

October 1992

ISOLATOR-11
STIMULUS ISOLATION UNIT
OPERATOR'S MANUAL

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QUESTIONS? Telephone (415) 571-9400 or Fax (415) 571-9500

SAFETY

The ISOLATOR-11 Stimulus Isolation Unit is not intended to be used and should not be used in human experimentation. The unit generates both high voltage and high current and care should be taken in its operation in any environment.

The ISOLATOR-11 Stimulus Isolation Unit is a constant current source, and so the voltage it produces is inversely dependent on the load resistance. The unit can output more than 150 Volts. It must therefore be handled at all times with caution.

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VERIFICATION

This instrument is extensively tested and thoroughly calibrated before leaving the factory. Nevertheless, researchers should independently verify the basic accuracy of the instrument using suitable test signals.

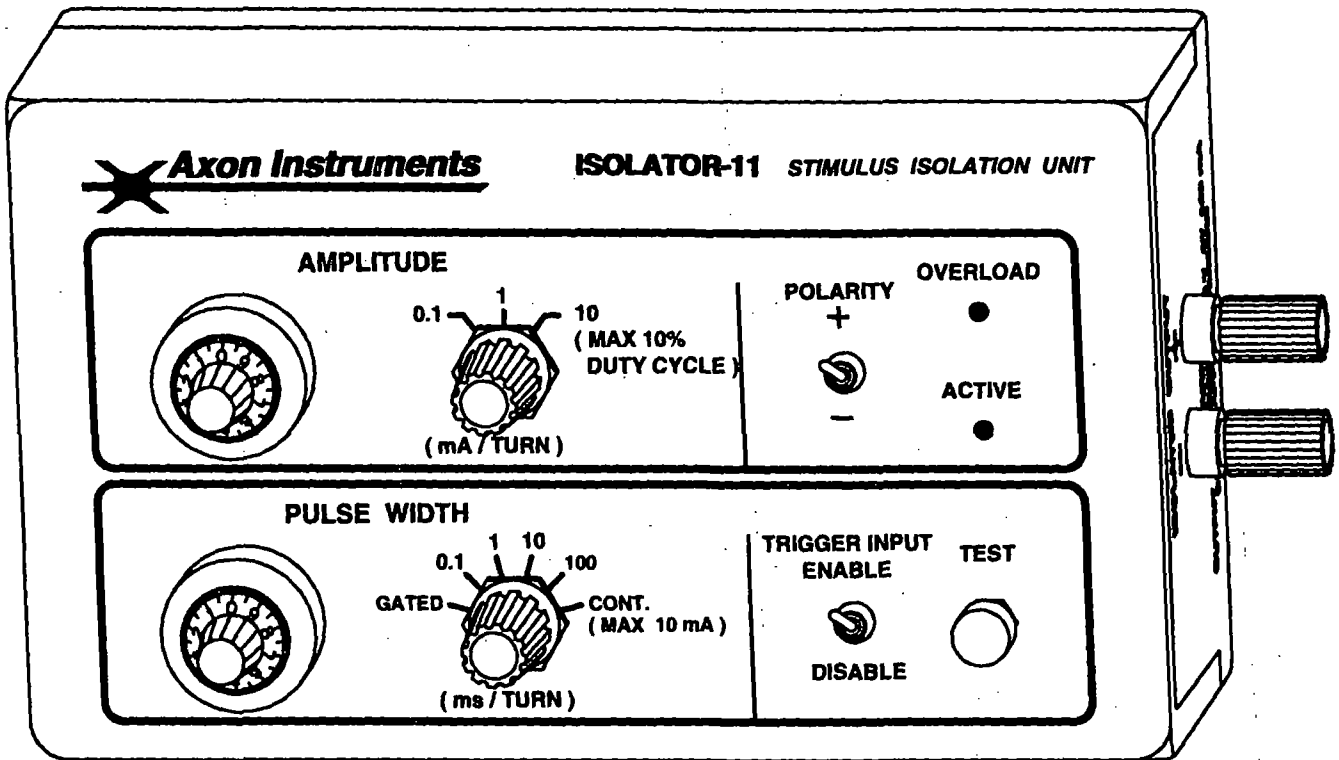


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INTRODUCTION

The ISOLATOR-11 is an isolated current pulse generator that can be driven from any type of pulse generator or data acquisition system. The full-scale output current may be set to 1 mA or 10 mA for any duration pulse, and to 100 mA for pulse duty cycles less than 10%. The output of the ISOLATOR-11 can be gated by the input trigger pulse, triggered by the input pulse, or set to continuous. The width of the output pulse in response to an input trigger may be set from 10 μ s to 1 second. Output pulse rise times are less than 10 μ s, output amplitudes are accurate within 5%, and the output leakage current is less than 0.05% of full scale. The ISOLATOR-11 has the simplicity of direct manual control and the versatility of complete amplitude and timing control.

The ISOLATOR-11 is useful in applications that require a controlled current source or a current source uncoupled from ground.

The basic operation of the ISOLATOR-11 Stimulus Isolation Unit is fairly simple. The ISOLATOR-11 is triggered or gated by a TTL input, and produces a unipolar square-wave pulse. The amplitude, duration and polarity of the pulse are manually controlled by controls on the top panel of the instrument. The current output is decoupled from any system or earth ground reference. Therefore, current flows only between the two outputs of the ISOLATOR-11, and does not flow to ground.

Axon Instruments also offers *another* Stimulus Isolation Unit, the ISOLATOR-10. ISOLATOR-10 is commanded by an *analog* input voltage input, and can follow a bipolar input waveform.

Prior to using the ISOLATOR-11 Stimulus Isolation Unit for the first time, it should be tested as described in the *Functional Checkout* chapter (page 5) to verify that the instrument was not damaged during shipping.

FUNCTIONAL DESCRIPTION

INPUT AND OUTPUT FEATURES

The ISOLATOR-11 has the following inputs and outputs:

- (1) **TRIGGER INPUT.** The timing of the output waveform is controlled by a TTL pulse to the TRIGGER INPUT. The amplitude of a suitable TTL pulse is between 3 V and 5 V. When the pulse width is gated, both the initiation and duration of the output are controlled by the input. When the pulse width is set manually, the TRIGGER INPUT only controls the initiation of the pulse.
- (2) **TRIGGER OUTPUT.** When a pulse is produced either by a TTL input or by the TEST button, a TTL pulse is available on TRIGGER OUT. It can be used to synchronize oscilloscopes or other equipment to the output of the ISOLATOR.
- (3) **POWER AND COMMAND INPUT.** The unit is powered by an external power supply, the PWR-1 Power Pack.

In place of the PWR-1 Power Pack, the unit can also be powered as well as controlled by an AxoWave signal generator from Axon Instruments. If the unit is being controlled through the POWER AND COMMAND INPUT connector the COMMAND INPUT BNC should be disconnected.

- (4) **OUTPUT.** The output is provided as two 4-mm banana plug jacks. Each is isolated from ground.

GENERAL FEATURES

- (1) **AMPLITUDE.** A rotary range switch and a 10-turn potentiometer are used in combination to set the current amplitude. Three ranges are provided: 0.1 mA/TURN, 1 mA/TURN, and 10 mA/TURN. The highest current range is limited to a maximal 10% duty cycle. Therefore, the maximal current output is 100 mA, with a duty cycle of less than 10%. The ISOLATOR-11 has a unipolar output, and the polarity is set with the POLARITY switch.
- (2) **PULSE WIDTH.** A rotary range switch and a 10-turn potentiometer are also used to control the pulse duration. When the rotary switch is set to GATED, the pulse duration is determined by the duration of the trigger input. Ranges of 0.1, 1, 10, 100 ms/TURN allow an evenly graded range of pulse durations from 1 μ sec to 1 sec.

A switch is provided to ENABLE or DISABLE the trigger input. It is recommended that the trigger be disabled unless in use. A TEST push button provides a manual trigger.

- (3) **OVERLOAD light.** The Overload light is active when the unit cannot supply the commanded current to the preparation. An ACTIVE light indicates when current is flowing between the output terminals.
- (4) **Power light.** The power light, located near the power receptacle, is on when the unit is powered up.

FUNCTIONAL CHECKOUT

Prior to using the ISOLATOR-11 Stimulus Isolation Unit for the first time, it should be subjected to a functional checkout to ensure the proper functioning of the instrument. All units are burned-in and thoroughly tested at the factory before shipping. If any shipping damage or problems with the functional checkout are observed, please call the factory.

For the initial checkout, make sure that the power is OFF.

Equipment required:

Oscilloscope
10 k Ω resistor (provided)
Analog signal generator
One BNC cable

- (1) Check the line voltage fuse on the PWR-1 power pack. See the Supply Voltage section on page 9. Alternatively, the ISOLATOR can be powered by an AxoWave signal generator.
- (2) Connect the PWR-1 power pack to the ISOLATOR-11 and plug in the power pack.
- (3) Make sure that the TRIGGER INPUT is set to DISABLE.
- (4) Place a 10 k Ω , high wattage resistor between the output banana jacks of the instrument.
- (5) Unless the unit is connected to an AxoWave, connect the TTL output of a signal generator (it may be labeled as the SYNC output) to the TRIGGER INPUT. Alternatively, use the analog output of the signal generator, at an amplitude of approximately 4 V.
- (6) Connect an oscilloscope input to the output jacks of the instrument. The inputs to the oscilloscope can be differential, or one output of the ISOLATOR-11 can be grounded to the signal ground of the oscilloscope (the shield of an oscilloscope BNC input). Connect the TRIGGER OUTPUT of the ISOLATOR to the oscilloscope external trigger input.
- (7) Set the gain of the oscilloscope to 2 V/division and the sweep speed to 2 ms/division.
- (8) Use the signal generator to generate a square wave at a frequency of 100 Hz.
- (9) On the ISOLATOR-11 turn the AMPLITUDE to 1 mA and turn the potentiometer to one full turn from zero. Turn the PULSE WIDTH switch to GATED and set the TRIGGER INPUT switch to ENABLE. A square wave of 10 V will appear on the oscilloscope. The command current is $1 \text{ mA} = 1 \text{ TURN} \times 1 \text{ mA} / \text{TURN}$. To produce this current across a 10 k Ω resistance, the unit produces a 10 V pulse. Turn up the sweep speed of the oscilloscope and measure the rise time of the output pulse—it should have a 10-90% rise time of approximately 10 μs .
- (10) Switch from GATED to a PULSE WIDTH sensitivity of 0.1 ms and confirm that turning the PULSE WIDTH potentiometer from 1 turn to 10 turns changes the duration of the pulse from 100 μs to 1 ms. In a similar fashion, check the other PULSE WIDTH ranges. Turn the TRIGGER INPUT switch to DISABLE and use the TEST button to initiate a single pulse.

- (11) Return the oscilloscope setting to 2 ms/division. On the ISOLATOR-11 turn the AMPLITUDE to 1 mA and turn the potentiometer five full turns from zero. Turn the PULSE WIDTH switch to GATED and set the TRIGGER INPUT switch to ENABLE. Turn the AMPLITUDE sensitivity to 1 mA / TURN. The recorded voltage should be 50 V, as the unit produces 5 mA of current across the resistor. As the command amplitude is increased to 10 mA, the OVERLOAD light should not come on, indicating that the unit has not exceeded its output compliance of approximately 150 volts. When the command amplitude is increased to 20 mA, the OVERLOAD light may indicate that the compliance has been exceeded. (With a lower resistance load, the unit can pass as much as 100 mA if the duty cycle of stimulation is below 10%).
- (12) Turn the TRIGGER INPUT switch to DISABLE, and remove the 10 k Ω resistor. There is now a very high resistance path between the outputs, and most command amplitudes will cause an OVERLOAD condition, as the unit is unable to pass the required current.

REFERENCE SECTION — GENERAL INFORMATION

STIMULATION OF BIOLOGICAL TISSUES

Repetitive stimulation of biological structures requires a precise reproducible waveform. The objective is to produce a rapidly changing potential gradient across or along the axis of an electrically active structure. The following factors need to be considered.

- (1) When the stimulating electrodes are at some distance from the target structure, the current flow across the target structure is determined locally by a complex circuit of resistances and capacitances. The experimenter has little control over this equivalent circuit, but can control the spatial and temporal distribution of the field at the electrodes. Therefore, placement of the electrodes can have an important effect on the efficacy of stimulation. For example, cells with processes are best stimulated by current flowing along the longitudinal axis of the processes.
- (2) The impedance of electrodes and surrounding tissues can change with time. If the stimulator produces a constant voltage pulse across the stimulating electrodes, the actual voltage gradient across the target structure will change when the system impedance changes. A stimulator with a *constant-current* output will produce a constant-voltage gradient across the target structure, regardless of impedance changes in surrounding structures. Therefore, constant-current stimulators, such as the ISOLATOR-11, are generally preferred to constant-voltage stimulators.
- (3) In constant-current stimulators, as the impedance of the preparation changes, the output voltage will change to maintain a constant current. High compliance stimulators extend the range of system impedances over which stimulation is effective. With a voltage compliance of 150 V, the ISOLATOR-11 can produce at least a 10 mA current across a load of 10 k Ω . If the stimulator overloads, try to decrease the system impedance by increasing the electrode size or by placing the electrodes closer to the target structure.
- (4) Electrically active structures are generally best stimulated by rapidly changing electrical fields. Of stimulating waveforms, a square pulse is generally most effective at the lowest current amplitude. To ensure that the target structure receives a square pulse, stray capacitance should be eliminated, as described below in the discussion of the stimulus artifact.

THE STIMULUS ARTIFACT

The experimenter who records from the system being stimulated must contend with the stimulus artifact. A stimulus artifact is produced when the current flow from the stimulator creates a voltage gradient that is sensed by the recording electrode. The stimulus artifact can be minimized by the following strategies.

- (1) Use an isolated stimulator. Stimulus artifacts are produced when the recording and stimulating electrodes share a common ground. The best solution is generally to uncouple the two systems by using *bipolar* stimulating electrodes driven by the ISOLATOR.
- (2) Decrease the pulse duration. Often the recorded response follows the stimulus with a latency. There is a trade-off between stimulus amplitude and duration that will produce a stimulus artifact that is over before the response is recorded.
- (3) Change the placement of the stimulating electrodes. A change in the placement of the stimulating electrodes will often have a dramatic effect on the stimulus artifact.

- (4) **Decrease capacitance coupling.** Every system has some finite capacitance coupling to ground, and hence transient current will flow across that capacitance and be recorded by an amplifier referenced to ground. To decrease capacitance coupling:
- (a) Decrease the length of leads between the ISOLATOR-11 and the electrodes. This is most readily achieved by locating the ISOLATOR-11 inside the Faraday cage.
 - (b) For the output leads, do not use a cable with a grounded shield.
 - (c) If using bipolar electrodes, minimize broadcast by using twisted pair leads.

GANGING TOGETHER ISOLATORS

The outputs of two or more ISOLATORS may be connected together to yield either increased current or increased waveform complexity. The outputs of the two ISOLATORS should be connected in parallel (+ pole to + pole and - pole to - pole), as shown below. This circuit will double the effective current range, and allow the generation of bipolar output waveforms.

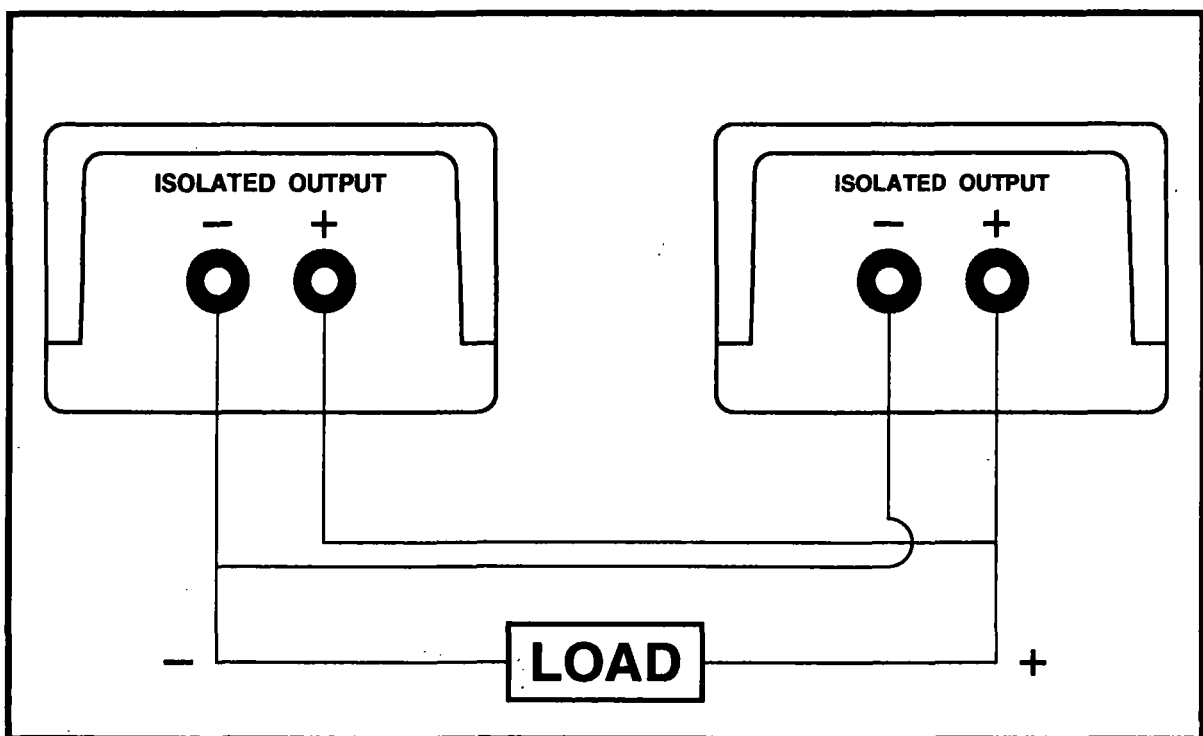


Figure 1. Two ISOLATORS in Parallel.

POWER SUPPLY VOLTAGE SELECTION AND FUSE CHANGING**Power Supplied by the PWR-1 Power Pack**

The ISOLATOR-11 requires a regulated ± 15 V power supply. This is provided by the Axon Instruments PWR-1 Power Pack. The PWR-1 operates from all international supply voltages. The two input ranges are:

- 1) 115 V: For 100 V_{ac} to 125 V_{ac} operation.
- 2) 230 V: For 200 V_{ac} to 250 V_{ac} operation.

Note: When shipped, the AC mains fuse and fuse holder are removed from the back of the PWR-1 Power Pack and placed in a bag taped to the power supply. All instruments shipped from Axon Instruments are set for a supply voltage of 115V_{ac}. If the supply voltage is not 115V_{ac}, have a qualified electronics technician perform the supply voltage change procedure according to the following instructions:

To change the supply voltage setting:

- 1) **Disconnect the power cord**
- 2) Use a screwdriver or similar device to pry open the fuse holder, located beneath the line cord connector.

For 115 V operation -- slide out the tab connector and insert it so that "110 V" appears in the window of the fuse holder.

For 230 V operation -- slide out the tab connector and insert it so that "240 V" appears in the window of the fuse holder.

- 3) **Reconnect the power cord.**

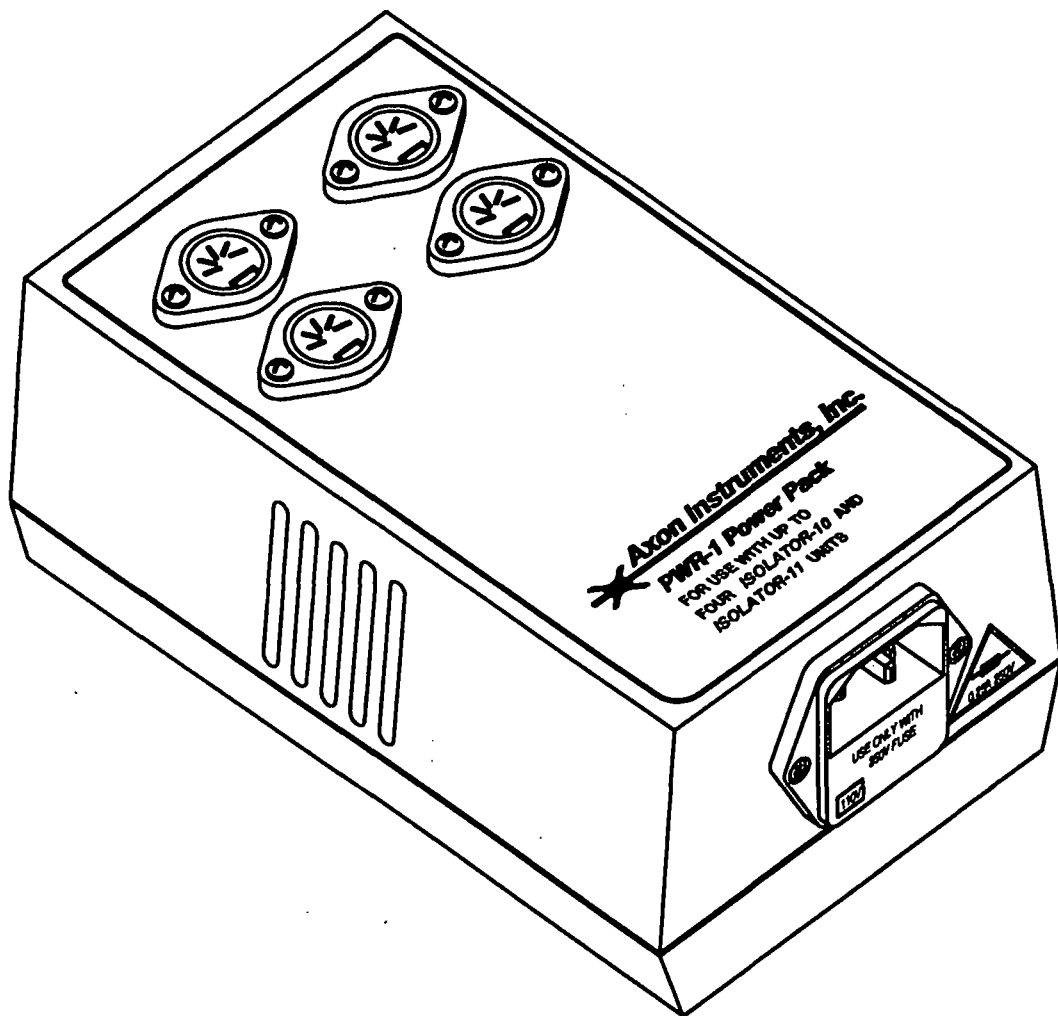


Figure 2. The PWR-1 Power Pack.

Changing The Fuse

The PWR-1 Power Pack uses a 500 mA, 250 V, slow acting, 5 x 20 mm fuse for both voltage ranges.

Before changing the fuse investigate the reason for its failure.

To change the fuse:

- 1) **Disconnect the power cord.**
- 2) Use a screwdriver or a similar device to pry open the fuse holder, located beneath the power line connector.
- 3) Replace the fuse with another fuse of the same rating.
- 4) Reconnect the power cord.

Power Supplied by the AxoWave Waveform Generator

The ISOLATOR-11 can also be powered and controlled by the AxoWave waveform generator. Both the regulated power supply voltages and the analog command voltage are supplied by the AxoWave unit through a single cable attached to the POWER AND COMMAND INPUT. If the ISOLATOR-11 is connected to an AxoWave unit, disconnect any external input to the COMMAND INPUT. Refer to the AxoWave manual for additional information.

GROUNDING AND HUM

Grounding

The ground line from the AC line connector is passed through the PWR-1 Power Pack to the output connector for use as the cable shield.

Hum

Line-frequency pickup, often referred to as hum or line-frequency noise, is a common problem in low-level recordings. Hum can occur not only at the line frequency but also at multiples of it.

The PWR-1 and its attached ISOLATOR unit, if used correctly, should not introduce hum into the recording system. The following procedures should be followed:

- 1) Locate the PWR-1 Power Pack outside the faraday cage.
- 2) Because it is powered by a regulated DC source, the ISOLATOR unit can be placed inside the faraday cage. The cable connecting the PWR-1 Power Pack to the ISOLATOR is shielded and will not act as an antenna.
- 3) The cables that provide power and provide the BNC command should not run near the AC line transformers of other equipment.
- 4) Try to ground auxiliary equipment from a single ground distribution bus.

SAFETY

The ISOLATOR-11 Stimulus Isolation Unit and the PWR-1 Power Pack are not intended to be used and should not be used in human experimentation.

EXPANSION

One PWR-1 Power Pack can supply power to any combination of four ISOLATOR-11 and ISOLATOR-10 Stimulus Isolation Units. Alternatively, the AxoWave waveform generator can power and control multiple ISOLATOR-11 or ISOLATOR-10 Stimulus Isolation Units.

REFERENCE SECTION — PRINCIPLES OF OPERATION

THE ISOLATION BARRIER

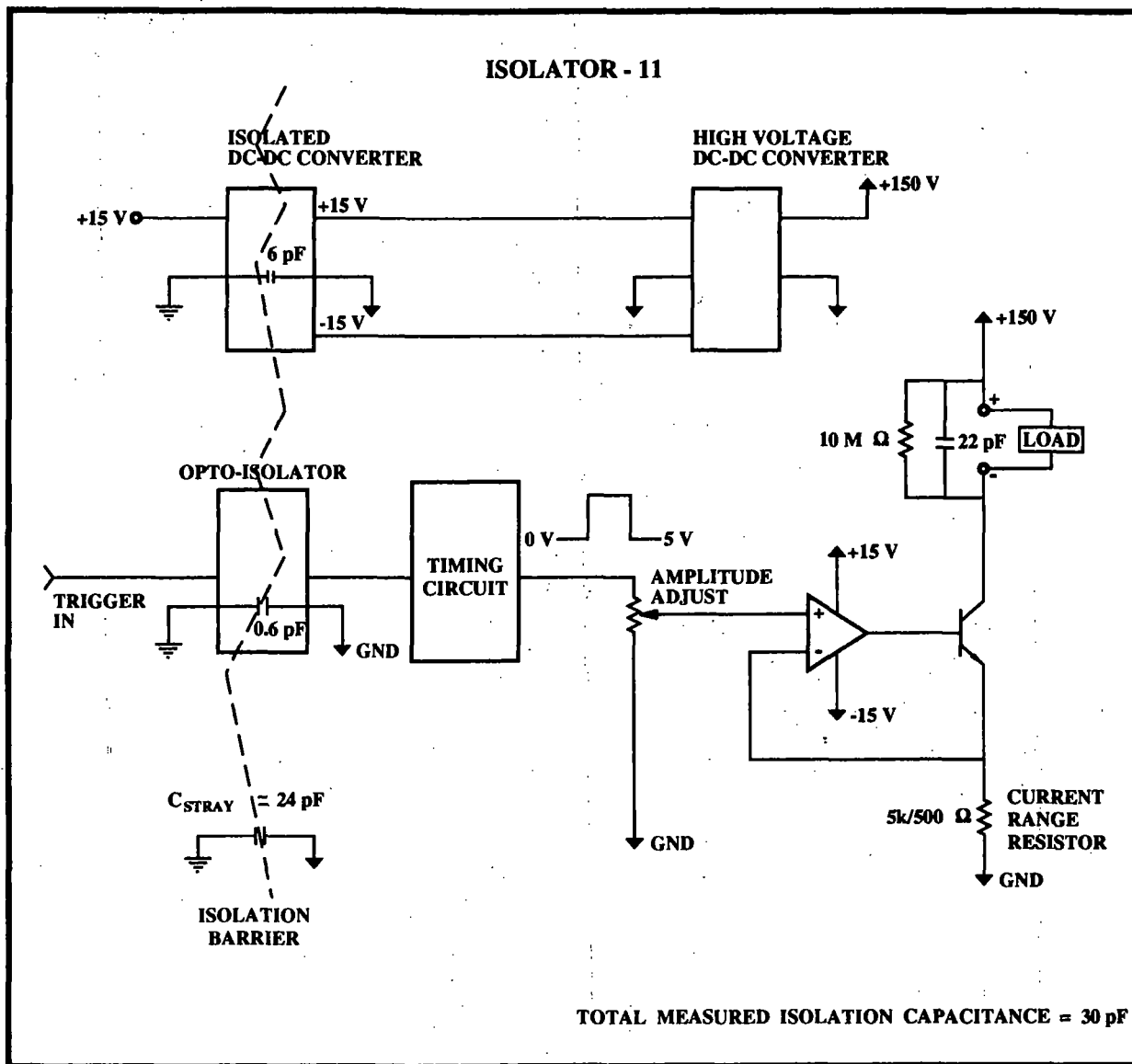


Figure 3. The Isolation Barrier of the ISOLATOR-11 Stimulus Isolation Unit.

Power Supply

As shown above, the ISOLATOR-11 contains two internal power supplies. An externally supplied 15 V source powers a very high isolation DC-DC converter that generates an isolated ± 15 V. This isolated voltage powers a second DC-DC converter that produces the high compliance ± 150 V.

Amplifier

The COMMAND INPUT is fed into an optically-coupled isolation amplifier. Its isolated output controls a high-compliance output amplifier. Switchable current-range resistors determine the output range. In parallel with the output, a feedback resistor limits the voltage output when no load is present. A capacitor in parallel attenuates high frequency noise on the output.

ISOLATION CAPACITANCE, MEANING, AND SOURCES

The ISOLATOR achieves a very high isolation while being powered by AC line voltage. One measure of merit when speaking of isolation is the impedance measured between the common of the input circuit and the common of the output of the device. This isolation impedance minimizes the stimulus artifact when recording in the stimulated preparation. It also prevents stimulus breakthrough to adjacent tissues. Both of these problems are caused by the stimulus current flowing to some common other than the common of the stimulator. The isolation impedance is modeled as a resistance with a parallel capacitor. If any impedance exists between the preparation and the input common, the stimulus current is given another return path to the current source. This stray impedance is in series with the isolation impedance, and therefore a high isolation impedance insures that most of the stimulus current will flow through the desired load. The isolation resistance of approximately $10^{11} \Omega$ makes a negligible contribution to the stimulus artifact. Isolation capacitance makes a more significant contribution.

The total isolation capacitance is actually the sum of many tiny parallel capacitors between the isolated and non-isolated commons. These stray capacitances can be lumped into two main sources, the stuffed circuit board and the internal cabling.

Both the circuit board and components that span the isolation barrier contribute to the isolation capacitance. The electrical components which cross the barrier are transformers and optocouplers. The transformers have capacitance between the primary and secondary windings, and the optocouplers have input-output capacitance due to the proximity of the photodiode to the LED and stray capacitance across the device package. The dielectric material of the printed circuit board creates an additional stray capacitance between the input and output commons on the board. These capacitances typically total 13 pF.

The second source of stray capacitance is the internal cabling. Panel controls and input/output connectors require a certain amount of cabling inside the enclosure, and performance specifications require some of these cables to be shielded. Wires which connect to the isolated side of the circuitry pass by wires which connect to the non-isolated side and add to the isolation capacitance. If these wires are shielded the capacitance added between commons can become quite large. The problem is further aggravated when the enclosure used is conductive. The wires that form the internal cables then share an additional capacitance to the enclosure itself. The ISOLATOR-11 is designed to minimize such strays, and the cabling typically contributes about 17 pF.

These two primary sources of isolation capacitance combine for a typical total of 30 pF in the ISOLATOR-11. These very high isolation impedances insure that both the stimulus artifact and stimulus breakthrough will be kept to a minimum.

HIGH FREQUENCY GROUND LOOP PHENOMENON

The ISOLATOR achieves its high isolation, in part, due to a high frequency DC-DC converter which generates the required isolated power. As described, the transformer which performs the power transfer has capacitance between its primary and secondary windings. If the output terminal of an

ISOLATOR is tied to the non-isolated common, the switching action of the DC-DC converter, along with the winding capacitance, causes high frequency current to flow in a ground loop.

The most likely case in which this occurs is when measuring across the output terminals with a scope probe hooked to one terminal and the scope ground lead hooked to the other. The scope ground lead grounds the output terminal to the input common through the scope. This creates a high frequency ground loop from the ISOLATOR input common, across the transformer capacitance, through the isolated supply lines, through the load resistance, and back through the scope to the input common.

A current flows through this loop due to the switching action of the DC-DC converter. For a given cycle of the converter, one half of the primary coil has a positive dV/dt and the other has a negative dV/dt relative to the isolated common. These voltage changes across any stray capacitance yields a net current flow between the non-isolated and isolated commons. This current flowing through the load resistance will appear as noise on the oscilloscope. As the switching of the DC-DC converter occurs at 400 kHz, this noise is well outside normal recording bandwidths.

To measure across the output terminals without creating a ground loop, use a differential input oscilloscope. If two high impedance scope probes are used, there is no path for the high frequency current to return to the input common, and therefore no current will flow.

TROUBLE SHOOTING

(1) *General*

If a problem is encountered please disconnect all instruments and probes from the ISOLATOR-11. Work completely through the Functional Checkout that commences on page 5. This can often uncover a problem in the set up of the ISOLATOR-11. If the problem persists, please call Axon Instruments for assistance.

(2) *No response*

Check the fuse in the PWR-1 power supply. Check the cable that connects the power supply to the ISOLATOR.

SPECIFICATIONS

All specifications at 25°C.

ISOLATOR-11 STIMULUS ISOLATION UNIT**TRIGGER INPUT**

Signal Type: TTL logic range
Input Signal Range: 0 to 5 V, >3 V for logic high
Safe Input Voltage: ±30 V

TRIGGER OUTPUT

Signal Type: TTL logic range, same duration as input trigger

ANALOG OUTPUT

Output Signal: Unipolar, isolated from both input and earth grounds
Polarity: Switch selectable
Output Current Range: Selectable, ±1.00 mA full scale or ±10.0 mA full scale constant output. ±100.0 mA full scale at <10% duty cycle.
Output Voltage Compliance: ±100 V minimum loaded
 ±190 V maximum unloaded
Output Power: 1.0 W minimum
Leakage Current: 0.1 µA max. at 1 mA range
 1.0 µA max. at 10 mA range
 10.0 µA max. at 100 mA range

TRANSFER FUNCTIONS

Response Time: 10 - 90% Response Time to Step Command: <10 µs
Output Accuracy: ±5.0% of full scale

ISOLATION

Barrier Resistance: 100 GΩ, isolated output to ground, measured at 100 Hz
Barrier Capacitance: 35 pF max. 30 pF typical

NOISE

Output Noise:	0.1 Hz - 100 kHz:	0.080 µA _{rms}	0.50 µA _{p-p}
	0.1 Hz - 10 kHz:	0.050 µA _{rms}	0.30 µA _{p-p}
	0.1 Hz - 1 kHz:	0.025 µA _{rms}	0.15 µA _{p-p}

Peak-to-peak noise is estimated using a factor of six times the measured rms value. Values vary with load resistance.

OTHER FEATURES

Overload Indicator: Overload is detected if the output voltage reaches the limit of its compliance. LED display remains on for 200 ms minimum.
Power On: LED display indicates that the ISOLATOR-11 is powered on.

CONNECTORS

Trigger Input & Output: BNC
Current Output: Two 4.44 mm banana jacks with screw terminals
Power and Trigger Input : 5 pin DIN female connector

ACCESSORIES PROVIDED

Power Connect Cable
 Manual
 10 k Ω , 1 W resistor

POWER AND DIMENSIONS

Power Requirements: +15 V at 150 mA
 -15 V at 15 mA
Dimensions: *Box:*
 7.5" (188 mm) long, 4.25" (106 mm) wide,
 2.4" (60 mm) high
Box with connectors:
 9.0" (225 mm) long, 4.25" (106 mm) wide,
 3.1" (78 mm) high
Net Weight: 24 oz. (688 gm)

PWR-1 Power Pack**ANALOG OUTPUT**

Output: +15 V at 0.56 A
 -15 V at 100 mA
Output Power: 10 W
Output Noise: 4 mV_{p-p} in 100 kHz bandwidth
 2.5 mV_{p-p} 60 Hz ripple at 90% of full load

POWER AND DIMENSIONS

Line Voltage: 105-130 V_{ac} or 210-260 V_{ac}.
 User selectable by switch in fuse holder
Line Frequency: 50-60 Hz
Power: Draws 200 mA at maximum load
Fuse: 0.5 A slow 5 x 20 mm
Cabinet Dimensions: 5.7" (145 mm) long, 3.2" (80 mm) wide,
 2.6" (65 mm) high
Net Weight: 1.5 lbs (681 gm)

REFERENCES

SUGGESTED READING MATERIAL

Geddes, L. A. & Baker, L. E. (1989) *Principles of Applied Biomedical Instrumentation*. New York: John Wiley & Sons.

Goldstein, N. N. & Free, M. J. (1979) *Foundations of Physiological Instrumentation, A Source Book with Experiments*. Springfield, Illinois: Charles C. Thomas.

Loeb, G. E. and Gans, C., (1986). *Electromyography for experimentalists*. Chicago: University of Chicago Press.

CIRCUIT DIAGRAMS

The ISOLATOR-11 Stimulus Isolation Unit was delivered with a complete set of circuit diagrams and a parts list. Please take care not to lose these because there is a charge for their replacement.

WARRANTY

We warrant every ISOLATOR-11 Stimulus Isolation Unit and PWR-1 Power Pack to be free from defects in material and workmanship under normal use and service. For 12 months from the date of receipt we will repair or replace without cost to the customer any of these products that are defective and which are returned to our factory properly packaged with transportation charges prepaid. We will pay for the return shipping of the product to the customer. If the shipment is to a location outside the United States, the customer will be responsible for paying all duties, taxes and freight clearance charges if applicable.

Before returning products to our factory the customer must contact us to obtain a Return Merchandise Authorization number (RMA) and shipping instructions. Failure to do so will cause long delays and additional expense to the customer. Complete a copy of the RMA form on page E-1 and return it with the product.

This warranty shall not apply to damage resulting from improper use, improper care, improper modification, connection to incompatible equipment, or to products which have been modified or integrated with other equipment in such a way as to increase the time or difficulty of servicing the product.

This warranty is in lieu of all other warranties, expressed or implied.

WARNING**Shipping the ISOLATOR-11 and PWR-1**

The ISOLATOR-11 should be properly packaged before shipping, in order to avoid damage in transit.

In general, the best way to package the ISOLATOR-11 is in the original factory carton. If this is no longer available, we recommend that you carefully wrap the ISOLATOR-11 in at least three inches (75 mm) of foam or "bubble-pack" sheeting. The wrapped ISOLATOR-11 should then be placed in a sturdy cardboard carton. Mark the outside of the box with the word FRAGILE and an arrow showing which way is up.

We do not recommend using loose foam pellets to protect the ISOLATOR-11. Instruments tend to migrate in loose pellet packaging and can be damaged if the carton is dropped by the shipper.

It is your responsibility to package the instrument properly before shipping. If it is not, and it is damaged, the shipper will not honor your claim for compensation.

RETURN MERCHANDISE AUTHORIZATION

RMA No. _____ Date of RMA _____

Shipping check list:

- 1. Package instrument with at least 3 inches of packing material all around.
- 2. Enclose a completed copy of this form.
- 3. Write RMA number on outside of package.
- 4. Pre-pay freight for door-to-door delivery.

Model _____ Serial No. _____

In warranty Out of warranty

Customer's purchase order No. _____
(not required for warranty repair)

DESCRIPTION OF PROBLEM: _____

Customer's Shipping Address:
Name _____

Phone (____) _____

Customers Billing Address:
Name _____

Phone (____) _____

Send completed form with merchandise to:

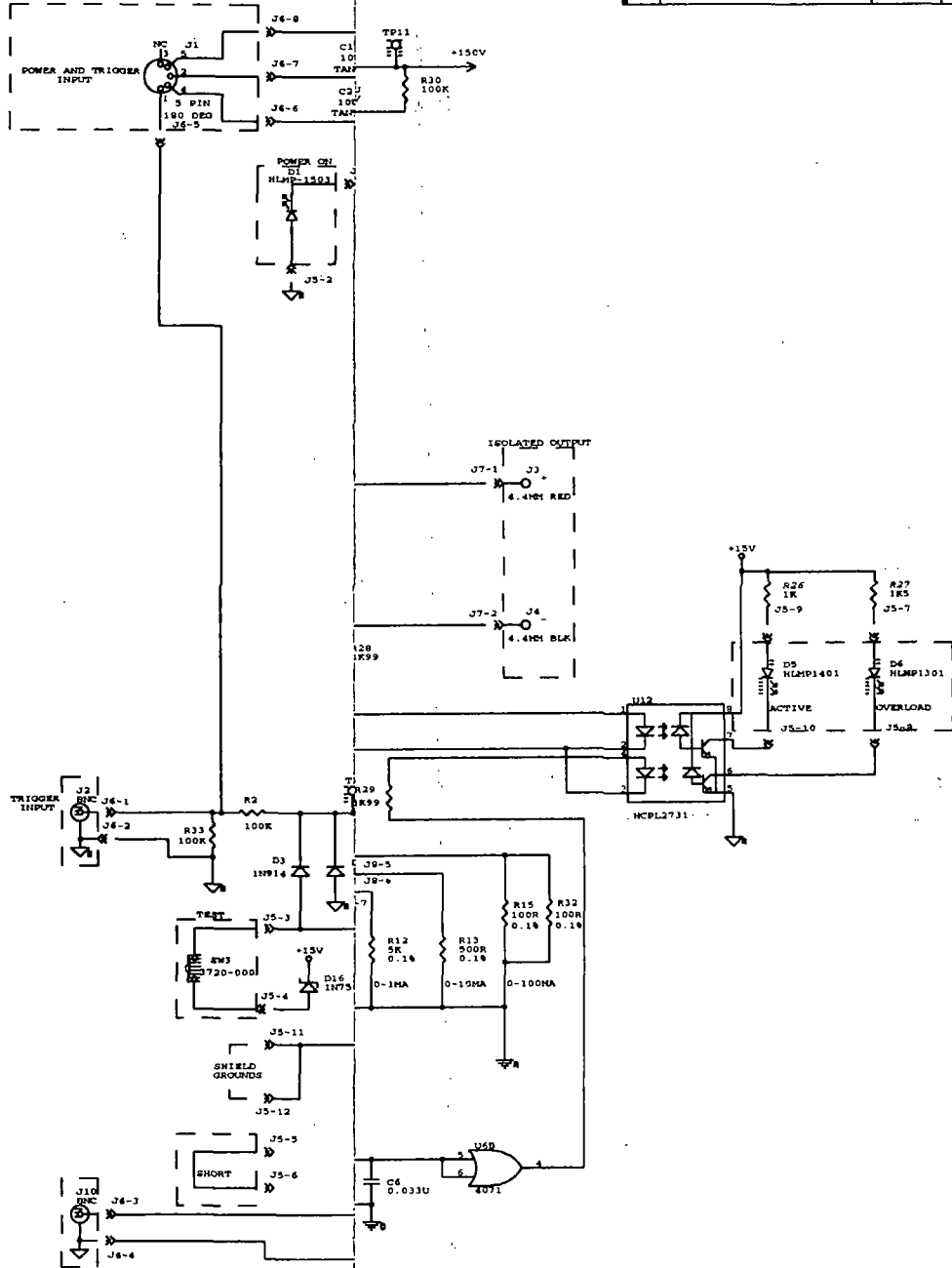
Axon Instruments, Inc.
1101 Chess Drive
Foster City, CA 94404
U.S.A.

Write RMA number on outside of package.

Amplifier, 14
Amplitude, 3
AxoWave, 11
Expansion, 11
Grounding, 11
Hum, 11
Input
 power and command, 3
 trigger, 3
Isolation
 barrier, 13
ISOLATORS, ganging together, 8
Output, 3
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Overload, 3
Power, 3
Power Supply, 13
Pulse Width, 3
PWR-1, 9
Safety, 11
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Stimulation, 7
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REVISION RECORD

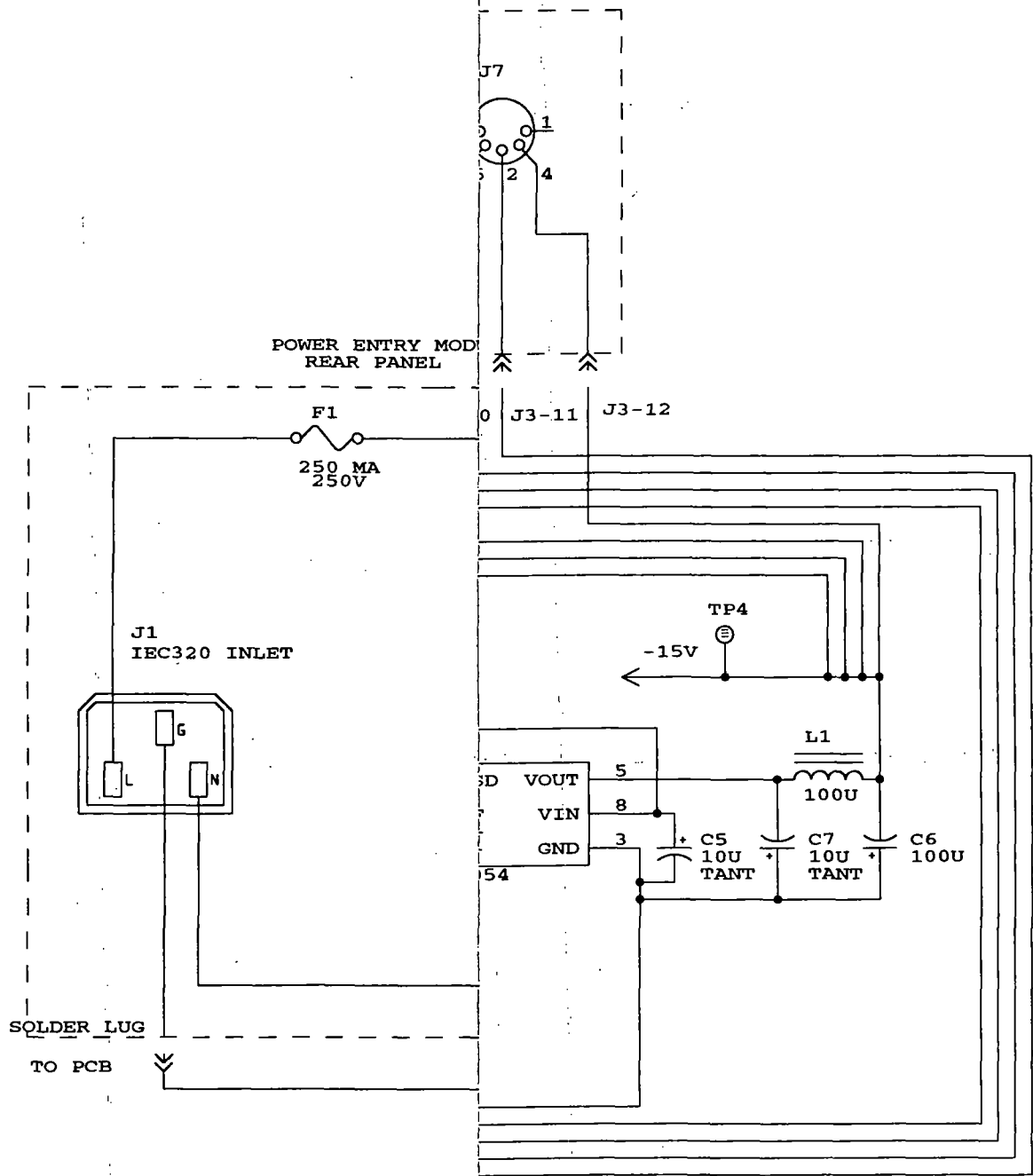
REV	DESCRIPTION	DATE	APPD
A	GENERATED INITIAL SCHEMATIC.	N/A	D.G.
B	PRODUCT TYPE WAS "150-11". REVISED PER ECO #738.	06/17/92	JSAIER
C	USD WAS U6A, USC WAS U6B. U6A WAS USC, AND U6B WAS USD PER ECO #773.	09/01/92	E.B.
D	VARIOUS CHANGES MADE TO THE CIRCUIT DESIGN. RELEASED SCH TO 1ST PRODUCTION RUN PER ECO # 821.	11/25/92	D.G.
E	REVISED DIAGRAM / ECO # 862.	02/10/93	D.G.



AXON INSTRUMENTS, INC.	
ISOLATOR-11	
DGN BY: DOMI GAMBETTA	
Title	SCHEMATIC, ISOLATOR-11
Part Number	3435-125
REV	D
DATE	FEBRUARY 11, 1993

Filename: \\ORCAD\ADMIN\125.sch
 Title: ISOLATOR-11
 Date: FEB 11 1993 11:18

DESCRIPTION	DATE	INI
WAS 2200U PER ECO #821.	12/03/92	mp



AXON INSTRUMENTS, INC.
 1101 CHESS DRIVE
 FOSTER CITY, CA 94404

POWER-1 POWER PACK	
Document Number	REV
3435-126	B
December 9, 1992	Sheet 1 of 1

11.2.15 Bill Of Material By Item Report
Axon Instruments, Inc.

Level	Item	Component	Rev	Description	Ref	Qty	UM	P	Mfg	Manufacturer	Item
PARENT		ISOLATOR-11 B		STIMULUS ISOLATION UNIT			EA				EFFECTIVE DATE: 02/04/93
1	101	2950-204	B	S/U, ISOLATOR-11	NONE	1.00	EA		AXON		
.2	101	2300-188	E	ELMCH, ISOLATOR-11	NONE	1.00	EA	y	AXON		
.3	101	2270-139	E	PCB, STUFFED, ISOLATOR-11	NONE	1.00	EA	y	AXON		
...4	101	3430-125	C1	PCB, ISOLATOR-11, ISOLATED STIMULATOR	NONE	1.00	EA		AXON		
...4	102	3435-125	E	SCH, ISOLATOR-11, ISOLATED STIMULATOR	NONE	1.00	EA		AXON		
...4	201	4200-018		IC, OP AMP, FET, LF356	U1	1.00	EA		LINTECH	LF356AN8	
...4	202	4220-008		IC, VOLTAGE REF, +5V, REF-02C	U2	1.00	EA		LINTECH	REF-02CN8	
...4	203	4210-003		IC, TIMER, 7555	U3	1.00	EA		HARRIS	ICM75551PA	
...4	204	4200-009		IC, OP AMP, FET, LT1056ACH	U4	1.00	EA		LINTECH	LT1056ACH	
...4	205	4200-015		IC, OP AMP, COMPARATOR, LM311	U5	1.00	EA		FAIRCHLD	UA311TC	
...4	206	4100-010		IC, CMOS, QUAD 2-INP OR, 4071	U6	1.00	EA		MOTOROLA	MC14071BCP	
...4	207	4210-014		IC, OSCILLATOR, PUSH-PULL DRIVER, PWS740-1	U7	1.00	EA		BURRBRWN	PWS740-1	
...4	208	4020-006		DIODE, BRIDGE, HIGH SPEED, PWS740-3	U8	1.00	EA		BURRBRWN	PWS740-3	
...4	209	4020-006		DIODE, BRIDGE, HIGH SPEED, PWS740-3	U9	1.00	EA		BURRBRWN	PWS740-3	
...4	210	4210-003		IC, TIMER, 7555	U10	1.00	EA		HARRIS	ICM75551PA	
...4	211	4230-001		IC, DUAL CMOS SPDT SWITCHES, 5043	U11	1.00	EA		SILCONIX	DG5043CJ	
...4	212	4430-001	A	IC, OPTOISOLATOR, DUALHIGH GAIN, HCPL-2731	U12	1.00	EA		HP	HCPL-2731	
...4	213	4430-002		IC, OPTOISOLATOR, HIGHSPEED, HCPL-4502	U13	1.00	EA		HP	HCPL-4502	
...4	251	4640-007		TRANSISTOR, POWER NMOSFET, 400V, IRF710	Q1	1.00	EA		MOTOROLA	IRF710	
...4	252	3000-001		COMPONENT NOT PRESENT	Q2	1.00	EA		AXON		
...4	253	4620-000		TRANSISTOR, NPN, TO-92, 2484/PN100A	Q3	1.00	EA		FAIRCHLD	PN2484	
...4	254	4630-000		TRANSISTOR, PNP, TO-92, PN4249/PN200A	Q4	1.00	EA		NATSEMI	2N5086	
...4	255	4620-000		TRANSISTOR, NPN, TO-92, 2484/PN100A	Q5	1.00	EA		FAIRCHLD	PN2484	
...4	256	4630-000		TRANSISTOR, PNP, TO-92, PN4249/PN200A	Q6	1.00	EA		NATSEMI	2N5086	
...4	261	4010-011		DIODE, LIGHT EMITTING, T1, GREEN, DIFFUSE 2MCD	D1	1.00	EA		H-P	HLMP-1503	
...4	262	4020-000		DIODE, SI, SIGNAL, 1N914	D2	1.00	EA		FAIRCHLD	1N914	
...4	263	4020-000		DIODE, SI, SIGNAL, 1N914	D3	1.00	EA		FAIRCHLD	1N914	
...4	264	4020-000		DIODE, SI, SIGNAL, 1N914	D4	1.00	EA		FAIRCHLD	1N914	
...4	265	3000-001		COMPONENT NOT PRESENT	D5	1.00	EA		AXON		
...4	266	3000-001		COMPONENT NOT PRESENT	D6	1.00	EA		AXON		
...4	267	4020-000		DIODE, SI, SIGNAL, 1N914	D7	1.00	EA		FAIRCHLD	1N914	
...4	268	4020-000		DIODE, SI, SIGNAL, 1N914	D8	1.00	EA		FAIRCHLD	1N914	
...4	269	4020-000		DIODE, SI, SIGNAL, 1N914	D9	1.00	EA		FAIRCHLD	1N914	
...4	270	4020-000		DIODE, SI, SIGNAL, 1N914	D10	1.00	EA		FAIRCHLD	1N914	
...4	271	4020-000		DIODE, SI, SIGNAL, 1N914	D11	1.00	EA		FAIRCHLD	1N914	
...4	272	4020-000		DIODE, SI, SIGNAL, 1N914	D12	1.00	EA		FAIRCHLD	1N914	
...4	273	4020-000		DIODE, SI, SIGNAL, 1N914	D13	1.00	EA		FAIRCHLD	1N914	
...4	274	4020-000		DIODE, SI, SIGNAL, 1N914	D14	1.00	EA		FAIRCHLD	1N914	
...4	275	4020-003		DIODE, SCHOTTKY, 1N5711 / 1N5712	D15	1.00	EA		H-P	1N5711	
...4	276	4030-002		DIODE, ZENER, 500MW, 10V, 1N758	D16	1.00	EA		MOTOROLA	1N758	
...4	277	4030-013		DIODE, ZENER, 500MW, 5.1V, 1N751/1N5231	D17	1.00	EA		MOTOROLA	1N5231B	
...4	301	3160-001		CAP, TANT, 25V, 10U	C1	1.00	EA		AVX	TAP106K025	
...4	302	3160-001		CAP, TANT, 25V, 10U	C2	1.00	EA		AVX	TAP106K025	
...4	303	3100-021		CAP, CER, ML, 50V, 20%, 1UF	C3	1.00	EA		AVX	SR305E105MAA	
...4	304	3100-001		CAP, CER, DISC, 50V, 10%, 100P	C4	1.00	EA		MALLORY	GE101K	
...4	305	3130-009		CAP, FILM, 10%, 100V, 0.0033U	C5	1.00	EA		ARCO	PRI-332-K-2A	
...4	306	3130-010		CAP, FILM, 10%, 100V, 0.033U	C6	1.00	EA		ARCO	PRI-333-K-2A	
...4	307	3100-021		CAP, CER, ML, 50V, 20%, 1UF	C7	1.00	EA		AVX	SR305E105MAA	
...4	308	3100-007		CAP, CER, DISC, 50V, 10%, 33P	C8	1.00	EA		MALLORY	GE330K	

Level	Item	Component	Rev	Description	Ref	Qty	UM	P	Mfg	Manufacturer	Item
...4	309	3130-027		CAP, FILM, 5%, 63V, 0.2", 0.01U	C9	1.00	EA		MALLORY	168103J100A	
...4	310	3130-030		CAP, FILM, 5%, 63V, 0.2", 0.1U	C10	1.00	EA		MALLORY	168104J63A	
...4	311	3130-033		CAP, FILM, 5%, 63V, 0.2", 1.0U	C11	1.00	EA		MALLORY	168105J50C	
...4	312	3160-001		CAP, TANT, 25V, 10U	C12	1.00	EA		AVX	TAP106K025	
...4	313	3160-001		CAP, TANT, 25V, 10U	C13	1.00	EA		AVX	TAP106K025	
...4	314	3160-001		CAP, TANT, 25V, 10U	C14	1.00	EA		AVX	TAP106K025	
...4	315	3100-021		CAP, CER, ML, 50V, 20%, 1UF	C15	1.00	EA		AVX	SR305E105MAA	
...4	316	3000-001		COMPONENT NOT PRESENT	C16	1.00	EA		AXON		
...4	317	3160-001		CAP, TANT, 25V, 10U	C17	1.00	EA		AVX	TAP106K025	
...4	318	3120-006		CAP, ALUM, ELCTLT, RDL LEAD, 25V, 100U	C18	1.00	EA		ILLINOIS	107RMR025	
...4	319	3120-006		CAP, ALUM, ELCTLT, RDL LEAD, 25V, 100U	C19	1.00	EA		ILLINOIS	107RMR025	
...4	320	3120-006		CAP, ALUM, ELCTLT, RDL LEAD, 25V, 100U	C20	1.00	EA		ILLINOIS	107RMR025	
...4	321	3100-020		CAP, CER, ML, 50V, 0.2IN, 0.1U	C21	1.00	EA		AVX	SR215E104MAA	
...4	322	3100-012		CAP, CER, DISC, 50V, 10%, 680P	C22	1.00	EA		MALLORY	GE681K	
...4	323	3100-018		CAP, CER, ML, 100V, 0.2IN, 0.1U	C23	1.00	EA		AVX	SR211E104 ZAA	
...4	324	3100-018		CAP, CER, ML, 100V, 0.2IN, 0.1U	C24	1.00	EA		AVX	SR211E104 ZAA	
...4	325	3100-018		CAP, CER, ML, 100V, 0.2IN, 0.1U	C25	1.00	EA		AVX	SR211E104 ZAA	
...4	326	3100-022		CAP, CER, ML, 200V, 0.1U	C26	1.00	EA		AVX	SR302C104KAA	
...4	327	3100-022		CAP, CER, ML, 200V, 0.1U	C27	1.00	EA		AVX	SR302C104KAA	
...4	328	3100-022		CAP, CER, ML, 200V, 0.1U	C28	1.00	EA		AVX	SR302C104KAA	
...4	329	3100-022		CAP, CER, ML, 200V, 0.1U	C29	1.00	EA		AVX	SR302C104KAA	
...4	330	3120-015		CAP, ALUM, ELCTLT, RDLLEAD, 200V, 100U	C30	1.00	EA		SPRAGUE	515D107M200EN6A	
...4	331	3120-015		CAP, ALUM, ELCTLT, RDLLEAD, 200V, 100U	C31	1.00	EA		SPRAGUE	515D107M200EN6A	
...4	332	3100-021		CAP, CER, ML, 50V, 20%, 1UF	C32	1.00	EA		AVX	SR305E105MAA	
...4	333	3100-021		CAP, CER, ML, 50V, 20%, 1UF	C33	1.00	EA		AVX	SR305E105MAA	
...4	334	3100-021		CAP, CER, ML, 50V, 20%, 1UF	C34	1.00	EA		AVX	SR305E105MAA	
...4	335	3100-021		CAP, CER, ML, 50V, 20%, 1UF	C35	1.00	EA		AVX	SR305E105MAA	
...4	336	3100-021		CAP, CER, ML, 50V, 20%, 1UF	C36	1.00	EA		AVX	SR305E105MAA	
...4	337	3100-021		CAP, CER, ML, 50V, 20%, 1UF	C37	1.00	EA		AVX	SR305E105MAA	
...4	338	3100-037		CAP, CER, DISC, 500V, 10%, 22P	C38	1.00	EA		DIGIKEY	P4004	
...4	355	3220-002		CONN, PCB, 0.100, STRAIGHT, GOLD, 12-PIN	J5	1.00	EA		PANDUIT	MPSS100-12-	
...4	356	3220-001		CONN, PCB, 0.100, STRAIGHT, GOLD, 8-PIN	J6	1.00	EA		PANDUIT	MPSS100-8-D-A	
...4	357	3220-044		CONN, PCB, 0.100, STRAIGHT, GOLD, 2-PIN	J7	1.00	EA		PANDUIT	MPSS100-2-CA	
...4	358	3220-002		CONN, PCB, 0.100, STRAIGHT, GOLD, 12-PIN	J8	1.00	EA		PANDUIT	MPSS100-12-	
...4	359	3220-002		CONN, PCB, 0.100, STRAIGHT, GOLD, 12-PIN	J9	1.00	EA		PANDUIT	MPSS100-12-	
...4	371	3810-017		INDUCTOR, MINIATURE SHIELDED, 100 uH	L1	1.00	EA		DALE	IMS-5 100uH +/-10%	
...4	372	3810-017		INDUCTOR, MINIATURE SHIELDED, 100 uH	L2	1.00	EA		DALE	IMS-5 100uH +/-10%	
...4	401	3500-006		RES, FILM, MET, 0.25W, 1%, 100PPM, 1K	R1	1.00	EA		DALE	CCF-55-1001-F	
...4	402	3500-012		RES, FILM, MET, 0.25W, 1%, 100PPM, 100K	R2	1.00	EA		DALE	CCF-55-1003-F	
...4	403	3500-009		RES, FILM, MET, 0.25W, 1%, 100PPM, 10K	R3	1.00	EA		DALE	CCF-55-1002-F	
...4	404	3500-171		RES, FILM, MET, 0.25W, 1%, 100PPM, 499R	R4	1.00	EA		DALE	CCF-55-4990-F	
...4	405	3500-009		RES, FILM, MET, 0.25W, 1%, 100PPM, 10K	R5	1.00	EA		DALE	CCF-55-1002-F	
...4	406	3500-012		RES, FILM, MET, 0.25W, 1%, 100PPM, 100K	R6	1.00	EA		DALE	CCF-55-1003-F	
...4	407	3500-204		RES, FILM, MET, 0.25W, 1%, 100PPM, 6K81	R7	1.00	EA		DALE	CCF-55-6811-F	
...4	408	3500-111		RES, FILM, MET, 0.25W, 1%, 100PPM, 30K1	R8	1.00	EA		DALE	CCF-55-3012-F	
...4	408	3500-162		RES, FILM, MET, 0.25W, 1%, 100PPM, 47K5	R9	1.00	EA		DALE	CCF-55-4752-F	
...4	410	3500-066		RES, FILM, MET, 0.25W, 1%, 100PPM, 2K	R10	1.00	EA		DALE	CCF-55-2001-F	
...4	411	3000-002		RES, LINK	R11	1.00	EA		AXON		
...4	412	3560-010		RES, FILM, MET, 0.25W, 0.1%, 25PPM, 5K00	R12	1.00	EA		DALE	CMF-55-5001-T9-B	
...4	413	3560-018		RES, FILM, MET, 0.25W, 0.1%, 25PPM, 500R	R13	1.00	EA		DALE	CMF-55-5000-B-T9	
...4	414	3500-174		RES, FILM, MET, 0.25W, 1%, 100PPM, 4K99	R14	1.00	EA		DALE	CCF-55-4991-F	
...4	415	3560-019		RES, FILM, MET, 0.25W, 0.1%, 25PPM, 100R	R15	1.00	EA		DALE	CMF-55-1000-B-T9	

Level	Item	Component	Rev	Description	Ref	Qty	UM	P	Mfg	Manufacturer	Item
...4	416	3500-009		RES, FILM, MET, 0.25W, 1%, 100PPM, 10K	R16	1.00	EA		DALE	CCF-55-1002-F	
...4	417	3500-009		RES, FILM, MET, 0.25W, 1%, 100PPM, 10K	R17	1.00	EA		DALE	CCF-55-1002-F	
...4	418	3530-001		RES, HI MEG, CARBON CMPSN, 0.25W, 5%, 10M	R18	1.00	EA		ALLNBRAD	RC07GF106J	
...4	419	3530-001		RES, HI MEG, CARBON CMPSN, 0.25W, 5%, 10M	R19	1.00	EA		ALLNBRAD	RC07GF106J	
...4	420	3500-009		RES, FILM, MET, 0.25W, 1%, 100PPM, 10K	R20	1.00	EA		DALE	CCF-55-1002-F	
...4	421	3530-001		RES, HI MEG, CARBON CMPSN, 0.25W, 5%, 10M	R21	1.00	EA		ALLNBRAD	RC07GF106J	
...4	422	3500-002		RES, FILM, MET, 0.25W, 1%, 100PPM, 10R	R22	1.00	EA		DALE	CCF-55-10R0-F	
...4	423	3500-009		RES, FILM, MET, 0.25W, 1%, 100PPM, 10K	R23	1.00	EA		DALE	CCF-55-1002-F	
...4	424	3500-002		RES, FILM, MET, 0.25W, 1%, 100PPM, 10R	R24	1.00	EA		DALE	CCF-55-10R0-F	
...4	425	3500-003		RES, FILM, MET, 0.25W, 1%, 100PPM, 100R	R25	1.00	EA		CORNING	RN350-100F	
...4	426	3500-006		RES, FILM, MET, 0.25W, 1%, 100PPM, 1K	R26	1.00	EA		DALE	CCF-55-1001-F	
...4	427	3500-039		RES, FILM, MET, 0.25W, 1%, 100PPM, 1K5	R27	1.00	EA		DALE	CCF-55-1501-F	
...4	428	3500-174		RES, FILM, MET, 0.25W, 1%, 100PPM, 4K99	R28	1.00	EA		DALE	CCF-55-4991-F	
...4	429	3500-174		RES, FILM, MET, 0.25W, 1%, 100PPM, 4K99	R29	1.00	EA		DALE	CCF-55-4991-F	
...4	430	3500-012		RES, FILM, MET, 0.25W, 1%, 100PPM, 100K	R30	1.00	EA		DALE	CCF-55-1003-F	
...4	431	3500-006		RES, FILM, MET, 0.25W, 1%, 100PPM, 1K	R31	1.00	EA		DALE	CCF-55-1001-F	
...4	432	3560-019		RES, FILM, MET, 0.25W, 0.1%, 25PPM, 100R	R32	1.00	EA		DALE	CMF-55-1000-B-T9	
...4	433	3500-012		RES, FILM, MET, 0.25W, 1%, 100PPM, 100K	R33	1.00	EA		DALE	CCF-55-1003-F	
...4	434	3500-111		RES, FILM, MET, 0.25W, 1%, 100PPM, 30K1	R34	1.00	EA		DALE	CCF-55-3012-F	
...4	501	3600-000		SOCKET, IC, GOLD PLD, DUAL LEAF, 8-PIN	XU1	1.00	EA		AMP	2-640463-4	
...4	502	3600-000		SOCKET, IC, GOLD PLD, DUAL LEAF, 8-PIN	XU2	1.00	EA		AMP	2-640463-4	
...4	503	3600-000		SOCKET, IC, GOLD PLD, DUAL LEAF, 8-PIN	XU3	1.00	EA		AMP	2-640463-4	
...4	504	3600-001		SOCKET, IC, GOLD PLD, 8-PIN ROUND, 0.23 DIA	XU4	1.00	EA		ARIES	8L-514-10	
...4	505	3600-000		SOCKET, IC, GOLD PLD, DUAL LEAF, 8-PIN	XU5	1.00	EA		AMP	2-640463-4	
...4	506	3600-004		SOCKET, IC, GOLD PLD, DUAL LEAF, 14-PIN	XU6	1.00	EA		AMP	2-640357-4	
...4	507	3000-001		COMPONENT NOT PRESENT	XU7	1.00	EA		AXON		
...4	508	3600-000		SOCKET, IC, GOLD PLD, DUAL LEAF, 8-PIN	XU8	1.00	EA		AMP	2-640463-4	
...4	509	3600-000		SOCKET, IC, GOLD PLD, DUAL LEAF, 8-PIN	XU9	1.00	EA		AMP	2-640463-4	
...4	510	3600-000		SOCKET, IC, GOLD PLD, DUAL LEAF, 8-PIN	XU10	1.00	EA		AMP	2-640463-4	
...4	511	3600-005		SOCKET, IC, GOLD PLD, DUAL LEAF, 16-PIN	XU11	1.00	EA		AMP	2-640358-4	
...4	521	3810-018		TRANSFORMER, PC MOUNT, HIGH FREQ., PUSH-PULL	T1	1.00	EA		BURRBRWN	PWS740-2	
...4	522	3810-018		TRANSFORMER, PC MOUNT, HIGH FREQ., PUSH-PULL	T2	1.00	EA		BURRBRWN	PWS740-2	
...4	523	3900-053		WIRE, EMI/RFI SHIELDING TAPE, COPPER, 0.5"	NONE	0.23	FT		ALPHA	CST-5	
...4	531	3800-003		TERMINAL, STAMPED TEST EYELET	TP1-TP12	12.0	EA		OVERLAND	330.100-TIN	
...4	532	5410-001		SCREW, PHH, PNH, SST, #4-40 X 0.250	NONE	1.00	EA		BAY CITY	4C14+PSS	
...4	533	5410-002		SCREW, PHH, PNH, SST, #4-40 X 0.375	NONE	2.00	EA		BAYCITY		
...4	534	5210-003		NUT, KEPS, PLD, #4-40	NONE	3.00	EA		BAYCITY		
...4	535	5700-015		WASHER, PLAIN, NYLON, 0.140 ID	NONE	4.00	EA		CABLCOMP	16FW006032	
..3	201	2600-230	E	MECH, ISOLATOR-11 ENCLOSURE, COMPLETE	NONE	1.00	EA		AXON		
...4	101	2600-231	E	MECH, ISOLATOR-11 ENCLOSURE, DRILLING DETAILS	NONE	1.00	EA	y	AXON		
...4	201	2605-231	B	ARTWORK, ISOLATOR-11 ENCLOSURE	NONE	1.00	EA		AXON		
...4	201	5010-011		BOX, PLASTIC, TAN, 7.4x4.3x2.4	NONE	0.00	EA		BICCVERO	65-223152	
..3	301	2100-169	C	CABLE, ISOLATOR-11, J5	NONE	1.00	EA	y	AXON		
...4	101	3220-010		CONN, INS DISPL SOCKET, 0.100, GOLD, 12-PIN	P5	1.00	EA		PANDUIT	CE100F24-12-T-A	
...4	102	3220-018		CONN, COVER FOR 0.100 INS DISPL, 12-PIN	P5	1.00	EA		PANDUIT	SCC100F-12T	
...4	103	3900-032		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/BLK	NONE	0.20	FT		ALPHA	7054-11	
...4	104	3900-033		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/BRN	NONE	0.20	FT		ALPHA	7054-16	
...4	105	3900-035		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/ORG	NONE	0.75	FT		ALPHA	7054-17	
...4	106	3900-036		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/YEL	NONE	0.75	FT		ALPHA	7054-14	
...4	109	3900-018		WIRE, HOOKUP, BUNCH-TINNED, 24G, GRY	NONE	0.75	FT		MILSPEC	BU24-732-BT-8	
...4	110	3900-017		WIRE, HOOKUP, BUNCH-TINNED, 24G, VIO	NONE	0.75	FT		MILSPEC	BU24-732-BT-7	
...4	111	3010-000	A	CABLE, 1 X 24G, SPIRAL SHIELD, 0.094 OD	NONE	1.50	FT		NATWIRE	S10-6727-B	

Level	Item	Component	Rev	Description	Ref	Qty	UM	P	Mfg	Manufacturer	Item
...4	112	3900-014		WIRE, HOOKUP, BUNCH-TINNED, 24G, YEL	NONE	0.75	FT		MILSPEC	BU24-732-BT-4	
...4	113	5120-001		FASTENER, WIRE & CABLE TIE, 0.1 x 4.0"	NONE	2.00	EA		PANDUIT	SST1M	
..3	302	2100-170	C	CABLE, ISOLATOR-11, J6	NONE	1.00	EA	y	AXON		
...4	101	3220-009		CONN, INS DISPL SOCKET, 0.100, GOLD, 8-PIN	P6	1.00	EA		PANDUIT	CE100F24-8-D-A	
...4	102	3220-017		CONN, COVER FOR 0.100 INS DISPL, 8-PIN	P6	1.00	EA		PANDUIT	SCC100F-8D	
...4	103	3900-012		WIRE, HOOKUP, BUNCH-TINNED, 24G, RED	NONE	0.25	FT		MILSPEC	BU24-732-BT-2	
...4	104	3900-016		WIRE, HOOKUP, BUNCH-TINNED, 24G, BLU	NONE	0.25	FT		MILSPEC	BU24-732-BT-6	
...4	105	3900-014		WIRE, HOOKUP, BUNCH-TINNED, 24G, YEL	NONE	0.75	FT		MILSPEC	BU24-732-BT-4	
...4	106	3900-035		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/ORG	NONE	0.25	FT		ALPHA	7054-17	
...4	107	3900-037		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/GRN	NONE	0.25	FT		ALPHA	7054-13	
...4	108	3900-033		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/BRN	NONE	0.25	FT		ALPHA	7054-16	
..3	303	2100-171	B	CABLE, ISOLATOR-11, J7	NONE	1.00	EA	y	AXON		
...4	101	3220-007		CONN, INS DISPL SOCKET, 0.100, GOLD, 2-PIN	P7	1.00	EA		PANDUIT	CE100F24-2-C-A	
...4	102	3220-015		CONN, COVER FOR 0.100 INS DISPL, 2-PIN	P7	1.00	EA		PANDUIT	SCC100F-2C	
...4	103	3900-038		WIRE, HOOKUP, BUNCH-TINNED, 24, WHT/BLU	NONE	0.20	FT		ALPHA	7054-15	
...4	104	3900-034		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/RED	NONE	0.20	FT		ALPHA	7054-12	
..3	304	2100-172	C	CABLE, ISOLATOR-11, J8	NONE	1.00	EA	y	AXON		
...4	101	3220-010		CONN, INS DISPL SOCKET, 0.100, GOLD, 12-PIN	P8	0.00	EA		PANDUIT	CE100F24-12-T-A	
...4	102	3220-018		CONN, COVER FOR 0.100 INS DISPL, 12-PIN	P8	1.00	EA		PANDUIT	SCC100F-12T	
...4	103	3900-032		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/BLK	NONE	0.50	FT		ALPHA	7054-11	
...4	104	3900-037		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/GRN	NONE	0.50	FT		ALPHA	7054-13	
...4	105	3010-000	A	CABLE, 1 X 24G, SPIRAL SHIELD, 0.094 OD	NONE	3.50	FT		NATWIRE	S10-6727-B	
...4	106	3900-014		WIRE, HOOKUP, BUNCH-TINNED, 24G, YEL	NONE	1.50	FT		MILSPEC	BU24-732-BT-4	
...4	107	5120-001		FASTENER, WIRE & CABLE TIE, 0.1 x 4.0"	NONE	3.00	EA		PANDUIT	SST1M	
..3	305	2100-173	C	CABLE, ISOLATOR-11, J9	NONE	1.00	EA	y	AXON		
...4	101	3220-010		CONN, INS DISPL SOCKET, 0.100, GOLD, 12-PIN	P9	1.00	EA		PANDUIT	CE100F24-12-T-A	
...4	102	3220-018		CONN, COVER FOR 0.100 INS DISPL, 12-PIN	P9	1.00	EA		PANDUIT	SCC100F-12T	
...4	103	3900-032		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/BLK	NONE	0.50	FT		ALPHA	7054-11	
...4	104	3900-033		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/BRN	NONE	0.50	FT		ALPHA	7054-16	
...4	105	3900-035		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/ORG	NONE	0.50	FT		ALPHA	7054-17	
...4	106	3900-036		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/YEL	NONE	0.50	FT		ALPHA	7054-14	
...4	107	3900-037		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/GRN	NONE	0.50	FT		ALPHA	7054-13	
...4	108	3900-039		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/VIO	NONE	0.50	FT		ALPHA	7054-19	
...4	109	3900-018		WIRE, HOOKUP, BUNCH-TINNED, 24G, GRY	NONE	0.50	FT		MILSPEC	BU24-732-BT-8	
...4	110	3900-017		WIRE, HOOKUP, BUNCH-TINNED, 24G, VIO	NONE	0.50	FT		MILSPEC	BU24-732-BT-7	
...4	111	3010-000	A	CABLE, 1 X 24G, SPIRAL SHIELD, 0.094 OD	NONE	0.50	FT		NATWIRE	S10-6727-B	
...4	112	3900-014		WIRE, HOOKUP, BUNCH-TINNED, 24G, YEL	NONE	0.66	FT		MILSPEC	BU24-732-BT-4	
...4	113	3900-040		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/GRY	NONE	0.50	FT		ALPHA	7054-18	
...4	114	3900-034		WIRE, HOOKUP, BUNCH-TINNED, 24G, WHT/RED	NONE	0.50	FT		ALPHA	7054-12	
...4	115	5120-001		FASTENER, WIRE & CABLE TIE, 0.1 x 4.0"	NONE	2.00	EA		PANDUIT	SST1M	
..3	401	5100-111	C	CHASSIS, PANEL SHIELD, ISOLATOR-11	NONE	1.00	EA		AXON		
..3	402	3400-033		POT, TEN TURN, WIREWOUND 100K	RP1	1.00	EA		BOURNES	3590S-291-104	
..3	403	3400-016		POT, TEN TURN, WIREWOUND, 20K	RP2	1.00	EA		BOURNS	3590S-291-203	
..3	404	3730-024		SWITCH, ROT, 0.75",NON-SHORTING, 1P3T	SW1	1.00	EA		GRAYHILL	71BY234062	
..3	405	3730-007	A	SWITCH, ROT, 0.75IN, NON-SHORTING, 2P6T	SW2	1.00	EA		GRAYHILL	71BY233308	
..3	406	3720-000		SWITCH, PB, MINI, MOM, 1P2T	SW3	1.00	EA		C & K	8121SHZGE	
..3	407	3750-000		SWITCH, TGL, MINI, 2P, ON-NONE-ON	SW4	1.00	EA		ALCOSW	MTA-206N	
..3	408	3750-001		SWITCH, TGL, MINI, 1P, ON-NONE-ON	SW5	1.00	EA		ALCOSW	MTA-106D	
..3	409	5210-009		NUT, DRESS, 0.25-40, FOR TOGGLE SWITCHES	NONE	2.00	EA		C&K	7099	
..3	410	3310-001		DIAL, TURNS COUNTING, 1IN DIAM, W/BRAKE	RP1	1.00	EA		BOURNS	H-494-3	
..3	411	3310-001		DIAL, TURNS COUNTING, 1IN DIAM, W/BRAKE	RP2	1.00	EA		BOURNS	H-494-3	
..3	412	3310-031		KNOB, WING, 14.5MM, 0.125, BLK W/LINE	SW1	1.00	EA		ELMA	023-3220	

11.2.15 Bill Of Material By Item Report
Axon Instruments, Inc.

Level	Item	Component	Rev	Description	Ref	Qty	UM	P	Mfg	Manufacturer	Item
..3	413	3310-021		KNOB, CAP FOR 14.5MM, BLK	SW1	1.00	EA		ELMA		040-3020
..3	414	3310-031		KNOB, WING, 14.5MM, 0.125, BLK W/LINE	SW2	1.00	EA		ELMA		023-3220
..3	415	3310-021		KNOB, CAP FOR 14.5MM, BLK	SW2	1.00	EA		ELMA		040-3020
..3	416	3720-002		SWITCH, CAP FOR MINI PB, 0.375, BLACK	SW3	1.00	EA		C&K		7527-02000
..3	417	4010-007		DIODE, LIGHT EMITTING, T1, YEL DIFFUS	D5	1.00	EA		H-P		HLMP-1401
..3	418	4010-000		DIODE, LIGHT EMITTING, T1, RED DIFFUSE	D6	1.00	EA		H-P		HLMP-1301
..3	501	3250-017		CONN, 5-PIN 180 DEG, PANEL DIN, FEMALE, PLASTIC	J1	1.00	EA		LZR		SD50S
..3	502	3250-004		CONN, BNC, ISOLATED, PANEL MOUNT, FEMALE	J2	1.00	EA		AMP		227726-2
..3	503	3230-020		JACK, BINDING POST(4.44MM), PANEL, RED	J3	1.00	EA		CONCORD		01-1044-1-0212
..3	504	3230-021		JACK, BINDING POST(4.44MM), PANEL, BLK	J4	1.00	EA		CONCORD		01-1044-1-0210
..3	505	3250-004		CONN, BNC, ISOLATED, PANEL MOUNT, FEMALE	J10	1.00	EA		AMP		227726-2
..3	506	5100-113		CHASSIS, FEET, RUBBER, FOR ISOLATOR-10/11	NONE	4.00	EA		BICVERO		65-2530
..3	507	5410-010		SCREW, PHH, PND, #4-40x0.375, BLK ANOD	NONE	2.00	EA		BAYCITY		4C38+PBLK
..3	508	5210-003		NUT, KEPS, PLD, #4-40	NONE	2.00	EA		BAYCITY		
..3	509	5120-003		FASTENER, TIE MOUNT, 4-WAY, ADHESIVE	NONE	2.00	EA		ICORALLY		ABMM-AC
..3	601	2050-017	A	ACCESSORIES, ISOLATOR-11	NONE	1.00	EA	y	AXON		
...4	101	3550-004		RES, POWER, FILM, MET, 2W, 5%, 10K	RTEST	1.00	EA		DALE		CPF-2-100F-T1
...4	102	2100-176	A	CABLE, DIN, 5 PIN, MALE-MALE, 12 FT	NONE	1.00	EA		LZRELECT		D5MDSM12
...4	103	6600-000		PACKAGING, ZIP-LOCK BAG, 3 X 5 X 0.002	NONE	1.00	EA		BARKOFF		3X5ZIPMIL
..3	701	3500-006		RES, FILM, MET, 0.25W, 1%, 100PPM, 1K	R11	1.00	EA		DALE		CCF-55-1001-F
1	301	2500-092	A	MANUAL, ISOLATOR-11	NONE	1.00	EA		AXON		
1	401	9250-166	D	DOC, SHIP CHECK LIST, ISOLATOR-11	NONE	1.00	EA		AXON		
1	501	8360-018	D	FORM, PROBLEMS AND SUGGESTIONS REPORT	NONE	2.00	EA		AXON		
1	601	8360-023	B	DOC, PRINTED, WARRANTY REGISTRATION CARD	NONE	1.00	EA		AXON		
1	701	9470-106	A	PROCEDURE, TEST, ISOLATOR-11	NONE	0.00	EA		AXON		
1	702	9470-119	A	PROCEDURE, TRIM, ISOLATOR-11	NONE	0.00	EA		AXON		
1	703	6300-048	A	LABEL, BAR CODE W/SERIAL NUMBER, 0.2 X 1.1"	NONE	1.00	EA		IMTEC		436 HIGHTACK POLY

End of Report