



AVTECH ELECTROSYSTEMS LTD.

NANOSECOND WAVEFORM ELECTRONICS  
SINCE 1975

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OTTAWA, ONTARIO  
CANADA K2C 3H4

## INSTRUCTIONS

MODEL AVOZ-E4-B-P-BAE2

0 TO 250 Volts, 125 Amp PULSE GENERATOR

WITH IEEE 488.2 AND RS-232 CONTROL

SERIAL NUMBER: \_\_\_\_\_

### WARRANTY

Avtech Electrosystems Ltd. warrants products of its manufacture to be free from defects in material and workmanship under conditions of normal use. If, within one year after delivery to the original owner, and after prepaid return by the original owner, this Avtech product is found to be defective, Avtech shall at its option repair or replace said defective item. This warranty does not apply to units which have been disassembled, modified or subjected to conditions exceeding the applicable specifications or ratings. This warranty is the extent of the obligation assumed by Avtech with respect to this product and no other warranty or guarantee is either expressed or implied.

### TECHNICAL SUPPORT

Phone: 888-670-8729 (USA & Canada) or +1-613-686-6675 (International)

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Manual Reference: /files/officefiles/instructword/avoz/AVOZ-E4-B-P-BAE2,ed1.odt.

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## INTRODUCTION

The AVOZ-E4-B-P-BAE2 is a high performance, GPIB and RS232-equipped instrument capable of generating 0 to +250V at repetition rates up to 3 kHz continuously (or 30 kHz in bursts of 100 ms or less) into loads of  $2\Omega$  or higher (i.e., up to 125 Amps). The pulse width is variable from 200 ns to 10  $\mu$ s. The maximum peak output power is 31250 Watts, and the maximum average output power is 47 Watts. Rise and fall times are fixed at less than 100 ns. The AVOZ-E4-B-P-BAE2 includes an internal trigger source, but it can also be triggered or gated by an external source. A front-panel pushbutton can also be used to trigger the instrument.


The output is provided on a high-voltage, high-current Positronic connector on the rear panel. A 1-meter / 3-foot mating cable is provided, along with a sample test load adapter. The resistors on the test load may be removed, allowing the adapter to be used with the user's load or DUT.

The AVOZ-E4-B-P-BAE2 features front panel keyboard and adjust knob control of the output pulse parameters along with a four line by 40-character backlit LCD display of the output amplitude, pulse width, pulse repetition frequency, and delay. The instrument includes memory to store up to four complete instrument setups. The operator may use the front panel or the computer interface to store a complete "snapshot" of all key instrument settings, and recall this setup at a later time.

The instrument is protected against overload conditions (such as short circuits) by an automatic control circuit. An internal power supply monitor removes the power to the output stage for five seconds if an average power overload exists. After that time, the unit operates normally for one second, and if the overload condition persists, the power is cut again. This cycle repeats until the overload is removed.

This instrument is intended for use in research, development, test and calibration laboratories by qualified personnel.

## HIGH-VOLTAGE PRECAUTIONS

 **CAUTION:** This instrument provides output voltages as high as 250 Volts under normal operating conditions, and generates up to 270V internally, so extreme caution must be employed when using this instrument. The instrument should only be used by individuals who are thoroughly skilled in high voltage laboratory techniques. The following precautions should always be observed:

- 1) Keep exposed high-voltage wiring to an absolute minimum.
- 2) Wherever possible, use shielded connectors and cabling.
- 3) Connect and disconnect loads and cables only when the instrument is turned off.
- 4) Keep in mind that all cables, connectors, oscilloscope probes, and loads must have an appropriate voltage rating.

Do not attempt any repairs on the instrument, beyond the fuse replacement procedures described in this manual. Contact Avtech technical support (see page 2 for contact information) if the instrument requires servicing.

ORIGINAL QUOTATION

Date: Thu, 13 Aug 2009 09:07:06 -0400  
From: Avtech Sales  
Subject: Avtech 250V / 125A pulse generator quote

XXXXX,

Following our phone conversation yesterday, I am pleased to quote as follows:

Quote number: 14910

Model number: AVOZ-E4-B-P-BAE2

Description: Customized Laser Diode Driver (Pulsed Voltage) with IEEE-488.2 GPIB and RS-232 Computer Control Ports

Amplitude, set voltage: +2.5V to +250V, adjustable

Resulting output current: +125 Amps maximum

Maximum PRF, inside a 100 ms (or less) burst: 30 kHz

Maximum PRF, averaged over 1 sec (or longer): 3 kHz

Maximum duty cycle, inside a 100 ms (or less) burst: 1.5%

Maximum duty cycle, averaged over 1 sec (or longer): 0.15%

Maximum average output power, averaged over 1 sec (or longer): 0.15% x 250V x 125A = 46.9 Watts

Pulse width (FWHM): 200 ns to 10 us, adjustable

Maximum droop: The amplitude may decay up to 15% during a 100 ms burst.

Triggering: The internal oscillator generates continuous, non-bursted triggers up to 30 kHz. However, the AVOZ-E4-B-P-BAE2 does not provide bursted triggering directly. To generate bursted waveforms, a user-supplied TTL-level pulse generator or arbitrary waveform generator should be used to drive either the external trigger input or the gate input. The gate input can be used to gate the internal oscillator. The external trigger input can be used to trigger the instrument fully without reference to the internal oscillator.

Power requirement: 100-240 V, 50-60 Hz AC. (No DC power supply is required.)

Other: Similar to the standard AVOZ-E4-B-P described at <http://www.avtechpulse.com/laser/avoz-e4>

Price: \$XXXXXX US each, DDU (Delivered Duty Unpaid). Includes the cost of shipping and insurance, but excludes customs duties, taxes, and other import fees. Shipments are from Canada, and are normally duty-free.

Quote valid for: 8 weeks

Estimated delivery: 8-10 weeks after receipt of order.

Please call or email me if I can be of further assistance.

Thank you for your interest in our products!

Regards,

Dr. Michael J. Chudobiak  
Chief Engineer

--- Avtech Electrosystems Ltd. ----- since 1975 ---

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Pulse Generators - Laser Diode Drivers - HV Amplifiers  
Monocycle Generators - Impulse Generators - Pulse Amplifiers  
Function Generators - Frequency Dividers - Standard & Customized

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## SPECIFICATIONS

Model <sup>1</sup> :	AVOZ-E4-B-P-BAE2
Amplitude <sup>2</sup> : set voltage: resulting current:	+2.5V to +250V +125A maximum
Minimum load impedance:	2.0 $\Omega$ (Must be non-inductive <sup>3</sup> .)
Pulse width:	200 ns - 10 $\mu$ s
Rise and fall times (20%-80%):	< 100 ns
Maximum PRF:	Inside a 100 ms (or less) burst: 30 kHz Averaged over 1 sec (or longer): 3 kHz
Duty cycle: (max)	Inside a 100 ms (or less) burst: 1.5% Averaged over 1 sec (or longer): 0.15%
Triggering:	The internal oscillator generates continuous, non-bursted triggers up to 30 kHz. However, the AVOZ-E4-B-P-BAE2 does not provide bursted triggering directly. To generate bursted waveforms, a user-supplied TTL-level pulse generator or arbitrary waveform generator should be used to drive either the external trigger input or the gate input. The gate input can be used to gate the internal oscillator. The external trigger input can be used to trigger the instrument fully without reference to the internal oscillator.
Output impedance (approx.):	0.05 Ohms
Maximum average output power:	Averaged over 1 sec (or longer), 0.15% x 250V x 125A = 46.9 Watts
Droop:	The amplitude may decay up to 15% during a 100 ms burst
Polarity <sup>4</sup> :	Positive
GPIO & RS-232 control <sup>1</sup> :	Standard on -B units. See <a href="http://www.avtechpulse.com/gpio">http://www.avtechpulse.com/gpio</a> for details.
LabView drivers:	Check <a href="http://www.avtechpulse.com/labview">http://www.avtechpulse.com/labview</a> for availability and downloads
Burst mode:	Optional <sup>5</sup> . Generates 1-500 pulses per trigger event. See <a href="http://www.avtechpulse.com/options/br">http://www.avtechpulse.com/options/br</a> .
Propagation delay:	< 200 ns (Ext trig in to pulse out)
Jitter:	$\pm 100$ ps $\pm 0.03\%$ of sync delay (Ext trig in to pulse out)
Trigger required:	External trigger mode: + 5 Volts, 50 to 500 ns (TTL)
Sync delay:	Variable, 0 to $\pm 1.0$ seconds (sync out to pulse out)
Sync output:	+ 3 Volts, 100 ns, will drive 50 Ohm loads
Gate input:	Synchronous or asynchronous, active high or low, switchable. Suppresses triggering when active.
Output connector, rear-panel:	Positronic ( <a href="http://www.positronic.com">www.positronic.com</a> ) female connector <sup>6</sup>
Output cable description:	An included 1 meter / 3 foot long accessory transmission line cable mates to the rear-panel connector. The transmission line cable matches the specified 1 or 2 Ohm minimum load impedance without degrading the signal rise and fall times. The chassis end of the cable is terminated with a Positronic male connector <sup>7</sup> , and the load end is terminated with a Positronic female connector <sup>6</sup> .  An adapter <sup>7</sup> is included which mates to the end of this cable, and provides the output on two identical contact posts into which M6x1 threaded screws may be screwed (to a maximum depth of 15 mm).
Output cable model:	AV-HLZ2-100
Output cable characteristic impedance ( $Z_0$ ):	2 Ohms, approximately
Other connectors:	Trig, Gate, Sync: BNC
Power, temperature:	100 - 240 Volts, 50 - 60 Hz.
Dimensions:	100 x 430 x 375 mm (3.9 x 17 x 14.8"),
Chassis material:	Anodized aluminum, with blue plastic trim
Temperature range:	+5°C to +40°C

- 1) -B suffix indicates IEEE-488.2 GPIO and RS-232 control of pulse amplitude, pulse width, delay and PRF. (See <http://www.avtechpulse.com/gpio>).
- 2) For operation at voltage amplitudes of less than 10% of full-scale, better results may be obtained by setting the amplitude near full-scale and increasing the load impedance accordingly. This will provide lower output currents.
- 3) For applications where additional resistance must be added in series with the device under test, Avtech recommends connecting multiple Ohmite ([www.ohmite.com](http://www.ohmite.com)) OY-series ceramic composition resistors in parallel to create a high-power, low-inductance effective resistance. These resistors can be purchased readily at <http://www.digi-key.com>.
- 4) Indicate desired polarity by suffixing model number with -P or -N (i.e. positive or negative) or -PN for dual polarity option.
- 5) Add the suffix -BR to the model number to specify the burst mode option. See <http://www.avtechpulse.com/options/br> for details about this option.
- 6) Positronic part number GG888F1, with four GGFIT00MS/AA high-current contacts. The inner two contacts carry the signal, and the outer two carry the ground lines.
- 7) Positronic part number GG888M1, with four GGMIT00MS/AA high-current contacts. The inner two contacts carry the signal, and the outer two carry the ground lines.

## REGULATORY NOTES

### FCC PART 18

This device complies with part 18 of the FCC rules for non-consumer industrial, scientific and medical (ISM) equipment.

This instrument is enclosed in a rugged metal chassis and uses a filtered power entry module. The main output signal is provided on a shielded connector that is intended to be used with shielded coaxial cabling and a shielded load. Under these conditions, the interference potential of this instrument is low.

If interference is observed, check that appropriate well-shielded cabling is used on the output connectors. Contact Avtech ([info@avtechpulse.com](mailto:info@avtechpulse.com)) for advice if you are unsure of the most appropriate cabling. Also, check that your load is adequately shielded. It may be necessary to enclose the load in a metal enclosure.

If any of the connectors on the instrument are unused, they should be covered with shielded metal "dust caps" to reduce the interference potential.

This instrument does not normally require regular maintenance to minimize interference potential. However, if loose hardware or connectors are noted, they should be tightened. Contact Avtech ([info@avtechpulse.com](mailto:info@avtechpulse.com)) if you require assistance.

### EC DECLARATION OF CONFORMITY



We                    Avtech Electrosystems Ltd.  
                          P.O. Box 5120, LCD Merivale  
                          Ottawa, Ontario  
                          Canada K2C 3H4

declare that this pulse generator meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance pertains to the following specifications as listed in the official Journal of the European Communities:

EN 50081-1 Emission

EN 50082-1 Immunity

and that this pulse generator meets the intent of the Low Voltage Directive 72/23/EEC as amended by 93/68/EEC. Compliance pertains to the following specifications as listed in the official Journal of the European Communities:

EN 61010-1:2001 Safety requirements for electrical equipment for measurement, control, and laboratory use

#### DIRECTIVE 2002/95/EC (RoHS)

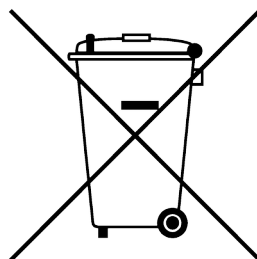
This instrument is exempt from Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment. Specifically, Avtech instruments are considered "Monitoring and control instruments" (Category 9) as defined in Annex 1A of Directive 2002/96/EC. The Directive 2002/95/EC only applies to Directive 2002/96/EC categories 1-7 and 10, as stated in the "Article 2 - Scope" section of Directive 2002/95/EC.

#### DIRECTIVE 2002/96/EC (WEEE)

European customers who have purchased this equipment directly from Avtech will have completed a "WEEE Responsibility Agreement" form, accepting responsibility for WEEE compliance (as mandated in Directive 2002/96/EC of the European Union and local laws) on behalf of the customer, as provided for under Article 9 of Directive 2002/96/EC.

Customers who have purchased Avtech equipment through local representatives should consult with the representative to determine who has responsibility for WEEE compliance. Normally, such responsibilities will lie with the representative, unless other arrangements (under Article 9) have been made.

Requirements for WEEE compliance may include registration of products with local governments, reporting of recycling activities to local governments, and financing of recycling activities.



## INSTALLATION

### VISUAL CHECK

After unpacking the instrument, examine to ensure that it has not been damaged in shipment. Visually inspect all connectors, knobs, liquid crystal displays (LCDs), and the handles. If the instrument has been damaged, file a claim immediately with the company that transported the instrument.

Confirm that the following items are present:

- The mainframe (i.e., the main instrument chassis)
- A power cord
- A GPIB cable
- An AV-HLZA2 test load
- An AV-HLZ2-100 transmission line cable assembly
- Two instrumentation manuals (this manual and the “Programming Manual for -B Instruments”) are with the instrument.

### POWER RATINGS


This instrument is intended to operate from 100 - 240 V, 50 - 60 Hz.

The maximum power consumption is 115 Watts. Please see the “FUSES” section for information about the appropriate AC and DC fuses.

This instrument is an “Installation Category II” instrument, intended for operation from a normal single-phase supply.

### CONNECTION TO THE POWER SUPPLY


An IEC-320 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket. The other end of the detachable power cord plugs into the local mains supply. Use only the cable supplied with the instrument. The mains supply must be earthed, and the cord used to connect the instrument to the mains supply must provide an earth connection. (The supplied cord does this.)

 Warning: Failure to use a grounded outlet may result in injury or death due to electric shock. This product uses a power cord with a ground connection. It must be connected to a properly grounded outlet. The instrument chassis is connected to the ground wire in the power cord.

The table below describes the power cord that is normally supplied with this instrument, depending on the destination region:

Destination Region	Description	Option	Manufacturer	Part Number
United Kingdom, Hong Kong, Singapore, Malaysia	BS 1363, 230V, 50 Hz	-AC00	Qualtek <sup>1</sup>	370001-E01
Australia, New Zealand	AS 3112:2000, 230-240V, 50 Hz	-AC01	Qualtek <sup>1</sup>	374003-A01
Continental Europe, Korea, Indonesia, Russia	European CEE 7/7 "Schuko" 230V, 50 Hz	-AC02	Qualtek <sup>1</sup>	364002-D01
North America, Taiwan	NEMA 5-15, 120V, 60 Hz	-AC03	Qualtek <sup>1</sup>	312007-01
Switzerland	SEV 1011, 230V, 50 Hz	-AC06	Qualtek <sup>1</sup>	378001-E01
South Africa, India	SABS 164-1, 220-250V, 50 Hz	-AC17	Volex <sup>2</sup>	2131H 10 C3
Japan	JIS 8303, 100V, 50-60 Hz	-AC18	Qualtek <sup>1</sup>	397002-01
Israel	SI 32, 220V, 50 Hz	-AC19	Qualtek <sup>1</sup>	398001-01
China	GB 1002-1, 220V, 50 Hz	-AC22	Volex <sup>2</sup>	2137H 10 C3

## PROTECTION FROM ELECTRIC SHOCK

 Operators of this instrument must be protected from electric shock at all times. The owner must ensure that operators are prevented access and/or are insulated from every connection point. In some cases, connections must be exposed to potential human contact. Operators must be trained to protect themselves from the risk of electric shock. This instrument is intended for use by qualified personnel who recognize shock hazards and are familiar with safety precautions required to avoid possibly injury. In particular, operators should:

1. Keep exposed high-voltage wiring to an absolute minimum.
2. Wherever possible, use shielded connectors and cabling.
3. Connect and disconnect loads and cables only when the instrument is turned off.
4. Keep in mind that all cables, connectors, oscilloscope probes, and loads must have an appropriate voltage rating.
5. Do not attempt any repairs on the instrument, beyond the fuse replacement procedures described in this manual. Contact Avtech technical support (see

page 2 for contact information) if the instrument requires servicing. Service is to be performed solely by qualified service personnel.

### ENVIRONMENTAL CONDITIONS

This instrument is intended for use under the following conditions:

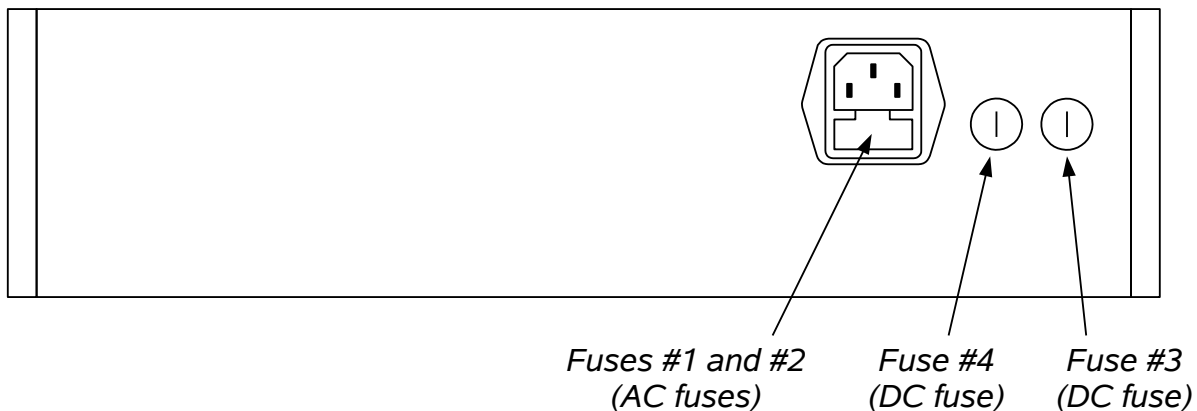
1. indoor use;
2. altitude up to 2 000 m;
3. temperature 5 °C to 40 °C;
4. maximum relative humidity 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C;
5. Mains supply voltage fluctuations up to  $\pm 10$  % of the nominal voltage;
6. no pollution or only dry, non-conductive pollution.

### LABVIEW DRIVERS

A LabVIEW driver for this instrument is available for download on the Avtech web site, at <http://www.avtechpulse.com/labview>. A copy is also available in National Instruments' Instrument Driver Library at <http://www.natinst.com/>.

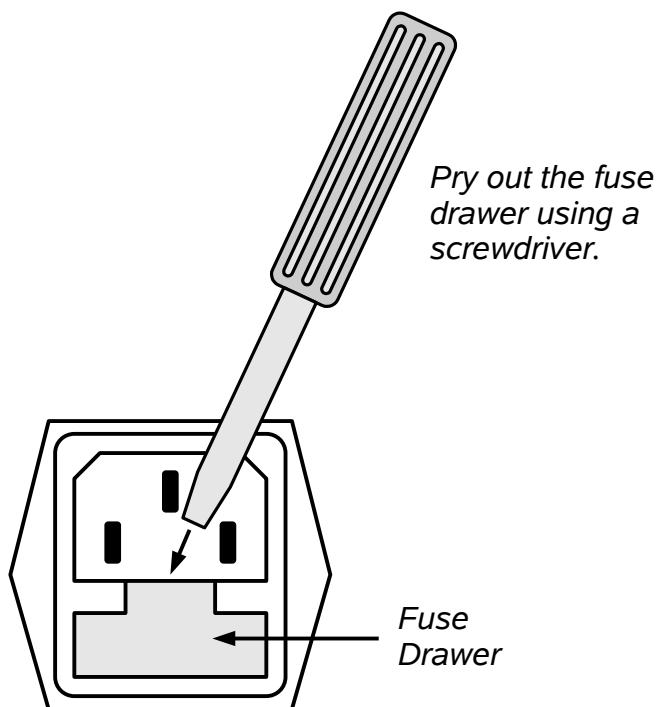
## FUSES

This instrument contains four fuses. All are accessible from the rear-panel. Two protect the AC prime power input, and two protect the internal DC power supplies. The locations of the fuses on the rear panel are shown in the figure below:



### AC FUSE REPLACEMENT

To physically access the AC fuses, the power cord must be detached from the rear panel of the instrument. The fuse drawer may then be extracted using a small flat-head screwdriver, as shown below:



## DC FUSE REPLACEMENT

The DC fuses may be replaced by inserting the tip of a flat-head screwdriver into the fuse holder slot, and rotating the slot counter-clockwise. The fuse and its carrier will then pop out.

## FUSE RATINGS

The following table lists the required fuses:

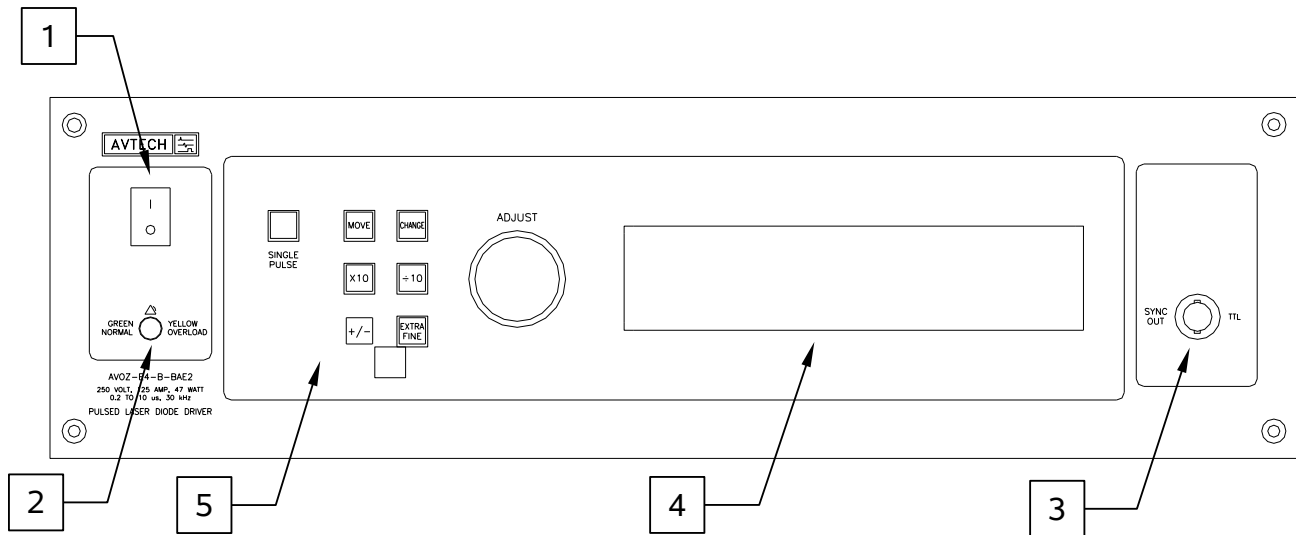
Fuses	Nominal Mains Voltage	Rating	Case Size	Recommended Replacement Part	
				Littelfuse Part Number	Digi-Key Stock Number
#1, #2 (AC)	115 V	1.0A, 250V, Time-Delay	5×20 mm	0218001.HXP	F2419-ND
	230 V	0.5A, 250V, Time-Delay	5×20 mm	0218.500HXP	F2416-ND
#3 (DC)	N/A	4.0A, 250V, Time-Delay	5×20 mm	0218004.HXP	F2421ND
#4 (DC)	N/A	3.15A, 250V, Time-Delay	5×20 mm	02183.15HXP	F2430-ND

The recommended fuse manufacturer is Littelfuse (<http://www.littelfuse.com>).

Replacement fuses may be easily obtained from Digi-Key (<http://www.digikey.com>) and other distributors.



## FRONT PANEL CONTROLS



1. **POWER Switch**. This is the main power switch. When turning the instrument on, there may be a delay of several seconds before the instrument appears to respond.
2. **OVERLOAD Indicator**. When the instrument is powered, this indicator is normally green, indicating normal operation. If this indicator is yellow, an internal automatic overload protection circuit has been tripped. If the unit is overloaded (by operating at an exceedingly high duty cycle or by operating into a very low impedance), the protective circuit will disable the output of the instrument and turn the indicator light yellow. The light will stay yellow (i.e. output disabled) for about 5 seconds after which the instrument will attempt to re-enable the output (i.e. light green) for about 1 second. If the overload condition persists, the output will be disabled again (i.e. light yellow) for another 5 seconds. If the overload condition has been removed, the instrument will resume normal operation.

This overload indicator may flash yellow briefly at start-up. This is not a cause for concern.

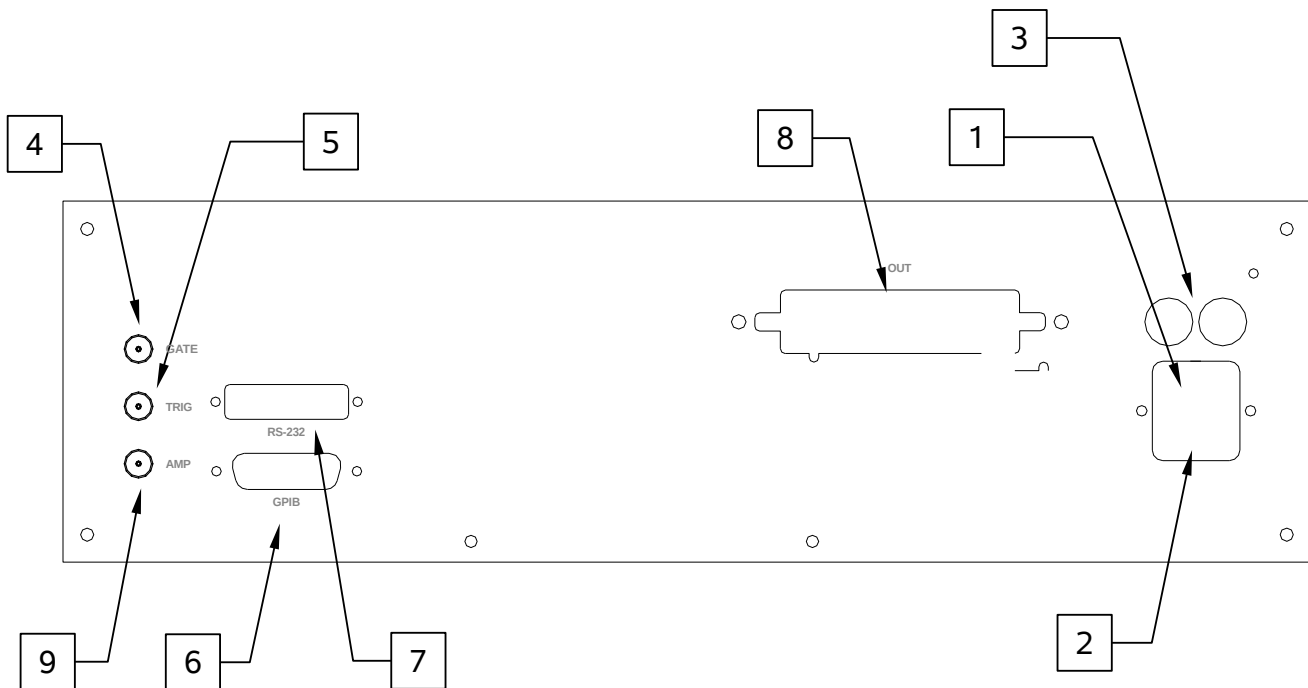
Note that the output stage will safely withstand a short-circuited load condition.

3. **SYNC OUT**. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal leads (or lags) the main output by a duration set by the "DELAY" controls and has an approximate amplitude of +3 Volts to  $R_L > 50\Omega$  with a pulse width of approximately 100 ns.
4. **LIQUID CRYSTAL DISPLAY (LCD)**. This LCD is used in conjunction with the keypad to change the instrument settings. Normally, the main menu is displayed, which lists the key adjustable parameters and their current values. The "Programming Manual for -B Instruments" describes the menus and submenus in detail.

5. KEYPAD.


Control Name	Function
MOVE	This moves the arrow pointer on the display.
CHANGE	This is used to enter the submenu, or to select the operating mode, pointed to by the arrow pointer.
×10	If one of the adjustable numeric parameters is displayed, this increases the setting by a factor of ten.
÷10	If one of the adjustable numeric parameters is displayed, this decreases the setting by a factor of ten.
+/-	If one of the adjustable numeric parameters is displayed, and this parameter can be both positive or negative, this changes the sign of the parameter.
EXTRA FINE	This changes the step size of the ADJUST knob. In the extra-fine mode, the step size is twenty times finer than in the normal mode. This button switches between the two step sizes.
ADJUST	This large knob adjusts the value of any displayed numeric adjustable values, such as frequency, pulse width, etc. The adjust step size is set by the "EXTRA FINE" button.  When the main menu is displayed, this knob can be used to move the arrow pointer.

## REAR PANEL CONTROLS



1. **AC POWER INPUT.** An IEC-320 C14 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket.
2. **AC FUSE DRAWER.** The two fuses that protect the AC input are located in this drawer. Please see the “FUSES” section of this manual for more information.
3. **DC FUSES.** These two fuses protect the internal DC power supplies. Please see the “FUSES” sections of this manual for more information.
4. **GATE.** This TTL-level (0 and +5V) logic input can be used to gate the triggering of the instrument. This input can be either active high or active low, depending on the front panel settings or programming commands. (The instrument triggers normally when this input is unconnected). When set to active high mode, this input is pulled-down to ground by a 1 k $\Omega$  resistor. When set to active low mode, this input is pulled-up to +5V by a 1 k $\Omega$  resistor.
5. **TRIG.** This TTL-level (0 and +5V) logic input can be used to trigger the instrument, if the instrument is set to triggering externally. The instrument triggers on the rising edge of this input. The input impedance of this input is 1 k $\Omega$ . (Depending on the length of cable attached to this input, and the source driving it, it may be desirable to add a coaxial 50 Ohm terminator to this input to provide a proper transmission line termination. The Pasternack ([www.pasternack.com](http://www.pasternack.com)) PE6008-50 BNC feed-thru 50 Ohm terminator is suggested for this purpose.)

When triggering externally, the instrument can be set such that the output pulse width tracks the pulse width on this input, or the output pulse width can be set independently.

 Do not exceed a repetition rate of 30 kHz when triggering externally. Excessive repetition rates may cause over-heating internally, and possible damage the instrument.

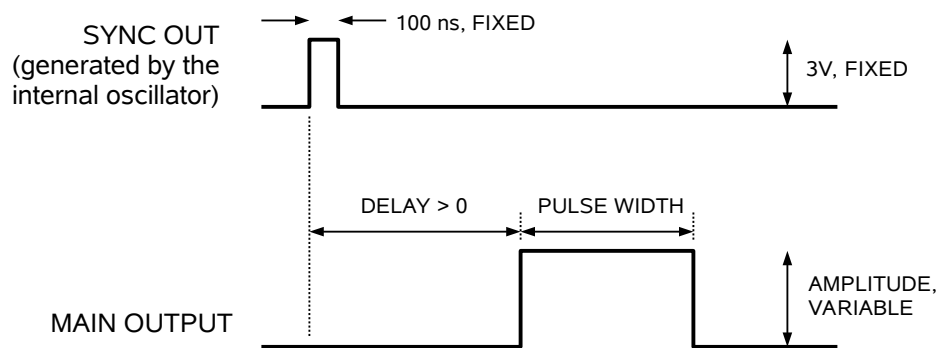
6. GPIB Connector. A standard GPIB cable can be attached to this connector to allow the instrument to be computer-controlled. See the “Programming Manual for -B Instruments” for more details on GPIB control.
7. RS-232 Connector. A standard serial cable with a 25-pin male connector can be attached to this connector to allow the instrument to be computer-controlled. See the “Programming Manual for -B Instruments” for more details on RS-232 control.
8. OUT/GND Connector. This is the main output connector (Positronic part number GG8888F1, with four GGFIT00MS/AA high-current contacts). The inner two contacts carry the signal, and the outer two carry the ground lines. The supplied AV-HLZ2-100 cable or the AV-HLZA2 test load may be plugged into this connector. Alternatively, the user may construct there own mating connector, by ordering Positronic ([www.positronic.com](http://www.positronic.com)) part number GG8888M1, with four GGMIT00MS/AA high-current contacts.
9. AMP Connector. Not used.

## GENERAL INFORMATION

### BASIC PULSE CONTROL

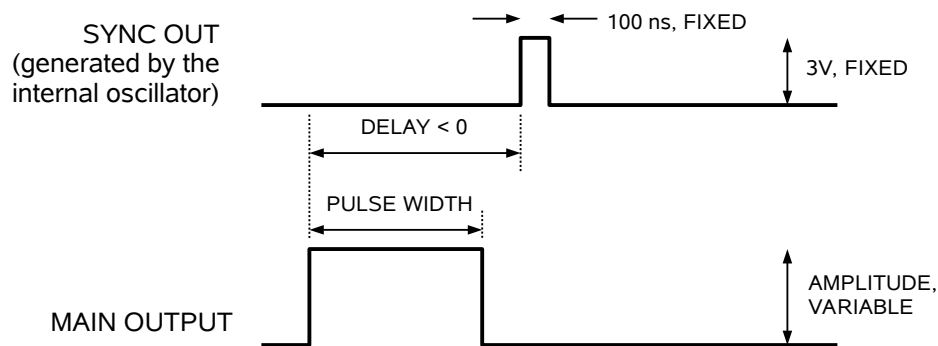
This instrument can be triggered by its own internal clock or by an external TTL trigger signal. In either case, two output channels respond to the trigger: OUT and SYNC. The OUT channel is the signal that is applied to the load. Its amplitude and pulse width are variable. The SYNC pulse is a fixed-width TTL-level reference pulse used to trigger oscilloscopes or other measurement systems. When the delay is set to a positive value the SYNC pulse precedes the OUT pulse. When the delay is set to a negative value the SYNC pulse follows the OUT pulse.

These pulses are illustrated below, assuming internal triggering and a positive delay:



*Figure A*

If the delay is negative, the order of the SYNC and OUT pulses is reversed:



*Figure B*

The next figure illustrates the relationship between the signal when an external TTL-level trigger is used:

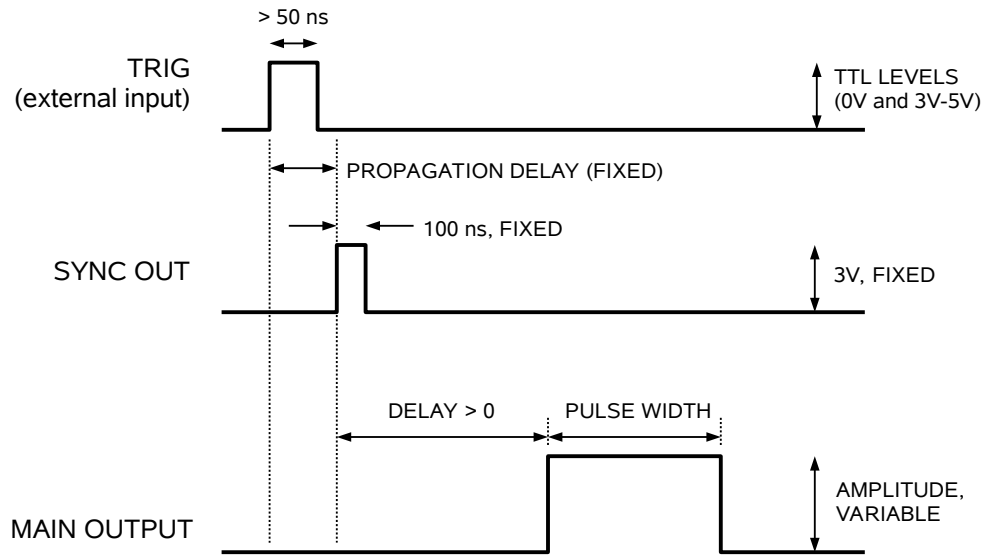


Figure C

As before, if the delay is negative, the order of the SYNC and OUT pulses is reversed.

The delay, pulse width, and frequency (when in the internal mode), of the OUT pulse can be varied with front panel controls or via the GPIB or RS-232 computer interfaces.

## TRIGGER MODES

This instrument has four trigger modes:

- Internal Trigger: the instrument controls the trigger frequency, and generates the clock internally.
- External Trigger: the instrument is triggered by an external TTL-level clock on the back-panel TRIG connector.
- Manual Trigger: the instrument is triggered by the front-panel “SINGLE PULSE” pushbutton.
- Hold Trigger: the instrument is set to not trigger at all.

These modes can be selected using the front panel trigger menu, or by using the appropriate programming commands. (See the “Programming Manual for -B Instruments” for more details.)

## GATING MODES

Triggering can be suppressed by a TTL-level signal on the rear-panel GATE connector. The instrument can be set to stop triggering when this input high or low, using the front-panel gate menu or the appropriate programming commands. This input can also be set to act synchronously or asynchronously. When set to asynchronous mode, the GATE will disable the output immediately. Output pulses may be truncated. When set to synchronous mode, the output will complete the full pulse width if the output is high, and then stop triggering. No pulses are truncated in this mode.

## AMPLITUDE CONTROL

The output voltage amplitude may be set from the front panel, or by computer command. However, the actual amplitude delivered to the load should always be verified using an oscilloscope, for several reasons:

1. The high currents (125A) may result in noticeable voltage drop across any user-attached cables and connectors.
2. The output impedance of the pulse generator is approximately 0.05 Ohms. The amplitude is factory-calibrated using a 2.0 Ohm load at 10 Hz with 10 us pulse width. If a high-impedance load is connected, the output amplitude may be somewhat higher.
3. The amplitude may vary by a few percent, depending on the duty cycle. The amplitude will be slightly reduced at high duty cycles.

When operating at high duty cycles, the internal high-voltage DC power supply may overload if the amplitude is suddenly increased by a large factor. For example, if the timing is set to maximum duty cycle and the amplitude to set to maximum, and the output is switched from “off” to “on”, the amplitude may not actually reach the set value. If this is a problem in your application, set the trigger mode to “hold”, set the output to “on”, increase the amplitude, wait a few seconds, and then set the desired trigger mode (“internal”, “external”, “manual” or “immediate”). This allows the internal power supply to charge up before enabling triggering.

## DUTY CYCLE LIMITS

The AVOZ-E4-B-P-BAE2 may be driven in a continuous trigger mode, or in a bursted mode.

Burst operation may be achieved by triggering the instrument externally using the EXT TRIG input. Also, the instrument may be triggered internally or externally and be gated into bursts using the GATE input.

When triggered continuously, the maximum PRF is 3 kHz, and the maximum duty cycle is 0.15%.

When triggered in bursts lasting less than 100 ms, the maximum PRF *inside the burst* is 30 kHz, and the maximum duty cycle *inside the burst* is 1.5%. The *average* PRF and duty cycle (when averaged over at least 1 second) are still limited to 3 kHz and 0.15%.

When triggered internally, the instrument will enforce the 30 kHz and 1.5% limits. It is the user's responsibility to observe the lower average limits of 3 kHz and 0.15%. Exceeding these limits may damage the instrument.

The instrument contains circuitry that monitors the average output power. It will disable triggerings and trip the OVERLOAD indicator if the 47 Watt average power limit is exceeded.

### PREVENTING OUTPUT STAGE FAILURE

The output stage is protected against overload conditions by an overload circuit and fuses on the main frame back panel. However, the output switching elements may fail if the unit is triggered at a PRF exceeding 3 kHz continuously or at duty cycles resulting in an average output power in excess of 47 Watts. Heating and subsequent possible failure of the output stage is reduced if the following action is taken where possible:

- PRF is kept to a minimum, i.e. operate in a low PRF range when possible rather than in a high PRF range.
- Keep the output PW to a minimum.
- Never apply an externally generated voltage to the output port.



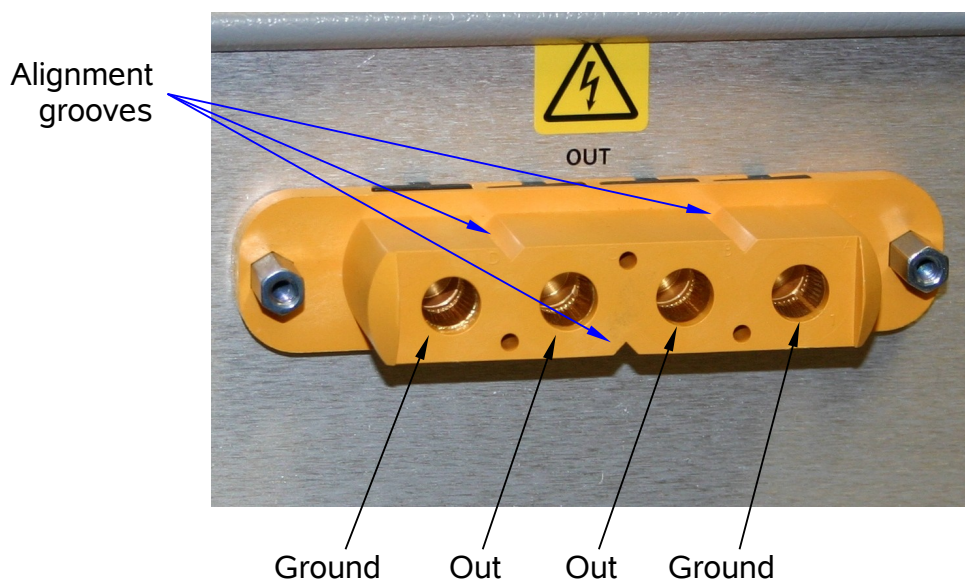
## CONNECTING TO THE LOAD

The main output connector is a Positronic part number GG8888F1, with four GGFIT00MS/AA high-current contacts.

The inner two contacts carry the signal, and the outer two carry the ground lines.

The supplied AV-HLZ2-100 cable or the AV-HLZA2 test load may be plugged into this connector. Alternatively, the user may construct their own mating connector, by ordering Positronic ([www.positronic.com](http://www.positronic.com)) part number GG8888M1, with four GGMIT00MS/AA high-current contacts.

Note the alignment grooves. Mating connectors must be positioned appropriately.



### AV-HLZ2-100 CABLE

One AV-HLZ2-100 cable is provided with the AVOZ-E4-B-P-BAE2. One end of the cable mates to the rear-panel OUT connector.

The cable is specially designed to have a transmission line characteristic impedance ( $Z_0$ ) of approximately 2 Ohms, to minimize distortions and reflections.

The cable may be attached to the OUT connector simply by inserting the male end of the cable into the OUT connector, taking care to align the alignment grooves. The jack screws may be used to secure the cable to the connector.

An attached cable is shown below:



### AV-HLZA2 TEST LOAD / ADAPTER

An AV-HLZA2 test load / adapter is provided with the AVOZ-E4-B-P-BAE2. When shipped from the factory, it is configured with twenty-three  $47\Omega$  2W resistors in parallel installed between the OUT and GROUND lines, for a total effective resistance of  $2\Omega$  46W.

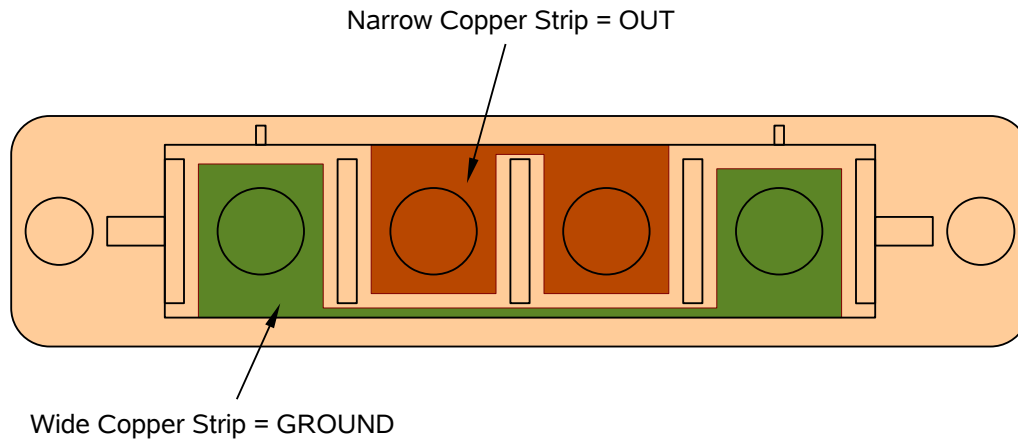


The user may use the provided resistance as-is, or disconnect one end to allow a diode load to be added in series with it, or remove the resistors entirely and connect to a different load as needed.

The AV-HLZA2 test load / adapter may be plugged directly into the rear-panel OUT connector, or it may be plugged into the end of the AV-HLZ2-100 cable. Both configurations are shown below:

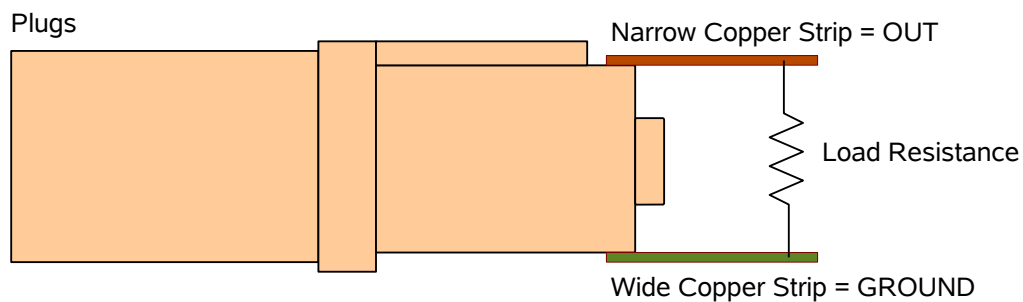


In both cases, the OUTPUT signal is provided on the NARROW copper strip, and the GROUND is provided on the WIDE copper strip. This is shown schematically below:



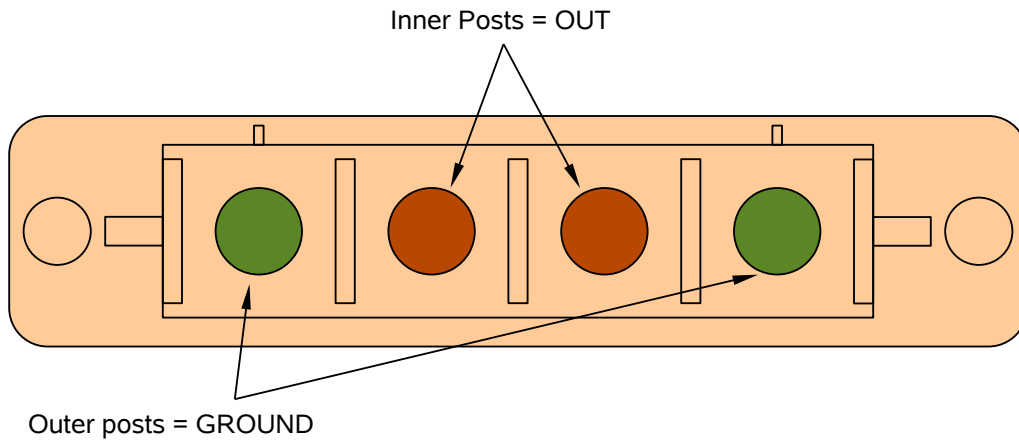
*End View of AV-HLZA*

The load may be installed between these two strips, as shown in a side view:



*Side View of AV-HLZA*

The copper strips may be removed entirely, if the user wishes to construct their own load attachment arrangement. If the copper strips are removed, the OUT and GROUND signals may be accessed using the four high-current posts, which are terminated with M6-1.0 internal threads. An M6-1.0x12 screw should be used to attach cabling to each of the four posts. The inner two posts carry the OUT signal, and the outer two posts carry the ground:



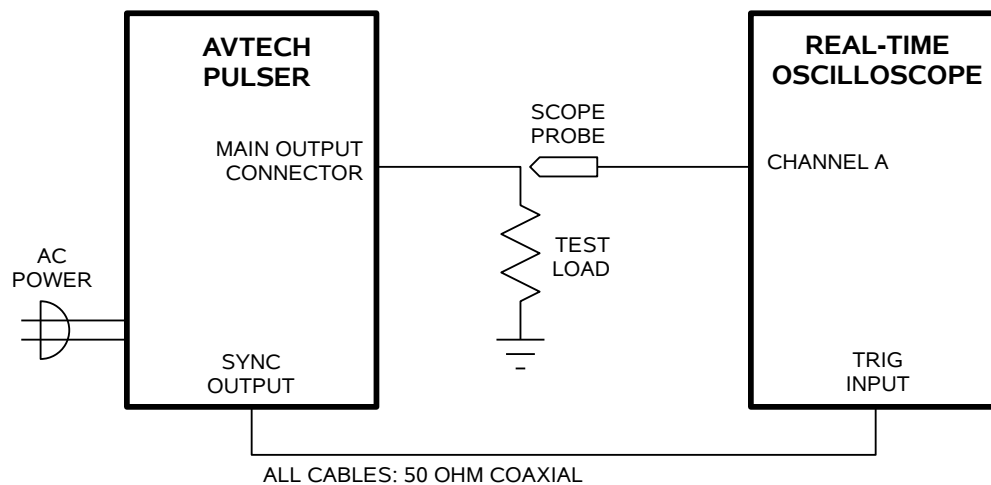
*End View of AV-HLZA,  
With Copper Strips Removed*

For maximum current carrying capability (i.e., least resistance), all four posts should be used.

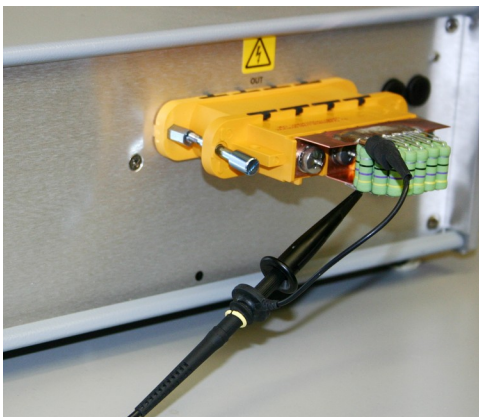
## OPERATIONAL CHECK

This section describes a sequence to confirm the basic operation of the instrument. It should be performed after receiving the instrument. It is a useful learning exercise as well.

Before proceeding with this procedure, finish read this instruction manual thoroughly. Then read the “Local Control” section of the “Programming Manual for -B Instruments” thoroughly. The “Local Control” section describes the front panel controls used in this operational check - in particular, the MOVE, CHANGE, and ADJUST controls.



1. Connect a cable from the SYNC OUT connector to the TRIG input of an oscilloscope. Connect the AV-HLZA2 test load directly to the rear-panel OUT connector and place the scope probe across this load. The probe signal clip should be attached to the narrow copper strip, and the ground clip should be attached to the wide copper strip. If you intend to operate near maximum duty cycle, the test load should be fan-cooled to dissipate the maximum possible 47 W of heat.



2. Set the oscilloscope to trigger externally with the vertical setting at 50 Volts/div and the horizontal setting at 1 us/div. Be sure that your oscilloscope and probe setup can handle the maximum amplitude of 250V.
3. Turn on the AVOZ-E4-B-P-BAE2. The main menu will appear on the LCD.
4. To set the AVOZ-E4-B-P-BAE2 to trigger from the internal clock at a PRF of 10 Hz:
  - a) The arrow pointer should be pointing at the frequency menu item. If it is not, press the MOVE button until it is.
  - b) Press the CHANGE button. The frequency submenu will appear. Rotate the ADJUST knob until the frequency is set at 10 Hz.
  - c) The arrow pointer should be pointing at the “Internal” choice. If it is not, press MOVE until it is.
  - d) Press CHANGE to return to the main menu.
5. To set the delay to 1 us:
  - a) Press the MOVE button until the arrow pointer is pointing at the delay menu item.
  - b) Press the CHANGE button. The delay submenu will appear. Rotate the ADJUST knob until the delay is set at 1 us.
  - c) The arrow pointer should be pointing at the “Normal” choice. If it is not, press MOVE until it is.
  - d) Press CHANGE to return to the main menu.
6. To set the pulse width to 5 us:
  - a) Press the MOVE button until the arrow pointer is pointing at the pulse width menu item.
  - b) Press the CHANGE button. The pulse width submenu will appear. Rotate the ADJUST knob until the pulse width is set at 5 us.
  - c) The arrow pointer should be pointing at the “Normal” choice. If it is not, press MOVE until it is.
  - d) Press CHANGE to return to the main menu.

7. At this point, nothing should appear on the oscilloscope.
8. To enable the output:
  - a) Press the MOVE button until the arrow pointer is pointing at the output menu item.
  - b) Press the CHANGE button. The output submenu will appear.
  - c) Press MOVE until the arrow pointer is pointing at the "ON" choice.
  - d) Press CHANGE to return to the main menu.
9. To change the output amplitude:
  - a) Press the MOVE button until the arrow pointer is pointing at the amplitude menu item.
  - b) Press the CHANGE button. The amplitude submenu will appear. Rotate the ADJUST knob until the amplitude is set at +200V.
  - c) Observe the oscilloscope. You should see 5 us wide, 200V pulses.
  - d) Rotate the ADJUST knob. The amplitude as seen on the oscilloscope should vary.
  - e) Press CHANGE to return to the main menu.
10. Repeat step 9, but set the amplitude to zero.
11. This completes the operational check.



## PROGRAMMING YOUR PULSE GENERATOR

### KEY PROGRAMMING COMMANDS

The “Programming Manual for -B Instruments” describes in detail how to connect the pulse generator to your computer, and the programming commands themselves. A large number of commands are available; however, normally you will only need a few of these. Here is a basic sample sequence of commands that might be sent to the instrument after power-up:

```
*rst                (resets the instrument)
trigger:source internal (selects internal triggering)
frequency 100 Hz    (sets the frequency to 100 Hz)
pulse:width 1 us   (sets the pulse width to 1 us)
pulse:delay 2 us   (sets the delay to 2 us)
volt 200           (sets the amplitude to 200 V)
output on          (turns on the output)
```

For triggering a single event, this sequence would be more appropriate:

```
*rst                (resets the instrument)
trigger:source hold (turns off all triggering)
pulse:width 1 us   (sets the pulse width to 1 us)
pulse:delay 2 us   (sets the delay to 2 us)
output on          (turns on the output)
volt 200           (sets the amplitude to 200 V)
trigger:source immediate (generates a single non-repetitive trigger event)
trigger:source hold (turns off all triggering)
output off         (turns off the output)
```

To set the instrument to trigger from an external TTL signal applied to the rear-panel TRIG connector, use:

```
*rst                (resets the instrument)
trigger:source external (selects external triggering)
pulse:width 1 us   (sets the pulse width to 1 us)
pulse:delay 2 us   (sets the delay to 2 us)
volt 200           (sets the amplitude to 200 V)
output on          (turns on the output)
```

These commands will satisfy 90% of your programming needs.

## ALL PROGRAMMING COMMANDS

For more advanced programmers, a complete list of the available commands is given below. These commands are described in detail in the “Programming Manual for -B Instruments”. (Note: this manual also includes some commands that are not implemented in this instrument. They can be ignored.)


<u>Keyword</u>	<u>Parameter</u>	<u>Notes</u>
LOCAL		
OUTPut:		
:[STATe]	<boolean value>	
:PROTection		
:TRIPped?		[query only]
REMOTE		
[SOURce]:		
:FREQuency		
[:CW   FIXed]	<numeric value>	
[SOURce]:		
:PULSe		
:PERiod	<numeric value>	
:WIDTh	<numeric value>	
:DCYClE	<numeric value>	
:HOLD	WIDTh   DCYClE	
:DELay	<numeric value>	
:GATE		
:TYPE	ASYNc   SYNc	
:LEVel	HIgh   LOw	
[SOURce]:		
:VOLTage		
[:LEVel]		
[:IMMEdiate]		
[:AMPLitude]	<numeric value>	
:PROTection		
:TRIPped?		[query only]
STATUS:		
:OPERation		
:[EVENT]?		[query only, always returns "0"]
:CONDition?		[query only, always returns "0"]
:ENABle	<numeric value>	[implemented but not useful]
:QUEStionable		
:[EVENT]?		[query only, always returns "0"]
:CONDition?		[query only, always returns "0"]
:ENABle	<numeric value>	[implemented but not useful]
SYSTEM:		
:COMMunicate		
:GPIB		
:ADDReSS	<numeric value>	
:SERial		
:CONTRol		
:RTS	ON   IBFull   RFR	
:[RECeive]		
:BAUD	1200   2400   4800   9600	
:BITS	7   8	
:ECHO	<boolean value>	
:PARity		

	: [TYPE]	EVEN   ODD   NONE	
	: SBITS	1   2	
:ERRor			
:[NEXT]?			[query only]
:COUNT?			[query only]
:VERSion?			[query only]
TRIGger:			
:SOURce		INTernal   EXTernal   MANual   HOLD   IMMEDIATE	
*CLS			[no query form]
*ESE		<numeric value>	
*ESR?			[query only]
*IDN?			[query only]
*OPC			
*SAV		0   1   2   3	[no query form]
*RCL		0   1   2   3	[no query form]
*RST			[no query form]
*SRE		<numeric value>	
*STB?			[query only]
*TST?			[query only]
*WAI			[no query form]


## MECHANICAL INFORMATION

### TOP COVER REMOVAL

If necessary, the interior of the instrument may be accessed by removing the four Phillips screws on the top panel. With the four screws removed, the top cover may be slid back (and off).

 Always disconnect the power cord and allow the instrument to sit unpowered for 10 minutes before opening the instrument. This will allow any internal stored charge to discharge.

There are no user-adjustable internal circuits. For repairs other than fuse replacement, please contact Avtech (info@avtechpulse.com) to arrange for the instrument to be returned to the factory for repair. Service is to be performed solely by qualified service personnel.

 Caution: High voltages are present inside the instrument during normal operation. Do not operate the instrument with the cover removed.

### RACK MOUNTING

A rack mounting kit is available. The -R5 rack mount kit may be installed after first removing the one Phillips screw on the side panel adjacent to the front handle.

### ELECTROMAGNETIC INTERFERENCE

To prevent electromagnetic interference with other equipment, all used outputs should be connected to shielded loads using shielded coaxial cables. Unused outputs should be terminated with shielded coaxial terminators or with shielded coaxial dust caps, to prevent unintentional electromagnetic radiation. All cords and cables should be less than 3m in length.

## MAINTENANCE

### REGULAR MAINTENANCE

This instrument does not require any regular maintenance.

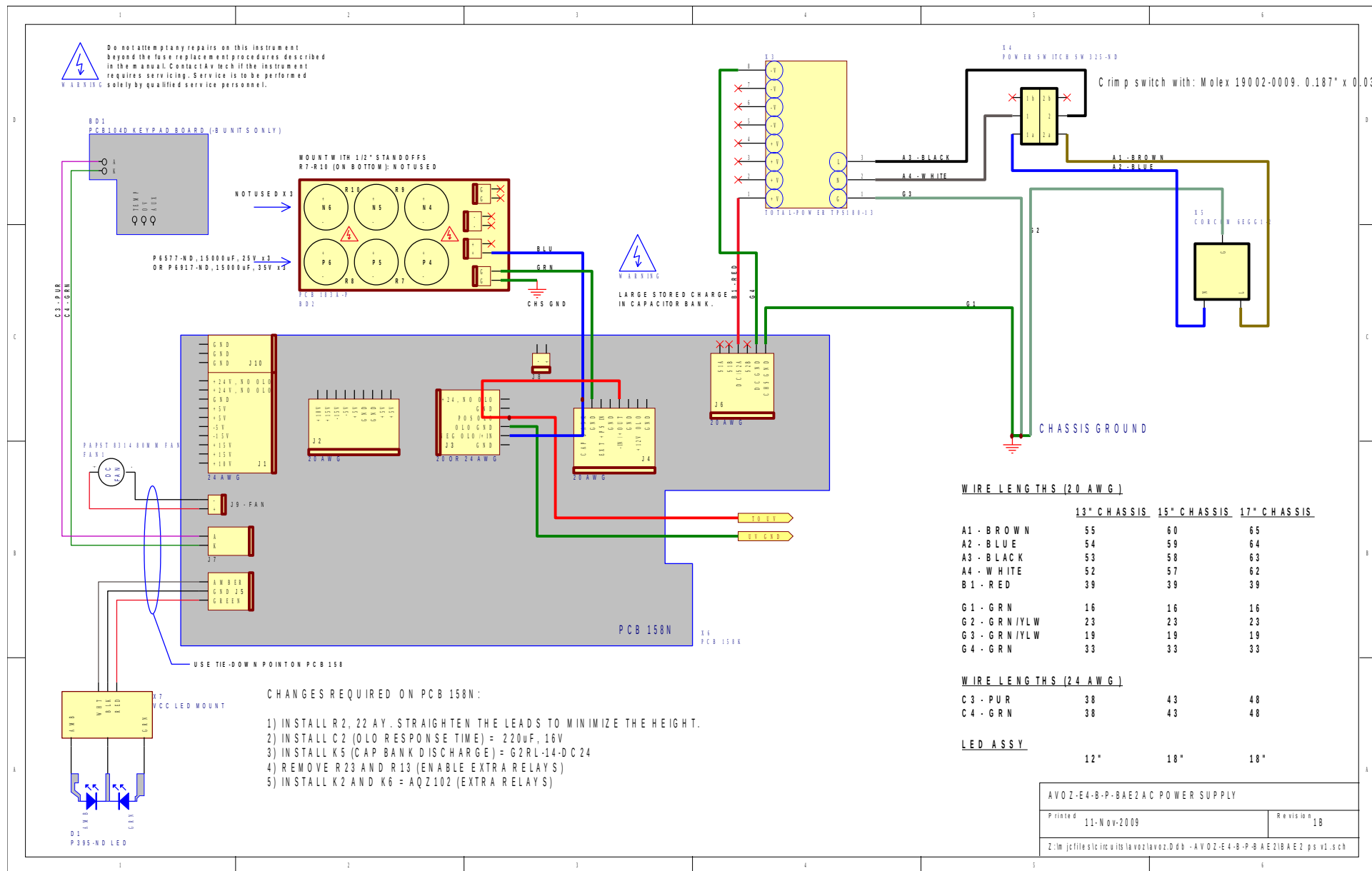
On occasion, one or more of the four rear-panel fuses may require replacement. All fuses can be accessed from the rear panel. See the “FUSES” section for details.

### CLEANING

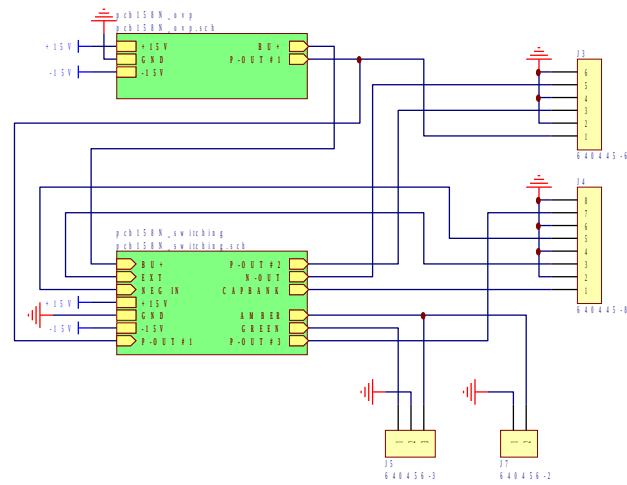
If desired, the interior of the instrument may be cleaned using compressed air to dislodge any accumulated dust. (See the “TOP COVER REMOVAL” section for instructions on accessing the interior.) No other cleaning is recommended.

# WIRING DIAGRAMS

## WIRING OF AC POWER



# PCB 158N - LOW VOLTAGE POWER SUPPLY, 1/3

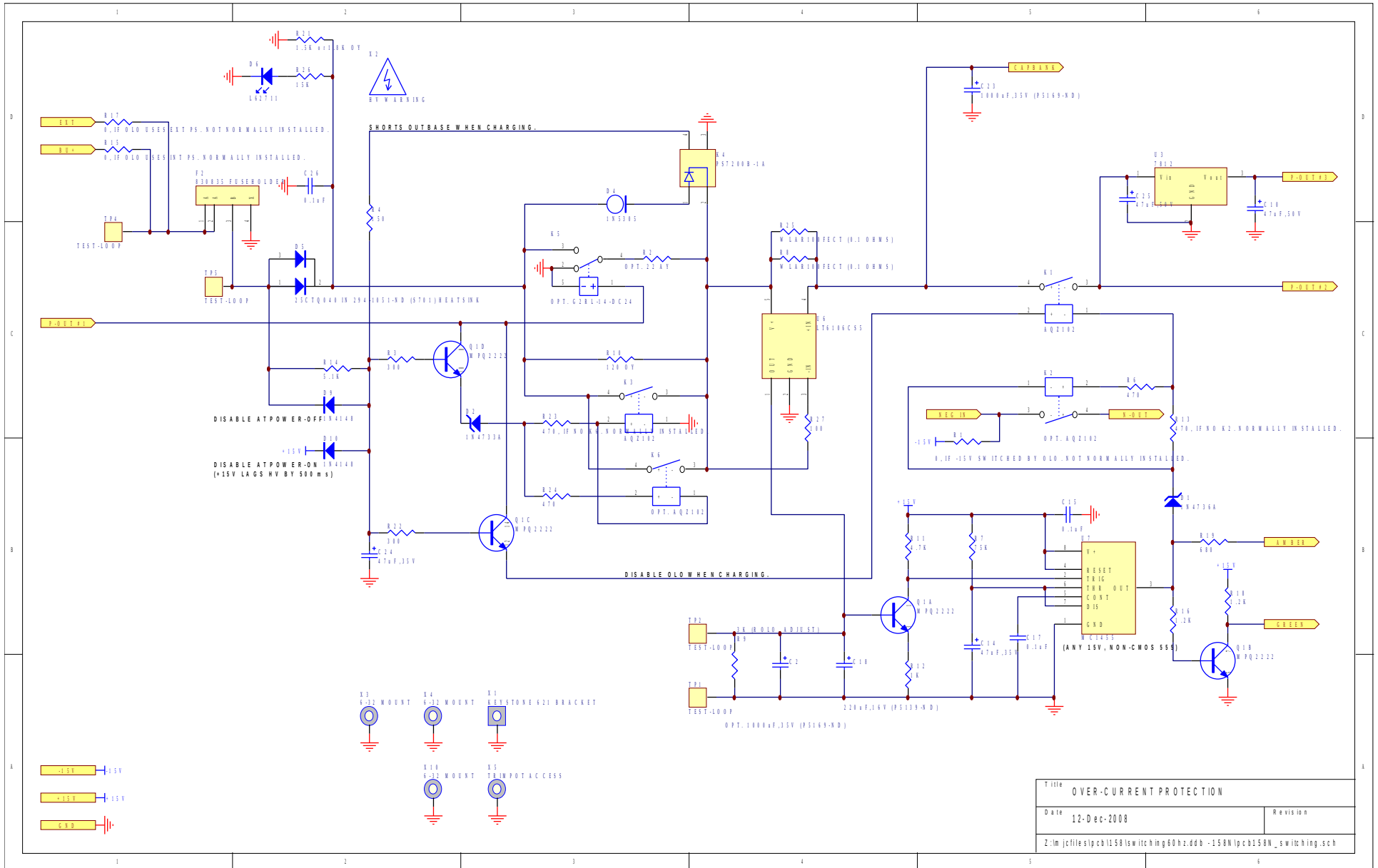


Title		LOW VOLTAGE DC/DC POWER SUPPLY
Date	12-Dec-2008	Revision
Z:\m\jcf\files\pcb158\switching\60hz.ddb - 158N\pcb158N.sch		

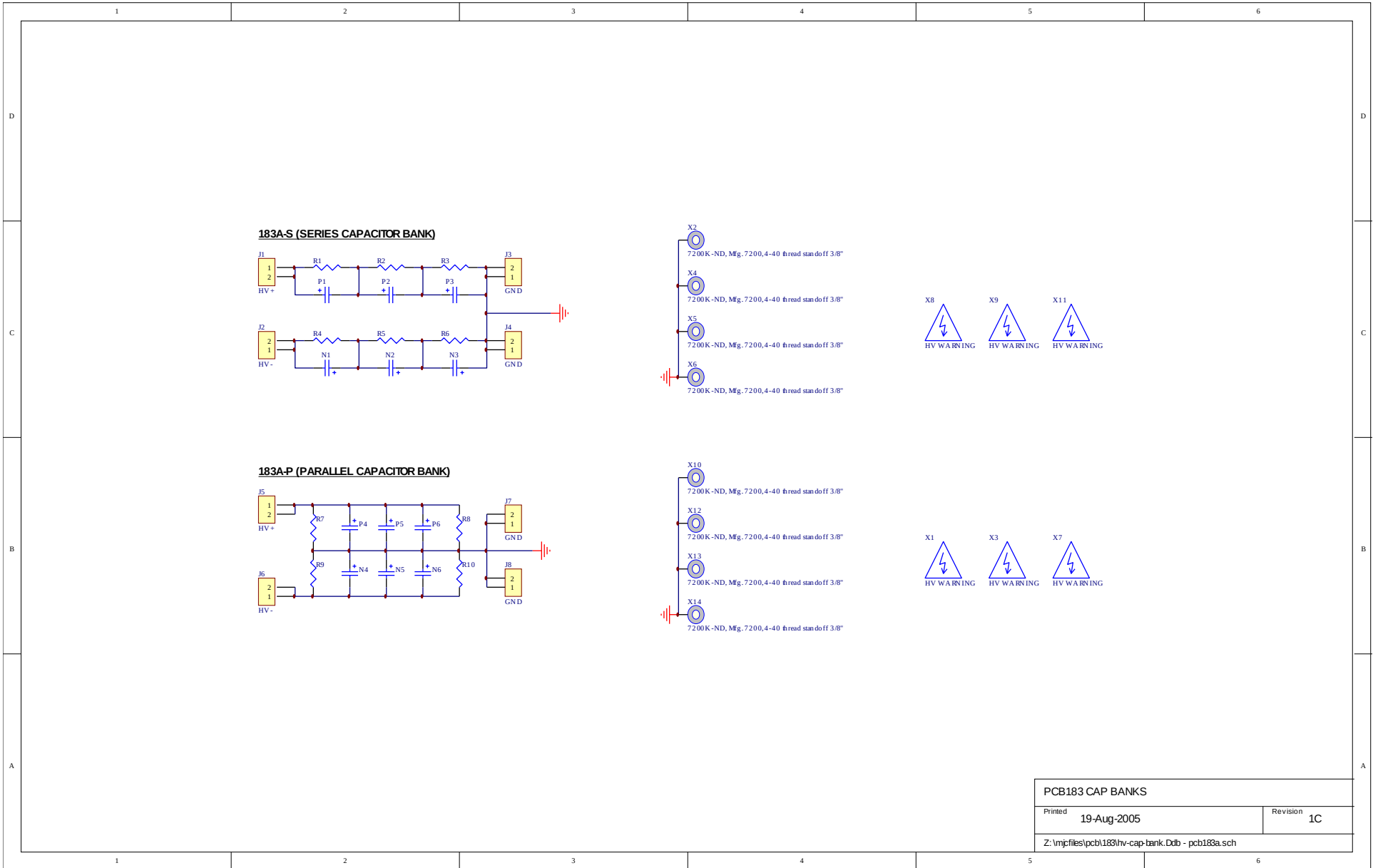




# PCB 158N - LOW VOLTAGE POWER SUPPLY, 3/3



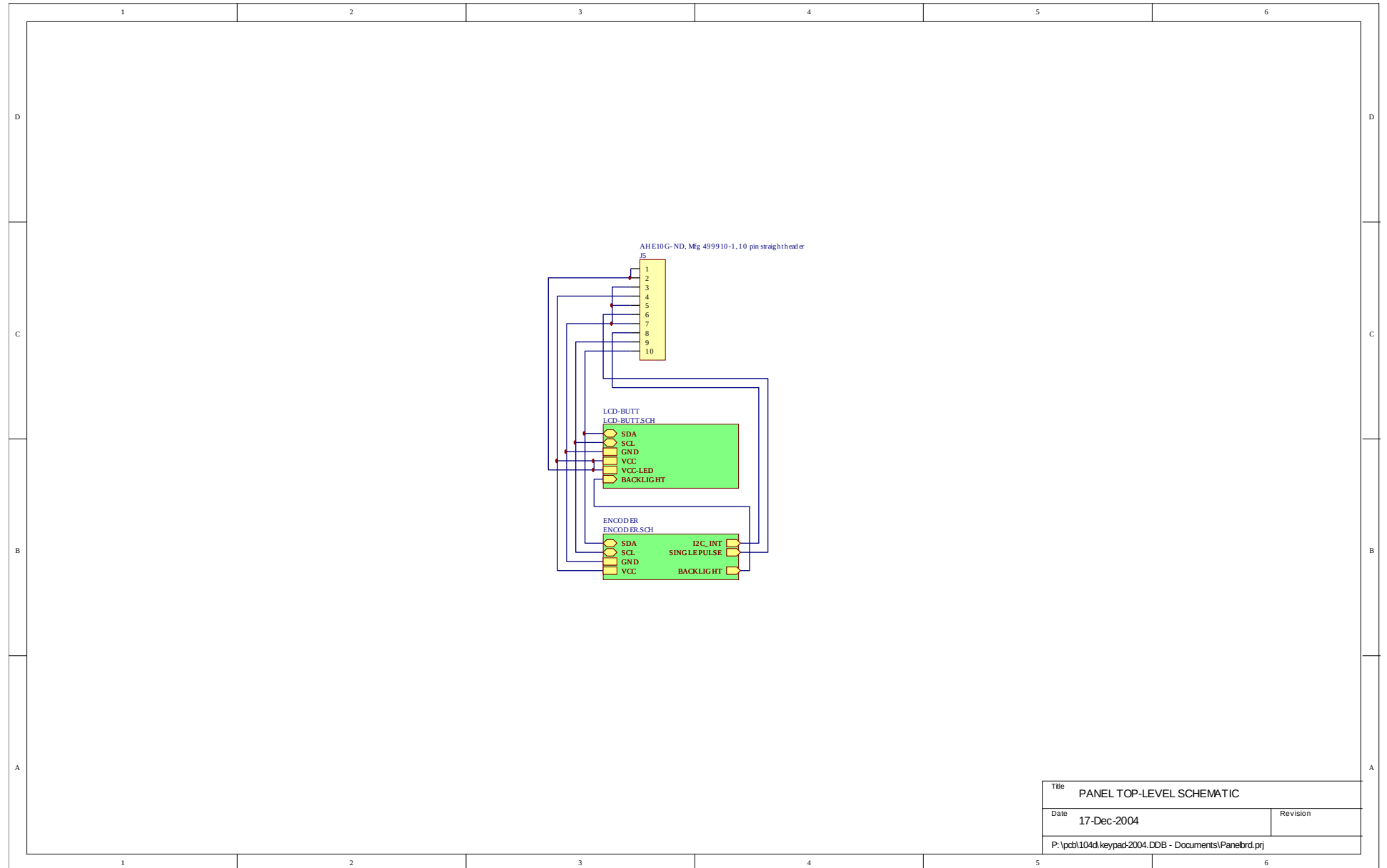
# PCB 183A-S AND 183A-P CAPACITOR BANKS



PCB183 CAP BANKS	
Printed 19-Aug-2005	Revision 1C
Z:\mprojfiles\pcb183\hv-cap-bank.Dtb - pcb183a.sch	

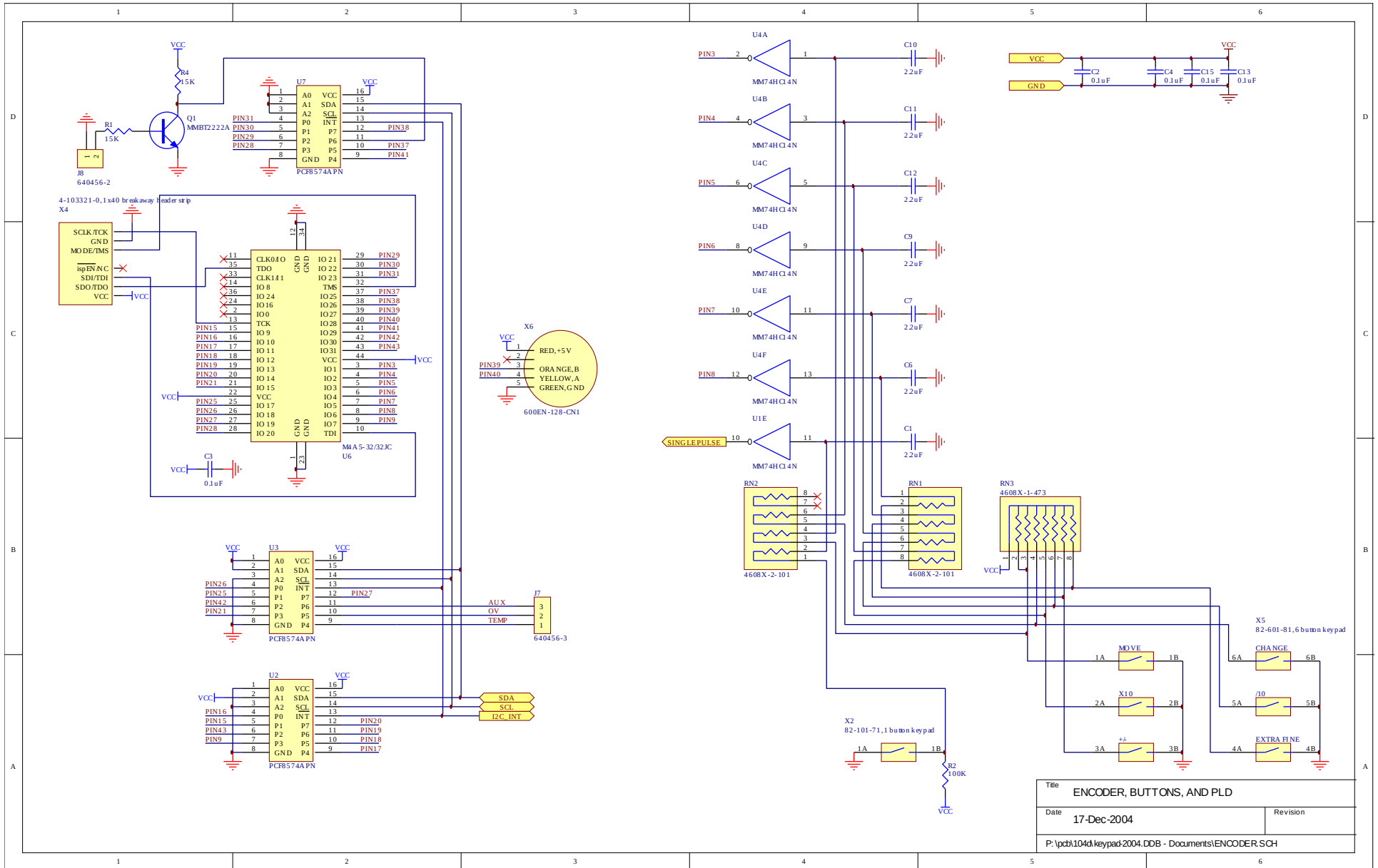


# PCB 104D - KEYPAD / DISPLAY BOARD, 1/3

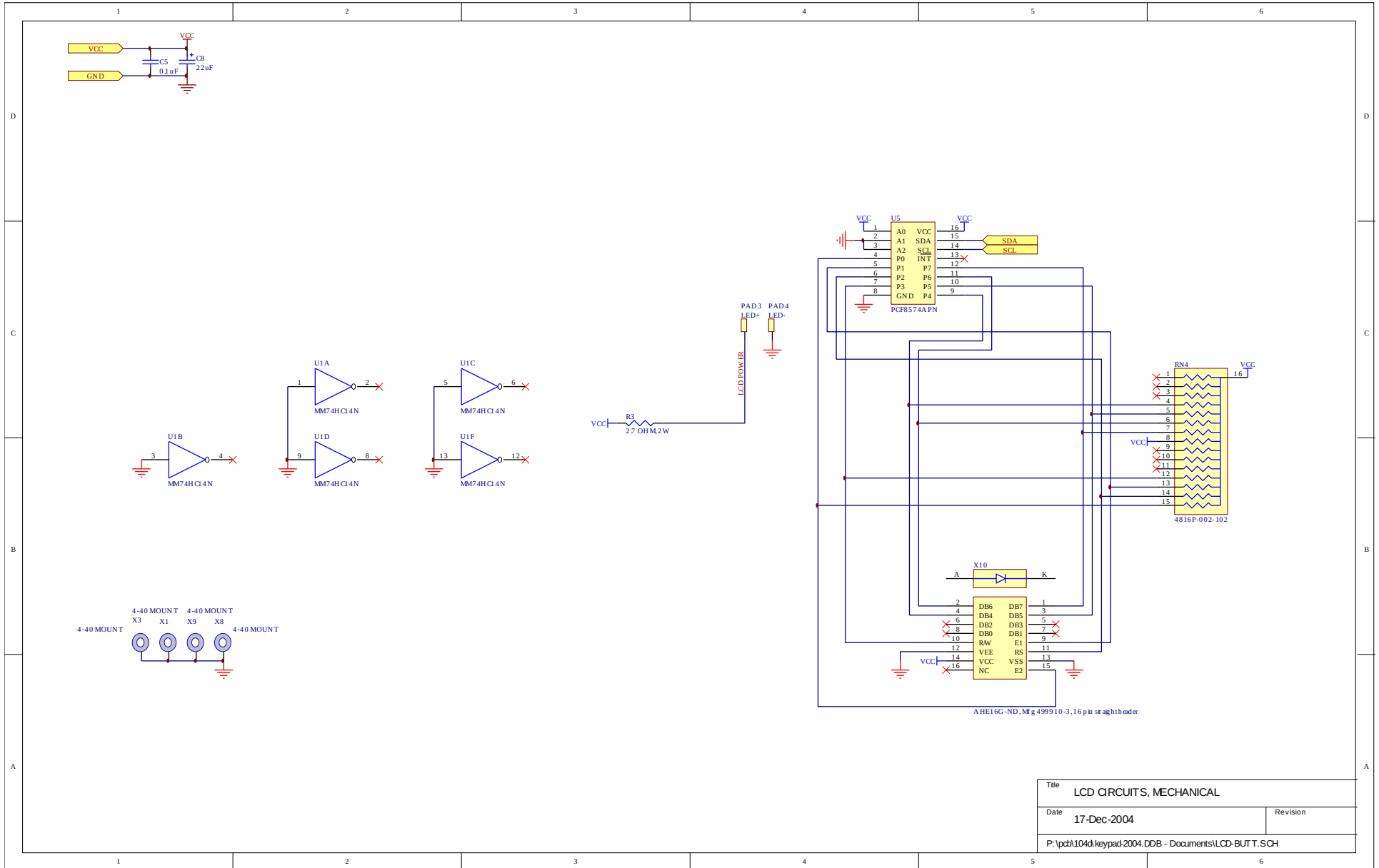


Title		PANEL TOP-LEVEL SCHEMATIC	
Date	17-Dec-2004	Revision	
P:\pcb\104d\keypad\2004.DDB - Documents\Panelbrd.prj			

# PCB 104D - KEYPAD / DISPLAY BOARD, 2/3

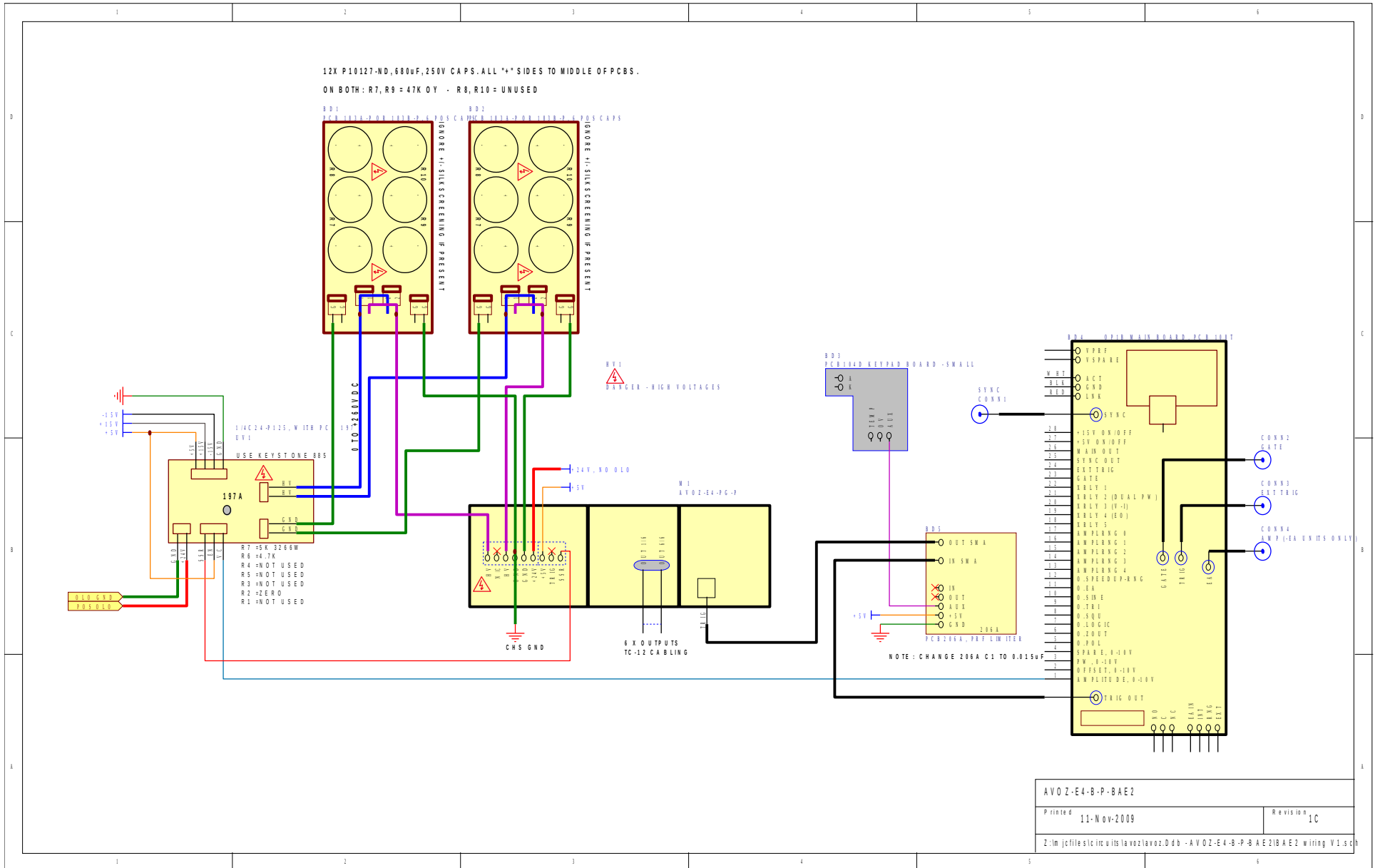


# PCB 104D - KEYPAD / DISPLAY BOARD, 3/3



Title		LCD CIRCUITS, MECHANICAL	
Date	17-Dec-2004	Revision	
P:\pcb\104d\keypad2004.DDB - Documents\LCD-BUTT.SCH			

# MAIN WIRING



PERFORMANCE CHECK SHEET