RF by SENSONIX

DX80 Gateway Installation & Operation Manual

Features

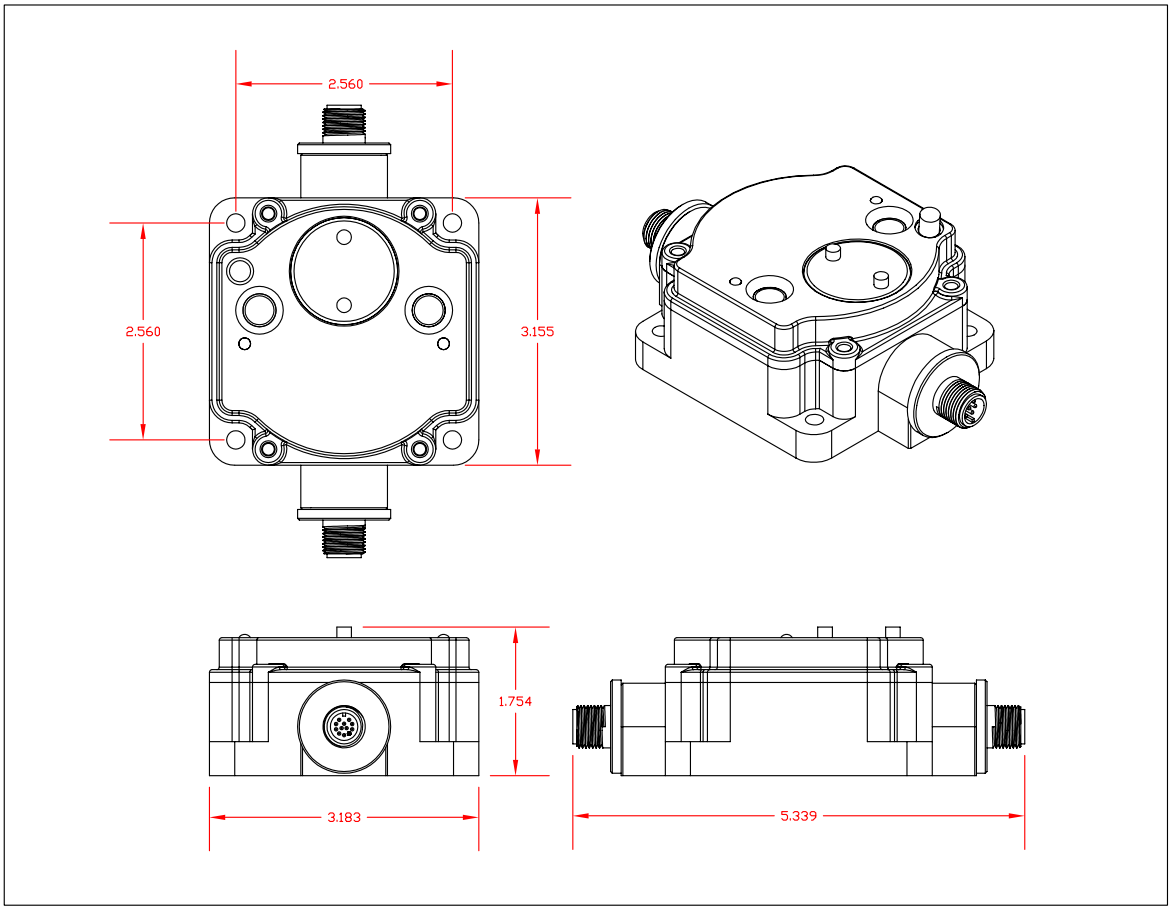
- Operates in 902-928MHz ISM Spectrum
- FHSS operation
- RF configurations – up to 150 mw
- External antenna connection
- RS232 / RS485
- 2 Analog In (4-20ma)
- 2 Analog Out (4-20ma)
- 2 Digital In
- 2 Digital Out
- 10-30v DC
- LCD, Control buttons, LED indicators
- Stand alone operation
- DX80 - NEMA 6, IP67 enclosure

The gateway and endpoint nodes communicate over multiple wireless channels within the 902-928MHz ISM Spectrum. Different configurations of internal & external antennas and different RF power options allow you to customize the wireless range from a few feet to > 10000'. The implementation of FHSS methodology allows for reliable communications even in harsh industrial environments. The gateway station and endpoint nodes communicate with acknowledge handshaking to verify reception of data. Error checking is also performed to validate the data transmission.

The Gateway and Endpoint node communications always collect signal strength information. The collected data can help gauge the strength and performance of the wireless signals. The received signal strength can be adjusted by various parameters such as the TX power settings and Receiver Sensitivity Modes. Hardware configurations can also impact the signal strength, such as internal / external antenna and antenna placement.

1 Mechanical

Low Profile DX80 enclosure, a two connector model is shown. A DX80 gateway unit in a single connector model is also available

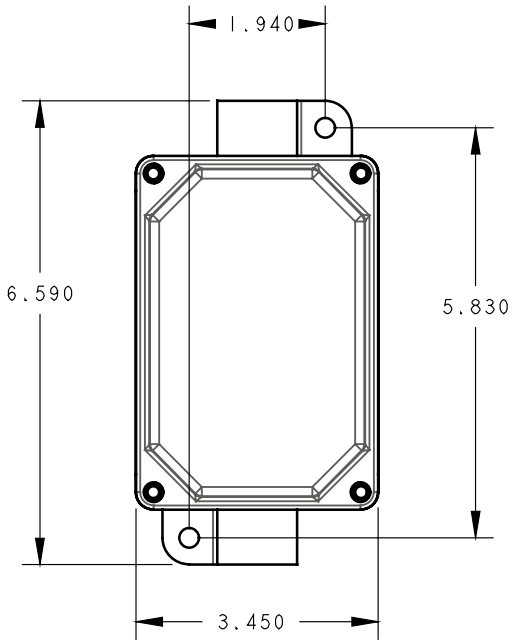


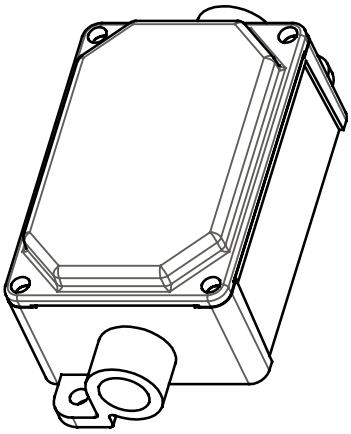
All DX80 mechanical enclosures

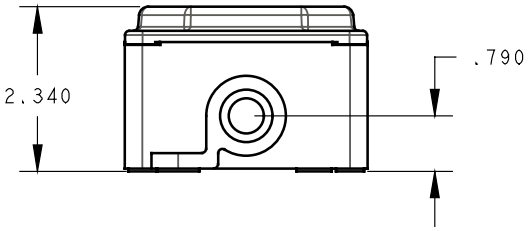
Model #	Description	Euro Connectors	High Profile	Low Profile
LPGW1	Line Powered Gateway	1 female, 1 male		X
LPGW2	Line Powered Gateway	1 male, 8 pin		X
LPEN1	Line Powered Endpoint Node	1 female, 1 male		X
BPDEN1	Battery Powered Endpoint Node	1 male, 8 pin	X	
BPMIEN1	Battery Powered Endpoint Node	1 female connector	X	
BPTMPEN1	Battery, RTD Endpoint Node	2 female connectors	X	
BPTMPEN2	Battery, Thermocouple Endpoint Node	1 female connector	X	
BPMG1	Battery, Magnetic Endpoint Node	No connectors	X	

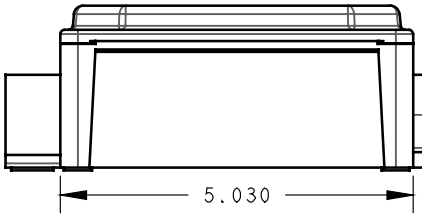
Junction Box

Junction box models – euro connectors, glands,
Euro-style connector or glands?
Mounting holes
Wiring diagram
PC Board with Terminals to identify connection.









2 Mounting & Electrical Connections

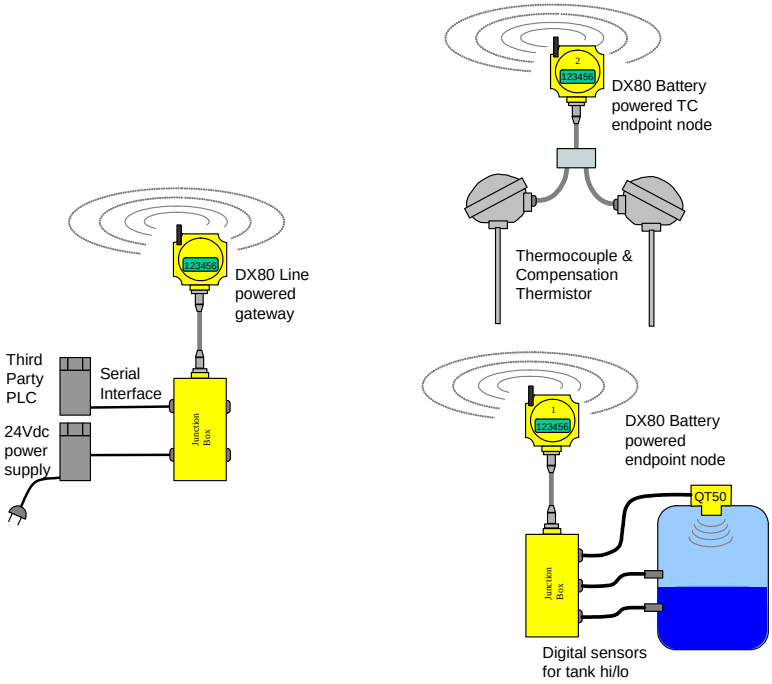
2.1 Placement

A wireless network can be hindered by radio interference as well has obstructions in the path of the receiver and transmitter. When planning for the best location to install the wireless gateway or endpoint node, it is best to be able to monitor the signal strength relative to the positions of the devices. A built in diagnostic called 'site survey' continuously monitors signal strength and displays the information on the gateway front panel LCD. Use this diagnostic tool to confirm signal quality before fixing devices for permanent installation. (Refer to the section on Front Panel Operation.)

Avoid placement of the wireless units in extreme temperatures, high vibration and high shock areas. The DX80 is IP67 compliant and designed for all types of environments but continued exposure to harsh environments will shorten the product life.

Although the DX80 devices are considered maintenance free, try to avoid installation in an unserviceable location.

Only place the DX80 devices in ambient operating temperatures of -40°C to 85°C.



2.2 External Antenna

For optimal RF communications the external antenna should be vertically mounted. A clear line of sight between gateway and nodes is ideal.

Only Banner approved external antenna should be connected to DX80 devices. Unsuitable antenna may void the user's authority to operate the equipment. The approved antennas are listed in the accessory section.

2.3 Mounting hardware requirements

DX80 devices have four #10 screw holes used for mounting the device vertically or horizontally. The screws should not be tightened more that XX ft/lbs.

Keep in mind sufficient clearances for the external antenna, euro-style connectors and for viewing the LCD display. The bottom unit dimensions are supplied in the mechanical section of this document.

2.4 Mounting accessories

DIN rail mounting hardware

Antenna mounting hardware, cables

2.5 Euro-Style Connectors

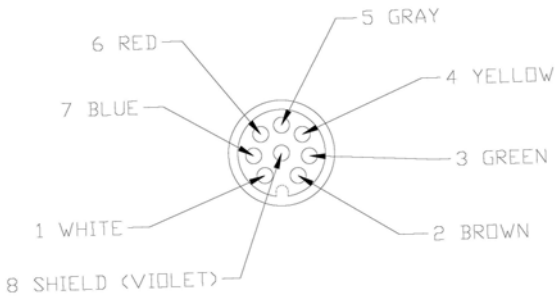
The Gateway devices have 8-pin or 12-pin euro-style connectors. The pin numbering and wire color is identified below. The signal wire to pin number association table identifies all wires for the DX80 Gateway.

2.5.1 8-pin Euro-Style Wiring (models LPGW2, BPDEN1)

Signal to pin association for 8-pin Euro-Style connectors. DX80 Gateway models

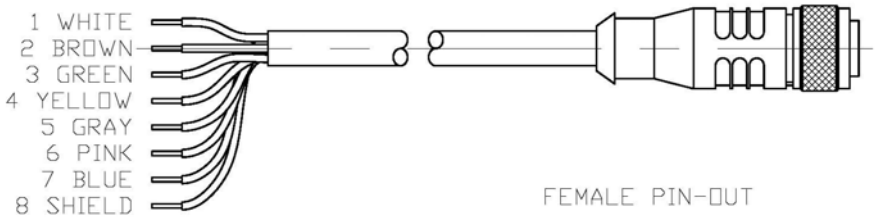
Euro-Style Connector			**LPGW2 –** Line Powered Gateway
Internal Wire Color	***Cable Wire Color***	***Pin #***	***Euro QD1 male***
White	White	1	
Brown	**Brown**	**2**	**10-30Vdc**
Green	Green	3	Digital Input
Yellow	Yellow	4	Courtesy Ground
Gray	Gray	5	NMOS Output
Red	Pink	6	
Blue	**Blue**	**7**	**Ground**
Violet	wire	8	Shield

DX80 internal 8-pin Euro Style Connector

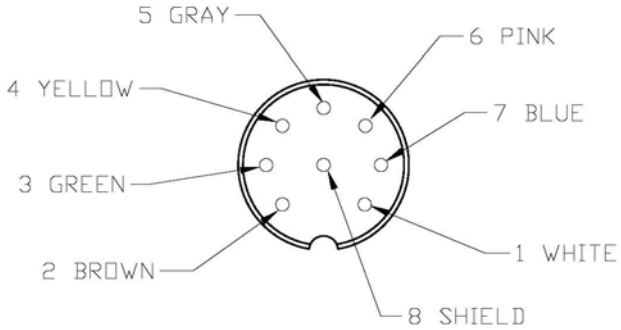


* Looking at the pin end

8-Pin Euro-Style Cable



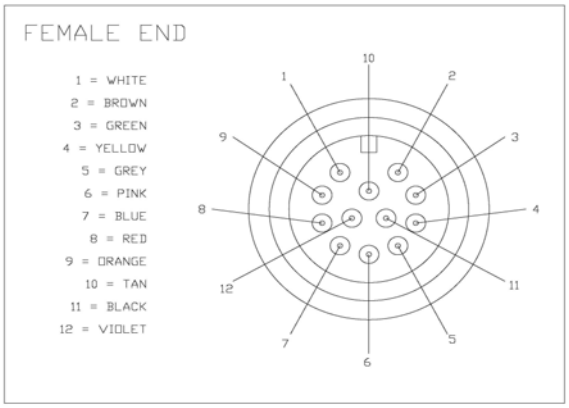
FEMALE PIN-OUT



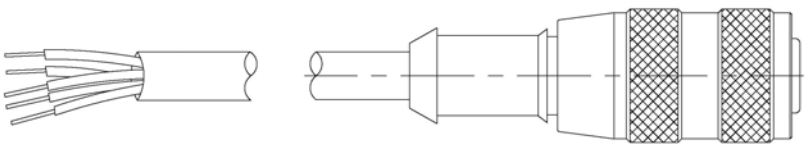
2.5.2 12-pin Euro-Style Wiring

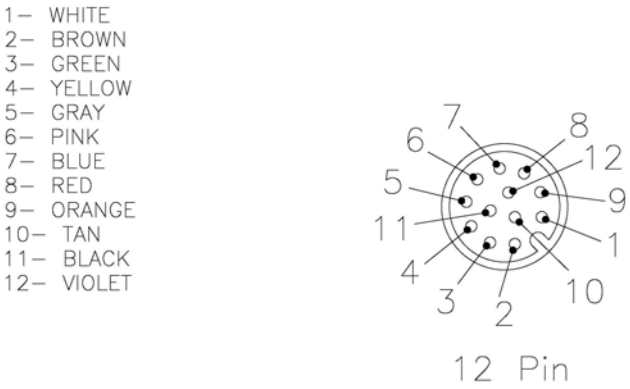
Signal to pin association for 12-pin Euro-Style connectors. DX80 Gateway models

Euro-Style Connector			**LPGW1 –** Line Powered Gateway	
Internal Wire Color	***Cable Wire Color***	***Pin #***	***Euro QD1 female***	***Euro QD2 male***
White	White	1		-
Brown	**Brown**	**2**	**10-30Vdc Output**	**10-30Vdc Input**
Green	Green	3	Analog In1 (4-20mA)	RS485 -
Yellow	Yellow	4	Analog Out1 (4-20mA)	RS485 +
Grey	Grey	5	Analog In2 (4-20mA)	RS485 Signal Gnd
White/Red	Pink	6	Analog Out2 (4-20mA)	-
Blue	**Blue**	**7**	**Ground**	**Ground**
Red	Red	8	-	RS232Tx
Orange	Orange	9	Digital In1	RS232Rx
White/Black	Tan	10	Digital Out1	-
Black	Black	11	Digital In2	-
Violet	Violet	12	Digital Out 2	-



Looking at the connection pin end





2.6 ModBus Communications, RS232 / 485 (model LPGW1)

The gateway interface is controlled using the Modbus RTU protocol. The gateway device operates as a Modbus slave device with a programmable slave address in the range of 01-99. The serial interface is set up with factory default parameters of 19.2k baud, one start bit, two stop bits, no flow control and a slave address of '01'.

The following Modbus function codes are supported. For DX80 configuration commands and DX80 user commands refer to the *DX80 Interface Protocol document.*

Type	Function Code		Description
Modbus Cmd	1	0x1	Read Coils, 1 – 2000 contiguous status of coils
Modbus Cmd	2	0x2	Read Discrete Inputs, 1 – 2000 contiguous status of discrete inputs
Modbus Cmd	3	0x3	Read Holding Registers, 1 – 125, contiguous block of holding regs.
Modbus Cmd	4	0x4	Read Input Registers, 1 – 125, contiguous block of input registers
Modbus Cmd	5	0x5	Write Single Coil
Modbus Cmd	6	0x6	Write Single Register
Modbus Cmd	15	0xF	Write Multiple Coils, 1 – 0x7B0 force multiple coils, ON or OFF
Modbus Cmd	16	0x10	Write Multiple Registers, 1 – 0x78, contiguous block of registers

The gateway front panel LED's are used to display information about the Modbus serial communications.

LED1

- 'GREEN' when power is applied and the gateway is operational.
- 'RED' indicates a system error has occurred. Review the LCD display for further information.

LED2

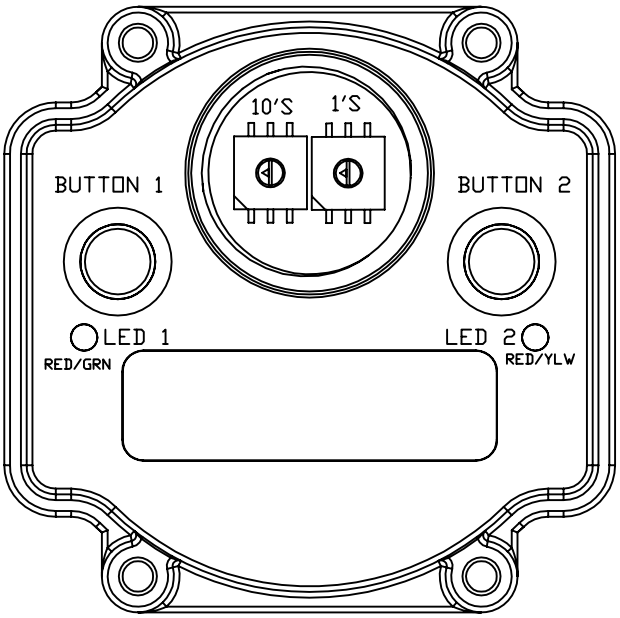
- 'YELLOW' signifies a frame reception or sending.
- 'RED' signals an internal Modbus error has occurred.
- Flashing 'RED' indicates a communications fault or configuration error.

The RS485 connections are on the 12-pin euro-style male connector QD2 on the gateway. See the Euro Connector Diagram section in this manual

3 Setup & Operation

3.1 DX80 Front Panel

The DX80 front panel picture helps identify each switch, button and LED. The rotary switches in the middle of the round window are identified as a 10's switch (left switch) and a 1's switch (right switch). The value for each rotary switch is 0 – 9.



The rotary switches define different parameters depending upon the current operating state and whether the device is a gateway or node.

During Run Mode the gateway rotary switches define the device information to display; the node switches indicate the node ID number.

During configuration of the Network ID, the rotary switches indicate the network ID number on both the gateway and the node.

During configuration of the Modbus slave number the gateway rotary switches indicate the Modbus slave number 01-99.

During Site Survey operations the gateway switches define the node ID number; the node rotary switches define the node ID number.

The gateway front panel LED's are used to display information about the Modbus serial communications

LED1

- 'GREEN' when power is applied and the gateway is operational.
- 'RED' indicates a system error has occurred. Review the LCD display for further information.

LED2

- 'YELLOW' signifies a frame reception or sending.
- 'RED' signals an internal Modbus error has occurred.
- Flashing 'RED' indicates a communications fault or configuration error.

The gateway LCD panel will display a variety of information about the gateway and wireless system.

3.2 Power on / Power Off

The gateway and nodes can be powered up or powered down with button 1. When the device is powered down (sleep mode), depress button 1 for 2-3 seconds, the device will activate. Holding down button1 for 2-3 seconds when the device is active will cause the device to power off. The wireless devices are not operational when in Sleep Mode.

3.3 Set-up / Configuration

The gateway and nodes must be configured to create a communications link. A properly running wireless network will be indicated on each endpoint node by LED1 flashing green every second. (The gateway LED's monitor the Modbus host link)

Complete the following configuration steps to set up the wireless link.

DC power or Battery power applied to all devices and powered up. (out of sleep mode) (See 4.2 Power on / Power off)

Gateway Set-up –

- Rotary switches = '00'
- Network ID set to a common value for the entire wireless network. The factory default is '01' and will work for most single network installations. (See Setting the Network ID to change the network ID)
- The Modbus slave number must be set to a unique number compared to other slaves on the serial host bus. This is only required if using a host interface with the gateway.

Node / Endpoint Set-up –

- Rotary switches = unique number for each node in the wireless network. 01-99, 00 is not valid
- LED1 will blink GREEN every second when a RF communications link is established.
- LED1 will blink RED every 3 seconds when a node is not communicating with the gateway.

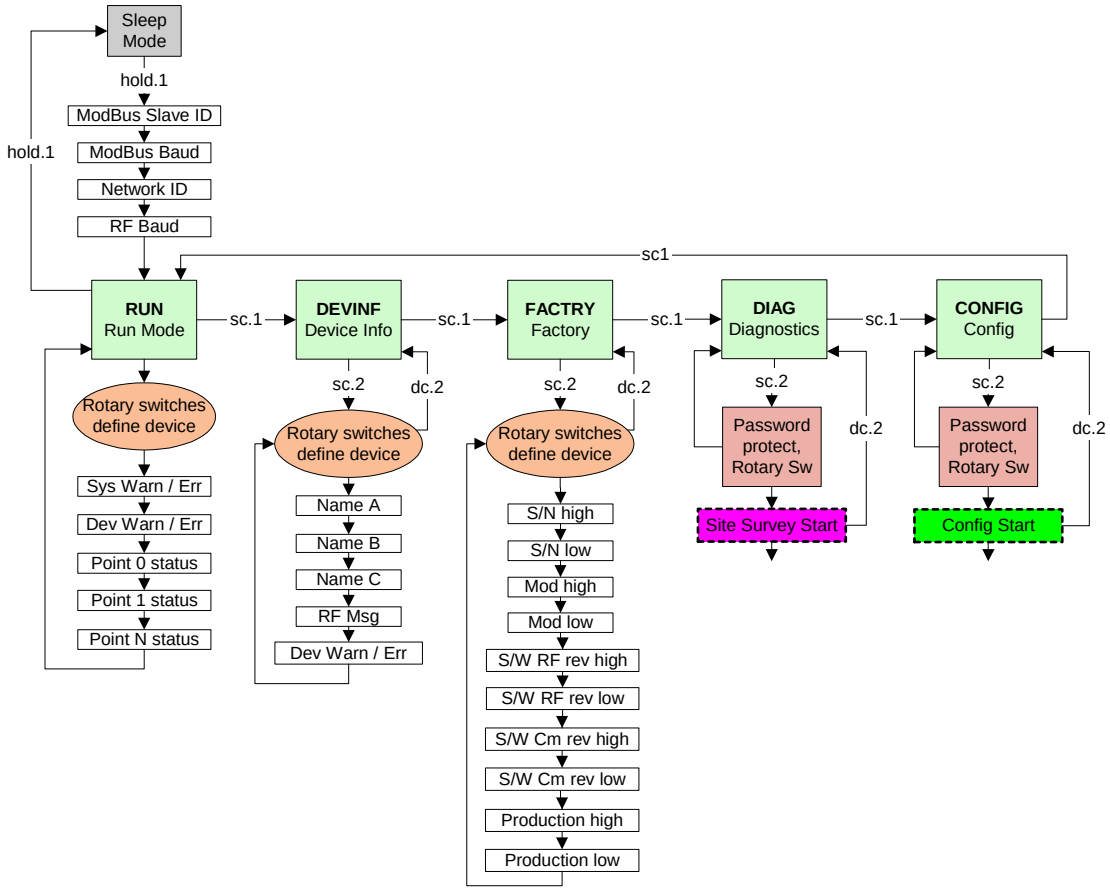
*Some endpoint nodes may require up to 20 seconds after power-on to synchronize with the gateway.

3.4 LabView Configuration

Node configuration, Sensor configuration,
System Parameters – dynamic TDMA

3.5 Front Panel Operation

The front panel rotary switches and push button switches control the display information and configuration of the DX80 devices. The flow diagram below shows the button sequences and operational flow for what is possible with the DX80 Gateway.



hold.1 = press and hold button 1 for 2-3 seconds
sc.1 = single click button 1
sc.2 = single click button 2
dc.2 = double click button 2

From a powered-off state, press and hold button 1 for 2-3 seconds will turn on the Gateway or Node. From any state, press and hold button 1 for 2-3 seconds will turn off the Gateway or Node. Configuration steps not fully completed before going into sleep mode will be lost.

3.5.1 Operating States

Sleep Mode – This is the off state for all devices. Sleep mode can be entered or exited by holding button 1 for 2-3 seconds regardless of the current state. All LED's will be turned off in this state. (The LCD display will be turned off for DX80 devices with an LCD display)

Run Mode – (LCD display = 'RUN') This is the default operating state for normal operation. Out of sleep mode the device will transition into run mode. If no buttons changes are detected the gateway will display device information. The rotary switches on the gateway will define which device information to

display on the LCD. If the rotary switches are set to '04' the information for endpoint node '04 will be displayed. The gateway can only display device information if they are defined with Modbus registers.

The LCD will display any system warnings or errors, any device warnings or errors and the state of each I/O point defined for that device. The LCD display will continuously cycle through this information until the rotary switches change or a button change is detected.

Device Information (LCD display = 'DEVINF') From the Run mode state, single click button 1 to get to the Device Information selection. Single click button 2 will begin displaying the information for the device defined by the rotary switches. The LCD will display 'NAME A', 'NAME B', 'NAME C', RF Message and Device warnings / errors.

The NAME A, B and C fields are a user defined name that can be associated with each device. A total of 18 characters can be used. The name fields can be defined under the CONFIG menu.

The RF message can be one of several informational messages about the RF link between the gateway and node. 'NO RF', 'RF OFF', 'RF SYNC' and 'RF OK' are the RF messages. 'NO RF' indicates there is no communication link between the device defined by the rotary switches and the gateway. 'RF OFF' indicates the device has been disabled. 'RF SYNC' indicates that the node and the gateway are in the process of trying to synchronize communications. All devices should synchronize within 20 seconds of being enabled. 'RF OK' indicates the wireless communications between the gateway and node are operating normally.

The device warnings and error messages displayed will be for the device defined by the rotary switches. See the 'Warnings & Error Messages' section for full explanations of each message.

To exit the device information state, double click button 2

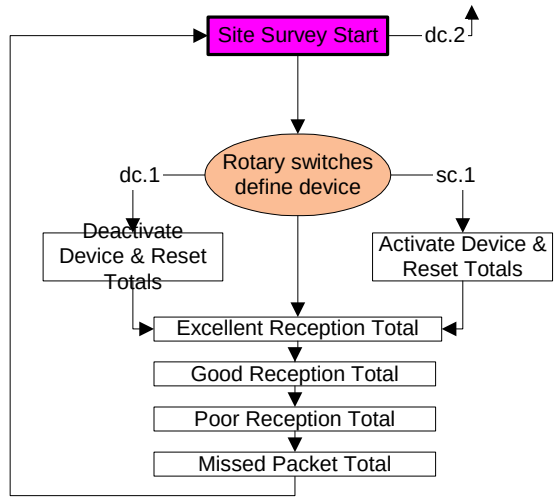
Factory Settings (LCD display = 'FACTRY') From the run mode state, single click button 1 and then single click button 1 again to arrive at the factory settings display. To begin the cycle through the factory information display single click button 2. The display information will include: serial number, model number, software version for the RF processor, software version for the communications processor and the production date.

To exit the factory settings state, double click button 2.

Diagnostics (LCD display = 'DIAG') The diagnostic menu is a password protected area. A 4-digit password must be entered before the system will enter into the diagnostics menus. The default password is '0000'. The password is entered starting at the right most character; use the right rotary switch to enter the proper digit, then single click button 2 to move to the next digit. When all four digits have been properly entered, double click button 2 to enter the site survey diagnostic.

The Site Survey mode can be used to judge the quality of the RF communications link between the gateway and any node. Site Survey mode can only be activated from the gateway menu.

The gateway LED1 and LED2 will alternately blink RED to indicate you are now in Site Survey Start. Now set the rotary switches to a node number to perform the Site Survey testing. Then single click button 1 to activate the node defined by the rotary switches.

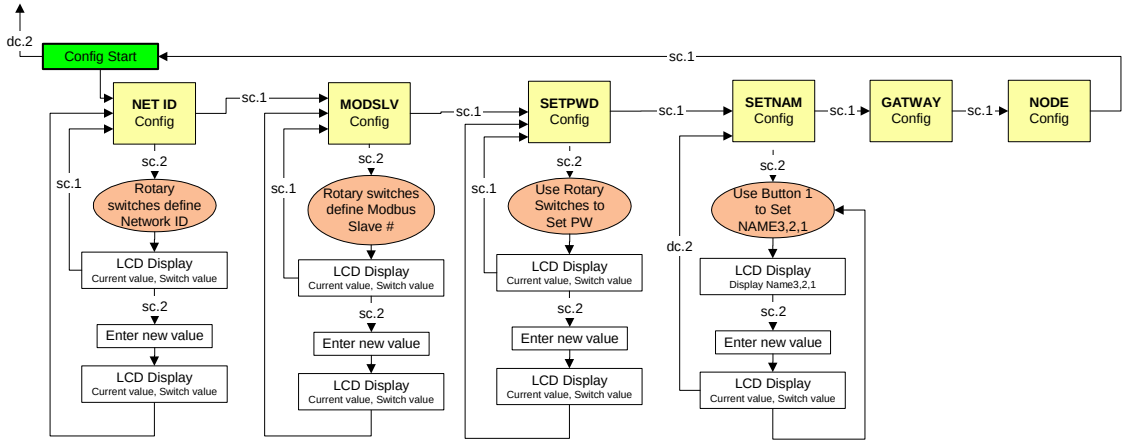


This will cause the LCD on the front panel of both devices (gateway and node) to display the signal strength for the wireless RF link. A group of 100 data packets are sent at different frequencies between the gateway and the node. The LCD display will show the breakdown of total missed packets, total poor reception packets, total good reception packets and the total number of excellent reception packets.

After 100 data packets the whole process is repeated. The LCD display is continually updated with the running totals for each category.

When testing the communication signal link using site survey, make sure to keep all wireless units separated by at least 3 feet.

Configuration (LCD display = 'CONFIG') To set the network ID or Modbus Slave number, from Run Mode single click button 1 until the LCD display reads 'CONFIG', now single clock button 2. The configuration menus are a password protected area. A 4-digit password must be entered before the system will enter into the configuration menus. The default password is '0000'. The password is entered starting at the right most character; use the right rotary switch to enter the proper digit, then single click button 2 to move to the next digit.. Double click button 2 when all four digits have been entered. This will allow access into the configuration menus.



The configuration menu is made up of 4 sub menus: Network ID, Modbus Slave number, Gateway and Node. Select the appropriate sub menu by single clicking button 2.

Configuration: Network ID. The network ID is a parameter used to define the sequence of RF channel hops and used to create a unique network ID that will allow devices to communicate with each other as a wireless network. A wireless network comprised of a gateway and nodes need to be programmed using the same network ID. For co-locating multiple wireless networks within range of each other, choose unique network IDs for each wireless network group. The default Network ID setting from the factory is '01'.

The network ID is set with the rotary switches. The rotary switches are defined as a 10's switch and a 1's switch. For example, if the 10's switch is set to '6' and the 1's switch is set to '2' the resulting value is read as '62'.

From within the configuration menu, single click button 1 until the LCD display reads 'NETID' and then single click button 2. The LCD will display the current value of the Network ID and the rotary switch values. When the rotary switches are set correctly for the new Network ID, enter the new value by a single click of button 2. The LCD will briefly display the new Network ID before exiting back to the Network ID top menu.

If you change the network ID on one device, gateway or node, all devices intended for that wireless network need to be changed to the same network ID.

Double click button 2 to put the device back into Run Mode.

Configuration: Modbus Slave Number. The DX80 gateway can have a Modbus slave address from 1 to 99. Each member of a Modbus RTU serial network must have a unique slave number.

From within the configuration menu, single click button 1 until the LCD display reads 'MODSLV' and then single click button 2. The LCD will display the current value of the Modbus Slave number and the rotary switch values. When the rotary switches are set correctly for the new Modbus Slave number, enter the new value by a single click of button 2. The LCD will briefly display the new Modbus Slave number before exiting back to the Modbus Slave top menu.

Double click button 2 to put the device back into Run Mode.

Set Password: The password is defined as a 4-digit number used to protect the configuration and diagnostic areas of the menu system.

Set Name: A user name can be applied to each device. Up to 16 alphanumeric characters can be stored.

4 Maintenance

The DX80 family of products is designed to be IP67 compliant and maintenance free. Annual cleaning and inspection is always recommended. When inspecting the equipment watch for housing cracks, residue build-up or corrosion on connectors. It is also a good idea to verify the mechanical connections are tight and still in good condition.

5 Trouble shooting

Network setup
A table of all LCD messages

6 Specifications

RS232 / 485 Serial Interface

Interface	RS-232 / RS-485
Baud Rates	19.2k
Data Format	8 data, no parity, 2 stop bit
Protocol	ModBus RTU

Radio Specifications

Range	Configurable – few feet to > 10000’
Frequency	902 – 928 MHZ ISM band
Transmit Power	Variable
Channel Hopping	FHSS – configurable # of channels
Rx Sensitivity	To -110 dBm
Antenna Connector	External Reverse Polarity SMA – 50 ohms

Operating Temperature Range

Electronics	-40C to +85C
LCD	-30C to +70C
LCD reduced visibility	-40C to +85C

Ethernet Interface

Interface	Ethernet 10/100
Connection	RJ-45 / Hardwired

General

Power	10-30V DC
Power Consumption	XX mW
Wiring Connections	Two 12-pin Euro-Style Connectors
Mounting	DX80 enclosure – horizontal or vertical mount.
Dimensions	3.15” x 3.15”
Case Material	ABS, polycarbonate
Weight	
Temperature Ratings	-40 to +85ºC
Approvals	
Environmental Ratings	NEMA 6, IP67
LED Indicators	(2) LED
Switches	(2) Push Button Switches
LCD	6 Character LCD

7 Agency Certifications

7.1 FCC

This device compiles 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 compiles with part 15 of the FCC rules. Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

Antenna usage: This device should be used with the antennas listed on page 17 of this manual. Care should be taken to maintain the minimum separation distances specified between the antenna and nearby persons.

7.2 UL

913
Intrinsically Safe –

7.3 Environmental Rating

NEMA 6
IP67

8 Accessories

Qualified Antennas

Manufacturer	Part Number	Type	Gain	Application	Min. Separation Distance
Nearson	S321AH-915	¼ wave, 3" antenna	0.0 dBi	Fixed / Mobile	20 cm
Nearson	S463AH-915	1/2 wave fixed antenna	2.0 dBi	Fixed / Mobile	20 cm
Nearson	S467AH-915S	1/2 wave Swivel antenna	2.0 dBi	Fixed / Mobile	20 cm

Cables
Mounting Brackets

9 Messages

Endpoint Node

RF link status messages

- RF OK –
- RF Sync –
- RF OFF –
- NO RF –

Warning / Error Messages

LOWBAT – Low battery condition, replace battery.

S FLT – Sensor response is outside of normal operating parameters.

P FLT – Parameter error in processing sensor status.

Gateway

ModBus errors