

# Conducting a Site Survey and Interpreting the Results



## Conducting a Site Survey (Gateway and Nodes)

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. 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.

## Conducting a Site Survey Using the Menu System

Follow these steps to 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. Note that the numbers displayed are a percentage. M displays the percent of missed packets while R, Y, and G display the percentage of received packets at a given signal strength.  
M = Percentage 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.

## Conducting a Site Survey Using Modbus Commands

A Site Survey can be started using Modbus commands sent from the host system.

All DX80 models reserve the Modbus register I/O 15 (write only) for control messages. The control message code for the Site Survey command is listed below.

To start a Site Survey using a Modbus write holding register command, send a control code of 32 (0x20) and the Node number 1–15 (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 any given 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:

- LED 1 – Green = excellent signal strength
- LED 2 – Yellow = good signal strength
- LED 1 – Red = 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 device also displays the Site Survey results on the 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 a control code of 32 (0x20) and a Node number of 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	
	[15:8]	[7:0]
I/O 7	Red Total	Missed Total
I/O 8	Green Total	Yellow Total


**Example Results**




	[15:8]	[7:0]
I/O 7	10	0
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]).

**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.

	Result	Description
	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 simply 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. A good rule of thumb is to keep the missed packets average to less than 40%. When the network misses more than 40% 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 40% or higher, improve the radio system performance by:

- Mounting the network’s antennas higher,
- Using higher gain antennas, or
- Adding data radios to the network.

Mounting the devices’ antennas higher allows the radio signal to clear obstacles in the area and improves the line of sight between SureCross™ devices. Higher gain antennas will focus the energy of the radio signal in a specific direction and extend the signal’s range. Using data radios is another option to consider when trying to extend the range of a radio network. For more information on data radios, please refer to Banner’s white paper on range extension.

## Site Survey Troubleshooting

Some tips and tricks about improving radio signal reception may improve the site survey results.

Problem	Solution
Marginal Site Survey (RSSI) Results	<p>If the distance between devices is greater than about 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 40 per 100 packets, consider the following steps:</p> <ul style="list-style-type: none"> <li>• Raise the DX80 units to a higher elevation, either by physically moving the devices or installing the antenna(s) remotely at a higher position.</li> <li>• Use high-gain antenna(s) such as Yagi and/or Omni (see Accessories).</li> <li>• Decrease the distance between devices.</li> <li>• Use data radios to extend the position of the Gateway relative to the host system.</li> </ul>