SECTION IV. THEORY OF OPERATION

4.4.1 INTRODUCTION

The wind sensor consists of four basic components: the wind speed sensor assembly, wind direction sensor, crossarm support, and wind sensor electronics enclosure. The ASOS wind speed and wind direction sensors, which use a separate cup and vane design, are updated versions of the Belfort Model F420 series sensor. The ASOS Model 2000 series sensors have additional capabilities for digital sensing, diagnostics, and digital communications. The wind speed and wind direction sensors are mounted to the crossarm support, which is physically aligned to north during installation and then secured to the tower. The sensors are easily removed from the crossarm support for replacement by unscrewing captive bolts. The housings of the sensors are keyed such that a replaced sensor on the crossarm support maintains true north alignment. The wind sensor electronics enclosure, which houses the data processing board, power supply, power input box (rf filter assembly), fiberoptic module, and tower signal cable W1 are mounted on the tower support. The data processing board, power supply, and fiberoptic module are field replaceable units (FRU's) that are easily removed for replacement by removing screws and disconnecting wires.

4.4.2 WIND SENSOR SENSING TECHNIQUES

4.4.2.1 **Wind Speed and Direction**. Figure 4.4.1 illustrates the sensing technique for both wind speed and wind direction. Wind speed is measured using an anemometer, which has a photointerrupter device installed on its shaft. The number of pulses produced by the photointerrupter in a given amount of time is directly proportional to the wind speed. Wind direction is determined using a precision potentiometer connected directly to the shaft of the wind vane. The voltage level of the potentiometer wiper is directly proportional to the wind direction. A micro controller on the data processing board collects data from both the wind speed and wind direction sensors, calculates wind speed and wind direction, formats the data for output, and communicates with the data collection package (DCP). The micro controller also runs diagnostic tests both continuously and upon demand from the DCP. The continuous diagnostic provides go/no go type testing of the wind sensor. The on-demand diagnostic performs a detailed operational checkout of the wind sensor.

4.4.2.2 **Temperature**. The temperature stabilization within the wind sensor electronics enclosure is provided by a thermostatically controlled heating element. This heater provides additional warming to the interior of the electronics enclosure such that wind sensor operation is not hampered by cold weather conditions.

4.4.3 BLOCK DIAGRAM DESCRIPTION

Wind sensor block diagrams are illustrated on figure 4.4.2. Sheet 1 is the block diagram for the wind sensor with the basic version of the electronics enclosure. Sheet 2 depicts the REV J version of the enclosure. The paragraphs below provide a block diagram level description of each of the functional areas.

4.4.3.1 **Wind Speed Sensor**. The sensing mechanism of the wind speed sensor consists of a photointerrupter mounted in the sensor housing (Figure 4.4.1). A slotted disk is attached directly to the wind cup assembly shaft. As the shaft rotates, the slots in the disk pass between a light source and light detector. An electrical pulse is output by the light detector each time the slot passes by. The electrical pulses created by the photointerrupter are input to the micro controller via a cable running inside the crossarm support. The micro controller counts the pulses for a period of time and then calculates the corresponding wind speed.

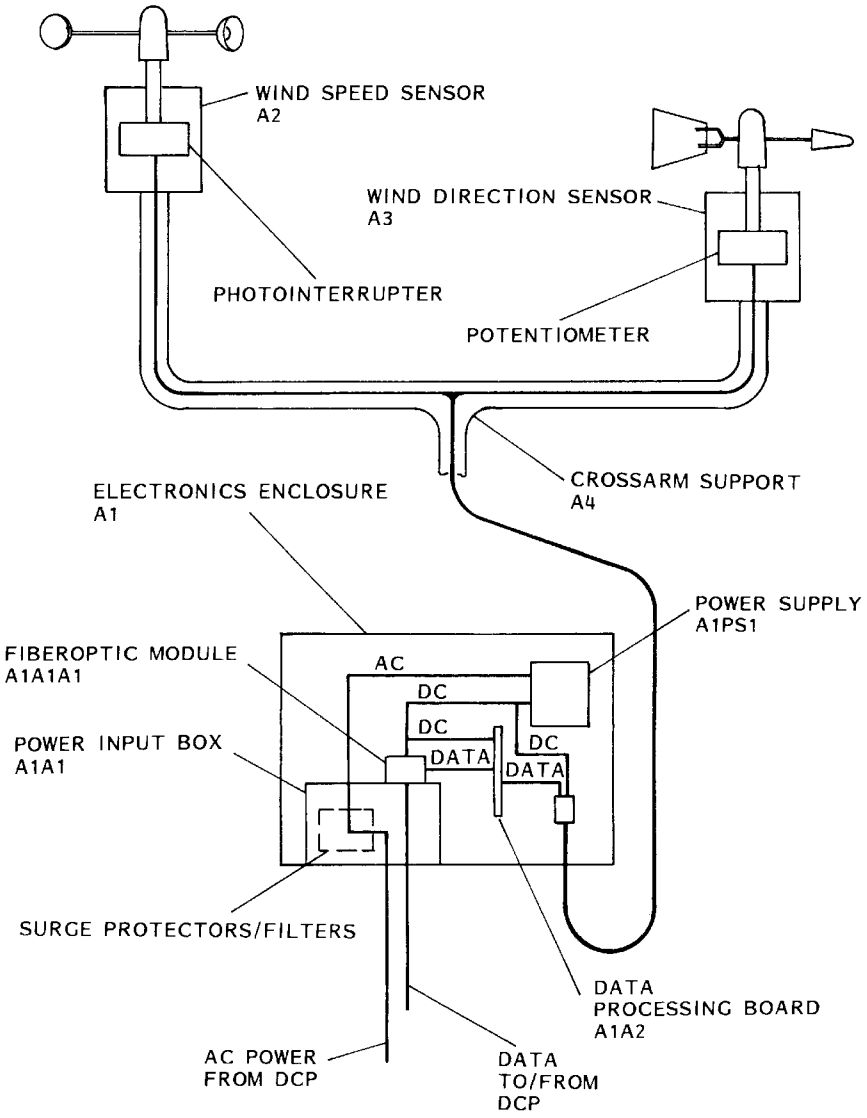

Figure 4.4.1. Wind Speed and Wind Direction Sensing Technique

4.4.3.2 **Wind Direction Sensor**. The sensing mechanism of the wind direction sensor is a precision potentiometer (Figure 4.4.2). The potentiometer is connected directly to the wind vane assembly shaft such that it rotates in unison with the wind vane. The voltage level output of the potentiometer is received by the data processing board, which compares the output to a reference voltage to determine the wind direction vector.

4.4.3.3 **Data Processing Board**. The wind sensor data processing board is located in the wind sensor electronics enclosure. The data processing board contains the wind sensor micro controller, which performs all of the data processing functions of the wind sensor apart from the actual sensing of the environment described above, including the following functions:

a. Accepts data from the photointerrupter and potentiometer to compute the wind speed and wind direction.

b. Accepts diagnostic data from the wind sensor electronics, temperature sensors, and power supply and warns the ASOS of a failure.

c. Performs self-test diagnostics and data quality checks (continuous and on-demand tests).

d. Communicates with the ASOS DCP.

4.4.3.4 **Fiberoptic Module**. The fiberoptic module located in the wind sensor electronics enclosure is the physical communication link between the wind sensor and the ASOS DCP. The wind sensor is capable of responding to an interrogation from the ASOS once every 5 seconds. The wind sensor receives ASCII commands from the ASOS through the fiberoptic module and formats the appropriate response. The fiberoptic module uses separate optical cables for transmitting (TX) and receiving (RX) data. The data format includes the following:

a. 1 start bit

b. 8 data bits

c. 1 stop bit

d. No parity

e. 2400 baud

f. Full duplex

g. Serial asynchronous

h. Configured as data terminal equipment (DTE)

4.4.3.5 **Wind Sensor Power Distribution**. Power for the wind sensor is provided from the DCP to the power input box and the power supply located in the wind sensor electronics enclosure. If one filter protrudes from the top of the power input box, the sensor is a one-filter configuration as illustrated on figure 4.4.2, sheet 2. If two filters protrude from the top of the power input box as illustrated on figure 4.4.2, sheet 1, the sensor is a two-filter configuration. DCP cables are connected to the sensor in an identical manner for both configurations. The power input box contains line surge protectors and rf filters to provide electromagnetic interference (EMI) protection. Low pass filters on the power lines are also used to filter out high frequency noise. The power supply converts the filtered 120V, 60 Hz ac power into 5 vdc power required by the wind sensor electronics.

4.4.3.6 **Obstruction Lights**. Figure 4.4.3 provides a detailed block diagram of the obstruction lights at the top of the wind sensor pole. The obstruction lights are controlled by a photo control (day/night switch) mounted above the ac junction box (beside the DCP). Power from this switch is routed through the Faraday box in the DCP where it is passed to an underground conduit to the wind sensor. At the wind sensor pad, power is passed through a flexible conduit to the junction box on the side of the wind sensor pole. From this junction box, power is routed up through the pole to the obstruction lights.

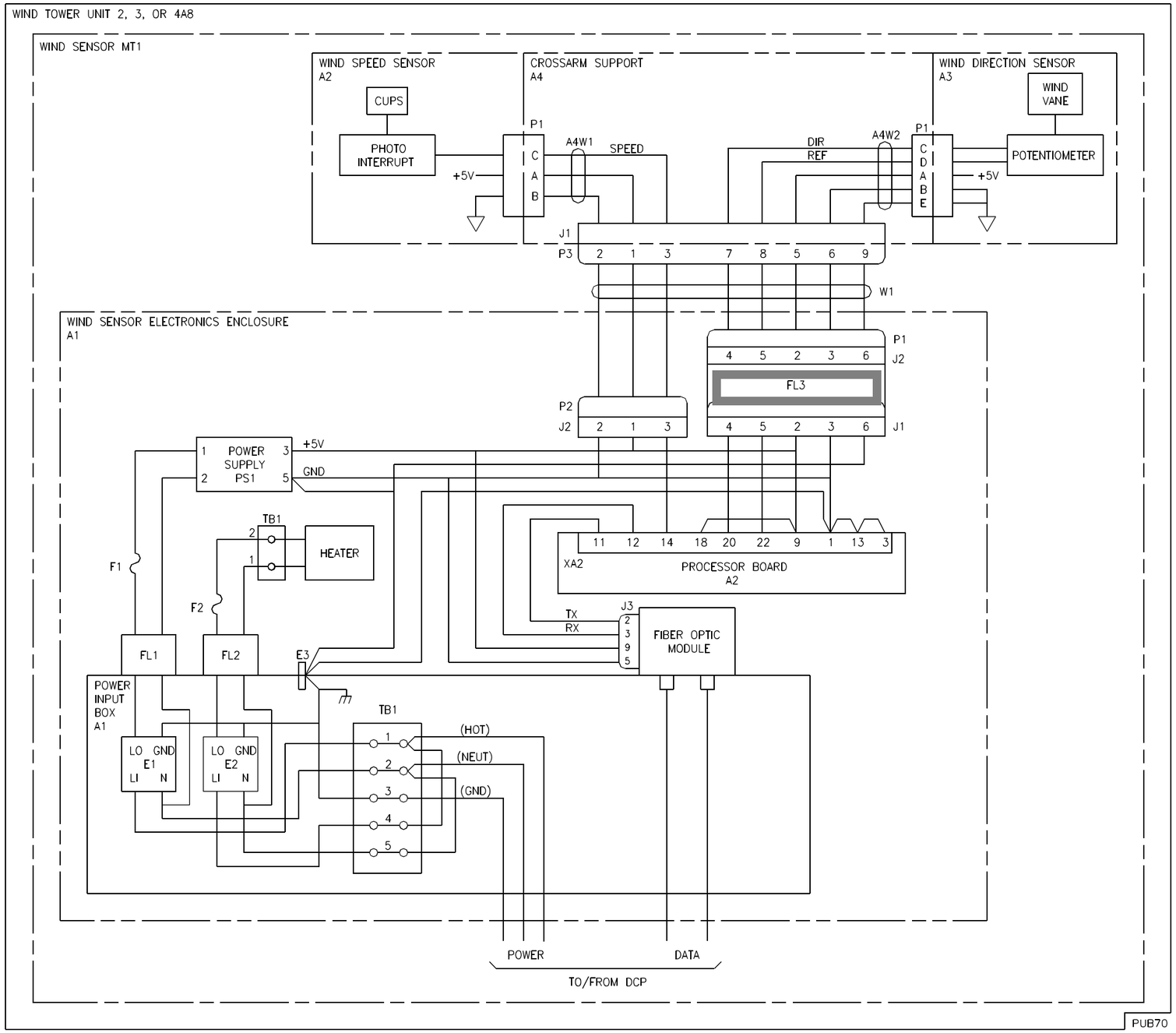

Figure 4.4.2. Wind Sensor Block Diagram (Sheet 1 of 2)

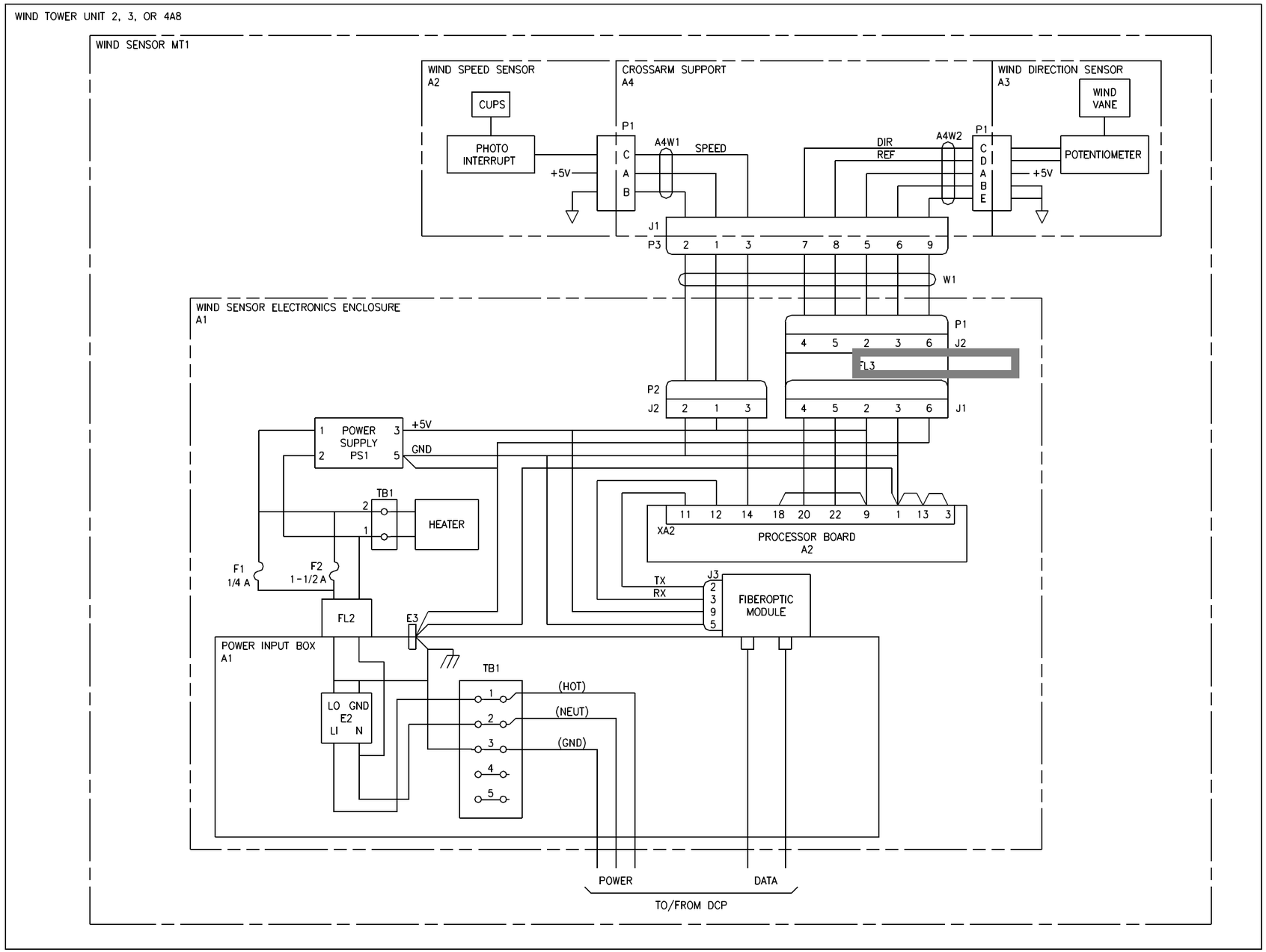

Figure 4.4.2. Wind Sensor Block Diagram (Sheet 2)

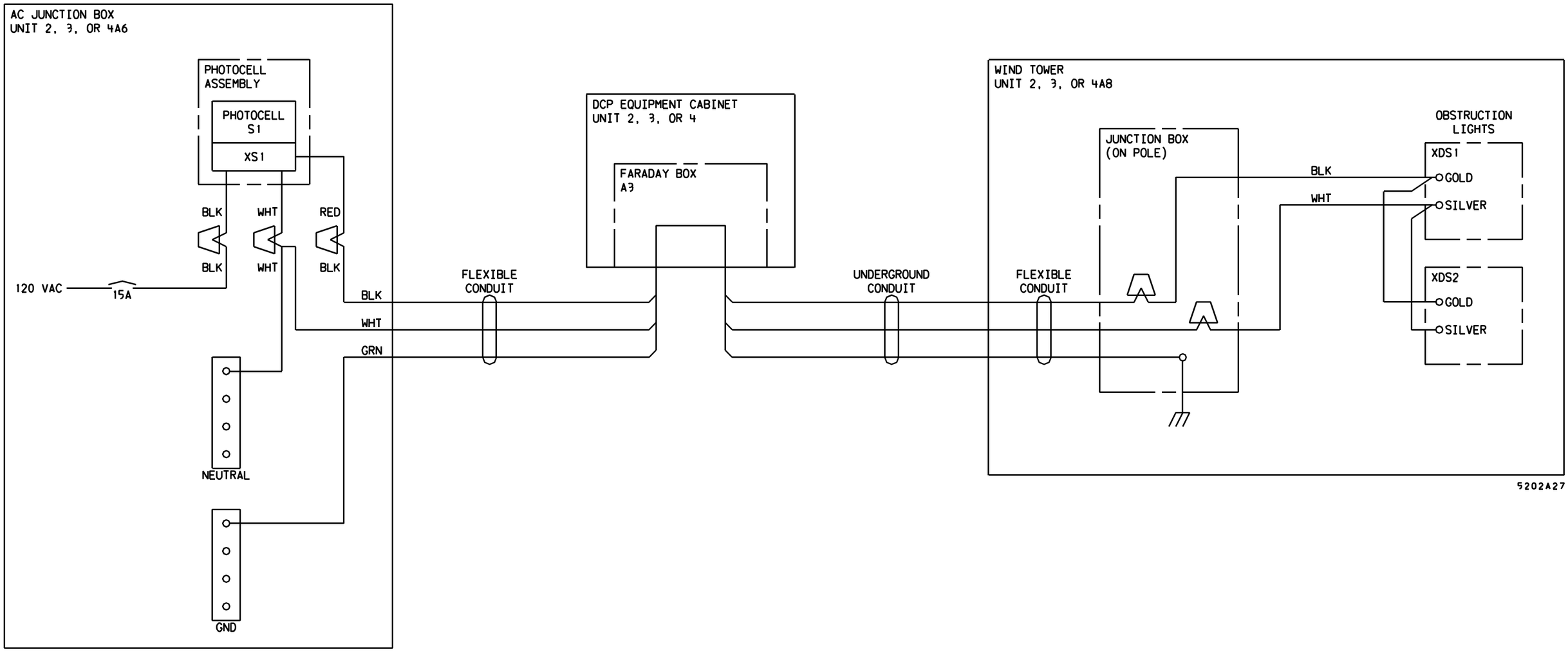

Figure 4.4.3. Wind Sensor Obstruction Lights Detailed Block Diagram