Model

H-4401

Wireless “DAA” SDI-12 Bridge

WATERLOG® SERIES

Owner's Manual

Version 1.0

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Chapter 1
Introduction

1.0 Introduction

The ***WATER*LOG®** H-4401 is a wireless "DAA" SDI-12 bridge. The wireless bridge is ideal where one or more SDI-12 sensors must be physically located hundreds or thousands of feet from the data logger. The radio link is easy to use and provides SDI-12 communication between a ***WATER*LOG®** XL data recorder and one or more remote sites. All SDI-12 commands are supported, including manufacturer specific extended commands. The radio system includes a "sleep and sniff" feature which provides low power operation for use with battery operated gauging stations. No device addresses or setup is required, the master broadcasts to all slaves at the same time, addressing is done by the individual SDI-12 sensors connected to the system.

The radio link uses modern direct sequence spread spectrum telemetry radios which operate in the license-free 900 MHz ISM band. Spread spectrum technology is highly secure and has good interference immunity.

1.1 Architecture

Wireless bridges are problematic in that the SDI-12 protocol was originally designed for direct wired connections and has no provisions for additional latency inherent to radio communications. Design Analysis Associates manufactures two types of wireless SDI-12 bridges. The H-424 is a transparent bridge which works with any SDI-12 data logger. It works by forcing the data logger to issue retries while simultaneously communicating with the remote sensors. This scheme normally provides sufficient time to send one data packet and collect the sensor response. Unfortunately, the transparent bridge can drop measurements because of corrupted radio packet transmissions. If a packet is missed, the retry scheme provides insufficient time for the radio to resend the packet.

The H-4401 is a non-transparent bridge which works only with ***WATER*LOG®** XL data loggers. Two H-4401 components are required; a H-4401M (master) is connected to a RS-232 serial port on the data logger (instead of the SDI-12 port). One or more H-4401S (slave) units are located at the remote sensor sites. The-H-4401 bridge works by sending and receiving SDI-12 communications as ASCII messages, without the timing restrictions of the SDI-12 protocol. The H-4401M has a 9600 baud packet radio. The H-4401S has both a packet radio and a H-4191 RS-232 to SDI-12 interface. The H-4191 provides the RS-232 to SDI-12 electrical interface, generates the critical bus timing, parity and command retries needed for the SDI-12 bus protocol..

1.2 Low-power Operation

The radios used in the H-4401 are programmed for "sleep & sniff" low power operation. The master radio is configured for "pin wake-up" and awakes from its low power sleep state when transmit data is available. When the master radio is awakened it transmits a 4.5 second beacon before sending the data packet. The slave radios are configured for "cyclic sleep". The slave radios awake every 4-seconds and "listen" for several milliseconds. When a slave radio detects

the wake-up beacon it remains awake to receive the subsequent data packet.

1.3 Operation

With the H-4401 non-transparent architecture the data logger is configured to initiate and collect SDI-12 commands/responses from a RS-232 port instead of its normal SDI-12 port. SDI-12 commands from the data logger are forwarded via the radios to the remote H-4191. When the remote data radio receives an inbound data packet, it pulses the CTS input which awakens the H-4191 in preparation to receive the inbound message. When the H-4191 detects the "!" character, it transmits the contents of its buffer to the remote SDI-12 bus in a contiguous frame with proper parity and bus timing. The H-4191 waits for and collects any sensor response and forwards it to the radio. The sensor response is sent over the radios to the data logger. If one or more of the radio transmissions is lost or corrupted, the data logger can retry the entire sequence as needed.

The H-4191 has an internal inactivity timer which keeps the module awake to process the service request and receive subsequent radio packets. If both the RS-232 and SDI-12 ports become inactive (and both CTS and RTS are not asserted) for longer than 10-seconds, the timer expires and the H-4191 enters its low power sleep mode. The H-4191 examines the "aTTTN<CR><LF>" sensor response initiated by an "aM!" measure command and initializes a second "keep-awake" timer to TTT + 3-seconds. This ensures the H-4191 will remain awake to process the service request. When the service request actually arrives, the keep-awake timer is zeroed. While the keep-awake timer is running the H-4191 sends a null (00h) to the radio once/second to keep the radio link awake while waiting for the service request.

1.4 Installation

The H-4401 may be used with a 50-ohm, 900 Mhz antenna providing the effective radiated power is 6dB or less. The antenna connector is a reverse type-TNC connector which is required to meet FCC part 15.203 regulations. A simple vertical whip antenna will work up to 2 or 3 miles. Longer distances require a directional antenna with gain. A 6dB or 9dB YAGI will work fine, do not use a 12dB model. At 900 MHz, RG58 type coaxial antenna feed lines have excessive loss (1.8dB/10 feet). Consider using newer low loss RF cable such as Times Microwave LMR-400 or similar (0.8dB/10 feet). The LMR-400 requires special RG8 connectors.

The H-4401 is packaged in a weather tight enclosure and is best mounted as close to the antenna as possible. The H-4401 has a ground lug which should be connected to a good earth ground with a heavy copper wire. The ground helps provides lightning protection for the radio, your sensors and the data logger.

The H-4401 radios all operate at the same frequency. If multiple data logger sites are deployed, make certain the radios of each separate logging site cannot "hear" each other. The radios can be ordered with alternate identification codes, please contact the factory for further information.

Words of caution:

a. Even though the master H-4401 operates in a low power mode, the transmitter requires 200mA for short bursts. Make certain your wiring and battery is capable of supplying sufficient current.
b. Keep the lead wires as short as possible.
c. Use shielded cables in noisy environments.
d. Connect the ground post to a good earth ground.
e. Make certain each sensor has a unique SDI-12 address.

1.5 Troubleshooting

The radios can be difficult to field test when operating with a data logger due to the intermittent short bursts of data. The radio system can be more throughly tested with the aid of a lap-top computer or RS-232 terminal. With the following setup you can transmit ASCII messages or other test data while adjusting or aligning the antennas. The radio link is tested by connecting a computer terminal to one radio and connecting a loopback connector to the other. With this setup, one person can test both up-link and down-link communication paths.

The radios have a standard RS-232C interface which operates at 9600 baud. With a straight-thru 9-pin RS-232 cable, connect the master radio to a laptop computer or terminal. The radios have a female DB9 connector, pin-2 is received data output and pin-3 is transmit data input. The slave radio must be setup for loopback operation. Do this by installing a loopback test connector or connecting a jumper between pins 2 & 3. Make sure your computer is set for 9600 Baud.

The wireless link is best tested with a test program provided by the radio manufacturer. The test program "X-CTU" can be downloaded from the www.maxstream.net website. X-CTU automatically tests the wireless link and provides a success/fail display of each data packet.

Alternatively, you can use a terminal program such as XTALK, PROCOMM or HYPERTERM to test the radio link. Make sure your computer or terminal is set for full-duplex operation. Test the radio link by typing characters and checking for the proper echoed response. As you type, the characters are transmitted to the remote station then re-transmitted back to the local station and displayed on your screen. Both up-link and down-link paths are tested at the same time.

1.6 FCC Restrictions

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

f. Reorient or relocate the receiving antenna.
g. Increase the separation between the equipment and receiver.
h. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
i. Consult the dealer or an experienced Radio/TV technician for help.

Declaration of Conformity to Part 15, subpart B

The following declaration applies:

MaxStream Inc. model 9Xstream frequency hopping spread spectrum transceiver.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

1. *This device may not cause harmful interference, and.*
2. *This device must accept any interference received, including interference that may cause undesired operation.*

The responsible party for this declaration is:

MaxStream Inc.
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