Technical Manual

Description, Operation, Parts Lists and Installation Instructions

MODEL 2100A SERIES DATA TELEMETRY SYSTEM

INDUCTION POWERED CLAMP-ON TRANSMITTER & MODEL RTC

AC POWERED

Honeywell

TECHNICAL MANUAL

Description, Operation, Parts List and
Installation Instruction

TOP ASSEMBLY:	Model 2100A Data Telemetry System
SUBASSEMBLIES:	Model 2120B Transmitter
	Model 2145A Data Telemetry Receiver
	Model 2175A Induction Power Supply
	Model 2126A High Speed Collar
	Model RTC

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CHAPTER 1

GENERAL INFORMATION

1.0 INTRODUCTION

This manual provides a complete description of the Model 2100A Data Telemetry System. This manual is arranged in the following formats:

Chapter 1	General Information
Chapter 2	Operation
Chapter 3	Parts List
Chapter 4	Installation - Standard
Chapter 5	Installation W / RTC

1.1 SYSTEM DESCRIPTION

The Model 2100A Data Telemetry System consists of rotating and stationary components as shown in Figure 1-1, and in Figure 1-2 when incorporating a Model RTC in the system. In figure 1-1, the rotating components are clamped to the rotating shaft and consist of a transmitter module installed in a pocket of a collar containing a built-in antenna. In Figure 1-2, the Model RTC is bolted inline with the rotating shaft and contains the transmitter and rotating antenna. The Stationary components receive and condition the transmitted signal. Power to operate the rotating transmitter and sensor is provided by a induction power supply via the stationary and rotating antennas. These units and components together provide the means to transmit physical sensor data from rotating equipment to stationary monitors and control systems. Once setup and operating they require no further operator action.

1-2. RELATIONSHIP OF UNITS

The following is a brief discussion of the major components of the Model 2100A Data Telemetry System. When using the 2100A System with an instrumented shaft or customer supplied sensor see Sections 1.2.1, 1.2.2, 1.2.3, and 1.2.4. When using the 2100A System with a Model RTC see Sections 1.2.1, 1.2.2, and 1.3.

1.2.1 Model 2145A Data Telemetry Receiver

The Model 2145A Data Telemetry Receiver is a bench top unit with a digital display and front accessible controls used for setting system calibration at the analog data output and the display scaling. The data telemetry receiver unit is the source for all system power requirements.

Internal adjustments are readily available for reversing data polarity, reducing data bandwidth and setting display decimal point.

1.2.2 Model 2175A Induction Power Supply (IPS)

The Model 2175A Induction Power Supply provides the power to the transmitter via a simple power antenna loop inserted into two special binding posts of the IPS. The power antenna loop acts as the primary of an air core transformer with the secondary winding, assembled as part of Honeywell Sensotec's standard high-speed collar, rotating on the shaft.

The transmitter will operate with or without shaft rotation.

1.2.3 Model 2126A High Speed Collar

The Model 2126A High Speed Collar is made of high strength material and is specially prepared to house the Model 2120B Transmitter in a pre-machined pocket. The High Speed Collar also has a built-in antenna to simplify system setup.

The High Speed Collar is application specific and has been machined per the user's request for a specific shaft size prior to shipment from the factory.

The Model 2126A High Speed Collar is usable at extreme RPMs but it does have limitations. Refer to the Shaft RPM versus Shaft Diameter graph located in the Chapter 2 for specifics.

1.2.4 Model 2120B Transmitter

The Model 2120B Transmitter is an encapsulated module with integral regulated power supply and input circuitry intended to interface with extremely low level output signals from four arm strain gage Wheatstone Bridge circuits or equivalent. The transmitter converts these low level signals into a Frequency Shift Keying (FSK) FM signal, a digital technique, used to maximize noise immunity and minimize the effects of rotating to stationary antenna movements and vibration.

1.3 SYSTEM DESCRIPTION – MODEL RTC

The Model RTC includes the Transmitter, High Speed Collar, and Sensing Element in one package. The Stationary components of the 2100A System when using a Rotary Torque Cell are the same as described in Sections 1.2.2 and 1.2.3.

1.3.1 RTC Transmitter

The transmitter in the Model RTC is the 2120B as described in Section 1.2.1. It is not accessible to the customer as it is already wired to the antenna and strain gages. Unless the customer elects to perform the calibration, the transmitter also comes with a CAT resistor installed.

1.3.2 RTC High Speed Collar

The Collar on the RTC houses the rotating antenna which is wired to the transmitter internally.

1.3.3 RTC Design

The Rotary Torque Cell is designed specifically to adapt to the bolt patterns for inline coupling in each application. Typically the calibration is performed at the factory, allowing the 2100A System with the Model RTC to be essentially 'Plug & Play'.

1.4 SPECIFICATIONS

Specifications for the Model 2100A Data Telemetry System are listed in Table 1-1 thru Table 1-5.

1.5 EQUIPMENT, ACCESSORIES AND PUBLICATIONS SUPPLIED

Equipment, accessories and publications are listed in Table 1-7.

Table 1-1. Model 2100A System, Reference Data

REFERENCE	SPECIFICATION
Input	4 Arm Wheatstone Bridge or equivalent
Sensitivity (max)	175 μ in/in, ±50% input to ±10 Volts output
Data Bandwidth	DC to 1000 Hz adjustable downward
Bridge Excitation	5 VDC Nominal, 15mA max (350 OHM minimum bridge resistance) (System will not work with 120 OHM bridge)
Typical Effects on Data	Less than ±0.05% FS
Filter Type	Constant time delay – 8-pole Bessel
Cable Length Capability	At least 200 ft. between induction power supply and readout; 15 ft. supplied standard

Table 1-2. Model 2120B Transmitter Module, Reference Data

REFERENCE	SPECIFICATION
Operating Temperature	-55°C to +125°C
Compensated Temperature	0°C to +75°C
Static g Force	15,000 (orientation specific)
Vibration:	100g, 0-1 kHz (any axis)
Input Power, Induction	350 milliwatts – power frequency 150 to 170 kHz
Calibrate AnyTime, “CAT”	Automatic, both plus and minus, user settable value

Table 1-3. Model 2145A Receiver Unit, Reference Data

REFERENCE	SPECIFICATION
Operating Temperature	-15°C to +65°C
Compensated Temperature	0°C to +50°C
Induction Power Source	7.5 to 15 Volts DC adjustable
Analog Data Output	±10 VDC +10% @ 1mA maximum
Output Impedance	Less than 1 OHM, NOT A CURRENT SOURCE
AC Input Power	115/230 VAC, 50/60 Hz, 200VA maximum

Table 1-4. Model 2126A Clamp-On Collar, Reference Data

REFERENCE	SPECIFICATION
Shaft Diameter Limits	2.5 through 42 inches (63 through 1,065mm). For shaft diameters less than 2.5 inches (63mm) consult factory.
Operating RPM	Review the OPERATING RPM LIMIT VERSUS SHAFT DIAMETER graph. Consult factory for operation beyond limits.
Cross Section	1.25 x 1.25 inches (31 x 31mm), 3.5 inch (88mm) diameter shafts and larger. For shafts below 3.5 inch the O.D. is fixed at 6.0 inches (152mm). Note: Operating RPM Limit drop on shafts below 3.5 in diameter.
Collar Material	Glass epoxy (commercial designation G-11)
Collar Density	≈0.07 pounds per cubic inch (1.94 grams/cu.cm.)

Table 1-5. Model 2175 Induction Power Supply

REFERENCE	SPECIFICATION
Operating Power	7.5 to 15 Volts DC, 500 milliamps maximum
Antenna Type	Single Turn
Antenna Attachment	Parallel Sockets to accept 5/32 diameter (4mm) brass rod
Operating Frequency	160 KHz ±6% Nominal

Table 1-6. Model RTC w/ Bolt-On Collar

REFERENCE	SPECIFICATION
Power, Temperature, g Force, Vibration & CAT Specifications	See Table 1-2 2120B Transmitter Module
Bolt on Collar Specifications	See Table 1-4 2126A Clamp-On-Collar
Model RTC output	Pulse Width Modulated RF Signal
Model RTC Accuracy	< 1.0% Full Scale Torque

Table 1-7. Equipment, Accessories and Publications

QTY	ITEM NAME	PART NUMBER	OVERALL DIMENSIONS H x W x D (INCHES)	UNCRATED WEIGHT (POUNDS)
	Model 2100A Data Telemetry System, AC Powered	54721-100		≈15
1	Model 2120B Transmitter	54775-xxx	1 x 1.5 x 0.5	0.036 (16 grams)
1	Model 2145A Data Telemetry Receiver, AC Powered	54725-xxx	3.5 x 8.6 x 11.5	6
1	Model 2175 Induction Power Supply	54840-010	2.5 x 4 x 6	1.5
1	Model 2126A High Speed Collar	Various	Various	Various
1	7/16 Deep Socket Thin Wall – 12-Point 1/4 Square Drive	90868-002	—	—
4	Resistors, 180 OHM	—	—	—
4	Fasten Connectors	—	—	—
1	Fuse Adaptor – 3AG to mm	—	—	—
1	1/4” Allen Wrench	90868-003	—	—
1	5/32” Allen Wrench	90868-004	—	—
1	Technical Manual	54749-010	8.5 x 11	—

xxx – indicates frequency 13 MHz to 22 MHz

Figure 1-1. Model 2100A Data Telemetry System

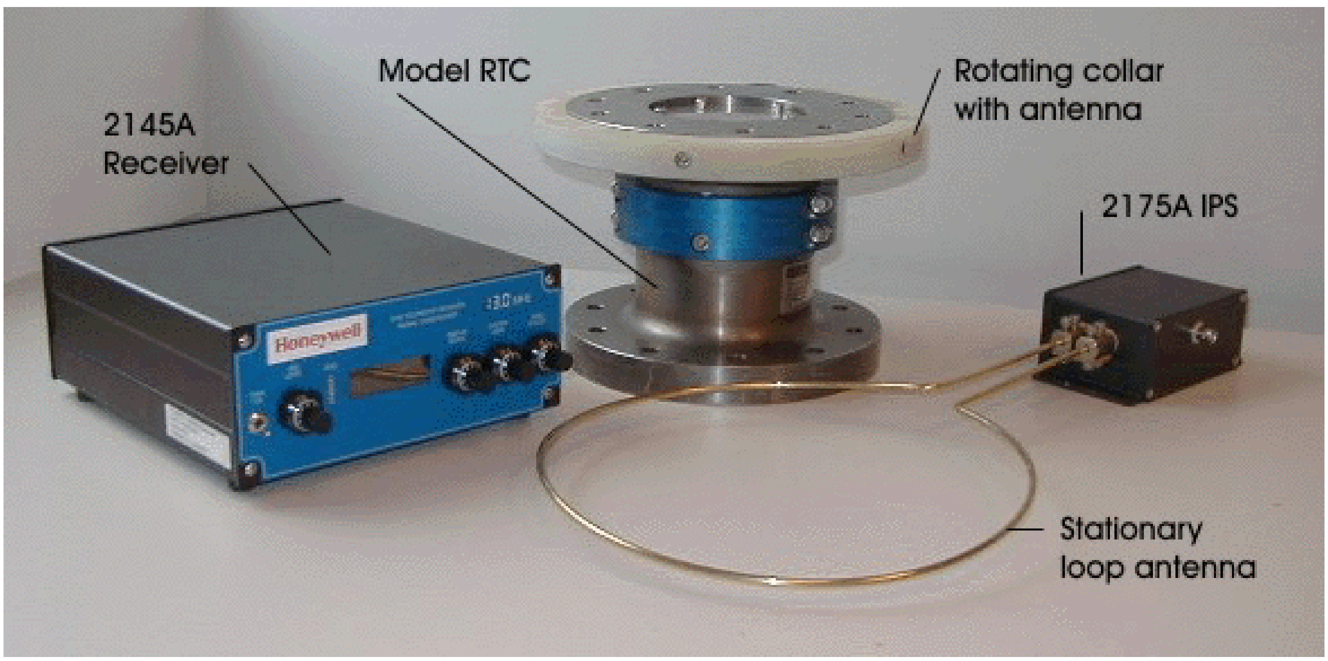


FIGURE 1-2   2100A SYSTEM W / MODEL RTC

CHAPTER 2

OPERATION

2.0 INTRODUCTION

This chapter discusses operation of the Model 2100A Data Telemetry System. It also identifies controls and indicators and describes correct operational procedures of the major components.

The Model 2100A Data Telemetry System consists of the following units:

- For the standard 2100A System:
  A single channel RF transmitter module installed into a machined pocket in a high-speed clamp-on collar secured to the shaft via two bolts. The transmitter power is received by a rotating antenna pre-assembled within the collar.

- For the 2100A System with a Model RTC:
  A single channel RF transmitter installed into a machined pocket in the Torque Sensor wired to the strain gages and the rotating antenna. The rotating antenna is embedded into a high-speed collar, which is bolted to the Torque Sensor.

- A data telemetry receiver that converts the RF signals from the transmitter into meaningful data. This unit also provides the power to operate the induction power supply, which in turn supplies the power necessary to operate the transmitter. The receiver can be located as far as 200 feet (65 meters) from the induction power supply and transmitter location.

- An induction power supply located at the rotating shaft that supplies power to the transmitter and picks up the RF signal to be sent to the data telemetry receiver. This unit has the mechanical attachments for the stationary power loop.

2.1 SYSTEM OPERATION

The following paragraphs provide a synopsis of the system operation on a unit-by-unit basis.

2.1.1 Model 2120B Transmitter

CAUTION

The transmitter module contains voltage sensitive components that are connected to the input pins. Ground yourself and the input wires before touching the pins.

The transmitter module has no displays or field adjustable controls. Terminal pins are provided for connecting input power, the four-arm bridge sensor, a balance resistor and the shunt calibration resistor for the “CAT” circuit. Once the unit is installed in the clamp-on collar, power and sensor leads connected and the proper power level achieved, no further operator action is required.

Although the transmitter has no built-in adjustments, the range of strain level input (input signal) could be changed from the high sensitivity of 175 micro-inch/inch (≈0.5 millivolts/volt) to anything in excess of 10,000 micro inch/inch (> 28 millivolts/volt). Refer to Figure 2-1 for the location of the gain-adjusting resistor.

The built-in “CAT” (Calibrate Any Time) feature provides plus and minus shunt calibration to be activated whenever desired without a need to access the sensor wiring or stop the machinery. Refer to Figure 2-1 for the location of the shunt calibration resistor.

NOTE: When using the 2100A System with a Rotary Torque Cell (Model RTC), the transmitter is pre-wired for the proper gain, and calibration and is not required by the customer.

2.1.2 Model 2145A Data Telemetry Receiver

The Model 2145A Data Telemetry Receiver is illustrated in Figure 2-2. This figure shows the controls, displays, display adjustment, and induction power adjustments. The frequency of the receiver is marked in the upper right-hand corner of the front panel for easy match to the transmitter in multiple (up to ten) channel installations. The RSSI (Received Signal Strength Indicator) identifies when an operating transmitter matches a receiver and that the signal to receiver path is completed. Power input and analog data output connectors and fuse locations are shown in Figure 2-3.

Figure 2-4 shows the data telemetry receiver with the cover removed exposing the analog data output polarity reversal switch, and a multi-position switch used to change the data output filtering. A switch for inserting a decimal point is located on the back of display board.

The telemetry receiver circuitry is designed to complement the Model 2120B transmitter. A full-scale plus and minus (±) signal input to the transmitter will produce a ±10-volt output at the analog data output port. The gain adjustment will allow a further variation of signal input of ± fifty (50%) percent and still output ±10 volts at the analog data output port. The zero adjustment will handle ±50% bridge offset signal. Any gross offset signal in excess of this must be corrected by offsetting the bridge circuit connected to the transmitter.

The display scaling adjustment can be used to set the display to represent engineering units, to match the specific application.

The induction power supply adjustment controls the level of direct current supplied to the Model 2175A Induction Power Supply unit, which powers the transmitter modules. The voltage range is about 7 to 15 volts with a maximum current output of 0.5 amperes. The final level is determined while monitoring the raw power received by the transmitter.

2.1.3 Model 2175A Induction Power Supply

The Model 2175A Induction Power Supply unit shown in Figure 2-5, couples power to the transmitter via a stationary power loop encircling the shaft and the High Speed Collar. The high speed collar or module support ring contains a secondary rotary loop. These primary and secondary loops form an air core transformer and are the means of power and signal transfer between the rotating transmitter and the receiver. The stationary power loop is attached to the induction power supply (IPS) via two binding posts mounted on the end of the IPS.

To maximize power transfer the stationary power loop and the IPS are adjusted for resonance at the factory. An internal circuit is provided to allow the user to fine tune (maximize) the power transfer after the system is installed in its final location. A built-in circuit with test points limits the required installation test devices to a single digital voltmeter. After fine-tuning the power level, the transmitter is set with the induction power source adjustment on the front of the telemetry receiver. No further adjustment will be required during normal operation.

2.1.4 Model 2126A High Speed Collar

CAUTION

DO NOT EXCEED THE RPM LIMITS OF FIGURE 2-6.

The Model 2126A High Speed Collar is a two-piece clamp-on assembly secured to the rotating shaft via high strength bolts. The collar contains a built-in antenna, which simplifies securing the transmitter to the shaft and minimizing system setup time. Each collar has a pre-machined pocket to hold the Model 2120B Transmitter.

Refer to Figure 4-1 to identify the built-in pins to be jumpered after clamping the collar to the shaft. The jumpers must be soldered in place for correct operation. Each bolt provided with the high-speed collar has been tested for strength conformance. Figure 2-6 shows the operating RPM Limits of the high-speed collar versus shaft diameter.

2.2 OPERATION OF PROTECTIVE DEVICES

The telemetry receiver is protected by a 5 ampere 3AG-type slow blow fuse on the rear panel. Additional fuse holder adapters have been provided to accommodate millimeter fuse types.

The dc powered telemetry receiver is protected from reverse connection by an internal diode. The induction power source is short circuit protected.

The induction power on the stationary power loop is non-hazardous and can be handled at any time without danger.

The analog data output is isolated from the power sources.

2.3 CONTROLS AND INDICATORS

The normal mode operation of the Model 2100A Data Telemetry System is automatic and requires no operator interface. The system will start up and operate correctly after a power outage without outside help.

The “CAT” feature will activate automatically upon power restoration so the system user can validate correct operation.

The following paragraphs will identify a specific unit followed by a description of all usable controls, displays and functions referenced to a figure.

2.3.1 Model 2145A Exterior Items

The Model 2145A Data Telemetry Receiver Front and Rear Panels are shown in Figures 2-2 and 2-3.

Front Panel:

a. PWR ON – Power switch which turns on power to the receiver and to the system. Figure 2-2 (1).

b. IPS LEVEL – Controls the DC Voltage level of the Induction Power Source used to supply power to the transmitter. Figure 2-2 (2).

c. RSSI – Received Signal Strength Indicator. Bar graph indicator which provides a relative value of received signal strength from the transmitter used to validate transmitter operation. Figure 2-2 (3).

d. DISPLAY SCALE – Used to set the display to engineering units to represent a specific application. Figure 2-2 (4).

e. SYSTEM GAIN – Used to set the voltage level of the Analog Data Out during system calibration. Figure 2-2 (5).

f. ZERO ADJUST – Used to correct signal offsets from the strain gage bridge. Will handle ±50% of full scale sensor unbalance. Figure 2-2 (6).

g. Receiver operating frequency identification in megahertz. See Figure 2-2 (7). (Not a control or adjustment – reference only).

Rear Panel:

a. ANALOG DATA OUT – Primary data output of the data telemetry system. The voltage output is capable of at least ±10 Volts. Engineering transfer function of input signal to output voltage is set during system calibration by user. Figure 2-3 (1).

b. INDUCTION POWER SOURCE – This power source is controlled by the IPS LEVEL adjust on the front panel. It is capable of a variable output voltage of 7.5 to 15 volts at a maximum current of 500 milliamps. The Induction Power Source is used to power the Model 2175A Induction Power Supply, which in turn supplies power to the transmitter and sensor. Figure 2-3 (2).

c. AC POWER – Input power connections for the receiver and therefore the complete system. AC line for direct connection to power supply. Figure 2-3 (3).

d. LINE VOLTAGE SELECT – Move the switch to the appropriate voltage. Figure 2-3 (4).

e. FUSE – The standard fuse is of the 3AG TYPE 5 AMP – SLO BLO. Millimeter fuse adaptors have been included in the accessory kit. Figure 2-3 (5).

2.3.2 Model 2145A Interior Items

The Model 2145A Data Telemetry Receiver interior features are shown in Figure 2-4. The cover is removed by unscrewing the four (4) top corner screws.

The analog data output polarity reversal switch allows for correction of sensor mis-wiring errors negating the need for tearing the sensor apart when a data control unit can only tolerate one direction signal polarity. For applications where data response of less than 1,000 HZ is allowable, a multi-position switch allows for filter settings to 100 HZ. A switch for 1 HZ filtering is also provided. See Figure 2-4. A decimal point for the display’s engineering units can be inserted using the switch on the back of the display board.

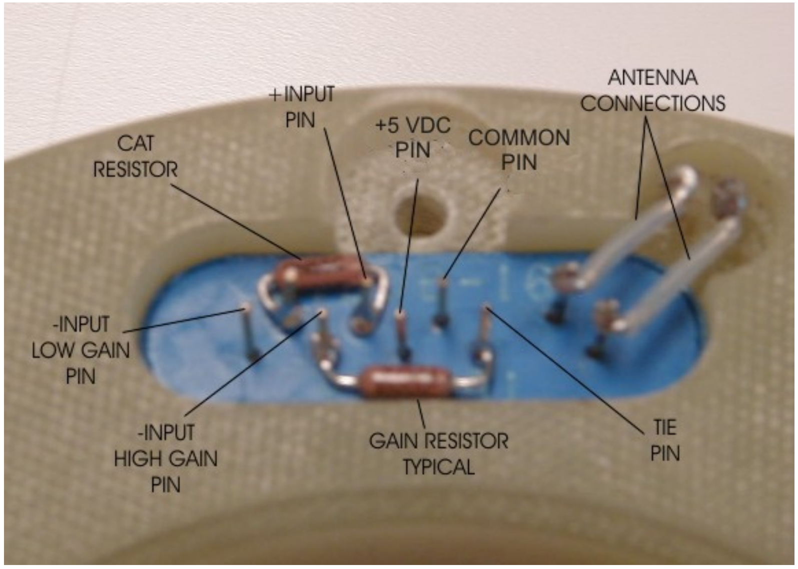


Figure 2-1. 2120B Transmitter

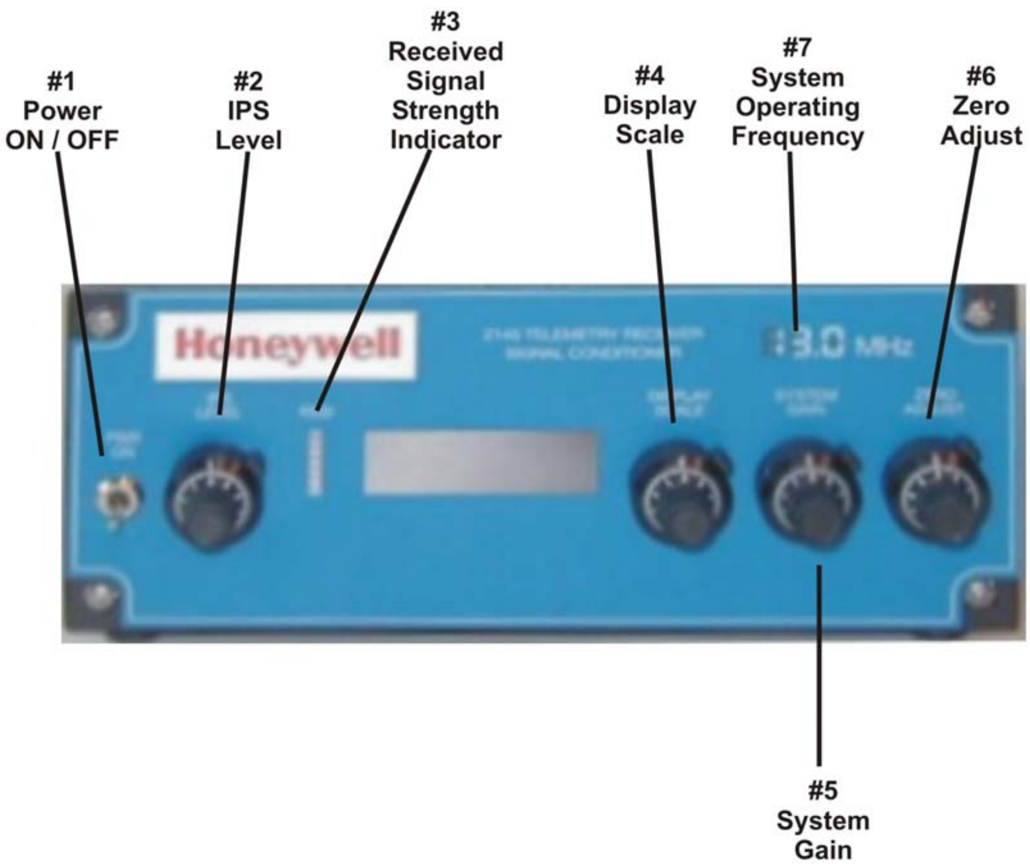


Figure 2-2. Model 2145 Data Telemetry Receiver Front Panel

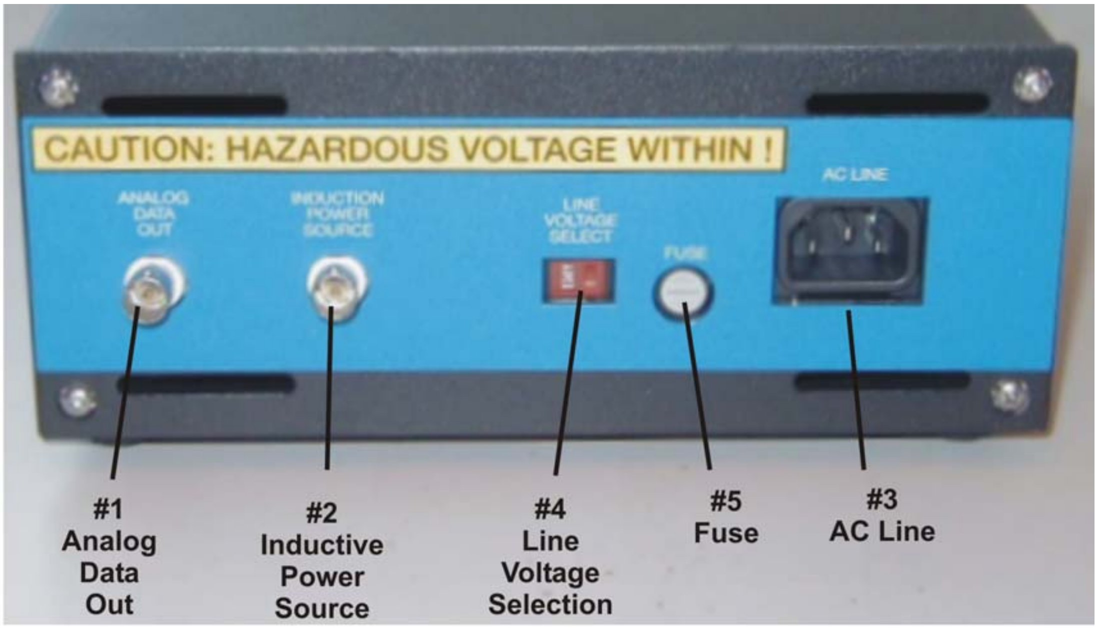


Figure 2-3. Model 2145 Data Telemetry Receiver Rear Panel – AC

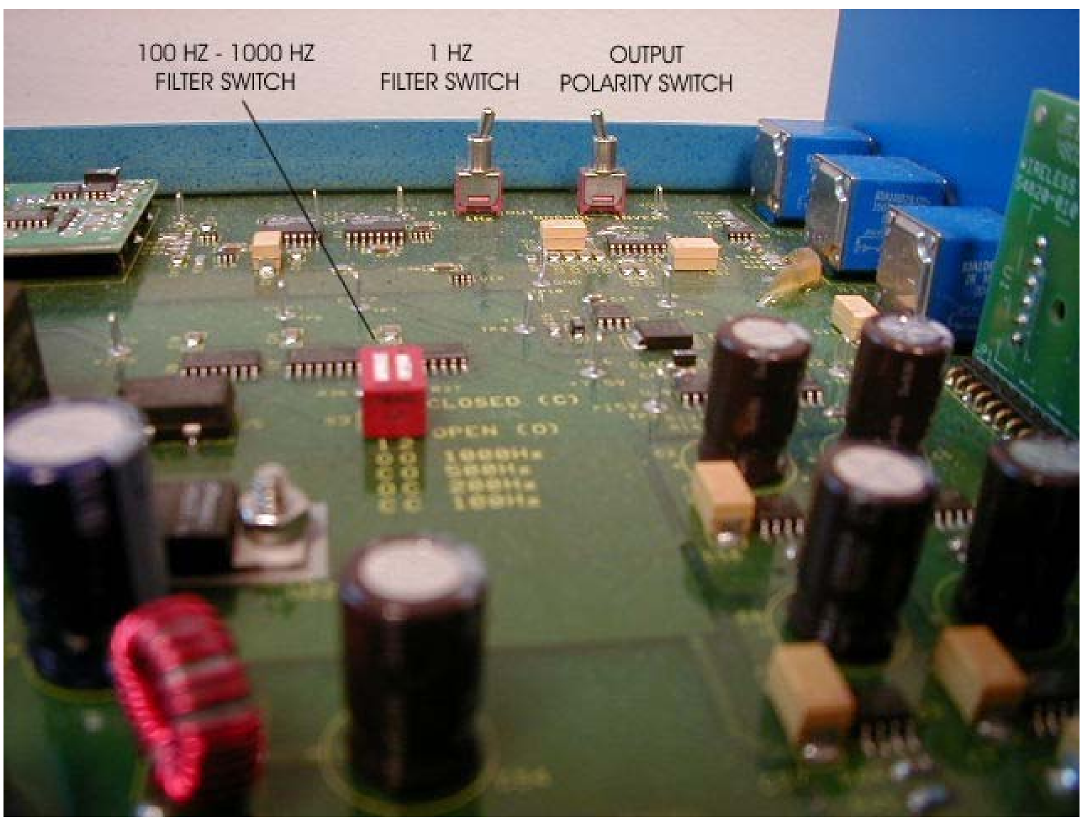


Figure 2-4. Internal View of Data Telemetry Receiver Showing Polarity Reversal, and Filter Switches

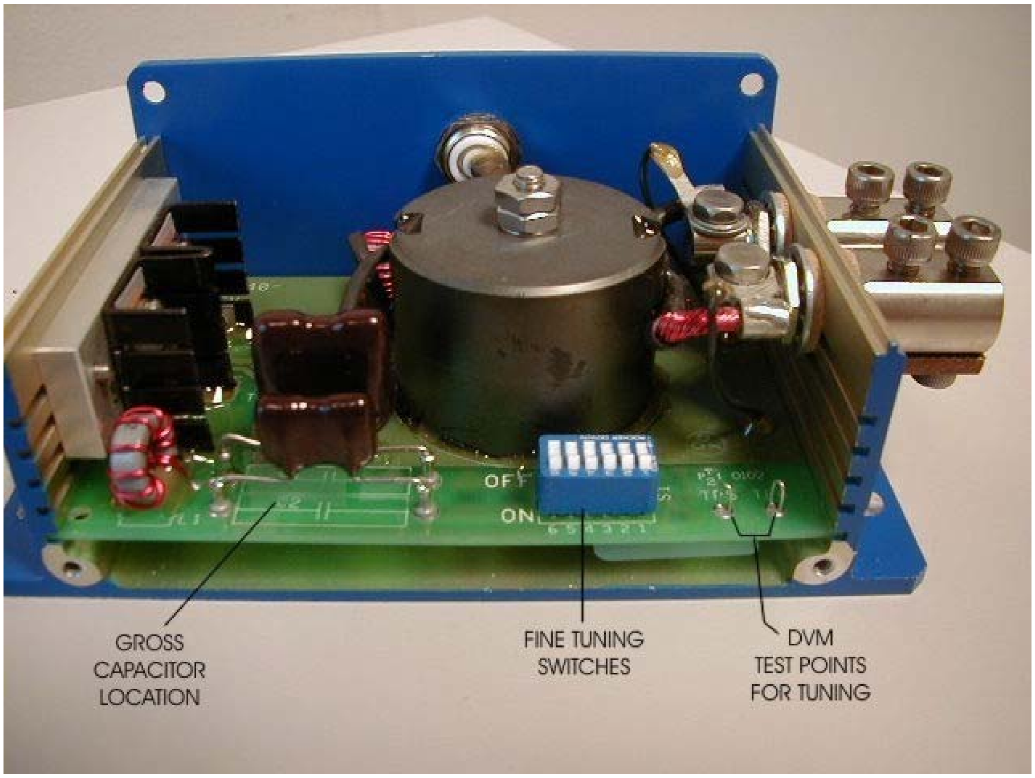
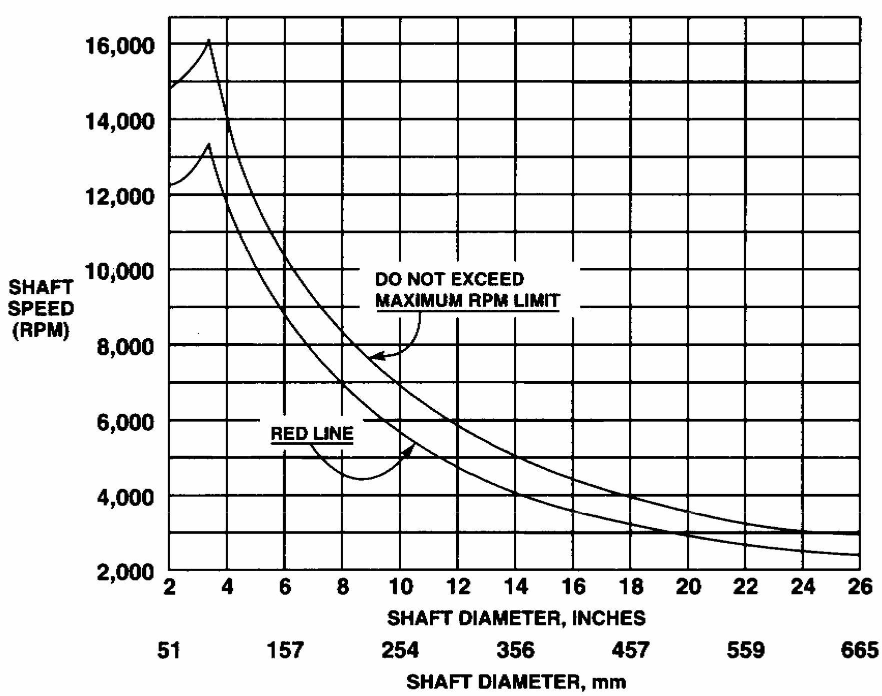


Figure 2-5. Internal View of the Induction Power Supply Identifying The Gross Capacitor Connections and Tuning Switch



Operating RPM Limit Versus Shaft Diameter

Figure 2-6

CHAPTER 3

PARTS LIST

3.0 INTRODUCTION

This chapter contains the list of all field replaceable parts of the Model 2100A Data Telemetry System. The listing in the tables identify the parts according to the index numbers used in figures in this manual. To obtain correct ordering information for any part, determine which figure identifies the part required and then find the index number of the part. (Figure number plus item number identified in the figure.)

3.1 LIST OF MAJOR COMPONENTS

Table 3-1 is a list of all major components of the Model 2100A Data Telemetry System. Refer to Figure 1-1. Table 3-2 lists the major components in the 2100A Data Telemetry System with a Rotary Torque Cell (RTC).

Table 3-1. Model 2100A Data Telemetry System

FIGURE	PART NUMBER	COMPONENTS DESCRIPTION
1-1	060-xxxx-xx (See Note A)	Data Telemetry System, Model 2100A, AC Powered
1-1	54775-xxx (See Note B)	Transmitter, Model 2120B
1-1	54725-xxx (See Note B)	Data Telemetry Receiver, Model 2145A, AC Powered
1-1	54840-xxx (See Note C)	Induction Power Supply, Model 2175A
1-1	Various	High Speed Collar, Model 2126A
None	54743-010	2126A Collar Accessory Kit (7/16” 12 pt. Deep Socket and ¼” Allen Wrench)
None	54745-010	2175A IPS Accessory Kit (5/32” Allen Wrench)
None	54747-010	2145A Receiver Accessory Kit (Power Cord and Extra Fuse)

Notes:

A. System Part Numbers vary with each order.

B. The suffix –xxx on Part Number 54775 and 54725 identifies the operating frequency in megahertz. Example –160 identifies an operational frequency of 16.0 MHz. –130 identifies 13.0 MHz.

C. The suffix on Part Number 54840 identifies whether the unit is to be used on systems for shaft sizes below or above 12 inches diameter (305mm). The suffix –010 is used for applications under 12 inches diameter and 020 is used for larger than 12 inches diameter (305mm).

Table 3-2. Model 2100A Data Telemetry System with Model RTC

FIGURE & INDEX NO.	PART NUMBER	COMPONENTS DESCRIPTION
1-2	060-xxxx-xx (See Note A)	Data Telemetry System, Model 2100A with Model RTC, AC Powered
1-2	060-xxxx-xx (See Note D)	Rotary Torque Cell (Contains transmitter)
1-2	54725-xxx (See Note B)	Data Telemetry Receiver, Model 2145A, AC Powered
1-2	54840-xxx (See Note C)	Induction Power Supply, Model 2175A
1-2	90900-005	Stationary Loop Antenna (.156” Brass Wire)
None	54745-010	2175A IPS Accessory Kit (5/32” Allen Wrench)
None	54747-010	2145A Receiver Accessory Kit (Power Cord and Extra Fuse)

Notes:

A. System Part Numbers vary with each order.

B. The suffix –xxx on Part Number 54725 identifies the operating frequency in megahertz. Example – 160 identifies an operational frequency of 16.0 MHz. –130 identifies 13.0 MHz.

C. The suffix on Part Number 54840 identifies whether the unit is to be used on systems for shaft sizes below or above 12 inches diameter (305mm). The suffix –010 is used for applications under 12 inches diameter and 020 is used for larger than 12 inches diameter (305mm).

D. The RTC Part Number varies with shaft diameter and transmitter frequency.

Table 4-1. Equipment Required for Installation

Digital Voltmeter	Fluke Model 800 or equivalent	3.5 digit resolution minimum
Torque Wrench with 1/4-inch Drive	Measure to 350 Pounds-Inch	

Table 4-2. Equipment Supplied to Aid Installation

• 7/16" – 12 Point – Deep Socket Thin Wall – 1/4 Drive	Used to tighten bolts on Collar
• Allen Wrench – 1/4" HEX.	Used to tighten bolts on Collar
• Allen Wrench – 5/32" HEX.	Used to secure Antenna to IPS

CHAPTER 4

STANDARD 2100A INSTALLATION (NO MODEL RTC)

4.0 INTRODUCTION

This chapter provides installation and checkout instructions for the Model 2100A Data Telemetry System with a review of pre-installation site and system considerations.

Note: Do not begin installation of the equipment until all instructions of this chapter and the Mechanical and Electrical Interface drawings have been reviewed.

4.1 DRAWINGS

Drawings and illustrations required to properly install and check out the Model 2100A Data Telemetry System in each specific application may not be fully provided in this manual. Be sure to check with the individual who is responsible for the installation.

4.2 SITE CONSIDERATIONS

The installation site of the Model 2100A Data Telemetry System has usually been determined at purchase and very little can be done in changing location due to component size change constraints.

However, the following Rules and suggestions will help in making the installation reliable and trouble-free.

- RULE #1
  Correct induction power setup assures correct FM signal reception if Rule #2 is followed.

- RULE #2
  Mount the induction power supply unit on a conductive bracket secured to the machine case or bearing housing that supports the shaft. Use wide conductive material for best RF grounding as wires tend to act as antennas and pickup unwanted signals and noise.

SUGGESTION:

- Install the induction power supply unit so that personnel can access the internal circuitry after the cover is removed.
- The stationary power antenna loop is one element of a resonant circuit and will be affected by magnetic material (motor case, flanges, etc.) and conductive material which form a complete circle (shorted turn) around the shaft. Plan to install the stationary power antenna as far away as possible (six inches minimum suggested) from these items.
- The rotating antenna embedded in the high-speed clamp-on collar is located in the outer corner on what is considered to be the backside of the collar (opposite the transmitter pins). Alignment of the stationary power antenna loop with the back edge of the high-speed clamp-on collar will place the loop in its optimum position. Variations of plus and minus 1/2 inch (±13mm) axial and radial motion of the stationary power antenna loop relative to this initial position will not affect data.
- There is no special restriction placed upon where the strain gages are to be placed on the shaft. Use the gap between clamp-on collar halves to pass the strain gage wires if you want to put them on the backside (side opposite the transmitter pins) of the collar.

4.3 TOOLS AND MATERIALS NEEDED

There are no special tools required for the installation of the Model 2100A Data Telemetry System. Table 4-1 identifies equipment needed for proper system installation. Table 4-2 identifies equipment Wireless Data Corporation supplies with each system as a convenience for the user. Table 4-2 equipment is commercially available should the user misplace the supplied items.
Please note that special jigs, fixtures, strain gages, wires, insulation, etc., necessary to instrument the rotating shaft or device are not part of the Model 2100A Data Telemetry System. These items must be fabricated or obtained from suppliers of the items by the installer or purchaser of the system.

4.4 UNPACKING, HANDLING AND REPACKING

CAUTION

Do not attempt to assemble or disassemble any items unless specifically instructed by this manual.

4.4.1 Unpacking

The Model 2100A Data Telemetry Systems may be shipped in one or more boxes depending upon size and numbers of channels. Commercial standards have been followed in packing the system to avoid damage or loss during shipment. Care must be exercised when unpacking the box(es) to prevent loss of parts or subassemblies or damage due to rough handling.

When unpacking, check each part against Table 3-1. If there is evidence of shipping damage, stop unpacking and notify the carrier. If any parts are missing contact your local representative or the factory.

4.4.2 Handling of Components

Care must be exercised while handling components of the system to prevent loss of hardware, damage to components or injury to workmen.

Care must be taken when handling the rotating assembly so that the glass epoxy collar is not damaged. Do Not Drop.

4.4.3 Repacking

CAUTION

Use Anti-Static (Conductive) Protective Bags to hold or ship the Model 2120B Transmitter Assembly in or out of the rotary collar.

When repacking the equipment for transfer to another site or returning equipment to the factory, follow commercial standards. As a general rule it is best to place any component in an anti-static envelope before packing in a shipping carton.

4.5 PREPARATION OF FOUNDATIONS

All support structures and foundations are the responsibility of the user. Due to the myriad of configurations possible, the factory can only support the user in determining the best arrangement.

4.6 INPUT REQUIREMENTS

The Model 2145A Data Telemetry Receiver is the source of the system’s power. The receiver unit operates on 115/230 VAC.

4.7 INSTALLATION PROCEDURES

The general order followed in an installation is as follows:

1. Plan the installation.
2. Assemble the clamp-on collar with transmitter in their approximate final location. Snug the bolts until the assembly is just slightly loose on the shaft.
3. Assemble and secure the induction power supply (IPS) with antenna in their final location.
4. Slowly rotate the shaft and check for concentricity and runout (wobble) on both the rotating and stationary components.
5. Secure the clamp-on collar bolts to the recommended torque.
6. Install the receiver unit in its operational location.
7. Complete the cable connection between the receiver unit and the IPS. DO NOT CONNECT SENSOR WIRES.
8. Connect the “T”-circuit and final tune the IPS.
9. Set the transmitter power level.
10. Verify system operation.
11. CONNECT SENSOR WIRES.

4.7.1 Planning the Installation

The optimum positioning for the stationary loop antenna is approximately 1/2 inch from the rotating antenna embedded in the collar. The stationary antenna leads do not have to be radially straight and can be as long as 12 inches (300mm).

It is advised that the installation location of the on-shaft components be somewhat near the rotating shaft's support but no closer than six (6) inches (150mm) if possible. The close proximity of ferrous or conductive material has the effect of absorbing induction energy requiring the induction power level to be raised. If there is to be a cover over the installation, it should be no closer than six (6) inches from the stationary antenna if the cover is ferrous or conductive.

4.7.2 Clamp-On Collar Assembly Installation

CAUTION

All high speed clamp-on collars have RPM operating limits. Do not exceed RPM limits shown in Figure 2-6.

Assemble the clamp-on collar with transmitter on the shaft using the supplied bolts, nuts and washers. Insert the bolts in opposite directions to assure the best rotational balance. Snug the bolts until the assembly is just slightly loose but will not move on its own when the shaft is turned.

4.7.3 Induction Power Supply Installation

Attach the IPS to a conductive bracket which can be secured to the machine case or bearing housing supporting the shaft. Use Figure 4-4 for the mounting pattern. Be sure to orient the IPS so that the internal circuitry can be accessed with the cover removed. The orientation of the stationary lead-in wires are not critical except as to support the relative positioning of the stationary antenna around the clamp-on collar rotating antenna. Secure the stationary antenna so the brass wire is stable and concentric around the clamp-on collar. Antenna support brackets, if needed, can be somewhat simple in construction such as 1 inch aluminum straps or 1/4 inch diameter rods with insulators. The stationary antenna need not be rigid but only constrained from moving beyond the runout and wobble limits.

4.7.4 Runout and Wobble Check

Runout and wobble can be checked by rotating the shaft slowly while adjusting both the stationary and rotating units to minimize variations. Perfection is not required but the better the adjustment now, the less effort will be required during system verification testing.

4.7.5 Securing the Clamp-On Collar Mounting Bolts

Tighten the clamp-on collar bolts to their final NET TORQUE of 300 INCH-POUNDS. While tightening the bolts, try to maintain an even spacing between the collar halves.

4.7.6 Completing Clamp-On Collar Antenna Wiring

Now is the time to complete the rotating antenna wiring. Refer to Figure 4-1 to identify the antenna pins on the clamp-on collar so that wire jumpers can be soldered to them to complete the rotating antenna loop.

4.7.7 System Wiring

It is now necessary to complete wiring of the data telemetry receiver unit and the IPS. Installation and attachment of the gear box and rotary seal fittings are not covered in this instruction. Cabling at the rear of the Model 2145A Data Telemetry Receiver is illustrated in Figures 4-5 Single Channel and Figure 4-6 Dual Channel Shaft Torque Telemetry Systems. Be sure to use the RG-58 C/U cable provided or an equivalent cable type to minimize the DC power loss between the receiver unit and the IPS. Connect the coax cable between the Induction Power Source BNC connector on the back of the Readout Unit to the BNC connector on the side of the IPS.

Use four (4) 180 ohm carbon or metal film resistors to create a "T" circuit. A "T" circuit is built by connecting (soldering) one lead of each of the 4 resistors together and soldering the other end of each resistor to the transmitter bridge connection pins (+5VDC, Common, +Input & -Input High Gain). This "T" circuit provides the correct load to the transmitter and provides a null (zero) signal to its input. The system is now ready for IPS final tuning and transmitter power level setting.
The data telemetry receiver unit must be located in an area that will keep the interior electronics within the operating temperature limits of 65°C (149°F).

4.7.8 Induction Power Supply Tuning

The Induction Power Supply (IPS) and the stationary antenna must be set to resonance (tuned) at the as-installed conditions to assure highest efficiency in coupling power to the transmitter. The IPS and antenna were factory tuned before shipment but in-site proximity of metal in motor casings and shafts cause variations in tuning requirements site-to-site.

The procedure for setting final resonance (tuning) of the IPS requires a DC voltmeter and a Philips screwdriver to open the cover of the IPS. Power to the receiver unit will also be required.

At the front of the data telemetry receiver unit, turn the Induction Power Source adjustment to its minimum setting, full counter-clockwise. The counter should show 000. Flip the Power switch up to turn on system power. Open the cover on the IPS. Refer to Figure 4-3 and connect the leads of the DC voltmeter to test points TP5 and TP6 on the IPS circuit board. Note the voltage level shown on the DC voltmeter (ignore the polarity) and the switch positions of SW1. Determine the capacitance needed for resonance. Change the rocker switch SW1 by one position, either up or down one capacitance step. If the DC Voltmeter reading decreases, change the rocker switches to move one step in the opposite direction. Continue until the DC Voltmeter reading again decreases. Back up one step to the highest reading. Check to be sure all closed switches are fully closed and all open switches are fully open. Secure the IPS cover.

4.7.9 Setting the Transmitter Power Level

The induced power level to the transmitter can now be set. Connect the DC voltmeter to the Common Pin (negative) of the transmitter and the Regulated 5 VDC Pin (positive). See Figure 4-2. The Induction Power Source adjustment can now be made to regulate the DC voltage of the transmitter to 5 Volts. Increase the level of the IPS Voltage as set on the front panel of the Readout by two turns once regulated voltage at the transmitter has been achieved.

Note the number setting on the Induction Power Source counter on the front of the Readout Unit for future reference.

4.7.10 Verifying System Operation

Correct operation of the Model 2100 system can be verified by noting the bar graph level of the RSSI and the quietness of the Analog Data Output. The RSSI level should be at least 2 bars above the base indicator with the data output stable at no greater than plus/minus 20 millivolts RMS.

4.7.11 Connect Sensor Wires

The “T” circuit can now be removed and the sensor strain gage bridge connected to the Common Pin, the +5VDC Pin, the +Signal Pin, and the High or Low Gain –Signal Pin of the transmitter. See Figure 4-2.

4.8 CALIBRATE ANY TIME (CAT) FEATURE

The Model 2120B transmitters have a unique, built-in, Calibrate Any Time (CAT) feature, which the user can activate without need to access the transmitter or strain gage leads. This remotely activated CAT circuit sequences through a shunt calibration routine, which automatically connects a user selected shunt resistor across one leg of the bridge and then across a second for a plus and minus calibrate. Each “shunt calibration” is held for about 20 seconds, allowing the user adequate time to observe and/or adjust scale factors at the readout. The final sequence of the circuit is to disconnect the shunt calibration resistor and shut down the circuit. The CAT can be activated at any time. Reference Figures 2-1, and A-3 for Shunt Resistor location.

<u>Equipment Required</u>

A. Model 2120B Series CAT Transmitter
B. Any WDC Model 2100 Data Telemetry System with Item A above as a transmitter.
C. User selected or calculated shunt calibration resistor, RN55C Size/Type or better.

4.8.1 CAT Pre-Use Considerations

The CAT user must recognize that the chosen system gain must allow for the additional shunt calibration step change. Otherwise, the step change may drive the system output signal into saturation. WDC suggests a system gain which has full scale equaling ±5.00 VDC which allows a 100% over-range and no shunt calibration output limiting.

4.8.2 Using the CAT Transmitter

Install and connect the Model 2120B transmitter following the Technical Manual. There is no affect on the transmitter until the user wires a shunt resistor between the 'CAT' Pin and the +Input Pin. See Figure 2-1 and A-3.

Proceed through normal system check out and shunt calibration or test stand calibration. When the user has decided all is correct, then a shunt resistor, selected by the user is installed per Figure 2-1 and A-3.

4.8.3 Activating CAT

To activate the CAT routine, interrupt power to the transmitter by turning the readout unit off for at least 5 seconds, then on. The circuit then sequences through a no action period of about 10 seconds, then connects the shunt resistor between the +5 Volts to + Signal leg for about 20 seconds. It then breaks the connection and reconnects the resistor between Common and + Signal for about 20 seconds. This sequence produces first a plus then a minus voltage calibration output. The circuit finally disconnects the shunt resistor restoring the original output condition. Data is continuous throughout this process and is valid except for the offsets.

Another method of interrupting power to the transmitter is to disconnect the cable between the readout unit and the IPS.

If one desires to not use the CAT feature, do not connect the shunt calibration resistor.

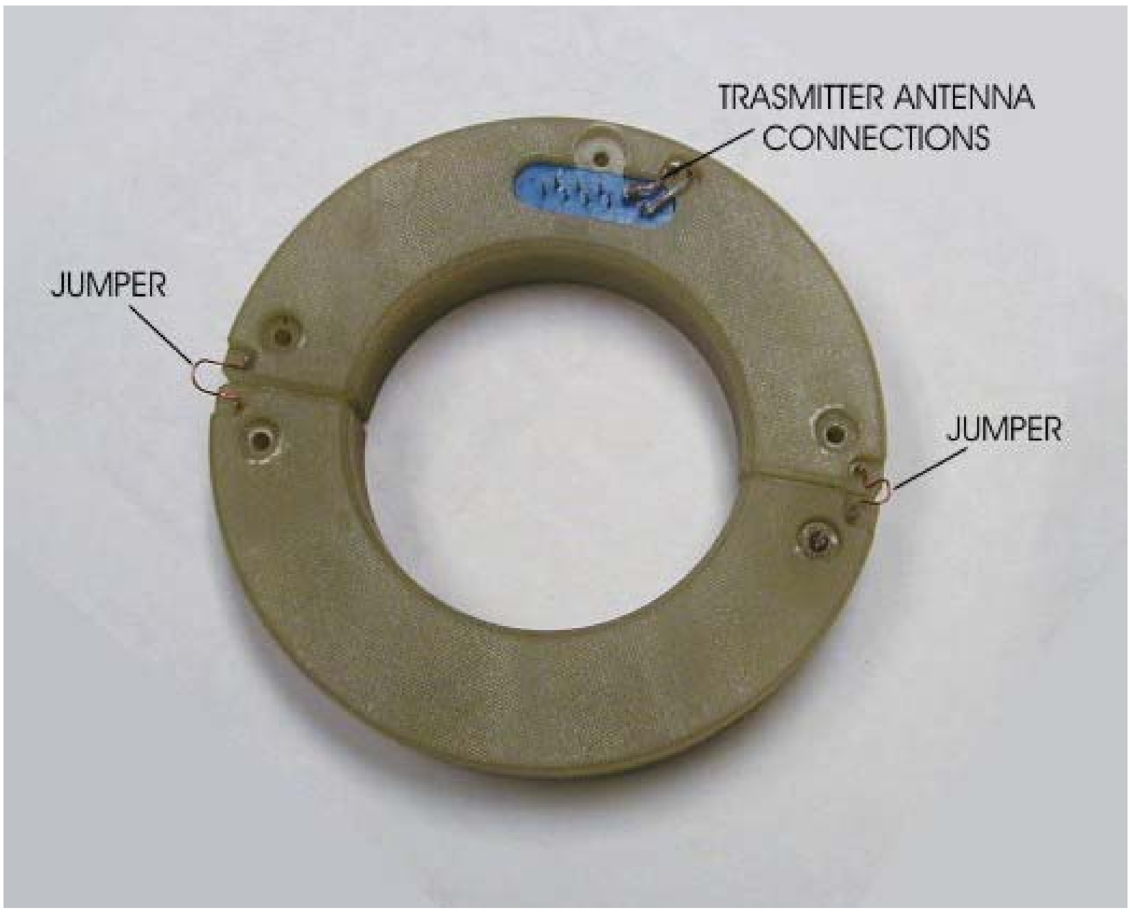


FIGURE 4-1. 2120B Mounted in 2126A High Speed Collar

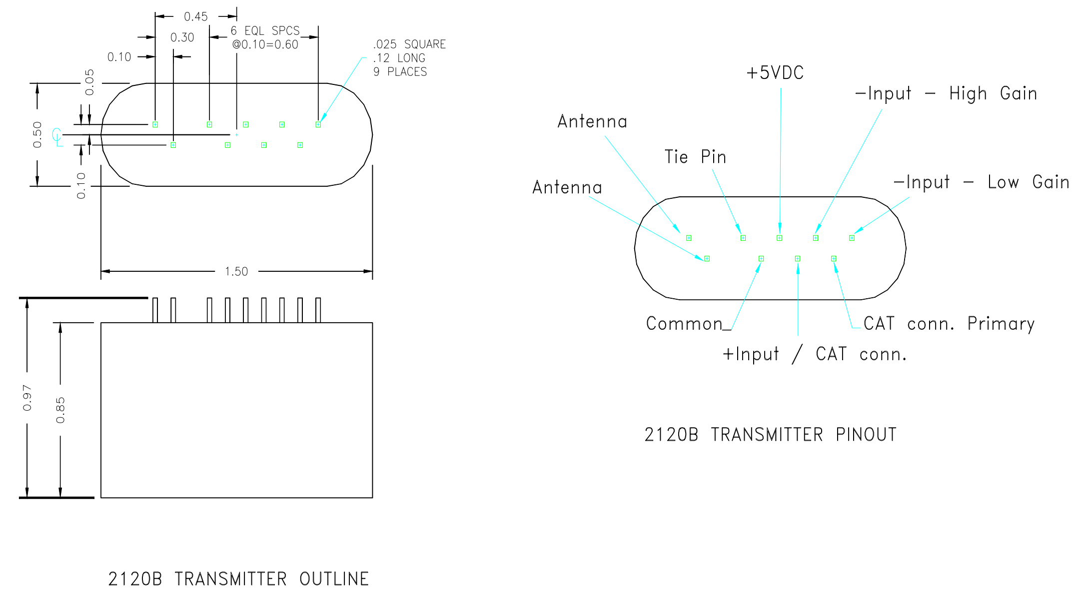


FIGURE 4-2 2120B Transmitter Dimensions and Pinout

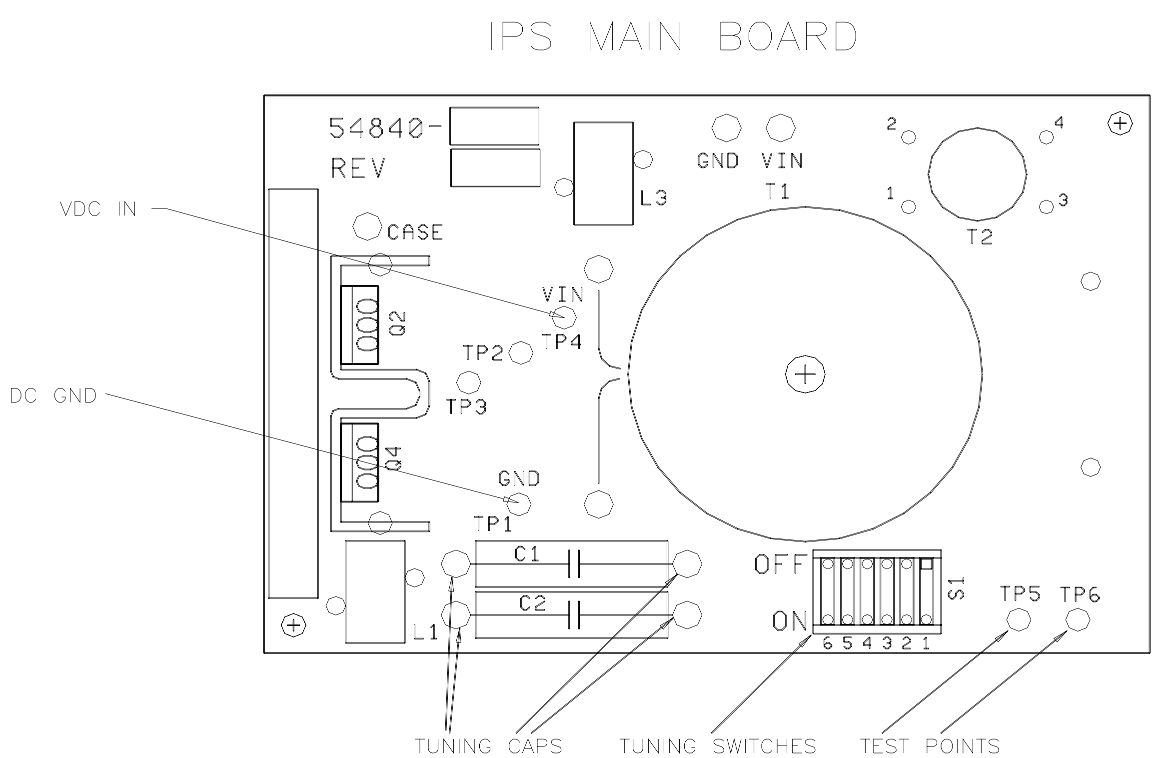


FIGURE 4-3. The Induction Power Supply Main Board

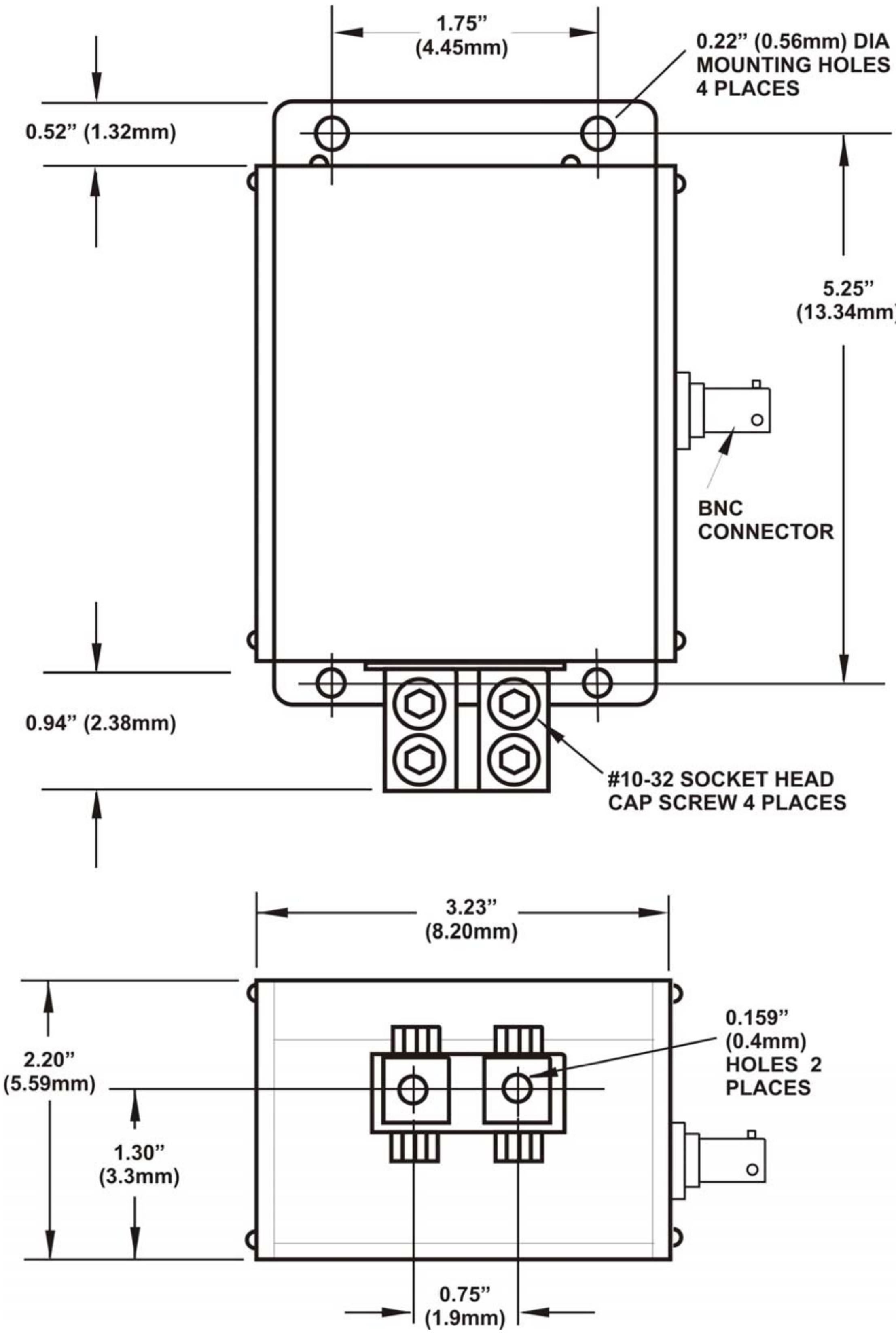


FIGURE 4-4. Induction Power Supply Installation Mounting Hole Pattern

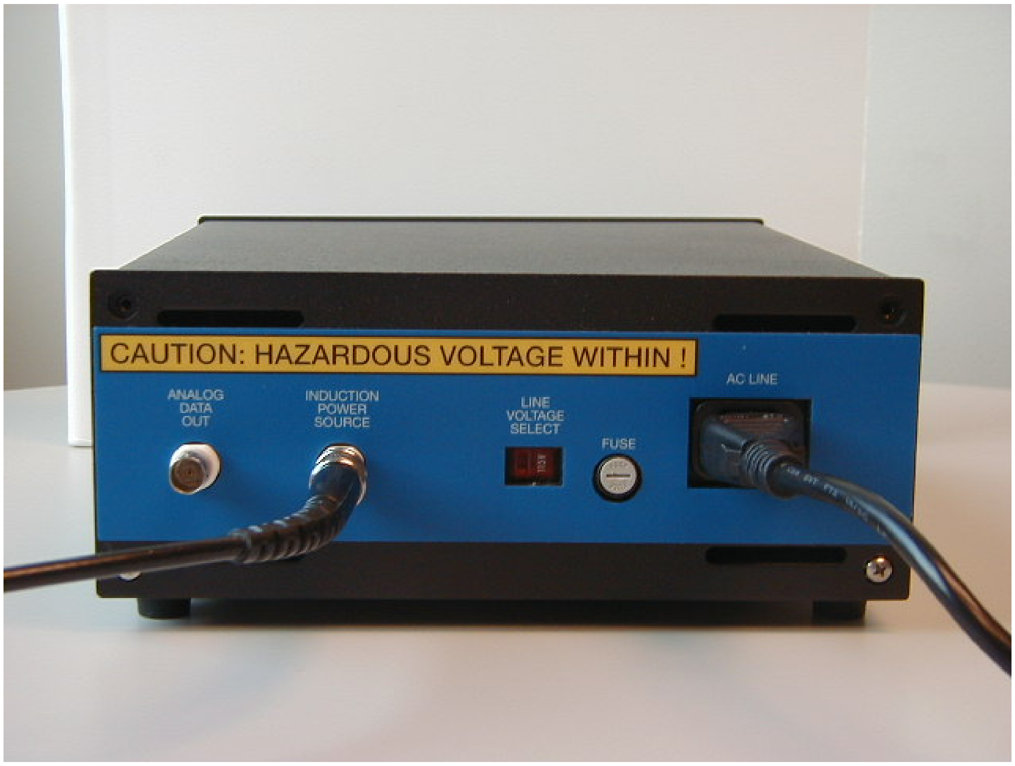


FIGURE 4-5 Single Channel IPS Power Connections

FIGURE 4-6 Dual Channel IPS Power Connections

CHAPTER 5

2100A WITH MODEL RTC INSTALLATION

5.0 INTRODUCTION

This chapter provides installation and setup instructions for the Model 2100A Data Telemetry System when used with a Rotary Torque Cell. See Figure 5-1.

Note: Do not begin installation of the equipment until all instructions of this chapter and the Mechanical and Electrical Interface drawings have been reviewed.

5.1 DRAWINGS

Drawings and illustrations required to properly install and check out the Model 2100A Data Telemetry System in each specific application may not be fully provided in this manual. Be sure to check with the individual who is responsible for the installation.

5.2 SITE CONSIDERATIONS

The installation site of the Model 2100A Data Telemetry System has usually been determined at purchase and very little can be done in changing location due to component size change constraints.

However, the following Rules and suggestions will help in making the installation reliable and trouble-free.

- RULE #1
  Correct induction power setup assures correct FM signal reception if Rule #2 is followed.

- RULE #2
  Mount the Induction Power Supply unit on a conductive bracket secured to the machine case or bearing housing which supports the shaft. Use wide conductive material for best RF grounding as wires tend to act as antennas and pickup unwanted signals and noise.

SUGGESTION:

- Install the Induction Power Supply unit so that personnel can access the internal circuitry after the cover is removed.

- The stationary power antenna loop is one element of a resonant circuit and will be affected by magnetic material (motor case, flanges, etc.) and conductive material which form a complete circle (shorted turn) around the shaft. Plan to install the stationary power antenna as far away as possible (six inches minimum suggested) from these items.

- The rotating antenna embedded in the RTC's high-speed collar is located in the outer corner on what is considered to be the backside of the collar. Alignment of the stationary power antenna loop with the back edge of the high-speed collar will place the loop in its optimum position. Variations of plus and minus 1/2 inch (±13mm) axial and radial motion of the stationary power antenna loop relative to this initial position will not affect data.

- The Model RTC is custom designed to match the bolt patterns for each particular shaft. In most cases, each end of the Rotary Torques Cell will bolt inline to the shaft at a predetermined location.

5.3 TOOLS AND MATERIALS NEEDED

The tools required for the installation of the Model 2100A System used with a Rotary Torque Cell are listed in Table 5-1 and the 5/32” Allen Wrench in Table 4-2 for the Standard 2100A Data Telemetry System.

5.4 UNPACKING, HANDLING AND REPACKING

CAUTION

Do not attempt to assemble or disassemble any items unless specifically instructed by this manual.

5.4.1 Unpacking

The Model 2100A Data Telemetry Systems may be shipped in one or more boxes depending upon size and numbers of channels. Commercial standards have been followed in packing the system to avoid damage or loss during shipment. Care must be exercised when unpacking the box(es) to prevent loss of parts or subassemblies or damage due to rough handling.

When unpacking, check each part against Table 3-2. If there is evidence of shipping damage, stop unpacking and notify the carrier. If any parts are missing contact your local representative or the factory.

5.4.2 Handling of Components

Care must be exercised while handling components of the system to prevent loss of hardware, damage to components or injury to workmen.

Care must be taken when handling the rotating assembly so that the glass epoxy collar is not damaged. Do Not Drop.

5.4.3 Repacking

When repacking the equipment for transfer to another site or returning equipment to the factory, follow commercial standards. As a general rule it is best to place any system component in a shock resistant shipping carton.

5.5 PREPARATION OF FOUNDATIONS

All support structures and foundations are the responsibility of the user. Due to the myriad of configurations possible, the factory can only support the user in determining the best arrangement.

5.6 INPUT REQUIREMENTS

The Model 2145A Data Telemetry Receiver is the source of the system's power. The receiver unit operates on 115/230 VAC.

5.7 INSTALLATION PROCEDURES

The general order followed in an installation is as follows:

1. Plan the installation.

2. Bolt the Model RTC to the designated area of the shaft. Snug the bolts, but do not tighten all the way.

3. Assemble and secure the induction power supply (IPS) with antenna in their final location.

4. Slowly rotate the shaft and check for concentricity and run-out (wobble) on both the rotating and stationary components.

5. Tighten the bolts to the recommended torque.

6. Install the receiver unit in its operational location.

7. Complete the cable connection between the receiver unit and the IPS.

8. Apply power to the system and check the RSSI signal at the front panel of the receiver unit.

9. Set the transmitter power level.

10. Verify system operation.

5.7.1 Planning the Installation

Figure 5-1 illustrates the optimum relative positions between the clamp-on collar with its rotating antenna and the IPS with its stationary antenna. The same positioning applies to the Model RTC's rotating collar and antenna. The stationary antenna leads do not have to be radially straight and can be as long as 12 inches (300mm).

It is advised that the installation location of the on-shaft components be somewhat near the rotating shaft's support but no closer than six (6) inches (150mm) if possible. The close proximity of ferrous or conductive material has the effect of absorbing induction energy requiring the induction power level to be raised. If there is to be a cover over the installation, it should be no closer than six (6) inches from the stationary antenna if the cover is ferrous or conductive.

5.7.2 Model RTC Installation

Match the Model RTC's bolt patterns to those on the couplings of the shaft. Bolt the unit in place and snug the bolts, but do not tighten all the way.

5.7.3 Induction Power Supply Installation

Attach the IPS to a conductive bracket which can be secured to the machine case or bearing housing supporting the shaft. Use Figure 4-4 for the mounting pattern. Be sure to orient the IPS so that the internal circuitry can be accessed with the cover removed. The orientation of the stationary lead-in wires are not critical except as to support the relative positioning of the stationary antenna around the clamp-on collar rotating antenna. Secure the stationary antenna so the brass wire is stable and concentric around the bolted-on collar of the RTC. Antenna support brackets, if needed, can be somewhat simple in construction such as 1 inch aluminum straps or 1/4 inch diameter rods with insulators. The stationary antenna need not be rigid but only constrained from moving beyond the run-out and wobble limits.

5.7.4 Runout and Wobble Check

Runout and wobble can be checked by rotating the shaft slowly while adjusting both the stationary and rotating units to minimize variations. Perfection is not required but the better the adjustment now, the less effort will be required during system verification testing.

5.7.5 Securing the Model RTC Mounting Bolts

Tighten the bolts in the Rotary Torque Cell to their final NET TORQUE of 300 INCH-POUNDS.

5.7.6 System Wiring

It is now necessary to complete wiring of the data telemetry receiver unit and the IPS. Installation and attachment of the gear box and rotary seal fittings are not covered in this instruction. Cabling at the rear of the Model 2145A Data Telemetry Receiver is illustrated in Figures 4-5 Single Channel and Figure 4-6 Dual Channel Shaft Torque Telemetry Systems. Be sure to use the RG-58 C/U cable provided or an equivalent cable type to minimize the DC power loss between the receiver unit and the IPS. Connect the coax cable between the Induction Power Source BNC connector on the back of the Readout Unit to the BNC connector on the side of the IPS.

The system is now ready for IPS final tuning and transmitter power level setting.

The data telemetry receiver unit must be located in an area which will keep the interior electronics within the operating temperature limits of 65°C (149°F).

5.7.7 Induction Power Supply Tuning

The Induction Power Supply (IPS) and the stationary antenna must be set to resonance (tuned) at the as-installed conditions to assure highest efficiency in coupling power to the transmitter. The IPS and antenna were factory tuned before shipment but in-site proximity of metal in motor casings and shafts cause variations in tuning requirements site-to-site.

The procedure for setting final resonance (tuning) of the IPS requires a DC voltmeter and a Philips screwdriver to open the cover of the IPS. Power to the receiver unit will also be required.

At the front of the data telemetry receiver unit, turn the Induction Power Source adjustment to its minimum setting, full counter-clockwise. The counter should show 000. Flip the Power switch up to turn on system power. Open the cover on the IPS. Refer to Figure 4-3 and connect the leads of the DC voltmeter to test points TP5 and TP6 on the IPS circuit board. Note the voltage level shown on the DC voltmeter (ignore the polarity) and the switch positions of SW1. Determine the capacitance needed for resonance. Change the rocker switch SW1 by one position, either up or down one capacitance step. If the DC Voltmeter reading decreases, change the rocker switches to move one step in the opposite direction. Continue until the DC Voltmeter reading again decreases. Back up one step to the highest reading. Check to be sure all closed switches are fully closed and all open switches are fully open. Secure the IPS cover.

5.7.8 Setting the Transmitter Power Level

Turn up (clockwise) the IPS Voltage on the 2145A front panel until the RSSI signal has moved up the bar graph and stabilized (generally 3 or 4 bars up). Add 2 turns to the IPS Voltage after the stabilization point.

Note the number setting on the Induction Power Source counter on the front of the Readout Unit for future reference.

5.7.9 Verifying System Operation

Correct operation of the Model 2100 system can be verified by noting the bar graph level of the RSSI, quietness of the Analog Data Output. The RSSI level should be at least 2 bars above the base indicator with the data output stable at no greater than plus/minus 20 millivolts RMS.

5.8 CALIBRATE ANY TIME (CAT) FEATURE

The Model 2120B transmitters have a unique, built-in, Calibrate Any Time (CAT) check feature which the user can activate without need to access the transmitter or strain gage leads. This remotely activated CAT circuit sequences through a shunt calibration routine which automatically connects a pre-installed shunt resistor across one leg of the bridge and then across a second for a plus and minus calibrate. Each “shunt calibration” is held for about 20 seconds, allowing the user adequate time to observe and/or adjust scale factors at the readout. The final sequence of the circuit is to disconnect the shunt calibration resistor and shut down the circuit. The CAT can be activated at any time. Refer to Figures 2-1 and A-3.

5.8.1 CAT Pre-Use Considerations

The CAT user must recognize that the chosen system gain must allow for the additional shunt calibration step change. Otherwise, the step change may drive the system output signal into saturation. WDC suggests a system gain which has full scale equaling ±5.00 VDC which allows a 100% over-range and no shunt calibration output limiting.

5.8.2 Using the CAT Transmitter

With a Model RTC the CAT resistor is preinstalled at the factory. Generally the CAT output will be between 50% & 100% of full scale output.

5.8.3 Activating CAT

To activate CAT, interrupt power to the transmitter by turning the readout unit off for at least 5 seconds, then on. The circuit then sequences through a no action period of about 10 seconds, then connects the shunt resistor between the +5 Volts to + Signal leg for about 20 seconds. It then breaks the connection and reconnects the resistor between Common and + Signal for about 20 seconds. This sequence produces first a minus then a plus voltage calibration output. The circuit finally disconnects the shunt resistor restoring the original output condition. Data is continuous throughout this process and is valid except for the offsets.

Another method of interrupting power to the transmitter is to disconnect the cable between the readout unit and the IPS.

If one desires to not use the CAT, the routine can be ignored at Power-Up or the Model RTC can be ordered without the shunt resistor.

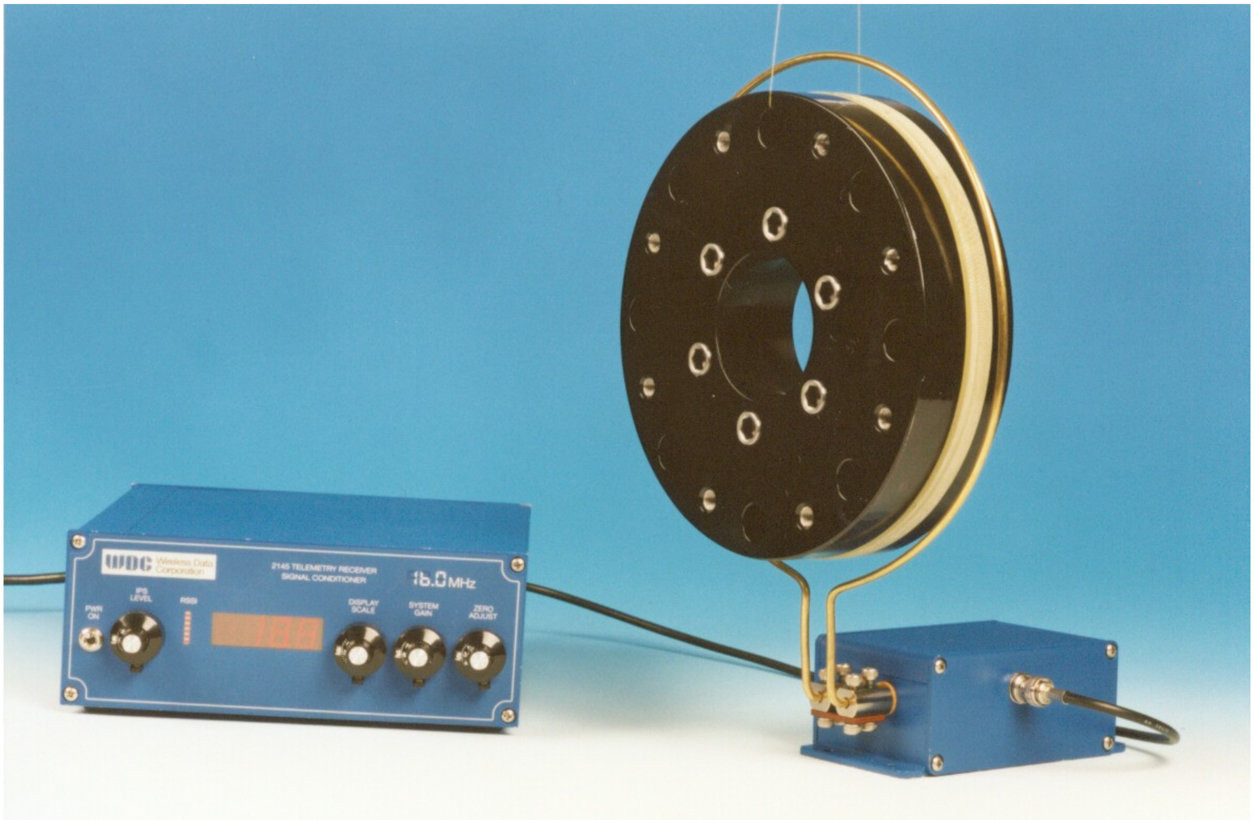


Figure 5-1. 2100A SYSTEM W / MODEL RTC

Table 5-1. Euipment Required (Not Supplied)

Digital Voltmeter	Fluke Model 800 or equivalent	3.5 digit resolution minimum
Torque Wrench with 1/4-inch Drive	Measure to 350 Pounds-Inch	

APPENDIX A
ADJUSTMENT OF SYSTEM GAIN

A.1 INTRODUCTION

In some cases it is necessary or desirable to customize the Standard 2100A System output to match a given strain level input. These cases occur when the gage and strain level combination produce a system output that is either unusable, has insufficient resolution, or is otherwise not appropriate for the user's needs. This note provides details on the considerations and procedures involved in adjusting the system output for any combination of bridge resistance and strain level.

A.2 SYSTEM GAIN AND ZERO

The input of the system can be modeled as a simple amplifier. The input to this amplifier is (normally) a strain gage Wheatstone bridge. The output is a voltage that is proportional to the bridge output voltage, but amplified many times.

In order to standardize the bridge output, the system (and our amplifier model) is provided with controls to adjust the system output zero (offset) and system gain. The zero offset adjustment is the ZERO ADJUST pot contained in the Data Telemetry Receiver.

There are two methods of adjusting system gain. First, the SYSTEM GAIN pot contained in the Data Telemetry Receiver provides a continuously variable gain adjustment over a range of about 4 to 14 times the input. The second gain adjust is provided in the transmitter through the selection of the bridge resistance and the transmitter input pin option. The available gain in the transmitter varies from a high of 571 times the input to (theoretically) 1 times the input.

Normally it is best to operate the system in a manner that produces maximum gain in the transmitter. This will yield maximum resolution and minimum system noise. Yet the transmitter's output must remain in a range that is compatible with the capabilities of the Data Telemetry Receiver. These two goals result in a nominal transmitter output that is defined as "full scale" for the purposes of the following discussions.

A.3 ADJUSTING TRANSMITTER GAIN

The following discussion provides a simplified approach to adjustment of the transmitter gain.

The gain of the transmitter is controlled by the input impedance that the transmitter "sees" at its negative input and a fixed (internal) feedback resistor. Thus the only method that the user has of controlling transmitter gain is by the selection or adjustment of the input impedance to the transmitter.

A.4 INPUT IMPEDANCE

Figure A-2 shows a model of a strain gage bridge and the transmitter. The input impedance that the transmitter "sees" is (usually) one-half the resistance of the bridge plus any resistance in series with the transmitter's negative input. The –Input High Gain pin of the transmitter is connected directly to the negative input, thus, this resistance is zero. The –Input Low Gain pin of the transmitter adds an internal 1K Ω resistor in series with the negative input. The Tie pin has no internal connections and is provided as convenient tie point for a user-selected resistor. See Figures 2-1 and A-3.

Two examples will illustrate how to determine what input impedance the transmitter "sees".

Example 1:

A 350Ω bridge is connected to transmitter's -Input High Gain pin and +Input pin.

The transmitter "sees" one-half of the bridge (175Ω) plus ZERO for a total of 175Ω.

Example 2:

A 1,000Ω bridge is connected to transmitter's -Input Low Gain pin and +Input pin. The transmitter "sees" one-half of the bridge (500Ω) plus 1,000Ω for a total of 1,500Ω.

A.5 IMPEDANCE, GAIN, STRAIN

The preceding discussion indicates:

1. The transmitter gain must be set at an appropriate level to achieve optimum system performance.

2. Gain is controlled by input impedance (bridge resistance plus any resistance in series).

Now let's tie all this together. Table A-1 gives the strain levels required to produce a full-scale transmitter output, for combinations of input pins and bridge resistances.

There are two things in Table A-1 that are important. First, note that 175 microstrain is the lowest strain level that can be input to the transmitter and still produce a (nominal) full-scale output. That is not to say that fewer microstrains cannot be processed by the system, it simply means that this is the minimum level for specified system performance.

Second, note that the transmitter gain can be reduced as the strain level increases. This will keep the transmitter output at full-scale level. Or, put another way, it ensures that the transmitter output is as large as possible and yet compatible with the Data Telemetry Receiver.

A.6 OTHER BRIDGES, OTHER STRAINS

What if your application doesn't exactly fit into one of the cases shown in Table A-1. Well, we know that we want the transmitter output to be "full scale" at the maximum strain input. In order to achieve this, we must find a value for the series resistance, Rs, that gives "full-scale" output with a given bridge resistance and strain level. The formula is:

$$\text{Series Resistance} = RS = \frac{K\epsilon - Rg}{2}$$

where:
- K = Gage factor
- ϵ = Strain in microstrain
- Rg = Resistance of the gage

For convenience, Figure A-1 is provided. This provides a plot of values of Rs for both a 350Ω and 1,000Ω bridge versus microstrain. These values produce a nominal "full-scale" transmitter output.

Let's check our formula and Figure A-1 in a couple of examples. At the same time we will determine how to connect the bridge output to the transmitter.

Example 1:

Given 350Ω bridge
Gage factor (K) = 2
175 microstrain
Find Rs

Using the formula, Rs is found to be zero. Thus one bridge output connection should be made to the –Input High Gain (which has zero resistance). The other bridge output will (as always) connect to +Input pin. See Figure A-2.

Example 2:

Given 350Ω bridge
Gage factor (K) = 2
1,200 microstrain
Find Rs

We calculate Rs to be 1,025Ω. This value (or close to it) must be connected in series with the negative input to the transmitter. The –Input Low Gain pin provides 1,000Ω in series (close enough to 1,025) thus the bridge outputs should be connected to the –Input Low Gain and the +Input pins. See Figure A-2.

Example 3:

Given 1,000Ω bridge
Gage factor (K) = 2
4,500 microstrain
Find Rs

RS is calculated to be 4,000Ω. The Tie pin is provided for just this kind of situation. A 4,000Ω resistor can be connected between the Tie Pin and the –Input High Gain pin. Then the bridge output is connected to the Tie pin and the +Input pin. The net result is 4,000Ω of Rs in series with the transmitter negative input. See Figure A-3.

A.7 NEGATIVE Rs?

What if you calculate Rs and end up with a negative number? In this case, connect the bridge output to the –Input High Gain and +Input pins.

When Rs comes out negative, the conditions are such that the transmitter output may not reach full scale, however, the system will still function and provide data.

A.8 WHAT TO USE FOR Rs, WHERE TO PUT IT?

The resistance in series (Rs) with the input controls gain. Thus, this resistor must be a temperature stable (100 ppm/degrees C, or better) type. We recommend metal film, RN55D (100 ppm) or RN55C (50 ppm) types or equivalent.

As far as the actual value of Rs versus the calculated value, it should match within 10 percent in most cases.

Figures 2-1 and A-3 show a suggested location for Rs on the transmitter. Note that when the Tie pin is being used for the balance, the Series Resistor should be secured in such a way that it will withstand the mechanical environment of the application and go between the –Input High Gain pin and the negative output connection to the bridge.

Table A-1. Strain Levels Required for Full-Scale Transmitter Output*

Strain Level Change (microstrain)	Bridge Resistance (Ω)	Transmitter Input Connection Pin	Transmitter Gain
175	350	-Input – high	571
500	1,000	-Input – high	200
1,200	350	-Input – low	85
1,500	1,000	-Input - low	67

*Assumptions:
- Four equally active arm Wheatstone bridge
- Gage factor equals 2.0

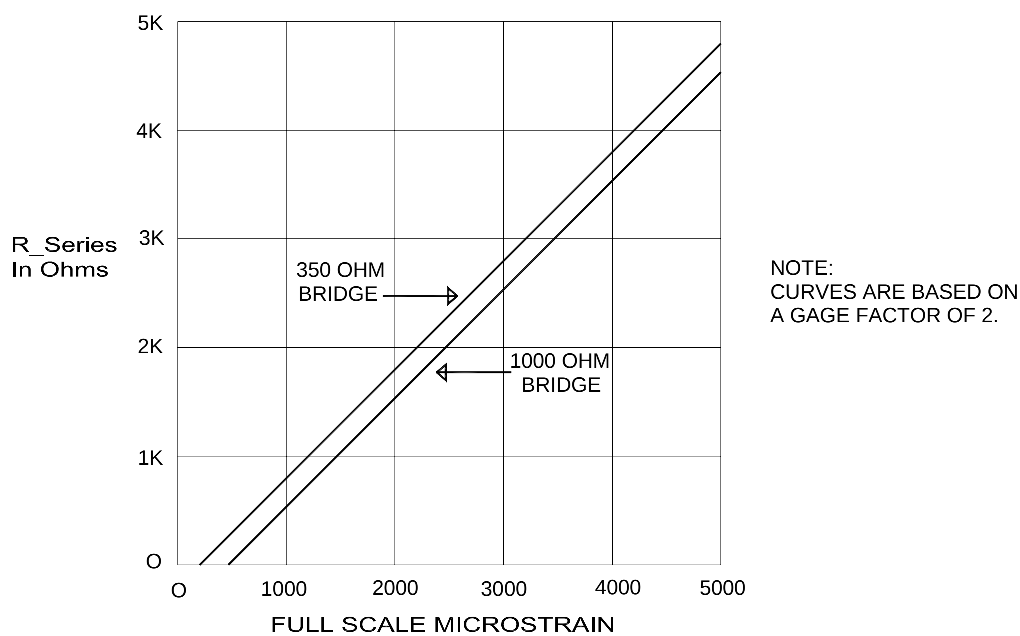


FIGURE A-1 Plot of Rs vs Microstrain

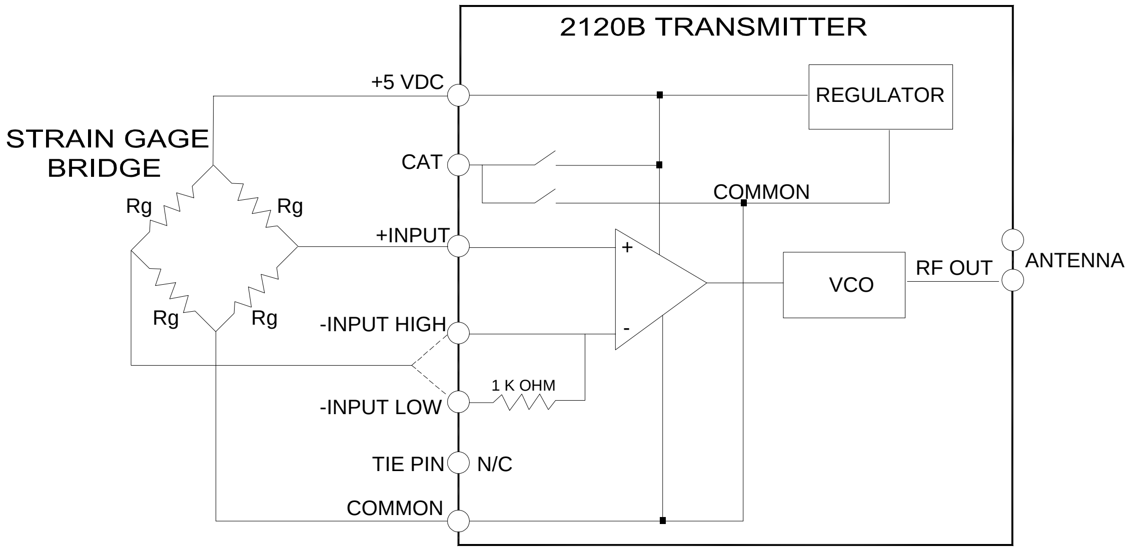


FIGURE A-2 Transmitter Block Diagram using Preset Gain Pins

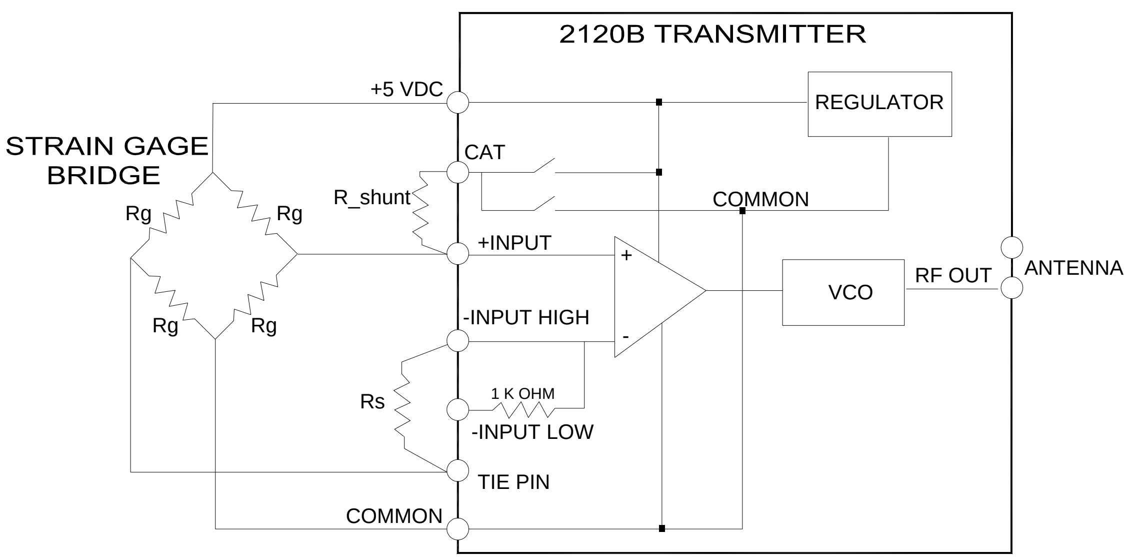


FIGURE A-3 Transmitter Block Diagram with Series & Shunt Resister