Wireless Transducer
INSTRUCTION MANUAL

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Operating Program Revision: 2

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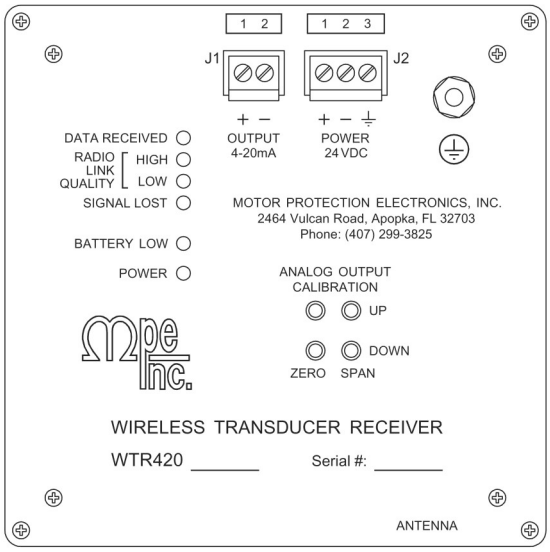
WIRELESS TRANSDUCER RECEIVER

DESCRIPTION



The Wireless Transducer Receiver reads the liquid level information in the radio signal from the nearby Wireless Transducer Transmitter and provides an analog 4-20mA output and SCADA register data that represents the liquid level being monitored.

The Transmitter and Receiver are capable of reliable communication even with the Transmitter inside a lift station wet well. The Receiver with its Antenna must however, be mounted nearby. For applications where the Transmitter and Receiver Antenna have line of site, reliable communication can be maintained at distances up to 125 feet.

The Pressure Sensor measures the Absolute Pressure, so in order to accurately determine the liquid level, the WTR420 measures the barometric pressure and makes the necessary correction.

When a message from the Transmitter is received, it must pass the following test before being accepted:

Must have the correct Frame Length value.	(Fault Code 101)
Must pass the Cyclic Redundancy Check (CRC).	(Fault Code 102)
Must not have noise in the message that causes the Buffer to be overwritten.	(Fault Code 103)
Must have Transmitter Address that matches the Receiver Address.	

If the incoming message passes all tests, then the DATA RECEIVED Indicator will blink, and the Radio Link Quality of this latest message will be indicated as either HIGH or LOW. HIGH indicates strong communication (Radio Link Quality 204 - 255). LOW indicates less than ideal communication (Radio Link Quality below 204).

If radio communication between the Transmitter and Receiver is lost for ten seconds or longer, the SIGNAL LOST indicator will be turned on, the 4-20mA output will be ramped down to just below 4.0mA, and Fault Code 100 will be generated.

Included in the message from the Transmitter is the status of it's Battery. If the Battery voltage is found to be low, the BATTERY LOW indicator will be turned on and blink and Fault Code 99 will be generated.

Also in the message from the Transmitter is a unique address programmed into each Transmitter. The Receiver checks the address in the incoming message from the Transmitter and verifies that it matches the Receiver address. This feature is necessary to allow two or more of these units to operate in the same area without confusion. The Receiver address may be changed in the field using the Touch Screen Interface Device (TSID) to write to Setup Parameter Register 40021.

The 4-20mA Analog Output may be calibrated in the field using the Zero and Span push-buttons on the front of the unit. The Span adjustment range is between 20mA @ 3.0 feet/H2O and 20mA @ 34.6 feet/H2O.

Connecting the RS-232 serial port (or optional Ethernet Port) to a SCADA system allows the Liquid Level, Barometric Pressure, Battery Status, Radio Link Quality, and Fault Codes to be monitored remotely.

SPECIFICATIONS

Input Power:	24 VDC ±10% 120 mA max
Analog Output:	Non-Isolated 4-20 mA Maximum Load 600 Ω
Radio Frequency:	2.4 GHz
Operating Temp:	-20 to +65 °C
Storage Temp:	-45 to +85 °C
Enclosure:	Aluminum, Din Rail Mounted

Receiver Subassembly: WTR420 A B

Analog Output Calibration:

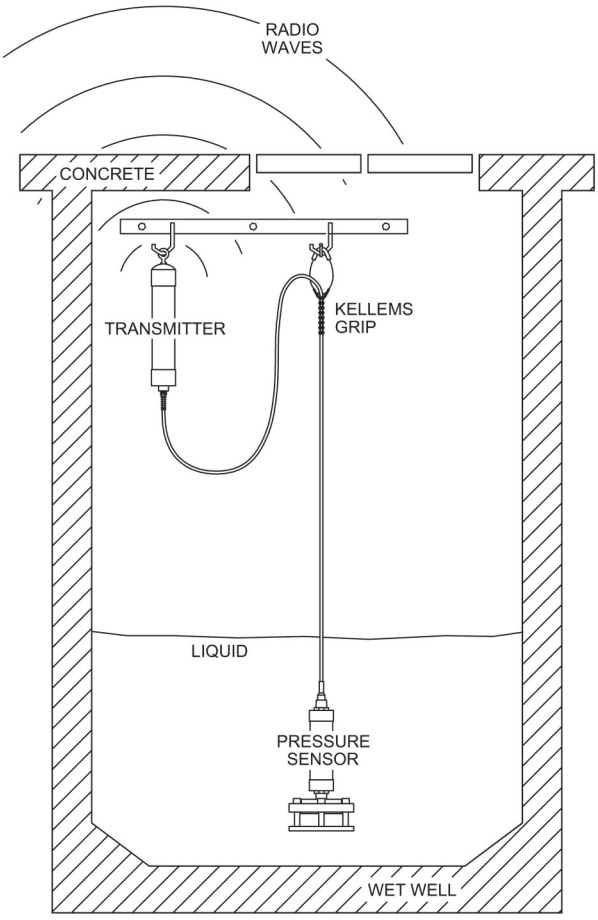
05 = 20mA @ 11.5 Ft/H2O
10 = 20mA @ 23.1 Ft/H2O
15 = 20mA @ 34.6 Ft/H2O

Communications Option:
Blank = Standard Unit **E** = Ethernet Port

Includes: Antenna and Antenna Cable

WIRELESS TRANSDUCER TRANSMITTER

DESCRIPTION



TRANSMITTER

The Transmitter is suspended above the liquid being measured, and is connected by a cable to the Pressure Sensor submerged in the liquid near the bottom of the tank.

Once each second the Transmitter sends to the Receiver the latest liquid level data, the battery status and the Transmitter address.

To conserve battery power, the Pressure Sensor and most of the circuitry in the Transmitter is powered down and put to sleep between updates.

After being asleep for one second, the Transmitter wakes up, powers up the Pressure Sensor, checks the level, checks the battery status, transmits the new data to the Receiver, and then goes back to sleep.

PRESSURE SENSOR

When submersed in liquid, the Pressure Sensor converts the pressure exerted by the liquid into an analog voltage signal that represents the liquid level. The sensor measures the absolute pressure, so a correction for the barometric pressure must be made. This correction is performed in the Receiver where the local barometric pressure is measured and subtracted from the absolute pressure value.

A stainless steel diaphragm and silicone oil fill is provided to isolate and protect the pressure sensor from the liquid being measured.

The weight of the Pressure Sensor acts to reduce its movement when placed in a moving liquid. A Strength Cord in the cable provides ample support for its weight. A Kellems Grip is provided to secure the Pressure Sensor Cable to a float hanger.

The Pressure Sensor and the Transmitter come connected together tested and calibrated as a unit. It is calibrated to read levels between 0.0 feet and 34.6 feet and to provide a 16 bit number to the Receiver that represents the measured level.

SPECIFICATIONS

TRANSMITTER

Enclosure Material:	PVC
Operating Temp:	-20 to +65 °C
Radio Frequency:	2.4 GHz
Battery:	Lithium, 3.6 V, Size “D”
Estimated Battery Life:	15 years
A/D Converter Resolution:	16 bit

PRESSURE SENSOR

Enclosure Material:	316 Stainless Steel
Cable Jacket Material:	Polyurethane
Operating Temp:	0 to +60 °C
Accuracy:	± 1.0 % full scale

Transmitter Subassembly: WTT40

Includes: 40 feet of Cable with Kellems Grip

TOUCH SCREEN INTERFACE DEVICE

The Touch Screen Interface Device (TSID) is a optional piece of equipment that is used to perform testing, troubleshooting and setup of the Wireless Transducer Receiver.

TSID Functions

- View Raw Level Data from Transmitter (Not compensated for Barometric Pressure)
- View Level Data from Transmitter (Compensated for Barometric Pressure)
- View Level Data from Transmitter Scaled into Feet and Tenths of Feet As Read by SCADA System
- View Barometric Pressure
- View Radio Link Quality
- View Incoming Transmitter Address
- View / Change Receiver Address
- View and Reset Fault Codes
- Simulate Liquid Level to Aid in Setting Zero and Span of Analog Output
- Set Modbus Slave Address for use in SCADA System
- Setup RS232 Serial Port for use in SCADA System
- Setup Ethernet Port for use in SCADA System

TSID Communication With WTR420

The **Touch Screen Interface Device** (TSID) communicates with the WTR420 through its RS232 serial port. The serial port setup of both devices must match the following:

Baud Rate = 9600 bps Parity Mode = 0 Stop Bits = 2 Slave Address = 1

To make the WTR420's serial port settings match the TSID's serial port settings, first have the TSID powered up and on one of the Wireless Transducer screens. Then with the TSID serial port cable connected to the WTR420, cycle the +24V power going to the WTR420 by momentarily disconnecting J2. Then as long as the WTR420 is being regularly polled by the TSID, the WTR420 will keep using the above serial port settings and continue to communicate.

When all the work using the TSID is done, the WTR420 may then be connected to the SCADA system where it will revert to the serial port settings programmed into it for the current application.

The Touch Screen Interface Device (TSID) consists of a 6 inch Touch Screen panel made by Automation Direct, housed in a durable carrying case with a power cord and an interface cable for connection to the serial port. It is programmed as a Modbus Master that continually polls the Wireless Transducer Receiver.

ORDERING INFORMATION

Part Number: **TSID**

ANALOG OUTPUT CALIBRATION

The 4-20mA Analog Output calibration may be changed in the field using the Zero and Span push-buttons on the front of the WTR420. The Span adjustment range is from 20mA @ 3.0 feet/H2O to 20mA @ 34.6 feet/ H2O.

Changing the Analog Output calibration will have no effect on the calibration of the liquid level read by SCADA from Register 40006.

Note: When first pressing either the Zero or Span push-button, there is a 4 second delay that must first expire before the setting begins to change. Once the delay has expired, all four of the push-buttons will be active and able to change the calibration without further delay.

There are two ways to perform the Analog Output calibration:

- The TSID may be used to simulate the Zero and Span levels, and the Zero and Span push-buttons on the WTR420 would be used to adjust the Analog Output.
- The Pressure Sensor may be manually raised or lowered in the liquid to provide the Zero and Span levels, and the Zero and Span push-buttons on the WTR420 would be used to adjust the Analog Output.

Calibration Procedure

Step 1

The Level Display on the device connected to the Analog Output must first be calibrated to read in feet of liquid with the desired span. This is typically done by using a 4-20mA generator.

Step 2

Use either the TSID to simulate zero feet or pull the Pressure Sensor out of the liquid and then use the Zero push-buttons on the WTR420 to make the HMI Level Display read zero feet.

Step 3

Use either the TSID to simulate the desired span or place the Pressure Sensor under a known depth of liquid and then use the Span push-buttons on the WTR420 to make the HMI Level Display read that level.

Repeat steps 2 and 3 several times until both are correct.

Note: The Pressure Sensor must be kept upright at all times to read correctly.

FAULT CODES

When a fault occurs a code is placed into the **Fault Code** Register and a copy of the Fault Code is placed into the **Last Fault Code** Register.

The **Fault Code** pertains to a currently pending fault. SCADA Register 40018.

The **Last Fault Code** is a record of the last occurring fault. SCADA Register 40019.

The Fault Code and Last Fault Code may be cleared by momentarily setting Coil 5 in SCADA Register 40001.

The **Fault Code** and the **Last Fault Code** may be viewed using the **Touch Screen Interface Device**. See the Table below for a description of each Fault Code.

Fault Code Table

Fault Code	Description of Condition
0	Normal
1	RS232 Serial Port - SCADA Communication Fault - Overrun Error reading incoming message.
2	RS232 Serial Port - SCADA Communication Fault - Time out error reading incoming message.
3	RS232 Serial Port - SCADA Communication Fault - Time out error responding to message.
4	RS232 Serial Port - SCADA Communication Fault - Incoming message failed Cyclic Redundancy Check (CRC).
5	RS232 Serial Port - SCADA Communication Fault - Invalid Modbus Function Code.
6	RS232 Serial Port - SCADA Communication Fault - Trying to preset more than 35 registers using Function Code No. 16.
7	RS232 Serial Port - SCADA Communication Fault - Trying to force to more than 100 Coils using Function Code No. 15.
13	RS232 Serial Port - SCADA Communication Fault - The UART detected a Framing Error reading the incoming message. It did not find Stop Bit where expected.
14	RS232 Serial Port - SCADA Communication Fault - Noise Detected on incoming message.
99	Transmitter - Battery Voltage Low.
100	Transmitter to Receiver Communication Fault - No communication from Transmitter for 10 seconds or longer.
101	Transmitter to Receiver Communication Fault - Incoming message Frame Length Error.
102	Transmitter to Receiver Communication Fault - Incoming message failed Cyclic Redundancy Check (CRC).
103	Transmitter to Receiver Communication Fault - Noise in the incoming message caused the Receiver's Buffer to be overwritten.
	Note: The Last Fault Code record of Fault Codes 101, 102, and 103 automatically clear after 60 successfully received messages from the Transmitter.

COMMUNICATION WITH A SCADA SYSTEM

A SCADA system may communicate with the WTR420 through either the RS232 Serial Port or through the optional Ethernet Port. The WTR420 operates as a Modbus Slave, where all communication is initiated by the Modbus Master.

MODBUS Functions Supported

Function Code	Function Description	Notes
01	Read Coil Status	
02	Read Input Status	
03	Read Holding Registers	
04	Read Input Registers	
05	Force Single Coil	
06	Preset Single Register	
08	Diagnostics - Sub-function 00 (Return Query Data)	
15	Force Multiple Coils	Limited to 100 Coils
16	Preset Multiple Registers	Limited to 35 Registers

Setup for Connection to a SCADA System

Each WTR420 in a SCADA system using the Modbus protocol is assigned a unique Slave Address so that it can be polled by the SCADA system Master using that unique Slave Address. However, if communication with the WTR420 is through the optional Ethernet Port, each WTR420 will already have a unique IP Address. In this case, the Modbus Slave Address Parameter may be set to 0. When set to 0 the WTR420 will ignore the value of the incoming Slave Address, but it will make a copy to be sent back in the response.

The following parameter must be set using the **Touch Screen Interface Device**:

Parameter	Default Value	Setting Definitions
Modbus Slave Address	1	Range: 0 - 247

RS232 SERIAL PORT

The RS232 serial port allows a SCADA system to communicate with the WTR420 using the Modbus RTU protocol.

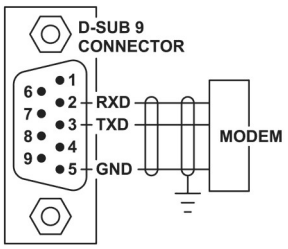
Setup of RS232 Serial Port

The WTR420's RS232 serial port must be setup to communicate with the device it is connected to. The Baud Rate, Parity Mode and Stop Bits parameter values of the two devices must be set to match.

The Delay Before Response parameter is provided for cases where the modem needs additional time to prepare itself before receiving a response back from the WTR420.

The following parameters must be setup using the **Touch Screen Interface Device**:

Parameter	Default Value	Setting Definitions
Baud Rate	4	1 = 1200 bps 2 = 2400 bps 3 = 4800 bps 4 = 9600 bps
Parity Mode	0	0 = No Parity 1 = Odd Parity 2 = Even Parity
Stop Bits	2	1 = 1 Stop Bit 2 = 2 Stop Bits (The 2nd Stop Bit is available only when No Parity is selected)
Delay Before Response	3 ms	Range: 1 – 100 ms



RS-232 Serial Port

ETHERNET PORT - Option

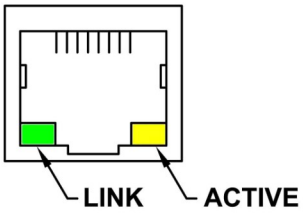
Features

The Ethernet Port has the following features:

- Protocols Supported: Modbus TCP or Modbus RTU
- IEEE 802.3 Compliant
- 100 Mbps communication speed
- Full-Duplex operation
- Link, and Active status LED indicators

LED Indicator	OFF	ON
LINK (Green)	Not Linked	Linked
ACTIVE (Yellow)	Idle	Active Communication

RJ45 Connector



Setup of Ethernet Port

Before connecting the controller to a SCADA system the following parameters must be setup using the **Touch Screen Interface Device**:

Parameter	Default Value	Setting Definitions
Protocol	2	1 = Modbus RTU 2 = Modbus TCP
IP Address	192 . 168 . 80 . 12 (IP4 . IP3 . IP2 . IP1)	Identifier for the device on an IP network. Range: 0 - 255
Subnet Mask	255 . 255 . 255 . 0 (SM4 . SM3 . SM2 . SM1)	Range of IP addresses that can be directly connected in the network. Range: 0 - 255
Default Gateway	192 . 168 . 80 . 1 (DG4 . DG3 . DG2 . DG1)	A node on the network that serves as an entrance to another network when no direct connection exists. Range: 0 - 255
Port Number	502	Range: 1 - 65,535

NOTE: The Ethernet Port reads the setup values upon power up; any changes require the power to be cycled before the new values are used.

The MAC Address is unique to each field device and is set at the factory. It can not be changed in the field, but may be viewed using the **Touch Screen Interface Device**.

Parameter	Fixed Value
MAC Address	0 : 80 : 194 : 219 : XXX : XXX (MA6 : MA5 : MA4 : MA3 : MA2 : MA1)

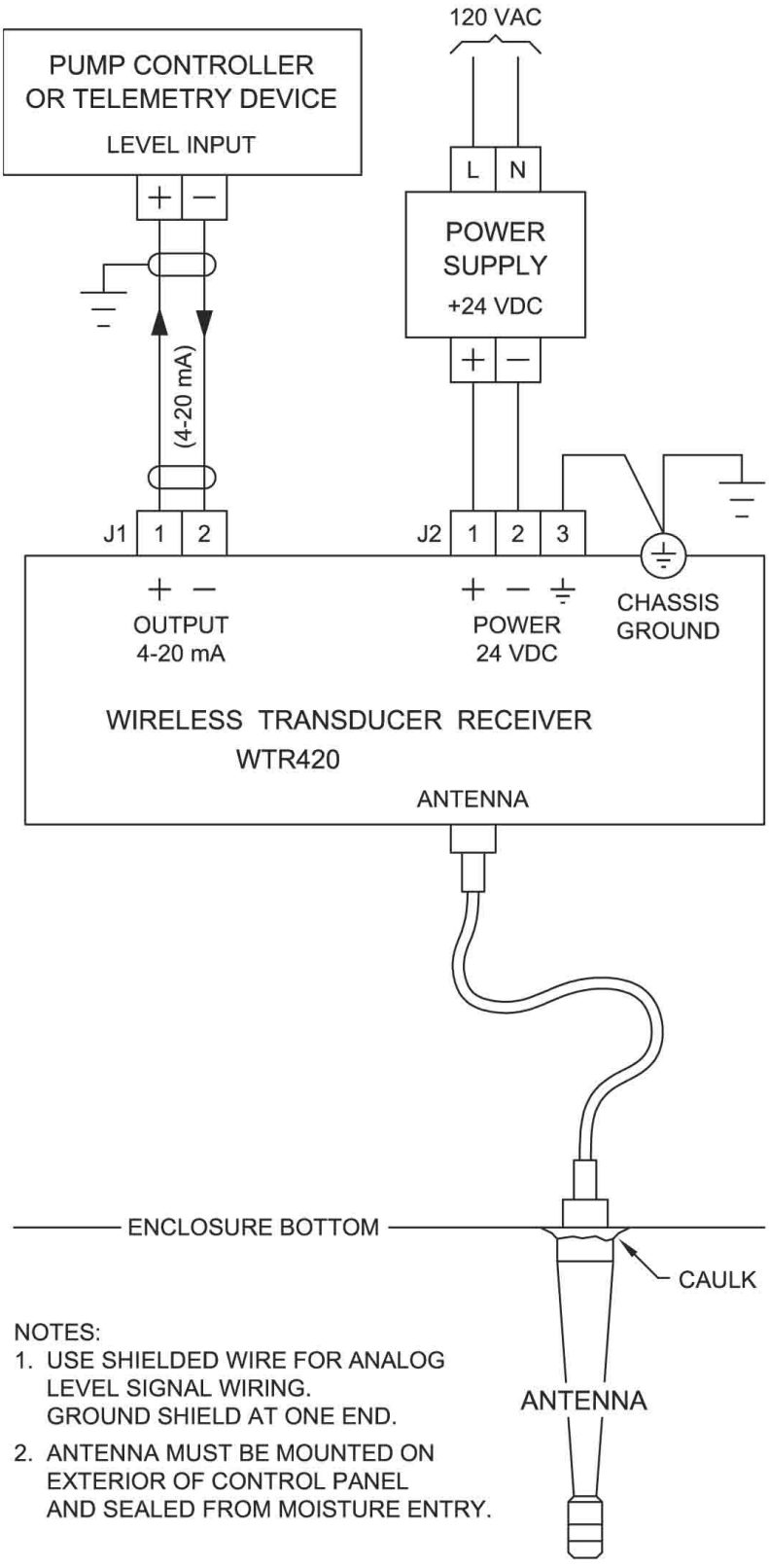
SCADA REGISTERS

<table>
<tr><th>Register Address</th><th>Read</th><th>Write</th><th>Description of SCADA Registers</th></tr>
<tr><td>40001</td><td>√</td><td>√</td><td>
<table>
<tr><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>Coil</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Fault Code - Reset</td><td></td><td></td><td></td><td>Transmitter Battery Voltage Low Alarm</td><td></td></tr>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td>Bit</td></tr>
</table>
</td></tr>
<tr><td>40002</td><td>√</td><td></td><td colspan="2">Transmitter Address (From Transmitter)</td></tr>
<tr><td>40003</td><td>√</td><td></td><td colspan="2">Radio Link Quality</td></tr>
<tr><td>40006</td><td>√</td><td></td><td colspan="2">Level - Feet & 1/10 Feet</td></tr>
<tr><td>40007</td><td>√</td><td></td><td colspan="2">Barometric Pressure - PSI</td></tr>
<tr><td>40008</td><td>√</td><td></td><td colspan="2">Barometric Pressure - Pascals - Most Significant</td></tr>
<tr><td>40009</td><td>√</td><td></td><td colspan="2">Barometric Pressure - Pascals - Least Significant</td></tr>
<tr><td>40018</td><td>√</td><td></td><td colspan="2">Fault Code</td></tr>
<tr><td>40019</td><td>√</td><td></td><td colspan="2">Last Fault Code</td></tr>
<tr><td>40020</td><td>√</td><td></td><td colspan="2">Receiver Program Revision Number</td></tr>
<tr><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td></td><td></td><td></td><td colspan="2"></td></tr>
</table>

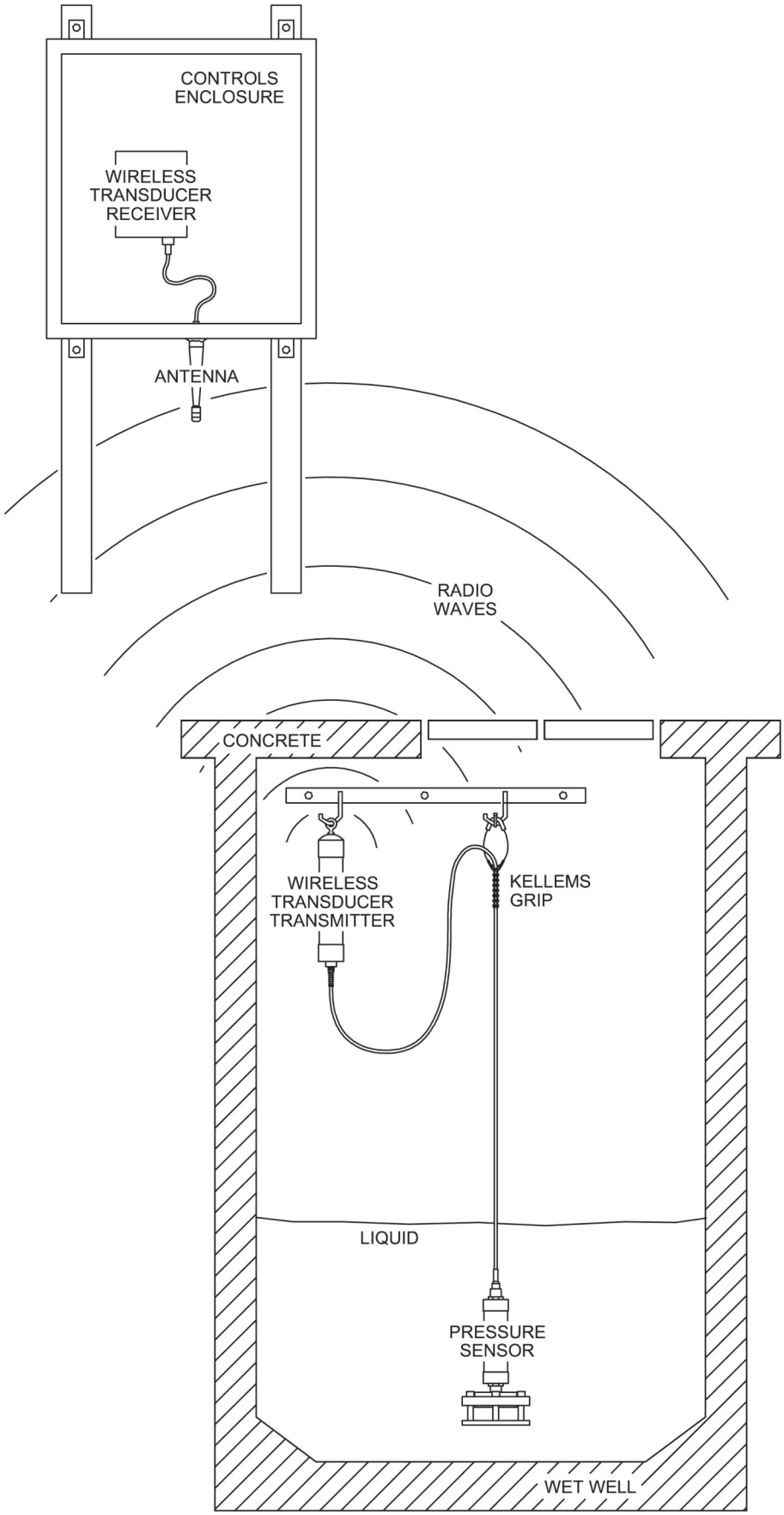
SETUP PARAMETER REGISTERS

Register Address	Read	Write	Description of Setup Parameter Registers
40021	√	√	Receiver Address (Must be set to match Transmitter Address)
40031	√	√	Modbus Slave Address
40032	√	√	RS232 Serial Port Setup - Baud Rate
40033	√	√	RS232 Serial Port Setup - Parity Mode
40034	√	√	RS232 Serial Port Setup - Stop Bits
40035	√	√	RS232 Serial Port Setup - Delay Before Response
40200	√	√	Ethernet Port Setup - Protocol
40201	√	√	Ethernet Port Setup - IP Address - IP1 IP4 . IP3 . IP2 . IP1
40202	√	√	Ethernet Port Setup - IP Address - IP2
40203	√	√	Ethernet Port Setup - IP Address - IP3
40204	√	√	Ethernet Port Setup - IP Address - IP4
40217	√		Ethernet Port Setup - MAC Address - MA1 MA6 : MA5 : MA4 : MA3 : MA2 : MA1
40218	√		Ethernet Port Setup - MAC Address - MA2
40219	√		Ethernet Port Setup - MAC Address - MA3
40220	√		Ethernet Port Setup - MAC Address - MA4
40221	√		Ethernet Port Setup - MAC Address - MA5
40222	√		Ethernet Port Setup - MAC Address - MA6
40223	√	√	Ethernet Port Setup - Subnet Mask - SM1 SM4 . SM3 . SM2 . SM1
40224	√	√	Ethernet Port Setup - Subnet Mask - SM2
40225	√	√	Ethernet Port Setup - Subnet Mask - SM3
40226	√	√	Ethernet Port Setup - Subnet Mask - SM4
40227	√	√	Ethernet Port Setup - Default Gateway - DG1 DG4 . DG3 . DG2 . DG1
40228	√	√	Ethernet Port Setup - Default Gateway - DG2
40229	√	√	Ethernet Port Setup - Default Gateway - DG3
40230	√	√	Ethernet Port Setup - Default Gateway - DG4
40232	√	√	Ethernet Port Setup - Port Number

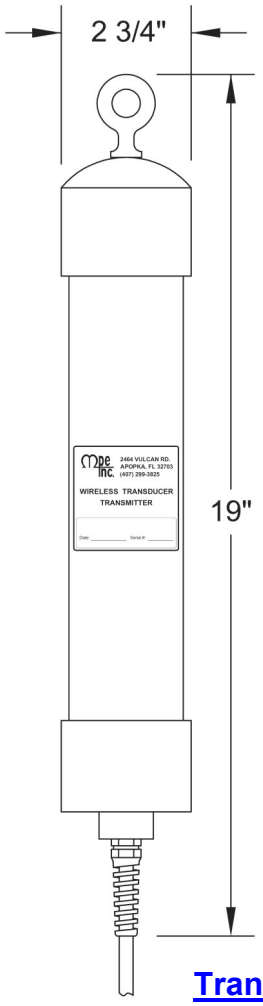
ELECTRICAL CONNECTION DIAGRAM



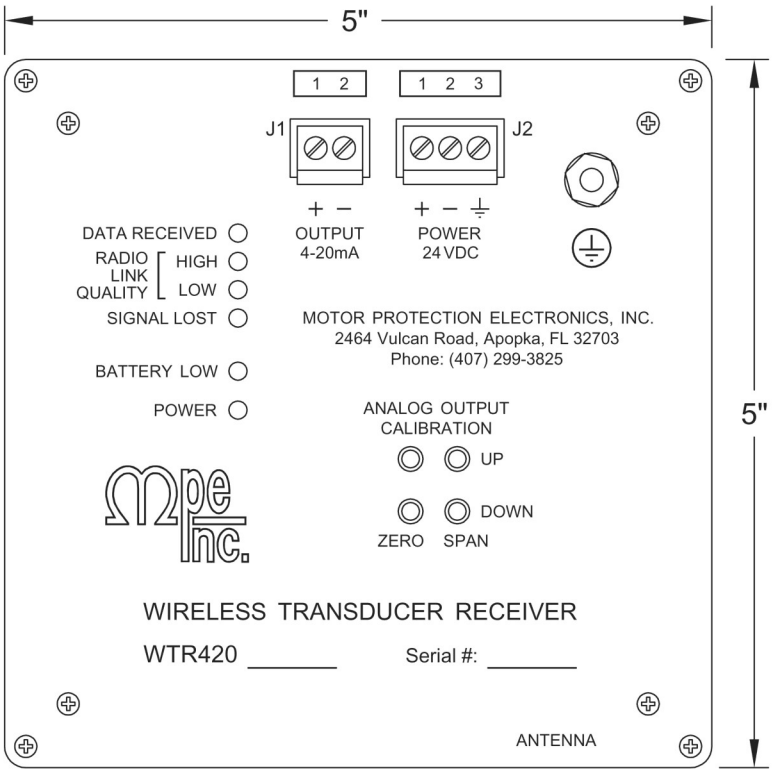
CONNECTION DIAGRAM



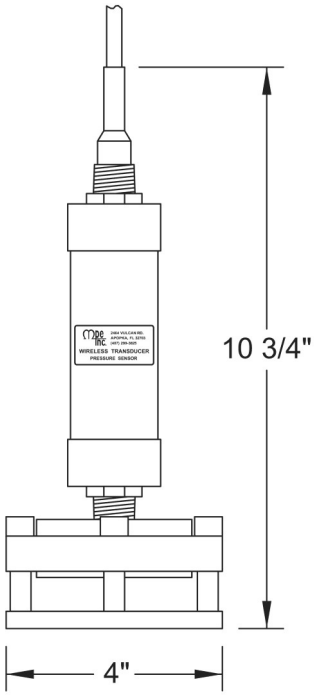
ENCLOSURE MECHANICAL LAYOUT



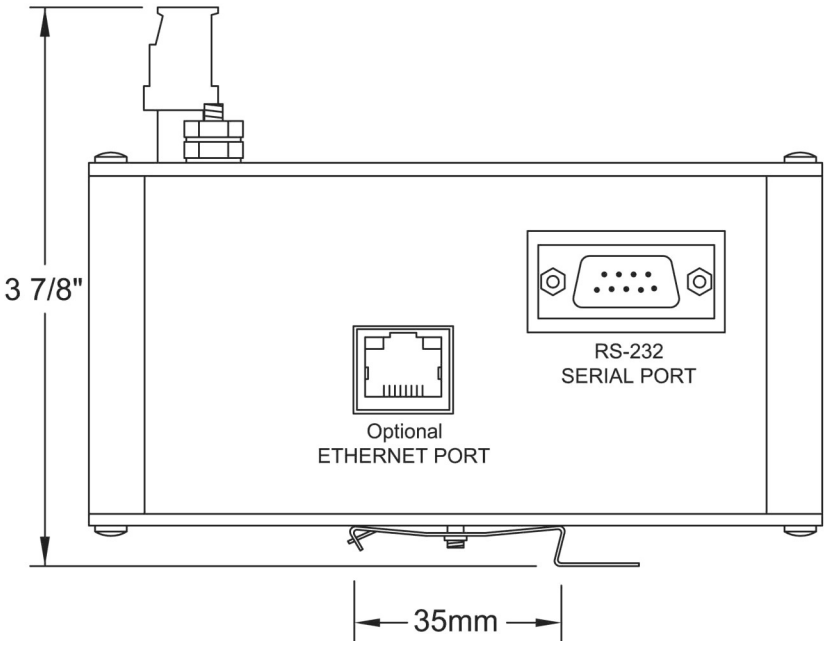
Transmitter



Receiver Front



Pressure Sensor



Receiver Left Side