METEOROLOGICAL INSTRUMENTS

INSTRUCTIONS

GILL PROPELLER ANEMOMETER

MODEL 27106DR

CE

R.M. YOUNG COMPANY 2801 AERO PARK DRIVE, TRAVERSE CITY, MICHIGAN 49686, USA
TEL: (231) 946-3980 FAX: (231) 946-4772 WEB: www.youngusa.com

PN: 27106DR-90
REV: C110817

MODEL 27106DR
GILL PROPELLER ANEMOMETER

SPECIFICATION SUMMARY

Range:	0 to 45 m/s (100 mph)
Sensor:	18 cm diameter 4-blade helicoid propeller molded of Polypropylene thermoplastic
Pitch:	28.7 cm air passage per revolution
Distance Constant:	2.7 m (8.9 ft.) for 63% recovery
Threshold Sensitivity:	0.5 m/s (1.1 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 (0.0287 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 08234 Black Polypropylene Thermoplastic Propeller has a 28.7 cm/rev pitch. This is equivalent to 0.00478 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 26800 Programmable Translator.

CALIBRATION FORMULAS

Model 27106DR Propeller anemometer photo chopper w/ 08234 Propeller

WIND SPEED	vs	PROPELLER RPM
m/s	=	0.00478 x rpm
knots	=	0.00929 x rpm
mph	=	0.01069 x rpm
km/h	=	0.01721 x rpm

WIND SPEED	vs	OUTPUT FREQUENCY
m/s	=	0.02868 x Hz
knots	=	0.05574 x Hz
mph	=	0.06414 x Hz
km/h	=	0.10326 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.

WARRANTY

This product is warranted to be free of defects in materials and construction for a period of 12 months from date of initial purchase. Liability is limited to repair or replacement of defective item. A copy of the warranty policy may be obtained from R. M. Young Company.

CE COMPLIANCE

This product has been tested and shown to comply with European CE requirements for the EMC Directive. Please note that shielded cable must be used.

ADDITIONAL REFERENCES

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

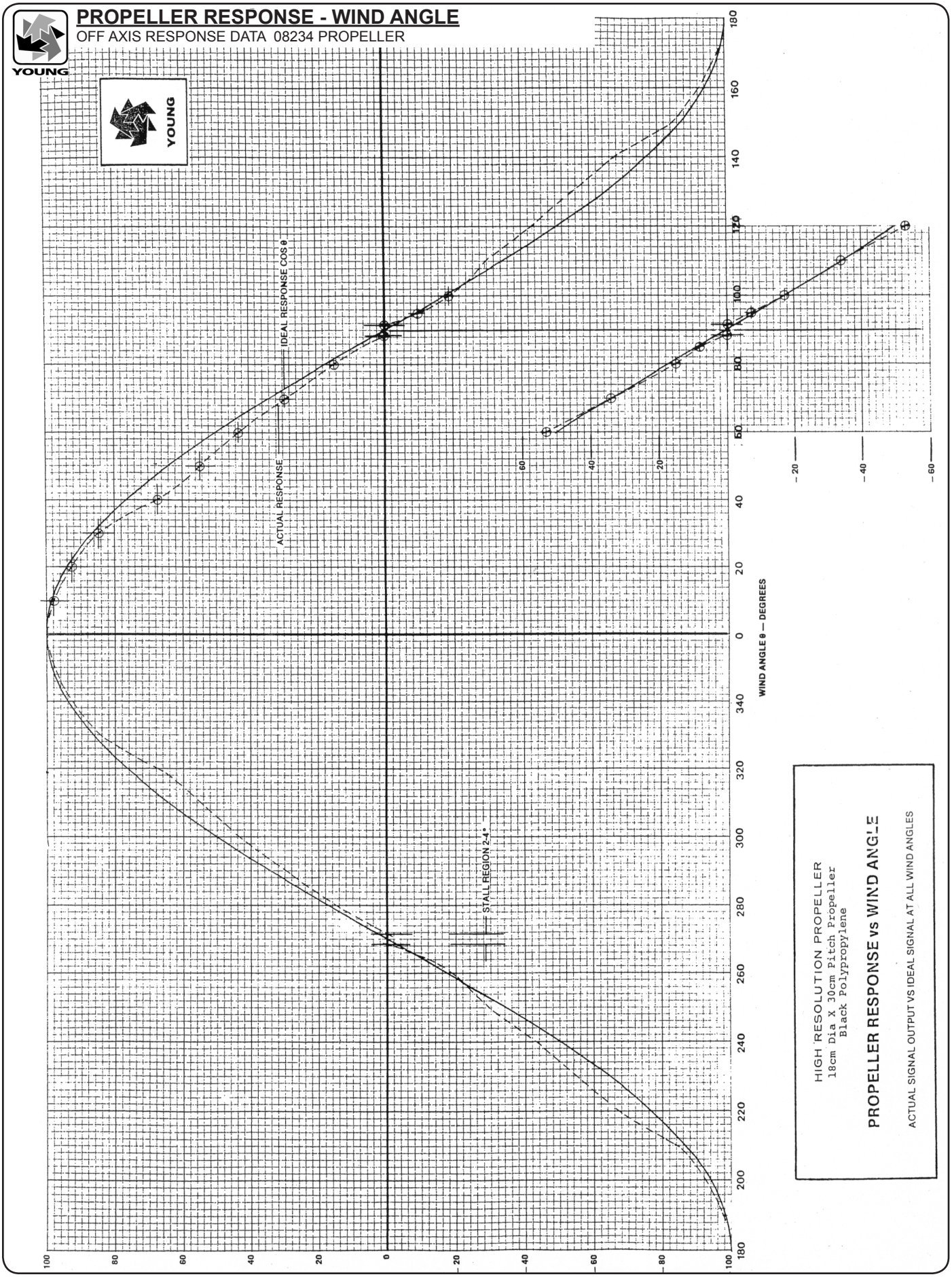
Holmes, R. M., Gill, G. C., and Carson, H. W., "A Propeller Type Vertical Anemometer", Journal of Applied Meteorology, Vol 3, 1964, pp. 802-804.

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.

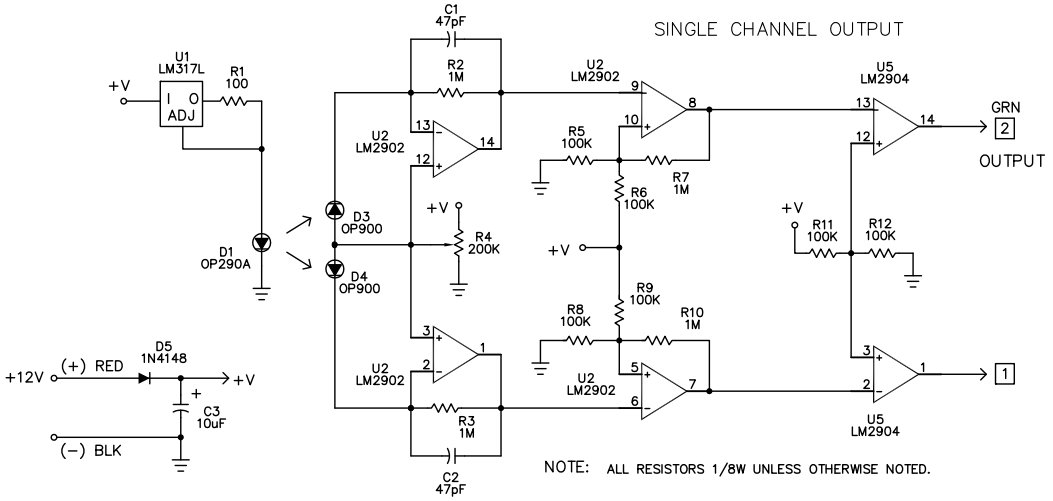
Fichtl, G. H., and Kumar, P., "The Response of Propeller Anemometer to Turbulent Flow with the Mean Wind Vector Perpendicular to the Axis of Rotation", Boundary-Layer Meteorology, Vol 6,1974, pp. 363-379.

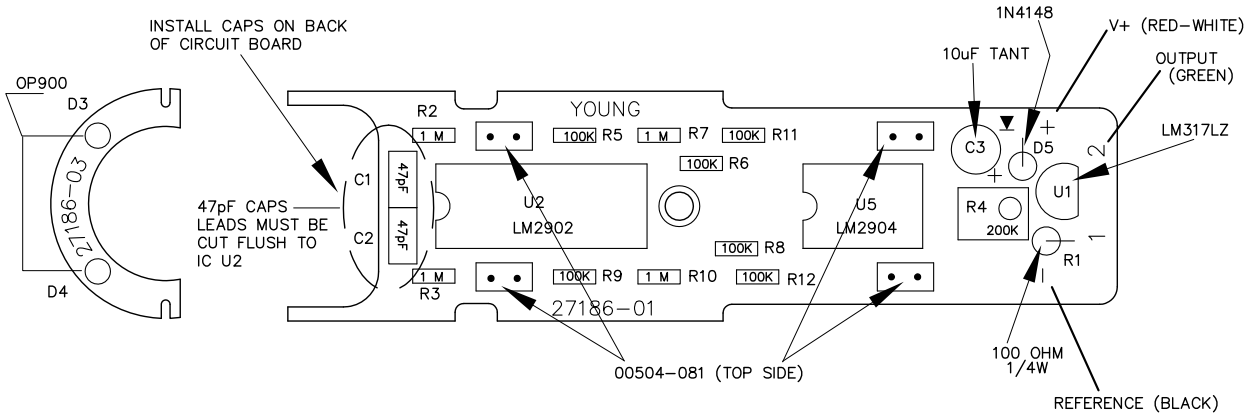
McMichael, J. M., and Klebanoff, P. S., "The Dynamic Response of Helicoid Anemometers", NBSIR 75-772, National Bureau of Standards, 1975.

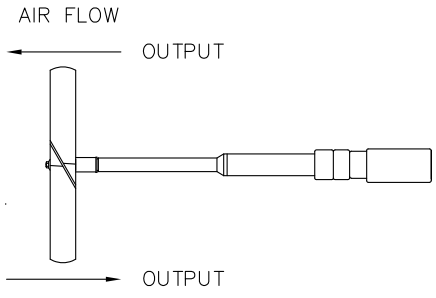

PROPELLER RESPONSE - WIND ANGLE
OFF AXIS RESPONSE DATA 08234 PROPELLER
YOUNG
IDEAL RESPONSE COS θ
ACTUAL RESPONSE
STALL REGION 2-4°
WIND ANGLE θ — DEGREES
HIGH RESOLUTION PROPELLER
18cm Dia X 30cm Pitch Propeller
Black Polypropylene
PROPELLER RESPONSE vs WIND ANGLE
ACTUAL SIGNAL OUTPUT VS IDEAL SIGNAL AT ALL WIND ANGLES

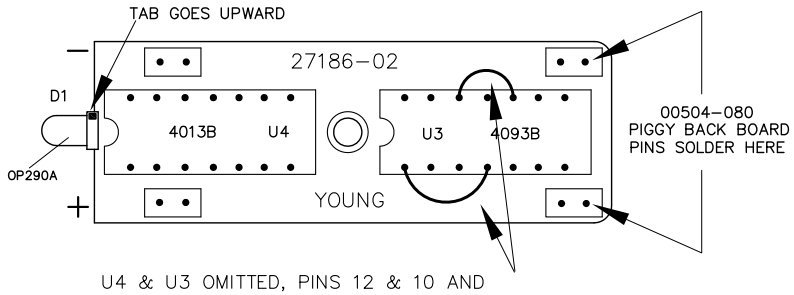
27186D (SINGLE CHANNEL)

PROPELLER ANEMOMETER - PHOTOCHOPPER CIRCUIT





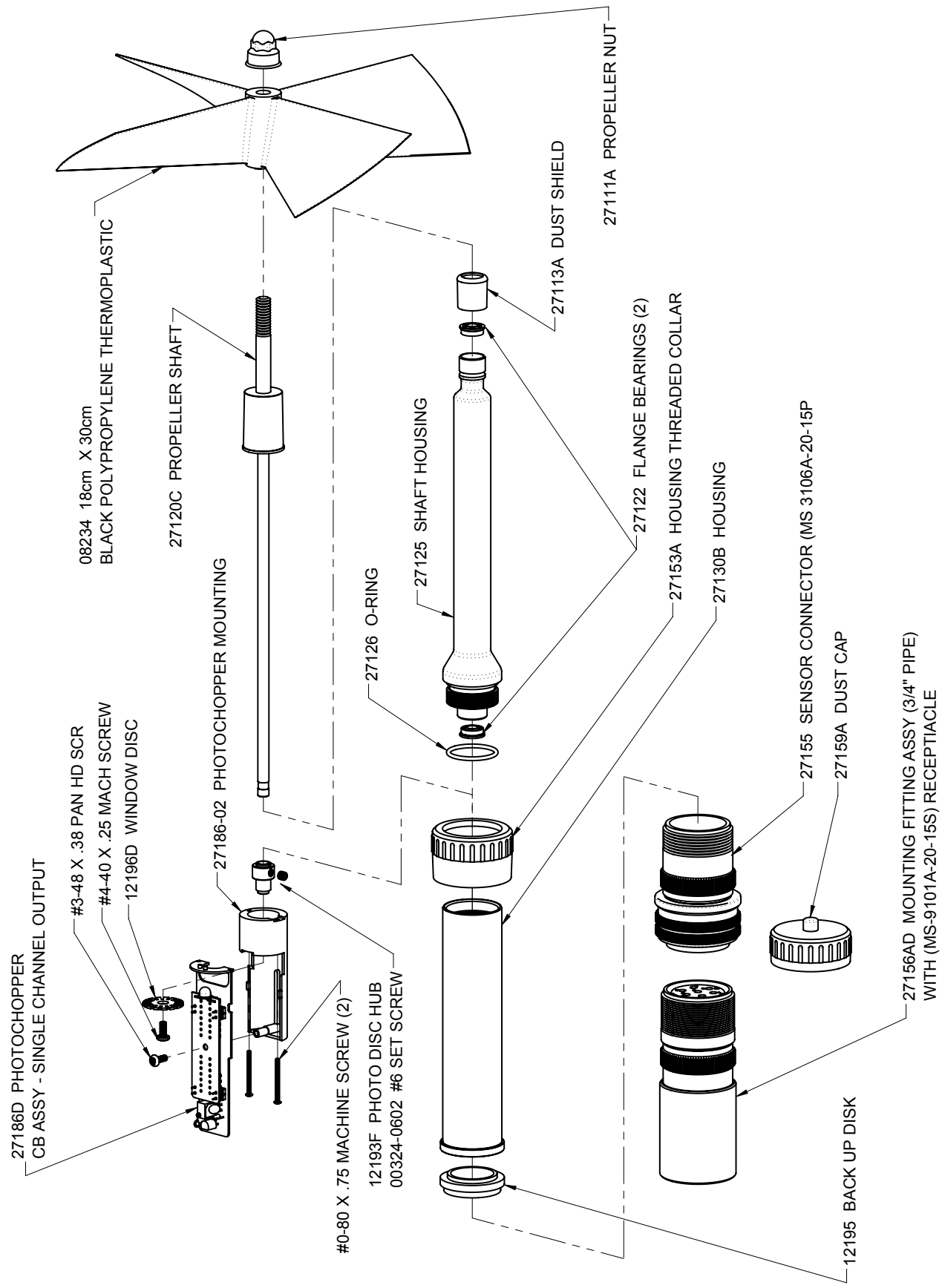




SUPPLY VOLTAGE	10 TO 14 VDC
SUPPLY CURRENT	12 mA

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

PIN A – GROUND & SIGNAL REFERENCE
PIN B – EARTH GROUND
PIN C – OUTPUT
PIN D – INPUT POWER (12 VDC)
PIN E – (NOT USED)

27106DR-90(C)

27106DR GENERAL ASSEMBLY & REPLACEMENT PARTS