# MODEL 27106D

## GILL PROPELLER ANEMOMETER

CE

**JANUARY 2003**

**MANUAL PN 27106D-90**


## R. M. YOUNG COMPANY

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# MODEL 27106D
# GILL PROPELLER ANEMOMETER

**SPECIFICATION SUMMARY**

| | |
|---|---|
| Range: | 0 to 30 m/s (67 mph) |
| Sensor: | 22 cm diameter 4-blade helicoid polystyrene propeller |
| Pitch: | 39.4 cm air passage per revolution |
| Distance Constant: | 1.0 m (3.2 ft.) for 63% recovery |
| Treshold Sensitivity: | 0.3 m/s (0.6 mph) |
| Transducer: | Optical photochopper |
| Power Requirement: | 10-14 VDC (12mA @ 12 VDC) |
| Operating Temp: | -50 to 50°C (-58 to 122°F) |
| Transducer Output: | Square wave signal with pulse amplitude approximately equal to supply voltage -2. |
| Output Frequency: | 10 pulses per propeller revolution (0.0294 m/s per Hz) |

## INTRODUCTION

The Gill Propeller Anemometer Photochopper is a low threshold precision air velocity sensor employing a fast response helicoid propeller. The instrument uses a high quality optical photo chopper which converts propeller rotation to a square wave signal whose frequency is linearly proportional to air velocity. The output signal is the same regardless of propeller rotation. For applications where propeller rotation in two directions is required, the model 27106F is offered.

Airflow from any direction may be measured, however, the propeller responds only to the component of the air flow which is parallel to the axis of its rotation. Off-axis response closely approximates a cosine curve (see accompanying graphs) with appropriate polarity. With perpendicular air flow the propeller does not rotate.

The instrument mounts to 3/4 inch standard pipe. A rugged cable connector provides both electrical and mechanical connection. A dust cap is provided to protect the connector when the instrument is removed.

## INITIAL CHECKOUT

When the instrument is unpacked it should be carefully checked for any signs of shipping damage. The propeller shaft should rotate easily without friction.

Using the WIRING DIAGRAM as a guide, connect the instrument to an oscilloscope or frequency meter and check for proper signals from the sensor. The calibration may be checked using the methods outlined in the CALIBRATION section of this manual.

## INSTALLATION

Generally, the instrument should be oriented with the propeller facing the predominant flow of air being measured. In some cases it is appropriate to orient the instrument so the predominant air flow is perpendicular to the propeller such as in applications measuring the vertical component of wind. Keep in mind that off-axis response increases the effective threshold and distance constant. For vertical measurements mount the instrument so the propeller faces upward. This helps prevent moisture or dirt from entering around the propeller hub and potentially contaminating the bearings.

If the instrument is used to measure high air velocity or left for extended periods without attention, tape the threaded cable connector collar to eliminate the possibility of loosening from vibration. The threaded joint between the photochopper and shaft housings may also be taped.

## CALIBRATION

Calibration is determined by propeller pitch and the output frequency of the photo chopper transducer.

The Model 08274 Polystyrene Propeller has a 29.4 cm/rev pitch. This is equivalent to 0.00490 m/s per rpm and is accurate to ±1%. Zero offset is insignificant. Formulas for other units of measurement appear below.

Information on checking bearing and transducer torque, which can affect propeller threshold, also appear in the MAINTENANCE section.

When the propeller is used for measuring vertical wind component, users may want to apply a 1.25 multiplier to the output signal. This may be done numerically in data processing operations or electronically in the signal conditioning. Using the multiplier brings the anemometer output signal within ±3% of the cosine response for elevation angles between -30 and +30 degrees. Since the standard deviation of wind elevation angle in open terrain rarely exceeds 12 degrees, 98% (2.5 standard deviations) of observations will be within ±30 degrees. Using the multiplier is NOT necessary when the anemometer is used in a UVW configuration with YOUNG Model 26700 Programmable Translator.

### CALIBRATION FORMULAS

**Model 27106D Propeller anemometer photo chopper w / 08274 Propeller**

WIND SPEED vs PROPELLER RPM

| | | |
|---|---|---|
| m/s | = | 0.00490 x rpm |
| knots | = | 0.00952 x rpm |
| mph | = | 0.01096 x rpm |
| km/h | = | 0.01764 x rpm |

WIND SPEED vs OUTPUT FREQUENCY

| | | |
|---|---|---|
| m/s | = | 0.02940 x Hz |
| knots | = | 0.05712 x Hz |
| mph | = | 0.06576 x Hz |
| km/h | = | 0.10584 x Hz |

## MAINTENANCE

Given proper care the Gill Propeller Anemometer should provide years of service. Components are conservatively rated and require little maintenance. The only parts likely to need replacement due to normal wear are the precision ball bearings. The replacement procedures are best performed in a service facility and only by qualified technicians. If service facilities are not available return the instrument to the factory.

Refer to the accompanying drawings to become familiar with part names and locations.

### FLANGE BEARING REPLACEMENT

If anemometer bearings become noisy or wind speed threshold increases above an acceptable level, bearings may need replacement. Check bearing condition using a Model 18310 Anemometer Bearing Torque Disk. If, after replacing bearings, the torque is still too high, check the photo chopper transducer for any misalignment.

Replace bearings as follows:

1. REMOVE OLD BEARINGS
   a) Remove propeller from anemometer.
   b) Unthread 27153A generator housing threaded collar.
   c) Unthread generator housing from shaft housing.
   d) Remove 3-48 screw securing photochopper circuit board to photochopper mounting.
   e) Remove 4-40 screw securing window disk to photo disk hub.
   f) Loosen set screw on photo disk hub and remove from propeller shaft.
   g) Pull front bearing dust shield off housing.
   h) Using the edge of a pocket knife, gently pry front and rear bearings out of housing.
2. INSTALL NEW BEARINGS
   a) Gently insert front bearing into housing.
   b) Push front bearing dust shield back onto housing.
   c) Carefully slide propeller shaft through front bearing and into housing.
   d) Slide rear bearing over propeller shaft and gently push it into housing.
   e) Place photo disk hub on propeller shaft.
   f) Allow 0.010 inch (0.25 mm) end play gap between shaft collar/coupling disk and bearing. Tighten set screw (80 oz in, 5600 gm-cm max torque).
   9) Re-assemble in reverse order as stated in step 1.
   h) Check bearing torque to confirm it is within specifications.

### ADDITIONAL REFERENCES

References containing additional information about the Gill Propeller Anemometer are listed below in chronological order:


Holmes, R. M., Gill, G. C., and Carson, H. W., “A Propeller Type Vertical Anemometer”, Journal of Applied Meteorology, Vol 3, 1964, pp. 802-804.

Drinkow, R., “A Solution to the Paired Gill-Anemometer Response Function”, Journal of Applied Meteorology, Vol 11, 1972, pp. 7-80.

Hicks, B. B., “Propeller Anemometers as Sensors of Atmospheric Turbulence”, Boundary-Layer Meteorology, Vol 3,1972, pp. 214-228.

Fichtl, G. H., and Kumar, P., “The Response of Propeller Anemometer to Turbulent Flow with the Mean Wind Vector Perpendicular to the Axis of Rotation”, Boundary-Layer Meteorology, Vol 6,1974, pp. 363-379.

McMichael, J. M., and Klebanoff, P. S., “The Dynamic Response of Helicoid Anemometers”, NBSIR 75-772, National Bureau of Standards, 1975.

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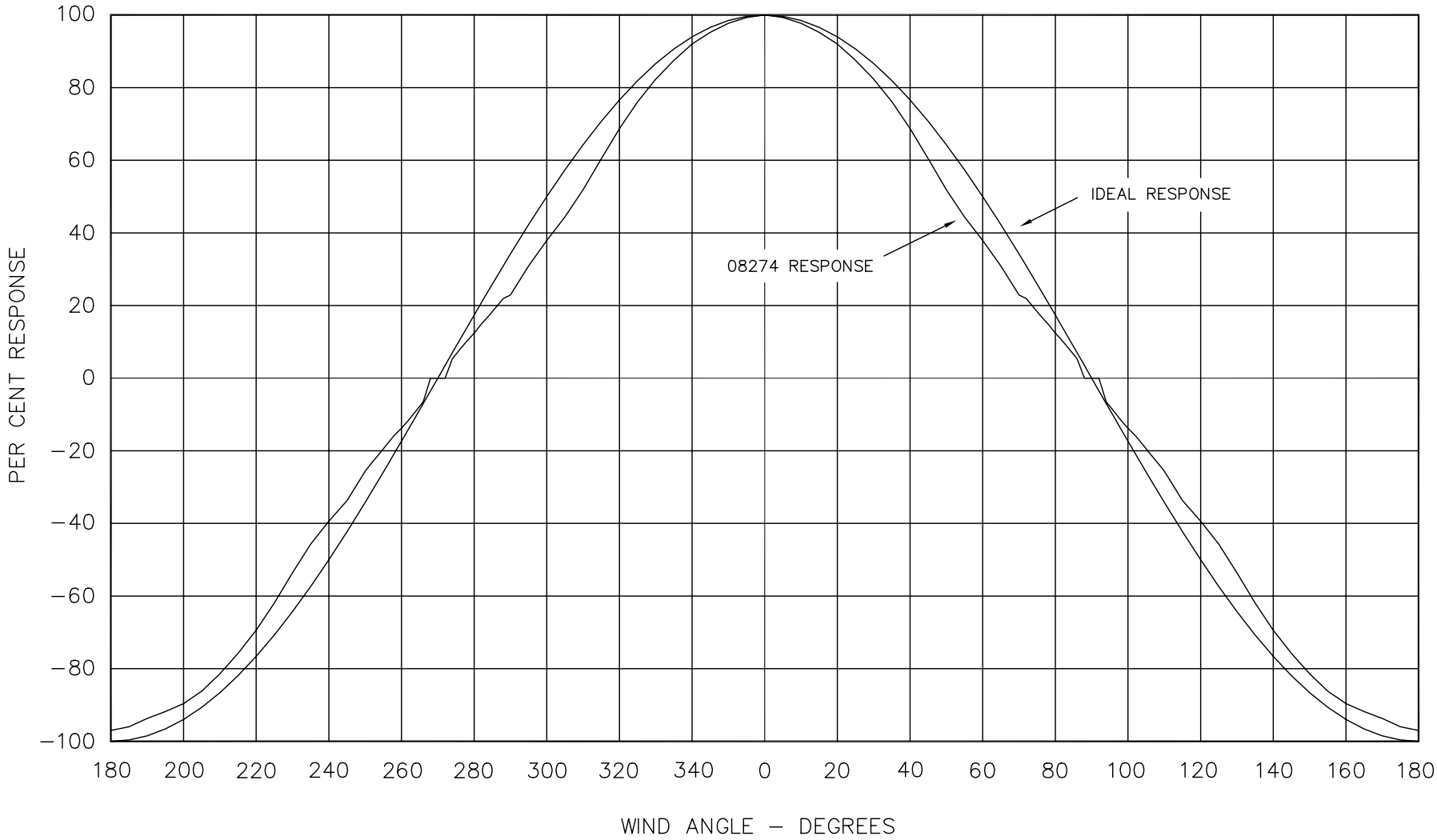
# MODEL 08274 PROPELLER REPONSE vs WIND ANGLE




| | | |
|---|---|---|
| MODEL 08274 22 cm EPS PROPELLER | DWG A | 08−87 |
| OFF−AXIS RESPONSE ON A MODEL 27106 | DWN KL | 08−88 |
| PROPELLER ANEMOMETER | CHK DP | A08274C |
| R.M. YOUNG CO. TRAVERSE CITY, MI 49686 U.S.A. 231−946−3980 | | |

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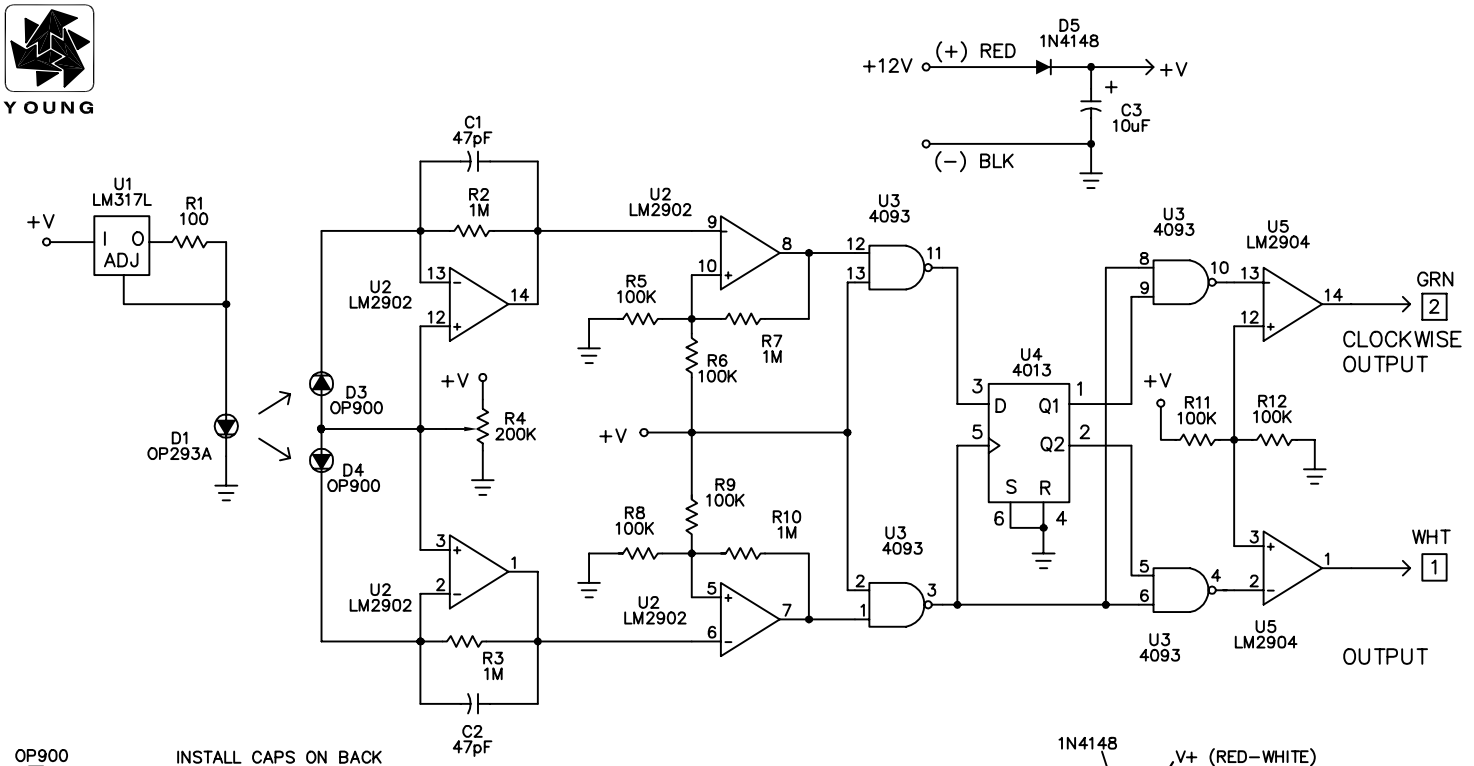



## WIRING INFORMATION

### MODEL 27106D/F (DUAL CHANNEL) PROPELLER ANEMOMETER

AMPHENOL CONNECTOR
MS−3106A−20−15P "W"

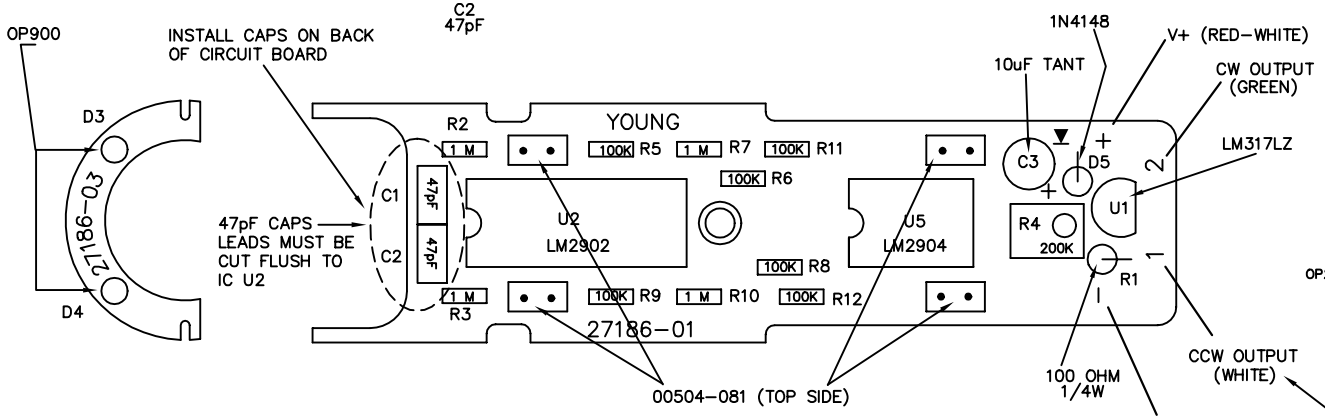
PIN A − GROUND & SIGNAL REFERENCE
PIN B − EARTH GROUND
PIN C − COUNTERCLOCKWISE OUTPUT *
PIN D − INPUT POWER (12 VDC)
PIN E − CLOCKWISE OUTPUT

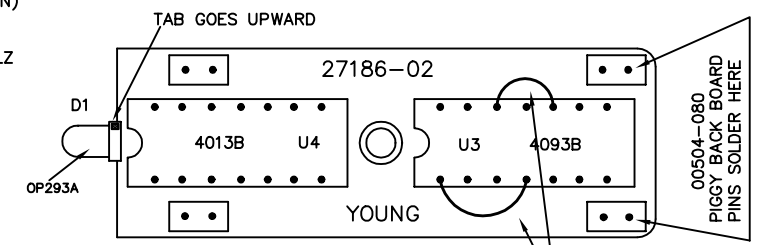
* SINGLE CHANNEL OUTPUT

### MODEL 12102D (SINGLE CHANNEL) CUP ANEMOMETER

AMPHENOL CONNECTOR
MS 3102A−14S−6P

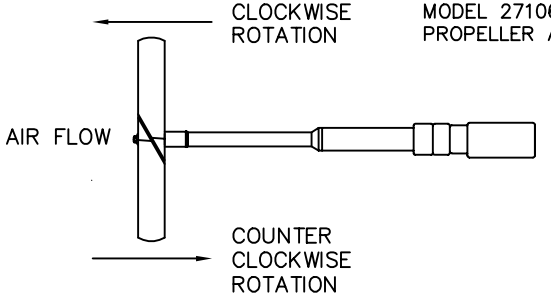
PIN A − GROUND & SIGNAL REFERENCE
PIN B − EARTH GROUND
PIN C − OUTPUT PULSE
PIN D − INPUT POWER (12 VDC)




U4 & U3 OMITTED FOR SINGLE CHANNEL PHOTOCHOPPERS.
PINS 12 & 10 AND 1 & 4 ON U3 JUMPERED RESPECTIVELY.

FOR SINGLE CHANNEL CONFIGURATION, OMIT WHITE WIRE (TERMINAL−1)




NOTE: ALL RESISTORS 1/8W UNLESS OTHERWISE NOTED.

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|---|---|
| PULSES PER REVOLUTION | |
| SUPPLY VOLTAGE | 10 TO 14 VDC |
| SUPPLY CURRENT | 12 mA |

| | | |
|---|---|---|
| PART NO. 27186A | DWG B | PRD 06−93 |
| FOR MODELS 27106D/F & 12102D | DWN KL | DWG 09−96 |
| PHOTOCHOPPER CIRCUIT ASSEMBLY | CHK | W27186 |
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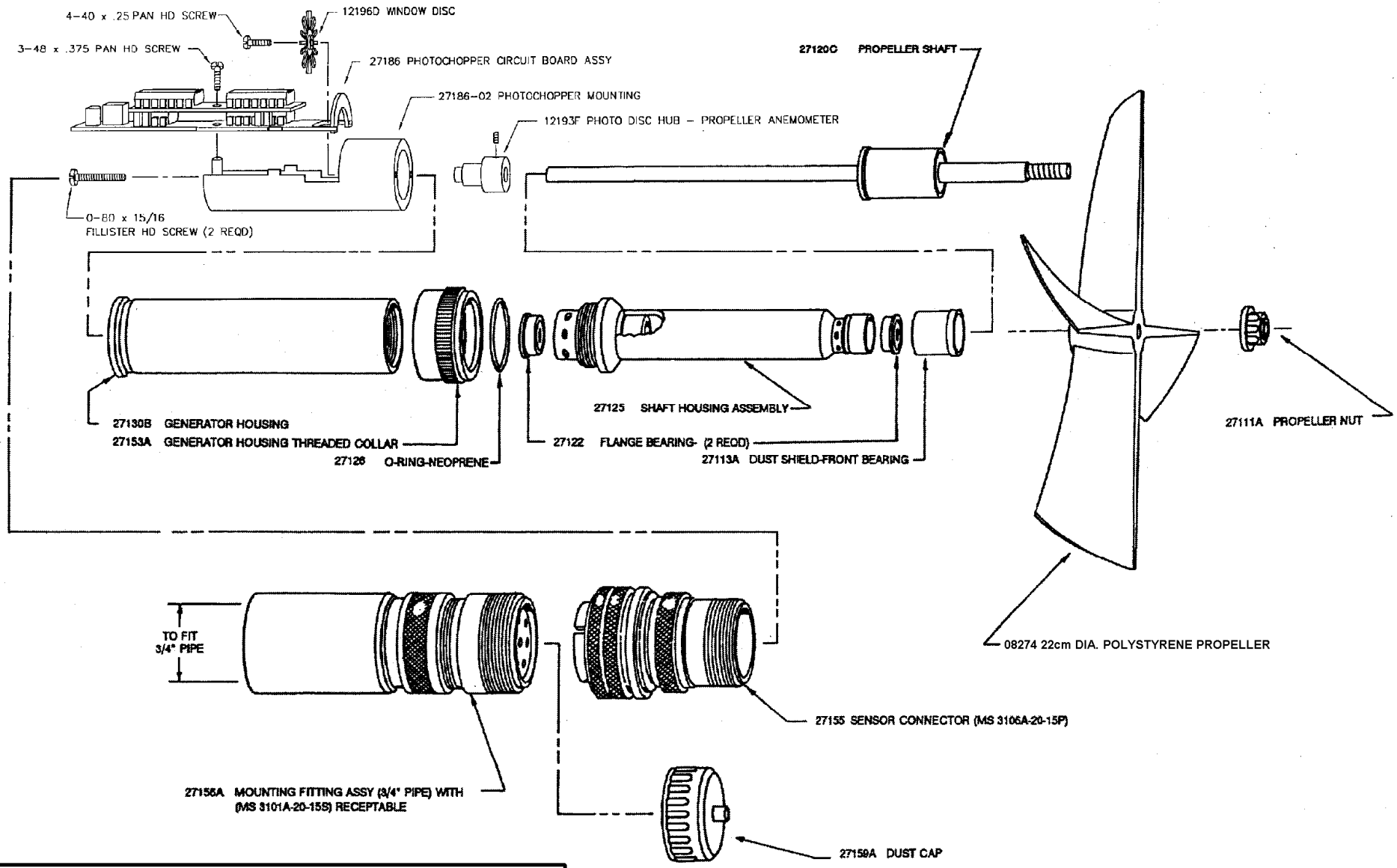


# GILL PROPELLER ANEMOMETER

## MODEL 27106D/F

## GENERAL ASSEMBLY & REPLACEMENT PARTS

R. M. YOUNG COMPANY
2801 AERO PARK DRIVE, TRAVERSE CITY, MICHIGAN 49684

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