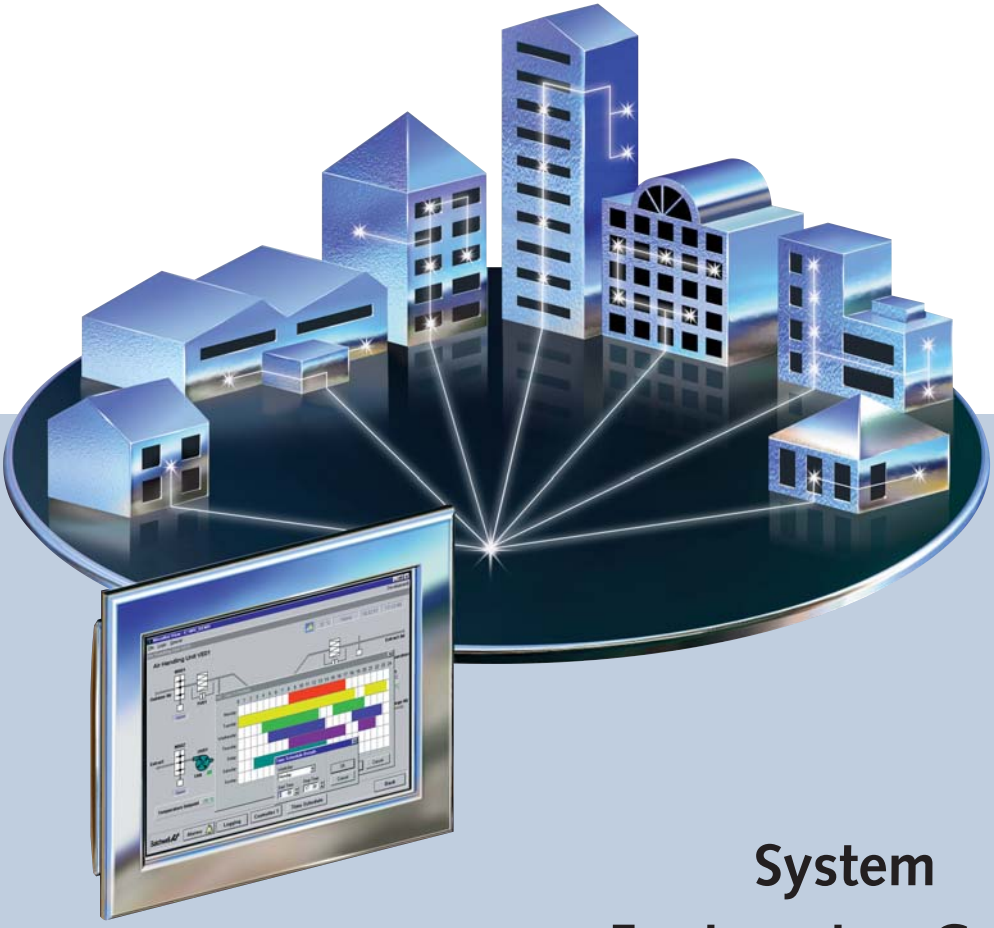
Satchwell™

MicroNet



System Engineering Guide

t.a.c®
Satchwell

EUROPEAN COMMUNITY DIRECTIVES

This equipment meets all requirements of European Community Directives for Low Voltage (72/23/EEC), General Safety (92/59/EEC), and Electromagnetic Compatibility (89/336/EEC).

FCC

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Canadian Department of Communications

This digital apparatus does not exceed the Class A limits for radio noise emissions for digital apparatus set out in the radio interference regulations of the Canadian Department of Communications.

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Table of Contents

Preface

Purpose of this Guide

The *MicroNet System Engineering Guide* is a reference document for the design of a complete MicroNet system. NCP, ARCNET® and LONWORKS® network considerations are addressed as related to features, system design, wiring topology, and function.

This guide is intended for use by design engineers, application engineers, industrial engineers, setup technicians, service technicians and users who are responsible for changing hardware or control logic.

It is assumed that readers of this manual understand basic HVAC concepts, networking practices, general hardware and software installation practices and conventions, as well as some understanding of intelligent environmental control automation. It is also assumed that the readers are aware of the capabilities of the various MicroNet products, as introduced in the *System Overview*.

Abbreviations

The following abbreviations are used in this guide, or may be used in other information and documentation referenced within this guide:

AHU	Air Handling Unit
AO	Analogue Output
ARCNET	Attached Resource Computer Network
AV	Analogue Value
BAS	Building Automation System
BRE	Building Research Establishment
DDE	Dynamic Data Exchange
DI	Digital Input
DIP	Dual In-line Package
DO	Digital Output
EEPROM	Electronically Erasable-Programmable Read Only Memory
EPROM	Erasable-Programmable Read Only Memory
FTT	Free Topology Transceiver
HVAC	Heating, Ventilation, and Air Conditioning
I/O	Input/Output
IEC	Intelligent Energy Corporation
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode

LNC-100	LON® Network Controller
LNS	LON Network Services
LON	Local Operating Network
mA	milliAmperes
MB	Megabyte
MN MI	MicroNet Manager Interface
MIP	Microprocessor Interface Program
MN	MicroNet
MN-Sx	MicroNet Sensor
NCI	Network Communications Input
NCP	Native Communications Protocol
NIM	Network Interface Module (Ethernet or Echelon®)
NVI	Network Variable Input
NVO	Network Variable Output
PC	Personal Computer
PSTN	Public Switched Telephone Network
PWM	Pulse Width Modulation
RAM	Random Access Memory
ROM	Read-Only Memory
RTC	Real Time Clock
RTU	Roof-Top Unit
S-LK	Sensor Link or S-Link
SNVT	Standard Network Variable Type
STP	Screened Twisted Pair (Cabling)
TO	Triac Output
UI	Universal Input
UTP	Unscreened Twisted Pair
Vac	Volts (Alternating Current)
VAV	Variable Air Volume
Vdc	Volts (Direct Current)
WAN	Wide Area Network
WP Tech	WorkPlace Tech Tool
XIF	External Interface File

Applicable Documentation

Number	Description	Audience	Purpose
Quote Name	MicroNet System Overview	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides an overview of the MicroNet system, including system components.
Quote Name	VisiSat Engineering Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides information for applying and using all aspects of VisiSat Configuration Tool.
Quote Name	MicroNet View Engineering Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides information for applying and using all aspects of MicroNet View.
Quote Name	NCP/ARCNET I/O-Server Engineering Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides information for applying and using all aspects of the I/O-Server in NCP or ARCNET networks.
Quote Name	MicroNet Touch Screen User's Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step instructions for using the Touch Screen Display.
DS 10.000	MicroNet Sensor Specification Data Sheet	– Application Engineers – Sales Personnel	Describes features and specifications of the MicroNet Sensors.
DS 10.050	MicroNet Touch Screen Display Specification Data Sheet	– Application Engineers – Sales Personnel	Describes features and specifications of the MicroNet Touch Screen Display.
DS 10.060	MicroNet MN50-LCD Display Specification Data Sheet	– Application Engineers – Sales Personnel	Describes features and specifications of the MicroNet MN50-LCD Display.
DS 10.151	MN350 Series Controllers Specification Data Sheet	– Application Engineers – Sales Personnel	Describes features and specifications of the MN350 Series Controllers.
DS 10.152	MN450 Series Controllers Specification Data Sheet	– Application Engineers – Sales Personnel	Describes features and specifications of the MN450 Series Controllers.
DS 10.153	MN550 Series Controllers Specification Data Sheet	– Application Engineers – Sales Personnel	Describes features and specifications of the MN550 Series Controllers.
DS 10.154	MN650 Series Controllers Specification Data Sheet	– Application Engineers – Sales Personnel	Describes features and specifications of the MN650 Series Controllers.
DS 10.201	MicroNet View Specification Data Sheet	– Application Engineers – Sales Personnel	Describes features and specifications of the MicroNet View software.
DS 10.202	MicroNet VisiSat Configuration Tool Specification Data Sheet	– Application Engineers – Sales Personnel	Describes features and specifications of the VisiSat Configuration Tool software.
DS 10.217	MicroNet Manager Interface/ARCNET Router Specification Data Sheet	– Application Engineers – Sales Personnel	Describes features and specifications of the MicroNet Manager Interface.
DS 10.250	EN-206 Guidelines for Powering Multiple Full-Wave and Half-Wave Rectifier Devices from a Common Transformer	– Application Engineers – Installers – Service Personnel	Offers guidelines for avoiding equipment damage associated with improperly wiring devices of varying rectifier types. Contains instructions for identifying device rectifier type, guidelines for correctly powering devices of varying rectifier types, and examples illustrating proper power wiring techniques.
DS 10.000A	MicroNet Sensor (MN-Sx) Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the MicroNet Sensor. Also includes checkout section.

Number	Description	Audience	Purpose
DS 10.050A	MicroNet Touch Screen Display Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the MicroNet Touch Screen Display. Also includes checkout section.
DS 10.060A	MicroNet MN50-LCD Display Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the MicroNet MN50-LCD Display. Also includes checkout section.
DS 10.151A	MicroNet MN350 Series Controllers Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the MN350 Series Controllers. Also includes checkout section.
DS 10.152A	MicroNet MN450 Series Controllers Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the MN450 Series Controllers. Also includes checkout section.
DS 10.153A	MicroNet MN550 Series Controllers Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the MN550 Series Controllers. Also includes checkout section.
DS 10.154A	MicroNet MN650 Series Controllers Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the MN650 Series Controllers. Also includes checkout section.
DS 10.217A	MicroNet Manager Interface/ARCNET Router Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the MicroNet Manager Interface. Also includes checkout section.

Conventions Used in this Guide

Special information or important words and phrases are identified as follows:

- Text appearing in *italics* is used for emphasis in a statement.
- Headers, titles, or other words and phrases requiring special recognition appear in **boldface type**.

Acrobat (PDF) Conventions

If reading this guide on-line in Adobe® Acrobat® (.PDF file format), numerous hypertext links exist:

- Hypertext links within the Guide include all entries in the Table of Contents, Index, and other standard cross references. These links are indicated when the cursor changes to a hand with a pointing finger.
- When viewing this guide with Adobe Acrobat, you can display various 'bookmark' links on the left side of your screen by choosing 'Bookmarks and Page' from the 'View' menu. When these links are indicated, they will also cause the cursor to change to a hand with a pointing finger.

Document Summary

The MicroNet System Engineering Guide contains the following:

Chapter 1 - Introduction

This chapter gives an introduction to the engineering of a MicroNet system.

Chapter 2 - Engineering NCP Networks

This chapter contains details of the engineering of NCP networks, including safety issues, wiring topologies, cable types and lengths, screening and addressing.

Chapter 3 - Engineering ARCNET Networks

This chapter contains details of the engineering of ARCNET networks, including safety issues, wiring topologies, cable types and lengths, screening, addressing, daughter board details, network variable usage and fault diagnosis.

Chapter 4 - Engineering LONWORKS Networks

This chapter contains details of the engineering of LONWORKS® networks, including safety issues, terminology, wiring topologies, cable types and lengths, screening, addressing, daughter board details, repeater and router details, SNVT usage and project engineering in VisiSat™, LonMaker™ and MicroNet View.

Glossary

The Glossary defines terms used in this manual as well as terms used in the HVAC industry.

Chapter 1
Introduction

General Information

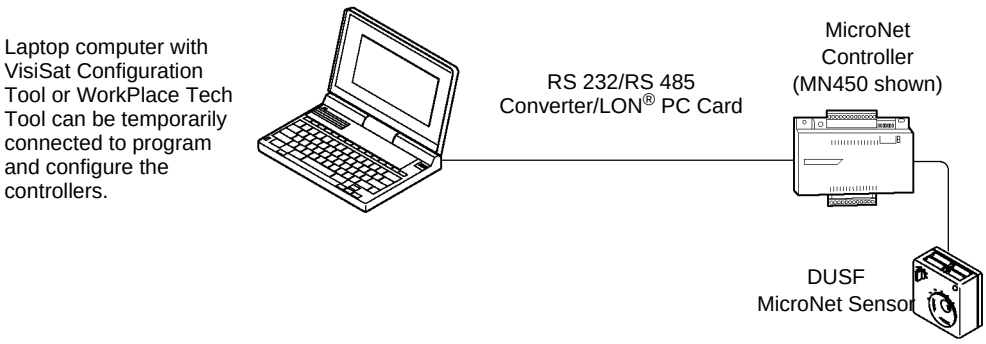
MicroNet is an HVAC control system incorporating configurable Bus du jour® Controllers, Sensors, Touch Screens, LCD display devices and the necessary software tools for system configuration and monitoring.

Note: For a complete list of the MicroNet devices supported and details of each device, refer to the *MicroNet System Overview*. Each MicroNet device also has an *Engineering Data Sheet*, which gives detailed wiring instructions and other information that is specific to the device (see page vii for a list of all relevant MicroNet publications).

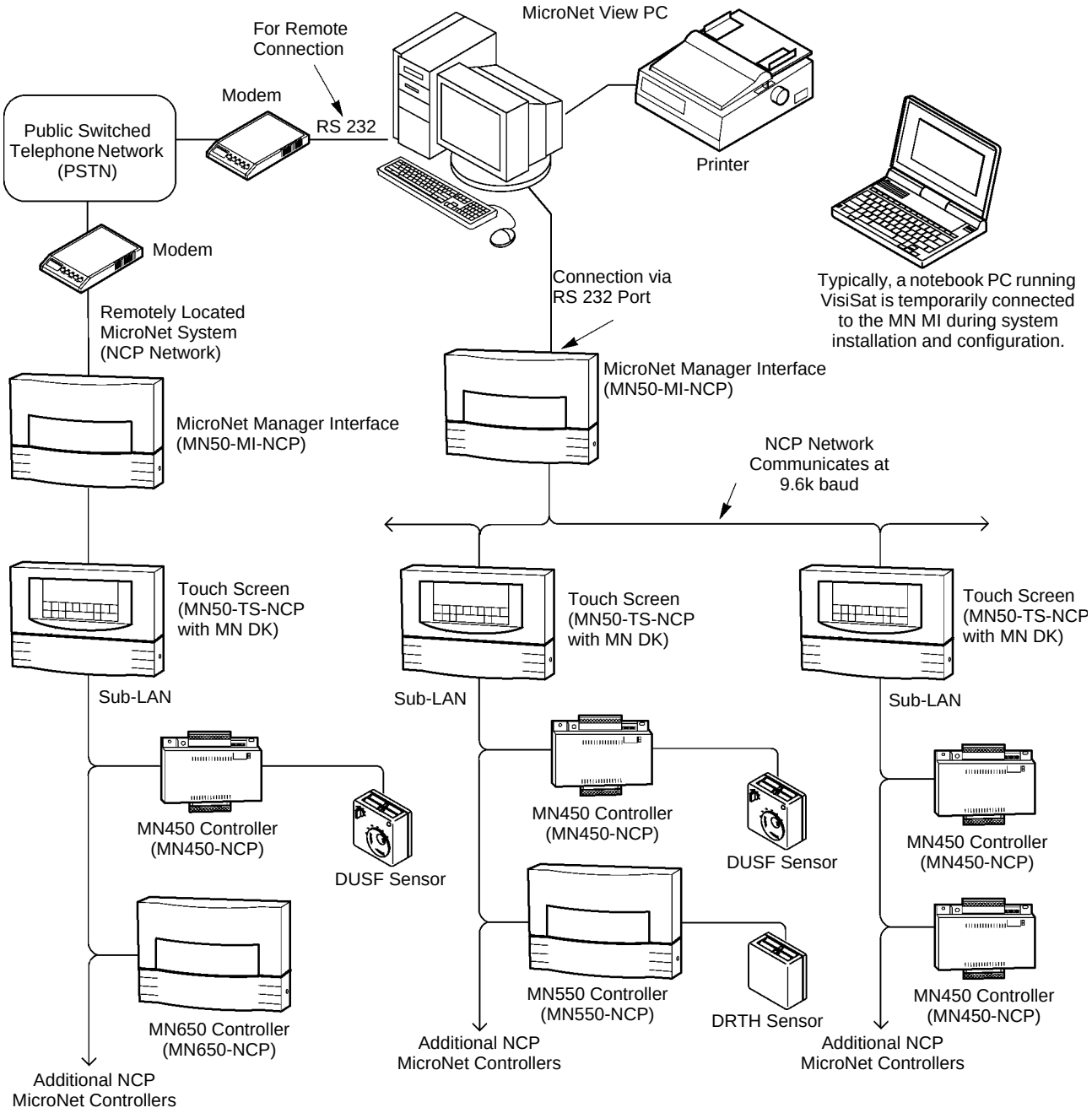
MicroNet controllers can be configured to run standalone (see (Figure–1.1)), or for more comprehensive control schemes, can be networked in an NCP, ARCNET® or LONWORKS® network (see (Figure–1.2)). MicroNet includes several different controller types and options, which enable you to match the hardware used to the requirements of the HVAC control system.

Software tools include VisiSat and WorkPlace Tech Tool, which are PC-based programs for configuring and downloading controller applications.

Also available is the powerful MicroNet View, which provides a set of sophisticated graphical applications for monitoring and acknowledging alarms, logging data and viewing or changing the operation of the equipment being controlled.



Figure–1.1 Stand-Alone System



Figure–1.2 Example Network (NCP)

Note: TAC Satchwell is always striving to provide accurate and complete information to our customers. Network examples in this manual may be amended as information acquired from continued testing becomes available.

MicroNet PC Software

MicroNet includes the following PC software:

- **VisiSat Configuration Tool** - This is used to program and download applications to the MN350, MN450, MN550, MN650, MN MI, Touch Screen and MN50-LCD devices in an NCP, ARCNET or LONWORKS network.
- **WorkPlace Tech Tool** - This is used to program and download applications to the MN 50, MN 100, MN 150, MN 200 and MN VAV controllers in a LONWORKS network.
- **MicroNet View** - This provides a set of sophisticated graphical applications for monitoring and acknowledging alarms, logging data and viewing or changing the operation of the equipment being controlled. The whole network can be viewed using active graphics and real-time information.

  MicroNet View is supplied with the NCP/ARCNET I/O-Server for communication with an NCP or ARCNET network. Communication with LONWORKS networks is achieved using the third-party LNS DDE I/O-Server.

For an overview of each of these software systems, refer to the MicroNet *System Overview*. Alternatively, refer to the following for more detailed information:

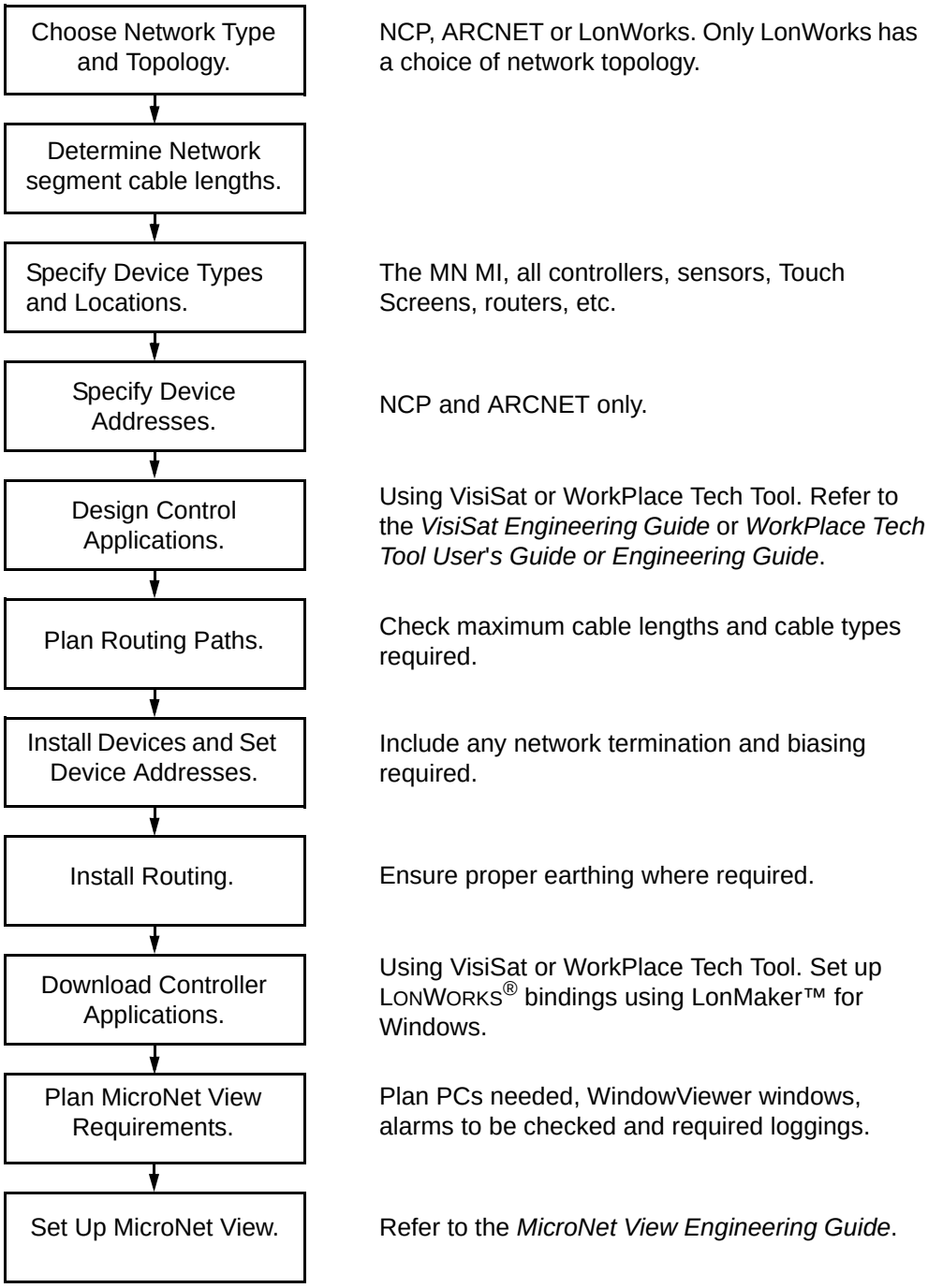
- *VisiSat Engineering Guide*.
- *NCP/ARCNET I/O-Server Engineering Guide*.
- *MicroNet View Engineering Guide*.
- *WorkPlace Tech Tool Engineering Guide*.
- *WorkPlace Tech Tool User's Guide*.

These manuals also provide details of the hardware and operating-system requirements necessary for software installation.

For advice on the distribution of MicroNet View applications over several networked computers, refer to the *MicroNet View Engineering Guide*.

Getting Started

Installation of a MicroNet network involves the following typical steps. Refer to the remaining chapters in this manual for further information, or to the specified manuals.



Figure–1.3 Typical Steps in Planning and Implementing a MicroNet Network

Chapter 2
Engineering NCP Networks

Introduction

An NCP network (Figure–2.1) represents a cost-effective solution when neither open protocol (LONWORKS®) nor peer-to-peer (ARCNET®) communications are required. An NCP network has a communications speed of 9.6kbaud using screened RS 485 dual twisted-pair cabling in a daisy-chain bus topology. No terminators are required.

MicroNet MN MI, MN350, 450, 550 and 650 controllers can be used on an NCP network. MicroNet Touch Screens can also be used. RS 485 communication drivers are built into these devices; no daughter board is required.

An LCD device can be connected to an MN550 or 650 controller. An LCD device can be connected to an MN350 or MN450 controller, providing the controller is not networked.

Since the network uses master-slave communications and the controllers do not communicate in peer-to-peer fashion, direct data exchange between controllers cannot take place. However, data can be exchanged through MicroNet View. (The master devices are the MN MI, PC, Touch Screen and LCD devices, and the slaves are the controllers.)

The Main LAN in an NCP network can support up to 63 devices. If required, the system can be expanded by adding Sub-LANs to the network. A Sub-LAN connects to a Touch Screen, which serves as the polling device for the devices on its Sub-LAN. A maximum of 20 Sub-LANs can be used, each with a maximum of 63 devices. A Touch Screen can display data only from its connected Sub-LAN controllers.

The maximum cable distance of the Main LAN is 1000m; each Sub-LAN extends this range by a further 1000m.

Note: Touch Screens cannot be 'cascaded'. A Touch Screen must connect only to the Main LAN.

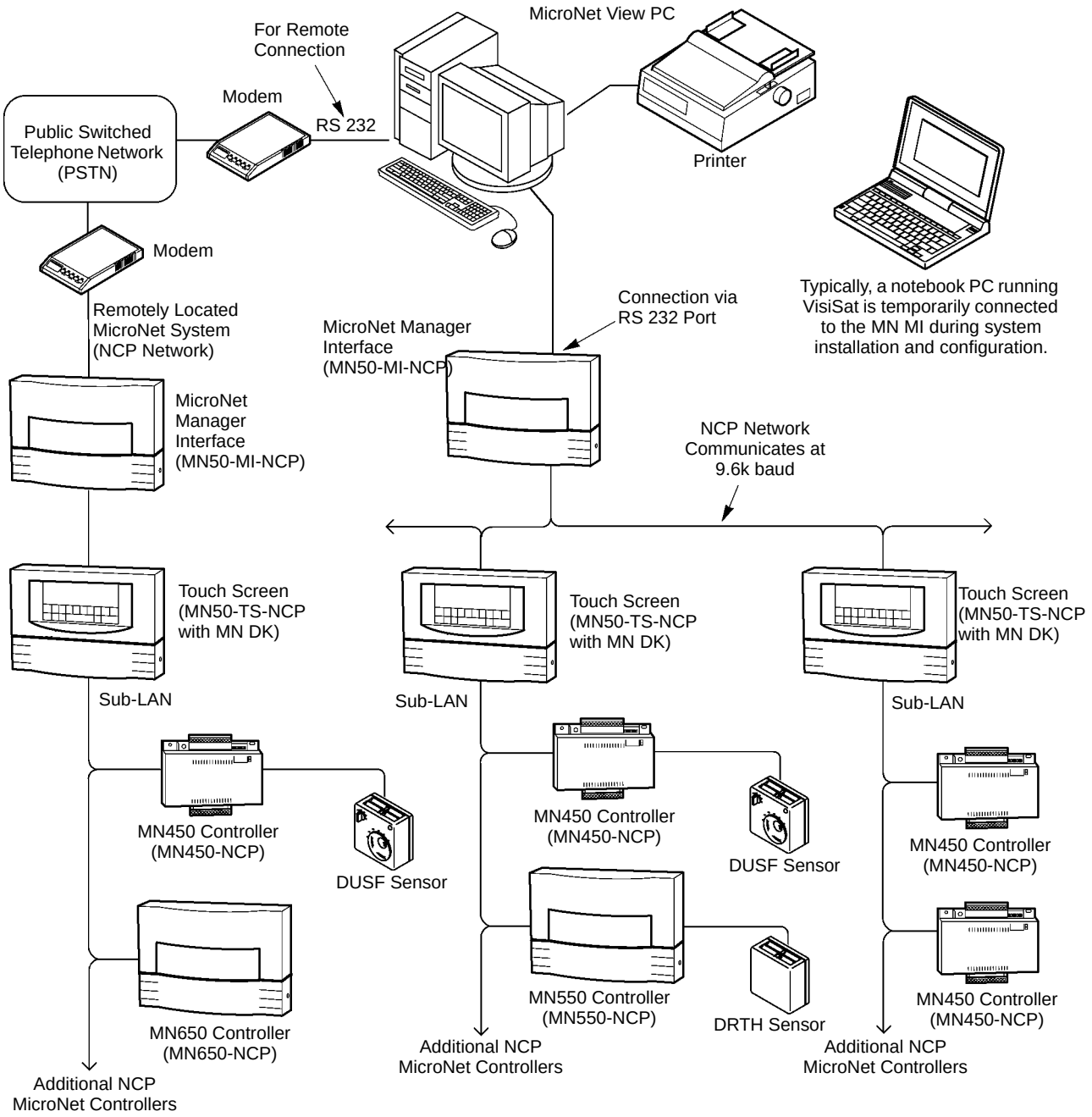
An NCP network can also be expanded by configuring MN MIs as NCP repeaters, which can be used in both Main LANs and Sub-LANS.

The PC-based VisiSat Configuration Tool is used to configure the MN MI, controllers, LCD displays and Touch Screens on the network.

MicroNet View provides alarm checking, plus dynamic and historical logging of data from the network. MicroNet View requires each local and remote NCP network to be headed by an MN MI.

Networks not using MicroNet View do not require an MN MI, but using an MN MI enables remote configuration via a serial port from VisiSat (as well as automatic network-level time synchronisation). NCP networks without an MN MI can be configured from VisiSat by using an RS 232-to-RS 485 converter (see page 18), which allows direct connection from the VisiSat PC to the NCP network.

Note: Please refer to the MicroNet Engineering Data Sheets for wiring details, which may be different for each MicroNet device type.



Figure–2.1 Example NCP Network

NCP Terms

These common terms are often used when explaining MicroNet NCP networks:

LAN - Either the Main LAN or a Sub-LAN.

Node - Any addressable device on the network, including any controller, MN MI and Touch Screen.

Sub-LAN - A physical group of devices on the network connected to a Touch Screen (see Figure–2.1). All devices on the same Sub-LAN have the same subnet address, which forms part of a node's complete address.

Main LAN - The top-level Local Area Network of NCP nodes.

Safety Warnings and Precautions

Digital Outputs

MicroNet controllers have digital outputs which can carry ***mains voltage***.

WARNING - ELECTRICAL SHOCK HAZARD.
REMOVE POWER FROM THE DIGITAL OUTPUTS BEFORE REMOVING CONTROLLER COVERS.

Power Supply

Before making connections, changing jumpers or fitting boards to a MicroNet node, make sure that you remove the power supply (i.e. switch off) the node first.

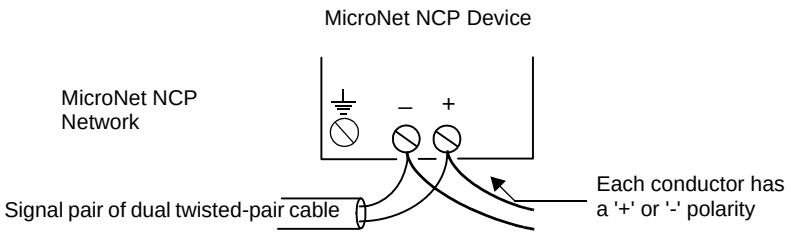
If replacing a node, first switch off the power supply then disconnect all terminals.

It is not necessary to switch off a node to change its node address using the bit switches.

Switching off a MicroNet node does not remove the control application stored in the node's memory.

Polarity

NCP communication connections *are* polarity sensitive.



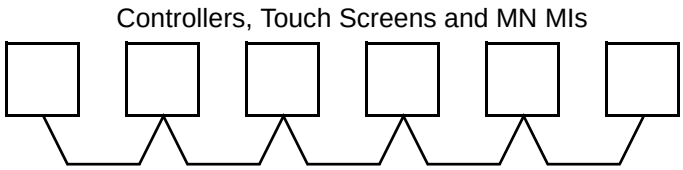
Figure–2.2 NCP Networks are Polarity Sensitive

NCP Wiring Topology

NCP networks are unterminated bus (daisy-chain) networks (Figure–2.3). The wiring path between the two most distant nodes on the main LAN must not exceed 1000m. Similarly, the wiring path between the two most distant nodes on any Sub-LAN must not exceed 1000m. Touch Screens cannot be 'cascaded' to increase wiring length; a Touch Screen must connect only to the Main LAN.

Note: The use of star or tee connections is not allowed (i.e. no branches or spurs).

Note: It is important to ensure that the polarity of the network connections is maintained and consistent throughout the system, i.e. (-) is connected to (-) and (+) is connected to (+).



Figure–2.3 NCP Bus Networks

Warning: Observe the safety warnings and precautions given on page 7.

Network Wiring

General

Network wiring practice can be viewed as three entities, i.e. Signal Wiring, LAN Referencing and Cable Screening. These are detailed in the following sections.

NCP Cable Requirements

Approved cable types are listed in Table–2.1. Multi-core cables used to carry other signals (e.g. sensor or telephone signals) are not permitted.

Table–2.1 Approved Cable Types.

Manufacturer/Distributor	Part Number	Cable Type	Gauge mm (AWG)	Maximum Bus Length (m)
Wadsworth Electronics Ltd Central Avenue, West Molesey, Surrey KT8 2QB 020 8268 7000 www.wadsworth.co.uk	Belden 9502	2-pair stranded, screened	.5 (24)	1000
Anixter UK Headquarters 1st Floor, Wellington House 4 - 10 Cowley Road Uxbridge, Middlesex UB8 2XW, England Tel: +44 1895 276800 Fax: +44 1895 276946 www.anixter.net	Belden 9502	2-pair stranded, screened	.5 (24)	1000

NCP LAN Connections

Table–2.2 provides details of Main LAN, Sub-LAN and cable screen terminals for the MicroNet devices used on an NCP network.

Table–2.2 NCP Device LAN Connections

NCP Device	Main LAN			Sub-LAN			Screen
	-	+	LAN REF	-	+	LAN REF	
MN50-MI-NCP	4	5	3	N/A			14
NCP Repeater	12	13	11	4	5	3	14
MN50-TS-NCP	7	8	6	4	5	3	1*
MN350-NCP	22	23	21	N/A			38*
MN450-NCP	13	14	15	N/A			1*
MN550-NCP	20	21	43/44	22	23	45/46	24*
MN550-XCOM	20	21	43/44	22	23	45/46	24*
MN650-NCP	30	31	69/70	32	33	71/72	40*
MN650-XCOM	30	31	69/70	32	33	71/72	40*
MN50-LCD	7**	8**	6**	N/A			1*

* Use these terminals when all network screens are connected individually to their respective controllers, otherwise connect all screens together and connect to pin 14 of the MN MI.

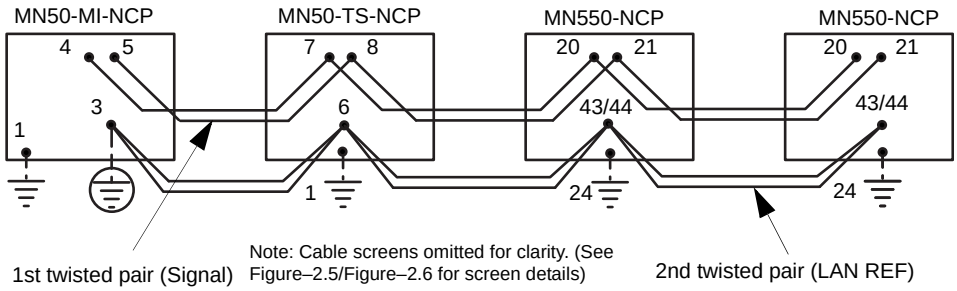
** Use these terminals to connect an MN50-LCD to a networked MN550 or MN650 controller (using controller's Sub-LAN).

Signal Wiring

See Figure–2.4. The first twisted pair of the Belden 9502 dual twisted pair cable should be connected to the LAN terminals of the network devices.

Caution: Observe polarity at all devices. Always connect (-) to (-) and (+) to (+) throughout the LAN.

Note: It is recommended that controllers on a Sub-LAN use a different power supply than that of the Touch Screen. "Power Supply Considerations" section in Appendix A.



Figure–2.4 NCP Network Wiring Example

Note: Refer to Appendix A for details of how to connect MN 50 Series devices to existing MicroNet networks.

LAN Reference

See Figure–2.4. The two conductors of the second twisted pair should be connected to the LAN REF terminal of each network device. This is intended to counteract any possible differences in potential between devices. All devices should be included. The LAN REF terminals on each device are annotated 'LAN A REF' or 'LAN B REF' (where LAN A is a Main LAN and LAN B is a Sub-LAN). It is important to connect the LAN REF pair to the isolated earth of the MN MI (Terminal 3).

Earthing of Cable Screens

Proper earthing of network cable screens can be critical to performance.

Note: Any lengths of more than approximately three inches of unscreened network cable should be avoided because this can pick up noise that can interfere with communications.

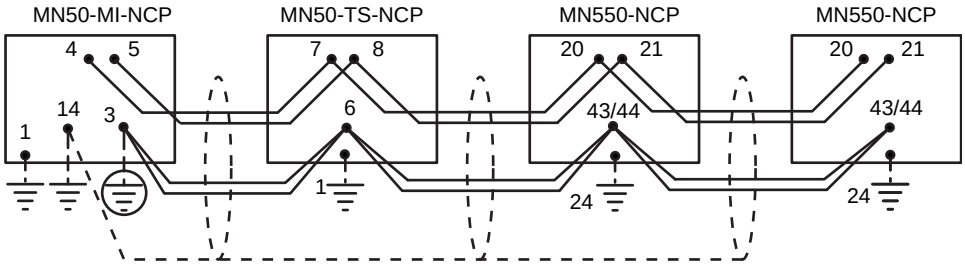
The overall screen of each section of dual twisted pair cable should be connected as in one of two ways as follows:

1. All screens joined together and then connected only to the GND terminal (1 or 14) of the MN MI at the end of the LAN.
2. Each screen connected to the GND terminal of its adjacent NCP device.

Connected Screens

See Figure–2.5. The screen of one cable can be joined to the screen of the next, and then the screen connected to earth at one point only (at the MN MI). The cable screens are joined together using a connector or by soldering, **but are not individually connected to earth**.

Note: It is recommended that controllers on a Sub-LAN use a different power supply than that of the Touch Screen. See the “Power Supply Considerations” section in Appendix A.



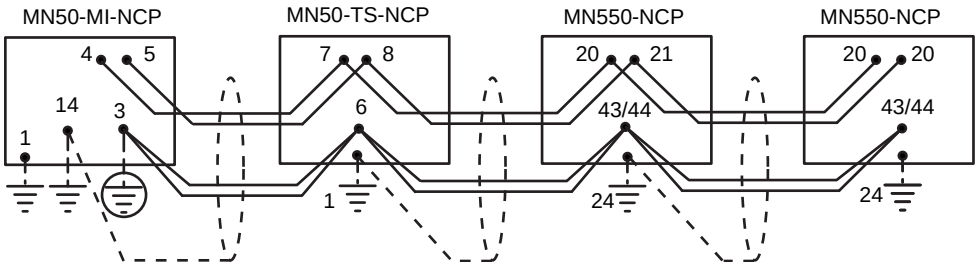
Figure–2.5 All Screens Joined and Connected to Earth at the MN MI

Note that terminal 3 of an MN MI connects to 0V (an isolated reference point), as does the GND terminal of all devices (e.g. terminal 24 of an MN550).

Individual Screens

An alternative (see Figure–2.6) is to connect one end of each cable screen to the 0V terminal of each device. The other end of the cable screen is isolated to prevent the formation of potential earth loops. This method can be useful for long runs of cable, since it helps to prevent 50Hz mains hum.

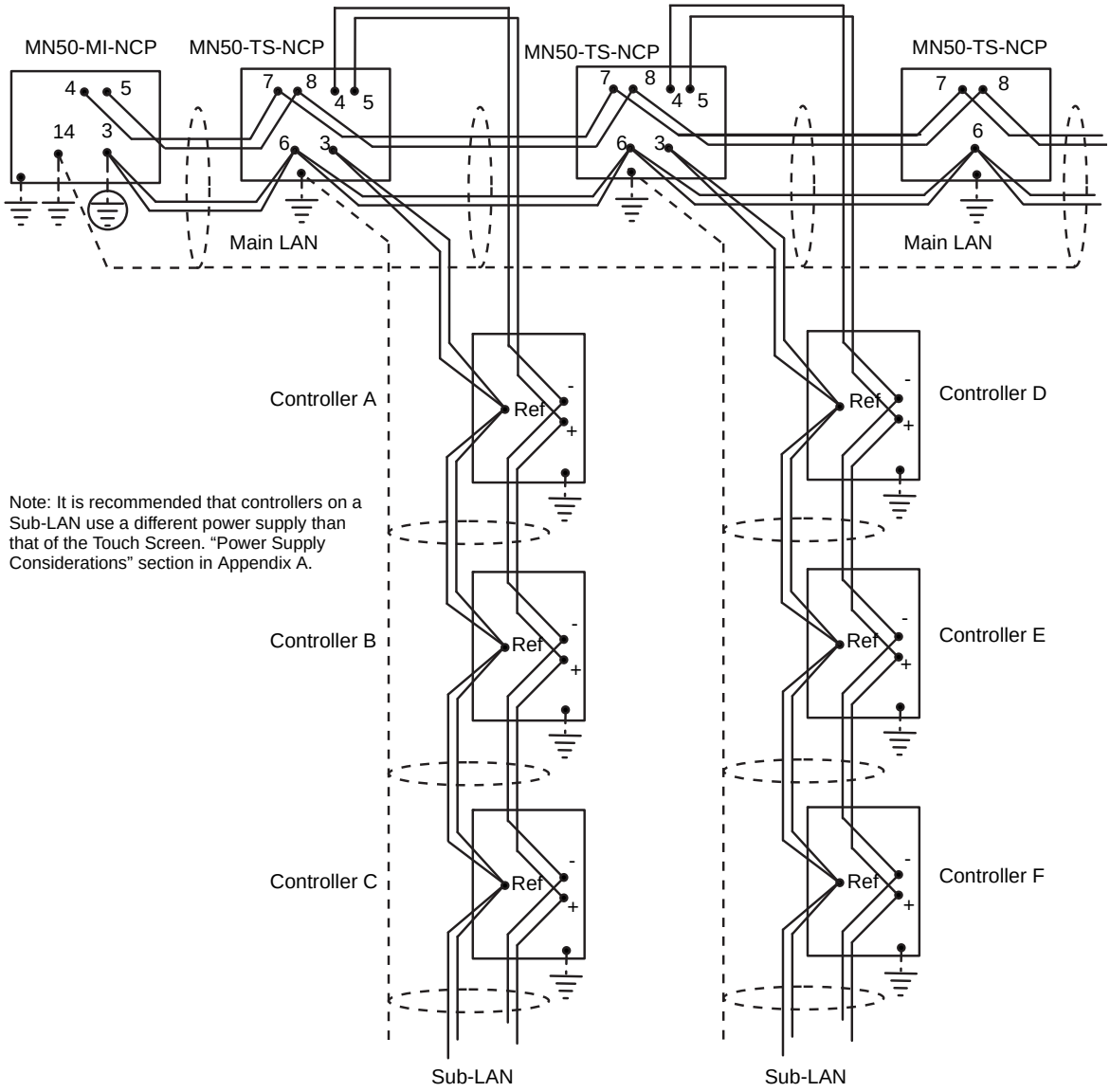
Note: It is recommended that controllers on a Sub-LAN use a different power supply than that of the Touch Screen. “Power Supply Considerations” section in Appendix A.



Figure–2.6 Individual Screens Connected to Earth at One End Only

Using Touch Screens to Create Sub-LANs

Figure–2.7 shows how NCP Touch Screens can be used to provide Sub-LANs. Each Touch Screen is connected the Main LAN via its Main LAN terminals (7 and 8) and the LAN REF terminal (6). Each of the two Sub-LANs are created by connecting a series of controllers to the Touch Screen's Sub-LAN terminals (4 and 5) and the Sub-LAN 0V terminal (3).



Figure–2.7 Using Touch Screens to create Sub-LANs

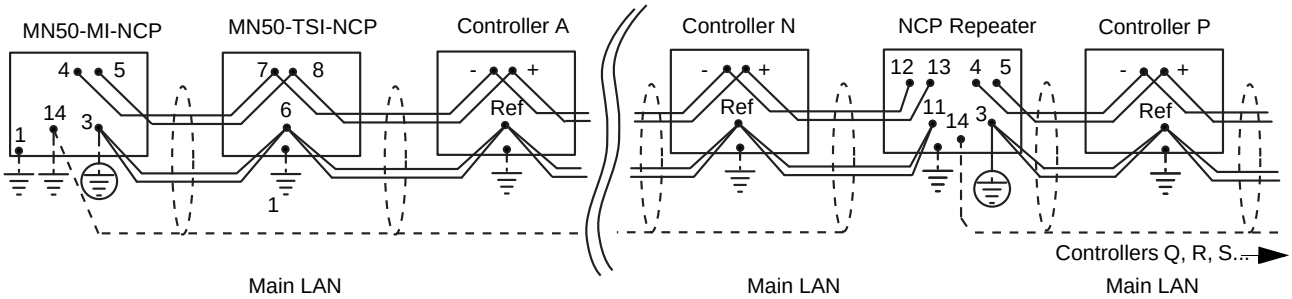
Using NCP Repeaters

The maximum cable length of an NCP Main LAN (or any of its Sub-LANs) is normally 1000m, and the maximum number of devices supported on each Main LAN (or Sub-LAN) is 63. However, each Main LAN or Sub-LAN can be extended in length, or more devices can be added, by using an NCP repeater (an MN MI configured to be a repeater) which provides electrical isolation between the two sections of the LAN.

Figure–2.8 shows a Main LAN, previously containing ‘N’ controllers, which has been extended using an NCP repeater and additional controllers (‘P’ onwards), introduced after Controller N. All devices to the left of the repeater (i.e. connected to the network from terminals 12 and 13) are electrically isolated from those to the right (i.e. connected to the network from terminals 4 and 5). Note that the devices on both sides of the NCP repeater are on the same LAN; no Sub-LAN is created.

Note: It is important to maintain the integrity of the LAN REF *across all devices in each section* of the LAN, both before and after the NCP repeater (see ‘LAN Reference’ section earlier in this chapter) - failure to connect all the LAN REF terminals together allows a ‘floating’ earth system in which a potential difference of more than 12V can exist between device earth terminals, which will affect signal quality. Furthermore, maintaining the LAN REF means that the repeater can be sited anywhere in the LAN.

NCP repeaters can be cascaded. There is no practical limit to the level of cascading, since each repeater adds only about 5mS delay.



Figure–2.8 NCP Repeater Introduced to Provide Electrical Isolation

The screen for the devices to the repeater's left can be earthed normally as described earlier. For example, the screen can be carried through from one cable to the next and earthed at terminal 14 of the MN MI (which is internally connected to Pin 1 (GND).

The screen for the devices to the right of the repeater must also under all circumstances connect to terminal 14 at the NCP repeater. It must **not** also connect to terminal 1. This does not earth the screen, and therefore once on the other side, the screen must be earthed normally; for example, it can be carried through from one cable to the next and connected to earth at the Controller at the end of the LAN.

Configuring an MN MI as a Repeater

To configure an MN MI as an NCP repeater:

1. Cold start the NCP repeater by placing switch 1 in the ON position and the remaining switches OFF, then toggling 8 (i.e. switching to ON, then back to OFF).
2. Set switches 2 and 6 to ON and the remaining switches OFF, then toggle 8 again.

Earthing of Screened Cable for AOs, DIs and UIs

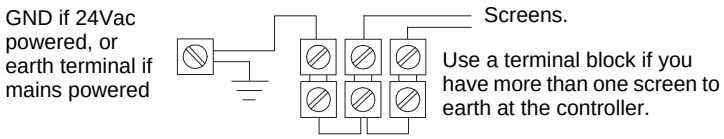
In some cases, it may be necessary to use screened cable for Analogue Outputs (AOs), Digital Inputs (DIs) and Universal Inputs (UIs), as given in the table on page 14.

If screened cable is used, the screen must be connected to earth at one end of the cable only. If earthing at the controller end, connect as follows:

- At an MN450, 550 or 650 controller, or a 24Vac-powered MN350, connect the screen to the GND terminal of the controller, i.e:
  - Terminal 1 for an MN450 controller.
  - Terminal 24 for an MN550 controller.
  - Terminal 40 for an MN650 controller.
  - Terminal 38 for a 24Vac-powered MN350 controller.

  The GND terminal connects to earth at the transformer.
- At a mains powered MN350 controller, connect the screen to the dedicated earth terminal.

In some cases, screens from different cables may need to connect to the same GND terminal. In this situation, use a terminal block as shown in Figure–2.9.



Figure–2.9 Connecting Screens to the GND or Earth Terminal

MN-Sx Wiring

Each MN-Sx digital wall sensor must be wired to an MN350, 450, 550 or 650 controller using an S-Link (S-LK) wire pair. The S-LK connection powers and provides communications between controller and sensor.

Warning: Observe the safety warnings and precautions given on page 7.

The maximum S-LK wire length is 61m. S-LK wiring may be housed in the same conduit with Universal Input, Analogue Output and Digital Input wiring.

If conduit is used between an MN-Sx sensor and a controller, the network and S-LK wiring may be housed in the same conduit, but should be in separate cables. Two-pair cable is not recommended.

Cable Routing

The following table shows the cable types that can be routed together. A tick indicates that routing together is allowable.

Table–2.3 Cable types that can be routed together

	Comms[a]	S-Link	DI	DI (MN650)	UI	AO	DO 24Vac	DO 240Vac
Comms[a]	✓	✓	✓	✓	✓	✓	✗	✗
S-Link	✓	✓	✓	✗	✓	✓	✗	✗
DI	✓	✓	✓	✓b	✓c	✓	✓b	✗
DI (MN650)	✓	✗	✓b	✓	✓c	✓d	✓	✗
UI	✓	✓	✓c	✓c	✓	✓	✓c	✗
AO	✓	✓	✓	✓d	✓	✓	✓d	✗
DO 24Vac	✗	✗	✓b	✓	✓c	✓d	✓	✗
DO 240Vac	✗	✗	✗	✗	✗	✗	✗	✓

a.= Comms must always be screened.
b.= Screen DI.
c.= Screen UI.
d.= Screen AO.

Notes:

- Always route network wiring away from mains wiring.
- If the cable is installed in areas of high RFI/EMI, the cable must be in conduit.
- In areas of high electrical noise, there may be a need to mount the MicroNet controllers and other devices inside an earthed metal panel.

NCP Addressing

Warning: Observe the safety warnings and precautions given on page 7.

Each MN MI, controller and Touch Screen on the NCP network needs a unique network address. This address includes both a subnet address and a node address:

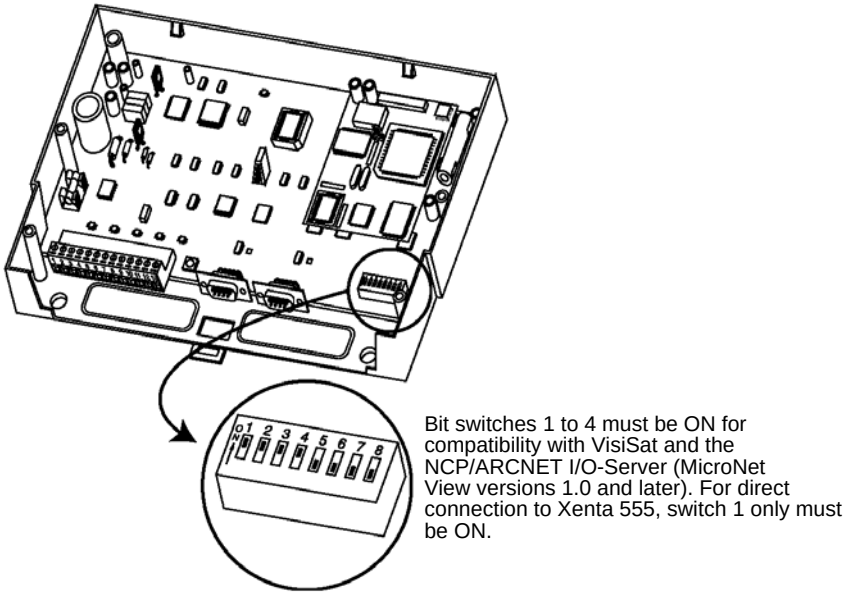
- The subnet address identifies the LAN to which the device is connected (i.e. the Main LAN or a Sub-LAN). At each site, the Main LAN and all Sub-LANs have a unique subnet address.
- The node address is unique to the LAN. Therefore, a device on the main LAN and another device on a Sub-LAN, or two devices on different Sub-LANs, can have the same node address.

When defining the control scheme in VisiSat, you need to specify the subnet and node address of each controller, MN MI and Touch Screen you place in the Project Definition drawing. Refer to Figure–2.11 for addressing examples. You set the subnet and node address as described in the following sections.

MN MI Addressing

The subnet and node address of an MN MI are always zero (0,0). Set the address of an MN MI using the bit switches inside the device (refer to the Engineering Data Sheet - DS 10.210A).

After you have set up the address, the first four bit switches will be ON.



Figure–2.10 MN MI Bit Switch Positions

Controller Addressing

You need to set the node address of a controller using the bit switches inside the device (refer to the appropriate Engineering Data Sheet). The node address must be in the range 1-63.

You do not set the subnet address manually. The subnet address is always 1 if the device is on the Main LAN (even if there is no MN MI). If a controller is connected to a Sub-LAN, the subnet address is the same as the node address of the Touch Screen that has created the Sub-LAN.

Touch Screen Addressing

You need to set the node address of a Touch Screen from the Touch Screen's Maintenance screen (refer to the Engineering Data Sheet - DS 10.050A). It must be in the range 2-63, but only 20 Sub-LANs are allowed on one NCP network. The Sub-LAN subnet address is the same as the device node address and is automatically set when you enter the node address. To prevent the Touch Screen's Sub-LAN subnet address from conflicting with the subnet address of the Main LAN, never use a node address of 1.

The subnet address is always 1, as a Touch Screen must always be on the Main LAN in NCP networks.

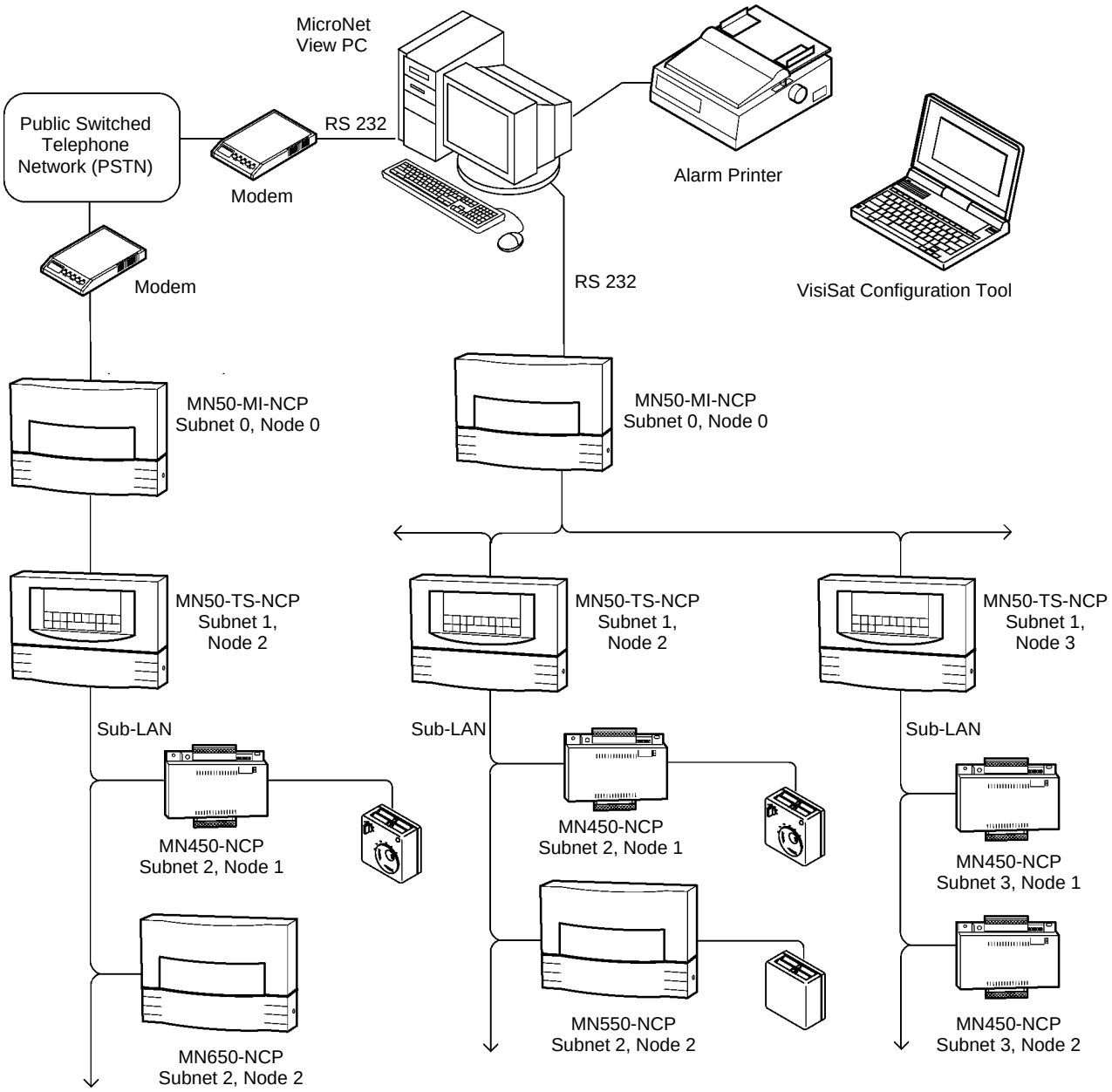
Broadcasting the Subnet Address

Each device throughout the network receives its subnet address when the MN MI sends a broadcast message. This is sent automatically every 5 minutes. However, by pressing the service pin in the MN MI, the subnet address is sent immediately to all devices under the MN MI, including those in Sub-LANs.

For networks that do not use an MN MI, VisiSat automatically sends the service pin message.

If you want to broadcast the subnet address to all devices under a specific Touch Screen, you can do so by using the Service Pin button in the Touch Screen's Configuration window.

Pressing the Service Pin also restarts any alarm polling that has gone offline, assuming that it has since come back online.



Figure–2.11 NCP Addressing Example

RS 232-to-RS 485 Converters

A LIB485 (port powered) or Westermo MA44 RS 232-to-RS 485 converter may be used to enable VisiSat to communicate with NCP networks that do not have an MN MI.

No setting up is required for a LIB485.

A Westermo MA44 requires the switches to be set as follows:

Switch S2:

Bit 1 = OFF
Bit 2 = OFF
Bit 3 = ON
Bit 4 = ON
Bit 5 = OFF
Bit 6 = ON
Bit 7 = OFF
Bit 8 = OFF
Bit 9 = OFF

Switch S3:

Bit 1 = OFF
Bit 2 = OFF
Bit 3 = ON
Bit 4 = ON

Chapter 3
Engineering ARCNET® Networks

Introduction

If peer-to-peer communications and high performance are desired, but the open LONWORKS® protocol is not required, the ARCNET network option may be the best choice. Figure–3.1 shows an example of a local ARCNET network, and Figure–3.2 an example of a network including a remote site.

Peer-to-peer communications enables controllers on an ARCNET network to send data to other controllers. That is, a parameter value can be sent from one controller to another over the network. This is achieved by using the Network Variable (NVTx and NVRx) control objects in VisiSat. Typical data shared includes overrides, non-critical sensor data and monitor points to other controllers. (It is not advisable to split a control system between different controllers, as no guarantee can be given over control performance.)

Network binding (i.e. specifying which controllers receive data from a controller) is also achieved within VisiSat.

The network protocol is token passing, i.e. only the node that has the token can send a message, after which the token must be given up (see page 43). This token-passing method means that the network performance and speed can be calculated i.e. performance is deterministic.

An ARCNET network has a communications speed of 156kbaud using screened RS 485 twisted-pair cabling as specified on page 30.

Note: It is important to ensure that the polarity of the network connections is consistent throughout the system, i.e. (-) is connected to (-) and (+) is connected to (+).

The Main LAN in the network can support up to 95 devices (plus the MN MI). Up to 31 Sub-LANs may be added using ARCNET routers attached to the Main LAN, and each Sub-LAN may contain up to 95 devices (plus the router). You should not use more than 31 Sub-LANs.

MicroNet MN MI, MN350, 450, 550 and 650 controllers can be used on an ARCNET network. MicroNet routers and Touch Screens can also be used, and LCD devices connected to MN550 or 650 controllers.

Note: To maintain network performance, it is recommended that only routers are connected to the Main LAN in an ARCNET network, not controllers or Touch Screens, except where no Sub-LANs are required.

The maximum cable distance of the Main LAN is 800m; each Sub-LAN extends this range by a further 800m. A maximum of 5 routers can be 'cascaded' to give a total maximum routing length of 4.8km.

Note: Network response times increase as a result of cascading of routers.

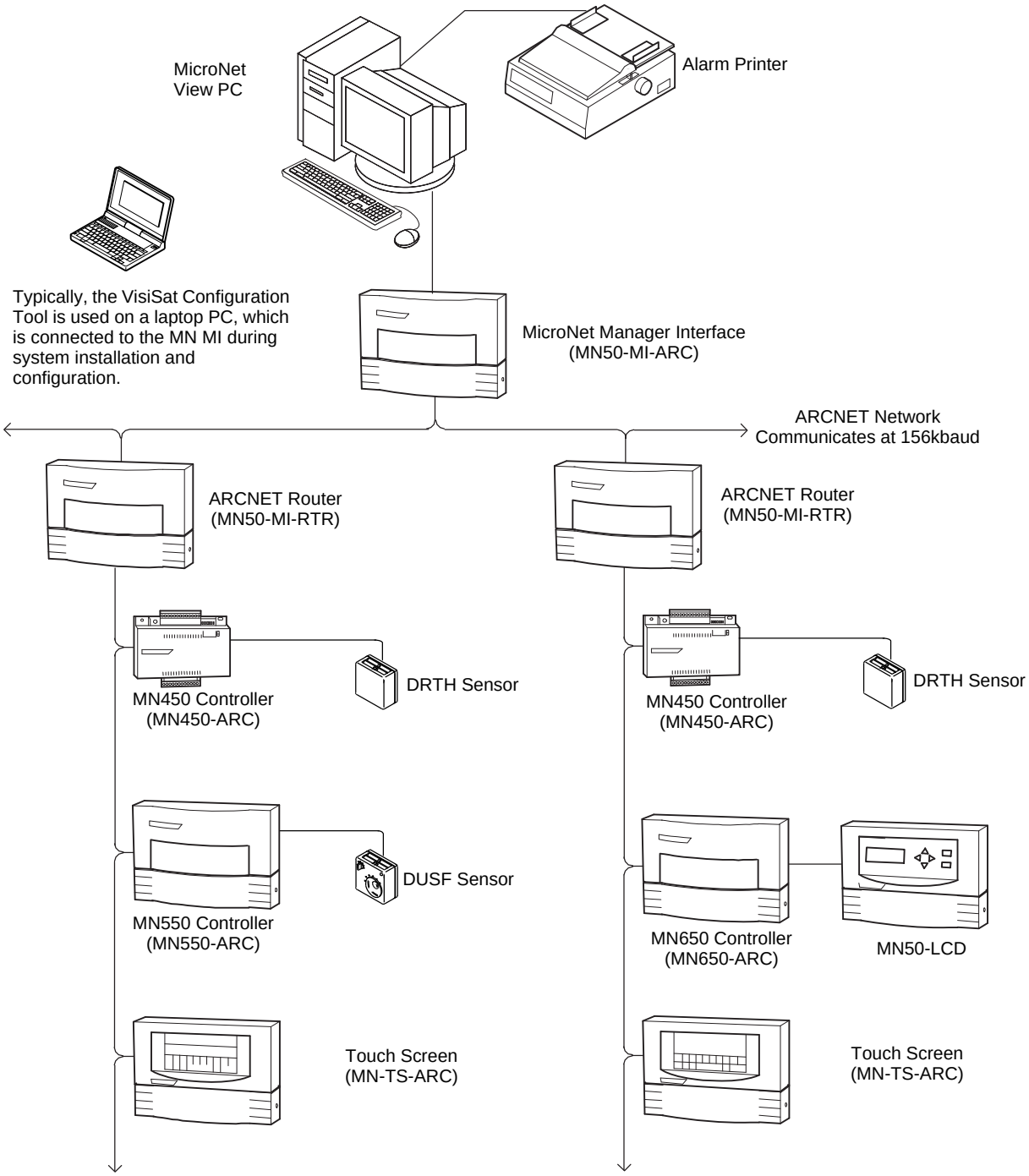
The PC-based VisiSat Configuration Tool is used to configure the MN MI, controllers, LCD displays and Touch Screens on the network.

MicroNet View provides alarm checking, plus dynamic and historical logging of data from the network. MicroNet View requires each local and remote ARCNET network to be headed by an MN MI.

Networks not using MicroNet View do not require an MN MI, but using an MN MI enables remote configuration via a serial port from VisiSat (as well as automatic network-level time synchronisation). ARCNET networks without an MN MI can be configured from VisiSat by using an ARCNET card in the PC, which allows direct connection from the VisiSat PC to the ARCNET network.

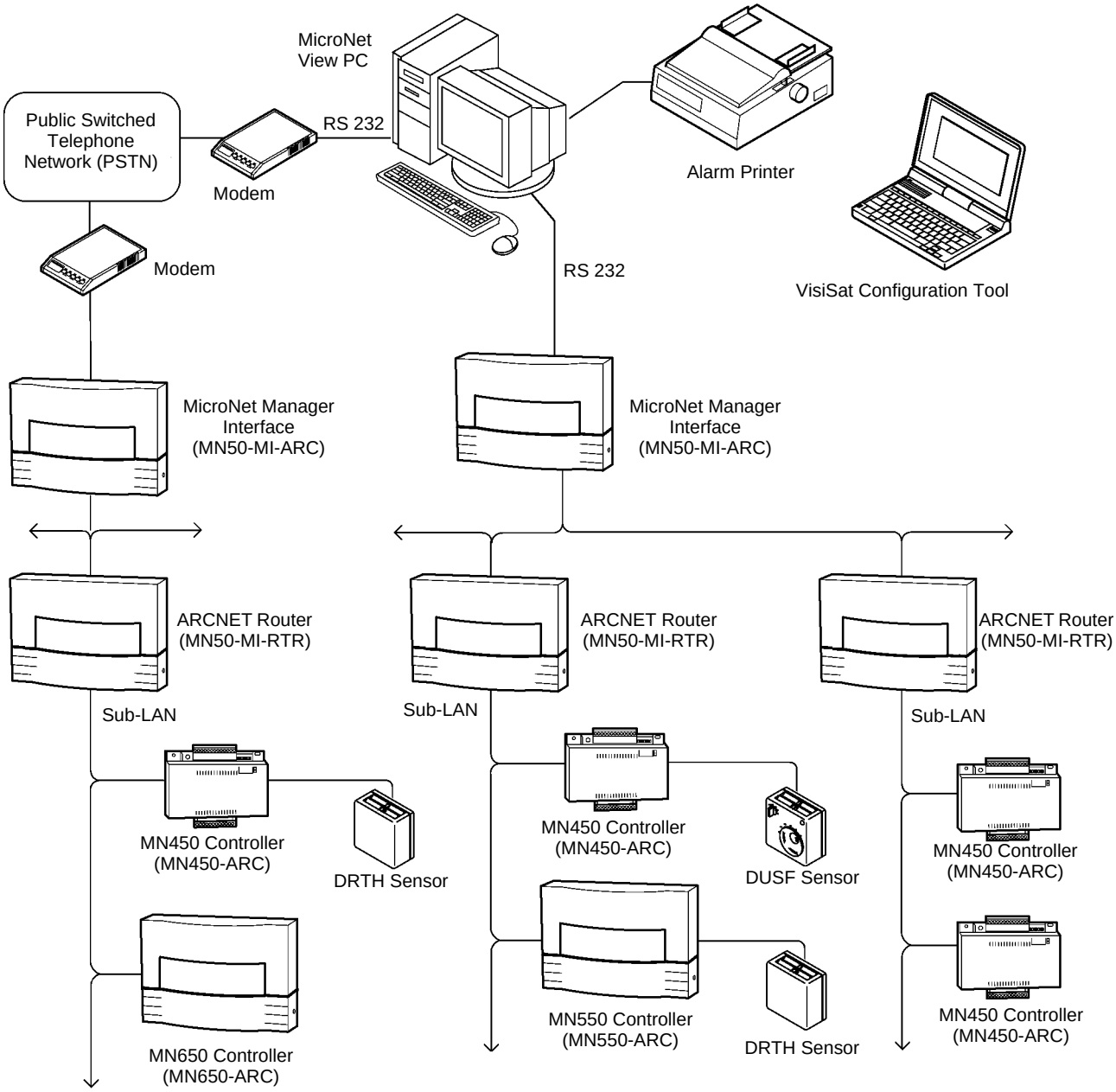
Note: Please refer to the MicroNet Engineering Data Sheets for wiring details, which may be different for each MicroNet device type.

Note: For optimum network performance, the network should be organised such that data (network variables) transferred between controllers does not have to pass through a router. Each LAN can transmit a maximum of only one network variable through a router to any other LAN.



Figure–3.1 Example ARCNET Network

Note: Routers can be attached to a Sub-LAN, as well as to the Main LAN.



Figure–3.2 Example ARCNET Network with Remote Site

ARCNET Terms

These common terms are often used when explaining MicroNet ARCNET networks:

LAN - Either the Main LAN or a Sub-LAN.

Node - Any addressable device on the network, including any controller, MN MI and Touch Screen.

Sub-LAN - A physical group of devices on the network connected to an ARCNET router (see Figure–3.2). All devices on the same Sub-LAN have the same subnet address, which forms part of a node's complete address.

Main LAN - The top-level Local Area Network of ARCNET nodes.

Safety Warnings and Precautions

Digital Outputs

MicroNet controllers have digital outputs which can carry ***mains voltage***.

WARNING - ELECTRICAL SHOCK HAZARD.
REMOVE POWER FROM THE DIGITAL OUTPUTS BEFORE REMOVING CONTROLLER COVERS.

Power Supply

Before making connections, changing jumpers or fitting boards to a MicroNet node, make sure that you remove the power supply (i.e. switch off) the node first. Network connections to the node should be removed before replacing an ARCNET daughter board (if fitted).

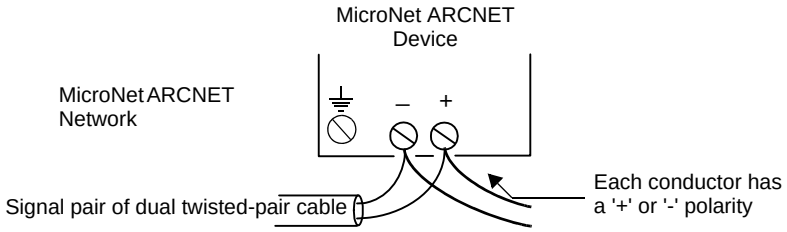
If replacing a node, first switch off the power supply then disconnect all terminals.

It is not necessary to switch off a node to change its node address using the bit switches.

Switching off a MicroNet node does not remove the control application stored in the node's memory.

Polarity

ARCNET communication connections *are* polarity sensitive.



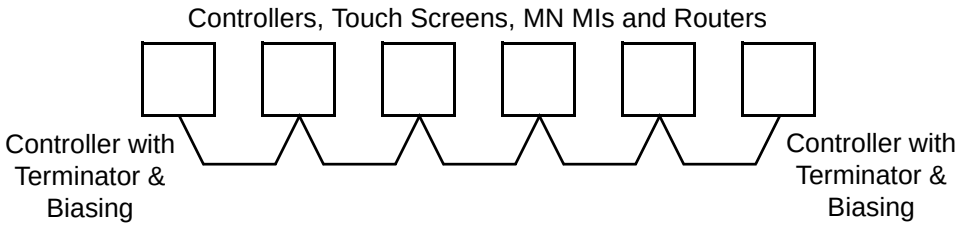
Figure–3.3 ARCNET Networks are Polarity Sensitive

ARCNET Wiring Topology

ARCNET networks are doubly-terminated bus (daisy-chain) networks (Figure–3.4). The wiring path between the two most distant nodes on the Main LAN must not exceed 800m. Similarly, the wiring path between the two most distant nodes on any Sub-LAN must not exceed 800m. A maximum of 5 routers can be 'cascaded' to give a total maximum routing length of 4.8km.

Note: The use of star or tee connections is not allowed (i.e. no branches or spurs).

Note: It is important to ensure that the polarity of the network connections is consistent throughout the system, i.e. (-) is connected to (-) and (+) is connected to (+).



Figure–3.4 ARCNET Bus Networks

Warning: Observe the safety warnings and precautions given on page 23.

Network Wiring

General

Network wiring practice can be viewed as three entities, i.e. Signal Wiring, LAN Referencing and Cable Screening. These are detailed in the following sections.

Effects of Incorrect Communication Wiring

ARCNET networks are adversely affected by incorrect wiring, more so than NCP or LONWORKS networks. Because the system bandwidth is in the order of 156kHz, it is important to wire the communications network carefully, using wire with the correct characteristic impedance (see page 25), and also to provide the correct bias and termination at the ends of the LAN. The LAN must also be daisy-chained to avoid stubs appearing in the network.

If the network is not wired as described, the high-speed signals will reflect from any unterminated ends or stubs and interfere with the signal on the LAN. Because ARCNET operates by token passing, this means the token will frequently be lost, so nodes will continuously lose and regain contact with the network.

In addition, any network variables (NVs) that are bound between controllers (as defined in VisiSat) will be lost and remote sites will dial their front-end PC each time the MN MI discovers there is an offline controller.

Shorts, poor connections or excessive noise will normally cause the ARCNET ERROR LED to flash (see page 39).

ARCNET Cable Requirements

Approved cable types are listed in Table–3.1. Multi-core cables used to carry other signals (e.g. sensor or telephone signals) are not permitted.

Table–3.1 Approved Cable Types.

Manufacturer/Distributor	Part Number	Cable Type	Gauge mm (AWG)	Maximum Bus Length (m)
Wadsworth Electronics Ltd Central Avenue, West Molesey Surrey KT8 2QB 020 8268 7000 www.wadsworth.co.uk	Belden 9502	2-pair stranded, screened	.5 (24)	800
Anixter UK Headquarters 1st Floor, Wellington House 4 - 10 Cowley Road Uxbridge Middlesex UB8 2XW, Tel: +44 1895 276800 Fax: +44 1895 276946 www.anixter.net	Belden 9502	2-pair stranded, screened	.5 (24)	800

ARCNET LAN Connections

Table–3.2 provides details of Main LAN, Sub-LAN and cable screen terminals for the MicroNet devices used on an ARCNET network.

Table–3.2 ARCNET Device LAN Connections

ARCNET Device	Main LAN			Sub-LAN			Screen
	-	+	LAN REF	-	+	LAN REF	
MN50-MI-ARC	9	10	11	N/A			14
MN50-MI-RTR	9	10	11	7	8	3	14
MN50-TS-ARC	7	8	6	4	5	3	1*
MN350-ARC	22	23	21	N/A			38*
MN450-ARC	13	14	15	N/A			1*
MN550-ARC	20	21	43/44	22	23	45/46	24*
MN650-ARC	30	31	69/70	32	33	71/72	40*
MN50-LCD	7**	8**	6**	N/A			1*

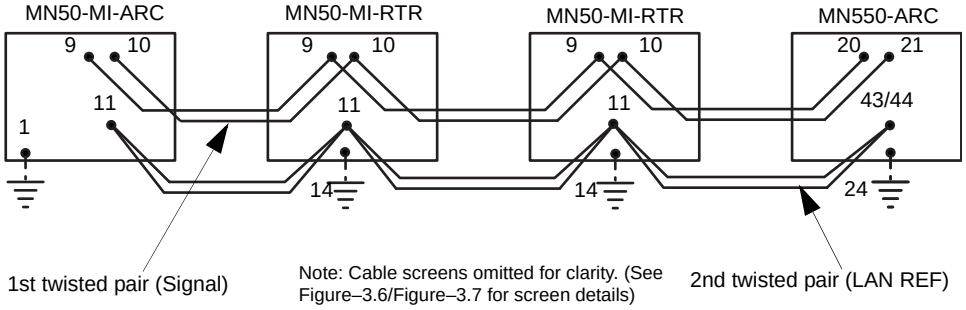
* Use these terminals when all network screens are connected individually to their respective controllers, otherwise connect all screens together and connect to pin 14 of the MN MI.

** Use these terminals to connect an MN50-LCD to a networked MN550 or MN650 controller (using controller's Sub-LAN).

Signal Wiring

See Figure–3.5. The first twisted pair of the Belden 9502 dual twisted pair cable should be connected to the LAN terminals of the network devices.

Caution: Observe polarity at all devices. Always connect (-) to (-) and (+) to (+) throughout the LAN.



Figure–3.5 ARCNET Network Wiring Example

Note: Refer to Appendix A for details of how to connect MN 50 Series devices to existing MicroNet networks.

LAN Reference

See Figure–3.5. The two conductors of the second twisted pair should be connected to the LAN REF terminal of each network device. This is intended to counteract any possible differences in potential between devices. All devices should be included. The LAN REF terminals on each device are annotated ‘LAN A REF’ or ‘LAN B REF’ (where LAN A is a Main LAN and LAN B is a Sub-LAN). It is important to connect the LAN REF pair to the isolated reference terminal on the MN MI (terminal 11).

Earthing of Cable Screens

Proper earthing of network cable screens can be critical to performance.

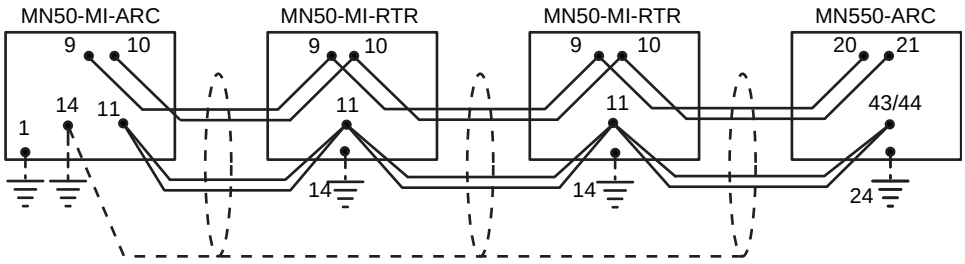
Note: Any lengths of more than approximately three inches of unscreened network cable should be avoided because this can pick up noise that can interfere with communications.

The overall screen of each section of dual twisted pair cable should be connected as in one of two ways as follows:

1. All screens joined together and then connected only to the GND terminal (1 or 14) of the MN MI at the end of the LAN.
2. Each screen connected to the GND terminal (14) of its adjacent ARCNET device.

Connected Screens

See Figure–3.6. The screen of one cable can be joined to the screen of the next, and then the screen connected to earth at one point only (at the MN MI). The cable screens are joined together using a connector or by soldering, **but are not individually connected to earth**.

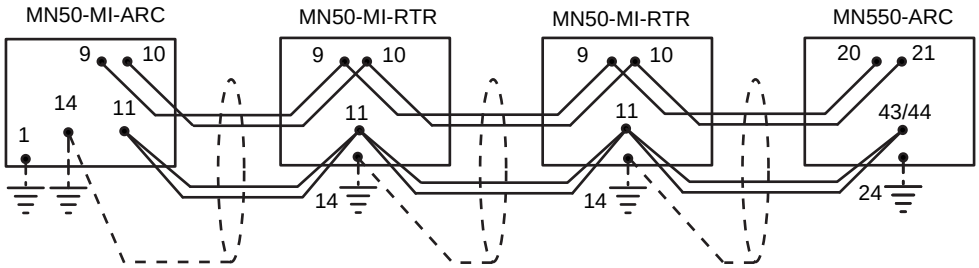


Figure–3.6 All Screens Joined and Connected to Earth at the MN MI

Note that terminal 3 of an MN MI connects to earth, as does the GND terminal of all devices (e.g. terminal 24 of an MN550).

Individual Screens

An alternative (see Figure–3.7) is to connect one end of each cable screen to the GND terminal of each device. The other end of the cable screen is isolated to prevent the formation of potential earth loops. This method can be useful for long runs of cable, since it helps to prevent 50Hz mains hum.



Figure–3.7 Individual Screens Connected to Earth at One End Only

Termination and Biasing

Each ARCNET LAN must be biased and terminated by fitting jumpers across the appropriate links in the devices *at each end* of the LAN. If the device is not at the end of the LAN, the links must be left open.

Links on the MN 50 series devices (MN350, 450, 550 and 650) are situated on the main board. On other devices (MN MIs, ARCNET Routers and the Touch Screen), the links are contained on an ARCNET daughter board. ARCNET Routers have two sets of links.

To bias and terminate MicroNet ARCNET devices, fit the links according to Table–3.3:

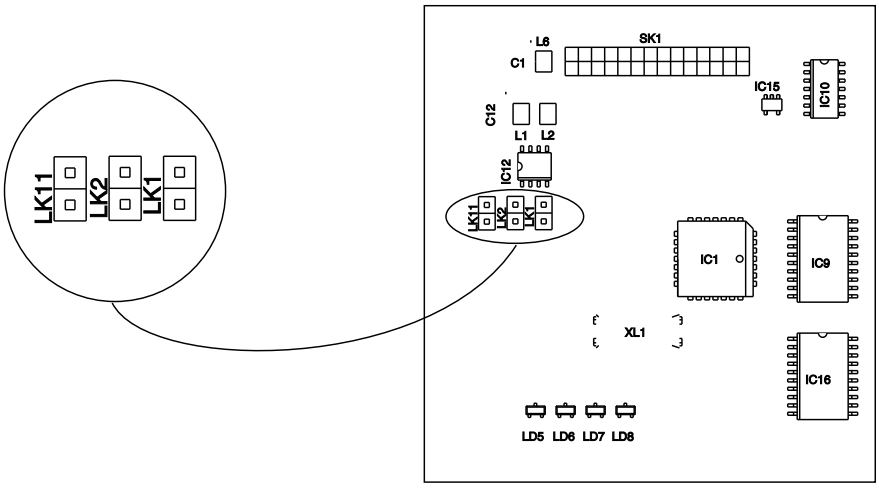
Table–3.3 ARCNET Biasing and Termination

Device	**820Ω Biasing[a] (one pull-up and one pull-down resistor)**	**120Ω LAN Termination Resistor**
MN50-MI-ARC	LK1 & LK2	LK11
MN50-MI-RTR[b]: (Main LAN) (Sub-LAN)	LK1 & LK2 LK8 & LK9	LK11 LK10
MN350-ARC	LK28 BIAS+ LK28 BIAS-	LK28 TM/TERM
MN450-ARC	LK27A & LK27C	LK27B
MN550-ARC	LK4A & LK4C	LK4B
MN650-ARC	LK4A & LK4C	LK4B
MN50-TS-ARC	LK1 & LK2 (on ARCNET daughter board)	LK11 (on ARCNET daughter board)

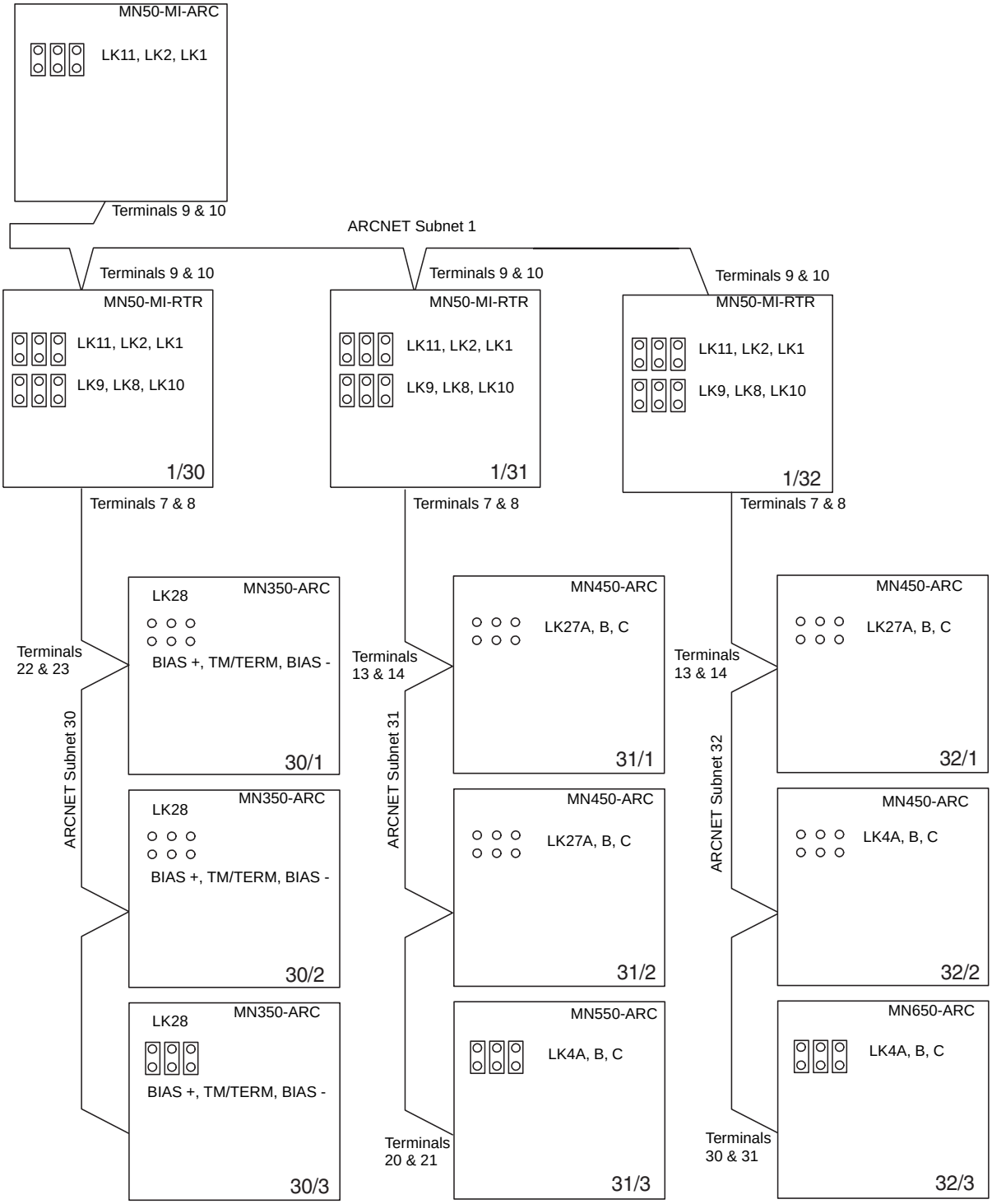
a. The bias is only provided when the controller is actually switched on because the voltage is derived from the controller's internal power supply

b. When a router is used to extend the LAN, the links for both channels must be fitted.

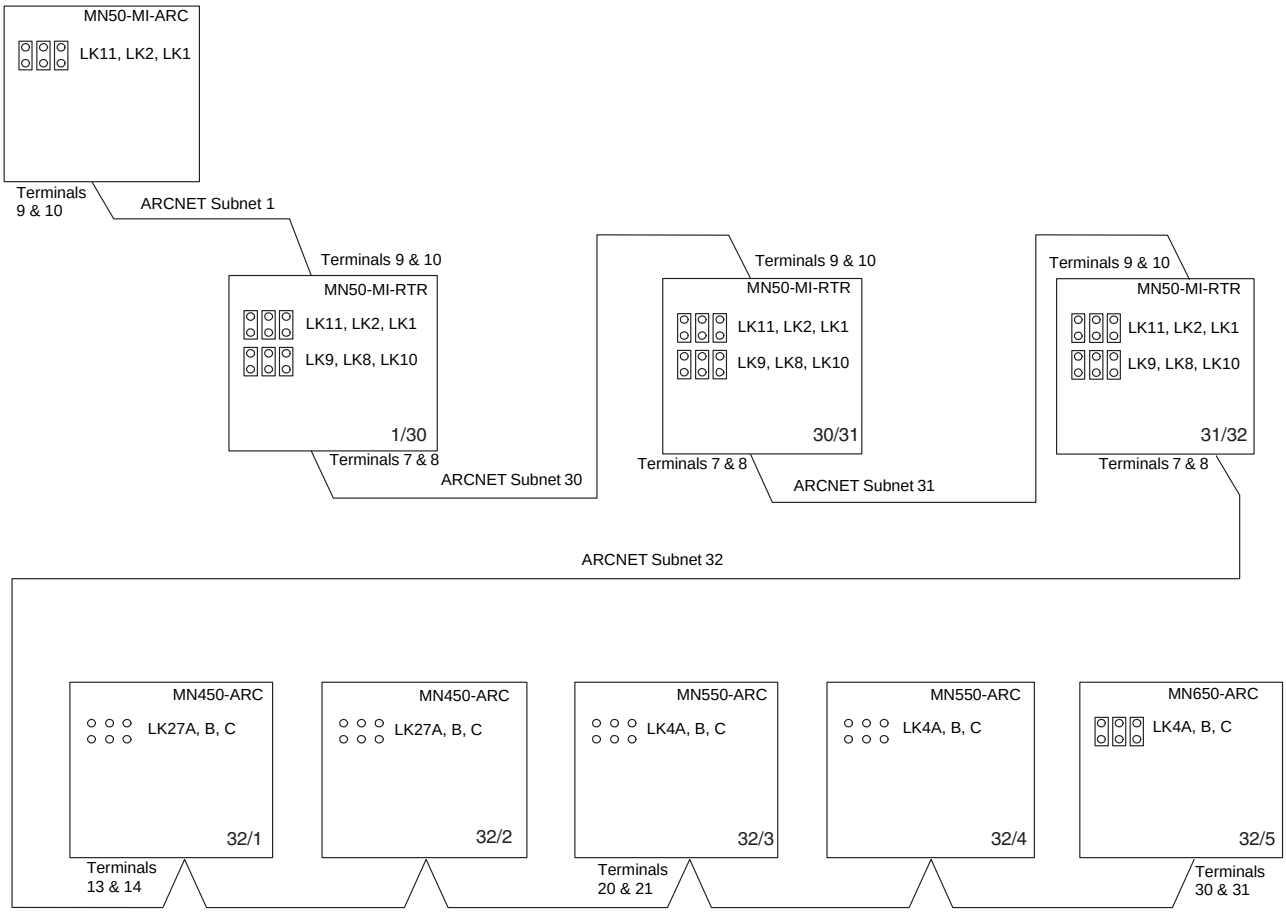
Figure–3.9 and Figure–3.10 give examples of termination.



Figure–3.8 ARCNET Termination and Biasing Links (shown on ARCNET daughter board)



Figure–3.9 ARCNET Termination and Biasing - Routers Used



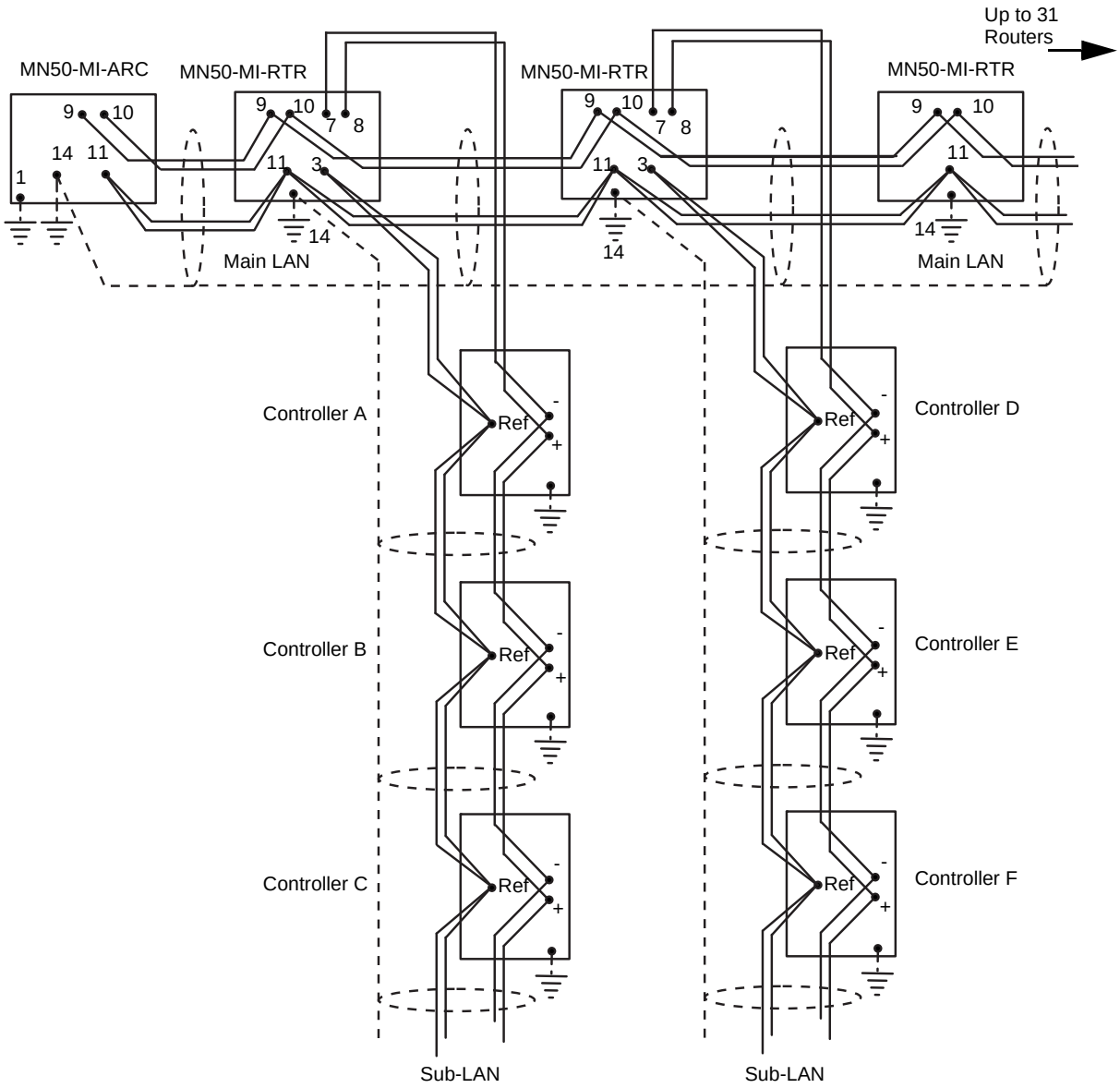
Figure–3.10 ARCNET Termination and Biasing - Routers Configured as Repeaters

Note: At present it is not recommended to connect any controllers on the subnets that interconnect between the repeaters. However controllers can be connected to the last repeater's subnet. Restricting the connection of controllers on the intermediate subnets will prevent Tags being bound across subnets and eliminates the possibility of data loss between controllers on other subnets.

Using ARCNET Routers to Create Sub-LANs

Figure–3.11 shows how ARCNET Routers can be used to provide Sub-LANs. Each router is connected to the Main LAN via its Main LAN terminals (9 and 10) and the LAN REF terminal (11). Each of the two Sub-LANs are created by connecting a series of controllers to the router's Sub-LAN terminals (7 and 8) and the Sub-LAN 0V terminal (3).

A maximum of 31 routers can be used in this way.



Figure–3.11 Using ARCNET Routers to create Sub-LANs

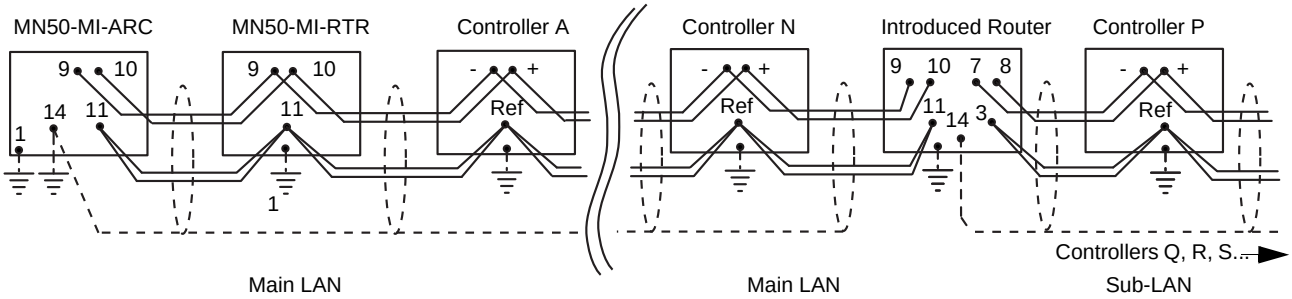
Using ARCNET Routers as Repeaters

The maximum cable length of an ARCNET Main LAN (or any of its Sub-LANs) is normally 800m, and the maximum number of devices supported on each Main LAN (or Sub-LAN) is 94 (plus the MN MI). However, each Main LAN or Sub-LAN can be extended in length, or more devices can be added, by using an ARCNET Router as a repeater, which provides electrical isolation between the two sections of the LAN.

Figure–3.12 shows a Main LAN, previously containing ‘N’ controllers, which has been extended using a router and additional controllers (‘P’ onwards), introduced after Controller N. All devices to the left of the introduced router (i.e. connected to the network from terminals 9 and 10) are electrically isolated from those to the right (i.e. connected to the network from terminals 7 and 8).

Note: It is important to maintain the integrity of the LAN REF *across all devices in each section* of the LAN, both before and after the router (see ‘LAN Reference’ section earlier in this chapter) - failure to connect all the LAN REF terminals together allows a ‘floating’ earth system in which a potential difference of more than 12V can exist between device earth terminals, which will affect signal quality. Furthermore, maintaining the LAN REF means that the router can be sited anywhere in the LAN.

A maximum of five routers can be cascaded.



Figure–3.12 Router Introduced to Provide Electrical Isolation

The screen for the devices to the router's left can be earthed normally as described earlier. For example, the screen can be carried through from one cable to the next and earthed at terminal 14 of the MN MI (which is internally connected to Pin 1 (GND).

The screen for the devices to the right of the introduced router must also under all circumstances connect to terminal 14 at the router. It must be carried through from one cable to the next and connected to earth at the controller at the end of the LAN.

Configuring an ARCNET Router as a Repeater

To configure an ARCNET Router as a repeater:

1. Cold start the router by placing switch 1 in the ON position and the remaining switches OFF, then toggling 8 (i.e. switching to ON, then back to OFF).
2. Set switches 2 and 6 to ON and the remaining switches OFF, then toggle 8 again.

Earthing of Screened Cable for AOs, DIs and UIs

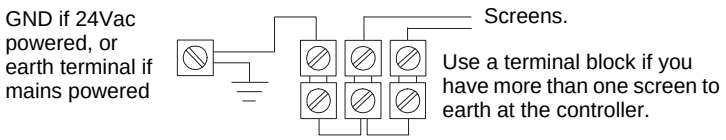
In some cases, it may be necessary to use screened cable for Analogue Outputs (AOs), Digital Inputs (DIs) and Universal Inputs (UIs), as given in the table on Page 13.

If screened cable is used, the screen must be connected to earth at one end of the cable only. If earthing at the controller end, connect as follows:

- At an MN450, 550 or 650 controller, or a 24Vac-powered MN350, connect the screen to the GND terminal of the controller, i.e:
  - Terminal 1 for an MN450 controller.
  - Terminal 24 for an MN550 controller.
  - Terminal 40 for an MN650 controller.
  - Terminal 38 for a 24Vac-powered MN350 controller.

  The GND terminal connects to earth at the transformer.
- At a mains powered MN350 controller, connect the screen to the dedicated earth terminal.

In some cases, screens from different cables may need to connect to the same GND terminal. In this situation, use a terminal block as shown in Figure–3.13.



Figure–3.13 Connecting Screens to the GND or Earth Terminal

Cable Routing

The following table shows the cable types that can be routed together. A tick indicates that routing together is allowable.

Table–3.4 Cable types that can be routed together

	Comms[a]	S-Link	DI	DI (MN650)	UI	AO	DO 24Vac	DO 240Vac
Comms[a]	✓	✓	✓	✓	✓	✓	✗	✗
S-Link	✓	✓	✓	✗	✓	✓	✗	✗
DI	✓	✓	✓	✓[b]	✓[c]	✓	✓[b]	✗
DI (MN650)	✓	✗	✓[b]	✓	✓[c]	✓[d]	✓	✗
UI	✓	✓	✓[c]	✓[c]	✓	✓	✓[c]	✗
AO	✓	✓	✓	✓[d]	✓	✓	✓[d]	✗
DO 24Vac	✗	✗	✓[b]	✓	✓[c]	✓[d]	✓	✗
DO 240Vac	✗	✗	✗	✗	✗	✗	✗	✓

a.= Comms must always be screened.
b.= Screen DI.
c.= Screen UI.
d.= Screen AO.

Notes:

- Always route network wiring away from mains wiring.
- If the cable is installed in areas of high RFI/EMI, the cable must be in conduit.
- In areas of high electrical noise, there may be a need to mount the MicroNet controllers and other devices inside an earthed metal panel.

MN-Sx Wiring

Each MN-Sx digital wall sensor must be wired to an MN350, 450, 550 or 650 controller using an S-Link (S-LK) wire pair. The S-LK connection powers and provides communications between controller and sensor.

Warning: Observe the safety warnings and precautions given on page 23.

The maximum S-LK wire length is 61m. S-LK wiring may be housed in the same conduit with Universal Input, Analogue Output and Digital Input wiring.

If conduit is used between an MN-Sx sensor and a controller, the network and S-LK wiring may be housed in the same conduit, but should be in separate cables. Two-pair cable is not recommended.

ARCNET Addressing

Warning: Observe the safety warnings and precautions given on page 23.

Each MN MI, router, controller and Touch Screen on the ARCNET network needs a unique network address. This address includes both a subnet address and a node address:

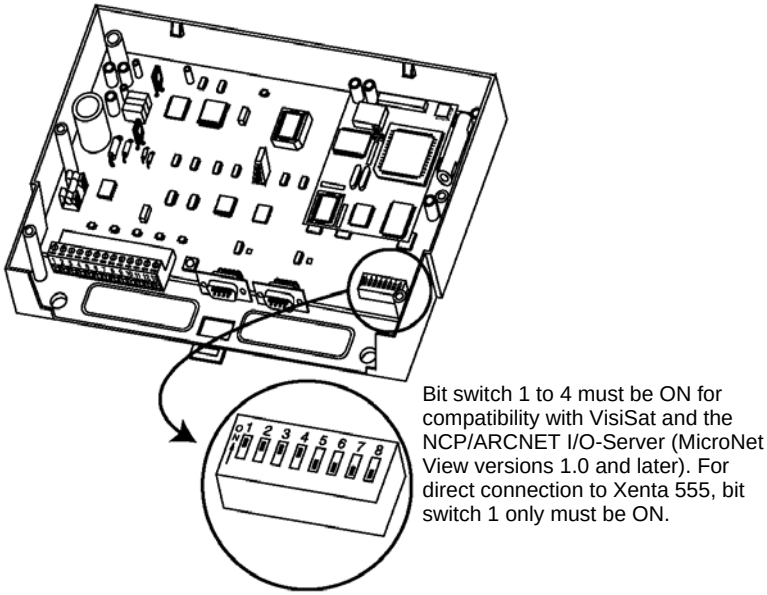
- The subnet address identifies the LAN to which the device is connected (i.e. the Main LAN or a Sub-LAN). At each site, the Main LAN and all Sub-LANs have a unique subnet address.
- The node address is unique to the LAN. Therefore, a device on the main LAN and another device on a Sub-LAN, or two devices on different Sub-LANs, can have the same node address.

When defining the control scheme in VisiSat, you need to specify the subnet and node address of each controller, MN MI and Touch Screen you place in the Project Definition drawing (there is no VisiSat symbol for a router). Refer to Figure–3.15 for addressing examples. You set the subnet and node address as described in the following sections.

MN MI Addressing

The subnet and node address of an MN MI are always zero (0,0). Set the address of an MN MI using the bit switches inside the device (refer to the Engineering Data Sheet - DS 10.210A).

Set the first four bit switches to ON and power up the MI. This will configure the MI for use with MN View.



Figure–3.14 MN MI Bit Switch Positions

Controller or Router Addressing

You need to set the node address of a controller or router using the bit switches inside the device (refer to the appropriate Engineering Data Sheet). The node address should be in the range 1-95 for a controller, and 2-63 for a router (never 1). The maximum number of routers is 31. Bit switch 7 in a router must always be in the ON position.

You do not set the subnet address manually. The subnet address is always 1 if the device is on the Main LAN (even if there is no MN MI). If a controller or router is connected to a Sub-LAN, the subnet address is the same as the node address of the router that has created the Sub-LAN.

Touch Screen Addressing

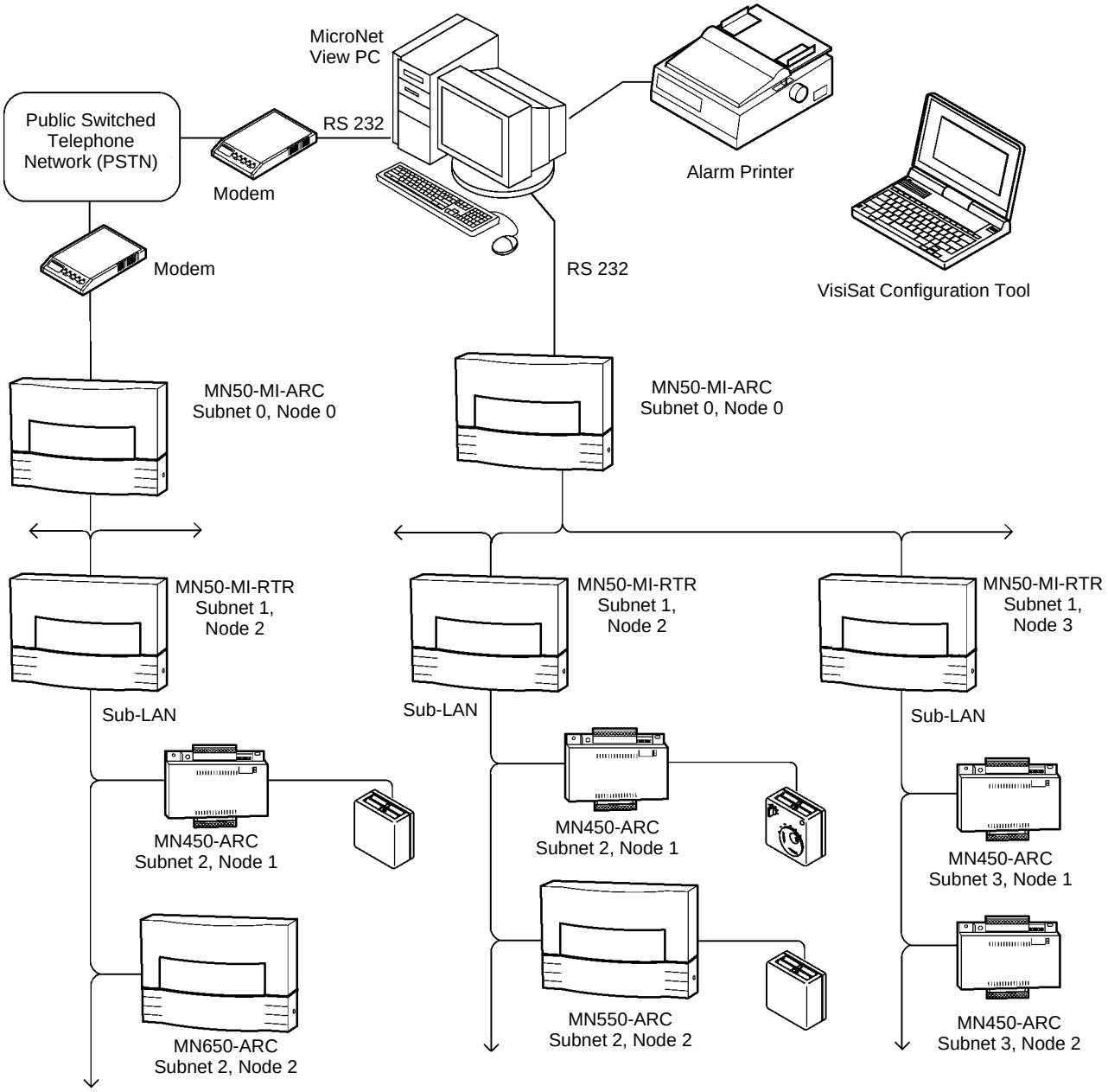
You need to set the node address of a Touch Screen from the Touch Screen's Maintenance screen (refer to the Engineering Data Sheet - DS 10.050A). It must be in the range 1-95 (same range as a controller).

The subnet address is always 1 if the device is on the Main LAN. If the device is connected to a Sub-LAN, the subnet address is the same as the node address of the router that has created the Sub-LAN. The subnet address is programmed automatically.

Broadcasting the Subnet Address

Each device receives its subnet address when the MN MI sends a broadcast message. This is sent automatically every 5 minutes. However, by pressing the service pin in the MN MI, the subnet is sent immediately to all devices under the MN MI.

For networks that do not use an MN MI, VisiSat automatically sends the service pin message.



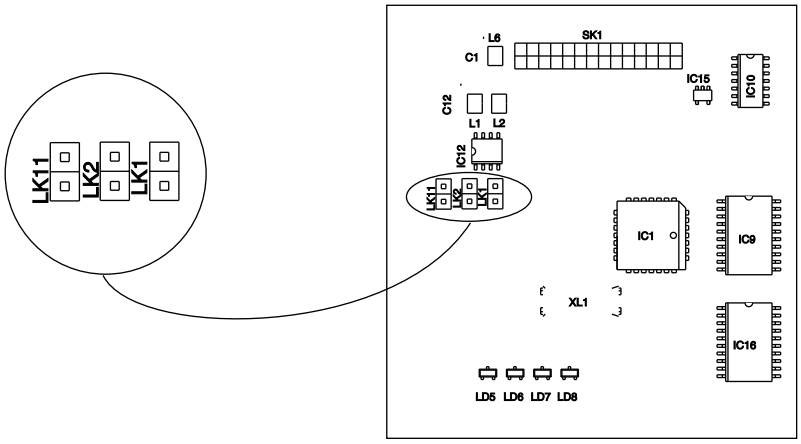
Figure–3.15 ARCNET Addressing Example

ARCNET Daughter Board

The ARCNET daughter board (MNA-C) is normally fitted only to certain devices, such as the MN MI and the Touch Screen, when it is required to use these devices in an ARCNET network. The ARCNET daughter board is not normally fitted to any of the MN 50 Series controllers (MN350, MN450, MN550 and MN650), although it is possible to do so. The ARCNET versions of these controllers have built-in ARCNET communications (on the main board).

Warning: Observe the safety warnings and precautions given on page 23. The node should be switched off and network connections removed before replacing an ARCNET daughter board.

Figure–3.16 shows the layout of the ARCNET daughter board. The links at the left side of the board are used for bias and termination (see page 27).



Figure–3.16 ARCNET Daughter Board

Static and Surge Protection

The MNA-C is fitted with a network controller IC (COM20020), which is situated directly on the MicroNet node's processor bus. On the network side, the device is connected to a MAXIM RS 485 driver (MAX1487ECSA). The device has 15kV internal protection against static surges that might be produced by someone touching the IC.

Further protection against higher energy surges (e.g. lightning strike) is provided by a transient suppressor. The device is designed to absorb surges, but will not protect against continuous applied power such as the connection of 24Vac to the wrong terminals.

ARCNET LEDs

ARCNET LEDs provide the status of a device’s ARCNET communications. Four LEDs are contained on each ARCNET device, either on the main board or on the ARCNET daughter board, if fitted.

Single-channel ARCNET daughter boards are fitted with LEDs 5, 6, 7 and 8 (ONLINE, ERROR, RX and TX respectively). Two-channel boards used in routers

are fitted with LEDs 5 to 8 (for channel 1), and LEDs 1, 2, 3 and 4 (ONLINE, ERROR, RX and TX respectively) (channel 2).

The following table describes the meanings of the ARCNET LEDs:

Table–3.5 ARCNET LEDs

	Green ONLINE LED	Red ERROR LED	Yellow RX LED	Yellow TX LED
OFF	Offline.	No network errors.	No message received.	No message transmitted.
ON	Online: Part of the network.	Duplicate address[a].	Message received.	Message transmitted.
Steadily flashes at 1Hz	Online, but have not seen the token for some time.	N/A	N/A	N/A
Short flash (under 1s)	N/A	LAN reconfigured. This node is okay.	N/A	N/A
Long flash (over 3s)	N/A	LAN reconfigured. This node caused the reconfigure.	N/A	N/A
Flickering (Mostly on)	N/A	Indicates traffic and line idle states. May indicate excessive noise or one side of LAN unconnected or shorted to ground.	N/A	N/A

a. The ERROR LED is not lit if there is a duplicate address and all controllers are powered up at the same time.

Note: Nodes with Version 8 firmware do not produce the short flash of the ERROR LED. The LEDs do not function with node firmware versions prior to Version 8. Version 8 firmware refers to controller firmware, not Touch Screen or MN MI firmware.

LAN reconfigurations occur automatically 13 seconds after a node joins the LAN. A LAN reconfiguration sets up token passing between nodes to enable the new node to function correctly on the LAN.

The node joining the LAN should give a long flash of its ERROR LED. All existing nodes on the LAN should briefly flash (under 1 second) their ERROR LED. When the LAN reconfiguration is complete, all controllers should have the ONLINE LED lit (with the ERROR LED no longer flashing).

If a node joins the LAN, but its ERROR LED remains permanently on, another node on the LAN has the same address.

When a node is removed from the LAN, the node that was passing the removed node the token flashes its ERROR LED briefly.

Note: Refer to page 44 for fault diagnosis procedures involving the ERROR LED.

Network Variables

Data exchange between controllers in an ARCNET network is achieved by using the following control objects in VisiSat:

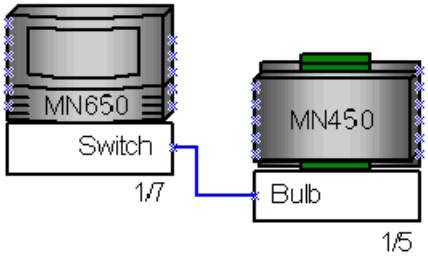
- **NVTx** (Network Variable Transmit): To transmit data to other controller(s).
- **NVRx** (Network Variable Receive): To receive data from another controller.

You specify which controllers are to receive values from a transmitting controller by defining connections between controllers in VisiSat.

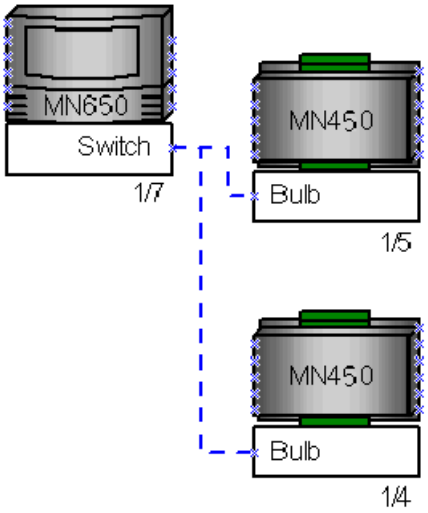
The ARCNET network uses a token-passing system that allows all the controllers on the network to transmit a value within a defined time. This does not necessarily mean the value will be received, because the receiving device may be busy processing the last value it received. However, if the value is transmitted to just one controller, the transmitting controller will automatically re-send its value until the receiving controller acknowledges receipt or until the transmitting controller gives up (after too many attempts).

If the transmitting controller sends a value to more than one controller (i.e. 'broadcasted'), there is no acknowledgement built into the ARCNET system; instead, the transmitting controller sends the value a number of times expecting all the other controllers to receive the value. This is why variables bound between two controllers are reliable, but when transmitted (broadcast) to many controllers, the variable should be re-transmitted by using a stopwatch module in the controller.

This reliability is shown in VisiSat by the unbroken (blue) line for the direct message and the dashed (blue) line for the broadcast message (see Figure–3.17 and Figure–3.18).



Figure–3.17 Representation of the Direct Message in VisiSat



Figure–3.18 Representation of the Broadcast Message In VisiSat

It is recommended that you do not use network variables to share a Bubbleland scheme between controllers, since if a single value is not received at a controller, this could have an adverse effect on the control program. Instead, use network variables only to transfer values such as sensed temperature values, which should be broadcast regularly and which are non-critical.

Maintaining Network Performance

The amount of network traffic should be kept to the minimum possible. Good performance is achieved if the number of network variable transmissions on the Main LAN or any Sub-LAN is kept below 60 per minute per LAN (i.e. 60 per minute on the Main LAN and 60 per minute on each Sub-LAN).

Network transmissions greater than 60 per minute can cause:

- Communication problems between VisiSat or MicroNet View and a controller.
- Routers on the LAN to miss variables that are to be routed to another LAN.

In addition, each LAN should transmit only one network variable through a router to any other LAN.

You can improve network performance by inserting routers to break up a large LAN into smaller LANs, assuming that the same network variables do not need to be transmitted to all controllers. All controllers that must receive a network value should be on the same LAN.

Note: 60 variables per minute is the maximum for network variable transmissions, not for data polled from MicroNet View. With logging and alarms not configured, MicroNet View should be able to manage approximately 240 pollings per minute, depending on setup.

Tokens - Technical Details

A token is an 'invitation to transmit'. There is only one token per LAN, and only the node that currently owns the token is allowed to transmit a value on the LAN. All other nodes must wait until they are passed the token.

When the token is received, the transmitting node verifies that the receiving node is ready by first transmitting a 'free buffer enquiry' message. If the receiving node transmits back an ACK (acknowledgement) message, the data packet is transmitted, followed by a 16-bit CRC. If the receiving node cannot accept the message because it is busy dealing with another one, it transmits back a NAK (Negative Acknowledgement) and the transmitter passes the token without sending the value.

If the value is transmitted and received successfully, the receiving node transmits back an ACK, which allows the transmitting node to set the status bits accordingly. These bits are set to indicate successful or unsuccessful delivery of the message, but only apply to messages sent to a particular node, not broadcast messages.

You can add and remove nodes to or from an existing LAN without causing problems with token passing.

Fault Diagnosis

This section describes methods to debug ARCNET communication problems on the network.

Warning: Observe the safety warnings and precautions given on page 23. A node should be switched off and network connections removed before replacing an ARCNET daughter board (if fitted). If completely replacing a node, first switch off the power supply then disconnect all terminals.

Checking the ERROR LEDs

Flashing of an ERROR LED may indicate excessive noise, shorts or poor connections on the communications wires. First check LAN cables, screening, termination and biasing.

If the ERROR LEDs flash at nodes where the LAN has been in operation for more than a minute, this indicates a possible node fault. If one of these nodes is giving a longer flash of the ERROR LED, this could be the faulty node.

Checking a Node

A simple way of checking a node is to do the following:

1. Power down the node, then disconnect the LAN from the node, but keep the LAN continuous (in most cases this can be achieved by simply disconnecting the Klippon connectors from the node).
2. Observe the effects. If the fault symptoms disappear, the disconnected node is faulty, in which case:
   a. Substitute the daughter board (on MN MIs and Touch Screens) for a known serviceable daughter board, OR;
   b. If no daughter board is fitted (MN 50 Series Controllers), fit a known serviceable daughter board to the node.
   c. Reconnect the LAN to the node, then reapply power and observe the effects.
3. If the fault symptoms remain, it is possible that the controller itself is at fault; you may need to test or replace ARCNET devices in turn (see page 46).

Checking Termination

Make sure that the LAN is terminated at both ends using the correct link for the device (see Table 3.3 on page 28). If the jumper is properly fitted, but you still suspect termination, you can test termination by switching off the power and removing network connections from the device at one end of the LAN and measuring the resistance between its two network terminals. The resistance should be about 120Ω. Repeat this procedure for the device at the other end of the LAN.

Checking Biasing

After checking termination, make sure that the LAN is biased at both ends using the correct termination links (see Table 3.3 on page 28). If the jumpers are properly fitted, but you still suspect biasing, you can test biasing by making sure that the power to all devices on the LAN is *switched on*, then measuring the voltage from each communication wire to LAN REF. With up to 16 controllers on the LAN, you should obtain the following results:

- The voltage from the negative communications wire to LAN REF should be

about 2V. Assuming termination is correct, a voltage of around 0.32V may indicate that there is no biasing at one end. A voltage of 1.2V may indicate no biasing at both ends.

- The voltage from the positive communications wire to ground should be about 3V. Assuming termination is correct, a voltage of around 1.5V may indicate that there is no biasing at one end. A voltage of 1.95V may indicate no biasing at both ends.

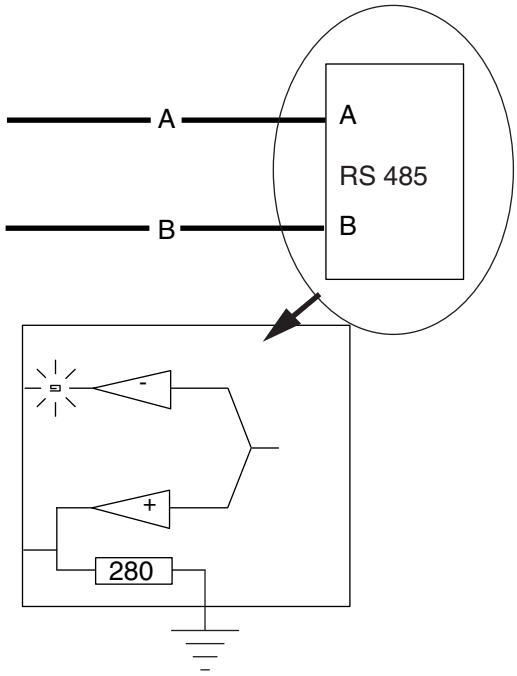
Note: If more than 16 controllers are present, the expected voltages can be up to 10% less. To obtain valid results for larger LANs, the LAN can be divided into smaller segments of 16 controllers with the bias and termination moved to the smaller group.

Checking Faulty ARCNET Devices

A faulty ARCNET device (i.e. a daughter board or the complete controller) may cause the ERROR LED at other nodes in the LAN to flash, but the ERROR LED in the faulty device may not flash. This is misleading information. Unfortunately, the only way to find the devices damaged in this way is to replace each device in turn, or to perform the voltage measurement test as described in this section.

Warning: Observe the safety warnings and precautions given on page 23.

Figure–3.19 shows the typical electrical state of an ARCNET daughter board that has been damaged by a high voltage applied to the network connections. The 'A' side driver has become open circuit and the 'B' side exhibits the common failure mode where the internal damage manifests itself as an internal resistance to ground.



Figure–3.19 High Voltage LAN Damage

The damage to the driver usually affects the driver side of the device such that there is an internal resistance to ground of varying amounts, but usually 280Ω. This resistance cannot be measured when the device is powered off.

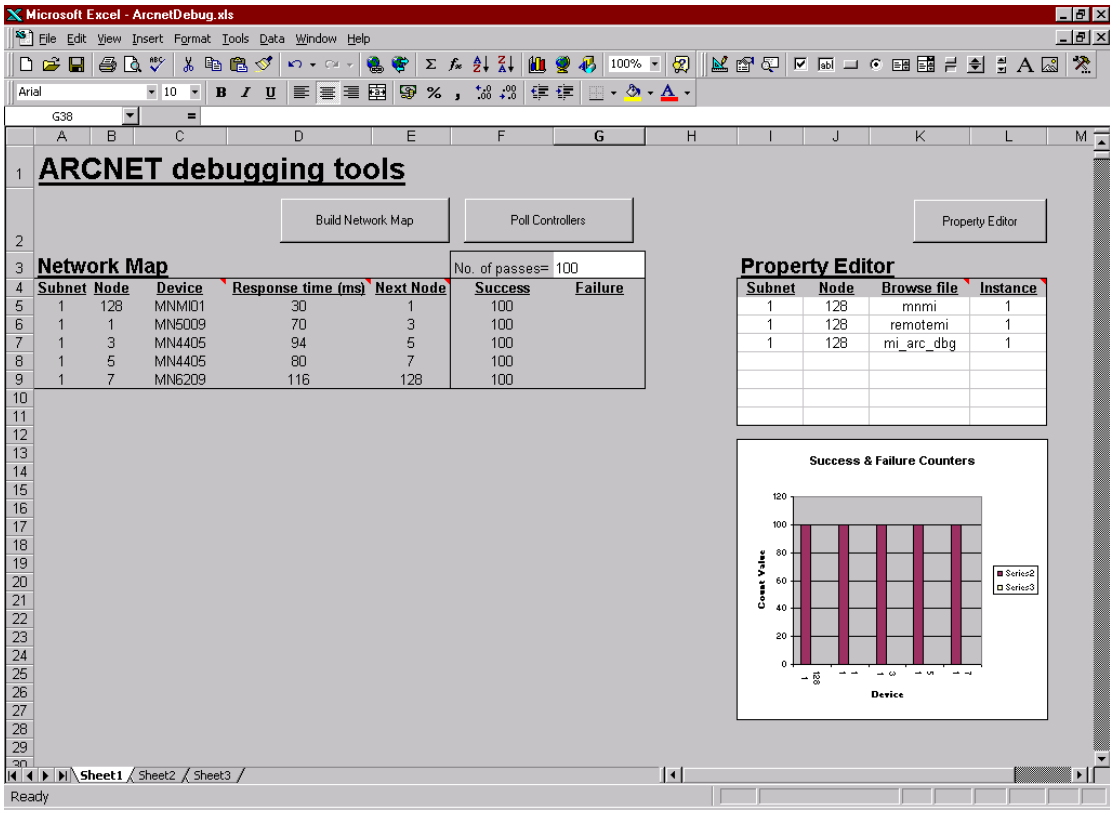
The test for this condition is to disconnect the power and LAN connections and fit jumpers across the bias links only. Note that a jumper across the terminating link is *NOT* to be fitted. The controller is powered up and the voltage relative to ground on 'A' and 'B' is measured at the LAN terminals of the controller. The expected values for a working board are only a few mV on 'A' and 4.7 to 5V on 'B'. If the values differ significantly from these, the board is probably damaged. Usually the damage shows up as a voltage of about 2V on 'B'.

If the board seems correct, repeat the procedure for each node.

Checking Token Passes

Each MicroNet controller keeps an entry in a debug table that refers to the node address it last passed the token to. This allows a network map to be built up quickly by asking each node in turn what address to query next. An Excel spreadsheet called 'ArcnetDebug.xls' is available as part of VisiSat 1.2.52 and later. This is contained in the TOOLS folder and can list all nodes in the ARCNET network. It can then poll all the addresses a number of times and keep a count of the number of successful and failed messages.

Figure–3.20 shows a screenshot taken from the spreadsheet after having found all the nodes and polled the controllers 100 times.



Figure–3.20 ARCNET Debugging Tools

The dialogue communicates with the controllers and presents the data back on the spreadsheet.

Clicking **Build Network Map** causes all devices to appear in the list.

The **Poll Controllers** button can be used to poll each controller in the list, and maintains a count of successful and failed messages.

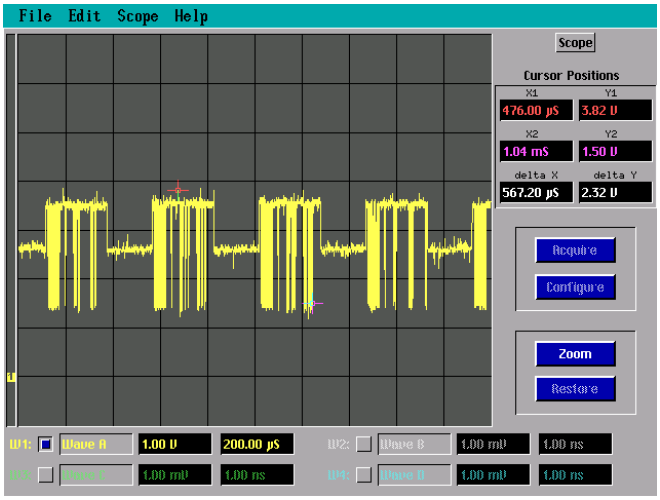
Oscilloscope Readings of Signal Quality

If required, an oscilloscope can be used to view the signal quality on each line on the LAN. The signal should be measured differentially across the two communications wires, which requires an oscilloscope capable of summing the voltage on both channels. This means both communications wires should be connected to the oscilloscope with the ground lead connected as near as possible to 0V on the ARCNET device.

To get the differential signal, either find the (A-B) option in the oscilloscope (where A is connected to the negative communications wire), or invert one of the signals and use the (A+B) option.

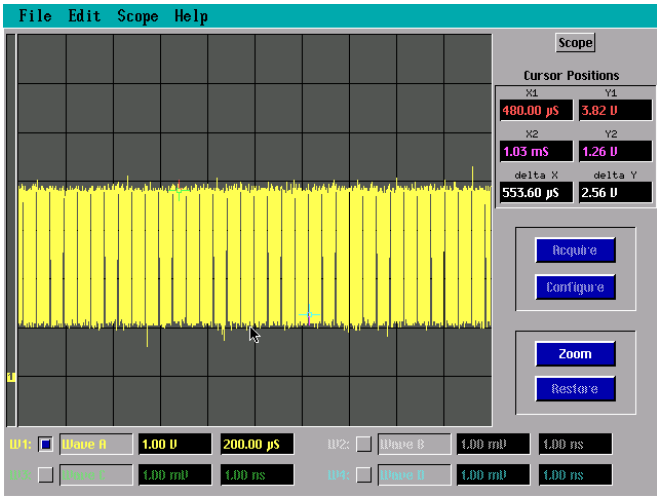
A good quality signal consists of small packets of data with fast rise and fall times. The amplitude of the signal should be about 1V or more with very little noise. The packets are actually the 'invitation to transmit' messages from each node on the LAN and consist of an alert burst (6 Logic 1's), EOT character, and a destination address repeated.

The signal from a LAN passing the token with no errors is as shown Figure–3.21:



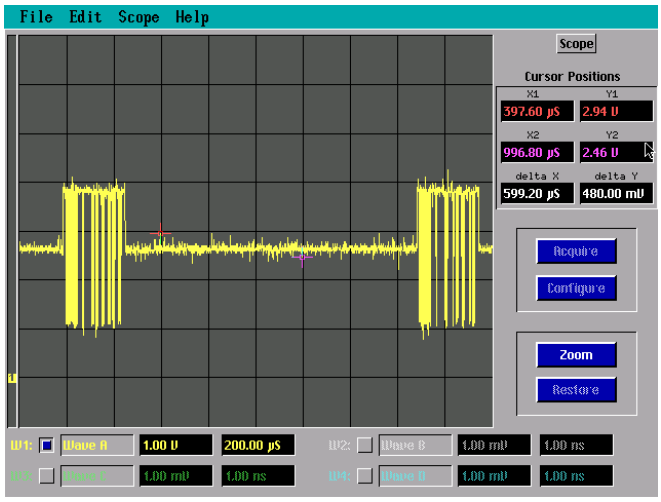
Figure–3.21 Network Signal (no errors)

If there is a reconfiguration burst (caused when a node joins the LAN), the signal is as in Figure–3.22.



Figure–3.22 Reconfiguration Burst

A node searching for the next node produces the signal shown in Figure–3.23. Note the time is 1.2ms between 'invitation to transmit' messages instead of the 200µs when the token is being passed successfully.



Figure–3.23 Node Searching for Next Node

Chapter 4
Engineering LONWORKS® Networks

Introduction

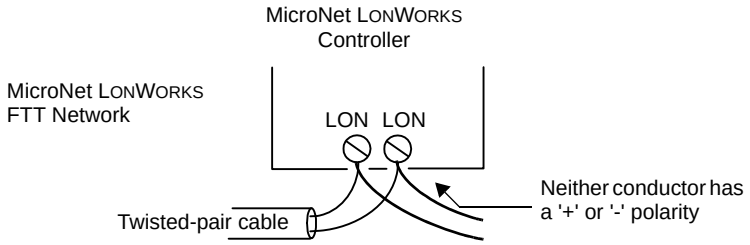
A LONWORKS network (Figure–4.2) offers the most flexibility of the three Bus du jour® network types, because its network communications uses a standard protocol named LONTALK®. This allows integration of other vendors' LONWORKS devices as nodes on the network, provided they are LONMARK® certified or utilise compatible Standard Network Variable Types (SNVTs). Nodes can be simple sensors and actuators to controllers, Touch Screens, network management tools and protocol analysers.

Nodes on a LONWORKS network can communicate with each other in a peer-to-peer fashion, meaning that they can freely share data via SNVTs. Typical data shared includes overrides, non-critical sensor data and monitor points to other LONWORKS nodes. (It is not advisable to split a control system between different controllers, as no guarantee can be given over control performance.)

A LONWORKS network allows the largest selection of MicroNet controllers. MN 50, 100, 150, 200, VAV, 350, 450, 550 and 650 controllers and LON® Touch Screens can all be used on a LONWORKS network.

Note: The LON Touch Screen is different from the normal Touch Screen and is designed for use only on a LONWORKS network. A normal Touch Screen is for use with NCP and ARCNET networks.

All MicroNet controllers use the popular FTT-10A transceiver. The FTT-10A transceiver operates at 78kbps over twisted pair cable, and connections are not polarity sensitive (see Figure–4.1).



Figure–4.1 LONWORKS FTT Segments Use Twisted-Pair Cabling.

A LONWORKS network uses a free-topology or bus (daisy-chain) configuration and can host up to 64 LONWORKS nodes per wiring segment. Using repeaters and routers allows a network to be expanded to contain up to 32,385 nodes.

VisiSat can be used to configure MN350, 450, 550, 650 LON variant controllers and LON Touch Screens on a LONWORKS network using a LONTALK card fitted to the PC. VisiSat is also able to configure LCD devices connected to an MN550 or 650.

WorkPlace Tech Tool is used to configure and program the MN 50, 100, 150, 200 and VAV controller applications.

MicroNet View uses Echelon® Corporation's LNS DDE server and provides alarm checking, dynamic logging and historical logging for the network.

Note: MN MIs are not currently supported on LONWORKS networks.

Note: Please refer to the MicroNet Engineering Data Sheets for wiring details that are specific to each MicroNet device type. It is also recommended that you refer to other LONWORKS documentation (see page 56) to determine whether or not there are additional local factors to consider for the site you are engineering and to obtain the very latest information.

History of LONWORKS

LONWORKS was developed by the Echelon Corporation. Echelon designed LONWORKS as a modular, 'open architecture' system, providing an 'off-the-shelf' method for manufacturers to build devices that can operate as *nodes* on an interoperable control network. This 'open architecture' system allows LONWORKS networks great flexibility.

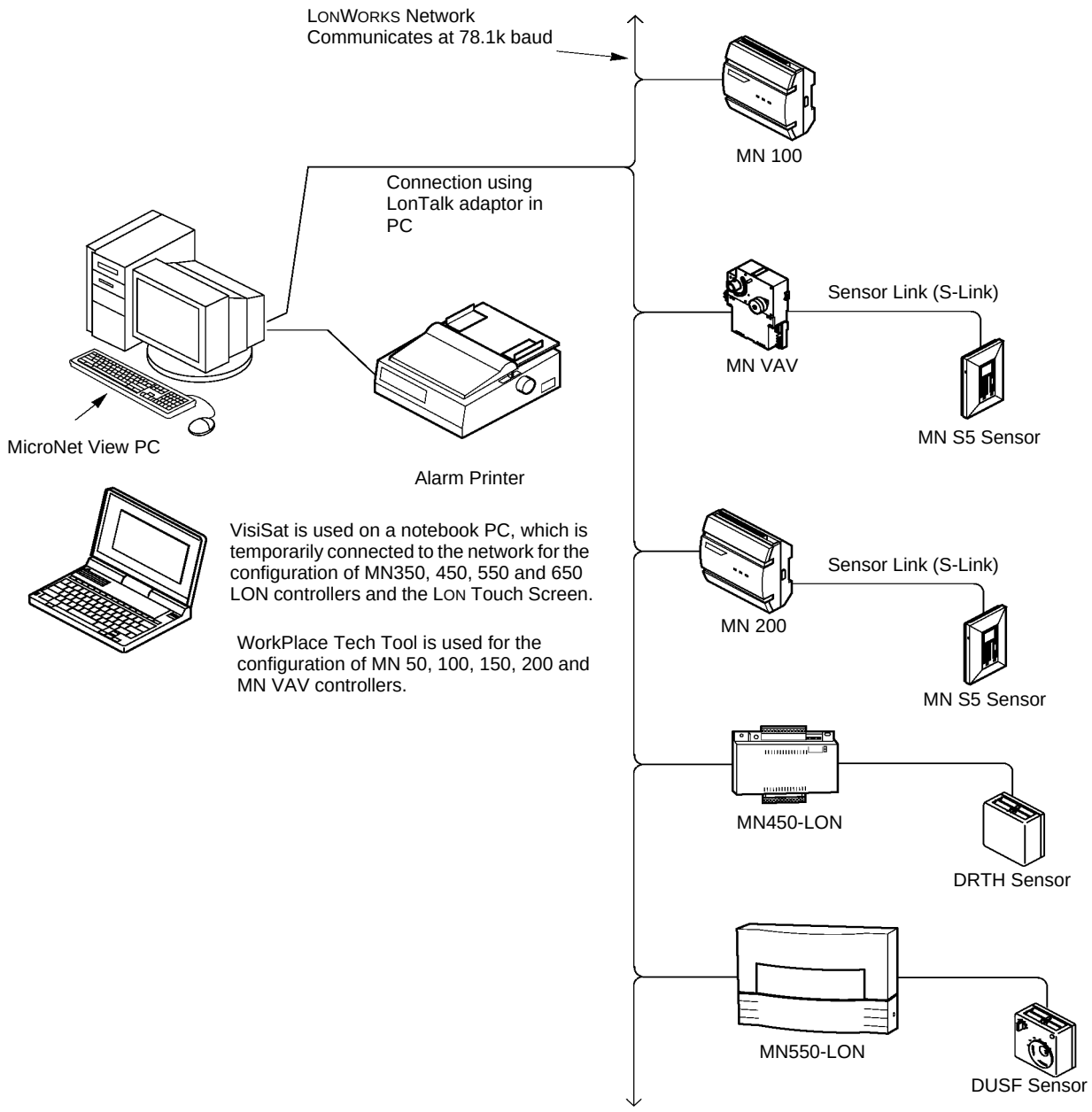
A LONWORKS network may contain nodes with different application purposes, such as HVAC control, lighting control, security control and many others. Using standardized data types (SNVTs), nodes with different application purposes can share information and can also be monitored from a common PC interface, allowing interoperability and integration.

LONMARK Certification

LONMARK certification guarantees a degree of interoperability between different nodes on a LONWORKS network. The MN 50, 100, 150 and 200 controllers are LONMARK certified and are allowed to contain the LONMARK logo.

To provide the greatest degree of flexibility and interoperability with other LonWorks nodes, the MN350, 450, 550 and 650 controllers and the Touch Screen are not LONMARK approved. The controllers are fully interoperable with other LONWORKS nodes, as standard LONTALK protocol and SNVTs are used. In reality, these controllers are far more interoperable with other LONWORKS nodes than if they were to be LONMARK approved.

Note: LONMARK approval does not guarantee that different devices are plug-and-play replacements, as LONMARK does not define the application inside a controller.



Figure–4.2 Example LONWORKS Network

LONWORKS Terms

The following terms are often used when describing LONWORKS networks:

Node - Any addressable device on the network, including any MicroNet controller or third-party LONWORKS device. Some LONWORKS documents refer to a node as a device.

Segment - A set of up to 64 LONWORKS nodes wired directly to each other using a free-topology or bus wiring topology. Each LONWORKS network has at least one wiring segment, the length of which is limited by the topology and cable type used. If more wiring is required, a LONWORKS FTT repeater or router must be installed.

Subnet - A logical group of nodes on the network; subnet is part of a node's complete address, namely: Domain, Subnet, Node Address. If required, a subnet can span multiple segments joined by repeater(s). The standard LONWORKS node limit of a subnet is 127 nodes.

Note that 'Subnet' in LONWORKS terminology does not have the same meaning as a subnet in NCP or ARCNET networks.

FTT Repeater - An active (powered) device that receives LonTalk messages on any attached wiring segment and rebroadcasts them to all other attached wiring segments. Some FTT repeaters have more than two ports to allow connection of more than two wiring segments. Each port is a separate wiring segment.

An FTT repeater is useful to prevent maximum wiring lengths from being exceeded or to increase the number of nodes beyond the 64-node limit.

Systems with high levels of network traffic may benefit from the use of LONWORKS routers, which forward packets only when necessary.

Channel - A specific LONWORKS communication medium, such as twisted pair or power line. Each communication medium is able to support only some of the available LONWORKS transceiver types. MicroNet controllers use the twisted-pair medium that is able to support FTT-10, FTT-10A and LPT-10 transceivers. In LONWORKS terminology, this is known as the TP/FT-10 channel type, or simply 'FTT'.

Router - A device that enables nodes on different wiring segments to pass information. A router has two ports, and each may connect to a different channel type. Routers allow a network to be expanded to support up to 32,385 nodes.

Safety Warnings and Precautions

Digital Outputs

MicroNet controllers have digital outputs which can carry ***mains voltage***.

WARNING - ELECTRICAL SHOCK HAZARD.
REMOVE POWER FROM THE DIGITAL OUTPUTS BEFORE REMOVING CONTROLLER COVERS.

Power Supply

Before making connections, changing jumpers or fitting boards to a MicroNet node, make sure that you remove the power supply (i.e. switch off) the node first. Network connections to the node should be removed before replacing an LON daughter board.

Switching off a MicroNet node does not remove the control application stored in the node's memory.

LPT-10

Before adding MicroNet LONWORKS nodes to an existing network, test for LPT level voltage (48Vdc) across the two network conductors. If this voltage is present, locate and temporarily remove the 48Vdc power *before* connecting new wiring and nodes to the segment. See page 65 for further details.

Echelon LONWORKS Documentation

It is recommended that you refer to the following publications (all downloadable from the Echelon Web site), to obtain the very latest information:

- **Introduction to the LONWORKS System (078-0183-01A)** - Provides an excellent introduction to LONWORKS systems. Available from www.echelon.com/support/documentation/manuals/default.htm.
- **Junction Box and Wiring Guideline for Twisted Pair LONWORKS Networks (005-0023-01)** - Gives details of cable types and suppliers, and junction boxes for all LONWORKS channel types. Available from www.echelon.com/support/documentation/bulletin/default.htm
- **FTT-10A Free Topology Transceiver User's Guide (078-0156-01F)** - Gives detailed reference information for the engineering of LONWORKS networks that use the FTT-10A transceiver. Available from www.echelon.com/support/documentation/manuals/default.htm.
- **LPT-10 Link Power Transceiver User's Guide (078-0105-01C)** - Gives detailed reference information for networks that use the LPT-10 transceiver. This document may be useful if the wiring segments contain a mixture of FTT-10A nodes and LPT-10 nodes. Available from www.echelon.com/support/documentation/manuals/default.htm.
- **LonMaker™ User's Guide (078-0168-02)** - Describes how to design, commission, manage and maintain a network using LonMaker for Windows®. Available from www.echelon.com/support/documentation/manuals/default.htm.

The Echelon Web site (www.echelon.com) contains many other publications, which you may find of use in special circumstances.

LONWORKS Wiring Topologies

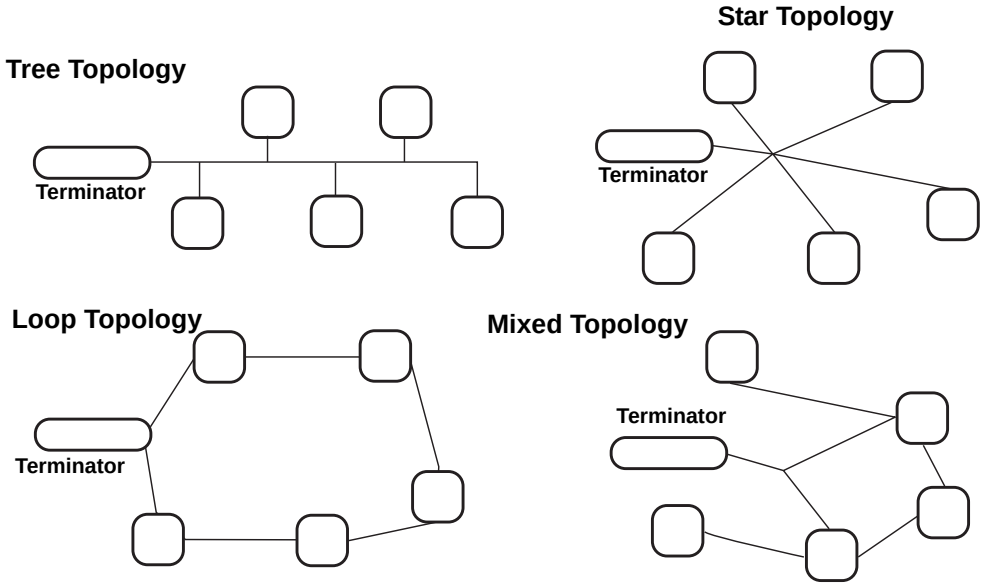
Two possible LONWORKS topologies exist for an FTT wiring segment:

- Free (singly-terminated) topology (wiring trees, stars, and even 'loops').
- Bus (doubly-terminated) topology.

Warning: Observe the safety warnings and precautions given on page 55.

Free-Topology Wiring

A free-topology approach to wiring allows any number of trees, stars, loops or mixed combinations in a wiring segment and requires a single termination module (terminator) installed on any node on the segment.

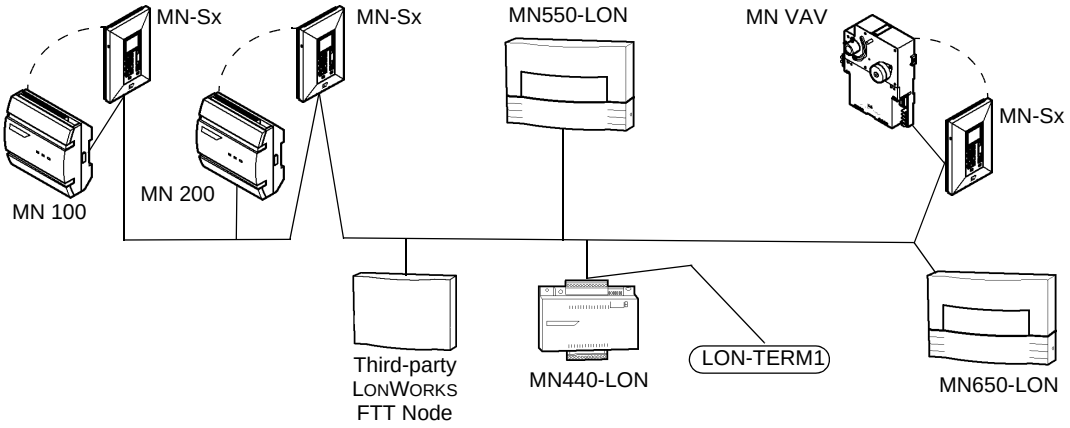


Figure–4.3 Simplified Examples of LONWORKS Free-Topology Wiring.

The free-topology method is used in most wiring segments due to its flexibility when wiring and making changes and additions, although maximum wiring lengths (see page 61) are less than when using the bus topology, and it is easy to exceed these limits. In addition, the wiring path between the two most distant nodes cannot exceed a specified length (see page 61).

As shown in Figure–4.3, a free-topology segment has virtually no restrictions in the ways that nodes can be connected. Wiring tees can be freely made, either on controller terminals or in electrical boxes on the wiring segment.

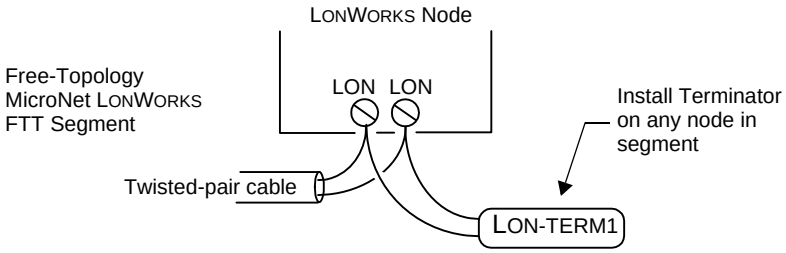
Note: The optional LONWORKS connection to an MN-Sx sensor must be daisy-chained to the LONWORKS network using a pair of cables, as shown in Figure–4.5; the sensor must not connect to the network as a spur. This is to prevent 'antenna' effects.



Figure–4.4 Free-Topology Segment (MN-Sx S-LK wiring shown in dashed lines).

End-of-Line Termination in Free Topology

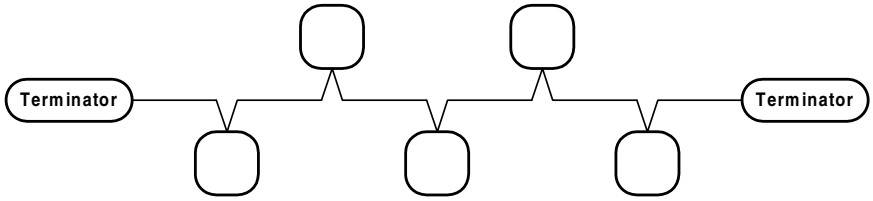
In free topology, multiple 'end of lines' exist, and so a single terminator consisting of a special RC circuit (LON-TERM1) is placed on any node on the segment (Figure–4.5).



Figure–4.5 Free-Topology Segment Requires a Single LON-TERM1 Terminator.

Bus-Topology Wiring

Longer wiring lengths (see page 61) are possible using the bus (daisy-chain) topology shown in Figure–4.6. Two terminators are required, one at each physical end of the wiring segment.

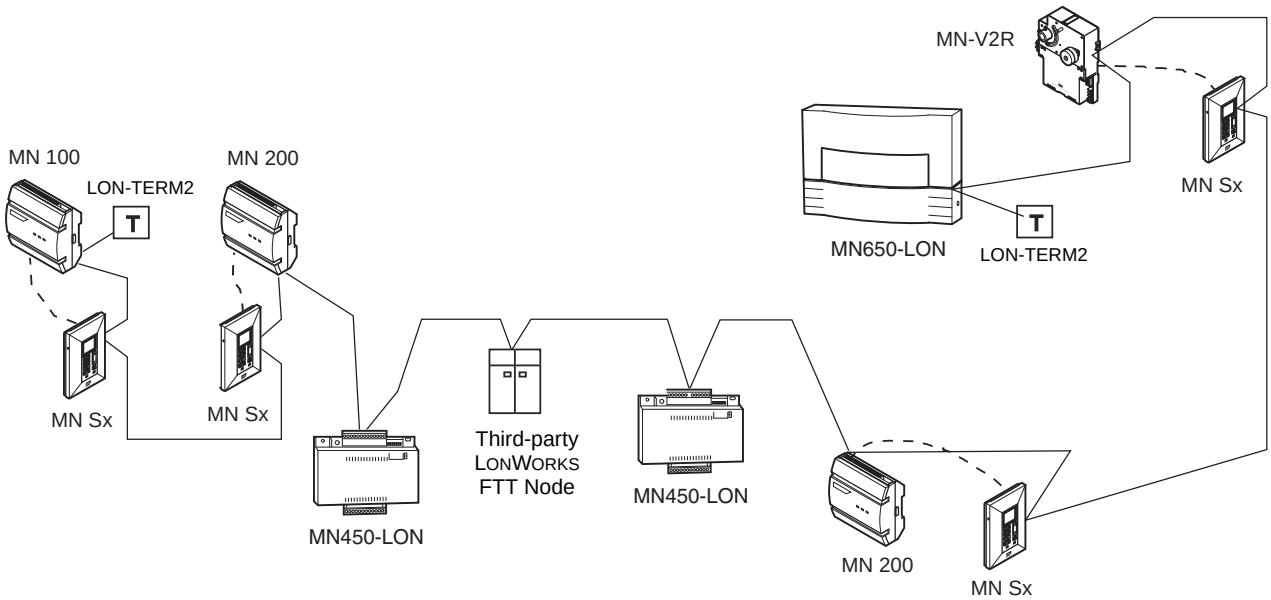


Figure–4.6 Simplified Example of a LONWORKS Bus Segment Wiring.

Warning: Observe the safety warnings and precautions given on page 55.

The bus topology has wiring connections only on the nodes themselves (no tee 'stubs'), as shown in Figure–4.7.

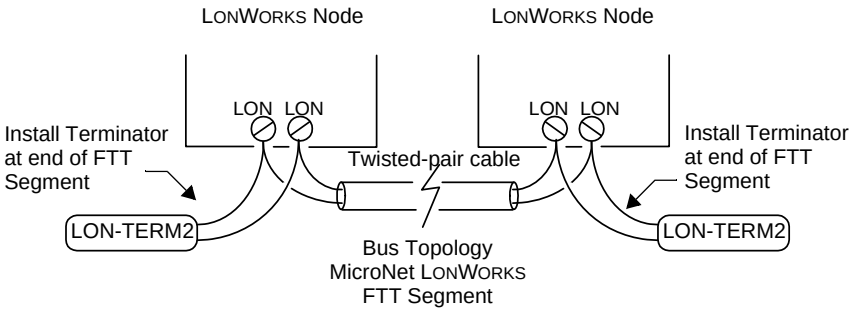
A wiring segment is either free topology or bus topology; a 'proportional hybrid' is not possible. This means that while most of an FTT segment might be daisy chained from node to node, the first wiring 'tee' makes the entire segment free topology, and therefore subject to the free-topology total wiring length limitations (and different end-of-line termination).



Figure–4.7 Bus Segment (Required MN-Sx S-LK wiring shown in dashed lines).

End-of-Line Termination in Bus Topology

Two terminators consisting of a special RC circuit (LON-TERM2) are required, one installed at each end of the segment as shown in Figure–4.8. Each terminator connects directly to the node at the physical end of the wiring bus.



Figure–4.8 Bus Topology Requires Two Terminators.

FTT-10A Cable Requirements

The Echelon-approved FTT-10A cable types are as shown in Table–4.1.

Note: To ensure compliance with the very latest information about cable specifications and lengths, cable suppliers and junction boxes, refer to the document titled *Junction Box and Wiring Guideline for Twisted Pair LONWORKS Networks* (see page 56).

The recommended cables for most MicroNet LONWORKS networks are the unscreened, Level 4 plenum-rated, 0.65mm (22 AWG) models. Unscreened cable is easier to install and better suited unless routed in an area of high electrical noise. Plenum-rated cable is often easier to obtain due to high demand. Non-plenum cable is likely to be needed only where conduit is required, and so may be harder to find.

Single-pair cables should be used. An exception would be for extending the LONWORKS connection, such as when wiring the network from a controller down to the sensor and then back up to the controller again. Multi-core cables used to carry other signals (e.g. sensor or telephone signals) are not permitted.

Table–4.1 Cable Types and Lengths for LONWORKS Networks

Cable Type	AWG	Diameter	Free Topology		Bus Topology
			Max segment node-to-node distance	Max segment wire length	Max segment wire length
TIA 568A Category 5 cable	24AWG	0.5mm	250m	450m	900m
Belden 8471 (PVC jacket) or equivalent	16AWG	1.3mm	400m	500m	2700m
Belden 85102 (Tefzel jacket) or equivalent	16AWG	1.3mm	500m	500m	2700m
Level 4 cable[a]	22AWG	0.65mm	400m	500m	1400m
JY (st) Y 2x2x0.8	20.4AWG	0.8mm	320m	500m	900m

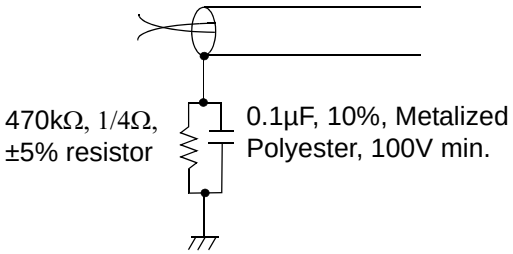
a. The Level 4 cable must adhere to the specifications originally defined by the National Electrical Manufacturers Association (NEMA). This is different from the specifications proposed by the Electronic Industries Association/Telecommunications Industry Association (EIA/TIA). Level 4 cable is available in plenum, non-plenum, screened and unscreened versions.

Note: If the network contains existing LPT-10 nodes, as well as FTT-10A or FTT-10 nodes, refer to page 65.

Cable Screening

If screened cable is used to overcome electrical noise problems, the screen must be grounded (through a 470KΩ resistor and a 0.1µF capacitor connected in parallel) *at one end only* (any point if a free-topology segment). See Figure–4.9. The capacitor avoids DC and 50/60Hz ground paths from being formed through the screen, and the resistor bleeds off any static charge on the screen. Ideally, the cable should be grounded at each node to assist in suppressing 50/60Hz standing waves.

Screened cable must be used for wiring segments that run outside of buildings. The screen should be connected to earth at each building entry point via a data lightning/surge arrester. Refer to the *FTT-10A Free Topology Transceiver User's Guide* (see page 56) for details.



Figure–4.9 Connecting the Screen to Ground.

If the cable is installed in areas of high RFI/EMI, the cable must be in conduit.

Cable Routing

The following table shows the cable types that can be routed together. A tick indicates that routing together is allowable. The table assumes that communications cables are unscreened.

Table–4.2 Cable types that can be routed together

	Comms[a]	S-Link	DI	DI (MN650)	UI	AO	DO 24Vac	DO 240Vac
Comms[a]	✓	✓	✓[b]	✗	✓[c]	✓[d]	✗	✗
S-Link	✓	✓	✓	✗	✓	✓	✗	✗
DI	✓[b]	✓	✓	✓[b]	✓[c]	✓	✓[b]	✗
DI (MN650)	✗	✗	✓[b]	✓	✓[c]	✓[d]	✓	✗
UI	✓[c]	✓	✓[c]	✓[c]	✓	✓	✓[c]	✗
AO	✓[d]	✓	✓	✓[d]	✓	✓	✓[d]	✗
DO 24Vac	✗	✗	✓[b]	✓	✓[c]	✓[d]	✓	✗
DO 240Vac	✗	✗	✗	✗	✗	✗	✗	✓

a.= Refer to Echelon wiring guidelines.
b.= Screen DI.
c.= Screen UI.
d = Screen AO.

MN-Sx Wiring

Each MN-Sx digital wall sensor must be wired to its own controller using an S-Link (S-LK) wire pair. The S-LK connection powers and provides communications between controller and sensor.

Warning: Observe the safety warnings and precautions given on page 55.

The maximum S-LK wire length is 61m. S-LK wiring may be housed in the same conduit with Universal Input, Analogue Output and Digital Input wiring.

Optionally, an MN-Sx sensor can also be wired to the LONWORKS network using a LONWORKS cable pair. This enables WorkPlace Tech Tool, VisiSat, the MicroNet VAV Flow Balance software and third-party network management tools to connect to the LON network using the MN-Sx's built-in 'LON Jack'.

To prevent antenna effects, the connection to the LONWORKS network must not be a spur. The sensor must be daisy-chained to the LONWORKS network.

An MN-Sx sensor does not count as a 'node', however, all LONWORKS network wiring to the sensor becomes part of the wiring segment.

If conduit is used between an MN-Sx sensor and a controller, the network and S-LK wiring may be housed in the same conduit, but should be in separate cables. Two-pair cable is not recommended.

Link Power (LPT-10) Considerations

LONWORKS segments using FTT-10A nodes can also include LPT-10 (LPT) nodes, which have 'Link Power Transceivers'. LPT nodes receive both operating power and communications from the same two conductors of the network cable. LPT power is sourced by a 'Link Power Supply', which produces 48Vdc. In operation, this voltage does not interfere with the FTT-10A based nodes connected on the wiring segment.

While TAC Satchwell currently has no LPT-based LONWORKS nodes, a MicroNet LONWORKS network based on an existing LPT-10 segment is possible. Any wiring segment that includes LPT nodes should use the Echelon-approved 1.3mm (16 AWG) wire, a free-topology architecture (singly terminated), and a termination designed specifically for use with the LPT-10 (LPT-10 Link Power Interface, with jumper at '1 CPLR' setting).

The heavier 16 gauge conductors prevent excessive voltage drop on the wiring segment.

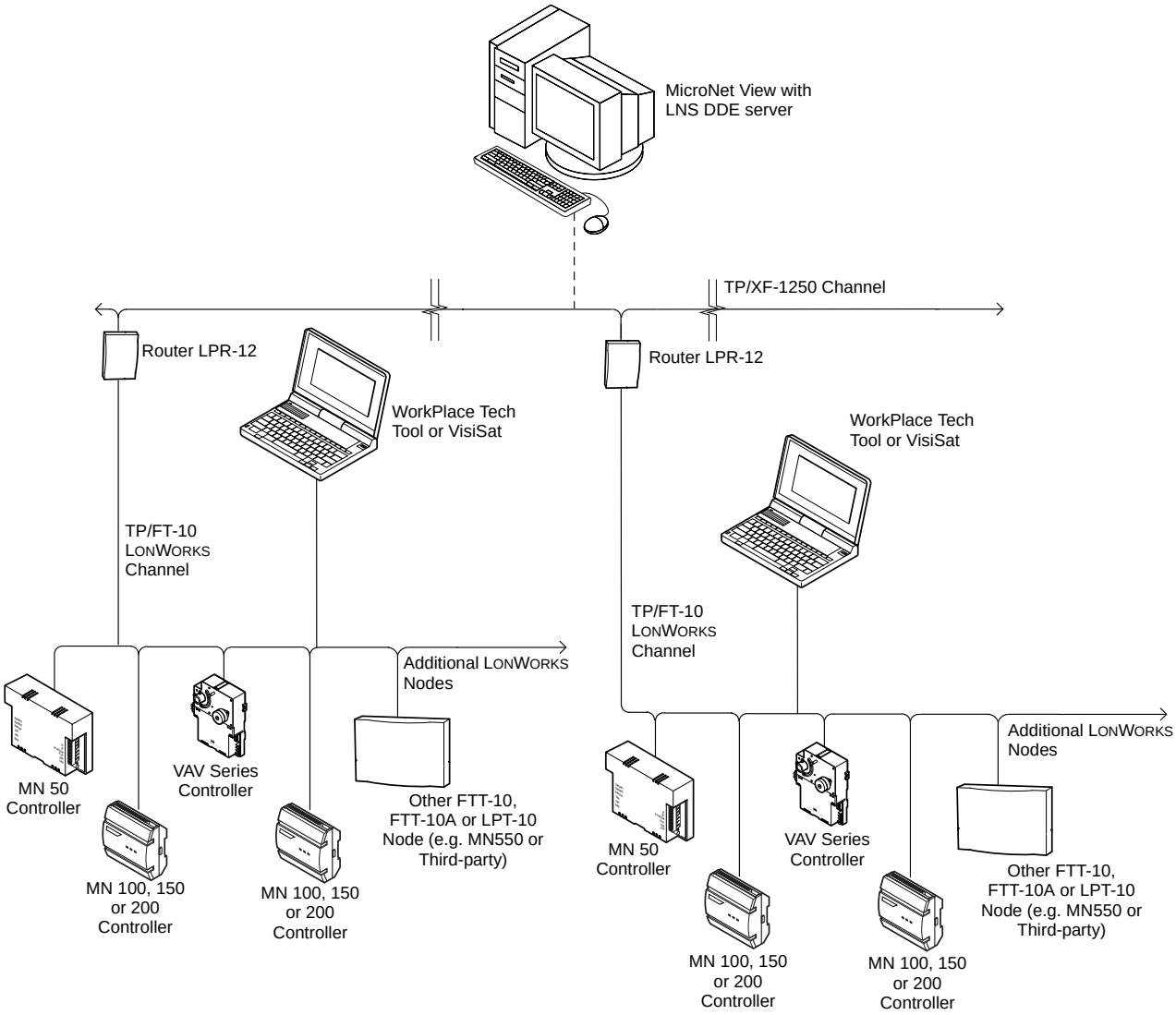
Note: Before adding MicroNet LONWORKS nodes to any existing segment, test for LPT level voltage (48Vdc) across the two network conductors. If this voltage is present, locate and temporarily remove the 48Vdc power *before* connecting new wiring and nodes to the segment.

Note: Refer to the Echelon document *LPT-10 Link Power Transceiver User's Guide* (see page 56) for the very latest information.

FTT repeaters are available in models that include a designated LPT channel, to allow a separate wiring segment for LPT nodes.

Guidelines on FTT Repeaters and Routers

LONWORKS FTT repeaters and routers are available from various vendors, which will allow multiple network segments to be connected. Several of these third-party products are also distributed by TAC Satchwell.



Figure–4.10 Routers in a LONWORKS Network

FTT Repeaters

FTT repeaters, such as the LPT-10 re-time and re-transmit all LonTalk packets among all connected wiring segments. An FTT repeater is useful to prevent maximum wiring lengths from being exceeded.

Each port on an FTT repeater is a separate wiring segment, which may be wired using either the free-topology or bus topology. No more than one repeater should be used on a wiring segment to prevent message timing problems.

FTT repeaters should not be used unless more wiring is required, as operation is dependent on local power.

FTT repeaters often include internal termination resistance which may preclude the use of external terminators (LON-TERM1 or LON-TERM2). Consult the repeater product documentation to determine how segment terminations are accomplished.

FTT Routers

FTT routers such as the LPR-10 (configurable as a router or repeater), LPR-12 and LPR-15 provide intelligence that can manage network traffic between segments and can extend a network to support up to 32,385 nodes.

The LPR-12 and LPR-15 models allow a LONWORKS network to use different communication media (channels) and hence different LONWORKS transceiver types (see Figure–4.10).

LON Daughter Board

Warning: Observe the safety warnings and precautions given on page 55.

MicroNet MN350, 450, 550 and 650 LON variant controllers and the MicroNet LON Touch Screen are built with a LON daughter board fitted. The daughter board contains the Neuron® chip (see page 72) and all the SNVT information.

Note: Use of the older Satchwell Echelon daughter boards is not supported.

The daughter board has a push-button switch (Service Pin, see page 72) that provides the Neuron ID to VisiSat when placing the controller symbol. Bit switch 7 on an MN350, 450, 550 or 650 controller has the same effect, but only if the Neuron application is online (this is the normal state).

The daughter board also has the following status LEDs:

Table–4.3 LON Daughter Board LEDs

LED	Meaning
Green LED D8 (on edge)	ON when data is being transmitted from the Lon daughter board to the controller/Touch Screen.
Green LED D7 (on edge)	ON when data is being transmitted from the controller/Touch Screen to the LON daughter board.
Yellow LED D5 (separate from others)	OFF in normal working mode. ON when SNVTs are being created by VisiSat, or if not yet configured by third-party LonMaker binding tool. If otherwise ON, the card is probably unserviceable. Flashes at 0.5Hz when LonMaker application has been deleted from the third-party application (i.e. no network addressing information).
LED 6	Not used.

Note: If the daughter board is replaced or the LON application has been deleted from LonMaker, the Neuron ID needs to be re-specified in VisiSat before VisiSat can communicate with the controller/LON Touch Screen.

Standard Network Variable Types (SNVTs)

About SNVTs

Data exchange on a LONWORKS network is based on formal data types as defined by the LONMARK Association. These data types are called Standard Network Variable Types (SNVTs). Over 120 SNVTs are defined; each provides a name, definition, and range of values for a type (unit) of data. For example, SNVT_temp allows temperature data to be sent from one controller to another. Other SNVTs are available for passing pressure, power, current, digital switch states, etc. For complete details on all the different types of SNVTs, refer to the LONMARK documents available online at the following URL: http://www.lonmark.org/.

LON NVI/NVO

There are two types of SNVT object in VisiSat and WorkPlace Tech Tool that allow transfer of data between nodes:

- **LON NVI** (Network Variable Input): To receive data from another node.
- **LON NVO** (Network Variable Output): To transmit data to other nodes.

The MN 50, 100, 150, 200 and VAV controllers each have a single fixed LONMARK functional profile. The profile contains a fixed set of NVIs and NVOs, each using pre-selected SNVTs.

The MN350, 450, 550 and 650 controllers and the LON Touch Screen do not have a permanent LONMARK functional profile. Instead, these devices provide a set of various SNVT types, from which you can choose which one to use for each LON NVI and LON NVO. The controllers and Touch Screen allow a maximum of 50 connections to LON NVI/NVO objects and therefore a maximum of 50 SNVTs, each with a single connection. (If you use SNVTs that have more than one connection, a fewer total number of SNVTs can be used.) Up to 30 inputs and 20 outputs can be used.

Refer to the *VisiSat Engineering Guide* for details of the types of SNVTs supported by LON NVI and LON NVO objects in VisiSat.

Refer to the *WorkPlace Tech Tool Engineering Guide* for details of the types of SNVTs supported by LON NVI and LON NVO objects in WorkPlace Tech Tool.

Binding

Exchange of data between nodes on a LONWORKS network is engineered by *bindings* using a network management tool such as LonMaker for Windows (see page 76). Binding links the transmitting SNVTs to the appropriate receiving SNVTs, so that data is passed to the correct controller/Touch Screen. Binding cannot be carried out in VisiSat.

SNVTs Must Match

The type of the SNVT at the transmitting end of the binding must be the same type as the SNVT at the receiving end. If, for example, the transmitting SNVT is SNVT_temp_p, the same SNVT type must be used at the receiving end. Note that two other temperature-related SNVT types (SNVT_temp and SNVT_temp_f) exist, but each defines a different range and resolution, and so are not compatible.

SNVT Usage

Typical SNVT usage is to provide overrides, non-critical sensor sharing or monitor points to other LONWORKS nodes.

In general, it is not advisable to allow a control system to be split between two or more control devices. SNVT communication is not deterministic and no guarantees can be given as to the resulting control performance.

Tip: You may want to use part of a controller scheme as a SNVT converter, e.g. to change SNVT_lev_percent to SNVT_switch, which could be used inside the controller scheme or by other nodes on the LONWORKS network.

Time-Stamp SNVTs

The LON daughter board (see page 68) has a time-stamp out SNVT to broadcast time to the LONWORKS network and a time-stamp in SNVT to receive the time from the network. These can be used for time synchronisation.

During the configuration of the LCD device in VisiSat, you can choose the LCD's MN550 or 650 controller to be a time master for all nodes on the LONWORKS network, thereby enabling the time to be set from the LCD device. In this situation, the time-stamp out SNVT in the LCD's controller must be bound (see Page 76) to a time-stamp in SNVT in each LONWORKS node that requires the time. The controller's code has been designed to initiate a SNVT time stamp broadcast (once per hour) to all bound nodes when the time is set at an LCD time master.

Even if the LCD's controller is not the time master on a LONWORKS network, the LCD can be used to change the time. To do this, bind the time-stamp out SNVT in the LCD's controller to a time-stamp in SNVT in the network time master. In order for the time master to update the time in other controllers or Touch Screens, a time-stamp out SNVT in the time master must be bound to a time-stamp in SNVT in all other nodes, including the LCD's controller.

Time-stamp SNVTs are provided by default and are in addition to the maximum of 50 configurable SNVT LON NVO and LON NVI objects. They are not configurable, and therefore do not appear in the properties of the LON NVI and LON NVO objects in VisiSat Bubbleland. They do, however, appear when binding.

Note: It can also be useful to use an LCD device to change the settings of a Time Schedule object in Bubbleland, and then broadcast the changes to the appropriate nodes on the network. This provides a solution to the problem of controller and third-party scheduling.

Automatic Transmission of SNVT Value

The LON daughter board contains all the SNVT information. Provision is made within the daughter board for the periodic re-transmission of SNVT values. This may be useful in, for example, cases where it is possible for a receiving node to 'miss' a value, perhaps after being offline.

Automatic retransmission of essential data can also be useful in cases where it is possible for a LON daughter board to become temporarily 'overloaded' with excessive SNVT traffic. The LON daughter board queues messages that occur more quickly than it is able to process. If there is an excessive number of messages to process, some may be lost. Retransmission ensures that essential data is received when the LON daughter board is less busy.

The period of retransmission can be set up in the properties of the LON NVO object in VisiSat, but efforts have been made within the daughter board to minimise the likelihood of all SNVTs being required to be re-transmitted at the

same instant in time consequently using up the LAN bandwidth. Time re-transmission is arranged to occur when a SNVT has remained at the same value for a specified period of time (as set up in the LON NVO properties in Bubbleland) and consequently may never need to occur if the SNVT receives normal value changes from the controller.

Reloading Defaults

On reloading defaults for an MN350, 450, 550 or 650 controller or Touch Screen, the controller/Touch Screen updates the daughter board configuration to prevent any further SNVT data exchange between daughter board and Touch Screen. However, this does not reset the SNVT names or configuration, as stored on the daughter board. This means that the SNVT details will remain in LonMaker. You can reset the SNVT names and configuration by using the **Set Defaults** option in the Configuration Library dialogue in VisiSat.

Reloading defaults can take approximately a minute to complete. There may be a period of up to 90 seconds after this when VisiSat will report communications errors.

Null Outputs

When in null-outputs mode, any new links you make to SNVTs (LON NVI and LON NVO objects) in Bubbleland for the MN350, 450, 550 or 650 controller or Touch Screen will not be transmitted to the daughter board.

On leaving null-outputs the controller/Touch Screen will send any links changed in Bubbleland to the daughter board.

LONWORKS Controller Addressing

Note: Bit switch settings do not determine network address of controllers in LONWORKS networks.

Neuron ID and Logical Addresses

A LONWORKS-based device uses a *Neuron*, the core LONWORKS hardware component. A single Neuron chip actually contains three separate but coordinated microprocessors, various input/output and communications ports and internal RAM, ROM and EEPROM memory.

Each Neuron device has a unique 6-byte ID code that is programmed during manufacture. In VisiSat and WorkPlace Tech Tool, you specify the address of a device directly by specifying the Neuron ID. Third-party network management tools (see page 76) normally associate the Neuron ID with a logical address consisting of the following:

- **Domain ID** - This identifies a collection of nodes (up to 32,385) that are in the same system. Nodes must be in the same domain to exchange data.
- **Subnet ID** - This identifies a collection of nodes that are in the same wiring segment, or in different wiring segments connected by repeaters (maximum of 127 nodes in a subnet). Subnet IDs are used to support the efficient routing of data in large networks. There can be up to 255 subnets in a domain.
- **Node ID** - This identifies an individual device within a subnet.

The Neuron ID enables VisiSat and Workplace Tech Tool to identify a controller irrespective of any logical domain, subnet address and node address that it may have been assigned by binding tools, third-party network management tools, etc.

Service Pin Methods

When adding a controller/Touch Screen in VisiSat or Workplace Tech Tool, the controller address (Neuron ID) can be obtained by pressing a service pin at the controller/Touch Screen to broadcast the Neuron ID across the network. The Neuron ID is automatically picked up by VisiSat or Workplace Tech Tool and inserted into the addressing dialogue. The controller/Touch Screen must be powered up, with power to the digital outputs disconnected.

Warning: Observe the safety warnings and precautions given on page 55.

Use one of the following methods to broadcast the Neuron ID, depending on the device:

- For any MN 50, 100, 150, 200 or VAV controller that has an MN-S2, S3, S4 or S5 sensor attached, press and hold the override key of the sensor for a period of eight seconds.
- Press the dedicated service pin push button on the controller (MN 50, 100, 150, 200 and VAV controllers).
- For any MN350, 450, 550 or 650 controller, press the service pin push button on the controller's LON daughter board, or toggle bit switch 7.
- For a Touch Screen, press the service pin push button on the LON daughter board.

You can initiate a Service Pin message from a MicroNet device as frequently as needed; it serves only as a method of device identification.

Wink Confirmation

In some cases after receiving a service pin message, you might want to confirm visually that the proper device is selected. The address dialogue in VisiSat and Workplace Tech Tool provides a **Wink** option that causes the wink LED at the controller or Touch Screen to blink, as described in (Table–4.4).

Warning: Observe the safety warnings and precautions given on page 55.

Table–4.4 Wink Confirmation Routines of Various MicroNet Devices.

MN 100, 150, 200, VAV Series	MN350, 450, 550, 650, MNL Touch
LON Service LED on the controller blinks ON and OFF five times, 10 seconds total.	Main LED on controller circuit board blinks at a different mark-space ratio for one minute. LON Touch Screen sounds its buzzer.

A wink message does not interfere with the normal application control provided by a MicroNet device; wink messages can be sent to controllers as frequently as needed.

Device Deletion in LonMaker

VisiSat and WorkPlace Tech Tool may not be able to communicate with a device after deletion in LonMaker for Windows. See the note on page 80.

Engineering a LONWORKS Project in VisiSat

This section gives a brief overview of how to configure a LONWORKS project in VisiSat. For further information, refer to the *VisiSat Engineering Guide*.

Refer to the *WorkPlace Tech Tool Engineering Guide* for details of how to engineer a LONWORKS project in WorkPlace Tech Tool.

LonTalk Cards Supported by VisiSat

Refer to the *VisiSat Engineering Guide* for details of the LonTalk cards that can be used to connect a VisiSat PC to a LONWORKS network, and how to install and test a LonTalk card.

LON Plugin for VisiSat

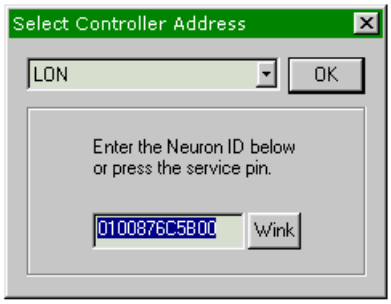
VisiSat requires the installation of the LON plugin software for VisiSat to become LONWORKS enabled. Refer to the *VisiSat Engineering Guide* for details of the software installation process. The plugin requires a separate unlocking code from the core VisiSat software.

Configuring a LONWORKS Project

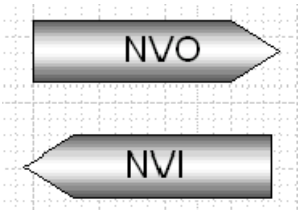
Warning: Observe the safety warnings and precautions given on page 55.

To configure a LONWORKS project in VisiSat:

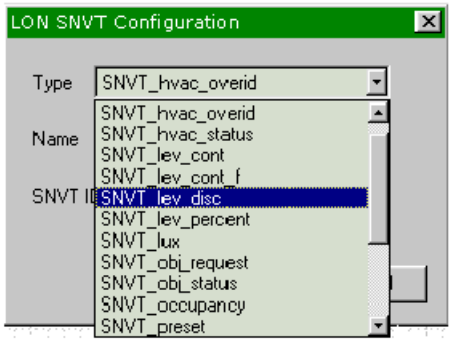
1. Place each controller or Touch Screen symbol into the VisiSat drawing. You will be prompted for each device's Neuron ID:



2. If the controller/Touch Screen is online, press the service pin on the LON daughter board. This sets the address automatically.
3. Enter Bubbleland, design the control scheme and if necessary add LON NVO and LON NVI objects to provide SNVT connectivity to other nodes on the LONWORKS network:

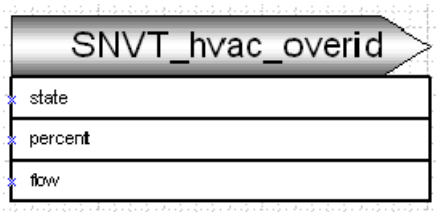


4. Double-click on LON NVI and LON NVO objects to select their SNVT type:



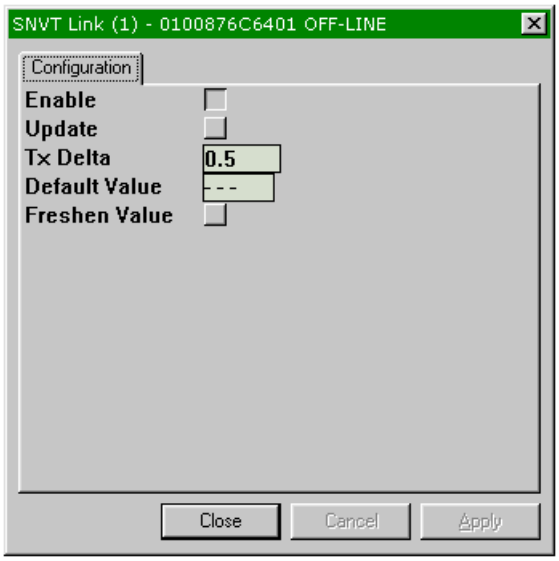
Caution: Set the Heartbeat time before setting the SNVT type.

5. The LON NVI or LON NVO object shape changes to show the connection types and points. Connect the LON NVI or LON NVO to the relevant points in the Bubbleland scheme:



It is important to ensure that the range of data passed to or from the Bubbleland scheme is valid. Refer to the SNVT details in the *VisiSat Engineering Guide* for further details.

6. Double-clicking on a wire to/from a LON NVI or LON NVO allows you to change properties such as to enable or disable the link:



Once the Bubbleland scheme is complete, it is necessary to perform binding in a network management tool, such as LonMaker for Windows. This is described next.

Using LonMaker for Windows

Once the VisiSat or WorkPlace Tech Tool scheme is complete, a network management tool is required to make 'bindings' between the SNVTs in the different nodes on the network. This ensures that the data transmitted by one node is received at the correct nodes on the network. Network management tools can also be used to modify external configuration parameters of a node.

One of the most widely used network management tools is Echelon's program called 'LonMaker for Windows' that provides a graphical representation of a LONWORKS network. It provides functions for node installation, network variable binding and network variable browsing in a client/server architecture.

LonMaker performs both binding and network management via an LNS database. The LNS database works on a credit system, with the user paying for a licence that grants the ability to add a maximum number of LONWORKS nodes to the database.

MicroNet MN350, 450, 550 and 650 controllers and the Touch Screen use a unique LONWORKS program ID for each controller application, not for each controller type. This overcomes binding problems when two or more controllers of the same type are used, but each contains different SNVT usage.

Using LonMaker and VisiSat on the Same PC

In order to use LonMaker and VisiSat on the same PC there are some basic configuration issues that need to be addressed.

Installation

Use only LonMaker for Windows version 3. If Visio® and VisiSat are already installed, it is important to remove them before installing LonMaker for Windows.

The procedure is as follows:

1. Remove VisiSat.
2. Remove Visio.
3. Install Visio.
4. Install LonMaker for Windows version 3.
5. Install VisiSat.

Note: If using LonMaker on a different PC from the one on which VisiSat is installed, LonMaker 2.0 can be used.

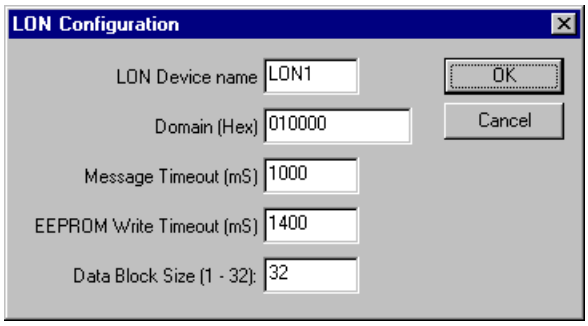
LonTalk Card

Unfortunately, it is not possible to have two applications simultaneously accessing the PC's LonTalk card, and therefore VisiSat and LonMaker can be run simultaneously only if two separate cards are installed. This is not seen as a particularly limiting factor, as in the normal sequence of events it would be usual to perform network SNVT binding only when the controller configuration stage is complete.

Specifying the Domain ID

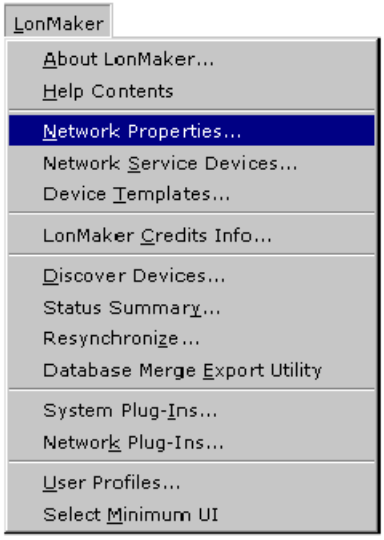
If you are using the same LonTalk card for VisiSat and LonMaker, you need to ensure that both are configured using the same domain ID, as stored in the card.

1. View the LON Configuration properties in the VisiSat Communications server (refer to the *VisiSat Engineering Guide* for details of how to do this):

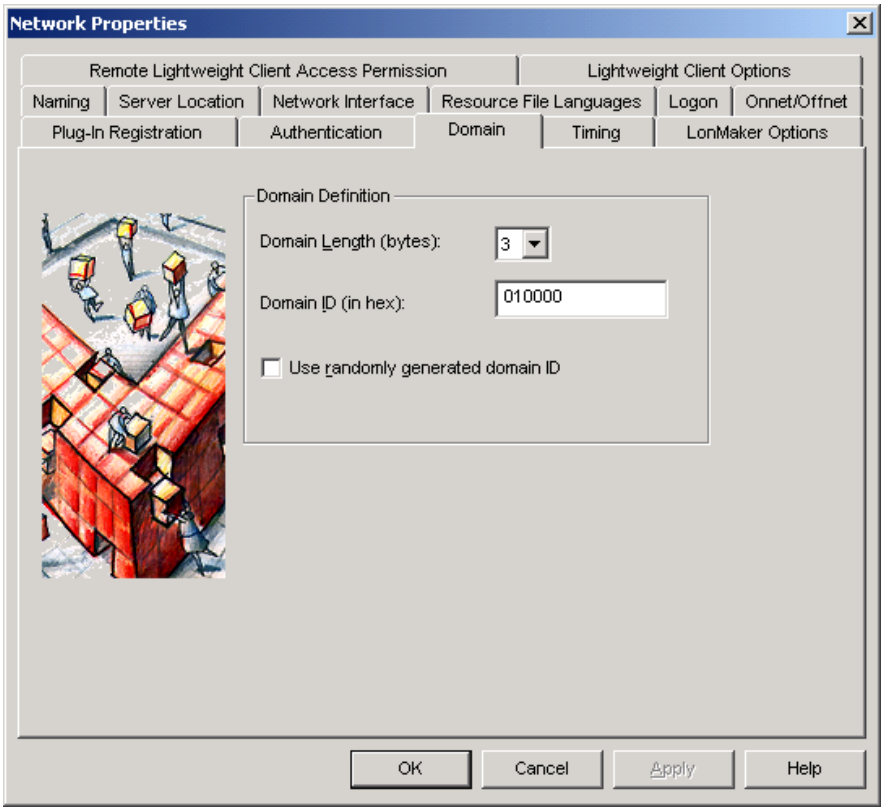


   Write down the Domain ID.

2. Start LonMaker and choose **Network Properties**:



3. Enter the same Domain ID as configured in VisiSat.

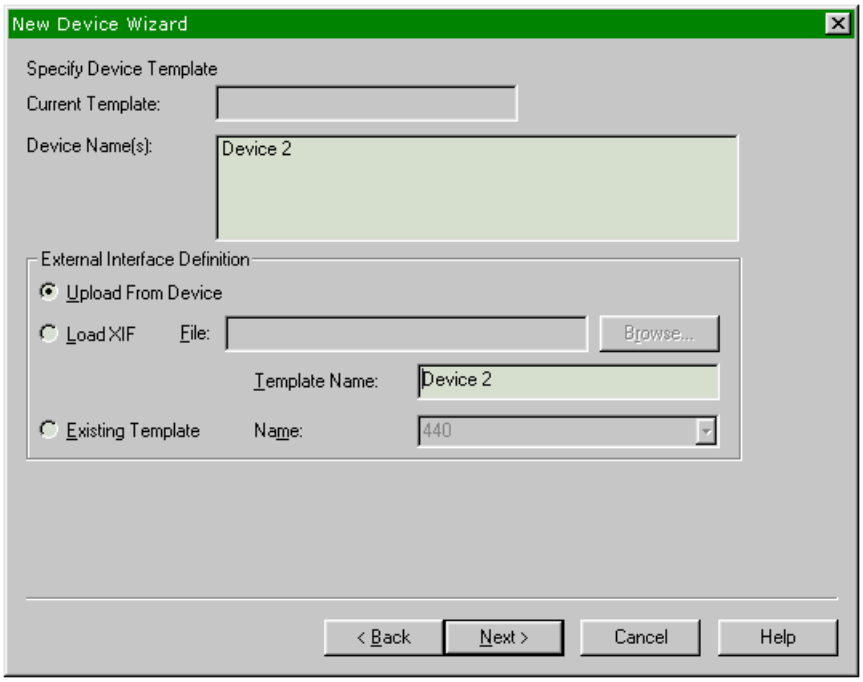


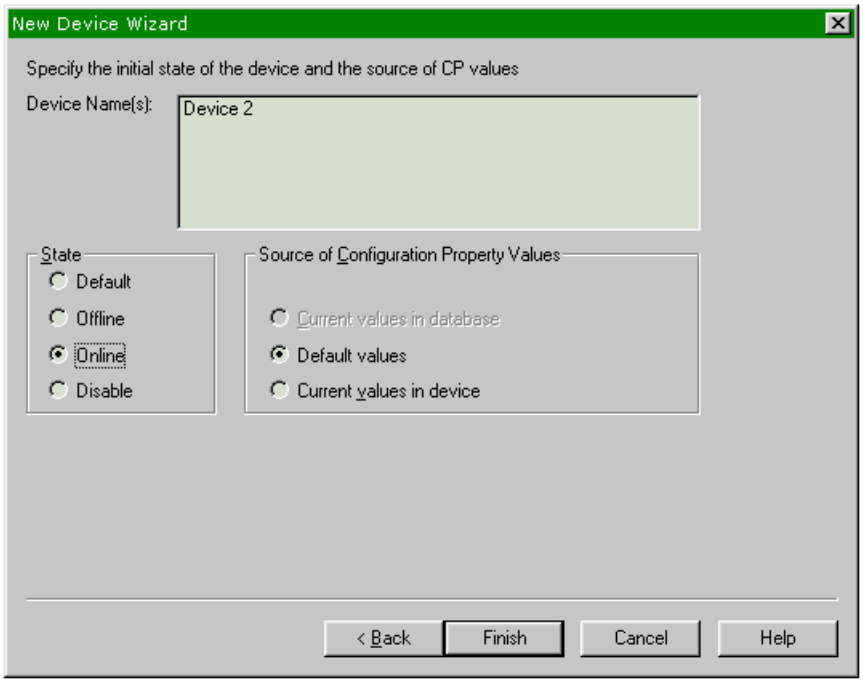
LonMaker Tips

This section gives advice on using LonMaker for Windows. For further information, refer to the LonMaker documentation (see page 56).

Adding a Device

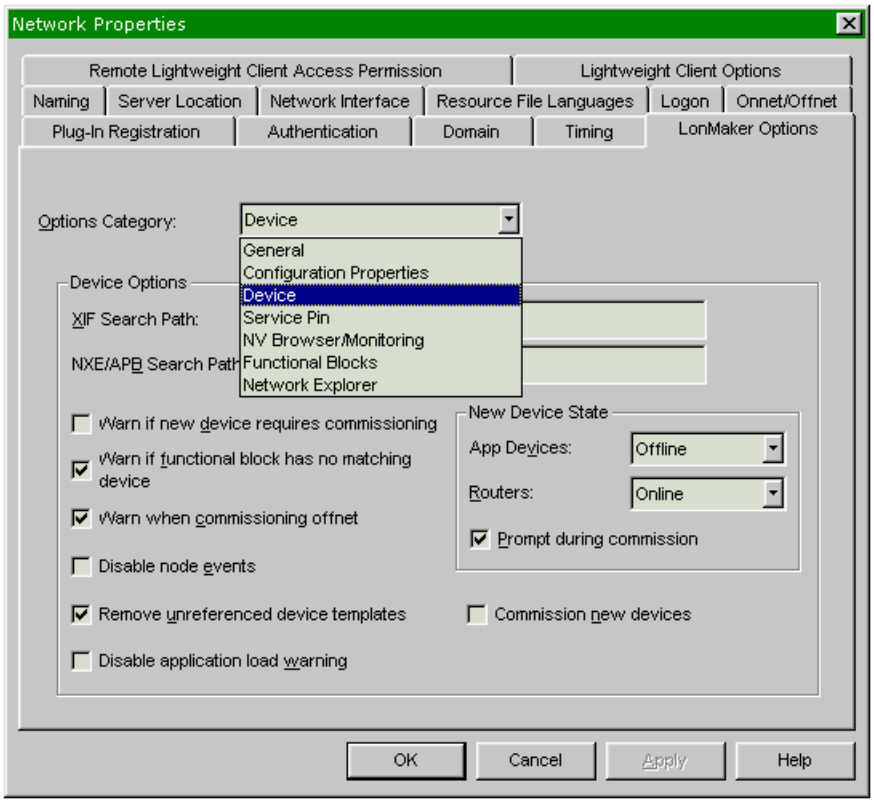
The key to adding a device (node) is to make sure that the External Interface Definition (XIF) for your device is uploaded from the device itself. Also make sure that the device is placed online on completion of the process. These options appear as radio buttons in the New Device dialogues.





Device Deletion

When a device (node) is deleted from LonMaker, it is also necessary to remove the associated device template. This can be carried out by listing the device templates of the LonMaker menu and then selecting those you wish to delete. It is also possible to configure LonMaker version 3 to delete the template automatically. This is carried out from the Network Properties dialogue by ticking the **Remove unreferenced device templates** option:



Note that following deletion from LonMaker, the device is placed in an unconfigured state, which means that when VisiSat or WorkPlace Tech Tool is subsequently run, it will be unable to communicate with it unless it is initialised first. This can be achieved by re-addressing (there is no need to press the service pin; just press return when the address dialogue is shown). LonMaker does this in order to manage its credits system and prevent people commissioning more devices than they have paid for by deleting them from the database.

Binding

It is more efficient to configure LONWORKS binding in LonMaker offline. This will save the time downloading each SNVT that is added to the scheme and will also prevent premature aging of the Flash memory in the daughter board. To set the whole network offline:

1. In LonMaker, select **Network Properties** from the LonMaker menu.
2. In the Onnet/Offnet tab, select **Offnet**.

Setting Up MicroNet View

MicroNet View displays controller data on LONWORKS networks using the standard LONWORKS LNS DDE Server, which allows access to SNVT values, but not to object values inside the controller scheme.

MicroNet View can connect to a TP/FT-10 LONWORKS network, or for faster communications on a backbone to a TP/XF-1250 LONWORKS network. The network type determines the LonTalk card used in the PC (refer to the *VisiSat Engineering Guide*).

This section provides an overview of how to set up the MicroNet View access names and tags necessary to use SNVT values in MicroNet View. Tags and access names are set up in MicroNet View WindowMaker.

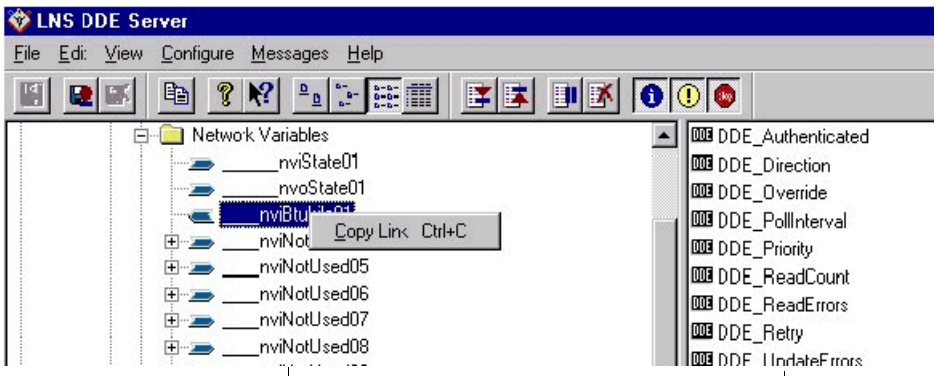
The process involves:

1. Copying the SNVT links from the LNS DDE Server.
2. Pasting the copied information to create an access name in WindowMaker.
3. Pasting the copied information to create a tag in WindowMaker, and repeating this step for each SNVT value to monitor in MicroNet View.

Copying the Link Details from LNS DDE Server

To copy the SNVT link details:

1. Start the LNS DDE Server.
2. Open the Networks folder in the Folder pane. The networks created in LonMaker will appear. Choose the network you want to use.
3. Select the controller in the Folder pane. The network variables of that controller will appear. Under Network variables, you can find all the SNVTs.
4. If the SNVT has only one data field, right-click on the SNVT and select **Copy Link**, as shown below. If the SNVT has more than one data field, right-click on the relevant item in the Detail pane and select **Copy Link**.



Folder pane

Detail pane

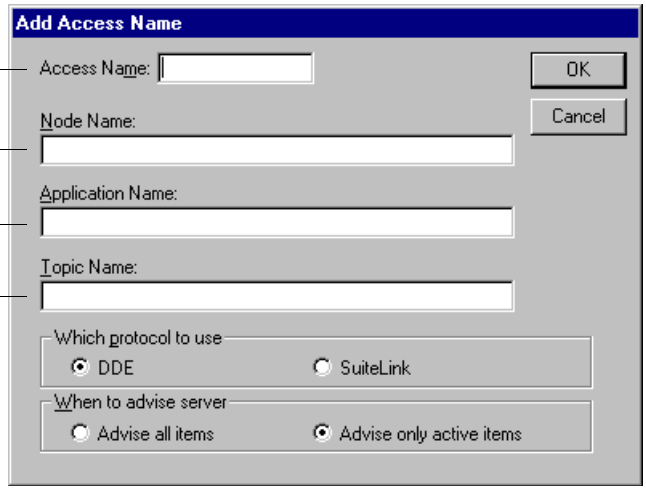
Setting Up an Access Name in WindowMaker

In MicroNet View WindowMaker, set up an access name (DDE topic) as follows using the text copied from the LNS DDE Server (refer to the *MicroNet I/O-Server Engineering Guide* for further details of creating access names and their purpose).

Enter any name here.

Enter the network name of the PC that runs the I/O-Server.

Enter **LNSDDE**.



Paste the text you copied from the LNSDDE Server into here. It should resemble the following:

=LNSDDE|'newtest.Subsystem1.DevNV'!'620-11._____nviState01'

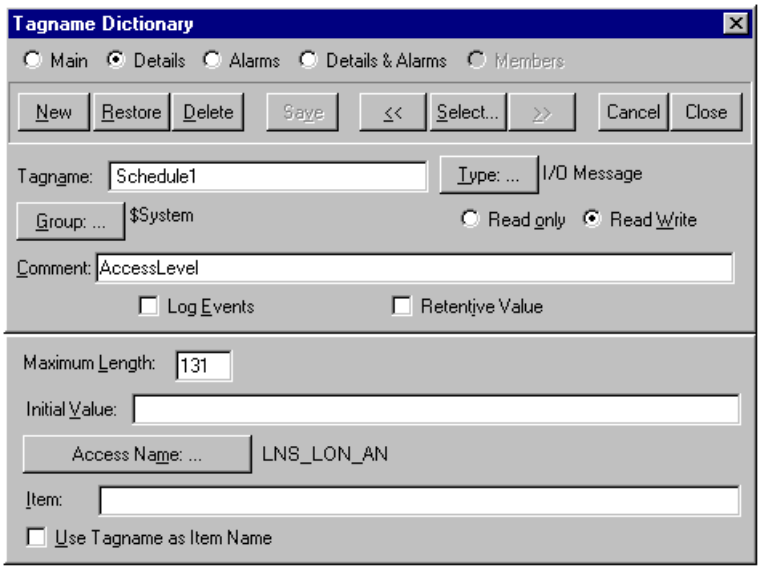
Delete the text at the beginning and end, so that it appears in the networkname.subsystemname.topictype format. For example, you would need to edit the above to:

newtest.Subsystem1.DevNV

Setting Up Tags in WindowMaker

In MicroNet View WindowMaker, set up the tags (DDE items) as follows using the text copied from the LNS DDE Server (refer to the *MicroNet I/O-Server Engineering Guide* for further details of creating tags and their purpose).

You need to create a tag for each SNVT value you want to use in MicroNet View. This means that you will need to repeat the process of using **Copy Link** in the LNS DDE Server and creating a new tag for each SNVT value.



Paste the text you copied from the LNSDDE Server into here. It should resemble the following:

=LNSDDE|'newtest.Subsystem 1.DevNV'!'620-11.____nvoState01.bit0'

Delete the text at the beginning and the quote character at the end, so that it appears in the devicenameInLonMaker.SNVTname.fieldextension format. For example, you would need to edit the above to:

620-11.____nvoState01.bit0

If the SNVT contains only one data item, a fieldname is not specified. For example:

620-11.____nviBtukilo01

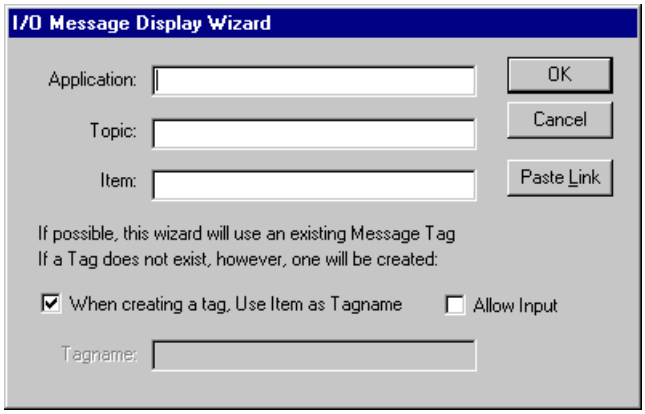
Alternative Method of Setting Up Access Names and Tags

This section describes an alternative method of setting up access names and tags, and at the same time creating a display box for the SNVT value in WindowMaker.

1. Display the window in which you want to place the display box.
2. Select the **Wizards** button in WindowMaker:

3. Select **Text Displays** in the left-hand area of the dialogue.
4. Double-click on the following button:

5. Click in the appropriate position in the window to place the display box.
6. Double click on the I/O Message display box to display the following dialogue:



7. Untick **When creating a tag, Use Item as Tagname**.
8. Copy the Link copied from the LNS DDE Server (see page 81).
9. Use **Paste Link** to paste the link into the dialogue (the top three fields are completed automatically). Topic must be in the format as described on page 82. Item must be in the format described on page 83.
10. Enter a suitable **Tagname**, then select **OK**.

    A tag and access name are created automatically.
11. If the LNSDDE I/O-Server is running on a different computer from the computer that is running WindowViewer, open the Tagname Dictionary and edit the access name to set **Node Name** to the network name of the PC that runs the LNSDDE I/O-Server.

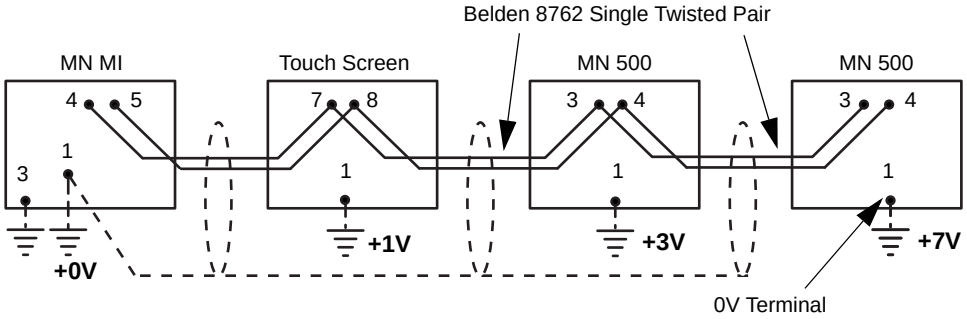
Appendix A
Mixing MN 50 Series and Older MicroNet Controllers on one Network

Adding an MN 50 Series controller to an Older MicroNet Network

Networks using Belden 8762 single twisted pair cable

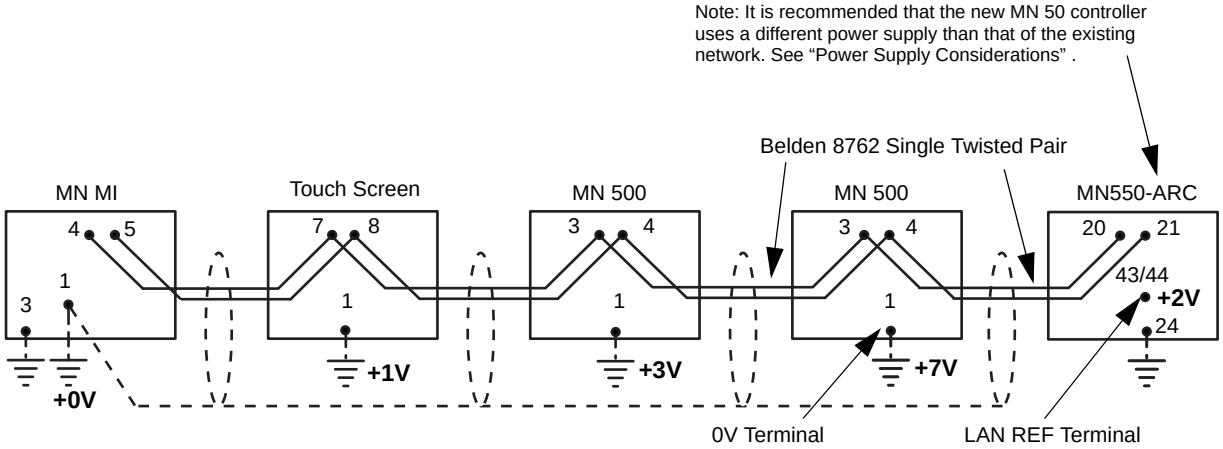
In an older MicroNet installation using Belden 8762 single twisted pair cable, the earth (0V) potential should not vary by more than 7V between any two MicroNet devices (e.g. between an MN MI and a router, or between any two controllers).

Consider the example of an existing installation shown in Figure–A.1. The maximum difference between the earth potentials at the MicroNet devices is not greater than 7V (in this case between the MN MI and the second MN 500).



Figure–A.1 Existing MicroNet Network using Belden 8762 Cable

Now consider the addition of an MN 50 Series controller (an MN550) to this existing network using the same cable (the MN550 will be an MN550-NCP if the existing network is NCP, or an MN550-ARC if the existing network is ARCNET). See Figure–A.2.



Figure–A.2 MN 50 Series Controller added to Existing MicroNet Network

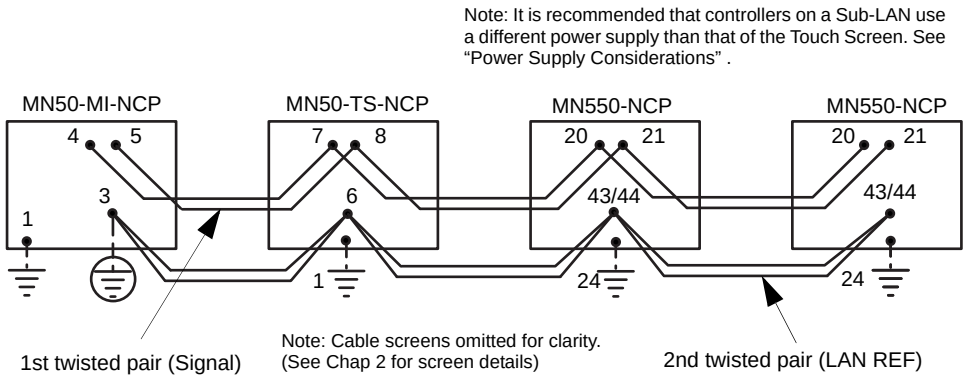
When installing the MN 50 Series controller, the following important points should be noted:

1. To provide electrical isolation, the MN 50 Series controller should be supplied from a different transformer than the one supplying the existing MicroNet devices.
2. The potential between any of the devices in the LAN should not be greater than 7V. This potential is measured:
   a. between 0V terminals for existing devices
   b. between the 0V terminal of an existing device and the LAN REF terminal of the introduced controller (***do not*** use the screen terminal)
   c. between the LAN REF terminals of introduced devices.
3. If this potential exceeds the defined limits, then either an MN MI is required as a repeater, or the LAN cable must be replaced with Belden 9502 dual twisted pair. Full details are contained in Chapter 2 (NCP networks) or Chapter 3 (ARCNET networks).

Adding an Older MicroNet controller to an MN 50 Series Network

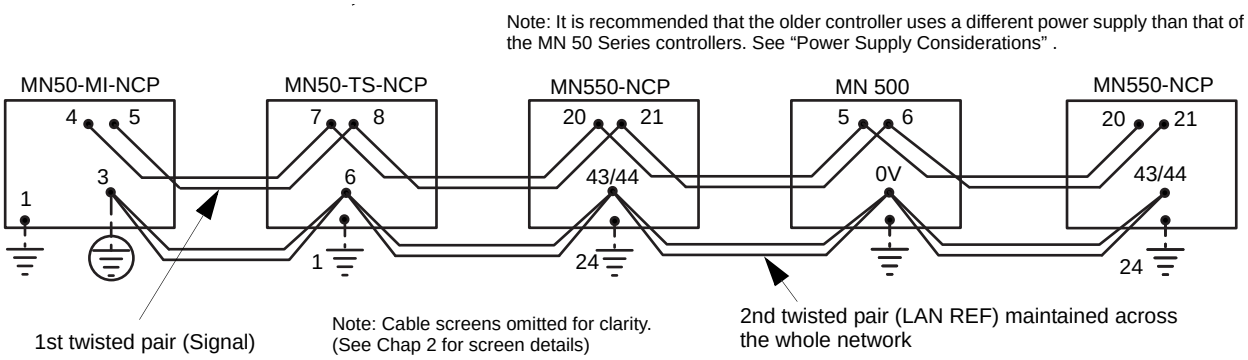
Networks using Belden 9502 dual twisted pair cable

An MN 50 Series MicroNet installation should use Belden 9502 dual twisted pair cable. See the example in Figure–A.3.



Figure–A.3 Existing MicroNet Network using Belden 9502 Cable

Now consider the addition of an MN 500 controller to this existing network using the same cable. See Figure–A.4.



Figure–A.4 Older MicroNet Controller added to MN 50 Series MicroNet Network

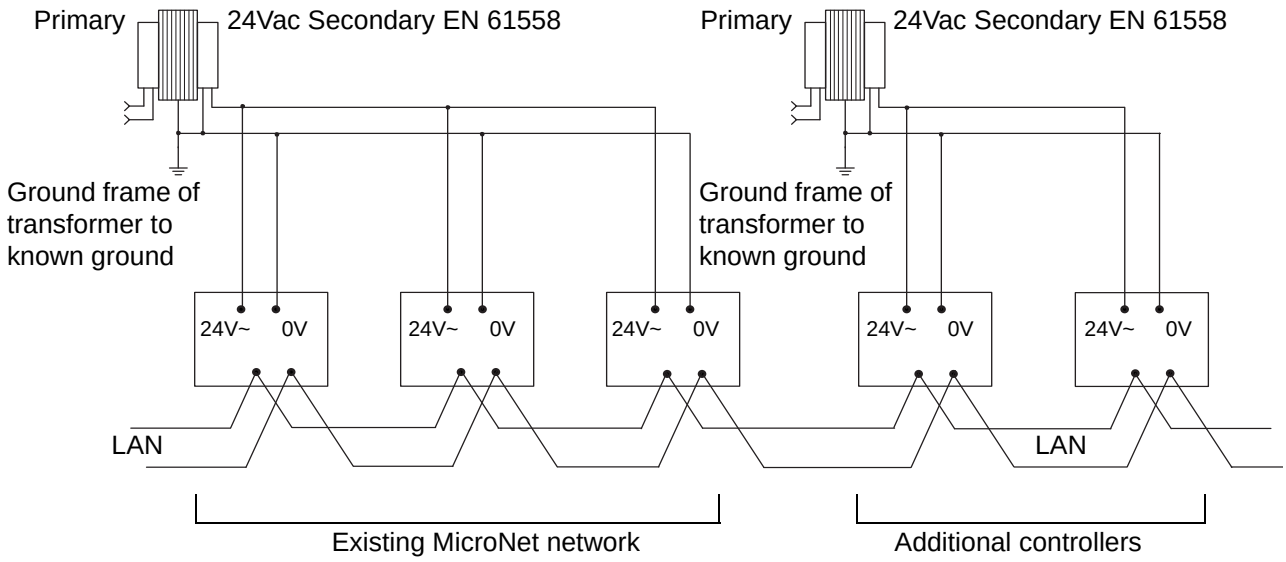
Power Supply Considerations

Use of Separate Transformers

To provide electrical isolation and to help prevent an excessive build-up of potential between controllers, it is recommended that separate transformers are used in the following situations:

- When older MicroNet controllers are used within an MN 50 Series network
- When MN 50 Series controllers are used within an older MicroNet network.
- When controllers are used on a sub-LAN headed by a Touch Screen.

Consider the addition of one or more older MicroNet controllers to an existing MN 50 Series network. See Figure–A.5.



Notes:

1. The revised network could be an existing MN 50 Series network with added older MicroNet controllers (MN 300, 440 etc.), or it could be an Older MicroNet network with added MN 50 Series controllers (MN350, 450 etc.)
2. When a Touch Screen is used to provide a sub-LAN in an MN 50 Series network, the controllers on the sub-LAN should use a separate transformer to that of the Touch Screen i.e. similar to the manner shown in the above diagram.

Figure–A.5 Using Separate Transformers for supplying controllers on Mixed MicroNet Networks

Equally, the existing network could be an older MicroNet network containing say MN 300 and MN 440 controllers, with MN 50 Series controllers added.

Cable Routing

The following table shows the cable types that can be routed together when using MN 50 Series controllers and older MicroNet controllers (MN 300, MN 440, MN 500 and MN 620). A tick indicates that routing together is allowable.

Table–A.1 Cable types that can be routed together (NCP and ARCNET networks)

	UI	S-Link	DI	Comms	DO, Power or Triac	AO
UI	✓	✓	✓	✓ If UI screened*	✗	✓
S-Link	✓	✓	✓ If DI screened*	✓	✗	✓
DI	✓	✓ If DI screened*	✓	✓ If DI screened*	✓ If DI screened	✓
Comms	✓ If UI screened*	✓	✓ If DI screened*	✓	✗	✓
DO, Power or Triac	✗	✗	✓ If DI screened	✗	✓	✓ If AO screened
AO	✓	✓	✓	✓	✓ If AO screened	✓

Notes:

- Where an asterisk is shown, this condition does not apply to MN 50 Series controllers.
- Always route network wiring away from mains wiring.
- If the cable is installed in areas of high RFI/EMI, the cable must be in conduit.
- In areas of high electrical noise, there may be a need to mount the MicroNet controllers and other devices inside an earthed metal panel.

Glossary

Term	Definition
Alphanumeric Data	Data for a modifiable property that is comprised of any combination of letters and/or numbers.
AO	Analogue Output, a controller output used to proportionally control (modulate) a damper or valve actuator or some other device.
Application	Essentially, an application is the reusable control logic contained in a controller. A controller stores control logic as algorithms acted on by its program (the executable code in the controller). In VisiSat Configuration Tool, we know an application as a Visio drawing file, which contains pages showing the application's modifiable properties, a graphical representation of the control logic and other drawing pages that define its implementation. Each MicroNet controller uses the control logic in a single application for control of a particular type of HVAC equipment, for example, a heat pump or fan coil unit.
ARCNET®	A high-performance, peer-to-peer communications protocol that may be used when an open communications standard is not necessary.
Bar Code Label	The label on each MicroNet controller that displays the controller's unique Neuron ID 'birthmark' number (both in bar code and as a legible number).
Bus du jour®	A term used for a flexible communications protocol which enables the use of NCP, ARCNET or LONWORKS networks.
Channel	LONWORKS term for the physical communications medium and transceiver type used by connected devices.
COM	Component Object Model.

Term	Definition
Compatibility	A level of interoperability that allows devices to fit together and perhaps work together, regardless of manufacturer.
Connectivity	The ability of a device to use a standardized method of communications, both physically (media connection) and logically (protocol implementation). LONWORKS provides both.
Control Logic	The control algorithms performed by a controller. For each application, control logic is graphically represented in VisiSat Configuration Tool as interconnected elemental control objects on Visio drawing pages.
Control Object	An elemental object used with other control objects to provide a control application in an MicroNet controller. Each control object typically has configuration properties, input properties and output properties. Control objects closely resemble NETWORK 8000 Blocks and are roughly analogous to DMS/MicroSmart points.
CRC	Cyclic Redundancy Check.
DDE	Dynamic Data Exchange. A protocol that allows DDE-compatible Windows® applications to interact with other applications and equipment.
DI	Digital Input. A physical input point on an MicroNet controller compatible with a two-state field contact (open/close contact).
Dialogue Box	A user-input window common in Windows-based software to enter or select data in the active program.
Digital I/O	Controller inputs and outputs that have only two states, such as Open/Closed.
DIN Rail	Also 'DIN track', is an extruded metal rail that allows a standardized 'snap-on' method for mounting of relays and other control modules.
DIP	Dual Inline Package. A package style for ICs, PC board mounted switches or other components. This term often refers to the small switches used to set the digital address for a networkable device or selected device functions such as signal input strength.

Term	Definition
Doubly Terminated Bus Topology	An alternative to Free Topology when wiring an FTT LONWORKS network segment. The Doubly Terminated Bus Topology requires that all twisted pair wiring is done in a linear bus ('node to node' or 'daisy-chain') fashion, without any wiring 'Tees'. The advantage of this topology is longer maximum wiring lengths per segment.
Drawing	The method of application storage in VisiSat Configuration Tool and WorkPlace Tech Tool, with each application saved as a Visio drawing file (.VSD) having multiple drawing pages.
Drop-Menu	A user-input control common in Windows-based software to select an entry from a list of choices. VisiSat Configuration Tool provides drop-menus for entering alphanumeric data in application properties.
Echelon®	The corporation that developed and supports LONWORKS technology and continues to promote interoperability through the LONMARK® Program.
Folders	Synonymous with directories and subdirectories in Windows. MicroNet View, VisiSat and WorkPlace Tech Tool stores each project in its own folder, which may contain one or more applications (files).
Free Topology	Describes the FTT LONWORKS network topology that allows any combination of multiple wiring tees, stars, loops or bus to interconnect nodes on the same wiring segment. Free Topology provides great flexibility when installing or modifying LONWORKS wiring.
FTT-10	Free Topology Transceiver. MicroNet controllers have an FTT-10A transceiver module for connection to a twisted-pair, polarity-insensitive LONWORKS network. The '10' in this term indicates a 10MHz input clock rate for the Neuron. An FTT LONWORKS network can use either a Free Topology or a Doubly Terminated Bus Topology.
Interoperability	The ability of multiple vendors' products to be integrated into one flexible system without using custom integration products. There are varying degrees of interoperability.
ISA	Industry Standard Architecture. The common 16-bit PC expansion bus available in most desktop and tower PCs.

Term	Definition
LONWORKS Termination Module	A LONWORKS termination module (terminator) is a two-lead device made of two capacitors and a resistor. It is required on each FTT LONWORKS network wiring segment, installed across the two twisted-pair conductors. Depending on the installed topology, one of two terminator models is used.
LONMARK	Is a logo signifying that a product has met LONMARK guidelines that allow it to interoperate with other LONMARK compliant products on a LONWORKS network.
LONMARK Profile	A special class of LONMARK Object that defines both a functional purpose and a standardized 'network image' to allow a device to share data and control on a LONWORKS network. A profile has a defined collection of input and output 'data slots' and configuration properties. Some example HVAC profiles are for a roof top unit, heat pump or fan coil unit. Profiles provide the highest class of interoperability.
LonTalk®	Echelon's open-architecture communications protocol used by all LONWORKS®-based devices.
LONWORKS	The collective hardware and software technology developed by Echelon to provide an open communications network for control devices.
LONWORKS Network	A peer-to-peer network of LONWORKS-based control devices. MicroNet controllers can be connected to a LONWORKS network with other nodes having FTT-10 (or LPT-10) transceivers, using low-cost, unscreened, twisted-pair cabling. In this context, also called an FTT LONWORKS network.
NC	Normally Closed. A type of relay contact *not* used in digital outputs on MicroNet controllers, where relay contacts are closed when the device is powered Off.
NCP	Native Communications Protocol. A communications protocol that may be used when an open communications standard is not necessary. NCP devices communicate in a polled-response fashion, at speeds of up to 9.6k baud.
Network Image	A description of how a device (node) appears to other nodes on a LONWORKS network, by using LONMARK Objects or a Profile.
Neuron	(Neuron Chip). The Echelon-developed core component of any LONWORKS node, containing internal processors and the LonTalk communications protocol.

Term	Definition
Neuron ID	The 48-bit identification number factory-assigned to the Neuron used in every LONWORKS-based node. Each MicroNet controller contains a unique Neuron ID, which also appears on a bar code label on the controller. Neuron IDs are used in the VisiSat Configuration Tool as a means of identifying a target controller to receive an application download.
NO	Normally Open. The type of relay contact used for digital outputs on MicroNet controllers, where output relay contacts are open when the controller is powered Off.
Node	An addressable device. In LONWORKS networks, each MicroNet LONMARK or LONWORKS controller can be a node, along with any LONWORKS-based sensor, actuator or other device (such as a PC with an Echelon LonTalk adapter).
NV	Network Variable.
PC Card	A newer generic term to refer to a notebook-PC adapter card that adheres to the PC Card Standard, previously called PCMCIA type adapter cards. The WPA-LON-2 Echelon LonTalk adapter used with the VisiSat Configuration Tool download function is a PC Card.
PCMCIA	Abbreviation for Personal Computer Memory Card International Association. A notebook-PC expansion bus standard that accepts adapter cards with a small form factor (credit card sized) and a special high-density 68-pin connector.
Peer-to-Peer	A method of direct communications among networked devices without a central host device or system. Nodes on a LONWORKS or ARCNET network communicate in a peer-to-peer fashion.
Physical Address	The address used to assign a particular I/O point on the controller to an input or output tag of a point object in the application's control logic.
Point	A controller data object.
Profile	See LONMARK Profile.
Program	The executable code processed by the Neuron in an MicroNet controller, it runs the application.
Project	A project is a folder (subdirectory) used to store job data in VisiSat or MicroNet View.

Term	Definition
Property	The modifiable components for any application opened in VisiSat, MicroNet View or WorkPlace Tech Tool.
S-Link	Sensor Link. The twisted-pair, polarity-insensitive connection between an MicroNet controller and an MicroNet sensor. The S-Link powers and enables the MicroNet sensor.
Segment	The wiring used to connect nodes on a FTT LONWORKS network. A segment can have a maximum of 64 nodes. A segment has a maximum wiring length dependent on the topology and the type of twisted-pair cable used.
Service Pin	In LONWORKS terminology, a special pin of the Neuron that when grounded results in a LonTalk broadcast message containing its Neuron ID and program ID. The service pin routine can be used with the application download function of VisiSat Configuration Tool and WorkPlace Tech Tool, as a means of physically selecting a particular controller. An MicroNet controller also has an on-board service pin for broadcasting the subnet addresses to all connected controllers.
Spin-button	A common user-input control in Windows-based software to select an integer value. You use a spin-button in VisiSat Configuration Tool and WorkPlace Tech Tool to modify numerical values in some types of application properties.
Stencil	An associated collection of Visio® master shapes that can be individually copied onto a Visio drawing.
Terminator	See LONWORKS network termination module.
UI	Universal Input. Used to describe the analogue inputs on MicroNet controllers.
Unitary	Unitary is a generic term for a pre-packaged HVAC unit, often using a through-the-wall or console design.
Universal I/O	A controller I/O point that can be used as either an input (analogue or digital) or output (analogue or digital). MicroNet controllers do not have universal I/O, but have dedicated universal inputs (UIs), digital inputs (DIs), digital outputs (DOs) and analogue outputs (AOs).
VAV	Variable air volume. A system that controls space temperature by varying the quantity of supply air rather than by varying the temperature of the supply air.

Term	Definition
Visio	The product name of the popular WIN-32 drawing application from the Microsoft® Corporation. Satchwell uses Visio as the user interface to the VisiSat Configuration Tool, allowing graphical representations of applications.

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