# MODEL 010C
# WIND SPEED SENSOR

## OPERATION MANUAL

Document No 010C-9800 Rev D

MODEL 010C WIND SPEED SENSOR
OPERATION MANUAL

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## 1.0 GENERAL INFORMATION

1.1 The 010C Wind Speed Sensor uses a durable, three-cup anemometer assembly and solid-optical link with a 40-slot chopper disk to produce a pulsed output whose frequency is proportional to wind speed. An internal heater reduces moisture for extended bearing life. This sensor is usually used in conjunction with the 191 Cross arm Assembly. The sensor may be used with a translator module, or used directly with a variety of data loggers.

1.2 The Sensor Cable has a quick-connect connector with vinyl jacketed, shielded cable. Cable length is given in -XX feet on each cable part number. A 1953-XX cable is used with translators having terminal strip connections.

Table 1-1
Model 010C Wind Speed Sensor Specifications

Performance Characteristics

| | |
|---|---|
| Maximum Operating Range | 0-60 meters/sec or 0-125 mph |
| Starting Speed | 0.27 meters/sec or 0.6 mph |
| Calibrated Range | 0-50 meters/sec or 0-100 mph |
| Accuracy | ±1% or 0.15 mph |
| Temperature Range | -50°C to +85°C |
| Response | Distance constant less than 5 ft of flow* |

*The distance traveled by the air after a sharp-edged gust has occurred for the anemometer rate to reach 63% of the new speed. Distant constant less than 15ft of flow with optional 010C-1 aluminum cupset.

Electrical Characteristics

| | |
|---|---|
| Power Requirements | 12 VDC at 10 mA |
| Output Signal | 11-volt pulse |
| Output Impedance | 100 ohms maximum |
| Heater Power Requirement | 12 VDC at 350 mA |
| Standard Cable Length | 300’ maximum (consult factory if longer cable is to be used for special requirements) |

Physical Characteristics

| | |
|---|---|
| Weight | 1.1 pounds |
| Finish | Anodized aluminum |
| Mounting | Use with 191 Crossarm |
| Cabling | 1953-XX Cable (XX is cable length in feet) |

Optional Accessories

A. External heater and power supply for extreme low temperature operation.
B. Ice Skirt for extreme icing environments.
C. Aluminum cup assembly.

## 2.0 INSTALLATION

### 2.1 The 010C Wind Speed Installation

A. Mount the cup assembly and secure with the Allen head set screw, check to see that the cup assembly rotates freely.

B. Install the sensor in the end of the Model 191 Crossarm Assembly (the end without the bushing).

C. Tighten the locking set screw. Do not over-tighten. Apply a small amount of silicone grease to set screws to prevent freezing in adverse environments.

D. Connect the cable assembly to the keyed sensor receptacle and tape it to the mounting arm.

### 2.2 Wiring

A. The cable assembly contains five wires. Typical wiring hookup is shown in Figure 2-1.

### 2.3 Lightning Protection

A. Weather sensors are sensitive to direct or nearby lightning strikes. A well-grounded metal rod or frame should be placed above the sensor installation. In addition, the shield on the signal cable leading to the translator must be connected to a good earth ground at the translator end and the cable route should not be vulnerable to lightning.

## 3.0 OPERATIONAL CHECK-OUT AND CALIBRATION

### 3.1 010C Wind Speed Sensor Check-Out

A. Spinning the anemometer cup assembly will produce a series of pulses (40 pulses per revolution). To verify sensor output, monitor this signal with either the translator module, data logger, or an oscilloscope. (Refer to Frequency vs. Wind Speed Table 3-1). Spinning the hub of the wind speed transmitter without the cup assembly mounted and allowing it to coast to a stop will give a good indication of threshold performance; a jerky or sudden stop indicates damage to bearings, bent drive shaft, or obstruction in the light chopper.

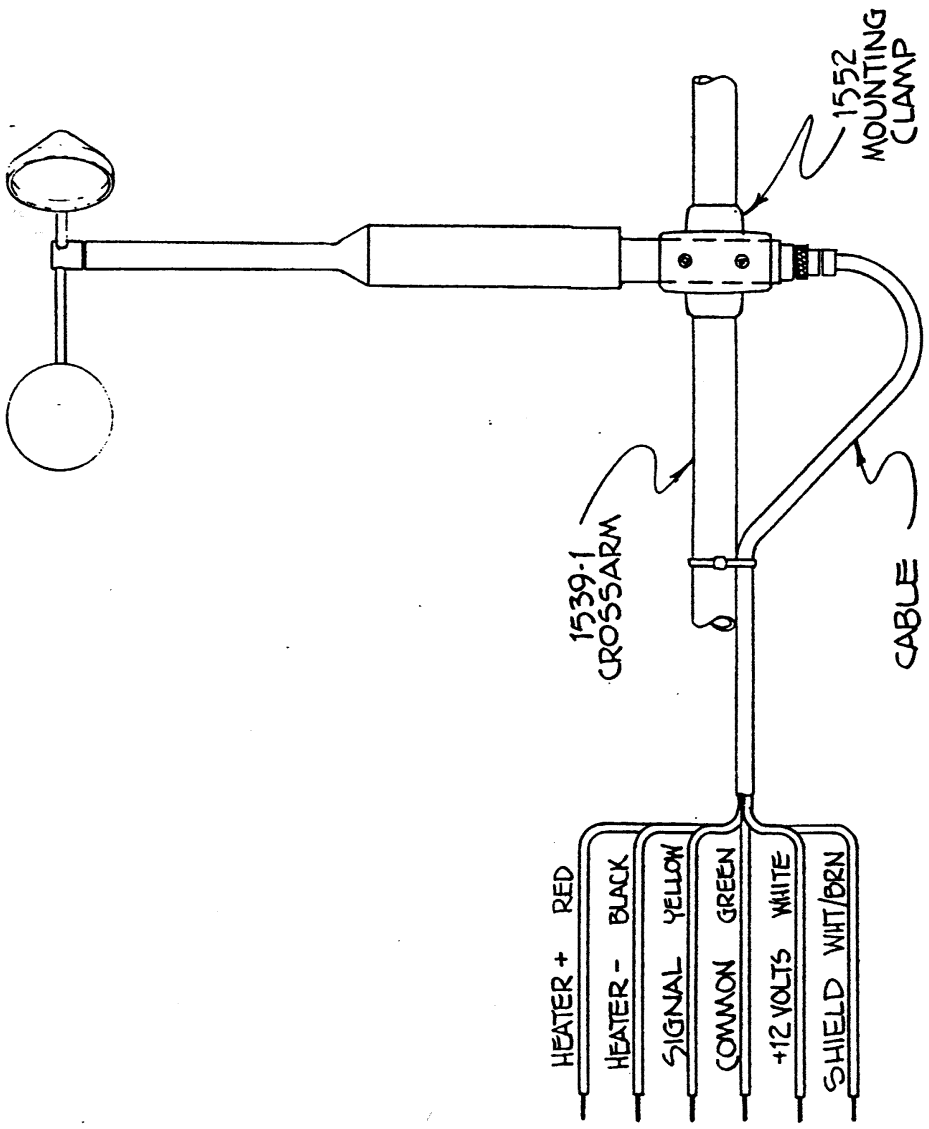



FIG. 2-1
TYPICAL 010C INSTALLATION

B. Inspect the cup assembly for loose cup arms or other damage. The cup assembly cannot change calibration unless a mechanical part has come loose or has been broken. If a cup arm is loose or broken the calibration of the sensor may be affected.

C. If the sensor heater is used, check internal heater operation by sliding sensor cover down and touching the housing behind the printed circuit board. The housing should feel warmer than the adjoining metal parts. The sensor has a built-in heater that is designed to provide a raise in the internal temperature, providing a small amount of positive pressure. This heater requires as external 12 V (@500ma) power supply.

**FREQUENCY vs WIND SPEED FOR 010 SENSOR**
**TABLE 3-1**

**Transfer Functions**

**Miles per hour:**

$rpm = 16.767 * (V_{mph} - 0.6)$

$V_{mph} = (rpm / 16.767) + 0.6$

$f_{Hz} = (V_{mph} - 0.6) / .08946$

$V_{mph} = V_{m/s} * 0.44704$

$f_{Hz} = rpm * 0.66667$

**Meters per second:**

$rpm = 37.522 * (V_{m/s} - 0.27)$

$V_{m/s} = (rpm / 37.522) + 0.27$

$f_{Hz} = (V_{m/s} - 0.27) / 0.039976$

$V_{m/s} = V_{mph} / 0.44704$

**Conversion Tables**

| $V_{mph}$ | $V_{m/s}$ | $f_{Hz}$ | rpm |
|---|---|---|---|
| 10.0 | 4.47 | 105.1 | 157.6 |
| 20.0 | 8.94 | 216.9 | 325.3 |
| 30.0 | 13.41 | 328.6 | 492.9 |
| 40.0 | 17.88 | 440.4 | 660.6 |
| 50.0 | 22.35 | 552.2 | 828.3 |
| 60.0 | 26.82 | 664.0 | 996.0 |
| 70.0 | 31.29 | 775.8 | 1163.6 |
| 80.0 | 35.76 | 887.5 | 1331.3 |
| 90.0 | 40.23 | 999.3 | 1499.0 |
| 100.0 | 44.70 | 1111.1 | 1666.6 |
| 110.0 | 49.17 | 1222.9 | 1834.3 |
| 120.0 | 53.64 | 1334.7 | 2002.0 |
| 130.0 | 58.12 | 1446.5 | 2169.6 |

| rpm | $V_{m/s}$ | $V_{mph}$ | $f_{Hz}$ |
|---|---|---|---|
| 100 | 2.94 | 6.56 | 66.67 |
| 200 | 5.60 | 12.53 | 133.3 |
| 300 | 8.27 | 18.49 | 200.0 |
| 400 | 10.93 | 24.46 | 266.7 |
| 500 | 13.60 | 30.42 | 333.3 |
| 600 | 16.26 | 36.38 | 400.0 |
| 700 | 18.93 | 42.35 | 466.7 |
| 800 | 21.59 | 48.31 | 533.3 |
| 900 | 24.26 | 54.28 | 600.0 |
| 1000 | 26.92 | 60.24 | 666.7 |
| 1100 | 29.59 | 66.21 | 733.3 |
| 1200 | 32.25 | 72.17 | 800.0 |
| 1300 | 34.92 | 78.13 | 866.7 |
| 1400 | 37.58 | 84.10 | 933.3 |
| 1500 | 40.25 | 90.06 | 1000.0 |
| 1600 | 42.91 | 96.03 | 1066.7 |
| 1700 | 45.58 | 101.99 | 1133.3 |
| 1800 | 48.24 | 107.95 | 1200.0 |

| $V_{m/s}$ | $V_{mph}$ | $f_{Hz}$ | rpm |
|---|---|---|---|
| 2.5 | 5.59 | 55.8 | 83.7 |
| 5.0 | 11.18 | 118.3 | 177.5 |
| 7.5 | 16.78 | 180.9 | 271.3 |
| 10.0 | 22.37 | 243.4 | 365.1 |
| 12.5 | 27.96 | 305.9 | 458.9 |
| 15.0 | 33.55 | 368.5 | 552.7 |
| 17.5 | 39.15 | 431.0 | 646.5 |
| 20.0 | 44.74 | 493.5 | 740.3 |
| 22.5 | 50.33 | 556.1 | 834.1 |
| 25.0 | 55.92 | 618.6 | 927.9 |
| 27.5 | 61.52 | 681.2 | 1021.7 |
| 30.0 | 67.11 | 743.7 | 1115.5 |
| 32.5 | 72.70 | 806.2 | 1209.3 |
| 35.0 | 78.29 | 868.8 | 1303.1 |
| 37.5 | 83.89 | 931.3 | 1396.9 |
| 40.0 | 89.48 | 993.8 | 1490.7 |
| 42.5 | 95.07 | 1056.4 | 1584.6 |
| 45.0 | 100.66 | 1118.9 | 1678.4 |
| 47.5 | 106.25 | 1181.5 | 1772.2 |
| 50.0 | 111.85 | 1244.0 | 1866.0 |
| 52.5 | 117.44 | 1306.5 | 1959.8 |
| 55.0 | 123.03 | 1369.1 | 2053.6 |
| 57.5 | 128.62 | 1431.6 | 2147.4 |
| 60.0 | 134.22 | 1494.1 | 2241.2 |

**Abbreviations:**

$V_{m/s}$ = Wind speed (meters per second)

$V_{mph}$ = Wind speed (miles per hour)

$f_{Hz}$ = Sensor output frequency (Hz)

rpm = Shaft speed (revolutions per minute)

Table 3-1

## 4.0 MAINTENANCE AND TROUBLESHOOTING

### 4.1 General Maintenance Schedule*

6 – 12 Month Intervals:

A. Inspect sensor for proper operation per Section 4.2.
B. Replace wind speed sensor bearings in extremely adverse environments per Section 4.5.

12 – 24 Month Intervals:

A. Recommended complete factory overhaul of sensor.

*Schedule is based on average to adverse environments.

Table 4-1
010C Wind Speed Sensor Troubleshooting

| Symptom | Probable Cause | Solution | Refer to |
|---|---|---|---|
| No wind speed output | Loss of supply voltage | Check translator +12 supply & connecting cables | Figure 2-1 |
| | Faulty integrated amplifier | Replace circuit board | Section 4.5 |
| | Faulty diodes, D1, D2 | Replace circuit board | Section 4.5 |
| | Faulty detector | Replace detector | Section 4.6 |
| No wind speed output below 2-5 mph | Bad bearing(s) | Replace bearing(s) | Section 4.4 |
| | Faulty detector | Replace detector | Section 4.6 |
| Wind speed signal drops as speed increases | Faulty detector | Replace detector | Section 4.6 |

4.2 010C Wind Speed Sensor: 6 – 12 Month Periodic Service

A. At the crossarm assembly, disconnect the quick disconnect plug from the sensor (leave the cable secured to the crossarm) and remove the sensor from the crossarm assembly.

B. Loosen the set screw holding the cup assembly. Support the rotating hub of the sensor with one hand and pull the anemometer cup assembly free.

C. Visually inspect the anemometer cups for cracks and breaks. Also, make sure that each arm is securely attached to the cup assembly hub.

D. Slide the sensor cover down to expose the light-chopper disc assembly, light source, detector, and circuit board.

E. Inspect the interior of the sensor for any signs of corrosion and/or dust buildup.

F. Inspect the light-chopper for cracks, and make sure that all slots are free of corrosion.

G. Inspect the signal-conditioning module for cracks and corrosion around soldered connections.

H. Rotate the sensor hub assembly to ensure that it turns freely and that the sensor bearings are not damaged. Make sure the light-chopper assembly is not contacting the light source and detector.

I. Apply a small amount of silicone lubricant. (Dow-Corning DC-33 or equivalent) to the sensor O-ring seals; slide the cover up over the sensor and wipe off any excess lubricant.

J. A moisture vent is located on the base of the sensor; make sure that this vent is clear.

K. Re-install sensor according to installation procedure (Section 2.0); verify proper operation using procedures in Section 3.0.

4.3 010C Wind Speed Sensor Maintenance (Refer to 010C Sensor Assembly Drawing)

The following procedures require a relatively clean, dry work area, a source of 12 VDC power at approximately 20 mA, and an oscilloscope (DC to 10 KHz minimum range required.

4.4 Sensor Bearing Replacement. (Refer to 010C Sensor Assembly Drawing)

A. Remove sensor from tower and remove cup assembly (1). Refer to Section 4.2.

B. Disassemble sensor and remove old bearings (6).

1. Slide the sensor cover (16) down to expose the light-chopper disc assembly (10), detector assembly (12) and circuit board (18).

2. Loosen both special set screws on the shaft of the light chopper assembly (11).

3. Support the light-chopper assembly (10) with one hand and slowly pull the rotating hub/shaft assembly (2) out of the column (8).

4. Remove the shield (4) and slinger (5) from the column (8).

5. Remove the light-chopper assembly (10) from the sensor housing, being careful not to damage the slots located between the light-chopper holder and the lower bearing.

6. Insert the lower end of the rotating hub/shaft assembly into the upper bearing, cock it slightly to one side and push out the lower bearing.

7. Insert a right-angle type of tool, such as an Allen wrench, into the upper bearing; cock it slightly to one side and remove the bearing.

8. Clean dirt from bearing bores, using a cotton swab and alcohol.

C. Install the new bearings and assemble the sensor.

1. Install new upper and lower bearings in the column (8). Bearings should slide easily into bearing bores.

2. Install a slinger and shield (4, 5) on the column assembly. Use new parts if old ones are damaged or corroded.

3. Insert the rotating hub shaft (2) into the column assembly (8), through the shield (4), slinger, and upper bearing, until it starts to protrude through the lower bearing.

4. Support the light-chopper assembly (10) with one hand and slowly push the rotating hub shaft into it until the shaft almost touches the bottom.

5. Tighten both special set screws on the light-chopper assembly; do not over tighten as the set screw tips will damage the shaft.

6. Rotate the sensor hub assembly (2) to ensure that it turns freely and that an endplay of about .005” exists.

7. Hold sensor vertically and make sure that the light-chopper assembly (10) is not contacting the detector assembly (12).

8. Apply small amount of silicone lubricant (Dow-Corning DC-33 or equivalent) to the sensor O-rings (9); slide the cover (16) up over the sensor and wipe off any excess lubricant.

D. Replace cup assembly and re-install (refer to Section 2.0)

4.5 1200-1 Circuit Board Assembly Replacement (Refer to 010C Assembly Schematic)

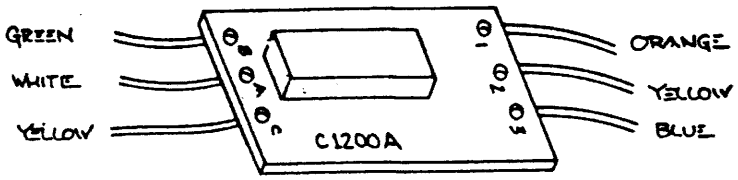
A. Remove sensor from tower and remove cup assembly (refer to Section 4.2).

B. Slide the sensor cover (16) down to expose the light-chopper disc assembly (10), detector assembly (12), and circuit board (18).

C. Remove two screws (17) holding circuit board assembly (18) and lift circuit board away from sensor housing.

D. Note color of wires and then unsolder wires to detector assembly from circuit board and three wires from connector (19).

E. Install new circuit board assembly by reversing above procedure.




— 010 WIND SPEED SENSOR —

4.6 Detector Assembly Replacement Refer to 010C Assembly Schematic)

NOTE: 010C sensors SN M10560 and later use 520253 photodetector. Older sensors use 1074 photodetector assemblies.

A. Remove sensor from tower and remove cup assembly. Refer to Section 4.2.

B. Slide the sensor cover (16) down to expose the light-chopper disc assembly (10), detector assembly (12) and circuit board (18).

C. Remove two screws (17) holding circuit board assembly (18) and lift circuit board away from sensor housing.

D. Note color of wires and then unsolder wires to detector assembly from circuit board (18).

E. Remove two screws (20) holding detector assembly (12) and remove assembly.

F. Install new detector assembly by reversing above procedures.

## 4.7 010C Wind Speed Sensor Repair and Recalibration Service

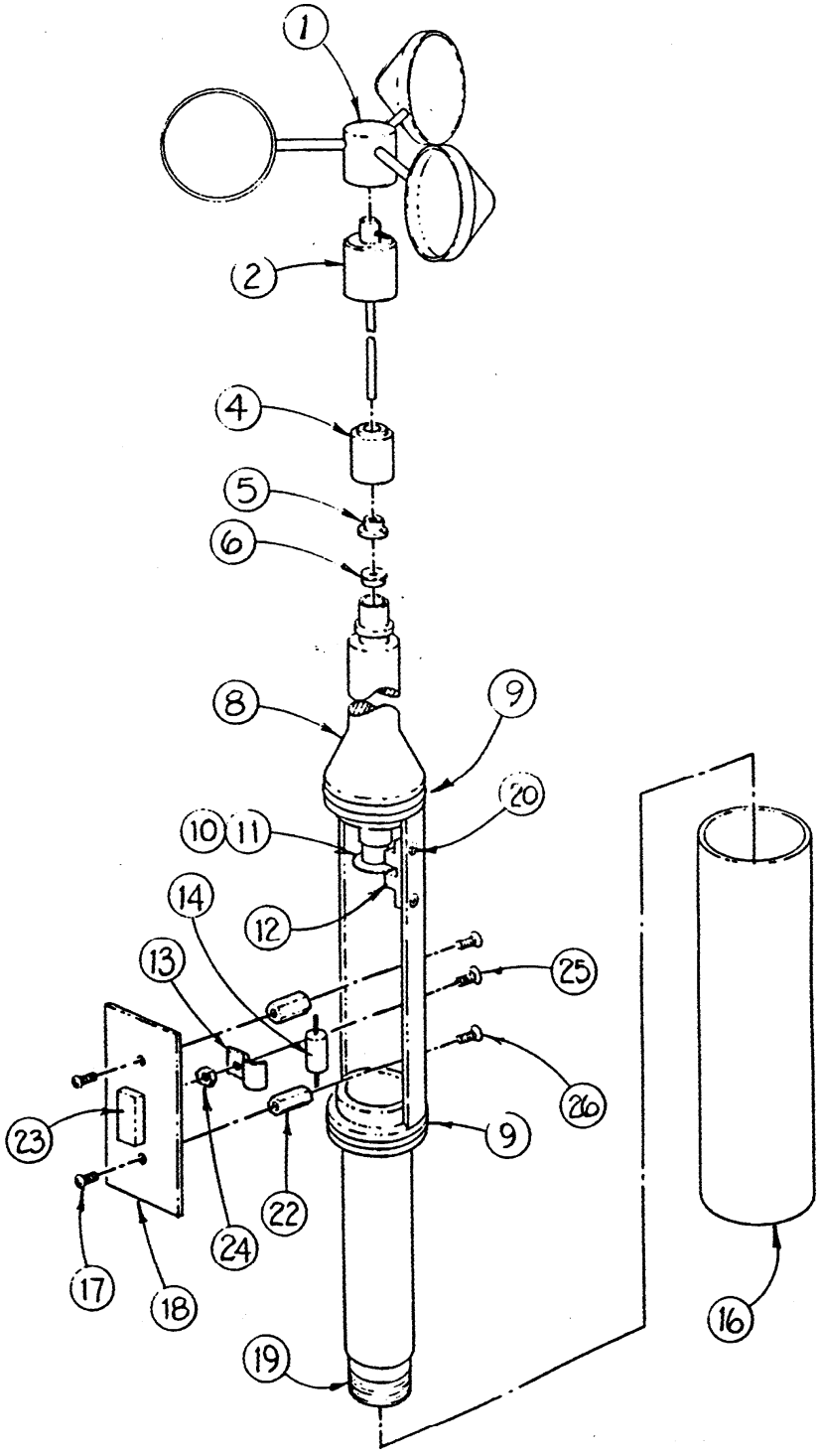
The factory provides fast, economical service for the user. This repair and calibration service includes disassembly and detailed inspection of all moving mechanical parts and electronic components.

Service includes replacement of bearings, regardless of apparent condition, and functional test of sensor. Replacement of the following items is also included: O-rings, shield and slinger, shaft, set screws. Other components will be replaced as required. Only charges for additional materials will be added to the basic service charge.

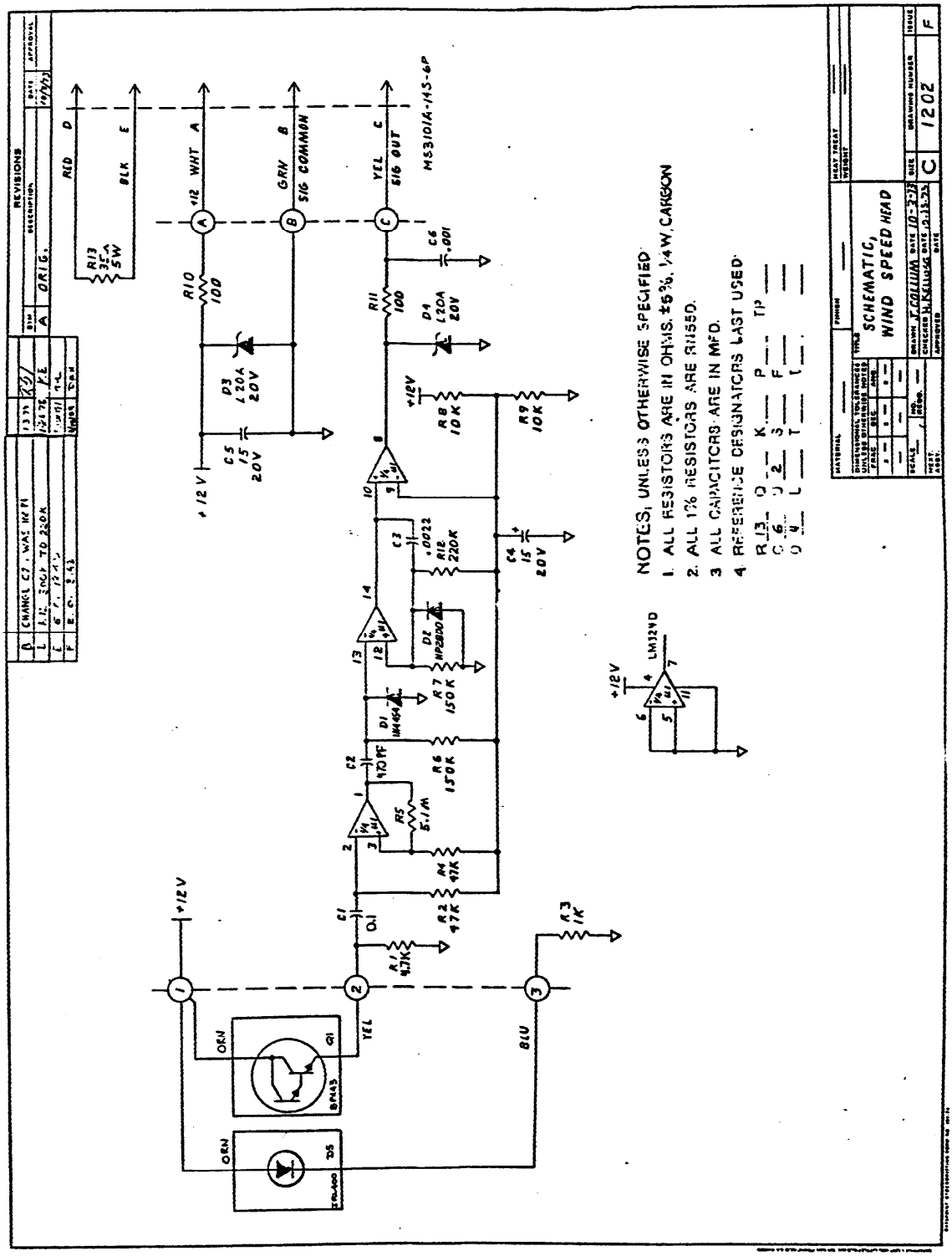
Table 4-2
Replacement 010C Parts List

| Ref No.U | Description | Part No. |
|---|---|---|
| 1 | Cup Assembly | Lexan - 2672<br>Aluminum – 2672-1 |
| 2 | Hub/Shaft Assy. | 2658 |
| 4 | Shield | 1009 |
| 5 | Slinger | 1010 |
| 6 | Bearing | 1055 |
| 9 | O-ring | 720120 |
| 10 | Chopper Wheel Assembly | 2202 |
| 11 | Set Screw | 601250 |
| 12 | Photo Detector | 520253* |
| 13 | Heater Clamp | 480100 |
| 14 | Heater | 805080 |
| 16 | Sensor Cover | 2675 |
| 17 | PCBA Mounting Screws | 601240 |
| 18 | PCBA | 1200-1 |
| 20 | Detector Assembly Mounting Screws | 601270 |
| 22 | Standoff | 860050 |
| 23 | Integrated Amplifier | 620300 |
| 24 | Nut, Hex, Kep 4-40 | 600400 |
| 25 | Screw FH 82° 4-40 x 3/8 | 601330 |
| 26 | Screw FH 82° 4-40 x ¼ | 601240 |

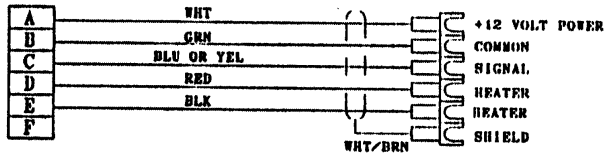
NOTE: 010C sensors SN M10560 and later use the black 520253 photodetector. Earlier sensors use the white 1074 photodetector assemblies.




MODEL 010C WIND SPEED SENSOR

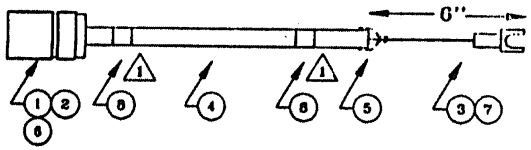

SCHEMATIC,
WIND SPEED HEAD
1202
NOTES, UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE IN OHMS, ±5%, 1/4 W, CARBON
2. ALL 1% RESISTORS ARE RN55D.
3. ALL CAPACITORS ARE IN MFD.
4. REFERENCE DESIGNATORS LAST USED
+12 V
+12V
GRN
YEL
BLU
ORN
RED
BLK
WHT
SIG COMMON
SIG OUT
MS3101A-14S-6P
LM324D
BPW34
2N4400

| REVISIONS | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | APPROVED |
| D | REDRAWN PER E.O. 1131 | 9/11/91 | DH |
| E | WIRE COLORS | 10/17/91 | DH |




SENSOR END

TRANSLATOR END





SOLDER CUP VIEW

| ITEM | PART NO. | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | 500351 | CONNECTOR, 6 PIN, FEMALE | 1 |
| 2 | 480500 | CLAMP | 1 |
| 3 | 600193 | LUG, SPADE, #6 | 6 |
| 4 | 400014 | CABLE, 6 COND., SHIELDED | A/R |
| 5 | 960060 | SLEEVING, 1/4", SHRINK | A/R |
| 6 | 960075 | SLEEVING, 1/8", SHRINK | A/R |
| 7 | 980510 | WIRE, 22 AWG, WHT/BRN | 6" |
| 8 | 960060 | SLEEVING, 1/4", CLEAR SHRINK | A/R |
| 9 | | | |
| 10 | | | |

⚠1 IDENTIFY CABLE 18" FROM EACH END.
DASH NUMBER = LENGTH IN FEET.

MET ONE INSTRUMENTS

ASSY, CABLE, 010
WIND SPEED

| SIZE | FSCM NO. | DWG NO. | REV |
|---|---|---|---|
| | | 1953 | E |
| SCALE | | SHEET 1 OF 1 | |