AVTECH ELECTROSYSTEMS LTD.

NANOSECOND WAVEFORM ELECTRONICS
SINCE 1975

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BOX 5120, LCD MERIVALE
OTTAWA, ONTARIO
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INSTRUCTIONS

MODEL AVOZ-D6-B-P-EMA

0 TO 750 VOLT, 150 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 dissembled, 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)
Fax: 800-561-1970 (USA & Canada) or +1-613-686-6679 (International)

E-mail: info@avtechpulse.com
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TABLE OF CONTENTS

Manual Reference: /fileserver1/officefiles/instructword/avoz/AVOZ-D6-B-P-EMA,ed1.odt.
Last modified February 29, 2024.

INTRODUCTION

The AVOZ-D6-B-P-EMA is a high performance, GPIB and RS232-equipped pulser generator that features ten identical outputs. These outputs can either be combined to drive a single low-impedance (5 Ohm) load, or can be used separately to drive multiple 50 Ohm loads simultaneously. This unique flexibility makes the AVOZ-D6-B-P-EMA ideal for testing high-current laser diode arrays, as well as testing multiple identical lower-current devices (for instance, production testing of attenuators).

The AVOZ-D6-B-P-EMA is capable of generating up to 750V on each of its ten identical outputs, at repetition rates up to 10 kHz (subject to the average amplitude limits). The pulse width is variable from 1 us to 10 us. Rise and fall times are fixed at less than 200 ns.

The ten outputs are all wired to the same point internally, and thus share common timing and amplitude controls. If the ten outputs are connected to a common 5 Ohm load, the AVOZ-D6-B-P-EMA can deliver up to 150 Amps of pulsed current to the load. If the ten outputs are connected to ten different 50 Ohm loads, each load will receive up to 15 Amps of pulsed current.

The maximum duty cycle, or average output amplitude, depends on the high-voltage power source used. The AVOZ-D6-B-P-EMA includes an internal high-voltage power supply that can deliver up to 75 Watts of average power to the load. This limits the maximum average output current to 0.1 Amps (or, equivalently, the average output voltage to 0.5 Volts). This power supply is controlled using the front-panel “AMP1” menu, or the “source:volt1” command.

The AVOZ-D6-B-P-EMA may also use an external user-supplied high-voltage power supply, allowing it to deliver up to 562 Watts of average power to the load. With this arrangement, the maximum average output current is 0.75 Amps (and the average output voltage limit is 3.75 Volts). The power supply voltage must be set to approximately 107% of the desired output amplitude. For example, to obtain a 750V pulse, the power supply needs to supply 800V, approximately. The DC power supply may be controlled directly from its front panel or computer interfaces, or it may be controlled from the AVOZ-D6-B-P-EMA using the “AMP2” menu or the “source:volt2” command. Varying the AMP2 setting from 0 to +750V will vary the voltage on the rear-panel “AMP” output from 0 to +7.5V. This voltage may be used to control the external DC power supply. The scale can be adjusted +/-20% by computer command to account for losses in the diodes and output transistors. Cabling to the power supply is the responsibility of the user.

The AVOZ-D6-B-P-EMA 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 pulse width can be set to follow an input trigger pulse width.

The AVOZ-D6-B-P-EMA 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.

ORIGINAL QUOTATION

Line item	Qty	Description
16442.01	1	**Model number:** AVOZ-D6-B-P-EMA **Description:** Customized High-Voltage Multi-Output Pulse Generator with IEEE-488.2 GPIB and RS-232 Computer Control Ports **Amplitude:** +50V to +750V, adjustable **Pulse width (FWHM):** 1 to 10 us, adjustable **Rise and fall times (20%-80%):** < 200 ns **PRF:** 1 Hz to 10 kHz, adjustable **Number of SMA output connectors:** 10 **Maximum peak current (total of all 10 outputs):** +150 Amps **Maximum peak current (on a single output connector):** +15 Amps **High voltage power sources:** Two. A low-power (75W) internal DC power supply is included, along with a rear-panel connector to connect to a user-supplied high-power DC power supply (562W). **Maximum average current (total of all 10 outputs), when using the internal DC power supply:** 0.1 Amps (for a maximum average power of 0.1A × 750V = 75 W). **Maximum average current (total of all 10 outputs), when using an external DC power supply:** 0.75 Amps (for a maximum average power of 0.75A × 750V = 562 W). **Power supply usage:** The voltages from the two power supplies (internal, and external if connected) will be combined in a “diode OR gate” circuit. That is, two high-voltage diodes will be used to allow the highest of the two voltages to pass to the pulse generator circuits. **Internal power supply control:** The front panel controls (AMP1 menu), or computer commands, may be used to control the internal DC power supply voltage. **External power supply control:** Two methods can be used to control the external DC power supply. The user may control its voltage directly, using the front-panel controls on the DC power supply, or its remote control ports (if present). Alternatively, Avtech will provide a second front-panel menu (AMP2), and computer commands, that can be used to control the DC voltage on a rear-panel BNC connector. As the AMP2 value is adjusted from 0 to +750V on the front panel of the Avtech pulser, the BNC voltage will vary from 0 to +7.5V. This voltage can be connected to the analog control input of the user-supplied DC power supply. The scale can be adjusted +/-20% by computer command to account for losses in the diodes and output transistors. Cabling to the power supply is the responsibility of the user. **External DC power supply specifications:** To operate average powers > 75 Watts, a user-supplied external DC power supply must be used. This power supply must be

Line item	Qty	Description
		capable of providing 0-800V, 0-800 mA. Possible power supplies include the Glassman FL1000F1.5 or the Matsusada AU-1R1200. Other manufacturers may also offer suitable models. **External DC power supply connector:** Two Pomona 6387-ST-T banana jacks (for sheathed banana plugs, rated at 1 kV / 15A) will be provided on the rear panel, to connect to the HV and GND outputs of the external DC power supply. Cabling to the power supply is the responsibility of the user. Other connectors can be provided if necessary (contact us to request a re-quote). **Polarity:** positive **Other:** similar to the standard AVOZ-D6-B-P described at: http://www.avtechpulse.com/laser/avoz-d6 http://www.avtechpulse.com/catalog/page_new_cat11_avoz-d_rev8.pdf

SPECIFICATIONS

Model[1]:	AVOZ-D6-B-P-EMA
Amplitude[2]: voltage (each output): peak current (sum of all outputs): peak current (single output):	 up to +750V up to +150A up to +15A
Average output voltage / current:	+0.5V / +0.1A (sum of all outputs), when using the internal DC power supply +3.75V / +0.75A (sum of all outputs), when using an external DC power supply
Minimum load impedance: (parallel combination of loads on all outputs)	5 Ω
Maximum number of 50Ω loads (if outputs used separately):	10
Load impedance notes:	The load must be non-inductive[3]
Pulse width:	1 us - 10 us
Rise time (20%-80%):	< 200 ns
Fall time (80%-20%):	< 200 ns
Maximum PRF:	10 kHz
Output impedance (approx.):	0.2 Ohms
Droop:	< 5%, at maximum pulse width and maximum amplitude
GPIB & RS-232 control[1]:	Standard on -B units. See http://www.avtechpulse.com/gpib for details.
LabView drivers:	Check http://www.avtechpulse.com/labview for availability and downloads
Propagation delay:	< 200 ns (Ext trig in to pulse out)
Jitter:	± 100 ps ± 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 ±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 connectors: (see above for quantity)	Mainframe:Multiple SMA female connectors, for connection to an equal number of separate 50 Ohm loads.
Number of output connectors:	10
Other connectors:	Trig, Gate, Sync: BNC
Power, temperature:	100 - 240 Volts, 50 - 60 Hz.
Dimensions:	Mainframe: 100 x 430 x 375 mm (3.9 x 17 x 14.8”), -OM10 output module: 43 mm x 66 mm x 107 mm (1.7” x 2.6” x 4.2”)
Chassis material:	Anodized aluminum, with blue plastic trim
Temperature range:	+5°C to +40°C

1) -B suffix indicates IEEE-488.2 GPIB and RS-232 control of pulse amplitude, pulse width, delay and PRF. (See http://www.avtechpulse.com/gpib).
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) 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.

REGULATORY NOTES

FCC PART 18

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

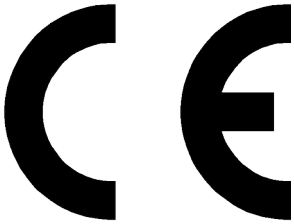
This instrument is enclosed in a rugged metal chassis and uses a filtered power entry module. The main output signal is provided on a shielded connector that is intended to be used with shielded coaxial cabling and a shielded load. Under these conditions, the interference potential of this instrument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

If interference is observed, check that appropriate well-shielded cabling is used on the output connectors. Contact Avtech (info@avtechpulse.com) 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) if you require assistance.

EC DECLARATION OF CONFORMITY



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declare that this pulse generator meets the intent of Directive 2004/108/EG 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)

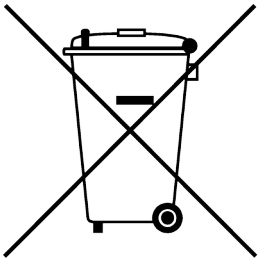
This instrument is exempt from Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment. Specifically, Avtech instruments are considered "Monitoring and control instruments" (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 with 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.



AC POWER SUPPLY REGULATORY NOTES

This instrument converts the AC input power to the +24V DC voltage that powers the internal circuitry of this instrument using a Tamura AAD130SD-60-A switching power supply. According to the manufacturer, the Tamura AAD130SD-60-A has the following certifications:

UL60950-1
IEC60950 -1
CSA C22.2 No. 60950- 1
EN60950 -1

and is compliant with:

EN61000-3-2
EN61000-4-2 Level 2
EN61000-4-2 Level 3 (Air Only)
EN61000-4-4 Level 3
EN61000-4-5 Level 3
EN61000-4-11
CISPR 11 and 22 FCC Part 15 Class B (conducted)

FIRMWARE LICENSING

Instruments with firmware versions 5.00 or higher use open-source software internally. Some of this software requires that the source code be made available to the user as a condition of its licensing. This source code is distributed on the device itself. To access it, log in as user “source” with password “source”. The source files are provided in this user's home directory, and are accessible using standard viewing and file transfer tools (such as vim, sz, and scp).

Earlier firmware versions do not contain any open source software.

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. Confirm that a power cord, a GPIB cable, and two instrumentation manuals (this manual and the “Programming Manual for -B Instruments”) are with the instrument. If the instrument has been damaged, file a claim immediately with the company that transported the instrument.

POWER RATINGS

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

The maximum power consumption is 150 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	370001-E01
Australia, New Zealand	AS 3112:2000, 230-240V, 50 Hz	-AC01	Qualtek	374003-A01
Continental Europe, Korea, Indonesia, Russia	European CEE 7/7 “Schuko” 230V, 50 Hz	-AC02	Qualtek	364002-D01
North America, Taiwan	NEMA 5-15, 120V, 60 Hz	-AC03	Qualtek	312007-01
Switzerland	SEV 1011, 230V, 50 Hz	-AC06	Qualtek	378001-E01
South Africa, India	SABS 164-1, 220-250V, 50 Hz	-AC17	Volex	2131H 10 C3
Japan	JIS 8303, 100V, 50-60 Hz	-AC18	Qualtek	397002-01
Israel	SI 32, 220V, 50 Hz	-AC19	Qualtek	398001-01
China	GB 1002-1, 220V, 50 Hz	-AC22	Volex	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:

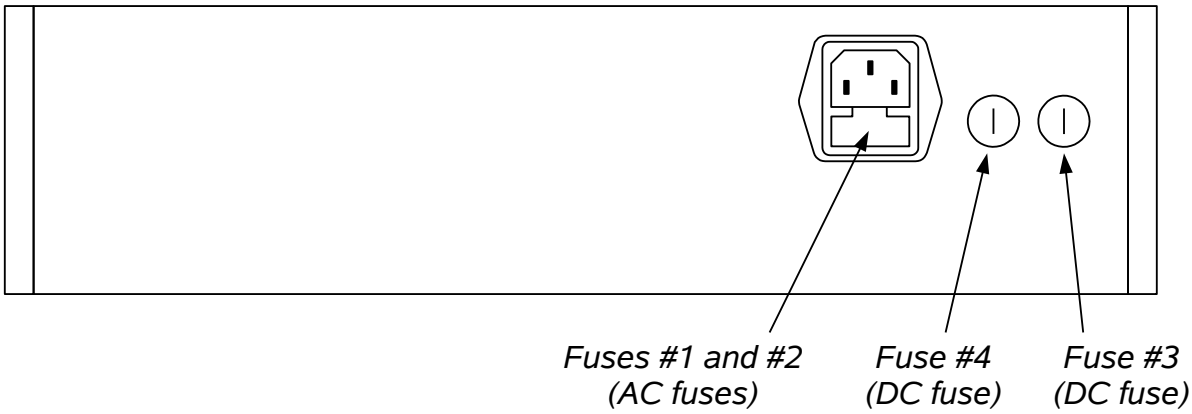
1. indoor use;
2. altitude up to 2 000 m;
3. temperature 5 °C to 40 °C;
4. maximum relative humidity 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C;
5. Mains supply voltage fluctuations up to ±10 % of the nominal voltage;
6. no pollution or only dry, non-conductive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

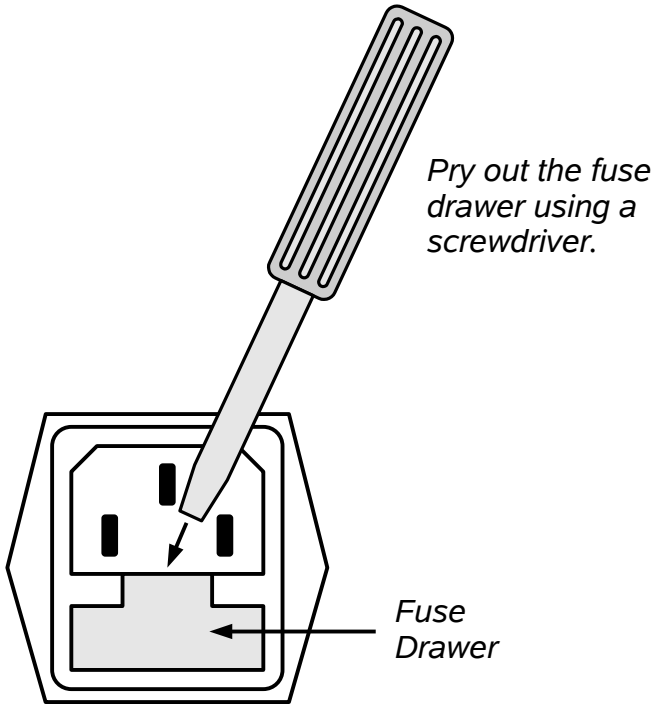
FUSES

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

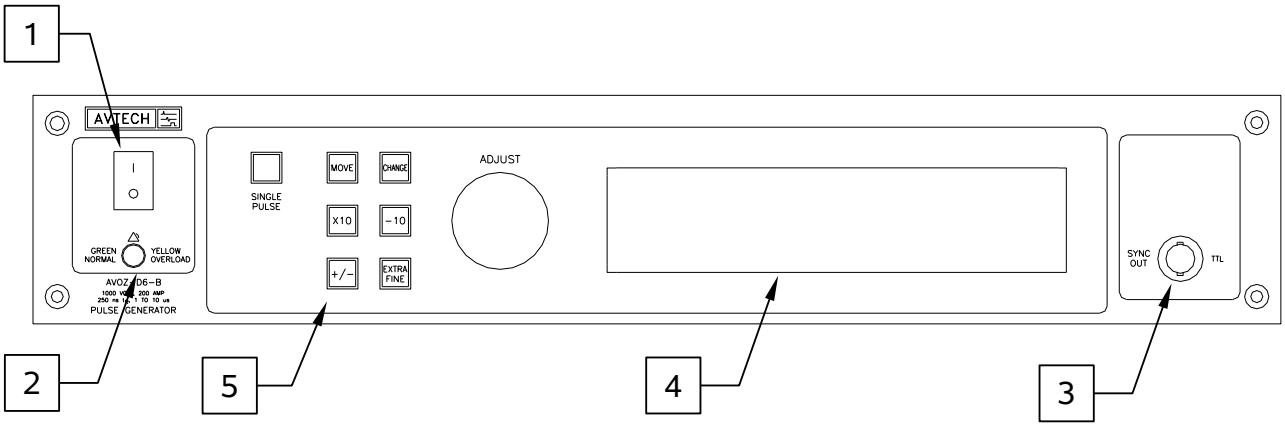
The following table lists the required fuses:

Fuses	Nominal Mains Voltage	Rating	Case Size	Recommended Replacement Part	
				Littelfuse Part Number	Digi-Key Stock Number
#1, #2 (AC)	115 V	1.6A, 250V, Time-Delay	5×20 mm	021801.6HXP	F2424-ND
	230 V	0.8A, 250V, Time-Delay	5×20 mm	0218.800HXP	F2418-ND
#3 (DC)	N/A	1.0A, 250V, Time-Delay	5×20 mm	0218001.HXP	F2419-ND
#4 (DC)	N/A	6.3A, 250V, Time-Delay	5×20 mm	021806.3HXP	F2428-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 is normally a delay of 5-10 seconds before anything is shown on the main display.

   If the main menu does not appear after 30 seconds, turn off the instrument and leave it off for at least 60 seconds before applying power again.

   Allow 30 seconds before re-powering an instrument that has been switched off. If the power is switched more frequently than that, the turn-on delay may be longer (up to 20 seconds) as the internal software performs filesystem checks.

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.

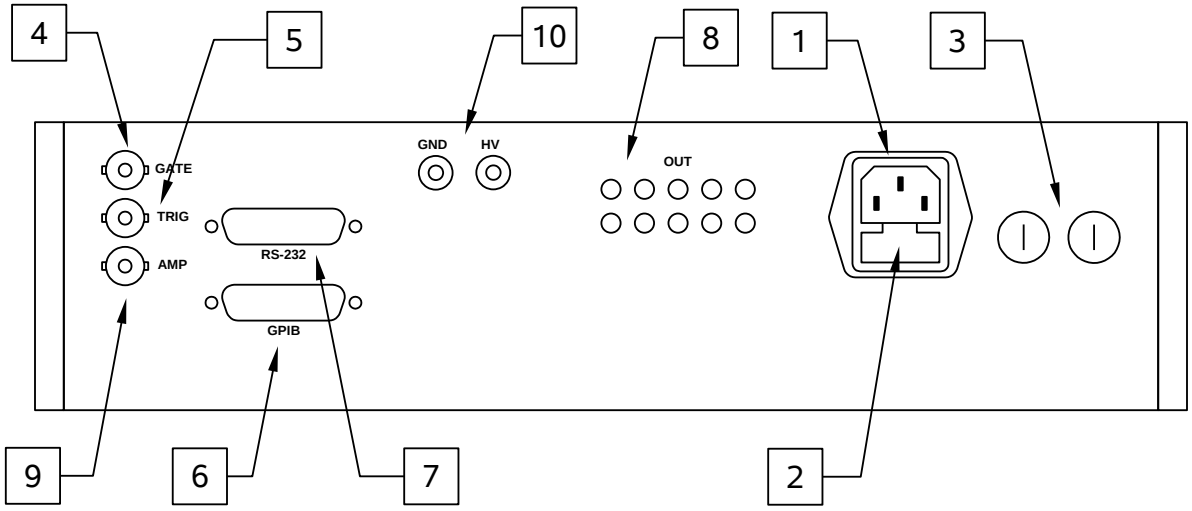
3. SYNC OUT. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal leads (or lags) the main output by a duration set by the "DELAY" controls and has an approximate amplitude of +3 Volts to R_L > 1kΩ with a pulse width of approximately 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 kΩ resistor. When set to active low mode, this input is pulled-up to +5V by a 1 kΩ 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 kΩ. (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) 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.

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 CONNECTORS. These ten SMA connectors provide the main output signals. These ten connectors are all wired to the same point internally.

   ⚠ Caution: Voltages as high as 750V may be present on the center conductors of these output connectors. Avoid touching these conductors. Connect to these connectors using standard coaxial cable, to ensure that the center conductors are not exposed.

9. AMP Connector. The voltage on this connector is controlled by the front-panel “AMP2” menu or the “source:volt2” command. Varying the AMP2 setting from 0 to +750V will vary the voltage on this connector from 0 to +7.5V. This voltage may be used to control an external DC power supply. The scale can be adjusted +/-20% by computer command to account for losses in the diodes and output transistors. Cabling to the power supply is the responsibility of the user.

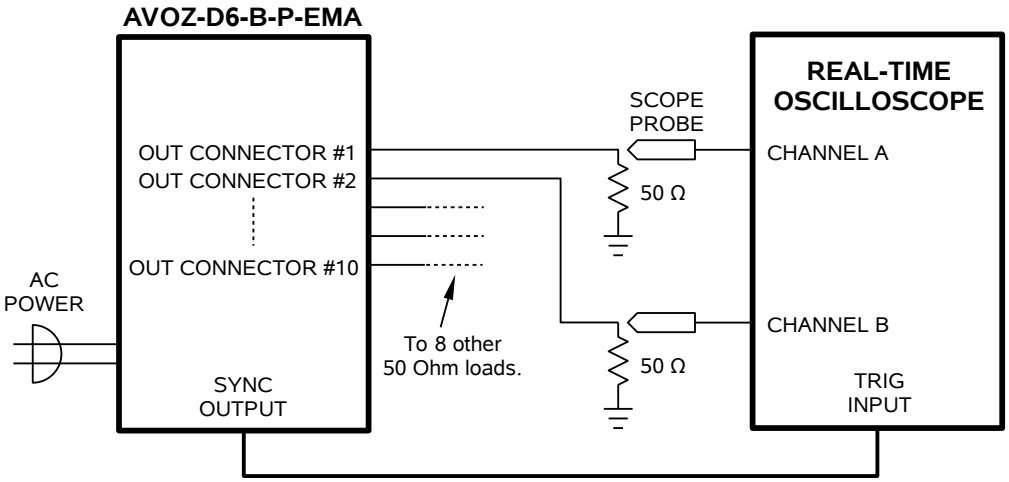
10. HV and GND Connectors. If an external high-voltage DC power supply is used, it should be connected to these safety banana connectors. The DC power supply may be controlled directly from its front panel or computer interfaces, or it may be controlled from the AVOZ-D6-B-P-EMA using the “AMP” output connector.

    ⚠ Caution: Voltages as high as 815V may be present on the center conductors of these connectors. Avoid touching these conductors. Connect to these connectors using shrouded safety cable, to ensure that the center conductors are not exposed.

GENERAL INFORMATION

BASIC TEST ARRANGEMENT, LOW AVERAGE POWER

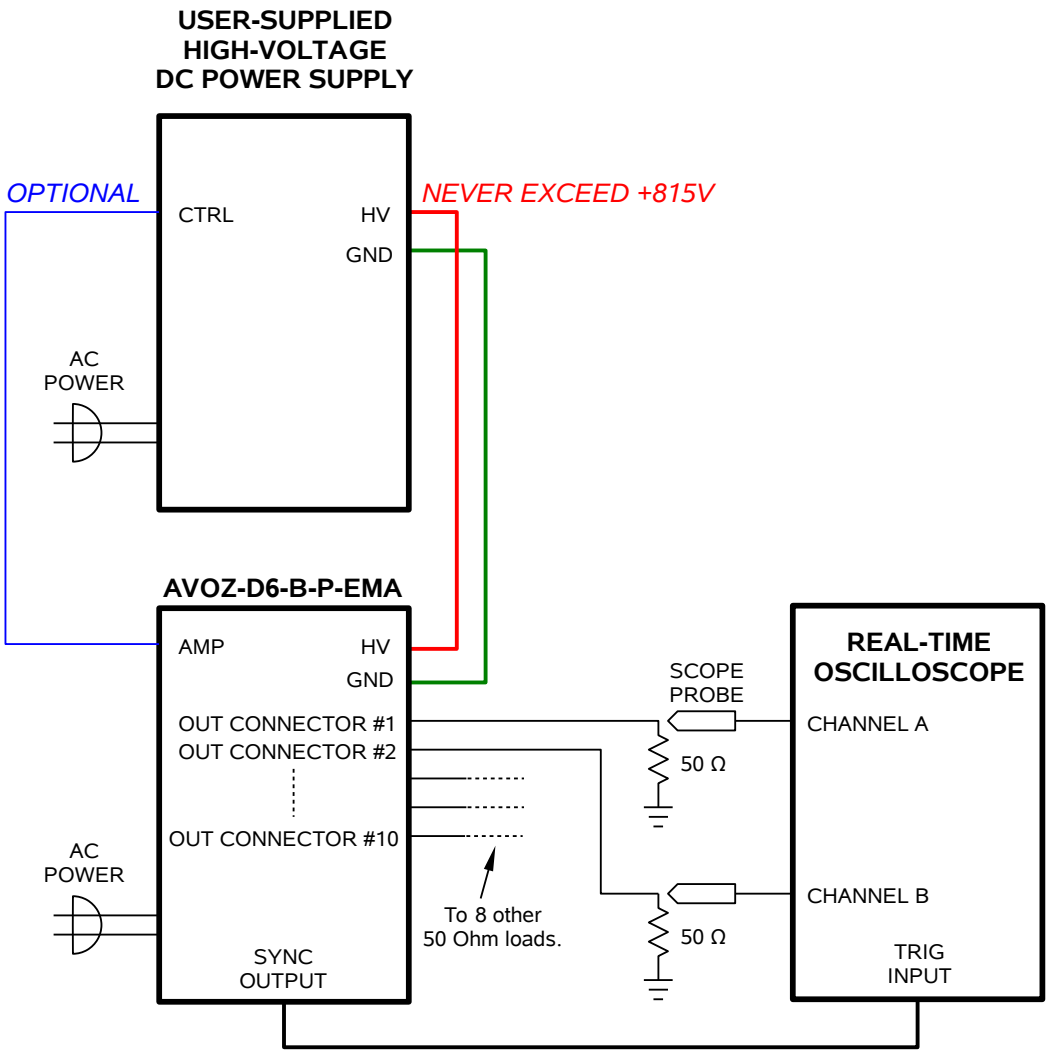
If the average output current (summed over all ten outputs) is less than 0.1 Amps, the internal high-voltage power supply may be used, and the pulser may connected as shown below:



In this arrangement, the output amplitude is controlled using the front-panel “AMP1” menu, or the “source:volt1” command.

BASIC TEST ARRANGEMENT, HIGH AVERAGE POWER

If the average output current (summed over all ten outputs) is greater than 0.1 Amps (up to a maximum of 0.75A), a user-supplied external high-voltage DC power supply must be used, and the pulser may connected as shown below:



The DC power supply may be controlled directly from its front panel or computer interfaces, or it may be controlled from the AVOZ-D6-B-P-EMA using the “AMP2” menu or the “source:volt2” command. Varying the AMP2 setting from 0 to +750V will vary the voltage on the rear-panel “AMP” output from 0 to +7.5V. This voltage may be used to control the external DC power supply. The scale can be adjusted +/-20% by computer command to account for losses in the diodes and output transistors. Cabling to the power supply is the responsibility of the user.

Even in the “AMP” output is not used to control the DC power supply, the user should set the “AMP2” menu or the “source:volt2” command to the value of the desired output voltage. This allows the internal software to calculate the appropriate safety limits and warn the user if the settings are not safe.

The user must ensure that the external power supply never provides more than +815V, or the AVOZ-D6-B-P-EMA may be damaged.

POWER SUPPLY NOTES

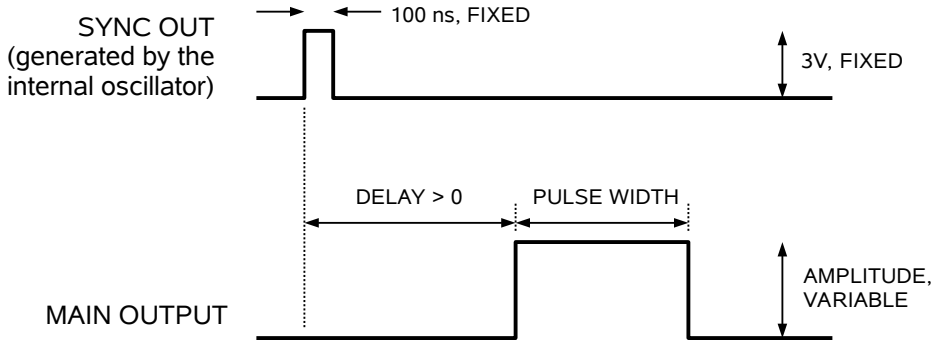
The voltages from the two power supplies (internal and external) are combined internally in a “diode OR gate” circuit. That is, two high-voltage diodes are used to allow the highest of the two voltages to pass to the pulse generator circuits.

Normally, one of the two power supplies will be set to zero.

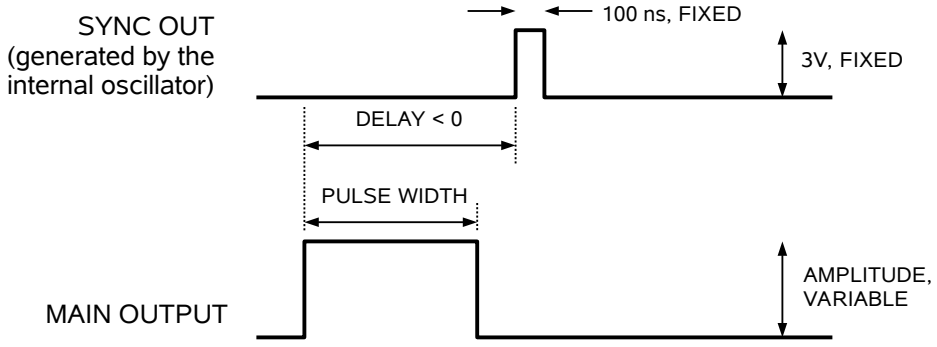
BASIC PULSE CONTROL

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.

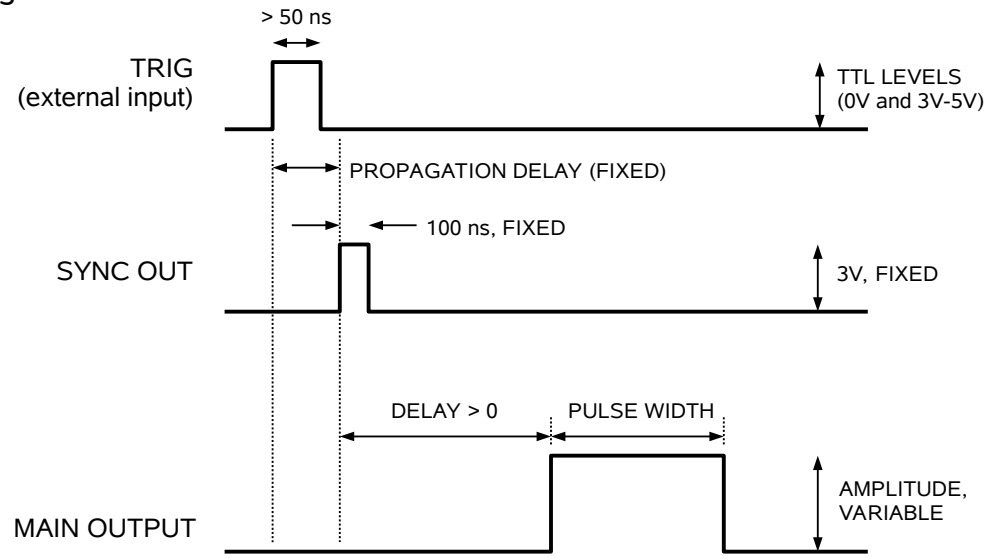
These pulses are illustrated below, assuming internal triggering and a positive delay:



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

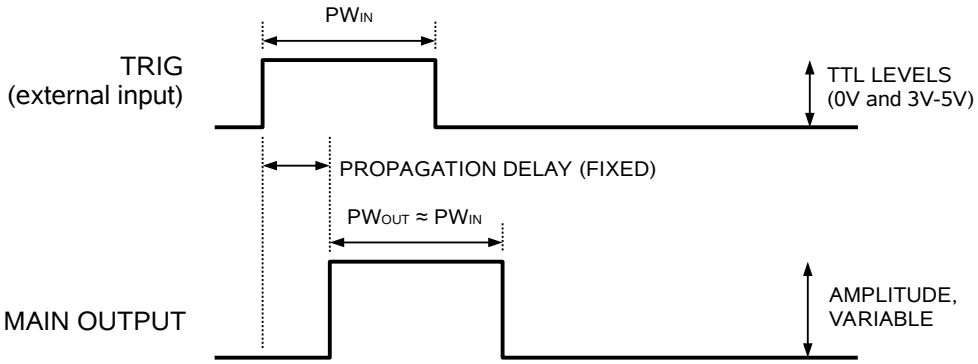


The next figure illustrates the relationship between the signal when an external TTL-level trigger is used:



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

The last figure illustrates the relationship between the signal when an external TTL-level trigger is used in the PW_{IN}=PW_{OUT} mode. In this case, the output pulse width equals the external trigger's pulse width (approximately), and the delay circuit is bypassed:



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.)

PULSE WIDTH MODES

This instrument has two pulse width modes:

- Normal: the instrument controls the output pulse width.
- $PW_{IN}=PW_{OUT}$: the output pulse width equals the pulse width of the trigger signal on the “TRIG” connector. The instrument must be in the external trigger mode.

These modes can be selected using the front panel pulse width 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 DECAY TIME

When reducing the amplitude, it may take several tens of seconds for the amplitude to fall to the set amplitude as the internal capacitor banks discharge.

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 10 kHz or at duty cycles resulting in an excessive average output power. Keep these points in mind:

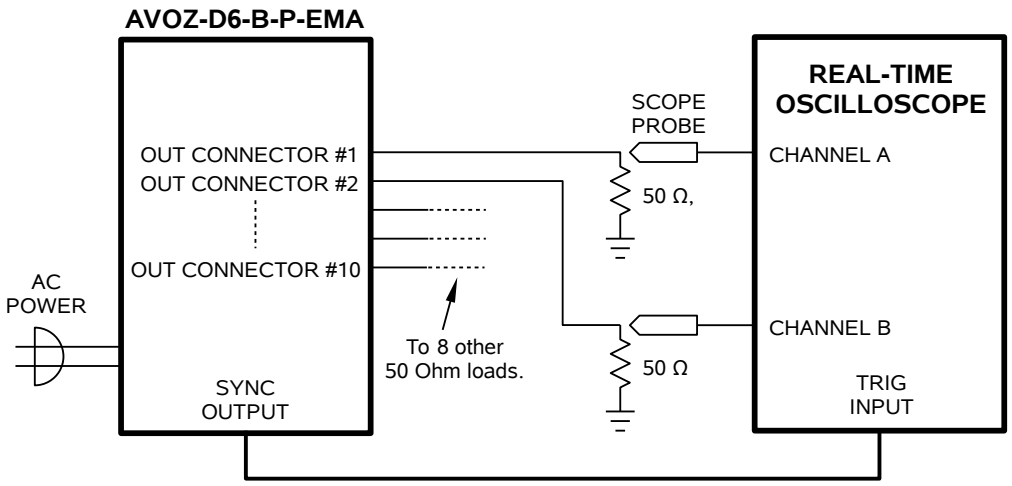
- The PRF must not exceed 10 kHz.
- Never apply more than +815V to the rear-panel HV connector.
- When using the internal high-voltage power supply, the maximum average output current must not exceed 0.1 Amps.
- When using the external high-voltage power supply, the maximum average output current must not exceed 0.75 Amps.

The temperature of the output circuitry is monitored by the instrument. If the internal temperature becomes too high, the output will be turned off and a warning will be triggered.

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.

2. Connect a 50 Ohm load to each of the ten outputs, using coaxial cabling. Connect one or more oscilloscope probes to the loads of your choice (all ten loads should show the same waveform).

3. Set the oscilloscope to trigger externally with the vertical setting at 200 Volts/div and the horizontal setting at 2 us/div.

4. Turn on the AVOZ-D6-B-P-EMA. The main menu will appear on the LCD.

5. To set the AVOZ-D6-B-P-EMA 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.

6. 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.

7. 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.

8. At this point, nothing should appear on the oscilloscope.

9. 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.

10. 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 +500V.

    c) Observe the oscilloscope. You should see 5 us wide, 500V pulses.

    d) Rotate the ADJUST knob. The amplitude as seen on the oscilloscope should vary.

    e) Press CHANGE to return to the main menu.

11. Repeat step 10, but set the amplitude to zero.

12. 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 10 Hz	(sets the frequency to 10 Hz)
pulse:width 1 us	(sets the pulse width to 1 us)
pulse:delay 2 us	(sets the delay to 2 us)
volt1 200	(sets the amplitude to 200 V, using the internal power supply)
volt2 0	(the external power supply is not used in this example)
output on	(turns on the output)

If the external power supply is used, this sequence would be more appropriate:

*rst	(resets the instrument)
trigger:source internal	(selects internal triggering)
frequency 10 Hz	(sets the frequency to 10 Hz)
pulse:width 1 us	(sets the pulse width to 1 us)
pulse:delay 2 us	(sets the delay to 2 us)
volt1 0	(the internal power supply is not used in this example)
volt2 750	(this generates +7.5V on the rear-panel AMP connector. This may be used to control the external power supply.)
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)

```
volt1 200                   (sets the amplitude to 200 V,
                             using the internal power supply)
volt2 0                     (the external power supply is not used
                             in this example)
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 internal triggering)
pulse:width 1 us            (sets the pulse width to 1 us)
pulse:delay 2 us            (sets the delay to 2 us)
volt1 200                   (sets the amplitude to 200 V,
                             using the internal power supply)
volt2 0                     (the external power supply is not used
                             in this example)
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.)

Keyword	Parameter	Notes
LOCAL		
OUTPut:		
:[STATe]	<boolean value>	
:PROTection		
:TRIPped?		[query only]
REMOTE		
[SOURce]:		
:FREQuency		
[:CW | FIXed]	<numeric value>	
[SOURce]:		
:PULSe		
:PERiod	<numeric value>	
:WIDTh	<numeric value> | EXTernal	
:DCYCle	<numeric value>	
:HOLD	WIDTh | DCYCle	

```
        :DELay                  <numeric value>
        :GATE
            :TYPE               ASYNC | SYNC
            :LEVel              HIgh | LOw
[SOURce]:
    :VOLTage1
        [:LEVel]
            [:IMMediate]
                [:AMPLitude]    <numeric value>
    :VOLTage2
        [: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]
```

CALIBRATION ADJUSTMENTS - SOFTWARE PROCEDURES

INTERNAL HIGH VOLTAGE POWER SUPPLY

The internal high voltage power supply is adjusted at the factory, but it may be adjusted in the field if required.

The following procedure is suggested:

1. Connect the pulse generator to a computer using the GPIB or RS232 ports.

2. Turn on the pulse generator, and set the time controls (frequency, delay, pulse width) to typical values.

3. Turn on the outputs.

4. Set the output amplitude to 80% of the maximum (i.e., 750V × 80% = 600V).

5. Observe the voltage across the load. For example, suppose it is actually 595V.

6. Send the measured value to the instrument using the following command:

   diag:ampl:cal1 595

   Note the “1” channel suffix. This specifies the internal power supply, rather than the external power suffix.

   The internal software compares the supplied measured value to the programmed value, and adjusts the internal calibration data to null out any differences.

7. Observe the voltage across the load again. The amplitude setting should now agree with the measured value.

EXTERNAL HIGH VOLTAGE POWER SUPPLY

Varying the AMP2 setting from 0 to +750V will vary the voltage on the rear-panel “AMP” output from 0 to +7.5V. This voltage may be used to control the external DC power supply. The scale can be adjusted +/-20% by computer command to account for losses in the diodes and output transistors.

The following procedure is suggested:

1. Connect the pulse generator to a computer using the GPIB or RS232 ports.

2. Turn on the pulse generator, and set the time controls (frequency, delay, pulse width) to typical values.

3. Turn on the outputs.

4. Set the output amplitude to 80% of the maximum (i.e., 750V × 80% = 600V).

5. Observe the voltage across the load. For example, suppose it is actually 595V.

6. Send the measured value to the instrument using the following command:

   diag:ampl:cal2 595

   Note the “2” channel suffix. This specifies the external power supply, rather than the internal power suffix.

   The internal software compares the supplied measured value to the programmed value, and adjusts the internal calibration data to null out any differences.

7. Observe the voltage across the load again. The amplitude setting should now agree with the measured value.

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.

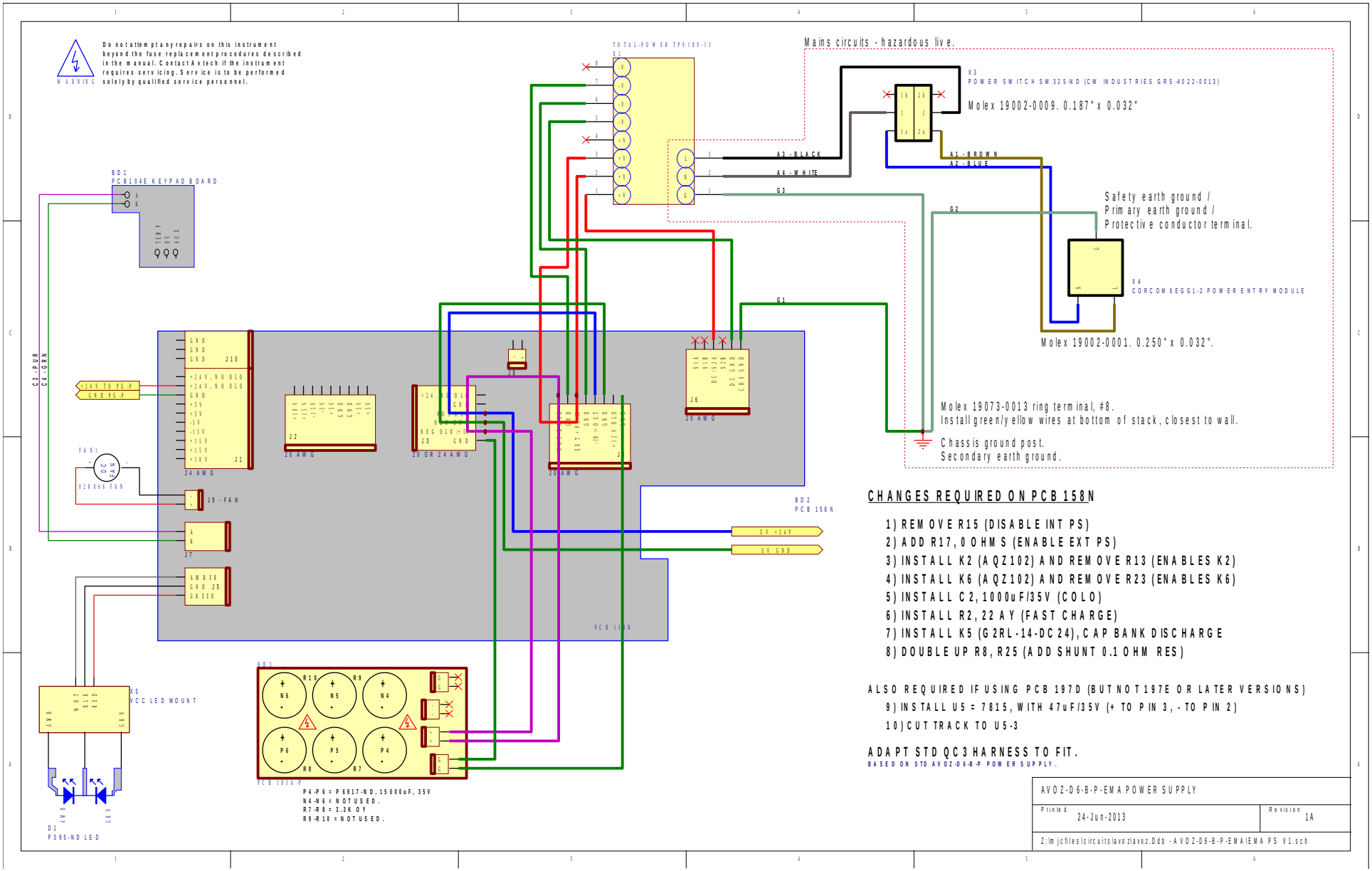
On occasion, one or more of the four rear-panel fuses may require replacement. All fuses can be accessed from the rear panel. See the “FUSES” section for details.

CLEANING

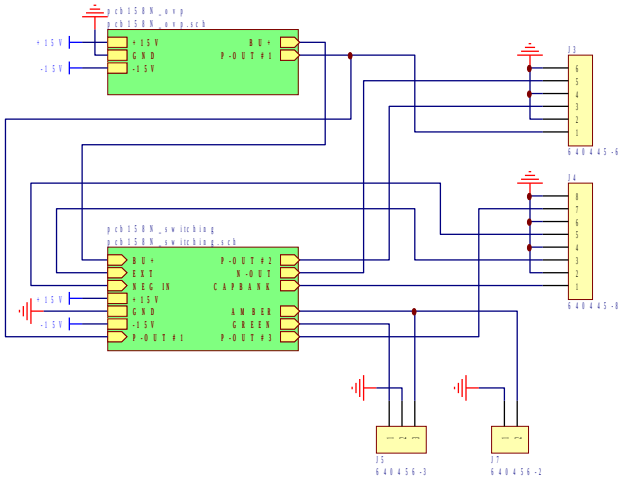
If desired, the interior of the instrument may be cleaned using compressed air to dislodge any accumulated dust. (See the “TOP COVER REMOVAL” section for instructions on accessing the interior.) No other cleaning is recommended.

WIRING DIAGRAMS

WIRING OF AC POWER

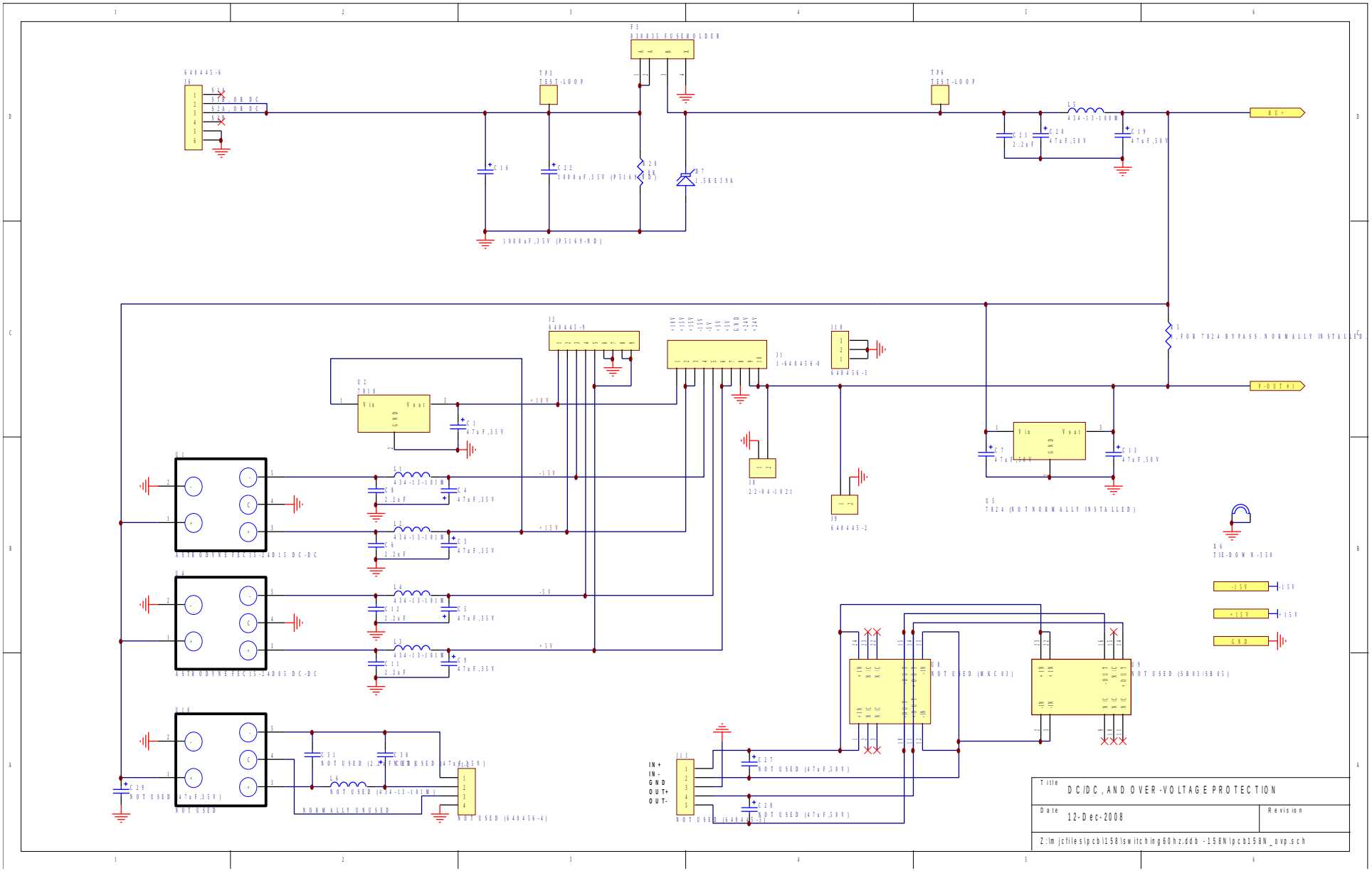


PCB 158N - LOW VOLTAGE POWER SUPPLY, 1/3

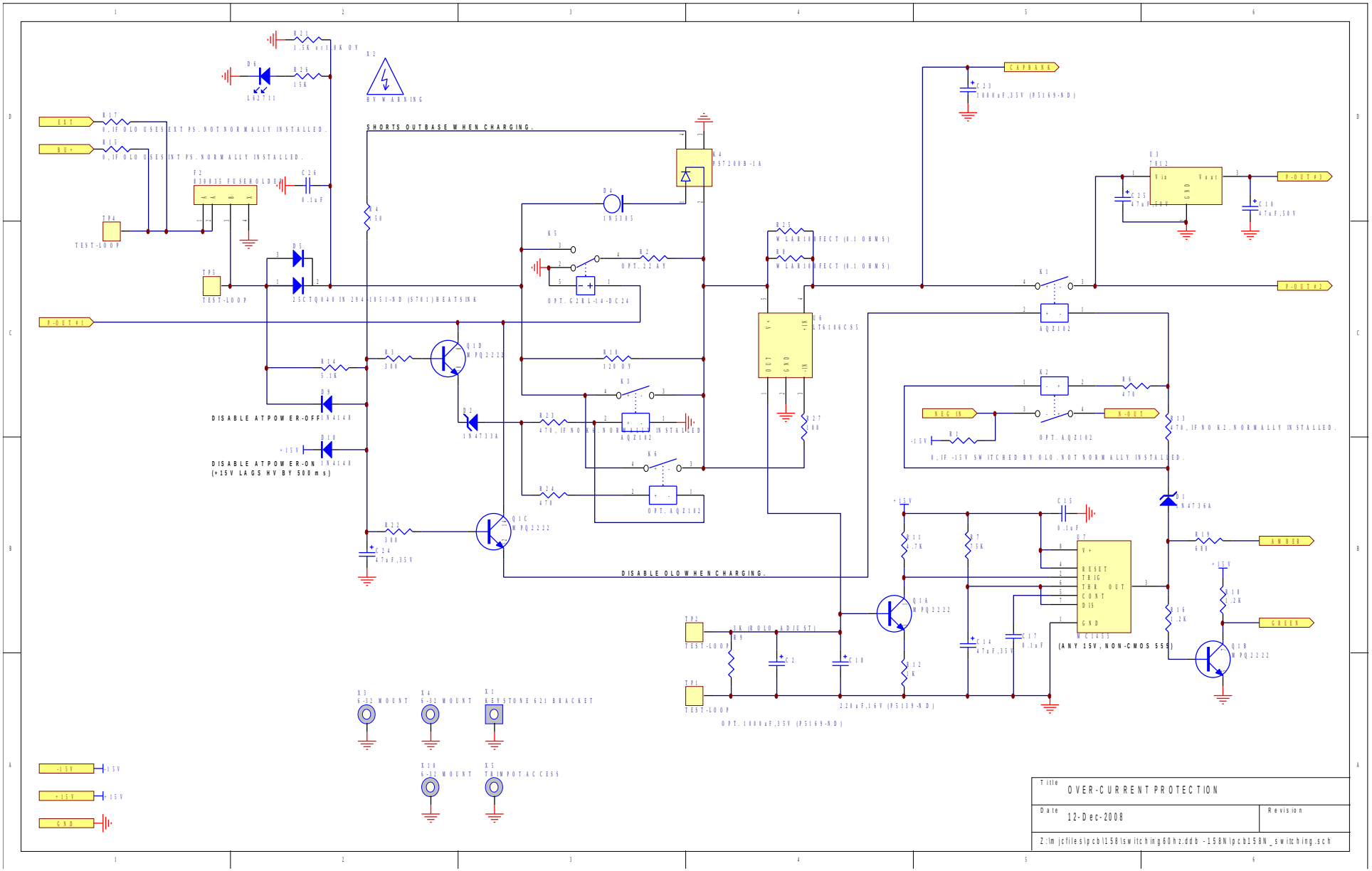


Title	LOW VOLTAGE DC/DC POWER SUPPLY
Date	12-Dec-2008
Revision	
Z:\mjcfiles\pcb158\switching60hz.ddb - 158N\pcb158N.sch	

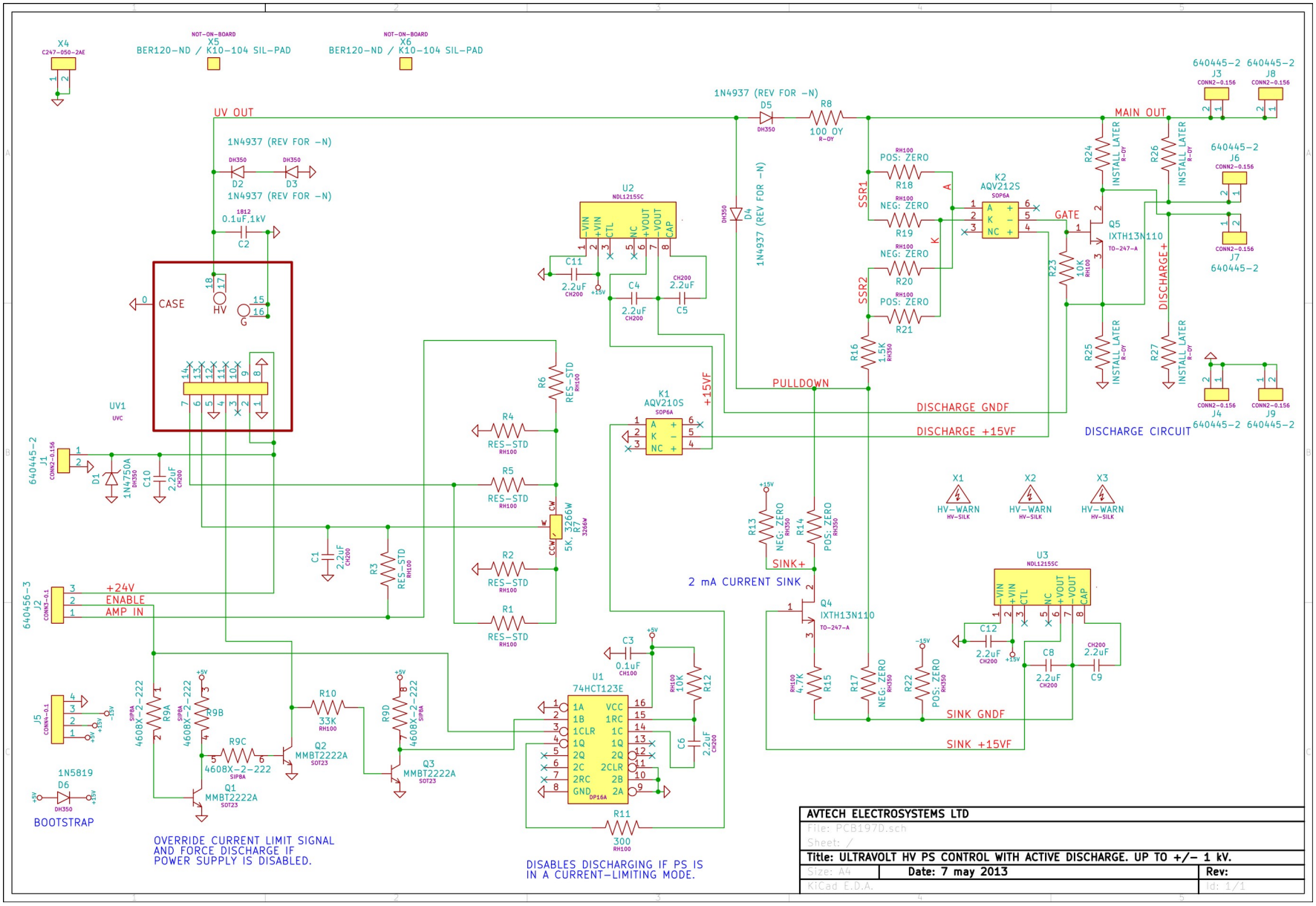
PCB 158N - LOW VOLTAGE POWER SUPPLY, 2/3



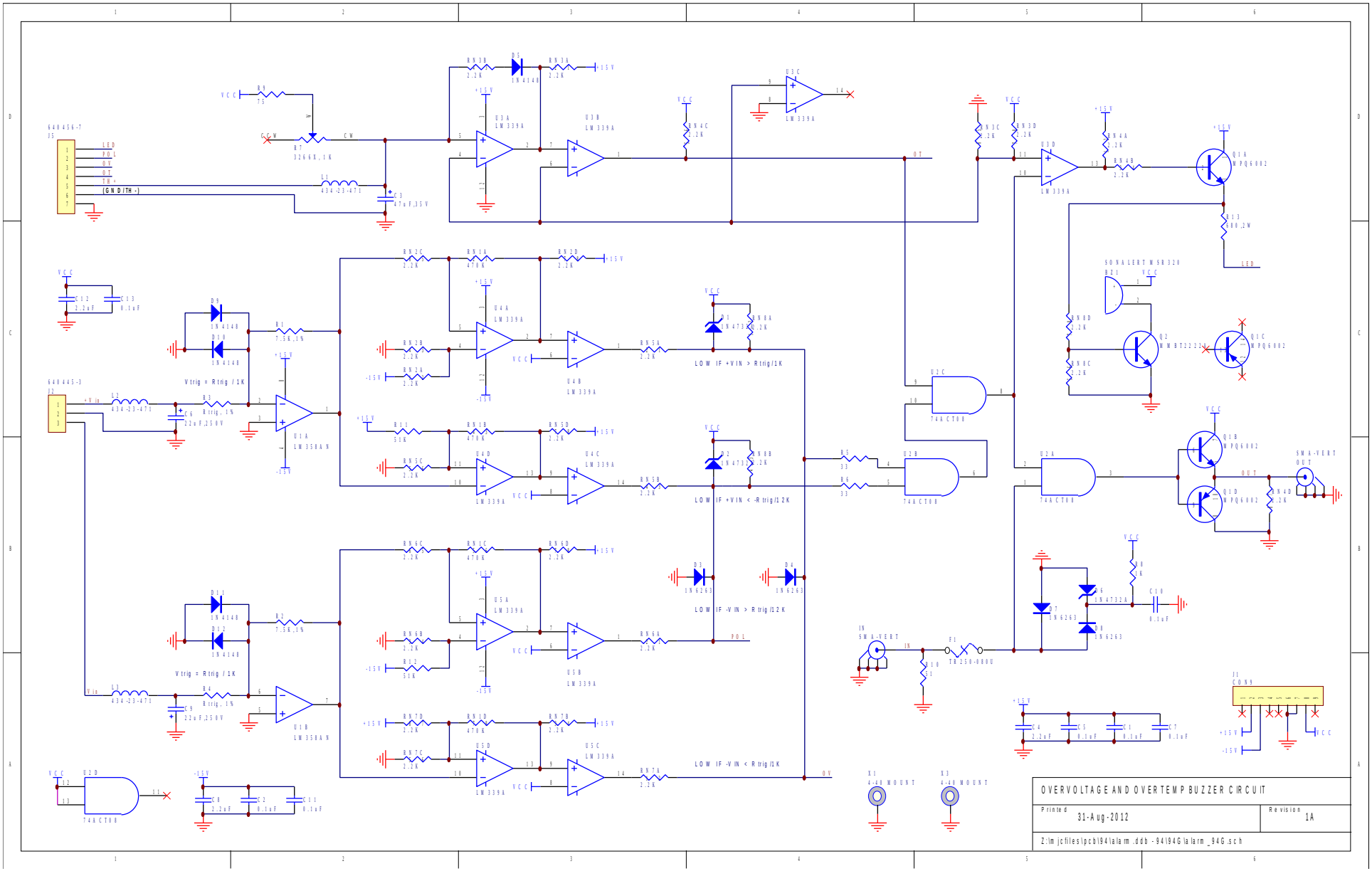
PCB 158N - LOW VOLTAGE POWER SUPPLY, 3/3



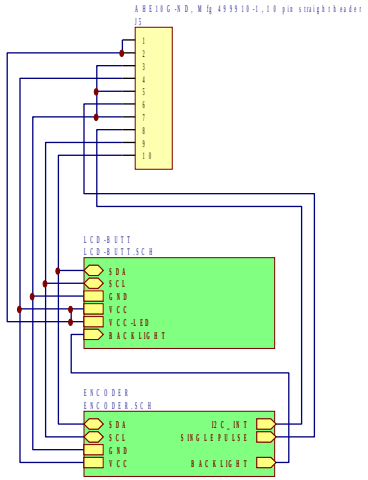
PCB 197D - HIGH VOLTAGE DC POWER SUPPLY



PCB 94G - ALARM BOARD

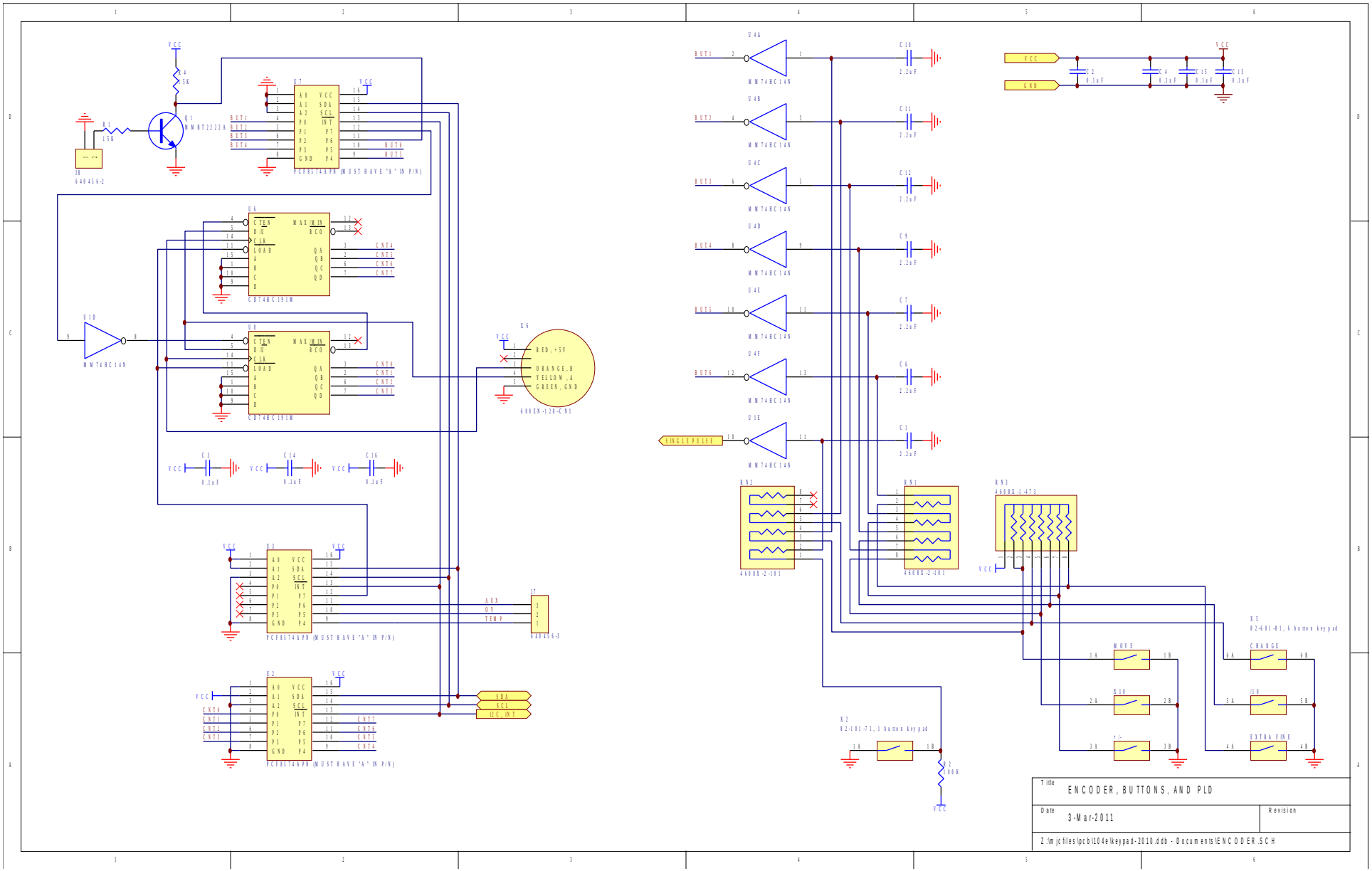


PCB 104E - KEYPAD / DISPLAY BOARD, 1/3

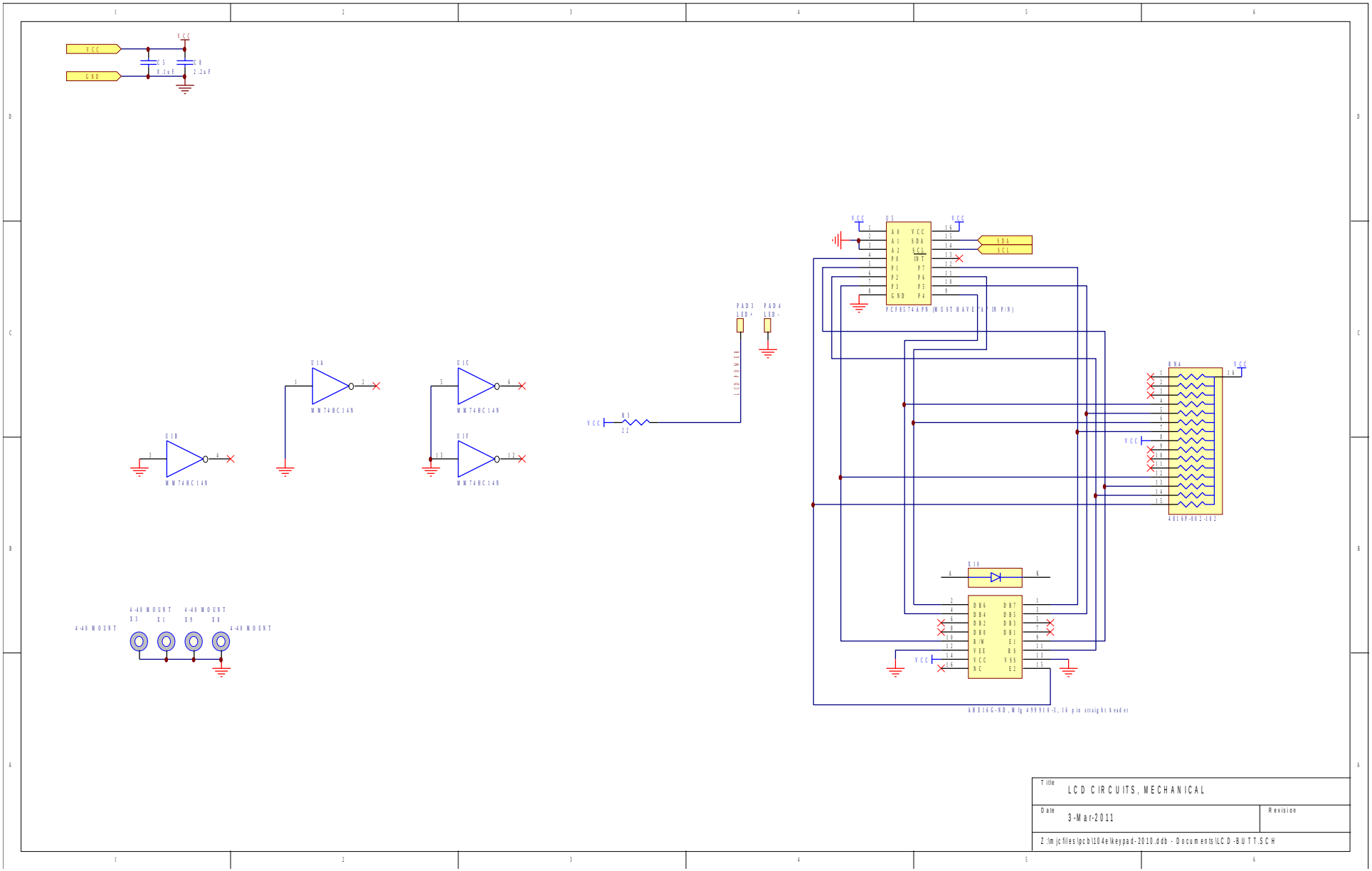


Title	PANEL TOP-LEVEL SCHEMATIC
Date	3-Mar-2011
Revision	
Z:\mjcfiles\pcb\104e\keypad-2010.ddb - Documents\Panelbrd.prj	

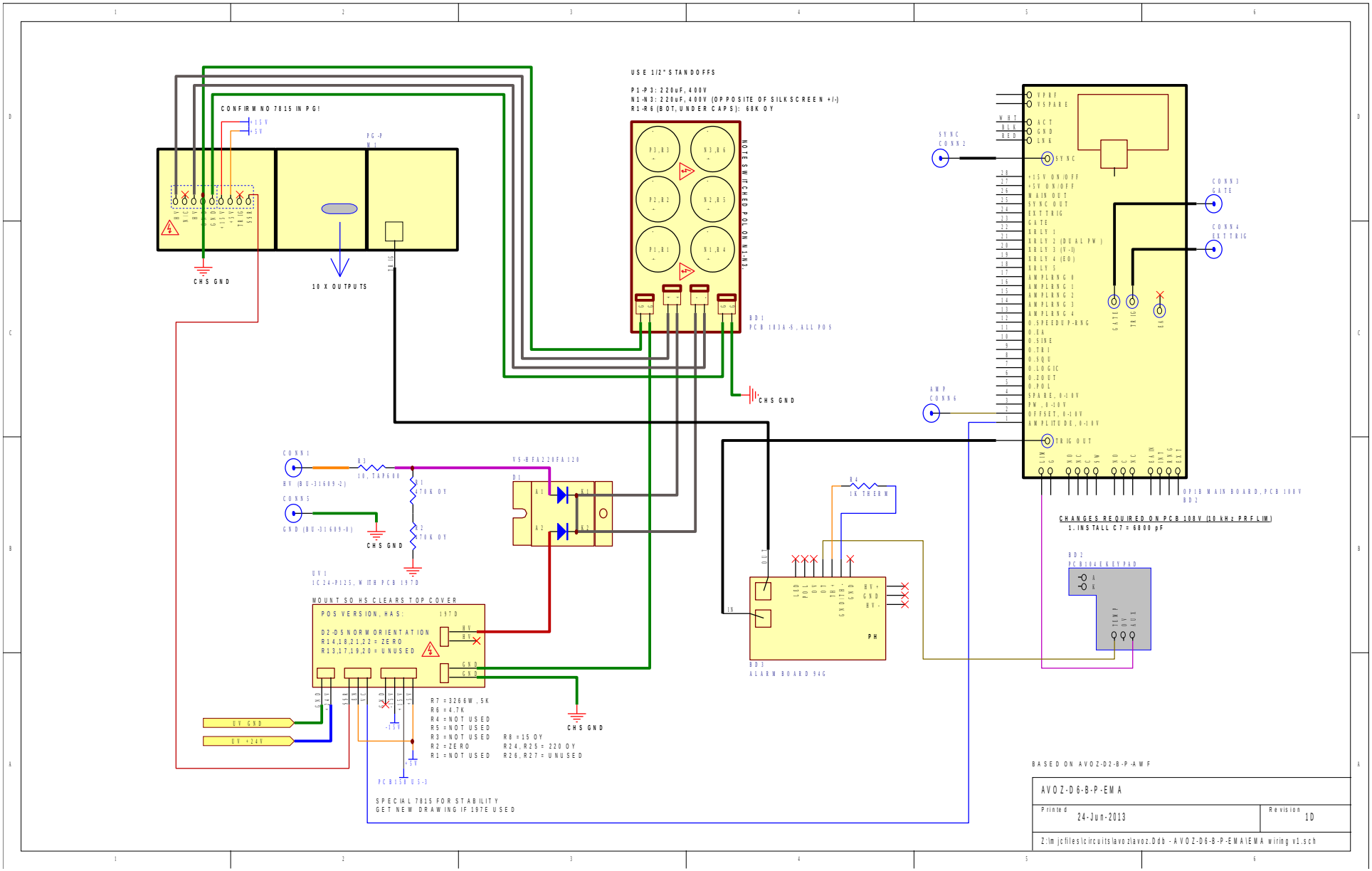
PCB 104E - KEYPAD / DISPLAY BOARD, 2/3



PCB 104E - KEYPAD / DISPLAY BOARD, 3/3



MAIN WIRING


CONFIRM NO 7815 IN PG!
CHS GND
10 X OUTPUTS
USE 1/2" STANDOFFS
P1-P3: 220uF, 400V
N1-N3: 220uF, 400V (OPPOSITE OF SILKSCREEN +/-)
R1-R6 (BOT, UNDER CAPS): 68K OY
NOTE SWITCHED POLARITY N1-N3
BD1 PCB 103A-5, ALL POS
CHS GND
SYNC CONN2
CONN3 GATE
CONN4 EXTTRIG
AMP CONN6
OPTIONS
BD2 PCB104 KEYPAD
CONN1
HV (BU-31609-2)
CONN5
GND (BU-31609-0)
CHS GND
VS-HFA220FA120
D1
UV1 IC24-P125, WITH PCB 197D
MOUNT SO HS CLEARS TOP COVER
POS VERSION, HAS: 197D
D2-D5 NORM ORIENTATION
R14,18,21,22 = ZERO
R13,17,19,20 = UNUSED
UV GND
UV +24V
-15V
+5V
CHS GND
R7 = 3266W, 5K
R6 = 4.7K
R4 = NOT USED
R5 = NOT USED
R3 = NOT USED
R2 = ZERO
R1 = NOT USED
R8 = 15.0Y
R24, R25 = 220.0Y
R26, R27 = UNUSED
PCB150 05-3
SPECIAL 7815 FOR STABILITY
GET NEW DRAWING IF 197E USED
IN THERM
BD3 ALARM BOARD 94G
CHANGES REQUIRED ON PCB 108V (10 kHz PRFLIM)
1. INSTALL C7 = 6800 pF
OPIB MAIN BOARD, PCB 100V
BD2
BASED ON AVOZ-D2-B-P-AWF
AVOZ-D6-B-P-EMA
Printed 24-Jun-2013
Revision 1D
Z:\mjcfiles\circuits\avoz\avoz.ddb - AVOZ-D6-B-P-EMA\EMA wiring v1.sch

PERFORMANCE CHECK SHEET