Starrett®

DataSure™
Wireless Hardware

Hardware Manual

www.starrett.com

Contents

1.1 Introduction

The Starrett *DataSure®* wireless network is designed to allow the transfer of data from electronic measuring tools to computers where measurements can either be easily logged or conveyed to an SPC software package. The wireless network environment allows tool operators to move freely without the constraints of data cables. The Starrett *DataSure®* system consists of a software application that must be installed onto the computer on which a Gateway is connected, (Refer to the Starrett *DataSure®* Users Guide) and hardware components that wirelessly transmit the data from a tool to the computer. The hardware components of the system are the: Gateway, Router/s, and EndNode/s. The Gateway is a radio transmitter/receiver attached to a PC. The Router is a network node that extends the communication range by automatically forwarding signals between EndNodes, other Routers, and the Gateway. The EndNode is a radio transmitter/receiver attached to a tool.

This document describes the hardware components of the system, please refer to the Starrett *DataSure®* Users Guide for information on the software application program.

The following statement applies to each of the *DataSure®* wireless devices (EndNode, Router, Gateway).

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

-- Reorient or relocate the receiving antenna.
-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the L.S. Starrett Company could void the user's authority to operate the equipment.

DataSure® is a trademark of the L.S. Starrett Company.

1.2   Features

- Eliminates wires for freedom of movement while collecting data on the shop floor.

- Easy to set up and scale – no training – no site surveys.

- Portable routers for flexible use.

- Very low power EndNodes for long battery life.

- Rugged design for shop environments.

- Remote access to *DataSure®* .

- Made entirely in the USA.

- Radio system works with Starrett, Mitutoyo, Sylvac, Fowler, Bowers, and CDI.

- Primarily calipers, micrometers and indicators.

- One Gateway system handles over 100 tools.

- Multi-mode function - 1 tool connected to Gateway or multiple, multi-plexers for complex shop environments.

- 916 MHz ISM band radio, self-configuring and self-healing network.

- Get data from tools initiated by operator or host control.

- EndNode radios can store up to 10 readings if main system is down or busy.

- Up to 32 tools per virtual multiplexer.

- Up to 8 virtual multiplexers.

- Operating distance up to 20 meters (65 feet) for EndNodes.

- Broadcast range up to 30 meters (98 feet) for Gateway and Routers.

- Additional routers can increase range up to 1000 m in 30m increments.

- System status feedback on the EndNode, including acknowledge of data received.

- No line-of-sight limitation.

- Optional wall mount for Routers.

- Routers equipped with a rechargeable battery backup.

- Gateway and Router antennae can be angled and swiveled to improve reception.

1.3   Care & Maintenance

External plastic surfaces of EndNodes, Routers, and Gateways may be cleaned with Isopropyl Alcohol and a non-abrasive cloth. Care should be taken not to wet internal surfaces or conductive cable ports. Antennae are delicate, and should be handled with caution.

Tools, EndNodes, Routers, and Gateways should all be plugged in, attached, and mounted before any hardware is powered on.

The recommended environmental bounds of use are $0 – 40°C$ and $0 – 80\%$ relative humidity (non-condensing).

1.4   Hardware Description

1.4.1   Contents

The Starrett *DataSure®* wireless system is shipped with Gateway, Router and EndNodes in specially fitted boxes to provide protection from shock, vibration and moisture normally encountered during shipment. Keep these boxes for storage and future shipments of the tools.

The wireless system may be ordered in a variety of configurations. Carefully check the contents to ensure that all items have been received.

1.4.2   Software

Before connecting a Gateway to the computer the software must be installed. The USB driver must be installed. Refer to the Software User Guide for installation and operation of the Starrett *DataSure* software application.

1.4.3   Group Identification and Device UID

The Gateway, Routers and EndNodes have a unique group number that links these various components to the network. The Group Number is the partitioning reference for all wireless network elements. Only EndNodes, Routers, and Gateways of the same group number will communicate with each other

Each element in the network is also uniquely identified by a read-only Device UID set at the time of manufacturing. The group number and device UID may be found on each of the component labels.

This numbering system is used by the *DataSure* Software Application to identify a tool within a network environment. To bring a tool in the *DataSure®* network the operator has only to connect an EndNode into the tool's data port and power them both on. When the EndNode comes within range of a Router or the Gateway, it will be automatically recognized by the wireless service.

1.4.4   EndNode

An EndNode is a radio, which links a tool to the wireless network. EndNodes connect into a tool's data port in the same way that conventional wired cables do. Use the data send button on the EndNode to send tool data. There are two status indicators on the EndNode; one is green and the other is red, refer to the LED Activity Flash Code section. When not in use, turn the EndNode off to conserve battery life, refer to the EndNode Operation section

1.4.4.1   EndNode Unpacking
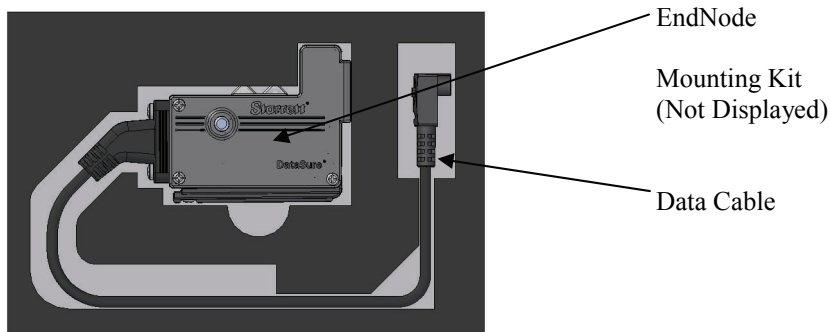

EndNode

Mounting Kit
(Not Displayed)

Data Cable

Figure 1
Packaged EndNode

The EndNode is packaged in a rectangular shaped enclosure approximately 1.84 x 2.25 x .51 inches with an 8 inch cable terminated with a connector. The attached data cable is terminated with one of a variety of connectors specific to the tool's data port plug type. The connector must have been selected during ordering to interface with your specific brand of measuring instruments. The connector selector guide may be found in Appendix A of this manual, in the Starrett Tool Catalog or on the Starrett web site (www.starrett.com).

Upon receiving the EndNode verify the connectors fit to the measuring instruments data port.

1.4.4.2   Connect the EndNode and Tool

The Mounting Kit includes 2 alcohol swabs and two square self-locking fasteners. Wipe the area on the tool on which the fastener will be placed with one of the alcohol swabs and let the alcohol residue dry. Remove the tape from the fastener and adhere the fastener to the tool. Wipe the back of the EndNode with the second swab. Remove the tape from the second fastener and place the fastener onto the back of the EndNode. Snap the two fasteners together.

The EndNode is now securely mounted onto the tool. Connect a data cable to the tool.

Figure 2
EndNode Mounted on a Starrett Micrometer

The data cable is attached to the EndNode as depicted in the drawing above, however the connector is reversible for easier mounting on a tool. To disconnect the connector unscrew the two Phillips head screws. Reverse the connector, carefully slide into the edge card connector and secure the screws.
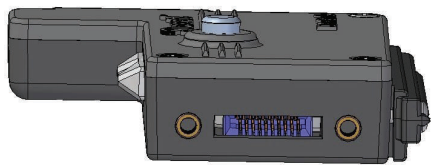

Figure 3
View of EndNode Edge Card Connector

1.4.4.3 Battery Replacement

The EndNode is shipped with a Lithium Coin Cell Battery CR2450

To replace battery, unscrew the Philips Pan Head screw locking the battery compartment.

Figure 4

Slide the battery compartment cover open. Remove the battery. Notice the positive battery terminal is marked on the battery holder.

Figure 5

Insert a fresh CR2450 battery observing the correct polarity, <u>positive side down</u>. Close the cover and screw the door securely.

Figure 6

Lithium Coin Cell Battery CR2450 (+) Plus Side Down

The Starrett EndNodes consume very low power. More than 500,000 readings can be taken with one 2450 battery.

1.4.4.4   EndNode Operation

Status Indicators
Red LED   Green LED

On/Off and Data
Send Button

Strain Relief for
Tool Interface Data
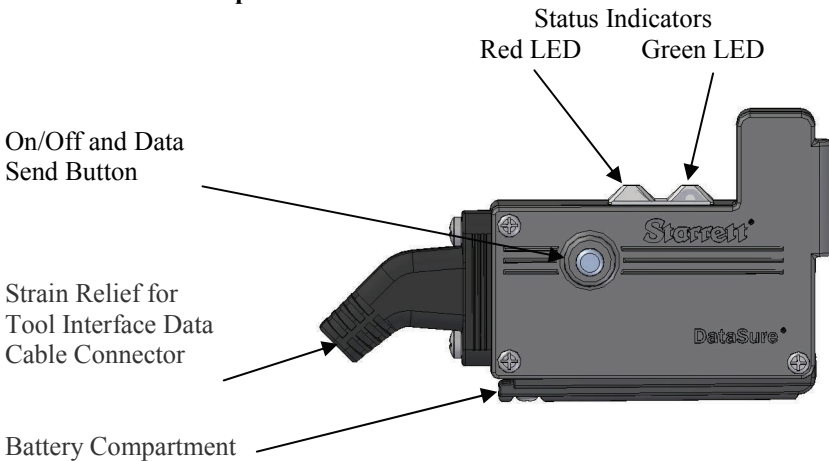Cable Connector

Battery Compartment

Figure 7

The power On/Off works with the assumption that it is always ON unless it is deliberately turned off; The user should assume the tool is ready to go - but if it has been deliberately turned off or gone into sleep mode and the user wants to measure now, the tool will alert them after pushing the On button by the simultaneous flashing of the green/red LED's and in turn there may be a delay in the measurement reaching the PC.

ON: Push and hold the button for ½ second to turn the EndNode ON; *GREEN & RED LED's* flash 6 times to let the user know it just powered up and there may be a delay in use.

OFF: Push and hold the button for 3 seconds, *GREEN* & *RED LED's* both turn ON and stay On for 1½ seconds. Tool and LED's turn off at the end of 3 seconds even if the button is held down longer.

SLEEP: EndNode goes to sleep after 4 hours of inactivity (no measurement taken). *GREEN* & *RED* LED's remain ON (*NOT FLASHING*) for 1.5 seconds before entering the sleep mode, same as OFF mode.

MEASURE: To begin taking measurements press the Data Send button once, a sequence of blinking red and green LED's will follow to indicate the End-Nodes response to events. The tools on/off state, data send button push, availability of network, modules ready state, or success or failure of data transmission are events that will cause changes in the LED sequence. Refer to the LED Activity Flash Code section. If the Starrett *DataSure®* software application is open, the measurement will be displayed on the Home page measurement box.
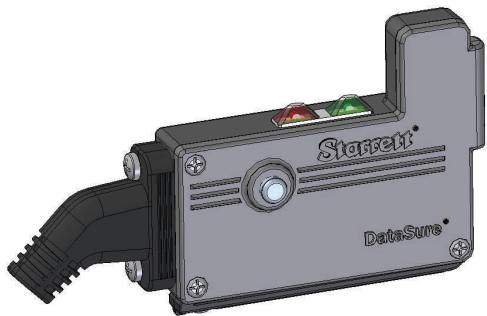
1.4.4.5 LED Activity Flash Code

Figure 8

These tables define the EndNode module's visual response to states and events. States refer to the EndNodes current status of operation within the wireless network. Events occur when nodes actively attempt to transfer data over the wireless network. A blink "combo" is any combination of red & green blinks as defined in the tables below.

State	Green LED	Red LED	Time between Blink Combos (Seconds)	Notes
No network	0	1	7	
Ready	1	0	5	
Data Stored In EndNode	2	1	5	Green-Red-Green

State	Explanation
No network	There is no network detected, tool on/off status is irrelevant
Ready	The tool is on, network is up and ready
Data Stored In EndNode	The EndNode has unsent tool data stored, waiting for network to be ready

Event	Green LED	Red LED	Time between combos (Seconds)	Notes
EndNode sends data	2	0	One combo	
Data success-fully received	4	0	One combo	
Data Stored In EndNode/ no network connection	2	1	0.5	2 combos, Green-Red-Green
Data Lost/ no network con-nection	0	3	0.5	3 combos

Event	Explanation
EndNode sends data	EndNode has sent data to the Gateway
Data success-fully received	Acknowledgement from the Gateway that data was received
Data Stored In EndNode/ no network connec-tion	Network connection has been lost and measurement is being stored in the EndNode
Data Lost/ no network connec-tion	No network connection is present and no more room is left in the EndNode to store measurements

1.4.5   Gateway

The Gateway is a radio device which provides a point of entry for the wireless network to interface with software running on a PC. Only one Gateway may be used for a group of network elements. There are two status indicators on the Gateway that show radio activity. The Gateways are powered on when they are plugged into a PC's USB port.

1.4.5.1   Gateway Unpacking

The Gateway package contains the items listed below. Check package for contents.

1. 1500-1-UN - USB Version
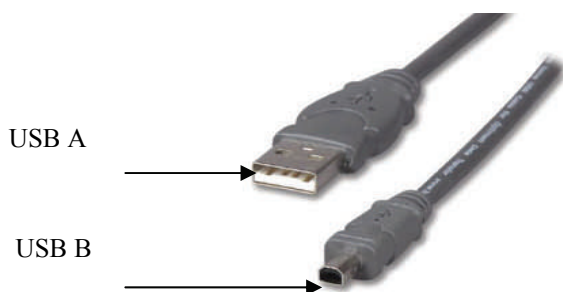2. USB Cable
3. Software Installation Disk

USB A

USB B

Figure 9
USB Cable Ends

1.4.5.2   Gateway Setup

Model 1500-1-UN
Place the gateway on a work surface near the computer away from metal obstructions or noisy environment.
Attach the USB B side of the connector to the matching USB connector located on the back of the gateway.
Attach the USB A side of the connector to your computer.
The gateway will be powered by the computer via the USB cable after the USB driver has been installed.

Figure 10
Gateway Connected to a Laptop Computer

Warning: Until the USB driver is installed the gateway will not detect the USB connection and power will not be applied.

To install software refer to the Starrett *DataSure®* or *DataSure Advanced* ™ Users Guide.

Power On – Locate Power On/Off Slide Switch. Slide switch to ON position. The LED's on the surface of the Gateway cover will illuminate.

1.4.6   Router

Routers are radio devices, which provide robustness, range, and scalability to the wireless network. They serve as intermediary steps between the EndNodes and a Gateway. Routers should be installed within range of a Gateway, or else within reaching distance of other Routers. EndNodes can be carried freely throughout a network environment bounded by the overlapping ranges of Routers and the Gateway. Adding more Routers to a network-enabled space further strengthens a network by providing multiple paths for data transmissions to follow. Routers operate automatically; they require no further operation beyond proper placement, antenna orientation, and supplying of power. There are two status indicators on the Router; one is a power indicator, and the other shows radio activity. The Router can be turned on or off via a sliding power switch. Routers are powered via an external AC wall adapter (included), and are also equipped with a rechargeable battery backup. The power cables may be looped around the posts located near the power entry jack on the rear of the Router. This provides strain-relief to guard against accidental shutoff if the cable should become snagged and pulled away unintentionally.

1.4.6.1   Router Unpacking

Check Package for contents.
- 500-2-RN Router – 120/240 VAC Version
- AC100-240 V 50/60 Hz to 5 Volt Power Supply Adapter
- C Size Rechargeable Nickel Metal Hydride Battery Pack Installed

1.4.6.2   Router Setup

Place the router on a work surface.
Attach the DC power jack end of the Power Supply Adapter to the power jack connector on the router, labeled DC power supply.

The Router comes with a wall mount bracket. The bracket may be installed on a vertical or horizontal surface using the screws provided. Keep the router antennae away from metal surfaces and objects or noisy environments, as this will reduce the signal strength. Place the bracket near a convenient power source. Slide the router into the bracket. Adjust the orientation of the antennae.

Figure 11
Router

Attach the two-prong plug to 100/240 VAC 50/60 Hz power source.

Power On – The Power On/Off Slide Switch is on the back panel of the router. Slide switch to ON position. The LED's on the surface of the Gateway cover will illuminate.

A Nickel Metal Hydride (NiMH) battery pack is supplied with the instrument in the event of power loss or remote operation. In a full charge state the battery will provide back-up power for up to 72 hours. The rechargeable battery was fully charged at the factory however; the battery may have been discharged during shipping and storage. It is recommended to leave the charger connected for at least four hours. The charging circuit is designed to provide a maintenance charge to the battery and may remain connected for the duration of use.

1.5   Determining the Network Layout

With the Starrett *DataSure*® system, EndNodes broadcast effectively within a 20-meter (65 feet) radius, more or less. Routers and Gateway network nodes have a broadcast radius of 30 meters (98 feet). With this knowledge, it is possible to draw out a schematic floor plan of the area for the *DataSure*® system to be deployed in and superimpose circles of the scaled radio ranges for each network element.

1.5.1   Steps to layout your network:

1. Render a floor plan of the shop area to be covered.
2. Locate work cells or locations where the measurements are to be taken on the floor plan.
3. Determine and locate any large obstruction or electrical noise source that radio coverage will be blocked. Typically, radio coverage can be considered impaired to zero in such places.
4. Draw scaled circles around the area in which the Gateway and Routers can or will be placed (30 meters to scale). Note the center of the circles as the location of the antennae.
5. Draw circles around the location or areas in which the EndNode radios will be used (20 meter to scale).
6. Where EndNode broadcast circles encompass the antennae of a Router or Gateway, radio coverage is good.
7. Where EndNode, Gateway, or Router antennae are not within mutual range of another's antenna there will be poor to zero coverage. To resolve this problem, move the Routers closer to cover the area or add a Router to fill the coverage gap.
8. In order to have contiguous coverage on a floor plan, there must be at least one path from EndNode to Gateway. The antennae of each radio element must be in range of at least one other radio in the path.
9. Take the written floor plan out to the actual area and physically place routers and the gateway in the locations indicated on the floor plan schematic.
10. Test the network to see if it works. If not, check for gaps in the actual coverage on the shop floor.

1.6   Tips for best performance:

1.   Make sure the batteries are good in the EndNodes. Battery condition and voltage value is indicated on the *DataSure®* 's Home page.

2.   Place Routers up high above machinery and their enclosures, but no more than 15 – 20 feet off of the floor or area in which measurements are to be taken.

3.   If using a STRING configuration make sure radio coverage of adjacent Routers overlap by several meters to insure good connectivity. Ideally the Routers are placed above interference areas. (See #2 above)

4.   Locate *DataSure®* nodes away from known EMI sources:

5.   When EndNodes are within the 20 meters distance to the nearest Router, but appearing to not get received by the Gateway, it may be because the EndNode's radio waves are being shielded by a large metal enclosure or there is EMI in the immediate vicinity of the measurement area. The possible remedies for this are to either wait for the EMI to subside or insure that the measurement button is pushed when the tool is in plain sight of the Router or Gateway (which ever is closer).

6.   Metal structures can shield and blocks radio waves. Be diligent in locating and using all *DataSure®* components away from metal expanses if possible. There is no danger, but radio reception/broadcast range will diminish significantly. When Routers or Gateways are mounted on structural/vertical 'I' beams or metal wall panels, radio waves are shielded or blocked behind the mounting plane of the units. Be aware that if coverage of 360 degrees around the router is needed, the metal obstruction will limit the radiation of the radio.

7.   EMI will disrupt radio waves and should therefore be avoided. Be aware of known EMI sources. Locating *DataSure®* nodes near these will impair reception/broadcast range. Some known industrial EMI sources are: induction hardeners, de-magnetizers, magnetizers, high power electric motors, arc welders, high voltage power lines, high voltage generators, wiring errors in buildings (incomplete ground to neutral connections), MRI and NMR medical magnetic imaging systems. Additionally, structural steel in a building can be magnetized when it is placed in a strong external dc magnetic field. This usually occurs by sending strong DC currents through the material such as grounding welding equipment to the steel during construction.

Large Shop Network Example

Machining Station

Work Cell 2

Work Cell 1

Work Cell 3
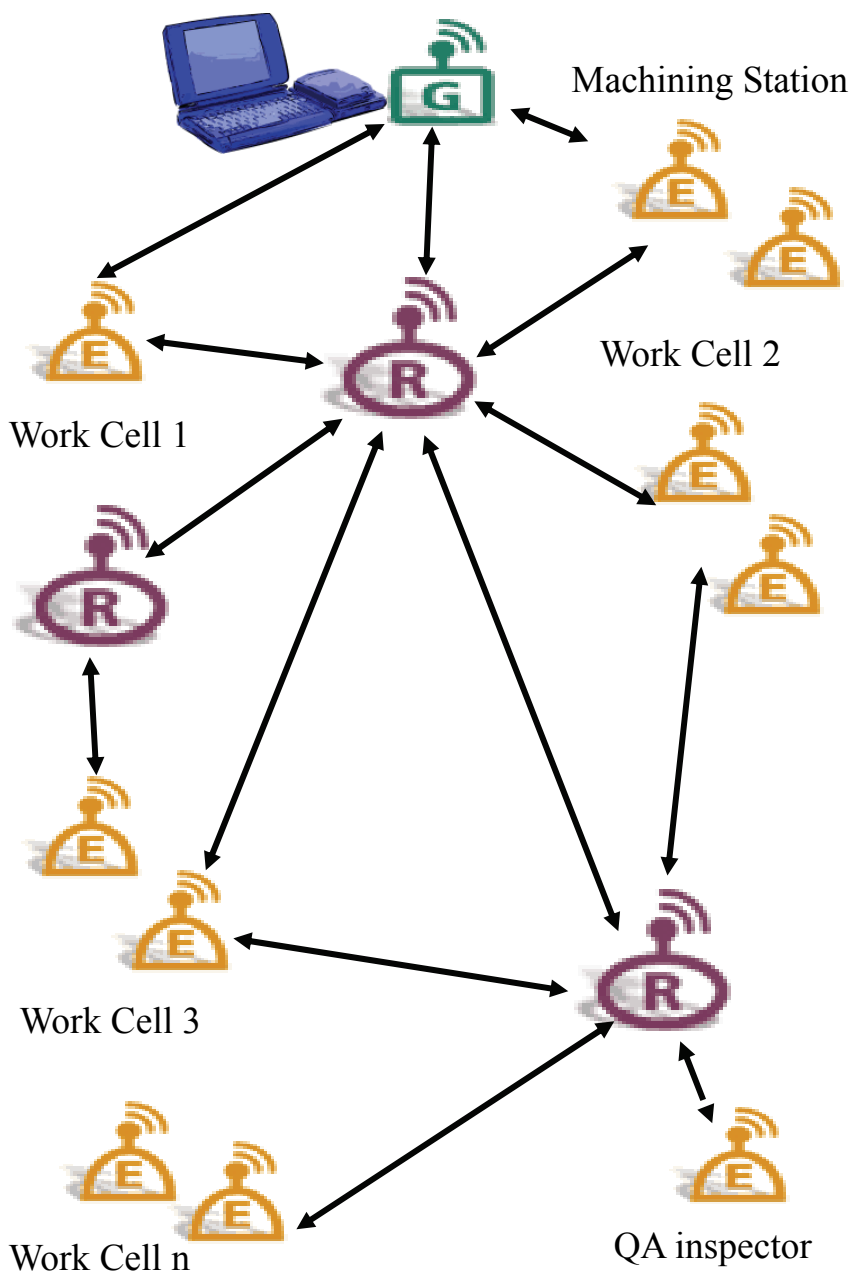
Work Cell n

QA inspector

Figure 12

1.7 Quick Start

Detailed information regarding each of these steps can be found in the *DataSure®* software Operations Manual. This procedure outlines the minimal actions required to extract measurement data from a tool, beginning from a first-time installation.

Install and run the *DataSure®* software

- Insert the *DataSure®* CD in the intended host PC's CD drive

- *For USB Gateway: Plug in Gateway cable to PC*

- *Install the drivers for the new hardware found*

- Begin the *DataSure®* install procedure

- Launch the *DataSure®* software

Make sure all hardware elements are powered on, and interconnected

- Tools and EndNodes should have fresh batteries, and be connected

- Routers, Gateway, and hosting PC are all plugged in and running

- EndNodes, Routers, and Gateway are all within working range of each other

Start the Wireless network service

- Refer to the Operations Manual to start the Starrett Wireless Network or DataSure Advanced application.

- Tools will appear on the Homepage after a short period for network self-identification

- As the EndNodes come online, the status of the tools will change from 'Unknown' to 'Ready'

Begin taking measurements

- Press the data-send button on the EndNode

- Or double-click on the tool's 'Measure' button on the *DataSure®* software Homepage

- Watch the tool reading and time-stamp appear on the Homepage

Export collected data

Appendix A

Gateways and Router

Catalog No.	EDP	Description
1500-1-UN	12051	Gateway for USB Port
1500-2-N	12059	Router, 120/240 VAC

End Nodes

Catalog No.	EDP	Description
1500-3A-1N	12064	For Starrett Opto, Cat. Nos. 782, 797, CDI, Sylvac
1500-3A-2N	12068	For Starrett 795 IP67 Micrometer
1500-3A-3N	12076	For Starrett 3rd Generation, Cat. Nos. 721, 733, 2600
1500-3A-4N	12076	For Starrett 2700 Indicators
1500-3A-5N	12080	For Starrett Cat. Nos. 2000, 2001, 3752 (with Spade type Connector)
1500-3A-6N	12084	For Mitutoyo 6-Pin
1500-3A-7N	12088	For Mitutoyo w/o absolute encoder
1500-3A-8N	12267	RS232, User configurable
1500-3A-9N	12785	For Mitutoyo IP66 Micrometer
1500-3A-10N	12786	For Mitutoyo IP65 Micrometer
1500-3A-11N	12187	For Digimatic W/D-Sub 9 pin
1500-3A-12N	12192	For Universal Mitutoyo 10-pin rectangular connector
1500-3A-13N	12196	For Mitutoyo w/Cable Nos. 936937 or 965014
1500-3A-14N	12214	For Mahr-Federal with uMaxum and XL
1500-3A-15N	12223	For Opto/Duplex
1500-3A-16N	12266	For Mahr-Federal EX Series
1500-3A-17N	12564	For 2000-24 Altissimo Height Gage
1500-3A-18N	12565	For Starrett 798 IP67 Caliper