Golf LINK900

OWNER'S MANUAL

Rev 2.2 December 2024

Contents

1. Introduction

Congratulations on purchasing a Rain Bird® irrigation system with LINK900 advanced wireless communication technology. LINK900 advanced wireless communication technology will provide you with robust communication between your Rain Bird® Golf Central Control MIM-LINK or TWI-LINK interface and field controllers for many years.

The LINK900 system uses custom designed Frequency Hopping Spread Spectrum (FHSS) radios.

- Rapidly hops through 128 frequencies between 902-928 MHz
- Highly resistant to narrowband interference
- Operating range of -40ºF (-40ºC) to 158ºF (70ºC)
- Signal can be repeated from one controller to the next
- Uses Digital technology
- No antenna height restriction in most areas

In early 2024, GE MDS discontinued the "board style" TransNET LINK900 radio that has been in use for many years. The replacement model is the GE MDS TransNEXT Lite radio. This radio is not available in a board style and must be accompanied with a printed circuit board to convert the TTL protocol we are using to RS232. This board is simply called the "PCB" board and is needed when the TransNEXT radio is used at the interface or inside our Golf controllers. It is not needed if the TransNEXT radio is used as a repeater only.

The new TransNEXT radio (and PCB) is fully compatible with the older TransNET radios and can be used to replace any older LINK900 radios or to add new controllers to an existing LINK900 system.

2. Components

Here are the main components needed for a Rain Bird® irrigation system with LINK900 wireless communications:

Central Control:

CirrusPRO™

Interface:

ICI+LINK

LINK900 radios & PCBs:

LINK900 Radio

PCB

PAR+ES (LINK) controllers:

PAR+ES LINK

3. Radio Basics

LINK900 wireless communication works by broadcasting radio waves to communicate between the central control and field controllers. The LINK900 system uses custom designed Frequency Hopping Spread Spectrum radios (FHSS).

Key Advantages:

- No FCC license required for operation in USA.
- No antenna height restriction in most areas (check local regulations)
- Capability to use field controller radios as repeaters to relay the signal
- FHSS is highly resistant to narrowband interference
- FHSS is difficult to intercept
- FHSS can coexist in a frequency band with other broadcasts with minimal interference

Signal strength is measured in decibels (dB). Radios transmit with a certain amount of power (Wattage) and signal reception is subject to loss of strength due to attenuation caused by impedance in the antenna cables, fittings, and the atmosphere itself.

Radio transmission power is related to signal strength in the following manner:

- Reducing the output wattage by half reduces the signal strength by 3dB
- Doubling the output wattage increases the signal strength by 3dB

In Rain Bird® LINK900 wireless communications, no true electronic signal boost is provided after the radios. Antennas can be used to shape or focus more of the transmitted signal energy into the areas targeted. This signal increase is termed as "Gain". An antenna with a "dB gain" value does not provide more power, but rather it modifies the shape of the transmitted signal. The higher the antenna gain, the narrower the useful signal beam width.

a) Antennas:

Rain Bird® LINK900 wireless communications uses two distinct types of vertically polarized antennas. Omni-directional and Directional (also known as Yagi).

Omni-directional:
This is the most common antenna used. Each Rain Bird® Golf LINK900 radio/modem/antenna kit (H59004 & H59008) comes with this type of antenna. Different types of Omni-directional antennas can be used on a LINK900 system.

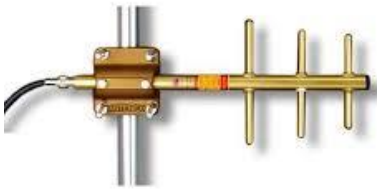
Here are two examples:

Standard PAR+ES Omni "shot glass style" antenna, 3dB (GSP-TRA9023N)

High Gain 48" Omni antenna, 5dB (GSP-ODA-48)

Directional Antenna (Yagi):
The Yagi antenna is typically used to focus the signal towards a single point and to minimize interference to and from other radios.

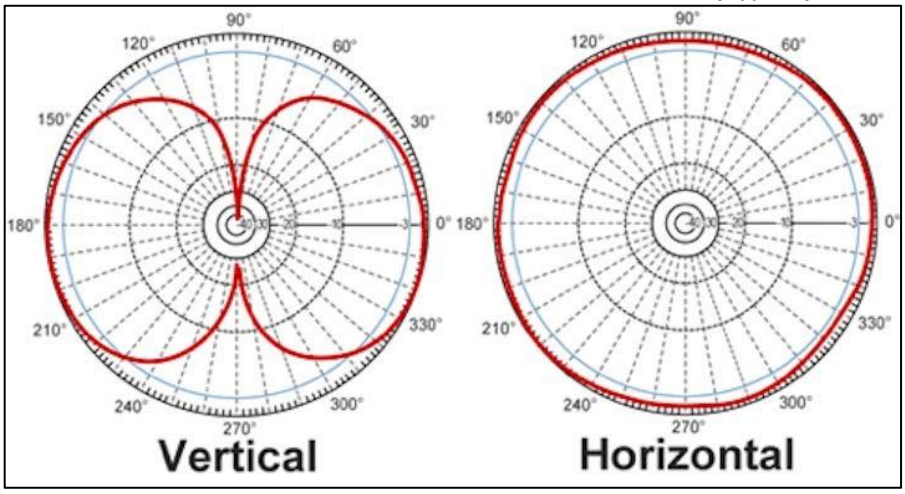
Yagi Antenna, 6dB (GSP-YAGI-6)



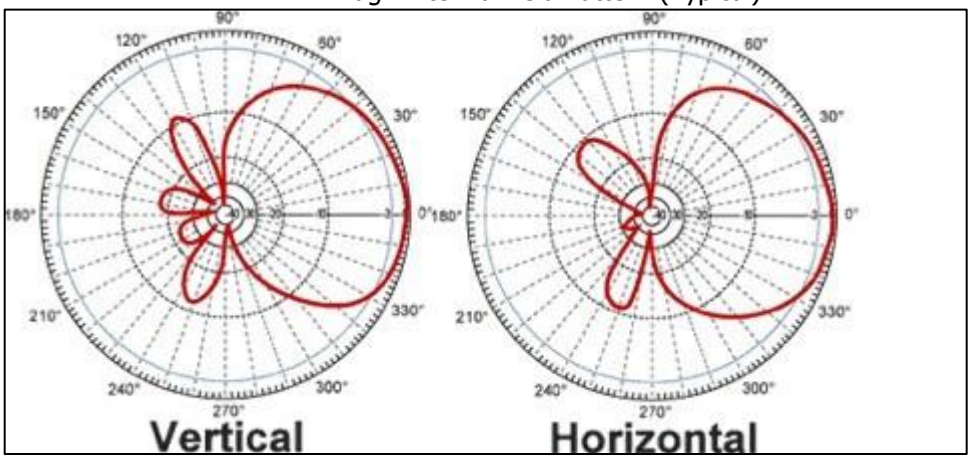
b) Antenna Radiating Patterns:

Each type of antenna has a defined radiating pattern. This indicates how the radio waves are transmitted from and received by the antenna. The following are examples of two common types of patterns; Omni-directional and Yagi.

Omni-directional Antenna Field Pattern (Typical)



Yagi Antenna Field Pattern (Typical)



c) *Antenna Cables:*

Cable selection is very important as too much signal loss can affect the overall communication performance. In general, lower loss cables tend to be larger in diameter and less flexible. LMR type cables are more weather resistant than RG type cables, but RG type cables tend to be much more flexible. Here is a table showing examples of signal loss based on the type of cable:

Cable Type	10 Feet	50 Feet	100 Feet	300 Feet
LMR 400	0.39	1.95	3.9	11.7
LMR 240	0.76	3.8	7.6	22.8
LMR 200	0.99	4.95	9.9	29.7
LMR 195	0.99	4.95	9.9	29.7
RG8X	1.28	6.4	12.8	38.4
RG-58/U	1.65	8.25	16.5	49.5
RG-174	2.79	13.95	27.9	83.7

Only 50 Ohm cable may be used with LINK900 systems. Please note that the frequency being used will also affect the cable loss. Normally, higher frequencies have a higher loss potential. This table is for the 900MHz range of frequencies.

d) *Antenna Cable Connectors*

There are a wide variety of cable terminations available for 50 Ohm antenna cable. Four different cable terminations are common in LINK900 systems: N, TNC, SMA and NMO. Other terminations may also be encountered, especially if custom antennas or other devices are used.

e) Adapters:

In some cases, adapters may be required to accommodate the different antenna and cable terminations used. However, the use of adapters should be minimized, as each adapter causes a signal loss of ~0.25dB. Rain Bird recommends using cables made with the proper connector types to minimize the use of adapters. The LINK900 radio is terminated with an TNC Female connector and requires an TNC Male cable end connection.

Here are some adapter examples:

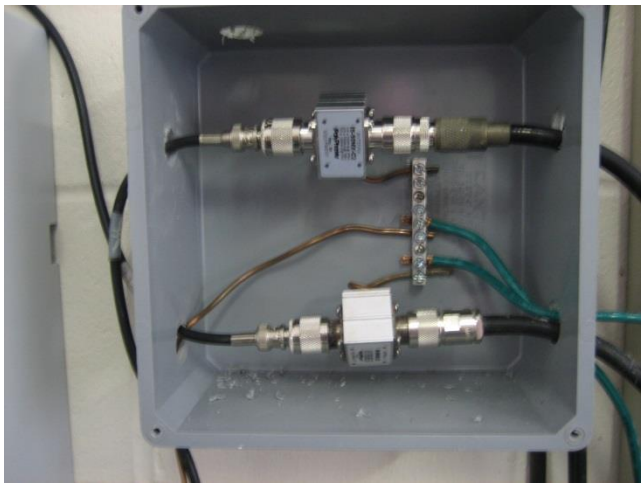
Adapter, TNC Male to N-Female

Barrel Adapter, N-Female to N-Female

e) Surge Protection:

Surge protection should be used on all external antenna installations such as at the ICI+LINK central control interface. There is no need for surge protection at a field controller location if the standard antenna included in the Rain Bird® LINK900 radio/modem/antenna kits (H59004 & H59008) is used. Where used, the surge protection MUST be rated for 900MHz operation and MUST be grounded with a bare copper wire and a ground rod or plate. Rain Bird recommends the Rain Bird® Polyphaser (HA1100) for surge protection of external antenna installations in LINK900 systems.

Rain Bird® Polyphaser (HA1100)
N-Female by N-Female



Two Polyphaser setup with proper grounding

Example of multiple Polyphasers installed on OEM grounding plate

4. Component Setup

Proper installation of all components is key to having a robust system. This section will cover in detail all the steps needed to properly set up LINK900 wireless communication for your Rain Bird® Golf irrigation system.

a) ICI+LINK Interface Connection to Central Control:

The ICI+LINK interface connects to the central control computer via a direct USB connection.

Direct connection instructions:

Connect the ICI+LINK interface to the central computer using the supplied USB cable. The USB B end of the cable goes to the USB connector on the LINK board of the ICI+ (not on the CPU board).

USB Cable

LINK Board

Then slide the USB cable through one of the holes at the bottom of the ICI+ enclosure and connect the other end (USB A connector) to the central control computer.

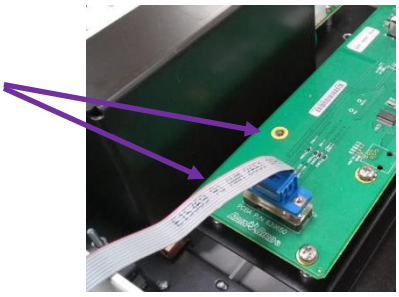
Please note that the maximum length allowed for this direct USB connection is 16 feet.

b) H59001 KIT Installation & Programming:

To install the LINK900 radio/modem kit (H59001) at the ICI+LINK interface:

1- Connect the serial ribbon cable to the LINK board.

2- Remove the two bottom left screws holding the LINK board.



3- Align the PCB mounting bracket holes with the holes on the LINK board and use the same screws to mount the PCB bracket.

4- Connect the other end of serial cable to the PCB.

5- Connect one end of the 4' Ethernet cable to the port labelled "Serial" (top right).

6- The TransNEXT radio is supplied with aluminum mounting brackets. Install them on the radio and then mount the radio on the wall next to the ICI+. Choose a mounting location where the LEDs on the radio are visible for troubleshooting.

7- Slide the other end of the Ethernet cable connected to the PCB through the opening of the steel frame holding the PCB (right above it). Slide the cable down, gently making a 180° turn towards the bottom of the ICI+ enclosure. Then slide the cable through one of the bottom holes of the ICI+ enclosure and connect the other end to the "COM" port of the TransNEXT radio.

8- Connect the antenna cable to the radio using the TNC connection.

9- The TransNEXT radio kit for the ICI+ comes with a 120v power supply. Plug in the power supply and connect the connector to the radio. Ensure that it is pushed in enough for the two orange tabs to lock down.

NOTE: *Always ensure that an antenna is connected to the LINK900 radio before the radio is powered-up, or damage to the radio may occur.*

Programming the Master radio for the ICI+LINK:
The LINK900 radios supplied with H59001, H59004, and H59008 are identical and interchangeable. However, they require different programming depending on the function of the radio. The LINK900 radio located at the ICI+LINK must be programmed as the Master (M) radio.

The TransNEXT LINK900 radios are programmed using the Ethernet cable shipped with the kit. If you do not have a cable with you, you can use the one that is connected to the PCB board or any of the 18" cables that are supplied with H59004 or H59008.

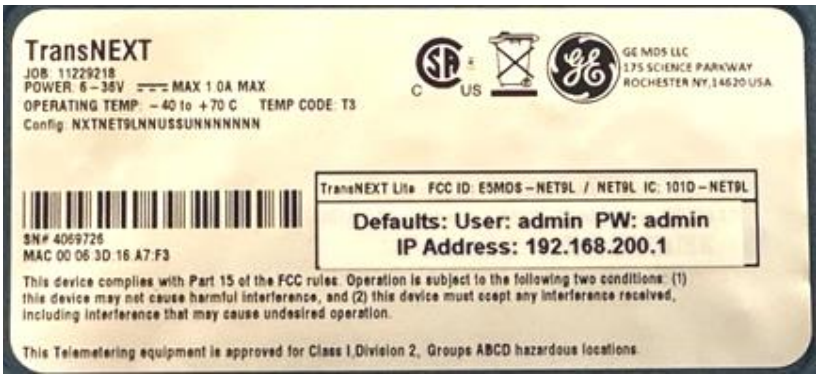
Note that the TransNEXT LINK900 radio must be powered before a connection can be established for programming. The Master radio receives power from its own 120v power supply.

To program the radios, the computer used must be equipped with an Ethernet port. If you are using a laptop that does not have one, you need to use a USB to Ethernet adaptor.

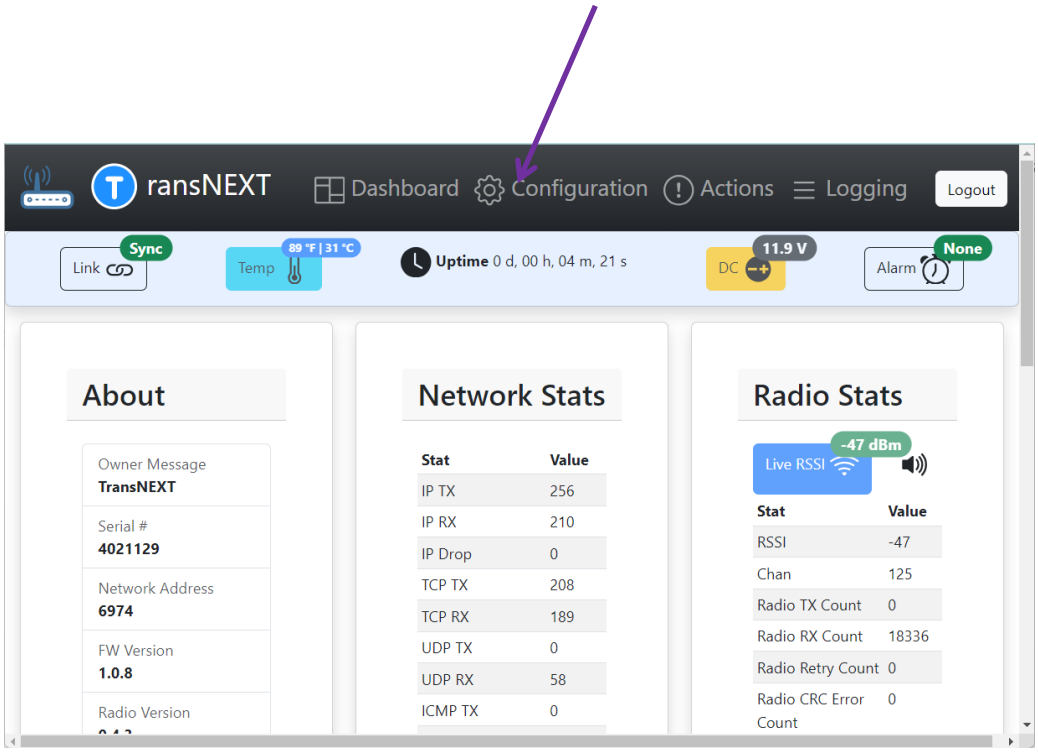
IMPORTANT: *The Ethernet card of your PC must be set to the "192.168.200.xx" architecture. Please see section c) of the Appendix of this document for further details on how to configure your network adaptor.*

Once your network adaptor is configured:

- Connect the Ethernet cable to the "ETH" port of the TransNEXT radio.
- Connect the other end to the Ethernet port of the PC.
- Open your web browser and type in the IP address of the radio in your address bar and hit enter.
    - The IP address of the radio is located on a sticker on top of the radio.
- At the login page, use **"admin"** as the username and **"admin"** as the password. The radio Dashboard should be displayed. Please note that if a radio has been restored to defaults, the password displayed on the back of the radio must be used:



- Select the "Configuration" menu as shown in the image below:



- A page will appear showing all the settings of the radio.

- To change a setting, you simply place your cursor on the setting that needs to be changed and type in the needed value, replacing the existing value.

- For the Master, the settings should look like this:

```
{
  owner: {
    message: "TransNEXT",
    name: ""
  },
  system: {
    mode: "TransNEXT",
    asense: "lo",
    amask: 0xFFFFFFFF
  },
  leds: {
  },
  pushbtn: {
  },
  display: {
    enabled: "off",
    invert: "off",
    show_ip: "on"
  },
  eth: {
    ipaddr: 192.168.200.xxx
    netmask: 255.255.255.0
```

Will vary from one radio to the other.

```
  gateway: 192.168.0.0
},
com1: {
  baud: 600,
  databits: 8,
  parity: "N",
  stopbits: 1,
  rxd: 0,
  cts: 0,
  ctshold: 0,
  device: "dce",
  port: "rs232",
  rtu: "off",
  rtuid: 0
},
radio: {
  power: 30,
  addr: 1129,
  xaddr: 0,
  fec: "off",
  retry: 2,
  repeat: 2,
  saf: "on",
  xpri: 0
  xmap: 0x00000000,
  skip: [0,0,0,0,0,0,0,0],
  unit_addr: 1129,
  mode: "M"
},
ippl: {
  enabled: "off",
  mode: "udp",
  talk_on_vrc: 1,
  listen_to_vrc: 1,
  local_ip_port: 30011,
  ip_peer_addr: 192.168.1.1
  ip_peer_port: 30011,
  connection_timeout: 0,
  keepAlive: "off"
},
dlink: {
  enabled: "off",
  type: "node",
  tcp_access: "off",
  connection_timeout: 0,
  tcp_port: 30020,
  trend_resp_win: 0
},
password: {
  min_chars: 5,
  max_chars: 64,
  min_lower_case: 1,
  min_capital_letters: 0,
  min_numbers: 0,
```

This setting is to change the power of the radio: 10 (low), 20 (medium) or 30 (high). May be required when radios are close to one another.

For a new system, this value should match the "unit addr" value in yellow below.*

This is the Primary address onto which the Master radio broadcasts (should be 0).

Please make sure this value is "on" for the Master.

This value needs to be "M" for Master.

```
    min_non_alpha_numeric: 0,
    permit_username: "off"
  }
}
```

*For existing systems, this value should match the "Network Address" that was used in the existing radios configuration.

- Once these values match, click "Save" on the bottom left of the web page. Your Master radio is programed and ready to be used.

c) H59008 KIT Installation (for Large Plastic Pedestal):

Note: *It may be simpler to program the radios prior to installation. See section e) on page 17.*

To install the H59008 Kit for a PAR+ES (Large Plastic Pedestal):

- Power down the controller.
- Remove the screw located on the left side of the chassis next to the power switch, above the PIB.
- Remove the screw located on the right side of the power switch (the top right screw holding the back plane to the plastic spine of the PAR+ES)
- Mount the PCB on the supplied bracket using the supplied screws
  Note: The screws are bottom mounted
- Mount the PCB and bracket as shown in the picture below using the chassis screws you just removed:

- Remove the faceplate.
- Slide the radio power cable coming from the PCB up through the opening under the faceplate.
- Connect the black flat Ethernet cable to the "Serial" Ethernet port on the PCB.
- Connect the white flat Ethernet cable to the "ETH" port of the PCB.
- Connect the serial ribbon cable to the DB9 connector on the PCB.
- Route the two Ethernet cable and the serial ribbon cable through the opening under the faceplate.
- Install the antenna for the pedestal.
- Lower the radio in the cavity located under the faceplate.
- Connect the antenna cable to the radio.
- Connect the Ethernet cables to the radio (black to COM and white to ETH).
- Connect the serial ribbon cable to the DB9 connector of the LINK IFB/IFX board.
- Connect the power cable to the power connector on the radio. Ensure that both orange tabs are in the locked down position.
- Place the radio right on top of the transformer box, with the LEDs facing the back of the controller so that they can be seen when removing the back door of the pedestal.

d) H59004 KIT Installation (Small Plastic Pedestal or ESP-SAT-LINK):

NOTE: *It may be simpler to program the radios prior to installation. See section e) on page 17.*

To install the H59004 Kit for a PAR+ (Small Plastic Pedestal), you will need two self-tap screws (#6 or #8 X 5/8" recommended, not supplied).

- Power down the controller.
- Disconnect the green wire harness connectors on the right side of the top two OSMs.
- Remove the PIB (required as there is not enough room to push the power connector through).
- Use the self-tap screws to mount the PCB as shown in the picture below.

- Remove the faceplate.
- Slide the radio power cable coming from the PCB up through one of the holes under the faceplate.
- Connect the black flat Ethernet cable to the "Serial" Ethernet port on the PCB.
- Connect the white flat Ethernet cable to the "ETH" port of the PCB.
- Connect the serial ribbon cable to the DB9 connector on the PCB.
- Route the two Ethernet cables through one of the holes under the faceplate.
- Route the serial ribbon cable to the DB9 connector of the LINK IFB/IFX connector.
- Install the antenna for the pedestal.
- Lower the radio in the cavity located under the faceplate.
- Connect the antenna cable to the radio.
- Connect the Ethernet cables to the radio (black to COM and white to ETH).
- Connect the serial ribbon cable to the DB9 connector in the LINK IFB/IFX board.
- Connect the power cable to the power connector on the radio. Ensure that both orange tabs are in the locked down position.

e) *H59004 AND H59008 KITS Programming:*

Programming the TransNEXT LINK900 radios from these kits is very similar to programming the H59001 radio.

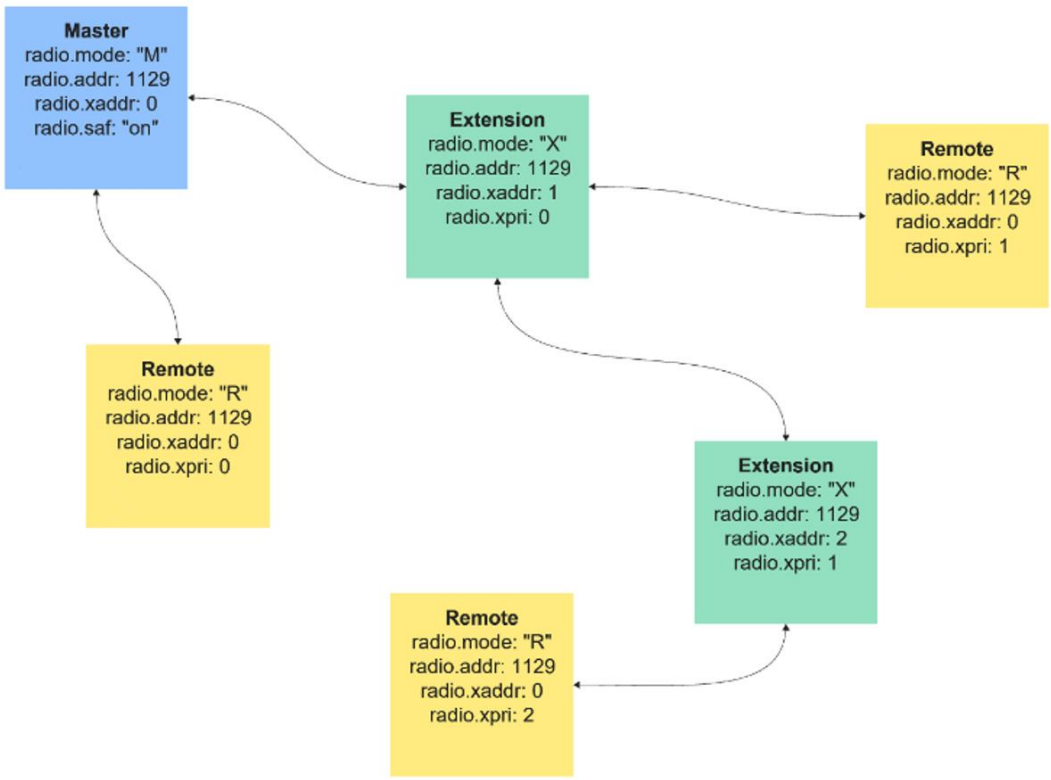
The simplest way to program these radios is to use the power supply used for the radio located at the ICI+LINK.

Otherwise, to program the radio, you will need to power the radio from the PCB installed at the controller. In that case, you will need to connect to the Ethernet cable used to program the radio directly on the PCB, in the port labeled "ETH CONFIG".

NOTE: *Always ensure that an antenna is connected to the LINK900 radio before the radio is powered-up, or damage to the radio may occur.*

Before programming the field radios, it is highly recommended to have a plan providing the location each field radio and if they are Remote or Extension radios.

Below is an example showing a simple layout plan for a system with only five controllers.



Note that the radio.addr value must be the same for all the radios for a given interface. A good practice is to use the last 4 digits of the serial number of the MASTER radio as the radio.addr setting. The radio.xpri setting defines which radio the unit listens to and for Extension radios, the radio.xaddr defines on which address the radio repeats the signal.

NOTE: *The signal from the Master may be repeated by a maximum of 4 Extension radios before terminating at a Remote Radio.*

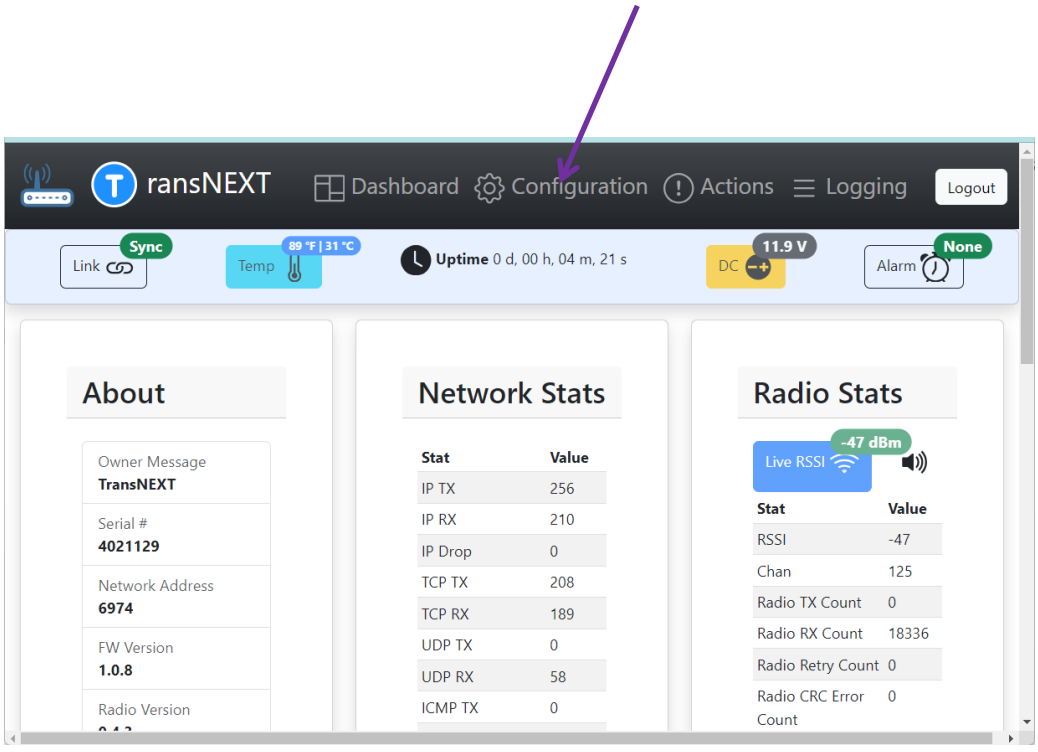
If not already done so, follow the steps in Appendix section c) to configure your Ethernet adaptor to program the radios. Once your network adaptor is configured:

- Connect the Ethernet cable to the "ETH" port of the TransNEXT radio or to the "ETH CONFIG" port of the PCB if the radio is installed at a controller.

- Connect the other end to the Ethernet port of the PC.

- Open your web browser and type in the IP address of the radio in your address bar and hit enter.
  - The IP address of the radio is located on a sticker on top of the radio.

- At the login page, use "admin" as the username and "admin" as the password. The radio Dashboard should be displayed. Select "Configuration":



- A page will appear showing all the settings of the radio.

- To change a setting, you simply place your cursor on the setting that needs to be changed and type in the needed value, replacing the existing value.

1. **Programming a Remote controller (not repeating):**

The settings should look like this:

```
{
 owner: {
   message: "TransNEXT",
   name: ""
 },
 system: {
   mode: "TransNEXT",
   asense: "lo",
   amask: 0xFFFFFFFF
 },
 leds: {
 },
 pushbtn: {
 },
 display: {
   enabled: "off",
   invert: "off",
   show_ip: "on"
 },
 eth: {
   ipaddr: 192.168.200.xxx
   netmask: 255.255.255.0
   gateway: 192.168.0.0
 },
 com1: {
   baud: 600,
   databits: 8,
   parity: "N",
   stopbits: 1,
   rxd: 0,
   cts: 0,
   ctshold: 0,
   device: "dce",
   port: "rs232",
   rtu: "off",
   rtuid: 0
 },
 radio: {
   power: 30,
   addr: 1129,
   xaddr: 0,
   fec: "off",
   retry: 2,
   repeat: 2,
   saf: "off",
   xpri: 0
   xmap: 0x00000000,
   skip: [0,0,0,0,0,0,0,0],
   unit_addr: 1041,
   mode: "R"
```

Will vary from one radio to another.

Must match the "addr" setting of the Master (1129 in our example).

This is the address on which the radio listens to (0 is the Master. 1 would be from a repeating satellite, as an example).

Number of the radio (do not change).

This value needs to be "R" for Remote.

```
 },
 ippl: {
  enabled: "off",
  mode: "udp",
  talk_on_vrc: 1,
  listen_to_vrc: 1,
  local_ip_port: 30011,
  ip_peer_addr: 192.168.1.1
  ip_peer_port: 30011,
  connection_timeout: 0,
  keepAlive: "off"
 },
 dlink: {
  enabled: "off",
  type: "node",
  tcp_access: "off",
  connection_timeout: 0,
  tcp_port: 30020,
  trend_resp_win: 0
 },
 password: {
  min_chars: 5,
  max_chars: 64,
  min_lower_case: 1,
  min_capital_letters: 0,
  min_numbers: 0,
  min_non_alpha_numeric: 0,
  permit_username: "off"
 }
}
```

- Once your values are finalized, click "Save" on the bottom left of the web page. Your Remote radio is programed and ready to be used.

2. Programming an Extension controller (repeating):

The settings should look like this:

```
{
 owner: {
  message: "TransNEXT",
  name: ""
 },
 system: {
  mode: "TransNEXT",
  asense: "lo",
  amask: 0xFFFFFFFF
 },
 leds: {
 },
 pushbtn: {
```

```
},
display: {
  enabled: "off",
  invert: "off",
  show_ip: "on"
},
eth: {
  ipaddr: 192.168.200.xxx
  netmask: 255.255.255.0
  gateway: 192.168.0.0
},
com1: {
  baud: 600,
  databits: 8,
  parity: "N",
  stopbits: 1,
  rxd: 0,
  cts: 0,
  ctshold: 0,
  device: "dce",
  port: "rs232",
  rtu: "off",
  rtuid: 0
},
radio: {
  power: 30,
  addr: 1129,
  xaddr: 1,
  fec: "off",
  retry: 2,
  repeat: 2,
  saf: "off",
  xpri: 0
  xmap: 0x00000000,
  skip: [0,0,0,0,0,0,0,0],
  unit_addr: 1045,
  mode: "X"
},
ippl: {
  enabled: "off",
  mode: "udp",
  talk_on_vrc: 1,
  listen_to_vrc: 1,
  local_ip_port: 30011,
  ip_peer_addr: 192.168.1.1
  ip_peer_port: 30011,
  connection_timeout: 0,
  keepAlive: "off"
},
dlink: {
  enabled: "off",
  type: "node",
  tcp_access: "off",
  connection_timeout: 0,
```

Will vary from one radio to another.

Must match the "addr" setting of the Master (1129 in our example).

This is the address on which the radio will repeat on.

This is the address on which the radio listens to (0 is the Master. 1 would be from a repeating satellite, as an example).

Number of the radio (do not change).

This value needs to be "X" for Extension (repeating) radios.

```
    tcp_port: 30020,
    trend_resp_win: 0
  },
  password: {
    min_chars: 5,
    max_chars: 64,
    min_lower_case: 1,
    min_capital_letters: 0,
    min_numbers: 0,
    min_non_alpha_numeric: 0,
    permit_username: "off"
  }
}
```

- Once your values are finalized, click "Save" on the bottom left of the web page. Your Extension radio is programed and ready to be used.

f) Using a standalone repeater:

If the signal needs to be repeated but there are no field controllers available to do so, you can install a standalone repeater radio. The part number to use for that kit should be the same as the radio kit used for the Interface (H59001). This kit includes a power supply, and the radio. You will not need to use the PCB included in the kit. However, the PCB can be kept as a replacement part for any field controller.

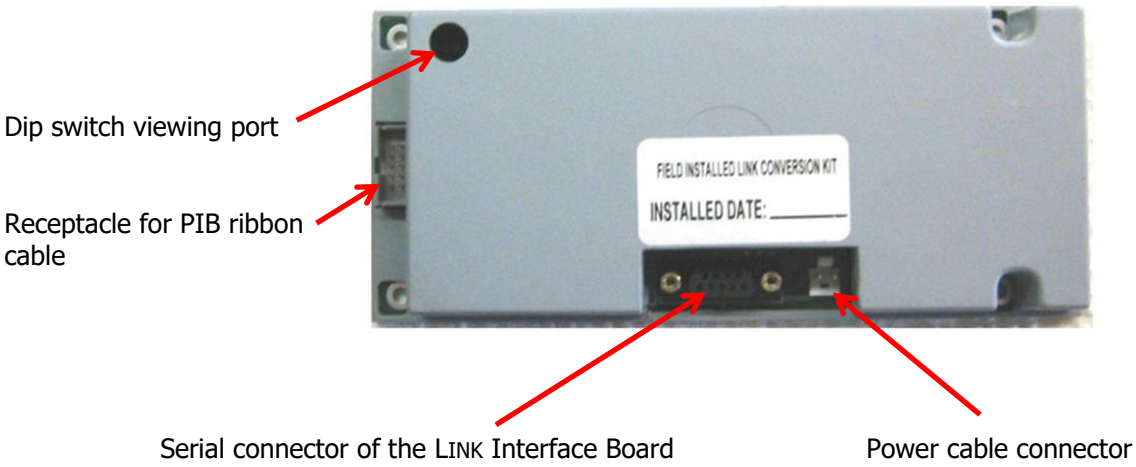
Note that this kit does not include any antennas or cables, which you can get from the Production & Service Center.

The standalone repeater needs to be programmed as an Extension radio, with the same settings as mentioned above.

g) Configuring the LINK Interface Board:

Older LINK IFB boards are similar to the newer LINK IFX boards. Both are interchangeable and can be used on the same system, regardless if the interface is an older MIM-LINK or a new ICI+LINK.

The LINK Interface Board must be configured for the Wire Group it will use to communicate with the ICI+LINK. There are dip switches on the upper right section of the LINK Interface Board. The first two dip switches are used to set the Group ID*. However, it is recommended to set the Group ID through the faceplate of the PAR+ or PAR+ES in the "System Information" menu. If the Group is assigned a value of 1, 2, 3, or 4 through the faceplate, it will override the setting of dip switch #1 and #2. It is recommended to never leave the Group at "0" in the System Information menu.



Wire Group set by dip switches on LINK IFB:	
Group 1	1 on, 2 off
Group 2	1 off, 2 on
Group 3	1 on, 2 on
Group 4	1 off, 2 off

*Please refer to Section 5 – Operation for more information on Group settings

Please always ensure that dip switches #3 and #4 are in the "Off" position.

Also ensure that the orange power cable is connected next to the 9-Pin serial connector on the LINK Interface Board, and the ribbon cable from the Power Interconnect Board (PIB) is connected.

h) Programming the PAR+ES Controller

The PAR+ES controller must also be configured for communication with the central computer via the LINK900 radio. A properly programmed PAR+ES controller will:

- Receive control information from the MIM-LINK in the form of START and STOP commands. This will activate or deactivate the 24 VAC outputs to applicable irrigation stations.
- Send feedback to the MIM once per minute for an activated station.
- Automatically revert to a stand-alone controller in the event that the wireless communication from the MIM is broken.

Using the user interface keypad of the PAR+ES Satellite Controller, set the Group and Channel ID. This must match the Group and ID assigned to this controller at the central control. Do not leave the Group set to "0" if the controller will be controlled via a central. The PAR+ES controller is modular and will require up to three channels based on its configuration:

- 16 to 24 stations use 1 channel
- 25 to 48 stations use 2 channels
- 49 to 72 stations use 3 channels

Notes concerning the LINK Interface Board:

1. LINK IFB Firmware Version 4 or later is required for 3 channel capability
2. LINK IFB Version 4 is backward compatible with PAR+ and MSC+
3. Older firmware versions are limited to 2 channels and 48 stations

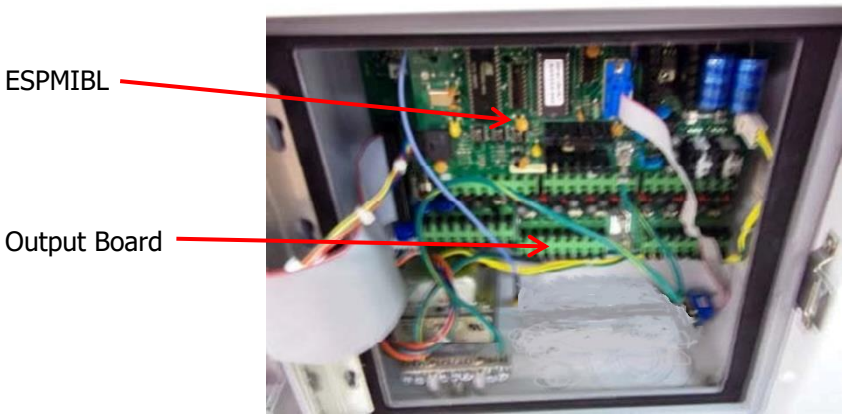
i) Using Sensors on a Golf LINK900 system

Sensors can be added to a LINK900 system using an ESP-SATL controller. The ESP-SATL controller is equipped with a MAXI® Interface Board that includes two sensor ports for connection of Static or Pulse type sensors. The H59004 radio kit will be required and must be purchased separately.

The ESP-SATL controller is only available in a 40 station configuration. Even if its primary role will be to relay sensor information back to the central, the stations in the ESP-SATL can be used through the Golf Central Control. For example, it may be used as a wall mount controller for irrigating landscaping around the Club House.

ESP40SATLW, 40 Station Wall-mounted Controller (M72900)

The MAXI® Interface Board (ESPMIBL) in the ESP-SATL controller is a circuit board mounted on top of the output board.



The LINK900 radio is connected to the ESPMIBL via a 9-Pin serial cable to the PCB and then using the Ethernet cables (refer to section 4 c) of this manual). The PCB can be mounted inside or outside the ESP-SATL cabinet. The HLINK900 Radio Kit for Small Pedestals (H59004) includes an antenna and cable with NMO style mount suitable for mounting to the top of the controller cabinet. Antennas should not be mounted inside the controller cabinet itself.

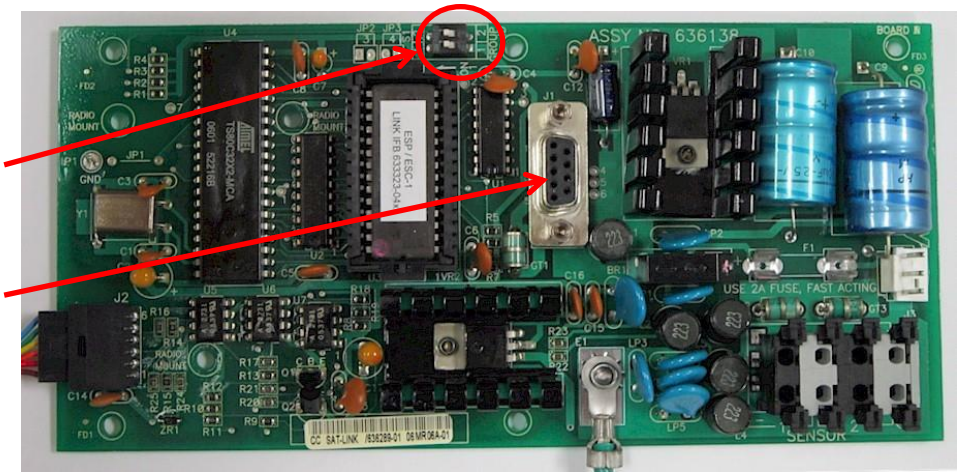
The dip switches on the ESPMIBL need to be set to determine the Group in which the ESP-SATL will be assigned.

Group 1 = dip 1 on, dip 2 off
Group 2 = dip 1 off, dip 2 on
Group 3 = dip 1 on, dip 2 on
Group 4 = dip 1 off, dip 2 off

Please note that the EPROM Chip in the MIM-LINK / TWI-LINK interface must be of version 10.5 or higher for the Golf central control to recognize an ESP-SATL used with sensors.

Dip Switch bank for Group setup

Serial connector for the radio



On the back side of the ESP-SATL faceplate, there is a small compartment. Make sure that the "Maxicom / Stand Alone" switch is set to "Maxicom".

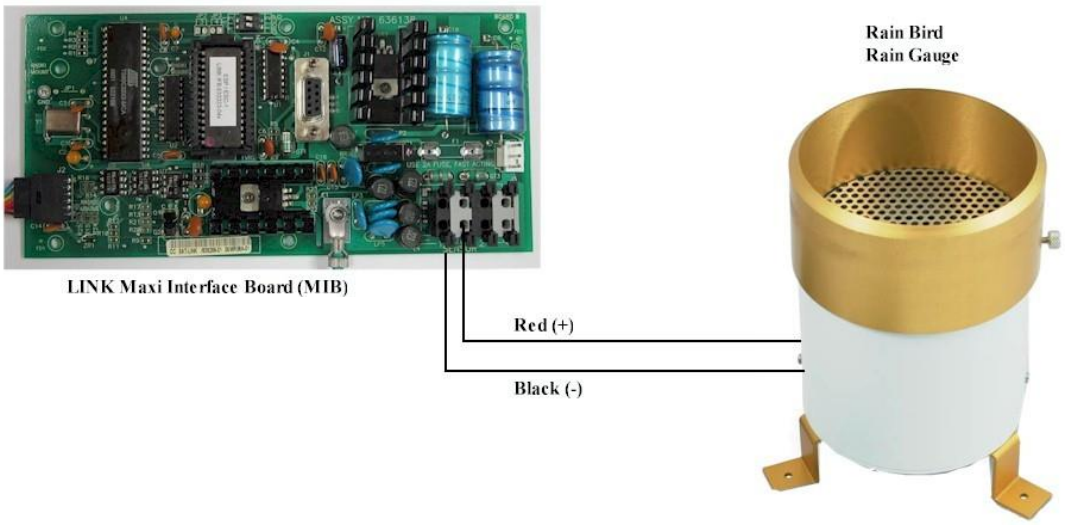
The Channel ID is set using the programming dial on the front of the faceplate. From the "Time / Calendar / Channel" position. Press the "Start/Adv." button until the Channel ID is displayed. Press the up and down arrows to set the proper channel.

Note: *The ESP-SATL controller will require 2 channels. When the channel number is set in the controller faceplate, stations 1-24 will occupy that channel and stations 25-40 will occupy the next higher channel number, e.g. 1-24=CH11,* ***25-40 will use CH12****. So, please keep this in mind when assigning channels to other controllers on the property!*

At the central, if using an old MIM-LINK / TWI-LINK, make sure the EPROM Chip is version 10.5 or higher.

In the satellite definition screen, make sure "ESP-LINK wi Sensor" model is selected in the drop down. Make sure to set "Channel B" to the number immediately following the channel selected on "Channel A".

Each ESP-SATL controller can have up to two sensors connected. Both sensors will use the first channel ID configured on the ESP-SAT-LINK. In the central control software, the sensors will be identified as A or B. Below is an example using a Rain Can connected to the Sensor input #1 (A) of the ESP-Sat-Link.



For more information on using different types of sensors with the ESP-SATL controller, please see Appendix section "7a".

5. Operation

The following provides a brief overview of the operation of the proprietary LINK communication protocol:

Communication protocol:

1. All LINK communication is a two-way polled Master/Remote type.
    a. ICI+LINK is the Master.
    b. Satellite Controllers are Remotes (or Extensions).
2. All communications are initiated by the central Interface.
    a. Field devices respond only to their unique address and only if the message type requires a response.
3. No communication is initiated by the field devices.
    a. A "Power Up" message output is the ONLY exception.
4. Messages received in error are treated as having never been received.
5. When irrigation is not occurring, the central polls 8 channels every two minutes, at the top of an even minute.

Message Types:

Different types of messages are sent by the central to the controllers in the field. Examples are:

1. Channel Station Output Request: Commands to turn on or turn off stations in the field.
    a. Sent every minute. Ex.: Controller #4, turn on station 6.
2. Channel Poll: Status request for controllers in the field:
    a. All active channels are polled every 2 minutes
    b. 8 inactive channels are polled every 2 minutes
3. Sensor Poll: When equipped, sensors are polled:
    a. Every minute, at the bottom of the minute.
    b. Controllers (ESP-SATL) with sensors respond with either current sensor ON/OFF condition or pulse count

Message Structure:

The ICI+LINK operates on a framework of Groups and Channels. A Group is composed of 28 channels. The ICI+LINK is capable of operating four Groups per LINK board installed. A channel controls up to 24 Stations on a Satellite Controller. Here are examples how channels are used:

- Controllers having up to 24 Stations: One channel is required. If the controller has only 16 stations, it still requires the entire channel. The eight stations remaining within the structure of that channel will not be used. They do not carry over into another channel.
- Controllers having up to 48 stations: Two channels are required. If the Satellite Controller has more than 24 stations, a second channel must be used by the controller. The channel number should be the next highest channel.
- Controllers having more than 48 stations: A third channel is required.
- On a LINK system, it is recommended to assign channels without any gaps in the numbering
- Example: If three 48 station controllers and one 72 station controller make up a complete system, the following Channel ID configuration for these controllers would comply with this recommendation:
    - Controller #1 (48 stations): Channel ID 1 and 2
    - Controller #2 (48 stations): Channel ID 3 and 4
    - Controller #3 (72 stations): Channel ID 5, 6 and 7
    - Controller #4 (48 stations): Channel ID 8 and 9

It is not recommended to skip a channel ID on the same controller, or between controllers. Use channels consecutively, do not leave blanks.

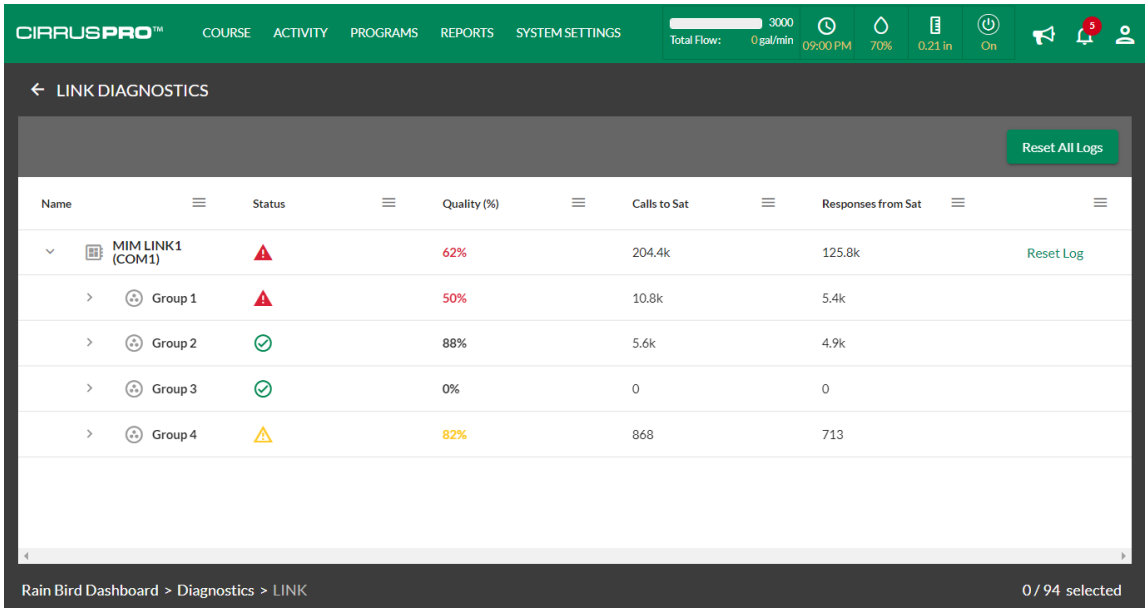
6. Troubleshooting

This section will cover basic troubleshooting techniques for the LINK900 communication system. Please note that this section is intended to help solve common issues. Complicated issues might require a call to your Rain Bird® distributor.

Most failures are first noticed as shortened or zero runtimes in the logs at the central. The following steps can help in identifying the cause of these issues.

a) CirrusPRO Link Diagnostic screen:

A good practice is to start by reviewing the "Link Diagnostics" screen in the Diagnostics section of System Settings.



LINK Diagnostic Screen

Name:	Show the name of the device, starting by the Interface, which can be expanded to see the controllers, which can also be expanded to see their respective channels.
Status:	Shows an icon representing the current status of the signal quality: Green Check Mark, Orange Triangle or Red Triangle.
Quality:	Indication of signal quality by dividing the number of Responses from Sat by Calls to Sat. Green – Good 80%-100% Yellow – Possible issue 50%-79% Red – Channel issue <50%.
Calls to Sat:	Indicates the total number of calls sent to a satellite/channel as measured by the ICI+LINK. A large number compared to the others indicates that either a controller is not responding or the ICI+LINK is not hearing the response.

Responses from Sat: Indicates the number of responses the ICI+LINK heard back from the satellite/channel after being called. A low number or a zero indicates that either the controller is not responding or the ICI+LINK is not hearing the response.

1. Basic Troubleshooting

On a LINK system, it is important to address communication issues promptly. As few as three non-responding controllers can slow down responsiveness from other devices as the system spends more time trying to reach the non-communicating controllers.

When first programming the central control and adding controllers, it is important to only add channels to the database as they are actually installed in the field. If a controller must be programmed prior to install, make sure to set the controller as "inactive" in the satellite definition screen until it is installed.

- Is the issue affecting multiple channels / controllers?
  - Are these controllers getting their signal directly from the ICI+LINK or through a repeating controller?
    - If from ICI+LINK, it could be related to a "general" issue, like MIM antenna, cables, etc. especially if the issue affects the furthest controllers
    - If these units are getting their signal from a single repeating controller, the issue is most likely at that unit
  - Have site conditions changed (New trees, lightning occurred, etc.)?
    - If there are multiple channels using the same radio (ex.: PAR+ES with 3 channels) and the lower channel number has poor diagnostics, it could indicate a poor signal strength issue. When the radio first receives a signal, it is in standby mode and may miss the first digit of message sent by the ICI+LINK.

2. PAR+ES Controller Troubleshooting

When trying to troubleshoot a PAR+ES with LINK900 radio, it is a good idea to synchronize a watch with the time on the central control computer. When the system is idle, the ICI+LINK will poll 8 channels every two minutes, at even minutes. Knowing when this polling happens while in the field is useful for troubleshooting. Also, cycling power to the controller can help resolve "frozen" radios. The TXD LED on the radio should briefly flash and the Sync LED should turn solid after a few seconds (see below).

At the faulty controller:

- Make sure that the Group and Channel ID are correctly defined in the "System Information" of the faceplate.
- Verify the status of the "MAXI® Mode LED" on the faceplate
  - ON – Locked to the interface via the LINK900 radio
  - OFF – Not in MAXI® (or centralized) mode
  - Flashing – In MAXI® mode but not seeing the interface
- Remove the front panel of the PAR+ES and look at the PCB status LED:

- RXD LED (top)
  - Normally OFF
  - Will flash when seeing transmitted signal by the ICI+LINK
    - The signal is not necessarily targeted to this radio. The radio sees all communications on the network, even for controllers on a different Group
- TXD LED (2nd from the top)
  - Normally off
  - ON when the radio is transmitting
- SYNC LED (3rd from top)
  - Solid – Synched to the network and signal is acceptable
  - Flashing – Locked on the network but signal too weak
  - OFF – Not synched with the interface. Check antenna, cables or programming.
    - OFF could also mean that there is no power to the radio. Remove back door of the PAR+ES and check that the "PWR" LED is on on the radio (you should be able to see that LED just above the transformer box if the radio was installed according to the provided instructions).
  - Solid – OK
- ALRM LED (bottom)
  - OFF – Normal
  - Flashing (5 times per second) – Fault indicator. The error code can be read with an Ethernet cable and connecting to the IP address of the radio (see section 4 e) of this manual)

Every two minutes, the RXD light on the radio should start flashing. This indicates that the interface is polling the next 8 channels. Even if the radio is not in the sequence being polled, the RXD should be flashing when the interface is polling.

- If the RXD light is not flashing, the signal is not reaching this radio
  - Is the Sync LED solid?
    - If not, check antenna and cables
    - Check programming
- The TXD LED should flash when the channel(s) for this controller is (are) responding. If the controller is using multiple channels, the TXD LED should flash once per used channel when polled.
  - If the TXD LED is not flashing
    - Either the channels in this controller were not polled during this sequence, OR
    - The controller did not receive the poll message.
      - Check the Group and Channel from the faceplate to insure the controller is properly programmed.

7. Appendix

a) Sensors on the LINK900 system

Sensors can play a very important role when using a Golf Central Control. Here are some examples of sensors and reasons to use them:

1) Flow Sensors: Allows the user to monitor flow at a pump station, monitor transfer pumps, etc.
2) Temperature Sensors: The Golf central control can be configured to react to high or low temperature conditions, or to just monitor conditions
3) Rain Sensors: RainWatch is one example. It is an intelligent rain monitoring system that allows the central to react and compensate irrigation based on rainfall
4) Etc.

Sensor Types:

Two types of sensors can be used on a LINK900 system: Static or Pulse.

Static sensors: Their output is a switch closure (just like an on/off switch). Examples of a static sensor:

Rain shut off device

Rain Check

WR-2 Wireless Rain / Freeze Sensor

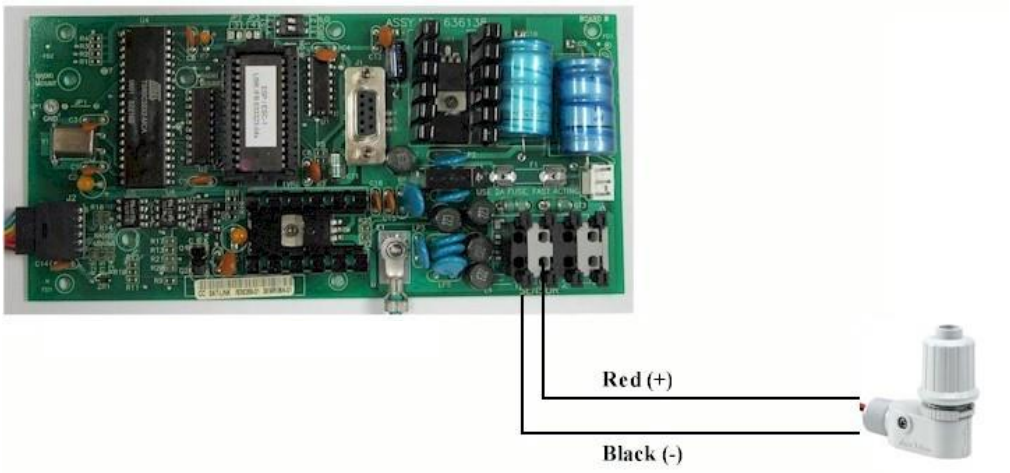
Pulse Sensors: These sensors deliver a pulse output. The rate of the pulses will change based upon varying conditions. Here are some examples:

Tipping bucket rain gauge

Paddle wheel flow meters

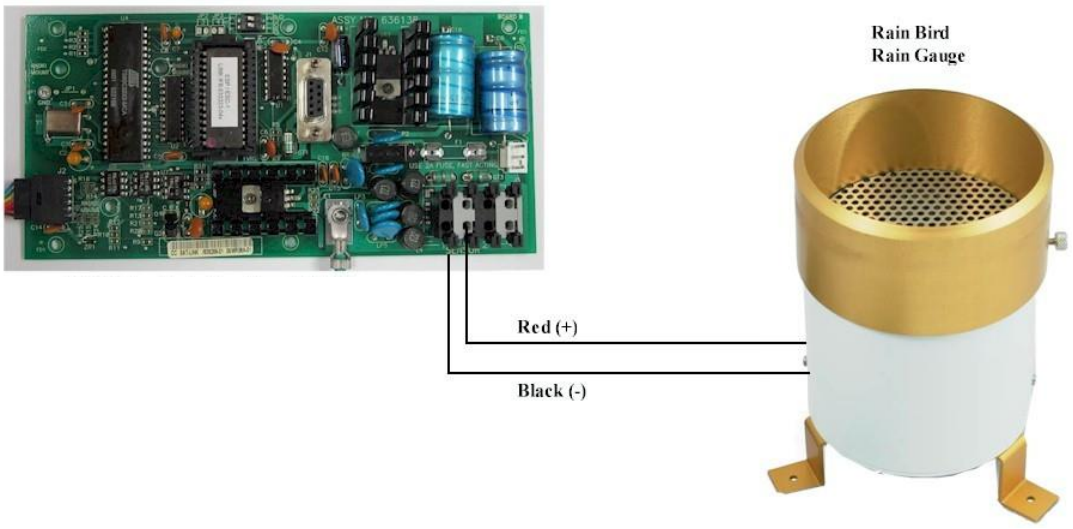
Using Static Sensors on a LINK900 communication system with an ESP-SAT-LINK controller

All static sensors are wired directly into the ESP-SATL, MAXI® Interface Board (ESPMIBL) Sensor 1 or 2 input connectors. The following wiring diagram illustrates how to connect a Static Sensor to the ESP-SATL, MAXI® Interface Board:



Using Pulse Sensors on a LINK900 communication system with an ESP-SATL controller

Sensors with less than 100 pulses per minute: When using a Pulse sensor, the method to connect it to the ESP-SATL, MAXI® Interface Board (ESPMIBL) will vary depending on the maximum rate of pulses output by the sensor. On the LINK900 communication system, the Central Control will only recognize a maximum of 100 pulses per minute. If the Pulse sensor being used will never exceed this value, it can be wired directly to the MAXI® Interface Board of the ESP-SATL controller. Here is an example using a tipping bucket:

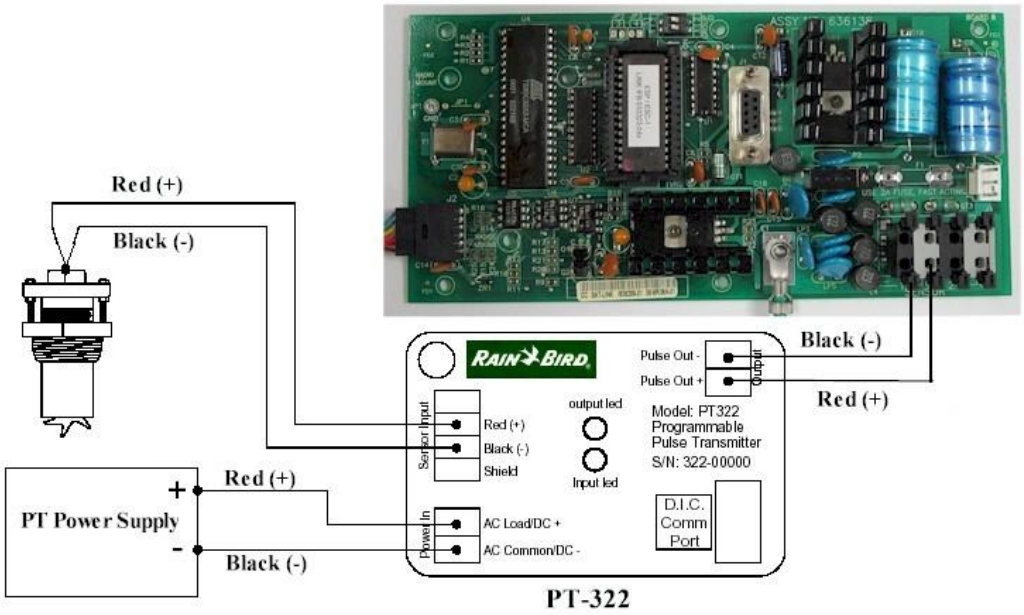


Sensors with more than 100 pulses per minute: Flow meters and wind anemometers are types of Pulse sensors that will almost always exceed 100 pulses per minute. In order to decrease the number of pulses sent to the central, a Pulse Transmitter must be installed. The

Pulse Transmitter is programmed to scale the number of pulses delivered by the sensor and allow them to be recognized by the central control. Two models of Pulse Transmitters are available: PT-5002 and PT-322.

Example using a paddle wheel flow meter:
If the number of pulses from the flow meter will have a maximum count of 300 pulses per minute, the Pulse Transmitter would be programmed to receive 3 pulses before emitting 1 pulse to the ESP-SATL controller.

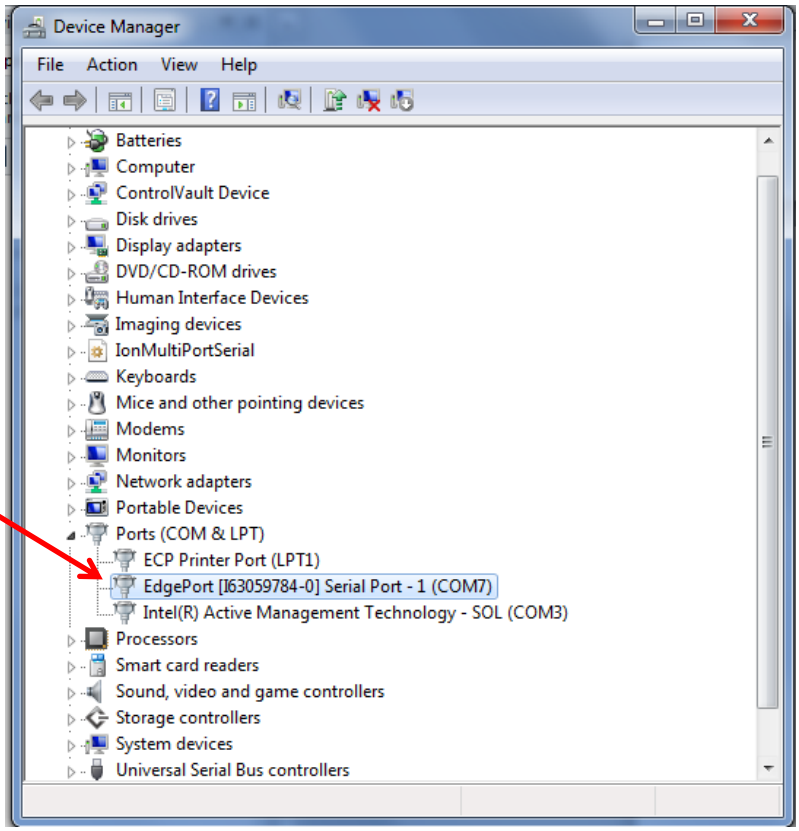
Wiring diagram when using the PT-322



b) Changing the COM port used by a USB-to-Serial Adapter

When a USB-to-Serial adapter is initially connected, Windows will assign a COM port to it. To find out what COM port has been assigned, go to Device Manager (type "device" in the Start Menu search field, then click on Device Manager).

Locate the "Ports" section and expand it. Find the USB-to-Serial adapter

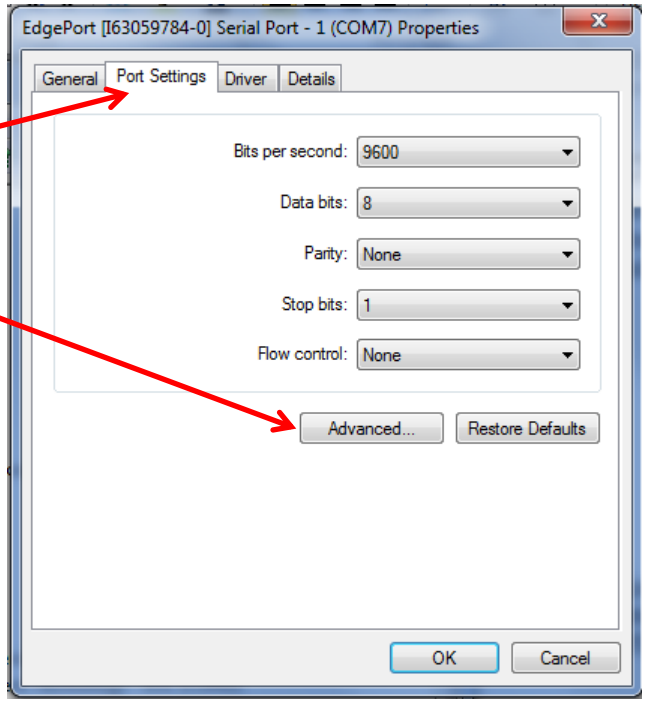


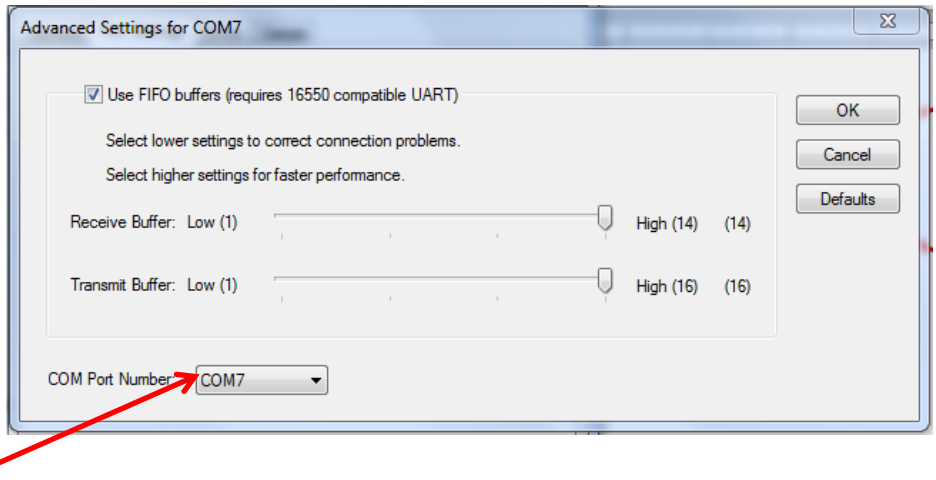
If needed, the COM port number may be using the following steps:

Right click on the USB-to-Serial adapter device in Device Manager and select Properties.

Chose the "Port Settings" tab

Click on "Advanced"

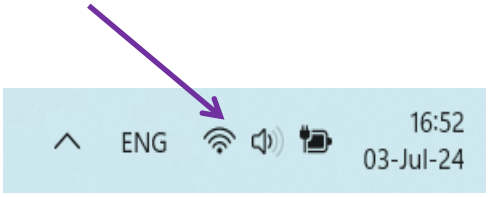




Click the "COM Port Number" drop down menu and choose the desired COM port number (e.g. COM1). Click OK twice to confirm your choice and close Device Manager.

c) *Configuring your network adaptor to program the TransNEXT radios:*

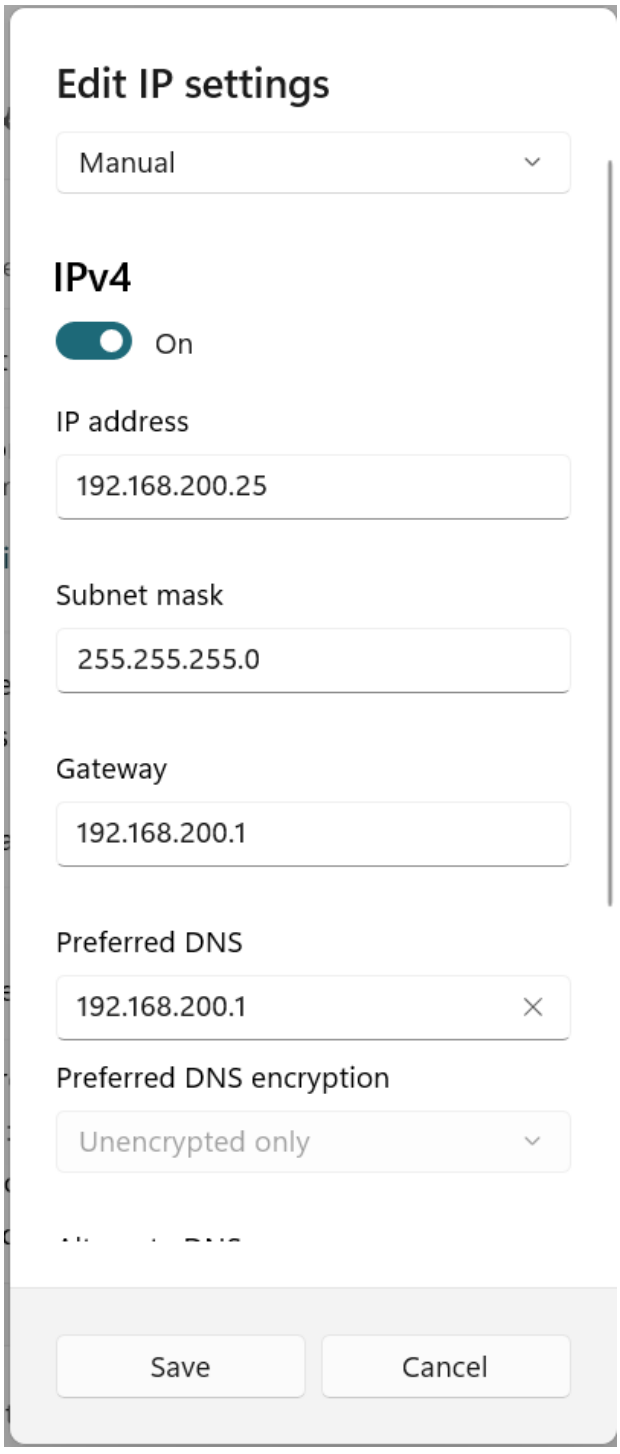
Your network adaptor settings in Windows must be configured to match the network convention of the TransNEXT radios. To do so (using Windows 11), right click on the network section of your system tray.



A pop-up showing "Network and Internet Settings" will appear. Click on it and then select "Ethernet".

Next to "IP assignment", select "Edit", change the IP setting to "Manual" using the drop down and turn on the IPv4 toggle.

Configure the next screen as below and save:


Edit IP settings
Manual
IPv4
On
IP address
192.168.200.25
Subnet mask
255.255.255.0
Gateway
192.168.200.1
Preferred DNS
192.168.200.1
Preferred DNS encryption
Unencrypted only
Save
Cancel

8. Regulatory Information

Please note that the information below comes mainly from the MDS™ TransNEXT manual from GE Vernova, which can be downloaded from the distributor section of our website.

RF Regulatory Information

RF Exposure Notice (English and French)

RF Exposure

Concentrated energy from a directional antenna may pose a health hazard to humans. Do not allow people to come closer to the antenna than the distances listed in the table below when the transmitter is operating. More information on RF exposure can be found online at the following website: www.fcc.gov/oet/info/documents/bulletins

l'exposition aux RF

Concentré d'énergie à partir d'une antenne directionnelle peut poser un risque pour la santé humaine. Ne pas permettre aux gens de se rapprocher de l'antenne que les distances indiquées dans le tableau ci-dessous lorsque l'émetteur est en marche. Plus d'informations sur l'exposition aux RF peut être trouvé en ligne à l'adresse suivante: www.fcc.gov/oet/info/documents/bulletins

Antennas must not be co-located. All transmission antennas must be at least 20 cm apart to comply with FCC co-location rules.

TransNEXT Minimum RF Safety Distance

TransNEXT Model	**Minimum Safety Distance from Antenna** *operating with a 10dBd (12.15dBi) antenna and so configured for the maximum allowable EiRP of +36dBm*
NET9L	34 cm

Approved Antennas

This radio transmitter 101D-NET9L has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

This product has been approved for use with the antennas listed in Table 1-1, below:

Manufacturer	Manufacturer's Part Number	Type	Gain (dBi)/per port	For use with (E5MDS- or 101D-)
Kathrein	OGB9-915N	Omni	11.0	NET9L
PCTEL	Z3336	Yagi	12.2	NET9L

Table 1-1. Approved Antennas for TransNEXT

According to Part 15.204 of the FCC rules, any antenna that is of the same type and of equal or less directional gain as an antenna that is authorized with the intentional radiator may be used with that intentional radiator. No retesting of this system configuration is required.

Professional installation is required. The installation site must conform to Part 15.247/RSS-247 of the FCC rules - Conducted and Radiated Power limits. Proper feedline selection and/or radio power setpoints must be set accordingly for use with each antenna type as detailed in Table 1-2.

Radio Model	Antenna Model	Radio Power Setpoint (dBm)	Minimum Cable Loss required for this configuration (dB)	Conducted Power into antenna (dBm) *Note 1*	EIRP(dBm) *Note 2*
NET9L	OGB9-915N	30	5.0	25	36
		25	0	25	36
NET9L	Z3336	30	6.2	23.8	36
		24	0.2	23.8	36

Table 1-2. Feedline losses and radio power setpoints for ERP and Conducted Power compliance for TransNEXT installations.

FCC Part 15 Notice and Industry Canada RSS Notices

This device complies with Part 15 of the FCC rules for a Class A digital device. Operation of this device 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. Any unauthorized modification or changes to this device without the express approval of the manufacturer may void the user's authority to operate this device. Furthermore, this device is intended to be used only when installed in accordance with the instructions outlined in this guide. Failure to comply with these instructions may void the user's authority to operate this device.

(a) Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

(b) The radio transmitters described herein (IC ID: 101D-NET9L and 101D-NET9S) have been approved by Industry Canada to operate with the antenna types listed in Table 1-1 with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil est conforme à la Partie 15 des règlements de la FCC et Industrie Canada exempts de licence standard RSS (s). Son utilisation est soumise à deux conditions:

(1) ce dispositif ne peut causer des interférences,
(2) cet appareil doit accepter toute interférence pouvant causer un mauvais fonctionnement du dispositif.

(a) En vertu des règlements d'Industrie Canada, cet émetteur radio ne peut fonctionner avec une antenne d'un type et un maximum (ou moins) approuvés pour gagner de l'émetteur par Industrie Canada. Pour réduire le risque d'interférence aux autres utilisateurs, le type d'antenne et son gain doivent être choisies de façon que la puissance isotrope rayonnée équivalente (PIRE) ne dépasse pas ce qui est nécessaire pour une communication réussie.

(b) Les émetteurs radio décrits ici (IC ID : 101D-NET9L et 101D-NET9S) ont été approuvés par Industrie Canada pour fonctionner avec les types d'antennes répertoriés dans le tableau (Table 1-1) avec le gain maximum autorisé et l'impédance d'antenne requise pour chaque type d'antenne indiqué. Les types d'antennes non inclus dans cette liste, ayant un gain supérieur au gain maximum indiqué pour ce type, sont strictement interdits pour une utilisation avec cet appareil.

IEEE-1613 Compliance

The TransNEXT is IEEE-1613 compliant provided that unshielded cables are <= 2 meters in length.

Operational Safety Notices

The TransNEXT may not be used in an environment where radio frequency equipment is prohibited or restricted in its use. This typically includes aircrafts, airports, hospitals, and other sensitive electronic areas.

Do not operate RF devices in an environment that may be susceptible to radio interference resulting in danger, specifically:

- **Areas where prohibited by law** - Follow any special rules and regulations and obey all signs and notices. Do not use the TransNEXT when you suspect that it may cause interference or danger.
- **Near Medical and life support equipment** - Do not use the TransNEXT in any area where medical equipment, or life support equipment may be located, or near any equipment that may be susceptible to any form of radio interference.
- **All cables and conductors making connections to the units need to be rated at 85 °C or higher.**
- **Use Copper Conductors Only**
- **Use 18 AWG wire**

NOTE The TransNEXT does not support Voice Communications.

Regulatory Limitations

Some product options including hardware and software configuration settings may be restricted based on applicable region-specific regulatory constraints.

FCC / IC IDs

As of the printing date, the following identifiers are assigned to the models listed below.

Model	FCC ID	IC ID
NET9L	E5MDS-NET9L	101D-NET9L

Servicing Precautions

No user-serviceable parts are contained inside this equipment. Opening of the unit by unauthorized personnel voids the warranty. All servicing must be performed by an authorized repair facility.

When servicing energized equipment, be sure to wear appropriate Personal Protective Equipment (PPE). During internal service, situations could arise where objects accidentally contact or short circuit components and the appropriate PPE would alleviate or decrease the severity of potential injury. When servicing equipment, all workplace regulations and other applicable standards for live electrical work should be followed to ensure personal safety.

CSA/us C1D2 Safety Notice

This product is approved for use in Class 1, Division 2, Groups A, B, C & D Hazardous Locations. Such locations are defined in Article 500 of the National Fire Protection Association (NFPA) publication NFPA 70, otherwise known as the National Electrical Code. The transceiver has been recognized for use in these hazardous locations by the Canadian Standards Association (CSA) which also issues the US mark of approval (CSA/US). The CSA Certification is in accordance with CSA STD C22.2 No. 213-M1987.

For Class I, Division 2, the product shall be installed in a tool secured enclosure providing a suitable degree of protection against deterioration of the equipment that would adversely affect its suitability for use in the hazardous locations area and to avoid USB-C diagnostic port /connectors from being accessible during normal operation. The antenna port shall be used with a passive antenna only. The final installation is subject to acceptance of CSA International or the local inspection authority having jurisdiction.

WARNING – EXPLOSION HAZARD. DO NOT REMOVE OR REPLACE WHILE CIRCUIT IS LIVE UNLESS THE AREA IS FREE OF IGNITIBLE CONCENTRATIONS

WARNING – EXPLOSION HAZARD. DO NOT CONNECT OR DISCONNECT WHEN ENERGIZED

AVERTISSEMENT – RISQUE D'EXPLOSION. NE PAS RETIRER OU REMPLACER LORSQUE LE CIRCUIT EST SOUS TENSION À MOINS QUE LA ZONE NE SOIT EXEMPTE DE CONCENTRATIONS INFLAMMABLES

AVERTISSEMENT – RISQUE D'EXPLOSION. NE PAS CONNECTER OU DÉCONNECTER LORSQU'IL EST SOUS TENSION