

Conducting a Site Survey (Gateway and Nodes)

A Site Survey, also known as a Radio Signal Strength Indication (RSSI), analyzes the radio communications link between the Gateway and any Node within the network by analyzing the radio signal strength of received data packets and reporting the number of missed packets that required a retry.

Perform a Site Survey before permanently installing the radio network to ensure reliable communication. Activate Site Survey mode from either the Gateway buttons or the Gateway Modbus holding register 15. Only the Gateway can initiate a Site Survey, and the Site Survey analyzes the radio communications link with one Node at a time.





Conduct a Site Survey Using the Menu System

Initiate a Site Survey using the Gateway's buttons and menu system.

1. Remove the rotary dial access cover.
2. To check the status of Node 1, change the Gateway's right rotary dial to 1.
The Gateway is now enabled to read the status of Node 1; the display scrolls through the Node's I/O status.
3. Single-click button 1 to scroll across the menu levels until reaching the Site Survey (SITE) menu.
4. Single-click button 2 to enter the Site Survey menu.
5. Single-click button 2 to begin conducting a Site Survey with the Node selected in step 2.
The Gateway analyzes the quality of the signal from the selected Node by counting the number of data packets it receives from the Node.
6. Examine reception readings (M, R, Y, G) of the Gateway at various locations.
Site survey results display as a percentage. M represents the percent of missed packets while R, Y, and G represent the percent of received packets at a given signal strength.
M = Percent of missed packets; R = RED marginal signal; Y = YELLOW good signal; G = GREEN excellent signal. Record the results if you need troubleshooting assistance from the factory.
7. Change the Gateway's right rotary dial to conduct a Site Survey with another Node and repeat steps 2 through 6.
8. To end the Site Survey, double-click button 2.
9. Change the Gateway's right rotary dial back to 0.
The LCD displays the device readings for the Gateway.
10. Double-click button 2 to move back to the top level menu.
11. Single-click button 1 to return to RUN mode.
12. Install the rotary dial access cover, referring to the Installation section of the manual to create an IP67 seal.

Interpreting the Site Survey Results

Site Survey results are listed as a percentage of data packets received and indicate the signal strength of the received signal.

	Result	Description
	Green	Packets received at a strong signal strength. A strong signal strength is greater than -90 dBm at the receiver.
	Yellow	Packets received at a good signal strength. A good signal is between -90 and -100 dBm at the receiver.
	Red	Packets received at a weak signal strength. A weak signal is less than -100 dBm at the receiver.
	Missed	Packets not received on the first transmission and requiring a retry.

Judging if the reliability of a network's signal meets the needs of the application is not just a matter of green, yellow, and red packets received. In normal operating mode, when data packets are not received, the transmitter re-sends the packet until all data is received.

For slow monitoring applications such as a tank farm, where data is required in terms of seconds or minutes, receiving most of the data in the 'red' range, indicating a weak but reliable signal, transmits enough data for accurate monitoring. Nodes positioned near the outside range of the radio signal may have 90% of the data packets received in the red zone, again indicating a weak, but reliable signal.



We recommend keeping the missed packets average to less than 25%. When the network misses more than 25% of the data packets, the signal is usually too unreliable or obstacles may be interfering with the signal. When Site Survey reports the missed packets are 25% or higher, improve the radio system performance by:

- **Mounting** the network's antennas higher to clear obstacles in the area and improve the line of sight between Sure Cross® devices
- Using higher gain antennas to focus the energy of the radio signal in a specific direction and extend the signal's range
- Adding data radios to the network to extend the range of a radio network. For more information on data radios, please refer to Banner's white paper on range extension on www.bannerengineering.com/wireless.

Conduct a Site Survey from a Gateway Board Model

Conducting a Site Survey, also known as an RSSI (Radio Signal Strength Indication), analyzes the radio communications link between the Gateway and any Node within the network by analyzing the radio signal strength of received data packets and reporting the number of missed packets that required a retry.

Perform a Site Survey before permanently installing the radio network to ensure reliable communication. Only the Gateway can initiate a Site Survey, and the Site Survey analyzes the radio communications link with one Node at a time. Follow these steps to conduct a Site Survey from the board module Gateway.

1. Set the Gateway's rotary dials to the Node address you'd like to conduct a Site Survey with.
For example, to analyze the signal strength between this Gateway and Node 02, rotate the left rotary dial to 0 and the right rotary dial to 2.
The Site Survey automatically begins running. If there is no device at address 02, the LED is solid red. If there is a device at address 02, the LED flashes amber.
2. Evaluate the signal strength. The amber LED flashes at specific rates to indicate the Site Survey results. Each signal strength represents the majority of the data packets being received at that signal strength. For example, a strong signal strength indicates the majority of the data packets were received at a strong signal, but a few may have been received at a good or weak signal strength.
 - Eight flashes per second: Very strong signal strength
 - Four flashes per second: Strong signal strength
 - Two flashes per second: Good signal strength
 - One flash per second: Weak signal strength
 - Solid amber LED: No radio communication detected
3. To exit the Site Survey, set the Gateway's rotary dials to 00. Otherwise, after 15 minutes the Gateway automatically exits Site Survey mode.
The LED flashes green to indicate the Gateway is in standard operating mode.

Improving Your Site Survey Results

Refer to the Sure Cross Installation Guide (p/n [151514](#)) for installation details and tips and tricks for improving your radio network's performance.

If your Site Survey results have more yellow than green, consider replacing the Node's antenna with one the following:

- Use a 2 dBi Omni dome antenna (model BWA-902-D) or a 5 dBi Omni antenna (model BWA-905-C)
- Use a 6 dBi Yagi (directional) antenna (model BWA-9Y6-A)

If the distance between devices is greater than 5,000 meters (3 miles) line-of-sight or objects, such as trees or man-made obstructions, interfere with the path, and the MISSED packet count exceeds 25 per 100 packets, consider the following steps:

- Install the antenna(s) remotely at a higher position (requires an antenna extension cable);
- Use a higher gain antenna;
- Decrease the distance between devices; or
- Use data radios to extend the position of the Gateway relative to the host system.

Performance Levels

Referenced omni-directional and directional antennas are listed at the end of this section.

Very strong signal strength is 100 green signals (displayed on the LCD) or eight flashes per second (models without LCDs). If the included 2 dBi OMNI antenna does not achieve this signal strength, use a different omni antenna, such as the 2 dBi dome antenna (same gain, different form factor) or 5 dBi antenna (higher gain). You may also use a low-gain directional antenna, such as the 6.5 dBd Yagi antenna.

Strong signal strength is represented by some green signals and some yellow signals (very few red signals and very few missed signals) or four flashes per second. To improve your radio performance, consider using a different omni antenna, such as the 2 dBi dome antenna, 5 dBi antenna, 6 dBi antenna, or 8 dBi antenna. You may also use a low-gain directional antenna, such as the 6.5 dBd Yagi antenna. We also recommend installing the antenna(s) remotely at a higher position. Additional antenna cables are available from Banner Engineering if needed.

Good or weak signal strength equals some yellow signals and a majority of red signals (very few green signals, a small number of yellow signals, and a small to medium number of missed signals) or one to two flashes per second. To improve your radio performance, consider using one of the 6 dBi or 8 dBi omni-directional antennas or the 10 dBd directional antenna. We also recommend installing the antenna(s) remotely at a higher position. Additional antenna cables are available from Banner Engineering if needed.

No radio **communication** is when more than 50% of the radio signals are missed or a solid amber LED. To improve radio performance, use a 8 dBi omni-direction antenna or a 10 dBd directional antenna and elevate the antenna above any obstructions. The lack of signals may also be due to the distance between the Gateway (master radio) and Nodes (remote radio). If this is the case, please contact Banner Engineering for further assistance. We also recommend installing the antenna(s) remotely at a higher position. Additional antenna cables are available from Banner Engineering if needed.

Omni-Directional (Omni) Antennas

BWA-9O2-D (2 dBi OMNI antenna, dome style)—For applications where a durable antenna is needed external to the radio enclosure.

BWA-9O5-C (5 dBi OMNI antenna with RP-SMA connector)—Antenna for medium antenna performance increase or to elevate the antenna above obstacles such as buildings or tall crops. We recommend using one of the following LMR200 extension cables (RP-SMA to RP-SMA):

- BWC-2MRSFRS3 (3 meters long)
- BWC-2MRSFRS6 (6 meters long)
- BWC-2MRSFRS9 (9 meters long)
- BWC-2MRSFRS12 (12 meters long)

BWA-9O6-AS (6 dBi OMNI antenna with Type N cable connector)— Antenna for strong antenna performance increase. Requires a RP-SMA to Type N converter cable (BWC-1MRSMN05). May require one of the following antenna extension cables:

- BWC-4MNFN3 (3 meters long)
- BWC-4MNFN6 (6 meters long)
- BWC-4MNFN15 (15 meters long)
- BWC-4MNFN30 (30 meters long)

Requires a surge suppression device (model BWC-LFNBMN-DC) if the antenna is external to a building, connected to other electronics, or elevated.

BWA-9O8-AS (8 dBi OMNI antenna with Type N cable connector)—Antenna for very strong antenna performance increase. Requires a RP-SMA to Type N converter cable (model BWC-1MRSMN05). May require one of the following antenna extension cables:

- BWC-4MNFN3 (3 meters long)
- BWC-4MNFN6 (6 meters long)
- BWC-4MNFN15 (15 meters long)
- BWC-4MNFN30 (30 meters long)

Requires a surge suppression device (model BWC-LFNBMN-DC) if the antenna is external to a building, connected to other electronics, or elevated.

Directional (Yagi) Antennas

BWA-9Y6-A (6.5 dBd YAGI antenna with Type N cable connector)—Antenna for strong, directional antenna performance. Requires a RP-SMA to Type N converter cable (model BWC-1MRSMN05). May require one of the following antenna extension cables:

- BWC-4MNFN3 (3 meters long)
- BWC-4MNFN6 (6 meters long)
- BWC-4MNFN15 (15 meters long)
- BWC-4MNFN30 (30 meters long)

Requires a surge suppression device (model BWC-LFNBMN-DC) if the antenna is external to a building, connected to other electronics, or elevated.

BWA-9Y10-A (10 dBd YAGI antenna with Type N cable connector)—Antenna for very strong, directional antenna performance increase. Requires a RP-SMA to Type N converter cable (model BWC-1MRSMN05). May requires one of the following antenna extension cables:

- BWC-4MNFN3 (3 meters long)
- BWC-4MNFN6 (6 meters long)
- BWC-4MNFN15 (15 meters long)
- BWC-4MNFN30 (30 meters long)

Requires a surge suppression device (model BWC-LFNBMN-DC) if the antenna is external to a building, connected to other electronics, or elevated.

Improving Your Site Survey Results within a **MultiHop** Network

In addition to the information in [Improving Your Site Survey Results](#) on page 2, here are some tip and tricks for MultiHop radio networks.

If a repeater radio is available in the network but is not being used, enable the forced routing function on the radio with a weak signal to force it to use a nearby radio with a stronger signal strength. Reference the Banner Engineering document titled *Forced Routing Method* for more information.

If you cannot use forced routing or add a repeater radio to the network, use a 8 dBi omni-direction antenna or a 10 dBd directional antenna.

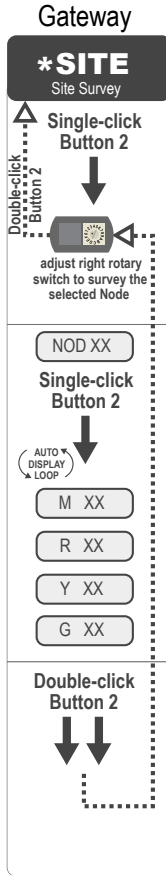
We also recommend raising the radio units to a higher elevation, either by physically moving the devices or installing the antenna(s) remotely at a higher position. Additional antenna cables are available from Banner Engineering if needed.

The absent of signals may also be due to the distance between the master (main) and slave (remote) radios. If this is the case, please contact Banner Engineering for further assistance.

Additional Information

SITE (Site Survey) Menu

The SITE menu displays the results of a Site Survey conducted with this Gateway.



The SITE menu displays the device number of the Node the Site Survey was conducted with as well as the missed, green, yellow, and red received packet count.

The SITE menu is only available on the Gateways.

To access the SITE menu, single-click button 1 to scroll across the menu levels until reaching the Site Survey (SITE) menu.

See [Conduct a Site Survey Using the Menu System](#) on page 1.

See [Interpreting the Site Survey Results](#) on page 1.

Conduct a Site Survey Using Modbus Commands

Use Modbus commands sent from the host system to start a Site Survey.

To start a Site Survey using a Modbus write holding register command, send a control code of 32 (0x20) and the Node number 1 through 15 (0x01 to 0x0F) to the Gateway Modbus holding register for I/O 15.

		Modbus Register	
		[15:8]	[7:0]
I/O 15		Control Code	Data Field

I/O 15 Control Messages			
Control Code	Data Field	Restrictions	Description
32	Node # 1-15	Gateway only	Enable Site Survey between Gateway and Node defined by the data field. All error messages from the Gateway are ignored when running Site Survey. Only one Node can participate in Site Survey at a time. To disable the Site Survey, use control code 0x20 with Node 0. A Node must be enabled to run the Site Survey, then disabled before selecting the next Node.

Example Command

Modbus Register		
I/O 15	32	02

When Site Survey runs, the accumulated results are stored in the Gateway's I/O 7 and I/O 8 holding registers. The LEDs on the both the Gateway and the Node's front panel display the signal strength for the wireless RF link. The quality of the communications link is indicated by:

- Green LED = excellent signal strength
- Amber LED = good signal strength
- Red LED = poor signal strength

The signal strength is the transmitted signal strength relative to the ambient RF signal present in a specific location, or noise floor.

The Gateway also displays the Site Survey results on the LCD (for models with an LCD). For one transmit and receive interval, the Gateway saves the lowest signal strength. The LCD and Modbus registers contain the results of the last 100 samples. The totals are a running tally of the last 100 samples and are continuously updated. Four categories are displayed:

- G (green) = excellent signal strength
- Y (yellow) = good signal strength
- R (red) = poor signal strength
- M = Missed packet

To disable Site Survey, send control code 32 (0x20) and Node number 0 (0x0).

Site Survey Data Holding

With Site Survey active, registers I/O 7 and 8 are Site Survey data holding registers that store the accumulated Site Survey results. Error collections in holding register 8 are saved when Site Survey runs and restored after Site Survey is disabled.

	Register			Example Results	
	[15:8]	[7:0]		[15:8]	[7:0]
I/O 7	Red Total	Missed Total	I/O 7	10	0
I/O 8	Green Total	Yellow Total	I/O 8	80	10



Note: This is the current register arrangement when using Modbus/TCP or Modbus RTU. In some older models, the Modbus/TCP registers are reversed (missed and yellow totals are in [8:15], red and green totals are in [0:7]).