Communication Protocols and Cable Networks

How They are Different and When to Use Them

About this Guide

pro•to•col *n* A message within a transmission that enables one electronic device to communicate with another.

Communication protocols such as SensorNet, RS422, and Manchester, enable two network-compatible devices, such as video controllers and remote camera domes to exchange data. Cable networks such as star, daisy chain, and backbone, provide the means through which communication occurs.

This guide explains the difference between protocols and cable networks and when to use each. *You should carefully plan the network layout before beginning an installation.* Because cable connections to each device are unique, see instructions shipped with the device for this information.

Note: Because customer requirements dictate placement of cables and devices, the manufacturer will supply this information separately.

If you need assistance...

Contact your Sensormatic Representative.

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Protocol Comparisons

Table 1 shows the difference between the three protocols: SensorNet, RS422, and Manchester. Note that each protocol requires a different type of cable. For example, the SensorNet protocol requires unshielded cable. For complete information, see **Cable Specifications** beginning on page 5.

Table 1. Differences between networks

	SensorNet	RS422	Manchester
Cable type	1 unshielded, twisted pair [1]	2 shielded, twisted pair [1]	1 shielded twisted pair [2]
Wire gauge	22 AWG	22 AWG	18 AWG
Max. length	1km (3,300') [3]	1km (3,300') [3]	1.5km (5,000') [3]
Connection	Non-polarized	Polarized	Polarized
Data rate	230.4 kbits/sec.	4.8 kbits/sec.	31 kbits/sec.
Max. devices per line	32 Max. Depending on device loading.	10 Max. Depending on device loading.	3 Max. Depending on device loading.

Note: In some environments, high noise on the network may limit cable distances to less than the maximums indicated in the table.

[1] **Sensormatic composite cable is recommended. This cable also contains wires for power and video. If another cable is substituted, cable wire colors may be different.**
If shielded cable must be used, signals may rapidly decline as more devices are connected or its length increases. As a result, the maximum length allowed for shielded cable is reduced. For example, the maximum length for Belden 8760 cable is 750m (2500') in ideal conditions (no noise).

[2] **Belden 8760 cable is recommended.**

[3] **May be significantly less depending on regulatory requirements and noise in the environment.**

[4] **In extremely high noise environments or installations with very long cable runs, fiber optic cable may be needed.**

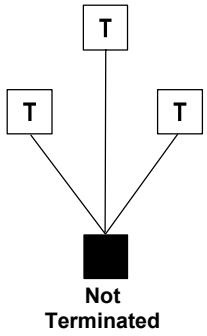
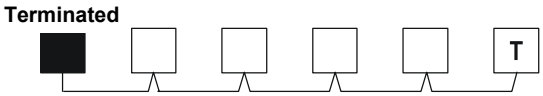
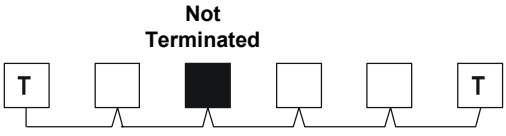
[5] **Star network is not recommended in high noise environments due to the extra terminations, which lower the signal to noise ratio.**

Cable Network Comparisons

Cable networks such as star, daisy chain, and backbone, provide the means through which a communication source speaks to remote devices. Table 2 explains what each network is, when to use it, and lists examples.

Note: The maximum number of remote devices connected to a network depends on the protocol and the electrical demands of each device. Refer to instructions supplied with the device.

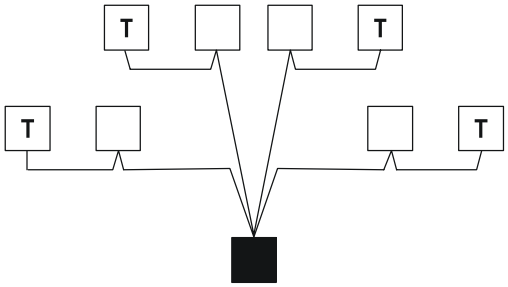
Table 2. Network comparisons

Cable Network	What It Is	Examples
Star	A separate cable (branch) runs from the source code distribution unit or repeater to each remote device. Limit branches to four. Use if you anticipate relocating devices. Can be used with SensorNet[6], RS422, and Manchester. However, the Star network is not recommended in high noise environments due to the extra terminations, which lower the signal to noise ratio.	Diagram below shows communications source as the hub of a star network. In this example, the communications source is not terminated, and all devices are terminated. Black box = Communications source 
Daisy-Chain/ Backbone	**Daisy Chain**: A separate cable connects each two adjacent devices along the chain. Daisy chaining makes it easy to add devices by extending the network from a nearby device. The source can connect anywhere along cable. Use if cable is to be short, extended in future, or when central distribution point and remote devices are in the same room. Can be used with SensorNet[6], RS422, and Manchester. **Backbone:** One cable is used. Along cable, 2.5cm (1") sections are stripped, bent, and connected to each remote device. The source can connect anywhere along cable. Use if cable is to be long and permanent. Operates same as daisy chain, but uncut wires may be more conductive and reliable. Can be used with SensorNet[6].	Diagram below shows communications source at end of a daisy chain or backbone network. In this example, the communications source and the last device in the chain are terminated. Black box = Communications source  Diagram below shows communications source inserted in a daisy chain or backbone network. In this example, the devices on both ends of the chain are terminated, and the communications source is unterminated. 

6 **SensorNet-compatible devices operate at signal levels from 0.3–5V, but 1–5V is recommended. Signal repeaters (e.g., J-Box Aux Out) should only be used to amplify the signal when maximum allowed distance or noise are issues. See Point 8 on page 4 about the 4 repeater rule: a maximum of 4 serial repeaters are allowed between any two devices on the network.**

Combining Cable Networks

Star and daisy-chain/backbone networks can be used in combination. The diagram below shows the communications source as the hub of a combination of a star and backbone/daisy-chain network.



Not Terminated

Line Terminations

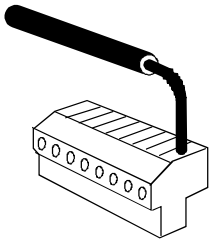
Each communications source or remote device has a termination switch or jumper to prevent signals from reflecting back along a cable. Only terminate a device when it is at the end of a cable.

Note: Because a J-box Aux Out (repeater) renews or amplifies the signal, its connection is always terminated unless a backbone is used. In this case, the Aux Out port is not terminated.

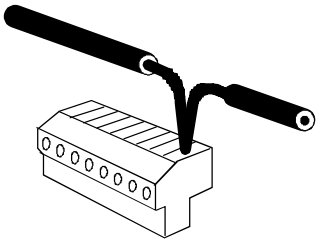
Wire Connection

Star and daisy-chain networks use standard wire connections where a wire at the end of a cable is inserted into a connector and tightened down.

A backbone network uses a different technique where 2.5cm (1") cable sections are stripped, bent, and connected to each device as if they were a single wire.



Standard (cut)



Daisy Chain (cut) Backbone (uncut)

8 Key Points to Remember

POINT 1: The SensorNet protocol requires unshielded cable containing 22 gauge twisted-pair wire, as long as the cable does not exceed 1km (3,300').[7] If shielded cable must be used, signals may rapidly decline as more devices are connected or its length increases. As a result, the maximum length allowed for shielded cable is reduced. For example, Belden 8760 cable limits the length to 750m (2500'). The protocol can use the star or daisy-chain/backbone network. Cable wires are not polarized.

POINT 2: The RS422 protocol requires shielded cable containing two 22 gauge twisted-pair wires, as long as the cable does not exceed 1km (3,300').[7] The cable must be in the form of a star or daisy-chain network. With a star network, a separate cable (branch) runs from the source code distribution unit or repeater to each remote device. Remember to limit branches to four with a maximum of 10 devices per link. Cable wires are polarized.

POINT 3: The Manchester protocol requires shielded cable containing 18 gauge twisted-pair wire, as long as the cable does not exceed 1.5km (5,000').[7] The protocol can use the daisy-chain network with a maximum of three devices per link. The last device in the link is terminated. Cable wires are polarized.

POINT 4: Each device has a termination switch or jumper to prevent signals from reflecting back along a cable. Only terminate a communications source or remote device when it is at the end of a cable.

POINT 5: The maximum number of remote devices connected to a network depends on the protocol and the electrical demands of each device. Refer to instructions supplied with device.

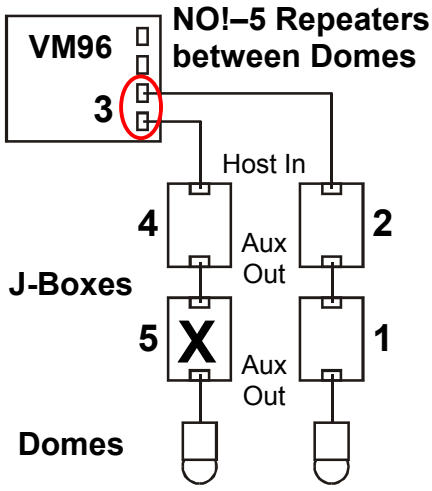
POINT 6: Attach remote devices in stages and check that their response is correct so you can correct the problem before continuing with the installation.

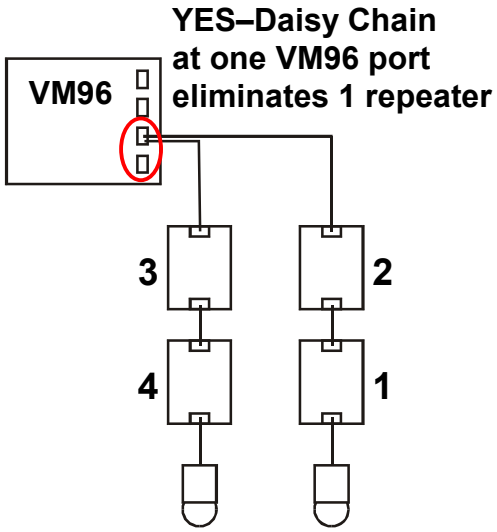
POINT 7: SensorNet-compatible devices operate at signal levels from 0.3–5V, but 1–5V is recommended. Signal repeaters (e.g., J-Box Aux Out) should only be used to amplify the signal when the maximum allowed distance or noise are issues.

[7] **May be significantly less depending on regulatory requirements.**

POINT 8: For SensorNet a maximum of 4 serial repeaters are allowed between any two devices on the network. Devices include domes, TouchTrackers, I/O units, and RS422 converters. Sensormatic 48 / 96 / 168 switches, J-boxes, and fiber optic transceiver sets contain repeaters between their separate output ports.

This 4-repeater restriction includes devices that are not on the same branch or leg of the network, as shown in the following diagram. Otherwise, because this is a LAN, network collisions resulting in loss of data may occur between out-bound (from the communications source) and in-bound communications.





Note: Signal repeaters (e.g., J-Box Aux Out) should only be used to amplify the signal when the maximum allowed distance or noise are issues.

Cable Specifications

SensorNet Non-Plenum Rated

Mechanical:

Inner Conductors: ..... 22AWG (7 x 30) Stranded Tinned Copper.

Inner Conductor Insulation: Plenum Rated PVC, OD .044" REF.

Lay: ..... Two insulated conductors twisted together with a 1.5" nominal lay length.

Color Code: ..... Pair #1 = Orange and Yellow

Protective Wrap: ..... Polyester wrap, Optional; (no aluminum/polyester shield permitted).

Outer Jacket: ..... PVC, OD .130" REF.

Electrical:

Voltage Rating: ..... 300 Volts Minimum

Capacitance: ..... 30 pf/ft

Attenuation @ 230KHz = 4dB/1000 feet maximum

Environmental:

Operating Temperature Range: -20˚C to +60˚C Min

Regulatory Requirements:

UL Listed, CSA Certified, and NEC Compliant.

NEC Classification Requirements: CM Minimum.

SensorNet Plenum Rated

Mechanical:

Inner Conductors: ..... 22AWG (7 x 30) Stranded Tinned Copper.

Inner Conductor Insulation: FEP Teflon, Halar, or Plenum Rated PVC, OD .044" REF.

Color Code: ..... Pair #1 = Orange and Yellow

Lay: ..... Two insulated conductors twisted together with a 1.5" nominal lay length.

Protective Wrap: ..... Polyester wrap, Optional; (no aluminum/polyester shield permitted).

Outer Jacket: ..... Plenum Rated PVC, OD .118" REF.

Electrical:

Voltage Rating: ..... 300 Volts Minimum

Capacitance: ..... 30 pf/ft

Attenuation @ 230KHz = 4dB/1000 feet maximum

Environmental:

Operating Temperature Range: -20˚C to +60˚C Min

Operating Humidity: ..... 95% RHNC

Regulatory Requirements:

UL Listed, CSA Certified, and NEC Compliant.

NEC Classification Requirements: CMP Minimum.

RS-422 Non-Plenum Rated

Mechanical:

Inner Conductors: ..... 22AWG (7 x 30) Stranded Tinned Copper.

Inner Conductor Insulation: PVC, OD .050 REF.

Color Code: ..... Pair no. 1; Red and Black
Pair no. 2; Green and White

Shield: ..... Aluminum/Polyester wrap with 25% overlap and foil side out; each twisted pair shall have an individual wrapped shield, 100% coverage.

Drain wire: ..... 22AWG, (7 x 30) Stranded Tinned Copper. The drain wire shall be installed in such a way so that electrical contact is common between the two shields and the drain wire.

Outer Jacket: ..... PVC, OD .200 REF.

Marking: ..... Cable shall be marked in accordance with the current UL and NEC guidelines, in relationship to the requirements specified herein.

Electrical:

Voltage Rating: ..... 150 Volts Minimum

Capacitance: ..... 24.1 pf/ft between adjacent conductors at 1 kHz.

Environmental:

Operating Temperature Range: -20˚C to +80˚C

Regulatory:

UL Listed, CSA Certified, and NEC Compliant.

NEC Classification Requirements: CM Minimum.

RS-422 Plenum Rated

Mechanical:

Inner Conductors: ..... 22AWG (7 x 30) Stranded Tinned Copper.

Inner Conductor Insulation: Plenum Rated PVC, OD .049" REF.

Color Code: ..... Pair #1 = Red and Black
Pair #2 = Green and White

Shield: ..... Aluminum/Polyester wrap, foil side out, each twisted pair will have an individually wrapped shield with 100% coverage.

Drain Wire: ..... 22AWG (7 x 30) Stranded Tinned Copper; Drain wire will be wrapped around both shielded twisted pair so that electrical contact between the shields and the drain wire is optimum.

Protective Wrap: ..... Optional

Outer Jacket: ..... Plenum Rated PVC, OD .195" REF.

Electrical:

Voltage Rating: ..... 150 Volts Minimum

Capacitance: ..... 61 pf/ft maximum between adjacent conductors at 1KHz.

Environmental:

Operating Temperature Range: -20˚C to +75˚C Min

Operating Humidity: ..... 95% RHNC

Regulatory Requirements:

UL Listed, CSA Certified, and NEC Compliant.

NEC Classification Requirements: CMP Minimum.

Manchester Non-Plenum Rated

Use Belden 8760 or equivalent

Inner Conductors: ..... 18AWG (16 x 30) Tinned Copper.

Inner Conductor Insulation: PVC, OD .050 REF.

Color Code: ..... Pair no. 1: Black and Clear

Shield: ..... Aluminum/Polyester wrap with 25% overlap and foil side out; each twisted pair shall have an individual wrapped shield, 100% coverage.

Drain wire: ..... 20AWG, (7 x 30) Stranded Tinned Copper. The drain wire shall be installed in such a way so that electrical contact is common between the two shields and the drain wire.

Outer Jacket: ..... PVC, OD .222 REF.

Marking: ..... Cable shall be marked in accordance with the current UL and NEC guidelines, in relationship to the requirements specified herein.

Electrical:

Voltage Rating: ..... 300V 60˚C Low Capacitance

Capacitance: ..... 24.0 pf/ft between adjacent conductors at 1 kHz.

Environmental:

Operating Temperature Range: -20˚C to +80˚C

Regulatory:

UL Listed, CSA Certified, and NEC Compliant.

NEC Classification Requirements: CM Minimum.

Manchester Plenum Rated

Use Belden 88760 or equivalent

Inner Conductors: ..... 18AWG (19 x 30) Tinned Copper.

Inner Conductor Insulation: Teflon, OD .157 REF.

Color Code: ..... Pair no. 1: Red and Black

Shield: ..... Teflon wrap with 25% overlap and foil side out; each twisted pair shall have an individual wrapped shield, 100% coverage.

Drain wire: ..... 20AWG, (7 x 30) Stranded Tinned Copper. The drain wire shall be installed in such a way so that electrical contact is common between the two shields and the drain wire.

Outer Jacket: ..... Teflon, OD .200 REF.

Marking: ..... Cable shall be marked in accordance with the current UL and NEC guidelines, in relationship to the requirements specified herein.

Electrical:

Voltage Rating: ..... 150 Volts Minimum

Capacitance: ..... 51.0 pf/ft between adjacent conductors at 1 kHz.

Environmental:

Operating Temperature Range: -20˚C to +80˚C

Regulatory:

UL Listed, CSA Certified, and NEC Compliant.

NEC Classification Requirements: CMP Minimum.