Golf LINK900

OWNERS MANUAL

Contents

December 2015

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

2. Components

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

Central Control computer:

Interface(s):

MAXI® Interface Module (MIM-LINK) or Two-Wire Interface (TWI-LINK)

LINK900 radios:

PAR+ES (LINK) controllers:

Standalone Repeater (optional):

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. Omnidirectional and Directional (also known as Yagi).

Omni-directional:
This is the most common antenna used. Each Rain Bird® Golf LINK900 radio/modem/antenna kit (H49008 & H49004) 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)
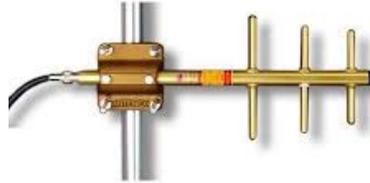
b)   *Antenna Field Patterns:*

Each type of antenna has a defined field 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)
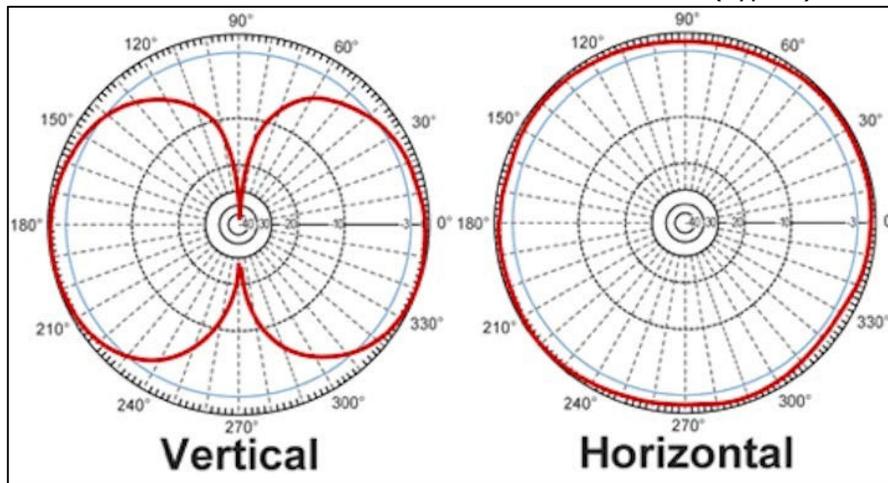
Yagi Antenna Field Pattern (Typical)

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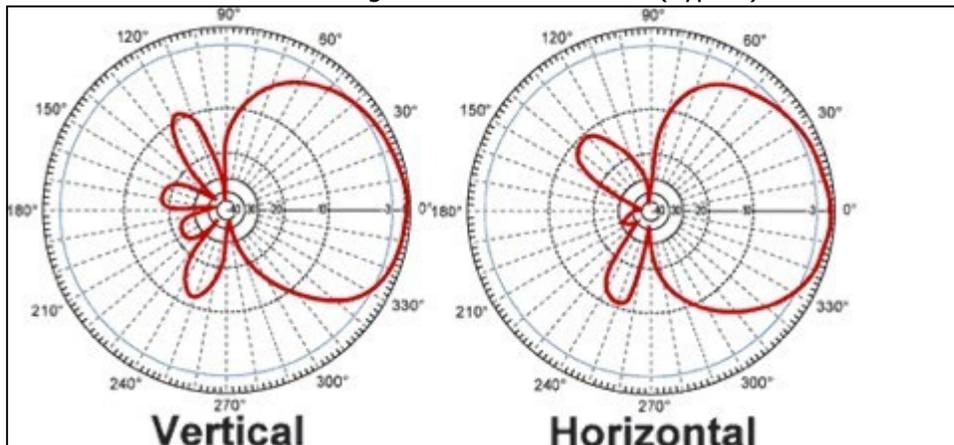
c)   Antenna Cables:

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 in dB 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.

N Male

N Female

TNC Male

TNC Female

SMA Male

SMA Female

NMO Mount

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 SMA Female connector and requires an SMA Male cable end connection. The Standalone Repeater is terminated with a TNC Female connector and requires a 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 MIM-LINK / TWI-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 (H49008 & H49004) 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**
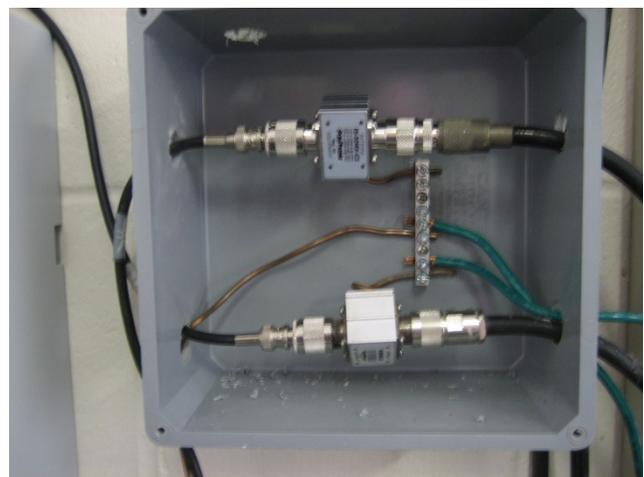
Two Polyphaser setup with proper grounding

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 setup LINK900 wireless communication for your Rain Bird® Golf irrigation system.

a) MIM-LINK / TWI-LINK Interface Connection to Central Control

There are two options for connecting the central control interface (MIM-Link or TWI-Link) to the central control computer: direct serial connection or via a MAXI® Remote Location Kit.

1. Direct Connect

For the direct connection when the interface is located near the central computer, just connect the interface to the computer using the supplied cable.

2. Connection via MAXI® Remote Location Kit (MRLK)

When the interface is remotely located away from the central computer, a MAXI® Remote Location Kit (p/n HA1000) is required.

b) LINK900 radio for MIM-LINK / TWI-LINK Installation & Programming

To install the LINK900 radio/modem kit (H49001) in the MIM-LINK / TWI-LINK interface, only two cables need to be connected. A 9-pin serial ribbon cable connects the LINK900 radio and the Output Board located in the back of the interface. The second cable is the antenna cable (SMA connector) which must be connected to an external antenna (not included in H49001).

Ribbon cable

Antenna cable

The pictures above show two different ways to mount the LINK900 radio inside the interface.

Programming:
The LINK900 radios supplied with H49001, H49004, and H49008 are identical and interchangeable. However, the programming in them will vary depending on the function of the radio. The LINK900 radio located at the MIM / TWI will always be programmed as the Master (M) radio.

LINK900 radios are programmed using the GE MDS Element Manager application which runs on Microsoft Windows OS computers. The software can be downloaded at this address:

https://www.gedigitalenergy.com/communications/MDS/software.asp?directory=Toolbox

The programming cable (GSP-MDS-PRGCBL) is also needed, which is composed of a proprietary cable and 9-Pin to RJ-11 adapter.

Connect the cable to the radio using the RJ-11 connector and connect the serial adapter to the computer. Please note that if the computer does not have a serial port and a USB-to-Serial adapter is used, the COM port used by the adapter must be selected in MDS Element Manager. See Appendix section "7b" for help.

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

The LINK900 radio must be powered before a connection can be established. The radio receives power from the MIM/TWI via the 9 pin ribbon cable. Programming the radio is completed via the Configuration menu in the GE MDS Element Manager application.

Start the GE MDS Element Manager application. Confirm Device Type is set to TransNet. Under Serial Connections, select the COM port that the programming cable is connected to. Confirm the Settings (9600, 8, N, 1). To connect to the radio, select Connect Serial to begin communicating with the LINK900 radio.

Device Type → Device Type [TransNet]

Serial Settings

COM Port → COM Port [COM6] [Settings]

Connect to LINK900 Radio → [Connect Serial]
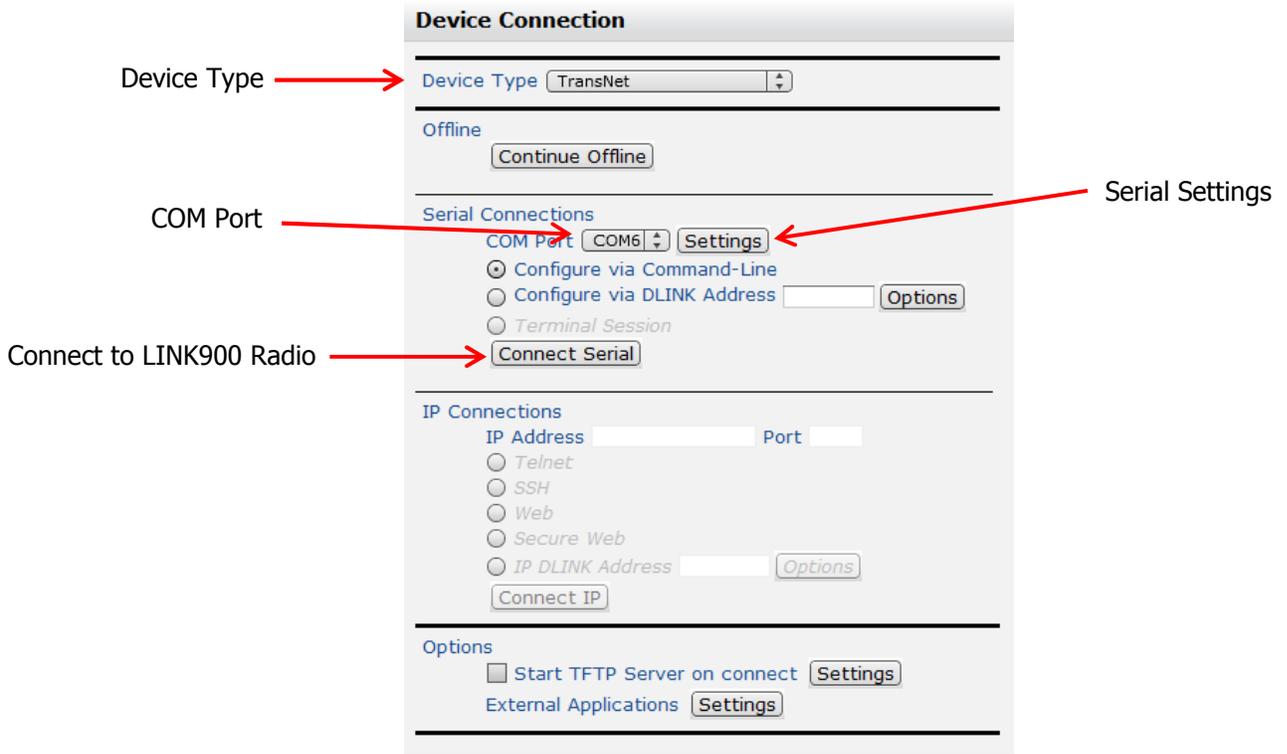
Upon successful connection to the LINK900 radio, the General Information will populate with the radio's Serial Number, Network Address, Firmware Revision Level and other details. This information may be updated at any time by clicking on the Refresh icon.

General Information

Serial Number:	2579672
Hardware Revision:	
Software/Firmware Revision Level:	06-4040A01 3.6.1 18Jan2006
Network Address:	4321
Extension Address:	0
Unit Address:	9672
TX RF Power Output Setting:	30 dBm
Internal Temperature:	+29 °C
Owner's Message:	
Owner's Name:	

[Refresh]

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For the **Master** radio at the MIM-LINK / TWI-LINK, the settings should be as follows:

Configuration

Radio Settings

TX RF Power Output Status:	30 dBm
TX RF Power Output Setting:	30 dBm
Loss of RX Data Alarm Time:	min ☑None
Received Signal Strength Indicator:	

[Apply] [Refresh] [Revert]

Configuration

Network Settings

Radio Operating Mode:	Master
Network Address:	4321
Extension Address:	0
Synchronization Qualifier List:	0000 0000

Radio Extended Address
00
01
02
03
04
05
06
07
08

Primary Extension Address:	0
RSSI Synchronization Qualifier:	dBm ☑None
RX Data Buffer:	○On ◉Off
Hop Time:	7 ms
Skip Zones:	☐Zone 1 ☐Zone 2 ☐Zone 3 ☐Zone 4 ☐Zone 5 ☐Zone 6 ☐Zone 7 ☐Zone 8
Clock SYNC Address:	☑None
AT Command Mode:	○On ◉Off
Forward Error Correction:	○On ◉Off
Low Power Mode:	○On ◉Off
Low Power Mode holdover time:	20 ms
Repeat Count:	2
Remote Retry Count:	3
Store and Forward:	◉On ○Off
Band setting:	BAND A
Encryption Setting:	☐ACTIVE
Minimum RSSI for Sync:	dBm ☑None
Sleep Mode:	○On ◉Off

[Apply] [Refresh] [Revert]

Maintenance and Status

Events and Alarms

Alarm Status:	NO ALARMS PRESENT
Alarm Mask:	FFFF FFFF

Event	Text Message
00	Network address
01	Improper software
02	Reserved
03	Reserved
04	Synthesizer out-of-lock
06	Analog-to-Digital fault
07	Voltage regulator fault detected
08	Radio not calibrated
09	Reserved

Alarm Sense: ○Low ◉High

[Apply] [Refresh] [Revert]

Maintenance and Status

Diagnostics

Diagnostic Link:	Status	◉On ○Off
	Baud Rate	19200
Unit's Diagnostic Type:	Root	
Unit Address:	9672	
RX Frequency:	910.6	MHz
Received Signal Strength Indicator:		
TX Frequency:	915	MHz

[Apply] [Refresh] [Revert] [Key Transmitter] [Unkey Transmitter]

Maintenance and Status

RTU Simulator

RTU Simulator:	Status	○On ◉Off
	Address	0

[Apply] [Refresh] [Revert]

*Please note that the "Network Address" shown in the Configuration Settings/Network needs to be the same in all the radios that will be used by the field controllers. That "Network Address" is a user definable 4-digit number. Using the last 4 digits of the serial number of the Master radio is recommended. The serial number is shown on the General Information of the GE MDS Element Manager application.

Set the baud rate for the LINK900 radio in the Command Line Mode under the Utilities menu. Type "BAUD 600 8N1" and Enter. Confirm the baud rate is set to 600 8N1 by typing "BAUD" and hitting Enter.

Confirm the Port is set to TTL by typing PORT and hitting Enter. PORT TTL should be displayed. If RS232 or RS485 is displayed, the radio is not a LINK900 radio.

c) *LINK900 radio for field controllers Installation & Programming*

The LINK900 radio can be mounted in different locations, depending on the type of field controller used. The following example is for the PAR+ES controller. The LINK900 radio inside the PAR+ES will connect to the LINK Interface Board and the antenna cable.

The 9-Pin ribbon cable connects from the 9-Pin connector on the radio to the 9-Pin connector on the LINK Interface Board, located under the faceplate of the controller.

Dip switch viewing port

Receptacle for PIB ribbon cable

Serial connector of the LINK Interface Board   Power cable connector
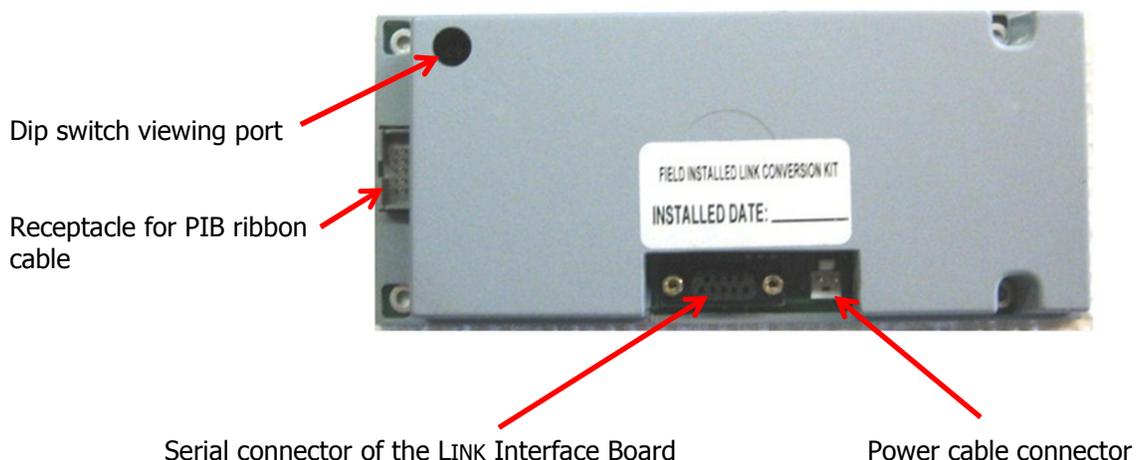
The LINK Interface Board must be configured for the Wire Group it will use to communicate with the MIM-LINK/TWI-LINK. There are dip switches on the upper right section of the LINK Interface Board. The first two dip switches are used to set the Group ID*. However, it is recommended to set the Group ID through the faceplate of the PAR+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

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.

The antenna cable connects to the SMA connector on the radio. The antenna cable that is provided with the LINK900 Radio/Modem/Antenna Kit H49008 will be routed from the radio to the enclosure lid. For the PAR+ES the standard antenna will be mounted on the aluminum plate that will be mounted to the enclosure lid.

Antenna cable connection

Programming:
LINK900 radios used in field controllers may be programmed as either a Remote (R) radio or an Extension (X) radio. A Remote radio may communicate either directly with the Master (M) radio, or through one or more Extension radios connected to the Master. In addition to acting as a Remote radio for the field controller it is installed in, an Extension radio also acts as a repeater, forwarding data between the Master and other Remote or Extension radios. Field controllers with radios programmed as an Extension are used to send and receive data to that field controller, and also repeat signals to other radios. The site survey process will help determine which radios should be programmed as Remote or Extension.

Programming Remote (R) radios:
Remote radios are programmed with the GE MDS Element Manager utility. Follow the same steps as programming the Master radio, but use the following settings:

For **Remote** radios at satellite locations, the settings should be as follows:

Configuration

Radio Settings

TX RF Power Output Status:	30 dBm
TX RF Power Output Setting:	30 dBm
Loss of RX Data Alarm Time:	___ min ☑None
Received Signal Strength Indicator:	

[Apply] [Refresh] [Revert]

Configuration

Network Settings

Radio Operating Mode:	Remote ⬍
Network Address:	4321
Extension Address:	0
Synchronization Qualifier List:	0000 0000

Radio Extended Address

00
01
02
03
04
05
06
07
08

Primary Extension Address:	0
RSSI Synchronization Qualifier:	___ dBm ☑None
RX Data Buffer:	○On ○Off
Hop Time:	⬍
Skip Zones:	☐Zone 1 ☐Zone 2 ☐Zone 3 ☐Zone 4 ☐Zone 5 ☐Zone 6 ☐Zone 7 ☐Zone 8
Clock SYNC Address:	___ ☑None
AT Command Mode:	○On ○Off
Forward Error Correction:	○On ○Off
Low Power Mode:	○On ○Off
Low Power Mode holdover time:	20 ms
Repeat Count:	
Remote Retry Count:	
Store and Forward:	○On ○Off
Band setting:	BAND A ⬍
Encryption Setting:	___ ☐ACTIVE
Minimum RSSI for Sync:	___ dBm ☑None
Sleep Mode:	○On ⦿Off

[Apply] [Refresh] [Revert]

Maintenance and Status

Events and Alarms

Alarm Status:	**NO ALARMS PRESENT**
Alarm Mask:	**FFFF FFFF**

Event	Text Message
00	Network address
01	Improper software
02	Reserved
03	Reserved
04	Synthesizer out-of-lock
06	Analog-to-Digital fault
07	Voltage regulator fault detected
08	Radio not calibrated
09	Reserved

Alarm Sense:	○Low ⦿High

[Apply] [Refresh] [Revert]

Maintenance and Status

Diagnostics

Diagnostic Link:	Status ⦿On ○Off
	Baud Rate 19200 ⬍
Unit's Diagnostic Type:	Node ⬍
Unit Address:	9672
RX Frequency:	910.6 MHz
Received Signal Strength Indicator:	-120 dBm
TX Frequency:	915 MHz

[Apply] [Refresh] [Revert] [Key Transmitter] [Unkey Transmitt]

Maintenance and Status

RTU Simulator

RTU Simulator:	Status ○On ⦿Off
	Address 0

[Apply] [Refresh] [Revert]

Set the baud rate for the LINK900 radio in the Command Line Mode under the Utilities menu. Type "BAUD 600 8N1" and Enter. Confirm the baud rate is set to 600 8N1 by typing "BAUD" and hitting Enter.

Confirm the Port is set to TTL by typing PORT and hitting Enter. PORT TTL should be displayed. If RS232 or RS485 is displayed, the radio is not a LINK900 radio.

Utilities

Command Line Mode

```
BAUD 600 8N1
PROGRAMMED OK
>
>BAUD
BAUD 600 8N1
>
>PORT
PORT TTL
>_
```

Note that the "Network Address" shown in the Configuration Settings/Network section needs to be the same as the address used on the Master radio. The Primary Extension Address setting is shown here with an XPRI value of "0" to receive its commands from the Master. If this Remote radio needs to be configured to receive its signal from an Extension radio, the Primary Extension Address (XPRI) value should match the Extension Address (XADDR) value of the Extension radio relaying the signal. Please refer to Figure A.
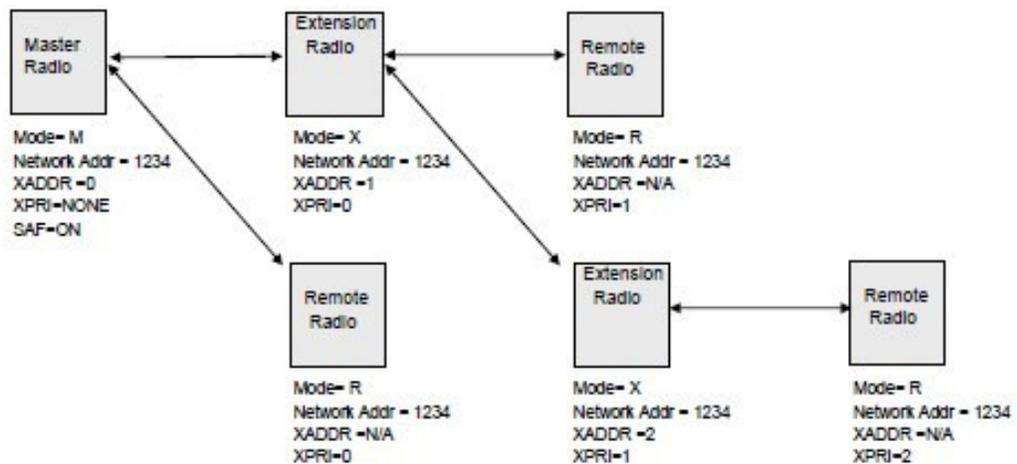
Figure A

Figure A above depicts the different configurations that can be seen when using the LINK900 radios to transmit the signal from the Master to Remote and Extension radios. Extension radios repeat the signal on a unique extension address defined by the Extension Address XADDR value. The signal from the Master may be repeated by a maximum of 4 Extension radios before terminating at a Remote Radio.

Programming Extension (X) radios:

Remote radios are programmed with the GE MDS Element Manager utility. Follow the same steps as programming the Remote radio, but use the settings below:

Configuration

Radio Settings

TX RF Power Output Status:	30 dBm
TX RF Power Output Setting:	30 dBm
Loss of RX Data Alarm Time:	min ☑None
Received Signal Strength Indicator:	

Apply   Refresh   Revert

Configuration

Network Settings

Radio Operating Mode:	X (Store and Forward)
Network Address:	4321
Extension Address:	1
Synchronization Qualifier List:	0000 0000

Radio Extended Address
00
01
02
03
04
05
06
07
08

Primary Extension Address:	0
RSSI Synchronization Qualifier:	dBm ☑None
RX Data Buffer:	○On ○Off
Hop Time:	
Skip Zones:	□Zone 1 □Zone 2 □Zone 3 □Zone 4 □Zone 5 □Zone 6 □Zone 7 □Zone 8
Clock SYNC Address:	☑None
AT Command Mode:	○On ○Off
Forward Error Correction:	○On ○Off
Low Power Mode:	○On ○Off
Low Power Mode holdover time:	20 ms
Repeat Count:	
Remote Retry Count:	
Store and Forward:	○On ○Off
Band setting:	BAND A
Encryption Setting:	□ACTIVE
Minimum RSSI for Sync:	dBm ☑None
Sleep Mode:	○On ○Off

Apply   Refresh   Revert

Maintenance and Status

Events and Alarms

Alarm Status:	NO ALARMS PRESENT
Alarm Mask:	FFFF FFFF

Event	Text Message
00	Network address
01	Improper software
02	Reserved
03	Reserved
04	Synthesizer out-of-lock
06	Analog-to-Digital fault
07	Voltage regulator fault detected
08	Radio not calibrated
09	Reserved

Alarm Sense:	○Low ◉High

Apply   Refresh   Revert

Configuration

Network Settings

Radio Operating Mode:	Remote
Network Address:	4321
Extension Address:	0
Synchronization Qualifier List:	0000 0000

Radio Extended Address
00
01
02
03
04
05
06
07
08

Primary Extension Address:	0
RSSI Synchronization Qualifier:	dBm ☑None
RX Data Buffer:	○On ○Off
Hop Time:	
Skip Zones:	□Zone 1 □Zone 2 □Zone 3 □Zone 4 □Zone 5 □Zone 6 □Zone 7 □Zone 8
Clock SYNC Address:	☑None
AT Command Mode:	○On ○Off
Forward Error Correction:	○On ○Off

Maintenance and Status

RTU Simulator

RTU Simulator:	Status	○On ◉Off
	Address	0

Apply   Refresh   Revert

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Set the baud rate for the LINK900 radio in the Command Line Mode under the Utilities menu. Type "BAUD 600 8N1" and Enter. Confirm the baud rate is set to 600 8N1 by typing "BAUD" and hitting Enter.

Confirm the Port is set to TTL by typing PORT and hitting Enter. PORT TTL should be displayed. If RS232 or RS485 is displayed, the radio is not a LINK900 radio.


```
Utilities
Command Line Mode

BAUD 600 8N1
PROGRAMMED OK
>
>BAUD
BAUD 600 8N1
>
>PORT
PORT TTL
>_
```

Note that the "Network Address" shown in the Configuration Settings/Network section needs to be the same as the address used on the Master radio. The Extension Address (in light green) for each Extension radio must be programmed with a unique (XADDR) value between 1 and 31. The Primary Extension Address (XPRI) setting (in yellow) is shown here with an XPRI value of "0" to receive its commands from the Master. If this Extension radio is to receive its signal from another Extension radio, the XPRI value should match the XADDR value of the Extension radio relaying the signal. Refer to Figure A for a visual representation.

If the signal needs to be repeated but there are no field controllers available to do so, a Standalone Repeater radio is available.

MIM/TWI
(Master Radio)

Stand Alone
Repeater (Extension Radio)

Satellite
(R) – Remote Radio
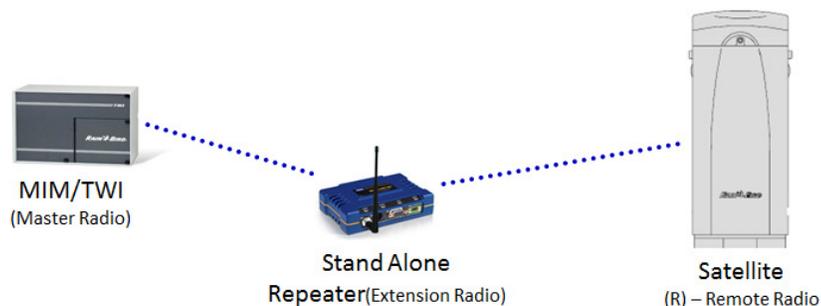
The Standalone Repeater radio kit (p/n IQ4630) is programmed as an Extension radio, with the same settings as mentioned above. Please note that the Standalone Repeater radio cannot be used to replace the LINK900 radio/modem/antenna kit needed for field controllers.

d) *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

e) *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. A LINK900 radio kit (SKU H49004) will also be required and must be purchased separately.

The ESP-SATL controller is available in 24 station and 40 station configurations. 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.
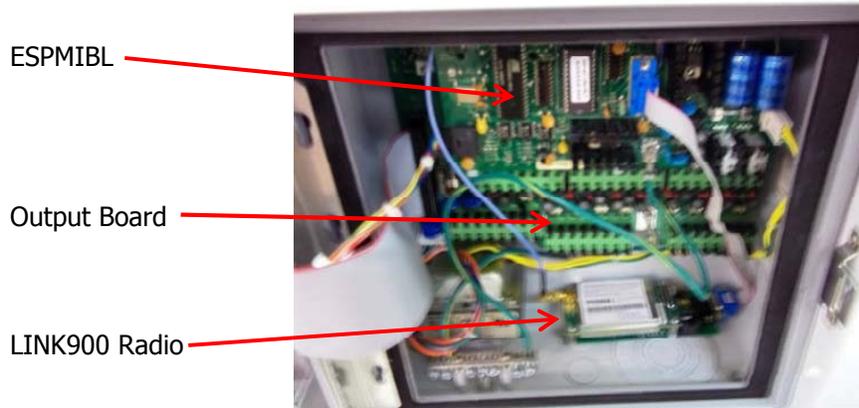
The LINK900 radio is connected to the ESPMIBL via a 9-Pin serial cable. The LINK900 Radio Kit for Small Pedestals (H49004) includes an antenna and cable with NMO style mount suitable for mounting to the top of the controller cabinet. Antennas should not be mounted inside the controller cabinet itself.

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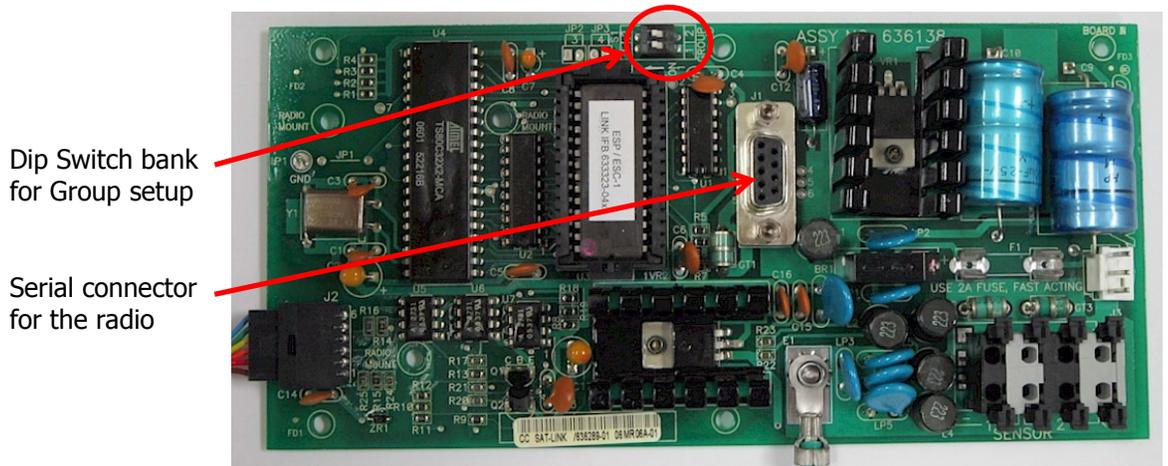
On the back side of the ESP-SATL faceplate, there is a small compartment. Make sure that the "Maxicom / Stand Alone" switch is set to "Maxicom".

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: ESP40SATLW controllers 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=CH1, 25-40=CH2.

At the central, make sure the EPROM Chip in the MIM-LINK / TWI-LINK is version 10.5 or higher.

In the satellite definition screen, make sure "ESP-LINK wi Sensor" model is selected in the drop down. If a 40 station controller is being used, set "Channel B" to the number immediately following the channel selected on "Channel A".
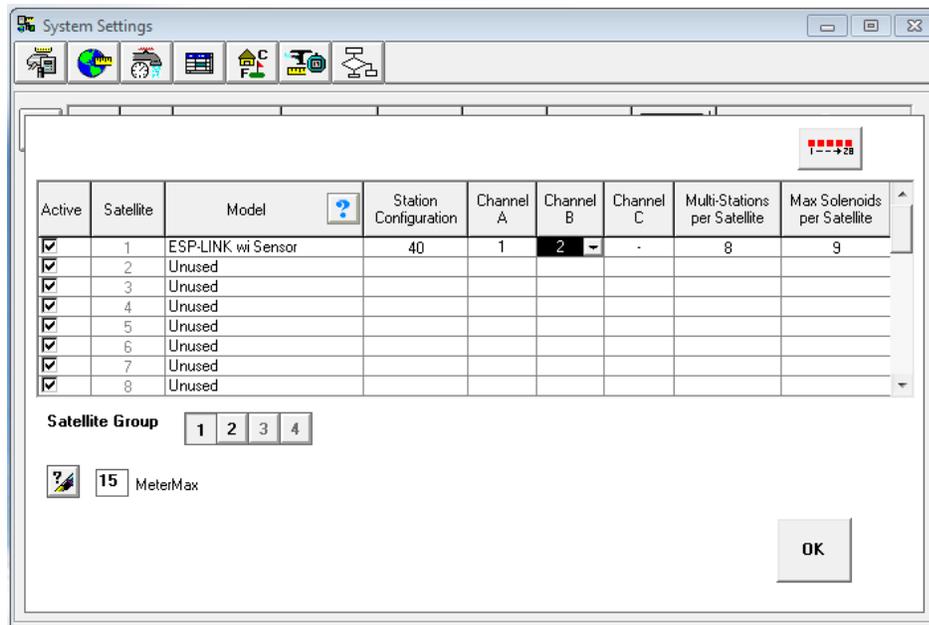
Each ESP-SATL controller can have up to two sensors connected. Both sensors will use the first channel ID configured on the ESP-SAT-LINK. In the central control software, the sensors will be identified as A or B. Below is an example using a Rain Can connected to the Sensor input #1 (A) of the ESP-Sat-Link.

LINK Maxi Interface Board (MIB)

Rain Bird
Rain Gauge

Red (+)

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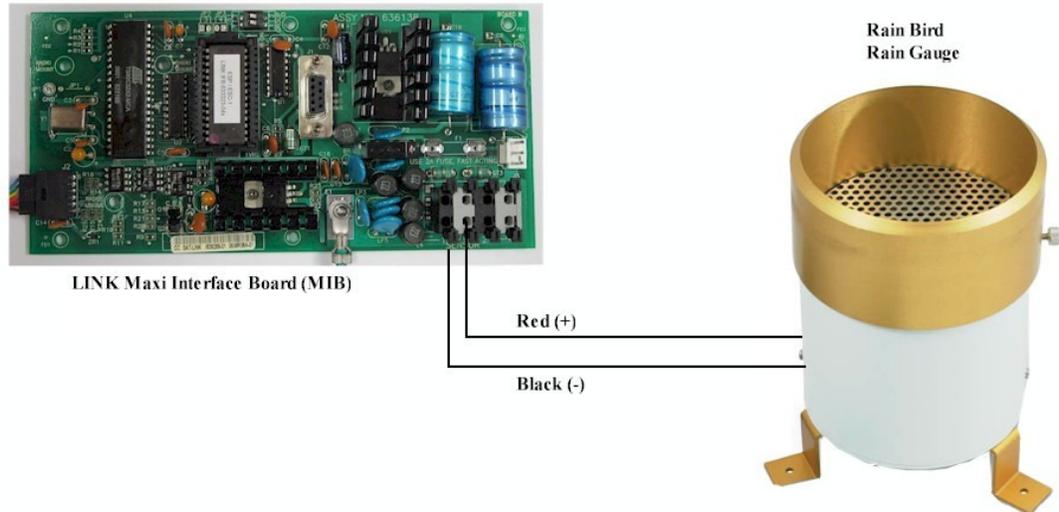
For more information on using different types of sensors with the ESP-SATL controller, please see Appendix section "7a".

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/Slave type
   a. The MIM-LINK / TWI-LINK is the Master
   b. Satellite Controllers are Slaves
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 requiring a response are retransmitted by the Central up to 5 times
   a. When a valid response is received, no further retries are attempted
5. No retries are sent for messages not requiring a response
6. Messages received in error are treated as having never been received
7. When irrigation is not occurring, the central polls a certain number of channels every two minutes
8. FCC upgrade changes made in 3rd/4th quarter of 1997
   a. Central must listen for traffic before it transmits
   b. Controller does not listen before it transmits
   c. Controller polls reduced to 8 channels per 2 minute period when inactive

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. With the same timing same as channel poll
   b. Controllers (COM only) with sensors respond with either current sensor ON/OFF condition or pulse count

Message Structure:

The MIM or TWI operates on a framework of Groups and Channels. A Group is composed of 28 channels. The MIM-LINK and the TWI-LINK are each capable of operating four groups (please note that some central control software have a limited number of Groups available). 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)   Link Diagnostic screen

Always start by reviewing the "Link Diagnostics" screen in the Monitor/Log section of the central control.

Location	1	2	3	4	5	6	7	8	9	10	
Link Quality	Fail	Fail	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pas
	0%	0%									
Calls to Sat	1198	1233	246	213	216	213	211	213	215	214	
Responses from Sat	0	0	230	206	208	209	209	209	209	209	
Total Calls Heard	0	0	224	197	200	201	201	201	202	201	2
Total Days	1	1	1	1	1	1	1	1	1	1	
System Availability	100%	99%	99%	99%	96%	96%	96%	96%	96%	96%	

Link Diagnostic Screen

Box: Allows selection of the correct box number, if multiple interfaces are installed.

Group: Allows selection of which group to display the diagnostics results.
Location: The row indicating the location serves two functions. It identifies the channel number when considering the "Calls to Sat", "Responses from Sat" and "Total Calls Heard" rows. It indicates hours of the day when considering the "Total Days" and "System Availability" rows.

Link Quality: 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 channel as measured by the MIM/TWI. A large number compared to the others indicates that either a controller is not responding or the MIM/TWI is not hearing the response

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

Total Calls Heard: This number indicates the total number of calls the channel heard from the MIM/TWI. This is compiled by the controller and downloaded to the MIM/TWI after it requested it. The MIM/TWI asks for this data once per hour, on the odd minutes, based on a defined schedule (ex.: Group 1, channels 1 to 14 is requested at the 3rd minute after the hour, channels 15 to 28 at the 11th minute after the hour, etc.)

Total Days: This indicates the number of days the system has recorded since the log was cleared.

System Availability: This percentage is an expression of the time available for communication for the MIM/TWI. It is an important indicator of interference with LINK communication. As an example, a value of 90% in Location column #14 (remember that the "Location" row indicate the hour of the day when looking at the System Availability row) means that the system could not transmit for 10% of the time (6 minutes) between 1 and 2 PM. This row allows pinpointing the time of the day an interference problem is occurring.

Examples of Link Quality issues:

If Channel 3 had 246 Calls to Sat, 130 Responses, and 124 Total Calls heard - Problem would be receiving.

If Channel 3 had 246 Calls to Sat, 130 Responses, and 224 Total Calls heard - Problem would be in Satellite Transmit

If Channel 3 had 246 Calls to Sat, 120 Responses, and 172 Total Calls heard - Could be a range problem (70% each way).

1. Basic Troubleshooting

On a LINK system, it is important to address communication issues promptly. As few as three non-responding channels can cause important communication issues with the rest of the controllers since the system is always trying to reach the non-communicating channels.

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 render the controller 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 MIM/TWI or through a repeating controller?
    - If from MIM/TWI, 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
  - Is the System Availability above 98% at all hours?

- If only a single controller is showing issues (note that the diagnostics could be showing issues with multiple channels as a PAR+ES can use up to 3 channels), look at the Link Diagnostic and try to determine if it is a receiving or transmitting issue.
  - o 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 MIM/TWI.

2. MIM / TWI Troubleshooting

Inside the MIM-LINK / TWI-LINK, the LINK900 radio is connected via a 9-Pin ribbon cable to the Output Board. On the right edge of the Output Board are four light emitting diodes (LEDs) indicating the current communication status

- RXD – Receive Data Indicator (Top LED)
  - o Normally ON when idle. Will blink when data is being received
  - o RXD can flash during transmit or when noise is present
- CD – Carrier Detect (2nd LED from top)
  - o Normally ON when idle
  - o Off when signal detected
  - o If blinking when no output occurring, interference likely
- TXD – Transmitted Data (3rd from top)
  - o Normally ON, blinks when data is transmitted
- RTS – Push-to-Talk (bottom LED)
  - o ON when idle
  - o OFF when radio is transmitting

When troubleshooting, make sure that the LEDs react accordingly when the MIM / TWI is transmitting or receiving.

Check the MIM CPU fuse for abnormal heat or if it is blown. This fuse is on the top right of the CPU board while looking at the back side of the MIM/TWI door while it is open.

Check the Link Output Board fuse as well. This fuse is located on the board mounted inside the MIM/TWI (not on the door).

Remember that the MIM-LINK / TWI-LINK will poll 8 channels every two minutes when the system is idle. It is easiest to do troubleshooting when the system is idle (no irrigation) as the expected Transmit / Receive patterns can be predicted.

3. 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 MIM/TWI 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 MIM/TWI via the LINK900 radio
  - OFF – Not in MAXI® (or centralized) mode
  - Flashing – In MAXI® mode but not seeing the MIM/TWI
- Locate the LINK900 radio and look at the status LED (see picture below)
  - Power LED (bottom)
    - Solid – OK
    - Flashing (5 times per second) – Fault indicator. The error code can be read with the GE MDS Element Manager application in the Maintenance and Status/Events and Alarms menu.
    - OFF – No power. Check IFB fuse.
  - Sync LED (2nd LED from bottom)
    - Solid – Synched to the network and signal is acceptable
    - Flashing – Locked on the network but signal too weak
    - OFF – Not synched with the MIM/TWI. Check antenna, cables or programming.
  - TXD LED (3rd from bottom)
    - Normally off
    - ON when the radio is transmitting
  - RXD LED (top)
    - Normally OFF
    - Will flash when seeing transmitted signal by the MIM/TWI
      - This signal is not necessarily targeted to this radio. The radio sees all communications on the network, even if for controllers on a different Group

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

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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:

Red (+)

Black (-)

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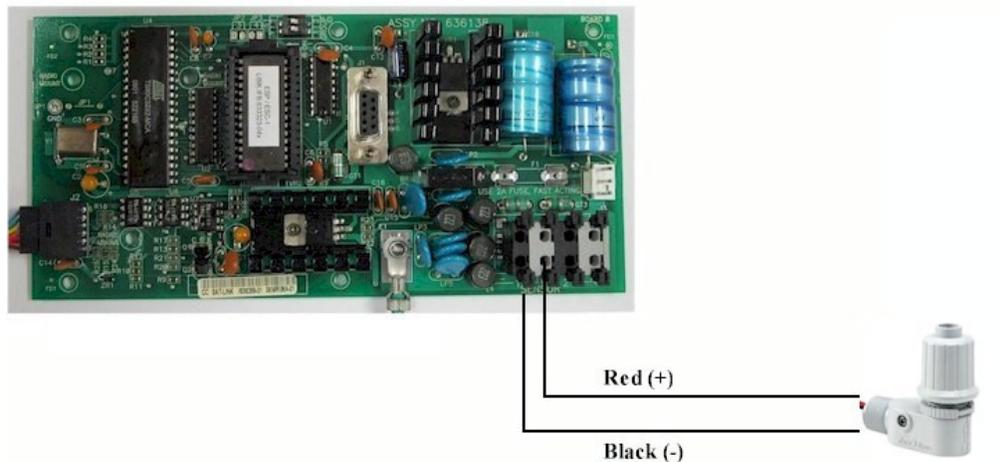
Using Pulse Sensors on a LINK900 communication system with an ESP-SATL controller

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:

Rain Bird
Rain Gauge

Red (+)

Black (-)
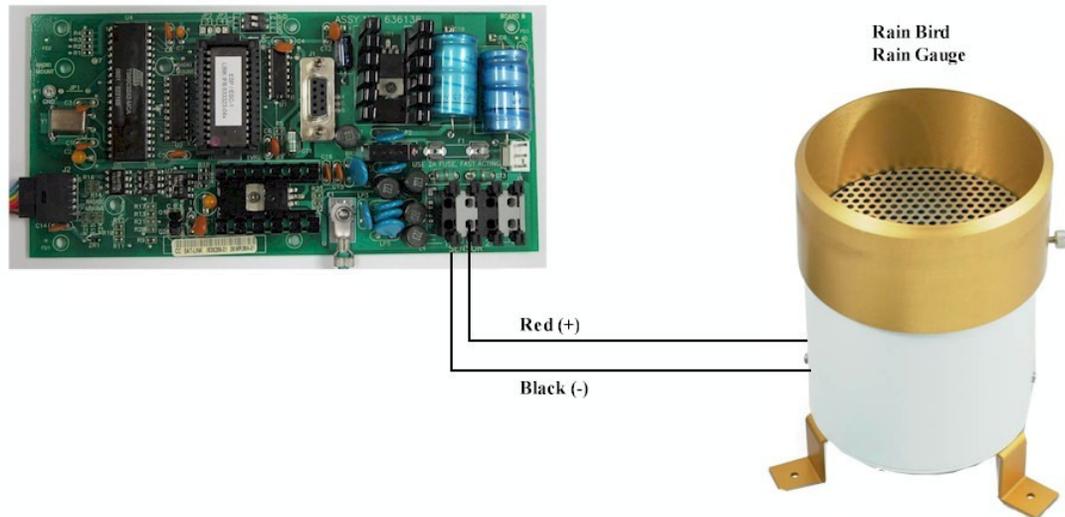
Sensors with more than 100 pulses per minute: Flow meters and wind anemometers are types of Pulse sensors that will almost always exceed 100 pulses per minute. In order to decrease the number of pulses sent to the central, a Pulse Transmitter must be installed. The Pulse Transmitter is programmed to 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-3002 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-3002:
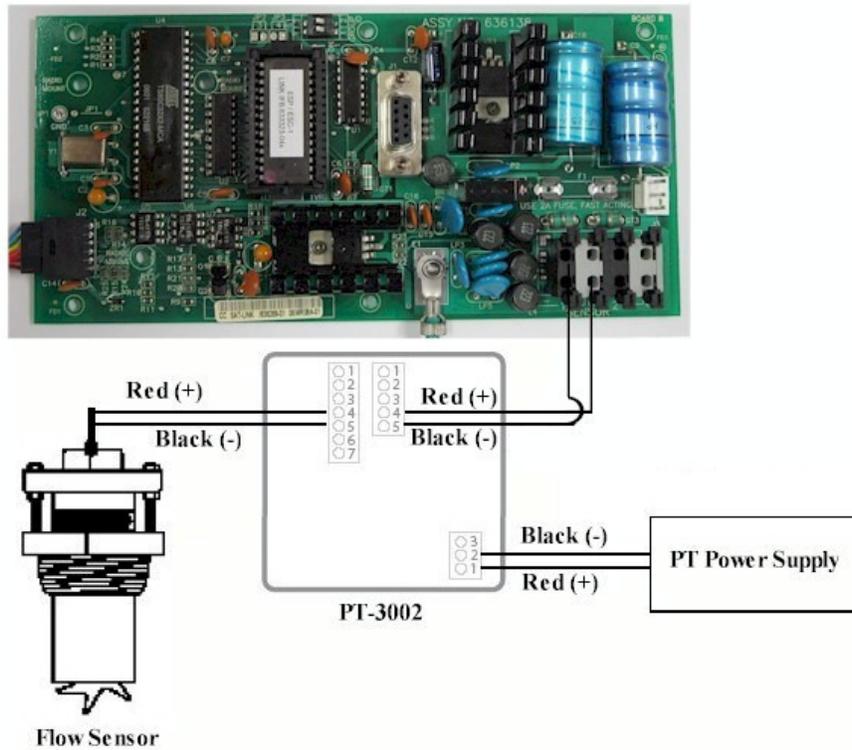
Wiring diagram when using the PT-322:

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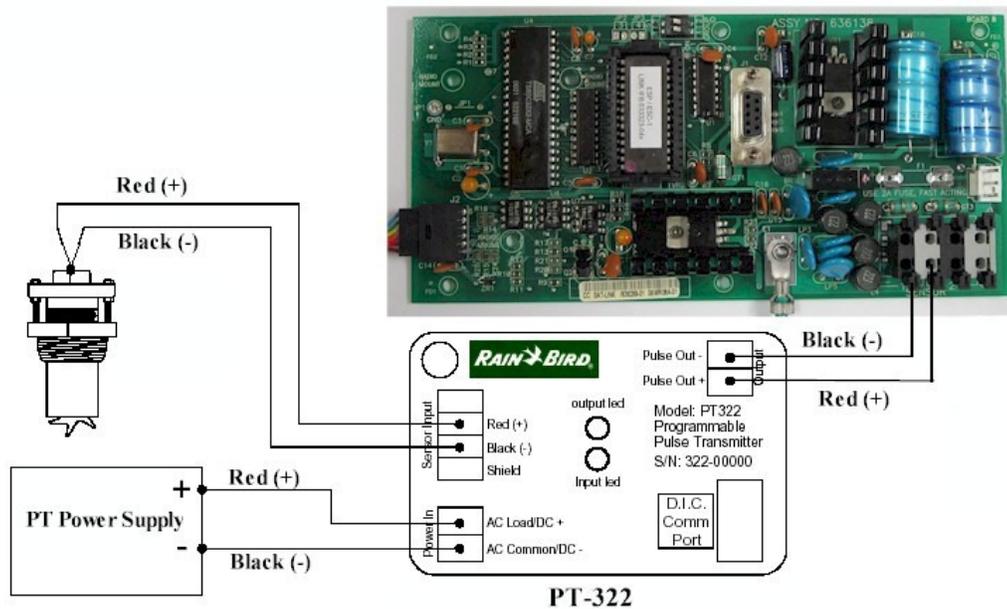
b) *Changing the COM port used by a USB-to-Serial Adapter*

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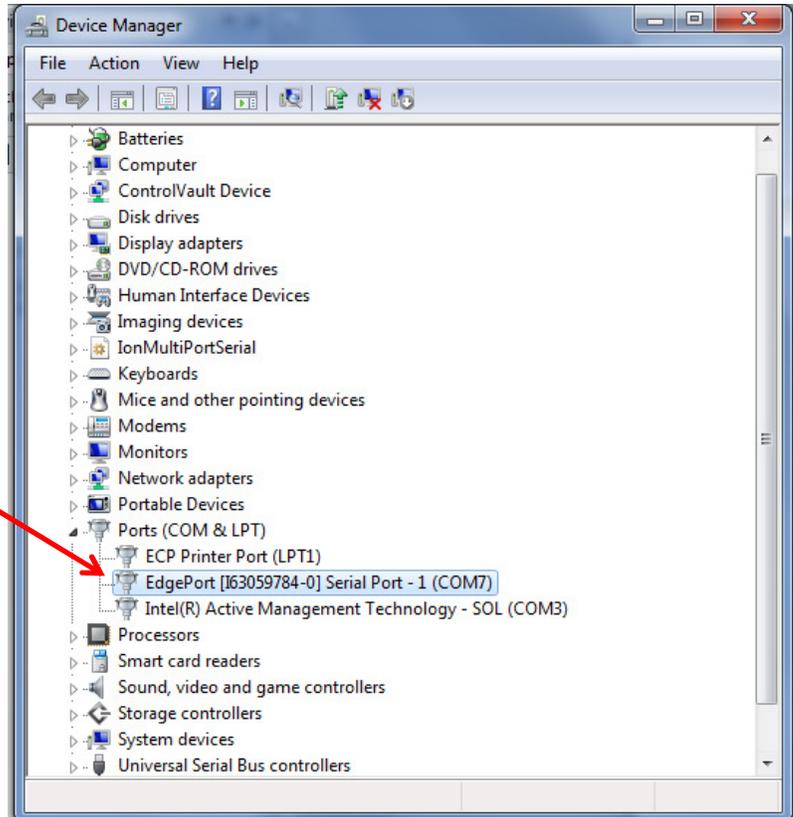
If needed, the COM port number may be using the following steps:

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

Chose the "Port Settings" tab

Click on "Advanced"

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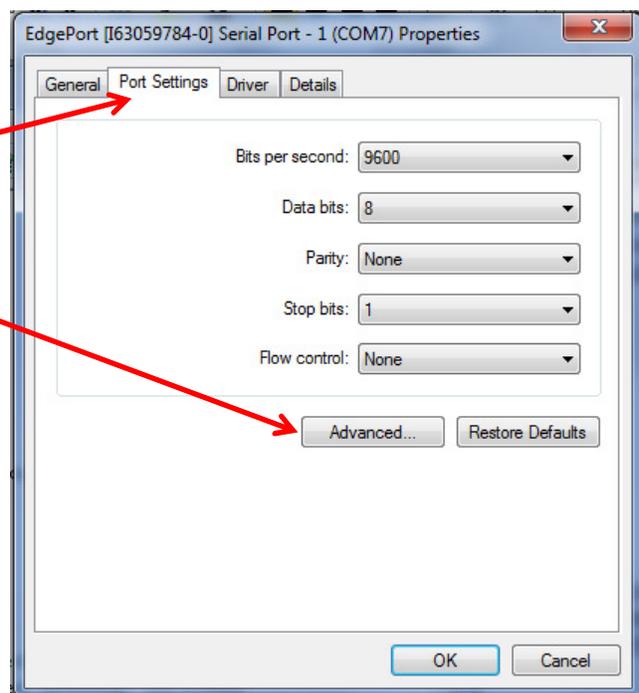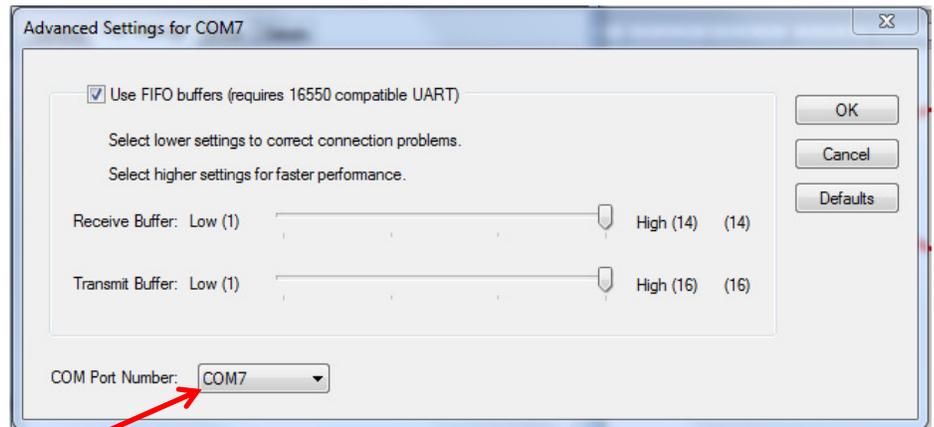
Click the "COM Port Number" drop down menu and choose the desired COM port number (e.g. COM1). Click OK twice to confirm your choice and close Device Manager.