Distributed device object's network variable. The reference is with respect to a Smart Distributed System host interface. Defined as receiving an output response from a Smart Distributed System host interface.
Physical component	An abstraction representing a single physical package that is optionally modular, comprises hardware and software, and is connected to the network. Contains one or more logical devices.
Power cycle	The act of removing and re-applying electrical power.
Power up	The time period beginning with the application of power.
Register	A RAM memory location used for the storage of numeric information or Flags.
Smart Distributed System Host	A device that consumes input network data and/or produces output network data. It may also perform the functions of message acknowledgment and start-up of other devices.

Smart device	Any device with an embedded CAN chip.
Tee	A physical three-way connector used to join devices to a trunk.
Terminating resistor	120 Ohm, 1/2 Watt, 2% resistors placed at the extreme ends of networks to eliminate reflections.
Topology	The physical arrangement and spacing of the trunk, branches, and other physical components.
Trunk	The main physical cable of a network to which devices and a controller connect via branches and tees.
Voltage drop	The voltage dropped over the length of the bus cable.

Topology

Topology is the physical arrangement and spacing of the trunk, branches and nodes. A standard topology is a single trunk with short branches. For information on minimum node separation, see the table on page 84.

Factors affecting bus length and physical layout include:

- Voltage drop on the power pair of the bus cable. See page 59 for additional information.
- Resistance of conductors and connectors.
- Current required by each node.

The table on page 84 gives maximum system trunk lengths for various data rates, independent of bus voltage drop.

Cables

The two cable categories (standard quick connect cables and conventional point-to-point wiring cables) relate to the two general connection schemes used to implement a system.

Standard (quick connect) Cables:

- 4-wire, shielded cable with 5-pin mini connectors.
- 4-wire, shielded cable with 4-pin micro connectors.
- 4-wire, shielded cable with 4-pin micro and 5-pin mini connector combinations.
- 4-wire, shielded cable with 4-pin micro and 5-pin mini connector pigtailed.
- Tee connectors for bus cable.
- Terminators that are placed at the ends of the bus cable.
- Others not listed.

These cables consist of two twisted shielded pair cables within a single sheath. One twisted pair provides power to devices, the other handles device communications.

Conventional Point-to-Point Wiring

Specifications for and diagrams showing these connectors and cables begin on page 89.

Physical Specifications

The Smart Distributed System is Controller Area Network (CAN) compatible. CAN specifications define the physical network medium (the cable) and other “layers” of the network environment. This section concentrates on the physical layer.

The table below provides physical specifications for Smart Distributed System cable and components. The following pages define other physical and electrical network specifications.

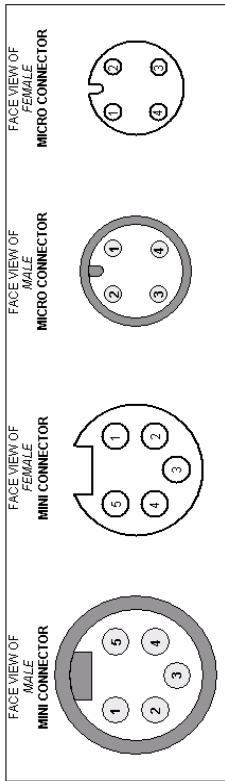
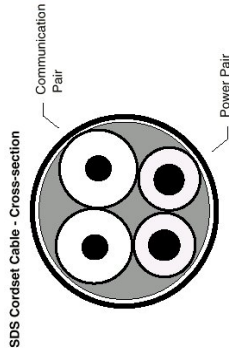
Characteristic	Standard Cables		Conventional		
	1 foot recommended separation. In any case, no more than 4 tees can be connected directly together (without trunk cable between tees).		.1 meter		
Minimum Separation of Nodes	Note: Not all controllers support all Baud rates				
Trunk Length (max)	Data Transmission Rate		Branch Length (max)	Number of Nodes (max)	Maximum Operations per Second
	feet	meters			
75	22.8	1 Mbit/s	1	32	800
300	91.4	500 kbit/s	3	64	500
600	182.8	250 kbit/s	6	64	300
1500	457.2	125 kbit/s	12	64	200

Plan Your Application

- Determine the type and location of all devices needed. Count the total number of I/O points needed.
- Count the number of bus devices required. Some devices, such as Honeywell smart devices with diagnostics, require one bus address each. A variety of remote I/O interfaces support multiple devices on a single address.
 - You can make a maximum of 64 electrical connections to a bus, even though a device may provide more than one I/O point.
 - Divide the total number of devices by 64 to determine how many buses you need. (It’s a good idea to leave some unused addresses for future expansion.)
 - Sketch the layout of each bus required. A device’s location on the bus has almost nothing to do with its control function. Information from all devices is integrated into the controller. Design your bus layout so it is easy to install and maintain.
 - Some devices only have one electrical connection to the bus but require more than one address. In such cases, the total number of addresses cannot exceed 126.
 - Devices connect to the bus trunk through tee and branch cables. The maximum length of both the trunk and each individual branch is determined by the bus’s baud rate. The faster the baud rate, the more severe the length limitation (refer to the chart on page 82). In addition, not all controllers support all baud rates.

Reference

Reference



Note: Male connectors have pin contacts, while female connectors have socket contacts.

Bus Cable Wire Termination and Color Code

Mini Pin	Micro Pin	Wire Insulation Color	Function
1	----	----	Bus Shield
2	1	Brown	Bus Power (V+)
3	2	Blue	Bus Power (GND)
4	4	Black	Bus Communications (CAN_H)
5	3	White	Bus Communications (CAN_L)



Select 125K baud if at all possible. This gives you the greatest flexibility, cable length, and controller selection. (If you need higher baud rates, consult an application engineer before proceeding.)

- Once you have a preliminary bus layout, the make sure it meets the following topology rules:
 - No more than 64 electrical bus connections.
 - No more than 4 tees connected directly together.
 - Total trunk length less than the maximum shown on page 84.
 - No branch cable longer than maximum shown on page 84.
 - Less than 2.0 volts through the V- wire to any device.

In addition, make sure selected devices do not create an excessive voltage drop along the bus. A complete analysis requires extensive Ohm's Law calculations. A simple Excel spreadsheet program (Bus Builder), available from Honeywell, can assist with this calculation.



Place the power supply near the midpoint of the electrical load to minimize voltage drop across the bus. The maximum voltage drop, as referenced to the power supply terminals, is 2.0 volts in either V- wire, or 4.0 volts from V- to V+.

- For each bus, prepare an installation drawing that shows:
 - Location and type of each device.
 - Length and routing of each trunk cable section.
 - Length and routing of each branch cable.
 - Bus power supply location and wiring.
 - Controller wiring.
 - Termination resistor locations (see page 25).

Reference

Reference

Wire and Cable Alternatives

A variety of cable and wiring schemes can meet your requirements. For example, you can use bulk cable and field-terminated cables for long runs, and bulkhead cables to simplify connections between the bus and control panels. You could purchase new communications cable only, and run the bus power over conventional wiring. New cable options continue to evolve. Contact Honeywell for the latest information.

Topology Alternatives

Some new wiring systems reduce installation time and cost at the expense of reducing overall bus trunk length. Also, CAN-level repeaters and bridges extend cable lengths past the limits by creating star topologies. Contact a Honeywell application engineer if you feel these alternatives might suit your application.

Plug-and-Play Cabling

Quick connection, ease of installation, and reliable operation make plug-and-play cables a good choice for most applications. While there are a number of suppliers of similar cables, these cables and connectors are not built to a common standard and may not be fully interchangeable. Consult the following pages for available Honeywell cables and wiring accessories.

Connector PIN Assignments

5-pin Connector	4-pin Connector	Wire Color	Bus Function
1	—	—	Cable Shielding
2	1	Brown	Power + V
3	2	Blue	Power - V
4	3	Black	Bus Communications (+)
5	4	White	Bus Communications (-)

Cable Catalog Listings

The first letter after the SDS- refers to construction material: A for Regular-Duty, B for Harsh-Duty. The second letter refers to the female end, the third letter to the male end.

Connector Letter Assignment

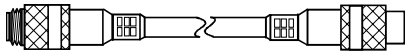
- A - Straight end mini connector.
- B - Straight end micro connector.
- C - Pigtail (no connector).
- D - Right angle mini connector.
- E - Right angle micro connector.

The last three digits of the part number refer to the cable length (for example, 003 is 3 feet).

Trunk Cables

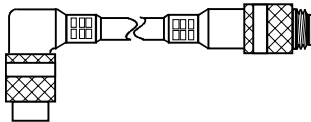
If a device has a mini connector, use a trunk cable.

STRAIGHT FEMALE MINI TO STRAIGHT MALE MINI CONNECTOR CABLE



Catalog Listing		Description
Regular	Harsh-Duty	
SDS-AAA-001	SDS-BAA-001	1 ft. (0,3 m)
SDS-AAA-002	SDS-BAA-002	2 ft. (0,61 m)
SDS-AAA-003	SDS-BAA-003	3 ft. (0,91 m)
SDS-AAA-006	SDS-BAA-006	6 ft. (1,83 m)
SDS-AAA-010	SDS-BAA-010	10 ft. (3,05 m)
SDS-AAA-012	SDS-BAA-012	12 ft. (3,66 m)
SDS-AAA-025	SDS-BAA-025	25 ft. (7,62 m)
SDS-AAA-050	SDS-BAA-050	50 ft. (15,25 m)
SDS-AAA-080	SDS-BAA-080	80 ft. (24,38 m)

RIGHT-ANGLE FEMALE MINI TO STRAIGHT MALE MINI CONNECTOR TRUNK CABLE

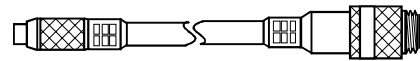


Catalog Listing		Description
Regular-Duty	Harsh-Duty	
SDS-ADA-001	SDS-BDA-001	1 ft. (0,3 m)
SDS-ADA-003	SDS-BDA-003	3 ft. (0,91 m)
SDS-ADA-006	SDS-BDA-006	6 ft. (1,83 m)
SDS-ADA-010	SDS-BDA-010	10 ft. (3,05 m)
SDS-ADA-012	SDS-BDA-012	12 ft. (3,66 m)
SDS-ADA-025	SDS-BDA-025	25 ft. (7,62 m)
SDS-ADA-050	SDS-BDA-050	50 ft. (15,25 m)

Branch Cables

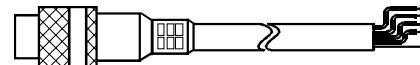
Use branch cables between the tee or junction box and device.

STRAIGHT FEMALE MICRO TO STRAIGHT MALE MINI CONNECTOR CABLE



Catalog Listing		Description
Regular Duty	Harsh-Duty	
SDS-ABA-001	SDS-BBA-001	1 ft. (0,3 m)
SDS-ABA-002	SDS-BBA-002	2 ft. (0,61 m)
SDS-ABA-003	SDS-BBA-003	3 ft. (0,91 m)
SDS-ABA-006	SDS-BBA-006	6 ft. (1,83 m)
SDS-ABA-010	SDS-BBA-010	10 ft. (3,05 m)
SDS-ABA-012	SDS-BBA-012	12 ft. (3,66 m)
SDS-ABA-015	SDS-BBA-015	15 ft. (4,57 m)

STRAIGHT FEMALE MINI CONNECTOR TO PIGTAIL BRANCH CABLE

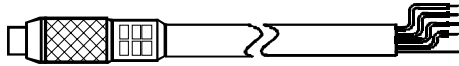


Catalog Listing		Description
Regular Duty	Harsh-Duty	
SDS-AAC-003	SDS-BAC-003	3 ft. (0,91 m)
SDS-AAC-006	SDS-BAC-006	6 ft. (1,83 m)
SDS-AAC-012	SDS-BAC-012	12 ft. (3,66 m)
SDS-AAC-150	SDS-BAC-150	150 ft. (45,72 m)

Reference

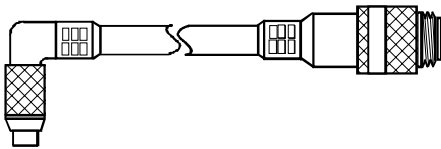
Reference

STRAIGHT FEMALE MICRO CONNECTOR TO PIGTAIL CABLE



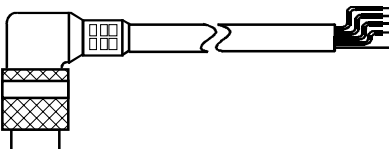
Catalog Listing		Description
Regular Duty	Harsh-Duty	
SDS-ABC-003	SDS-BBC-003	3 ft. (0,91 m)
SDS-ABC-006	SDS-BBC-006	6 ft. (1,83 m)
SDS-ABC-012	SDS-BBC-012	12 ft. (3,66 m)

RIGHT-ANGLE FEMALE MICRO TO STRAIGHT MALE MINI CONNECTOR BRANCH CABLE



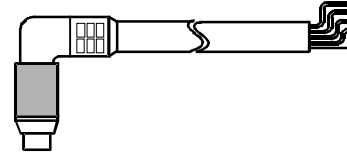
Catalog Listing		Description
Regular Duty	Harsh-Duty	
SDS-AEA-001	SDS-BEA-001	1 ft. (0,3 m)
SDS-AEA-003	SDS-BEA-003	3 ft. (0,91 m)
SDS-AEA-006	SDS-BEA-006	6 ft. (1,83 m)
SDS-AEA-010	SDS-BEA-010	10 ft. (3,05 m)
SDS-AEA-012	SDS-BEA-012	12 ft. (3,66 m)

RIGHT-ANGLE FEMALE MINI CONNECTOR TO PIGTAIL BRANCH CABLE



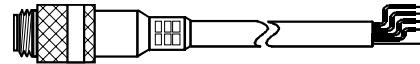
Catalog Listing		Description
Regular Duty	Harsh-Duty	
SDS-ADC-003	SDS-BDC-003	3 ft. (0,91 m)
SDS-ADC-006	SDS-BDC-006	6 ft. (1,83 m)
SDS-ADC-012	SDS-BDC-012	12 ft. (3,66 m)

RIGHT-ANGLE FEMALE MICRO CONNECTOR TO PIGTAIL CABLE



Catalog Listing		Description
Regular Duty	Harsh-Duty	
SDS-AEC-003	SDS-BEC-003	3 ft. (0,91 m)
SDS-AEC-006	SDS-BEC-006	6 ft. (1,83 m)
SDS-AEC-012	SDS-BEC-012	12 ft. (3,66 m)

STRAIGHT MALE MINI CONNECTOR TO PIGTAIL BRANCH CABLE



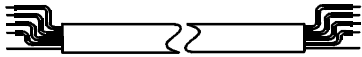
Catalog Listing		Description
Regular Duty	Harsh-Duty	
SDS-ACA-003	SDS-BCA-003	3 ft. (0,91 m)
SDS-ACA-006	SDS-BCA-006	6 ft. (1,83 m)
SDS-ACA-012	SDS-BCA-012	12 ft. (3,66 m)

Reference

Reference

Bulk Cable

Use bulk cable for installations using hardwire methods.



Catalog Listing		Description
Regular Duty	Harsh-Duty	
SDS-BLK-100	SDS-BBLK-100	100 ft. (30,5 m) Bulk Cable
SDS-BLK-500	SDS-BBLK-500	500 ft. (152.5 m) Bulk Cable
SDS-BLK-1000	SDS-BBLK-1000	1000 ft. (305 m) Bulk Cable

PC Control Cables

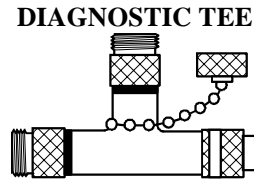
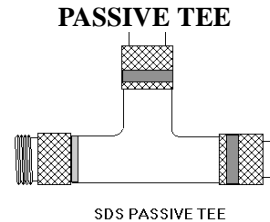
Use a PC control cable to connect a PC interface circuit card to the Smart Distributed System.

Catalog Listing		Description
Regular	Harsh-Duty	
SDS-AFA-003	SDS-BFA-003	3 ft. (0,91 m) Mini D sub with/straight exit
SDS-AFC-010	SDS-BFC-010	10 ft. (3,05 m) Female D sub pigtail

Passive And Diagnostic Tees

There are two types of Smart Distributed System tees: passive and diagnostic. Use passive tees to connect devices to the trunk. Use a diagnostic tee with the activator.

Install a diagnostic tee in the trunk during installation. If maintenance is required, remove the tee's protective dust cap and install the activator into the system via the tee.



NOTICE

Make sure bus is powered before attaching the Activator.

Catalog Listing		Description
Regular Duty	Harsh-Duty	
SDS-TEE	SDS-BTEE	Passive Tee
SDS-DIAG	SDS-BDIAG	Diagnostic Tee

Reference

Reference

Male And Female Terminators

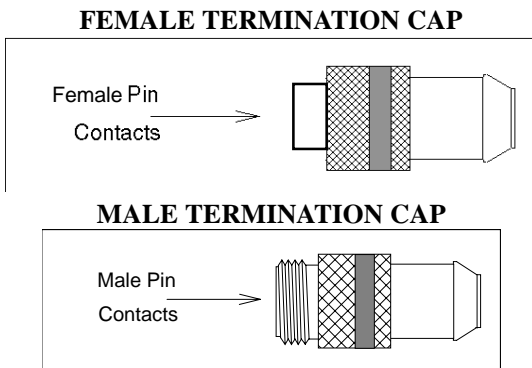
Use a termination cap to match the impedance of the signal communication lines on the bus, preventing signal reflection. A cap consists of a 120Ω resistor between the Bus+ and Bus- contacts inside a molded connector body.

The Smart Distributed System bus must be terminated at each end with a 120 ohm resistor between the BUS+ and BUS- connectors. When the bus ends at a tee, use a termination cap.

Mini And Micro Dust Caps

Mini and micro dust caps prevent dirt from entering unused tee and multipoint connectors. The caps also help prevent system short circuits.

Catalog Listing	Description
SDS-CAP-MEXT	Mini dust cap with external threads
SDS-CAP-MINT	Mini dust cap with internal threads
SDS-CAP-MCRO	Micro dust cap with external threads



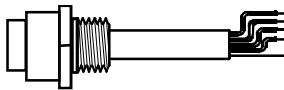
Catalog Listing		Description
Regular Duty	Harsh-Duty	
SDS-TERM	SDS-BTERM	Male Termination Cap
SDS-TERM-F	SDS-BTERM-F	Female Termination Cap

Reference

Reference

Bulkhead Connectors

Use bulkhead connectors to connect the Smart Distributed System bus through walls or electrical enclosure bulkheads.



Catalog Listing		Description
Regular Duty	Harsh-Duty	
SDS-BKHD-001	SDS-BBKHD-001	0.5 ft. (0,15 m) female Bulkhead Cable
SDS-BKHD-003	SDS-BBKHD-003	3 ft. (0,91 m) female Bulkhead Cable
SDS-BKHD-006	SDS-BBKHD-006	6 ft. (1,83 m) female Bulkhead Cable
SDS-BKHD-010	SDS-BBKHD-010	10 ft. (3,05 m) female Bulkhead Cable
SDS-BKHD-M-001 -003 -006 -010	N/A	Male Bulkheads

Activator Cables

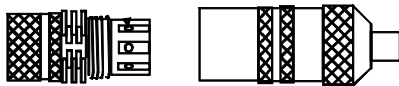
The activator comes with a mini-connector cable, micro-connector cable, Quad I/O Concentrator cable, and a diagnostic tee. If needed, you can order extra cables.

See passive and diagnostic tee catalog listings to order a diagnostic tee. We recommend that you mount a diagnostic tee permanently into each Smart Distributed System bus for easy activator installation.

Catalog Listing	Description
Regular Duty	
SDS-ACTA	Mini connector cable 6 ft. (1,83 m)
SDS-ACTB	Micro connector cable 3 ft. (0,91 m)
SDS-ACTS	5-Pin European cable connector, 3ft. (0,91m)

Field Terminatable Plug And Receptacle Connectors

The field terminatable plug and receptacle connectors allow you to cut cable to a specified length. These products provide you with the ability to customize your cabling requirements and install connectors where convenient.



Catalog Listing	Description
SDS-FTCF	Mini female field terminatable plug connector
SDS-FTCM	Mini male field terminatable receptacle connector

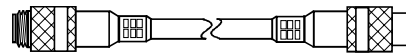
Accessory (Multiport) Cables

Accessory cables come in two types: actuator and sensor multiport. Use these cables to connect non-Smart Distributed System devices to actuator or sensor multiports. Use these yellow cables with non-bus products.

Actuator Multiport Cables

Use actuator multiport cables to connect non-Smart Distributed System devices to actuator multiports. All are 3-pin.

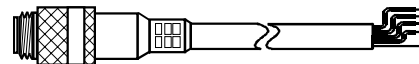
MINI-MINI ACTUATOR MULTIPORT POWER/OUTPUT CABLE



FEMALE END=STRAIGHT PLUG MALE END=STRAIGHT PLUG

Catalog Listing	Description
84914-0070	3 ft. (0,91 m)
84914-0071	6 ft. (1,83 m)
84914-0072	9 ft. (2,74 m)
84914-0073	12 ft. (3,66 m)
84914-0074	20 ft. (6,10 m)
84914-0085	25 ft. (7,62 m)
84914-0086	50 ft. (15,24 m)

MINI MALE PIGTAIL ACTUATOR MULTIPORT POWER/OUTPUT CABLE



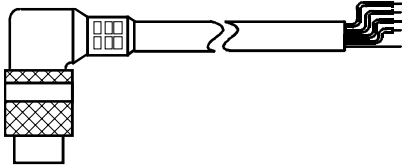
MALE END=STRAIGHT PLUG

Catalog Listing	Description
14341M11	3 ft. (0,91 m)
14342M12	6 ft. (1,83 m)
14343M11	9 ft. (2,74 m)
14344M11	12 ft. (3,66 m)
14345M11	20 ft. (6,10 m)
14346M11	25 ft. (7,62 m)
14347M11	50 ft. (15,24 m)

Reference

Reference

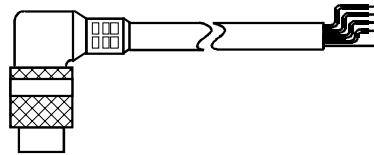
MINI MALE PIGTAIL ACTUATOR MULTI-PORT POWER/OUTPUT CABLE



MALE END=RIGHT ANGLE PLUG

Catalog Listing	Description
14341K11	3 ft. (0,91 m)
14342K11	6 ft. (1,83 m)
14343K11	9 ft. (2,74 m)
14344K11	12 ft. (3,66 m)
14345K11	20 ft. (6,10 m)
14346K11	25 ft. (7,62 m)
14347K11	50 ft. (15,24 m)

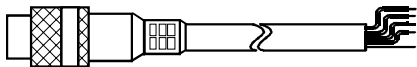
MINI FEMALE PIGTAIL ACTUATOR MULTI-PORT POWER/OUTPUT CABLE



FEMALE END=RIGHT ANGLE PLUG

Catalog Listing	Description
14341K01	3 ft. (0,91 m)
14342K01	6 ft. (1,83 m)
14343K01	9 ft. (2,74 m)
14344K01	12 ft. (3,66 m)
14345K01	20 ft. (6,10 m)
14346K01	25 ft. (7,62 m)
14347K01	50 ft. (15,24 m)

MINI FEMALE PIGTAIL ACTUATOR MULTI-PORT POWER/OUTPUT CABLE



FEMALE END=STRAIGHT PLUG

Catalog Listing	Description
14341M01	3 ft. (0,91 m)
14342M01	6 ft. (1,83 m)
14343M01	9 ft. (2,74 m)
14344M01	12 ft. (3,66 m)
14345M01	20 ft. (6,10 m)
14346M01	25 ft. (7,62 m)
14347M01	50 ft. (15,24 m)

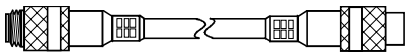
Reference

Reference

Sensor Multiport Cables

Use sensor multiport cables to connect non-Smart Distributed System devices to sensor multiports. All are 4-pin.

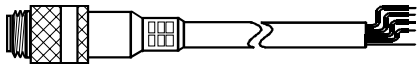
MINI-MINI SENSOR MULTIPORT INPUT CABLE



FEMALE END=STRAIGHT PLUG MALE END=STRAIGHT PLUG

Catalog Listing	Description
84914-0075	3 ft. (0,91 m)
84914-0076	6 ft. (1,83 m)
84914-0077	9 ft. (2,74 m)
84914-0078	12 ft. (3,66 m)
84914-0079	20 ft. (6,10 m)
84914-0080	25 ft. (7,62 m)
84914-0081	50 ft. (15,24 m)

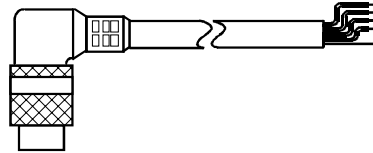
MINI MALE PIGTAIL SENSOR MULTIPORT INPUT CABLE



MALE END=STRAIGHT PLUG

Catalog Listing	Description
14441M11	3 ft. (0,91 m)
14442M11	6 ft. (1,83 m)
14443M11	9 ft. (2,74 m)
14444M11	12 ft. (3,66 m)
14445M11	20 ft. (6,10 m)
14446M11	25 ft. (7,62 m)
14447M11	50 ft. (15,24 m)

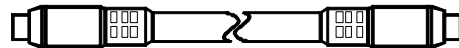
MINI MALE PIGTAIL SENSOR MULTIPORT INPUT CABLE



MALE END=RIGHT ANGLE PLUG

Catalog Listing	Description
14441K11	3 ft. (0,91 m)
14442K11	6 ft. (1,83 m)
14443K11	9 ft. (2,74 m)
14444K11	12 ft. (3,66 m)
14445K11	20 ft. (6,10 m)
14446K11	25 ft. (7,62 m)
14447K11	50 ft. (15,24 m)

MICRO-MICRO SENSOR MULTIPORT INPUT CABLE



FEMALE END=STRAIGHT PLUG MALE END=STRAIGHT RECEPTACLE

Catalog Listing	Description
84908-0165	3 ft. (0,91 m)
84908-0166	6 ft. (1,83 m)
84908-0167	9 ft. (2,74 m)
84908-0168	12 ft. (3,66 m)
84908-0169	20 ft. (6,10 m)
84908-0200	25 ft. (7,62 m)
84908-0201	50 ft. (15,24 m)

Reference

Reference

**MICRO MALE PIGTAIL SENSOR MULTIPORT
INPUT CABLE****MALE END=STRAIGHT RECEPTACLE**

Catalog Listing	Description
84908-0170	3 ft. (0,91 m)
84908-0171	6 ft. (1,83 m)
84908-0172	9 ft. (2,74 m)
84908-0173	12 ft. (3,66 m)
84908-0174	20 ft. (6,10 m)
84908-0205	25 ft. (7,62 m)
84908-0206	50 ft. (15,24 m)

Reference

Communication Pair Physical Specifications

Physical Characteristics	MINI Specification	MICRO Specification
Conductor Pair Size	20 AWG	22 AWG
Insulation Color Conductor 1 (CAN_L)	White	White
Insulation Color Conductor 2 (CAN_H)	Black	Black
Insulation Type	Foamed Polyethylene, Foamed Polyolefin, or Foamed Polypropylene	Foamed Polyethylene, Foamed Polyolefin, or Foamed Polypropylene
Shield	Al/Mylar Tape Helical Wrap (100% coverage, 25% minimum lap, aluminum side of tape out)	Al/Mylar Tape Helical Wrap (100% coverage, 25% minimum lap, aluminum side of tape out)
Twist (min)	5 twists/foot	5 twists/foot

Reference

Communication Pair Electrical Specifications

Physical Characteristics	MINI Specification	MICRO Specification
Capacitance between Conductors (max)	15.0 pF/ft	15.0 pF/ft
DC Resistance	10Ω/1000 ft	10Ω/1000 ft
Impedance	120Ω ± 10% at 1 MHz	120Ω± 10% at 1 MHz
Insulation Resistance (min)	10 ⁹ Ω	10 ⁹ Ω
Velocity of Propagation (min)	76% at 1 MHz	76% at 1 MHz

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Power Pair Physical Specifications

Physical Characteristics	MINI Specification	MICRO Specification
Conductor Pair Size	16 AWG	22 AWG
Insulation Color Conductor 1	Brown	Brown
Insulation Color Conductor 2	Blue	Blue
Insulation Type	Foamed Polyethylene, Foamed Polyolefin, or Foamed Polypropylene	Foamed Polyethylene, Foamed Polyolefin, or Foamed Polypropylene
Shield	Al/Mylar Tape Helical Wrap (100% coverage, 25% minimum lap, aluminum side of tape out)	Al/Mylar Tape Helical Wrap (100% coverage, 25% minimum lap, aluminum side of tape out)
Twist (min)	5 twists/foot	5 twists/foot

For application help: Call 1-800-537-6945

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Power Pair Physical Specifications (continued)

Physical Characteristics	MINI Specification	MICRO Specification
Resistance (max)	4.3Ω/1000 ft	4.3Ω/1000 ft

Power Pair Electrical Specifications

Physical Characteristics	MINI Specification	MICRO Specification
Conductor Size	20 AWG stranded, tinned copper	22 AWG stranded, tinned copper
Resistance (max)	10Ω/1000 ft	17Ω/1000 ft

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Honeywell, Inc.
11 W. Spring Street
Freeport, Illinois 61032

For application assistance:
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