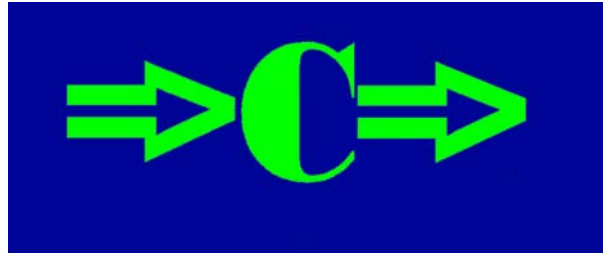


# CyberSense



## **CyQ<sup>®</sup> 120**

# **OPERATOR'S MANUAL**

# SUPPORT

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# QUICK START

## Quick Check

1. Plug in the wall transformer
2. Flip the power switch on (red handle up); the yellow SAT light will flash followed by the red PMT light.
2. Press the zero switch and the Blue light should flash for a while and then stop.

## Detailed Setup

1. Connect a coaxial cable from the photomultiplier output to the BNC receptacle labeled INPUT on the back of the 120 case.
2. Connect a coaxial cable from the 120 OUTPUT BNC receptacle to a voltmeter or AD input.
3. Insert WALL TRANSFORMER barrel plug into the 120 POWER receptacle.
4. Plug WALL TRANSFORMER into wall outlet.
5. Flip the power switch (red handle) up to the ON position.
6. The yellow SATuration warning light will flash followed by the red PMT warning light.
7. Set range to 10 ua/volt.
8. With the PMT in the dark press the zero switch.
9. The yellow SAT light will flash for a while and then stop. The output should go to a value less than 200 uv (typically < 0.1 mv).

# CALIBRATION

Precision (0.1 % accuracy, 25 ppm temperature coefficient) resistors are used throughout the CyQ120 in the amplifier stages. Operational amplifiers are low noise, low drift, low offset, and high open loop gain. Therefore, gain adjustments are not needed.

Dark current offset compensation can be done automatically by pressing the zero switch. This cancels out the input voltage due to dark current with a theoretical accuracy of 73 microvolts, and a practical accuracy of 100 uv to 1 millivolts (500 ms time constant during zero; minimizes noise effects from the PMT cable). At high PMT high voltage levels noise and drift will prohibit more precise “zero” setting.

The saturation light comes on at 10.2 volts on any output stage. The PMT warning light comes on at 120 microamperes from the PMT.

# INPUTS

## ***Photomultiplier input***

This is a BNC receptacle. It is labeled INPUT and is on the left when the module is viewed from the back. This is intended for direct coupled PMT anode signals (Negative high voltage to the cathode).

This is the common standard. DO NOT APPLY HIGH VOLTAGE TO THIS INPUT !!!!).

## ***Power input***

This is a two conductor barrel receptacle and mates with a 2.1 mm barrel plug. Power is supplied by a 9 to 12 VDC unregulated wall transformer. The wall transformer must deliver adequate current to provide 12 vdc under load; at 9 VDC a 200 ma or more current rating is recommended. We provide either a 9 VDC unregulated, 200 ma or a 12 VDC, 100 ma unit.

The power input is varistor protected at 20 VDC against surges and diode protected against reverse polarity. There is a 500 ma self-resetting fuse between the varistor and the power input jack.

# OUTPUT

This is a standard BNC connector.

The output will sink or source 21 ma typically and is guaranteed to deliver 16 ma. The output swing capability is from -10.5 to +10.5 volts. Capacitor loads in excess of 120 pf may cause oscillations (typically, RG59 coaxial cable has 17 pf/ft while RG62 has 14 pf/ft)

# CONTROLS

## *Range Switch*

The amount of input current from the PMT needed to produce a 1 volt change in the output increases as the switch is rotated clockwise. Gain, sensitivity, decreases as the switch is rotated clockwise contrary to convention. If we had adhered to the gain convention then the switch would be labeled 100 volts per microamp in the 0.01 ua/volt position. This suggests that the output is capable of reaching 1000 volts - a frightening thought if you are connecting to an AD converter. This is why we chose to use Scale factor instead of gain - the units in the label are realistic in terms of both input and output.

Ranging is brought about by using four amplifiers in series. The final amplifier has a gain of 1, 2, or 5; it is present for all ranges. This is preceded by 3 amplifiers each with a gain of 10. These are in series so additional gains of 10, 100, and 1000 are switched in at the 1, 0.1, and 0.01 ua /volt positions respectively.

Bandwidth is reduced with each additional stage; on the 0.01 range it is reduced to 200 Hz. The most sensitive ranges may have a power line (60/50 Hz) noise component when the input is connected to a source. External noise can only be removed with the time constant setting.

## *Zero Switch*

The internal offset of the 120 is near zero due to the use of high precision operational amplifiers. The primary purpose of the zero adjust is to compensate for PMT dark current with zero light applied. Theoretically zero lumens should give zero microamps, and this should yield zero volts on the output. If this perfection is attained then the baseline is independent of range. As a practical matter this is of course impossible; the 120 will zero to about 50-100 microvolts. Note that without zero compensation it is likely that the output would be saturated on, or before, the high sensitivity range.

Noise on the input will reduce the accuracy of the autozero. Therefore, the most

accurate zero will be attained with the input time constants set to 500 ms; allow a few seconds for settling before pressing the zero switch.

*Pressed, Down position and release:*

This activates the internal automatic zero adjustment. This is a momentary position and the switch will return when it is released. This initiates a zero cycle, the BLUE light will blink. When zero is complete the light will stop blinking. Output should be less than 1 mV (on the 10 $\mu$ A/volt range). Zero data is retained in EEPROM memory. Thus, the zero setting is retained as it would be by a mechanical control.

If the zero button is held down for 5 seconds, then the blue led will be disabled (will not light). This allows the 120 to be used in **total dark applications**. Blue led operation may be restored by holding down the ZERO for 5 seconds again. In other words holding the zero button down for 5 seconds toggles the blue light operation between enabled and disabled.

### ***Time Constant***

This sets the value of a capacitor in the first stage transconductance amplifier (an amplifier that converts a current input to a voltage output). Recall that four time constants are needed for a 95% change in signal level.

# SPECIFICATIONS

**Gain:** Input stage: 1 volt/10 ua.  
Post stages: X1 to X1000.

**Bandwidth:** one-half amplitude  
0.01 ms: 10 ua/V, 20 kHz; 0.1, 20 kHz; 0.01, 1 kHz;

## **Input:**

- **Bias current:** 10 pa
- **Drift:** 8 uv/deg C
- Maximum voltage: +/- 10 vdc.

## **Zero:**

- **Automatic:** initiated by momentary switch depression.
- **Accuracy:** +/- 500 uv typical, +/- 1mv maximum (1 ua/volt setting, low PMT HV)).
- Zero retention: 5 years.

## **Output:**

- **Range:** 0.0 to 10.0 used ( -10.5 to 10.5 vdc capable).
- **Connector:** BNC center pin: Signal out, sleeve: analog ground ,

## **Power:**

- A barrel type receptacle, 2.1 mm center positive is provided for a 9 vdc unregulated wall transformer.
- Surge protected at 18 vdc
- Self resetting 500 ma fuse
- Diode protected against reverse input voltage

## **Physical:**

- **Size:** width 4 in.(10 cm), depth 3 in.(7.6 cm), height 2.0 in. (5 cm)
- **Weight:** 7.7 oz ( 218 g)
- **Material:** ABS plastic case, FR94, interior conductive nickel coating, exterior textured gray.

# LEGAL STUFF

## ***Limited Warranty***

CyberSense warrants to the original purchaser or end-user complete satisfaction for 90 days - money back or exchange; we pay shipping. This product is warranted to be free from defects in material or workmanship for a period of three years. During this period, and upon proof of purchase, the product will be replaced or repaired without charge for either parts or labor. This warranty is voided if the product is modified, misused, subjected to abnormal environments, unauthorized attempts at repairs.

Purchase price refund for 90 days, or repair and replacement for a period of 3 years, are the **ONLY REMEDY** of the purchaser. This warranty is in lieu of all other warranties either express or implied; specifically, any warranties of implied merchantability or fitness for a particular use or purpose. CyberSense shall in no way be liable for indirect or consequential damages of ANY kind or nature.

Some jurisdictions do not allow exclusion or limitation of consequential or incidental damages, or how long implied warranties last; therefore the above limitations may not apply to you. This warranty gives you specific legal rights. In some states you may have other rights.

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