AVTECH ELECTROSYSTEMS LTD.

NANOSECOND WAVEFORM ELECTRONICS
SINCE 1975

P.O. BOX 265
OGDENSBURG, NY
U.S.A. 13669-0265

TEL: 888-670-8729 (USA & Canada) or +1-613-686-6675 (Intl)
FAX: 800-561-1970 (USA & Canada) or +1-613-686-6679 (Intl)

info@avtechpulse.com - http://www.avtechpulse.com/

BOX 5120, LCD MERIVALE
OTTAWA, ONTARIO
CANADA K2C 3H5

INSTRUCTIONS

MODEL AVR-CD1-B-SCHD

REVERSE RECOVERY TIME TESTER

WITH REVERSE BIASES OF -100 TO -800V

AND dI/dt = 1 A/us

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
World Wide Web: http://www.avtechpulse.com

TABLE OF CONTENTS

Manual Reference: /fileserver1/officefiles/instructword/avr-cd1/AVR-CD1-B-SCHD,ed1.odt.
Last modified February 29, 2024.

INTRODUCTION

The AVR-CD1-B-SCHD is a customized, GPIB and RS232-equipped instrument intended for reverse recovery time testing of high-voltage diodes.

This pulser generates a 250 us wide forward bias pulse of 0.1 to 0.4A into a diode load. After 200 us, the forward pulse is interrupted by a negative-going current ramp (1 A/us) until the diode stops conducting. The maximum allowed reverse current is -1A. Measurements of the DUT performance may be generated using a user-supplied oscilloscope and high-voltage probes.

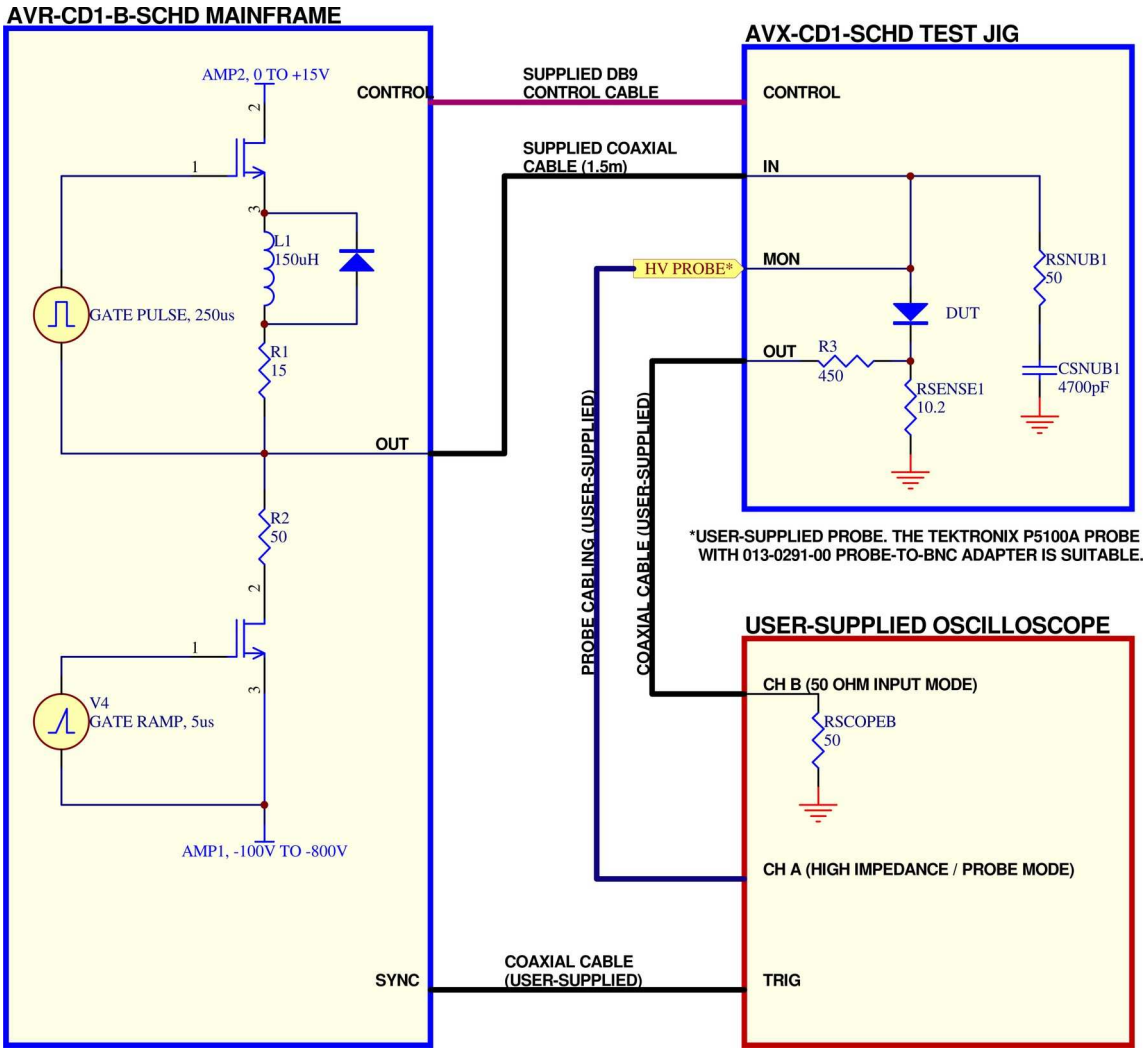
The current slew rate is adjustable over a narrow range to ensure that the desired value of 1 A/us can be achieved with different operating conditions and DUT characteristics. The actual slew rate should *always* be verified by measurement, and the set value should be treated as a *relative* control, rather than as an absolute calibrated control.

The AVR-CD1-B-SCHD includes one AVX-CD1-SCHD test jig. The instrument mainframe is connected to the test jig using a DB-9 control cable and a coaxial cable. The test jig contains spring pins that will hold the square-MELF device under test (DUT).

The reverse bias voltage is adjustable from -100V to -800V. The rate of the voltage rise at the end of the reverse transient is controlled by the capacitance of the DUT, the capacitance of the current-source MOSFET and parasitic capacitance of the pulser/jig ($C_{CURRENTSOURCE} + C_{PULSERJIG} \approx 300$ pF), and the added capacitance C_{SNUB1} on the test jig. The dV/dt rate will influence the measured t_{RR} value and the amount of extracted charge. C_{SNUB1} will be 4700 pF as shipped from the factory, but it may be changed by the user. It will be important to note the value of C_{SNUB1} when comparing results between systems. R_{SNUB1} is provided in series with C_{SNUB1}, solely to damp possible oscillations.

The output signals are provided on BNC connectors on the test jig. These outputs should be viewed on a user-supplied high-bandwidth (≥ 300 MHz) oscilloscope. The main output signal is generated by a sensing resistance in series with the DUT, and the voltage it generates is directly proportional to the current through the diode. By observing the current waveform through the diode, the reverse recovery time may be determined. A MON output is also provided, which permits the voltage across the DUT (and the sensing resistance) to be monitored.

The basic equivalent circuit of the test system is shown below:



The AVR-CD1-B-SCHD 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 AVR-CD1-B-SCHD 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 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.

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

SPECIFICATIONS

Model:	AVR-CD1-B-SCHD
Intended application:	Reverse recovery time tests, for a customized non-standard application
Basic waveform:	This pulser will generate a 250 us wide forward bias pulse into a diode load. After 200 us, the forward pulse will be interrupted by a negative-going current ramp until the diode stops conducting.
Forward bias pulse:	+0.1A to +0.4A, adjustable. The 250 us duration is fixed.
Reverse bias ramp:	After 200 us of forward bias, the output current ramps down at a rate of -1 A/us, approximately. The rate will be adjustable over a narrow range to ensure that the nominal rate of -1 A/us may be achieved. The dI/dt rate shall be calculated between I=0 and a time 100 ns after that. The user should verify the actual dI/dt using oscilloscope measurements. The maximum permitted reverse current is -1A. The duration of the reverse ramp is fixed at 5 us. Once the diode load stops conducting, the output voltage will approach the set reverse bias voltage for the remainder of the 5 us duration. Internally, the dI/dt ramp rate will be controlled by a voltage ramp on a MOSFET gate, rather than using an inductor in series with the drain or source.
Reverse bias voltage:	-100V to -800V, adjustable
dV/dt control:	The rate of the voltage rise at the end of the reverse transient is controlled by the capacitance of the DUT, the capacitance of the current-source MOSFET and parasitic capacitance of the pulser/jig ($C_{CURRENTSOURCE}$ + $C_{PULSERJIG}$ ≈ 300 pF), and the added capacitance C_{SNUB1} on the test jig. The dV/dt rate will influence the measured t_{RR} value and the amount of extracted charge. C_{SNUB1} will be 4700 pF as shipped from the factory, but it may be changed by the user. It will be important to note the value of C_{SNUB1} when comparing results between systems. R_{SNUB1} is provided in series with C_{SNUB1}, solely to damp possible oscillations.
Repetition rate:	1 to 10 Hz, adjustable
Load connection arrangement:	A test jig will be connected to the instrument mainframe with a length of coaxial cabling, as well as a control cable. The jig will contain spring pins that will hold the square-MELF device under test (DUT). The main switching circuitry will be located in the mainframe. The user may modify the jig to install a heater, as needed. The jig PCB shall be made of TG = 170°C FR4 material.
Calibration:	None of the programmed settings should be relied upon for any particular degree of accuracy, as the load characteristics may significantly affect the actual measured output parameters. All output parameters should be measured with user-supplied equipment.
Required measurement equipment:	The current through the DUT will be sensed by a 10 Ohm resistor (RSENSE1) on the test jig. A 10:1 attenuated version of this sense voltage may be observed by connecting a jig SMA output to the 50 Ohm input of a user-supplied oscilloscope. This will provide a 1 mV = 1 mA conversion ratio. The voltage across the series combination of the DUT and RSENSE1 will be provided on a jig BNC output connector. This voltage should be measured using a user-supplied Tektronix P5100A high-voltage probe with the Tektronix 013-0291-00 probe-to-BNC adapter (or similar high-voltage probes). The AVR-CD1-B-SCHD itself does not provide any measurement functionality.
GPIB and RS-232 control:	Standard on -B units. See http://www.avtechpulse.com/gpib for details.
LabView driver:	Check http://www.avtechpulse.com/labview for availability and downloads
Trigger required:	Ext trig mode: + 5 Volts, 10 ns or wider (TTL)
Gate input:	Active high or low, switchable. Suppresses triggering when active.
Power requirements:	100 - 240 Volts, 50 - 60 Hz
Dimensions:	H x W x D: 100 mm x 430 mm x 375 mm (3.9” x 17” x 14.8”)
Chassis material:	Cast aluminum frame and handles, blue vinyl on aluminum cover plates
Temperature range:	+5°C to +40°C

REGULATORY NOTES

FCC PART 18

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

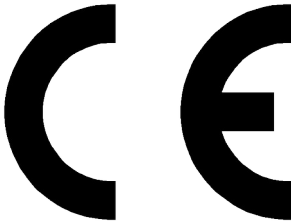
This instrument is enclosed in a rugged metal chassis and uses a filtered power entry module (where applicable). The main output signal is provided on a shielded connector that is intended to be used with shielded coaxial cabling and a shielded load. Under these conditions, the interference potential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



We Avtech Electrosystems Ltd.
P.O. Box 5120, LCD Merivale
Ottawa, Ontario
Canada K2C 3H5

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)

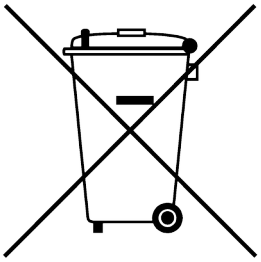
This instrument is exempt from Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment. Specifically, Avtech instruments are considered "Monitoring and control instruments"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

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. If the instrument has been damaged, file a claim immediately with the company that transported the instrument.

Please read the packing list(s) provided with the shipment carefully, and ensure that every item noted in the list(s) is present.

POWER RATINGS

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

The maximum power consumption is 57 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.

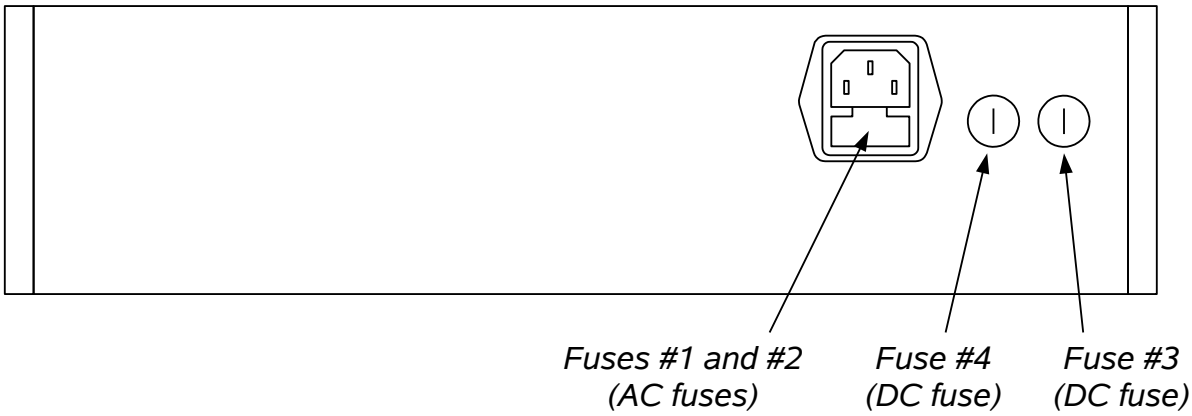
ENVIRONMENTAL CONDITIONS

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.

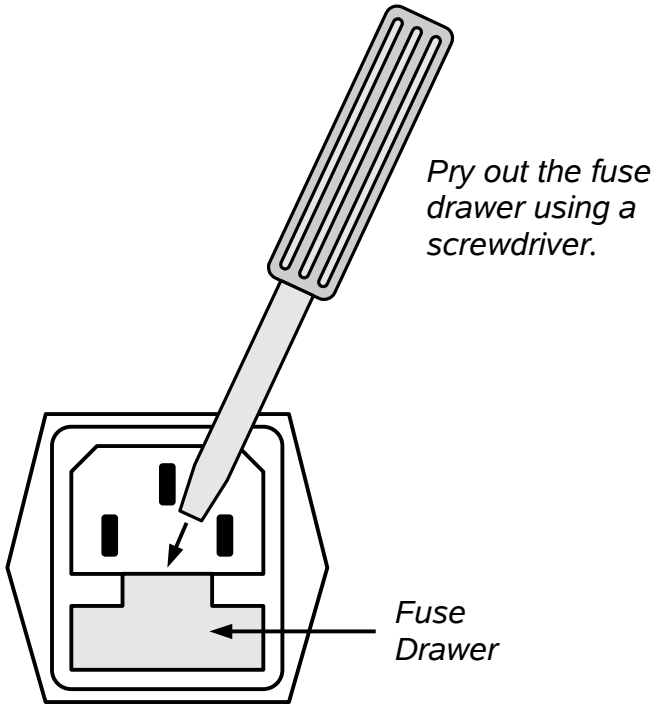
FUSES

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

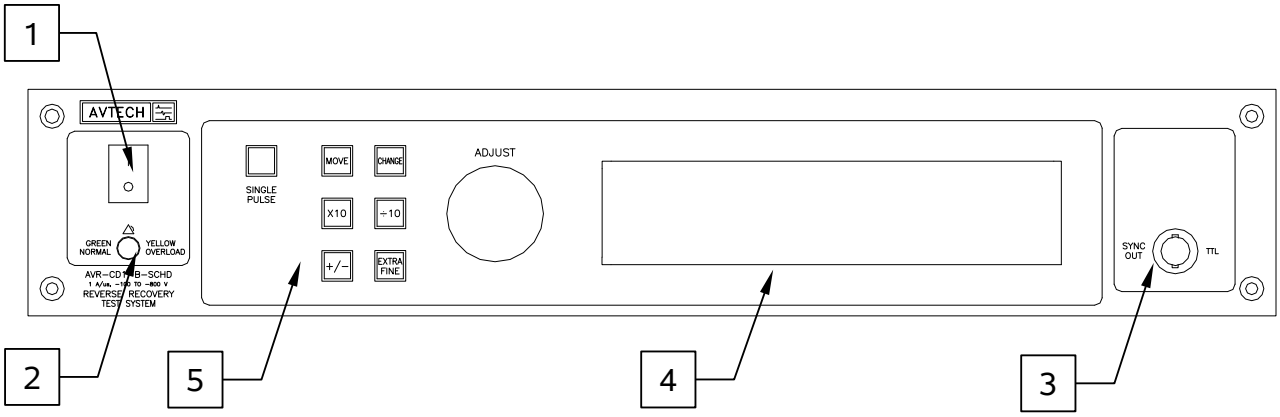
The following table lists the required fuses:

Fuses	Nominal Mains Voltage	Rating	Case Size	Recommended Replacement Part	
				Littelfuse Part Number	Digi-Key Stock Number
#1, #2 (AC)	100-240V	0.5A, 250V, Time-Delay	5×20 mm	0218.500HXP	F2416-ND
#3 (DC)	N/A	1.6A, 250V, Time-Delay	5×20 mm	021801.6HXP	F2424-ND
#4 (DC)	N/A	0.5A, 250V, Time-Delay	5×20 mm	0218.500HXP	F2416-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 60 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, or the instrument may remain unresponsive indefinitely.

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 abOUT1 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.

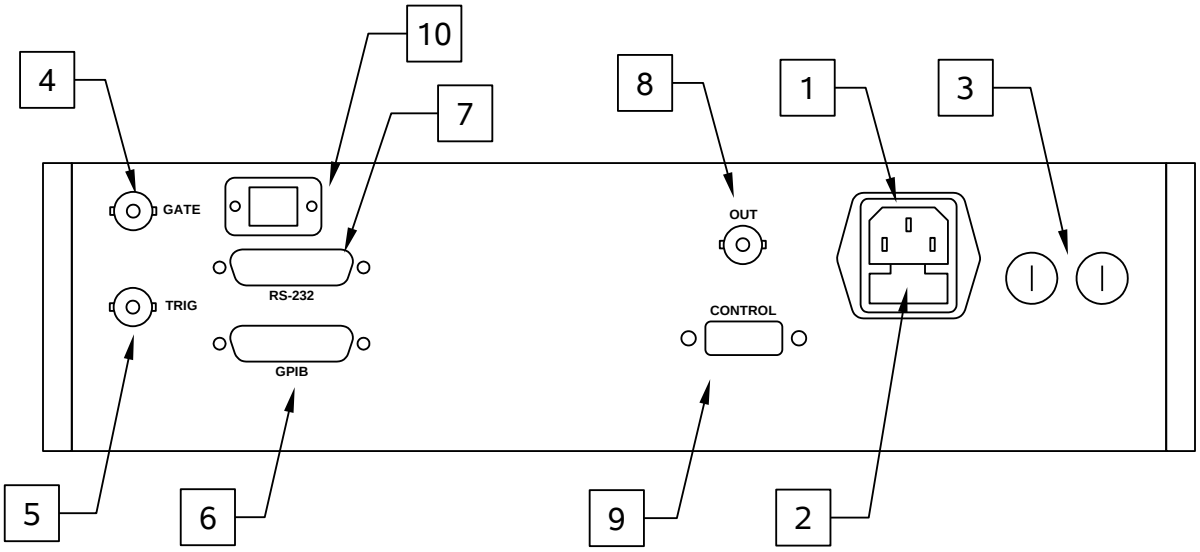
3. SYNC OUT. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal leads (or lags) the main output by a duration set by the "DELAY" controls and has an approximate amplitude of +3 Volts to R_L > 50Ω with a pulse width of approximately 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



Note: some connectors may be in different positions than shown above, depending on the exact combination of options ordered.

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.)

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. Instruments with firmware versions of 5.00 or higher require a user name (“admin”) and a password (“default”, as shipped from the factory) when logging into a serial terminal session. See the “Programming Manual for -B Instruments” for more details on RS-232 control.

8. PULSE OUT CONNECTOR. This BNC connector provides the pulse output signal to the test jig. This output should be connected to the corresponding input on the test jig using the supplied coaxial cable.

   ⚠ Caution: Voltages as high as 850V may be present on the center conductor of this output connector. Avoid touching this conductor. Connect to this connector using standard coaxial cable, to ensure that the center conductor is not exposed.

9. CONTROL Connector. This DB-9 female connector should be connected to the corresponding connector on the test jig using the supplied DB-9 cable. This cable contains the safety interlock signals that ensure that the test jig lid is closed. The pinout is as follows:

   Pin 1 - To test jig switch 1.
   Pin 2 - To test jig switch 2.
   Pin 5 - Ground.
   Pin 6 - To test jig switch 1.
   Pin 7 - To test jig switch 2.
   Pin 9 - Safety sensor power supply (+15V through 680 Ohms).

   When the test jig lid is safely closed, Pin 1 is shorted to Pin 6, and Pin 2 is shorted to Pin 7.

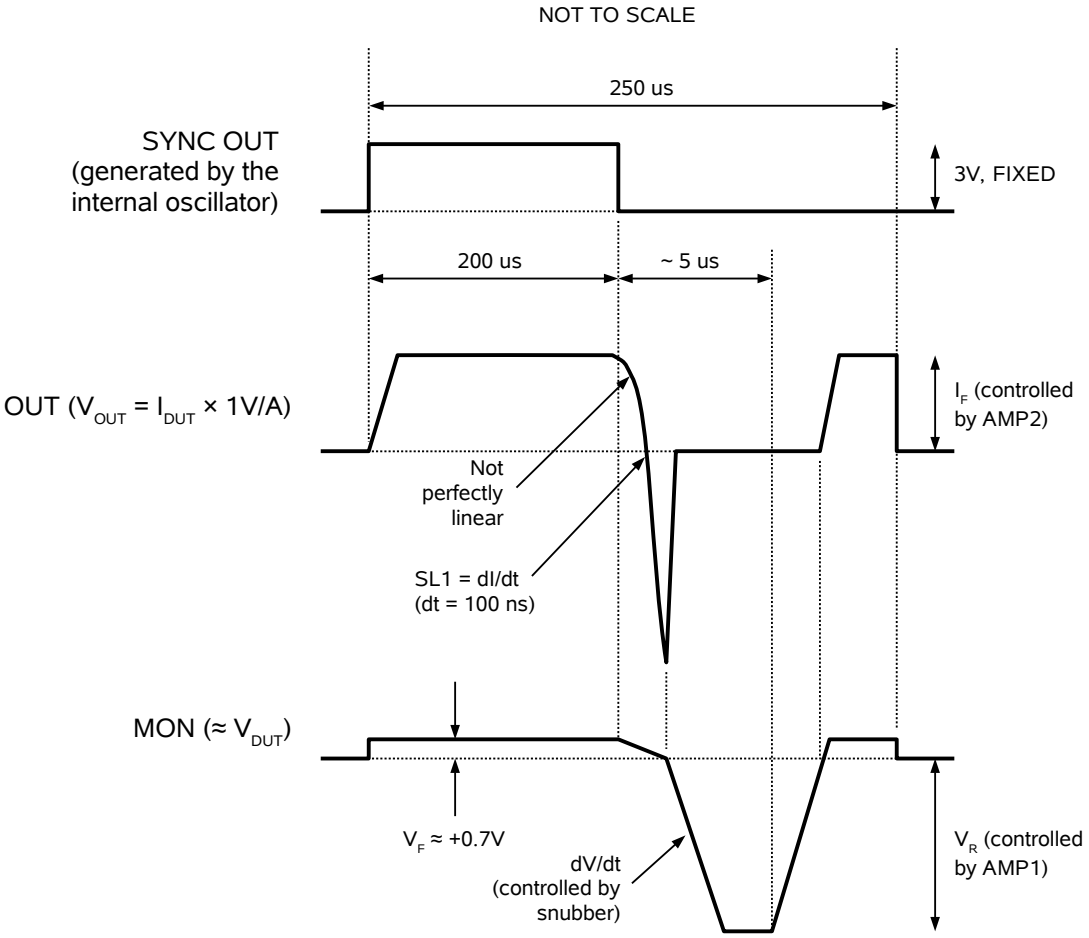
10. Network Connector. (Optional feature. Present on -VXI units only.) This Ethernet connector allows the instrument to be remotely controlled using the VXI-11.3, ssh (secure shell), telnet, and http (web) protocols. See the “Programming Manual for -B Instruments” for more details.

BASIC CONTROLS

BASIC TIMING 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: the main signal and the SYNC output.

The SYNC pulse is a TTL-level reference pulse used to trigger oscilloscopes or other measurement systems. The rising edge is approximately coincident with the start of the forward bias pulse. The falling edge is approximately coincident with the start of the negative bias ramp. The falling edge should be used to trigger the user's oscilloscope.



AMPLITUDE CONTROL – REVERSE BIAS

AMP1 is the DC bias voltage applied to the source of the reverse ramp MOSFET. This may be adjusted from -100 to -800V. This voltage should not exceed the breakdown voltage of the DUT. This voltage may be adjusted from the AMP1 menu of the front panel display, or using a command like “sour:volt1 -400V”. This setting controls the maximum voltage that will be developed across the DUT. The DUT voltage may not necessarily reach this value, depending on the dV/dt rate (see the “RC Snubber” section on page 25).

AMPLITUDE CONTROL – FORWARD BIAS

AMP2 is the DC bias voltage applied to the drain of the forward pulse MOSFET. It may be set anywhere between +1 and +15 Volts. This may be adjusted from the AMP2 menu of the front panel display, or using a command like “sour:volt2 +10V”.

A resistance of 15 Ohms is present in series with the source (output) of the forward pulse MOSFET, and 10 Ohms is present in series with the DUT in the test jig. The DUT peak forward current is therefore related to the AMP2 setting by:

$$I_F \approx (AMP2 - V_F) / 25\Omega$$

RAMP RATE

SL1 is the “slew rate” of the negative-going ramp, and is nominally 1 A/us. This may be adjusted from the SL1 menu of the front panel display, or using a command like “sour:curr:slew 1 A/us”.

The current slew rate is adjustable over a narrow range to ensure that the desired value of 1 A/us can be achieved with different operating conditions and DUT characteristics. The actual slew rate should *always* be verified by measurement, and the set value should be treated as a *relative* control, rather than as an absolute calibrated control.

The slew rate setting will be noticeably inaccurate when the forward current is not near its maximum, due to rounding of the ramp at low currents (see the “not perfectly linear” area in the figure above). The rounding is caused by the nature of MOSFETs – a current source is used to generate a voltage ramp on a MOSFET gate, to generate a corresponding current ramp. However, the gate capacitance is not constant, nor it the I_D/V_G relationship fully linear, so the current ramp is not fully linear either.

The dI/dt slew rate should be calculated between I=0 and a time 100 ns after that, for consistency.

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.)

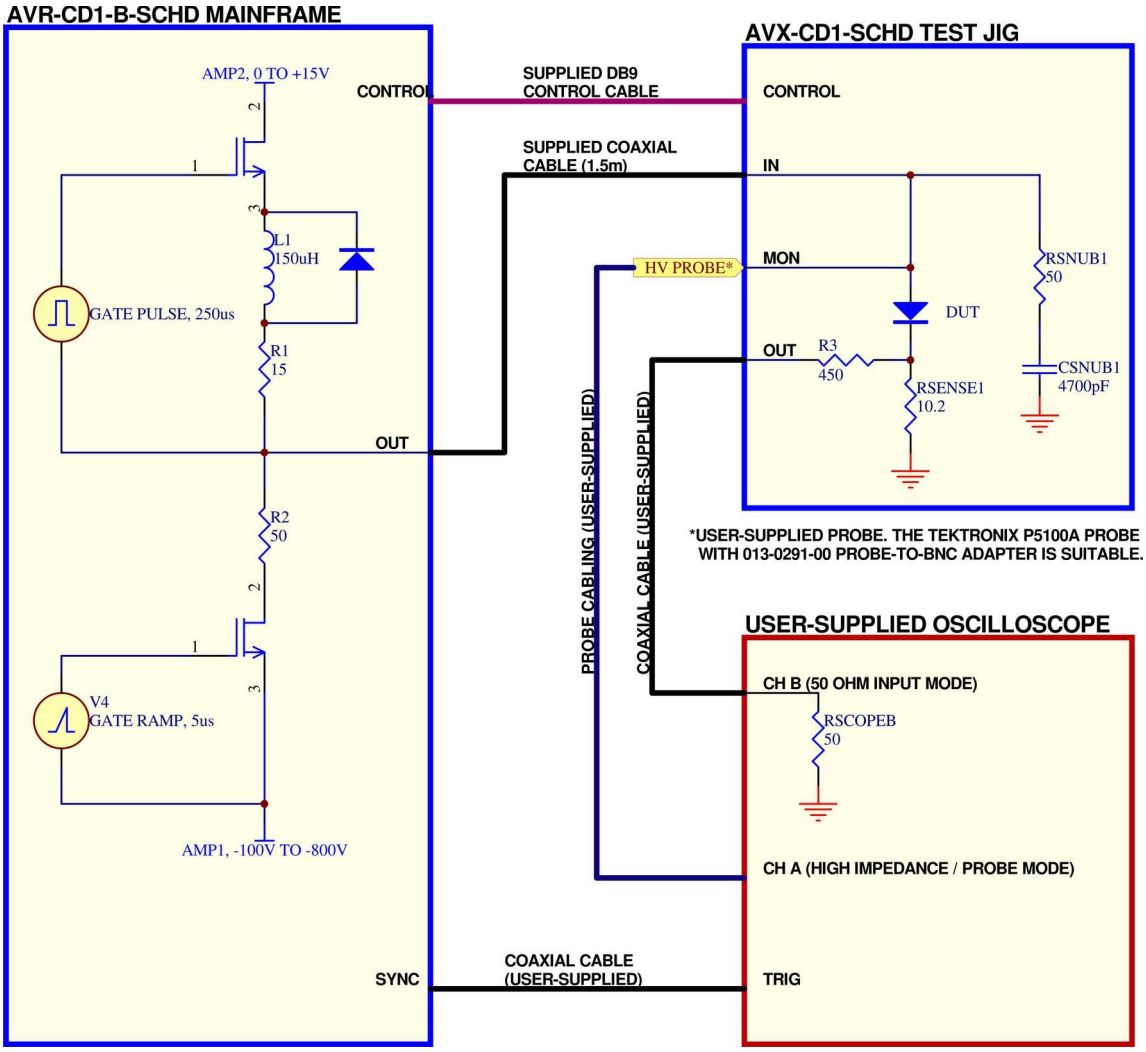
GATING MODES

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. When gated, the output will complete the full pulse width if the output is high, and then stop triggering. Pulses are not truncated.

BASIC TEST ARRANGEMENT

The basic test arrangement for the AVR-CD1-B-SCHD is shown in the figure below. The mainframe is connected to the test jig using the supplied DB9 control cable and 1.5m coaxial cable.

The test jig is connected to the user-provided oscilloscope as shown below. The jig OUT signal must be connected to a 50 Ohm input on the oscilloscope (or a 50 Ohm feed-through terminator must be used). The MON output must be measured using a high-voltage probe. The Tektronix P5100A high-voltage probe with the Tektronix 013-0291-00 probe-to-BNC adapter is one suitable probe. The probe must connect to a high-impedance input on the oscilloscope.



The DUT current is sensed by the resistance in series with the DUT, which consists of RSENSE1 (10.2Ω) in parallel with R3 + RSCOPEB = 500Ω, for a total effective series

resistance of 10.2Ω || 500Ω = 10.0Ω. R3 and RSCOPEB act as a 10:1 voltage divider, making the sensing resistance appear to the oscilloscope to be 10.0Ω / 10 = 1.0Ω.

Thus, the voltage at CH B of the oscilloscope is simply I_{DUT} × 1.0Ω.

The oscilloscope should be set to trigger on the falling edge of the TTL-level pulse on the SYNC output of the mainframe. The TRIG input impedance should be set to 50Ω.

RC SNUBBER

The reverse bias voltage is adjustable from -100V to -800V. The rate of the voltage rise at the end of the reverse transient is controlled by the capacitance of the DUT, the capacitance of the current-source MOSFET and parasitic capacitance of the pulser/jig ($C_{CURRENTSOURCE}$ + $C_{PULSERJIG}$ ≈ 300 pF), and the added capacitance C_{SNUB1} on the test jig. The dV/dt rate will influence the measured t_{RR} value and the amount of extracted charge. C_{SNUB1} will be 4700 pF as shipped from the factory, but it may be changed by the user. It will be important to note the value of C_{SNUB1} when comparing results between systems. R_{SNUB1} is provided in series with C_{SNUB1}, solely to damp possible oscillations.

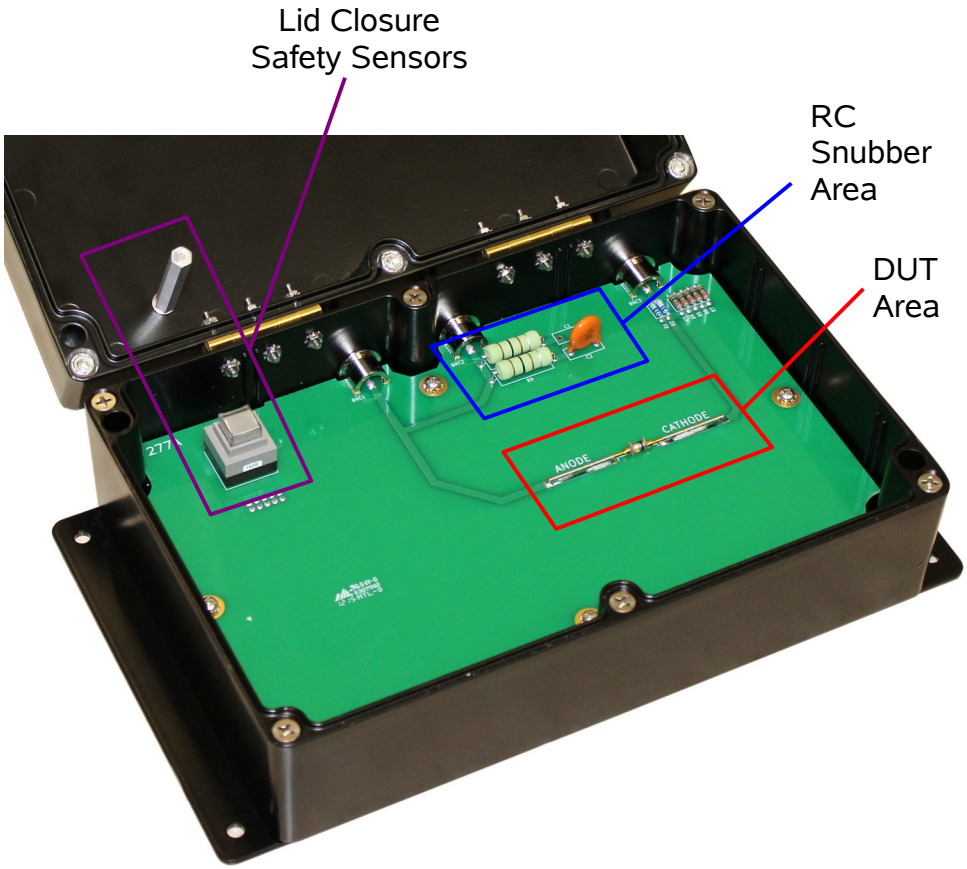
SAFETY INTERLOCK

The mainframe provides DC voltages of up to -800V to the test jig. For this reason, the output is automatically disabled when the test jig lid is open. The lid must be closed to obtain measurements.

TEST JIG MECHANICAL ASPECTS

AVX-CD1-SCHD TEST JIG

The AVX-CD1-MIX test jig directly accepts a range of through-hole and axial devices, using pin sockets and spring-loaded pins. It is intended for use with diodes in DO-41, TO-220, DO-204AR, or similar packages. A photo of the arrangement is shown below:



The instrument and the DUT will not be damaged if the diode is installed with the incorrect orientation (i.e., with the anode and cathode reversed). However, incorrect waveforms will be generated.

To install a DUT, use tweezers to pull back one or both of the spring pins, and slide in the DUT. This may take some practice. The user may prefer to solder one of the movable spring pins into a permanent fixed position, for easier DUT insertion.

Spring pins may be desoldered and replaced as needed. The jig is shipped with Test Connections, Inc. (http://www.tciinfo.com) model 70-3H serrated-head spring pins installed.

TEST JIG CONNECTORS

The IN, MON, OUT, and CONTROL connectors are on the rear of the jig, below the hinges:

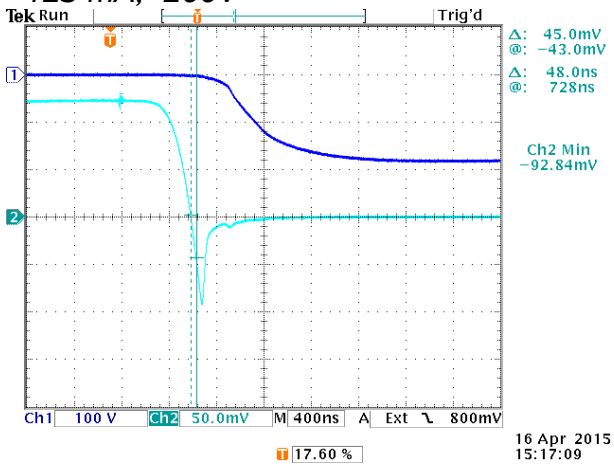
TYPICAL RESULTS

Obtaining meaningful results with the AVR-CD1-B-SCHD requires care, experience, and an understanding of diode transient behavior and the impact of inductive and capacitive parasitics. To assist the user, typical results are provided below. The user should be able to reliably duplicate these results.

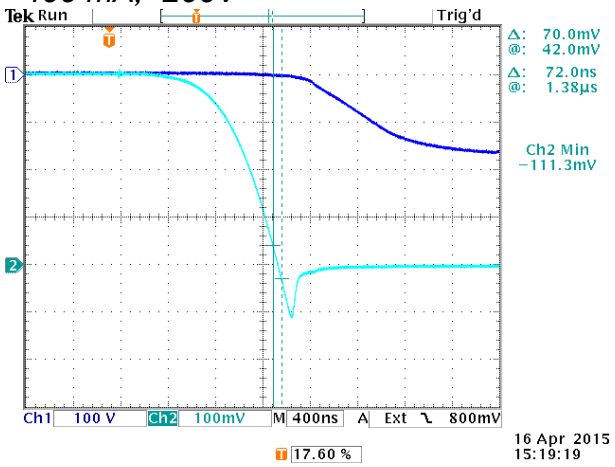
"TYPE 1" RESULTS

A user-supplied "Type 1" square-MELF DUT was tested with forward current of 125 mA and 400 mA, with reverse biases of -200, -600, and -800V. The resulting waveforms are shown below. The oscilloscope vertical cursors are positioned near the zero-crossing point, allowing the dI/dt rates to be calculated. For example, the first waveform has dI = 45.0 mA and dt = 48.0 ns, giving dI/dt = 0.94 A/us (close to the nominal desired value of 1 A/us).

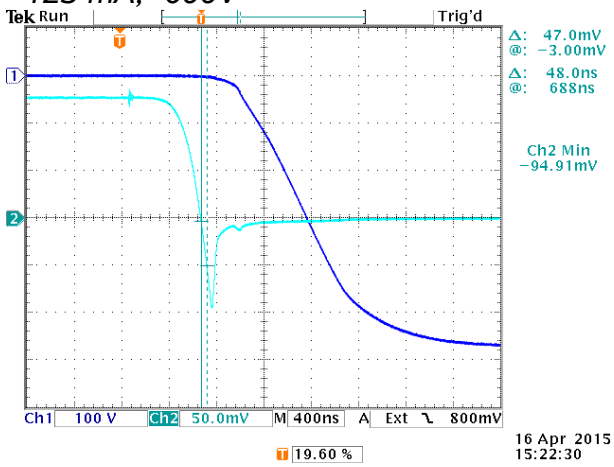
+125 mA, -200V



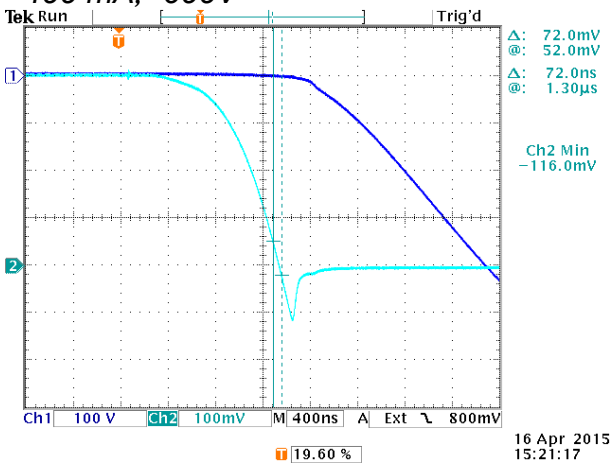
+400 mA, -200V



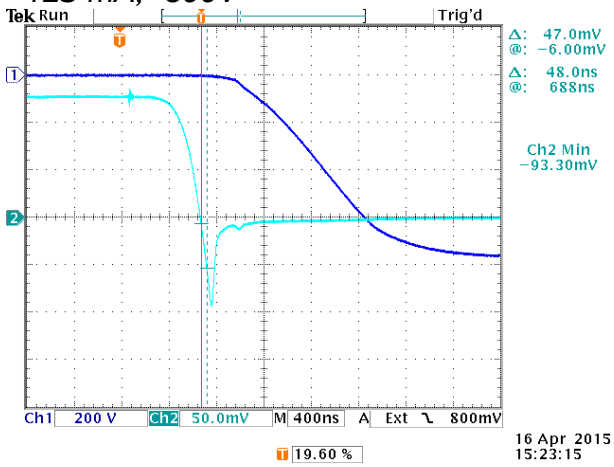
+125 mA, -600V



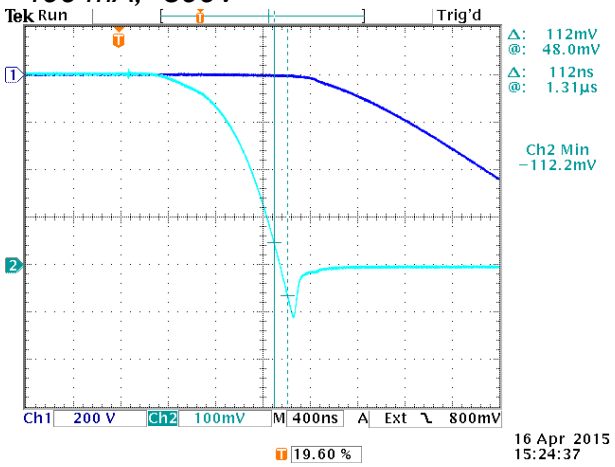
+400 mA, -600V



+125 mA, -800V



+400 mA, -800V



In each photo, the top waveform is the MON output, and the bottom waveform is the OUT waveform (1 mV = 1 mA).

The measurements were taken using a Tektronix TDS3052B oscilloscope.

TROUBLESHOOTING

If you obtain “strange” output waveforms, or unexpected values of t_{RR}, keep these points in mind:

1) The test jig OUT output *must* be terminated with 50 Ohms, and the MON output *must* be terminated with a high impedance (megohms).

2) Keep device lead lengths as short as possible, to minimize parasitic inductance.

3) The test jig lid must be closed, or the pulser output will be disabled.

For technical support, contact info@avtechpulse.com. Sample waveforms and digital photos of your setup are always helpful!

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 100 Hz)
sour:volt1 -800V        (sets the reverse bias DC voltage to -800V)
sour:volt2 +10V         (sets the forward bias DC voltage to +10V)
curr:slew1 1e6          (sets the slew rate to 1 A/us = 1e6 A/s)
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)
output on               (turns on the output)
sour:volt1 -800V        (sets the reverse bias DC voltage to -800V)
sour:volt2 +10V         (sets the forward bias DC voltage to +10V)
curr:slew1 1e6          (sets the slew rate to 1 A/us = 1e6 A/s)
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)
sour:volt1 -800V        (sets the reverse bias DC voltage to -800V)
sour:volt2 +10V         (sets the forward bias DC voltage to +10V)
curr:slew1 1e6          (sets the slew rate to 1 A/us = 1e6 A/s)
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>	
:DELay	<numeric value>	
:GATE		
:LEVel	HIgh | LOw	
[SOURce]:		
:CURRent		
:SLEW	<numeric value>	
: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.

TRIGGER DAMAGE

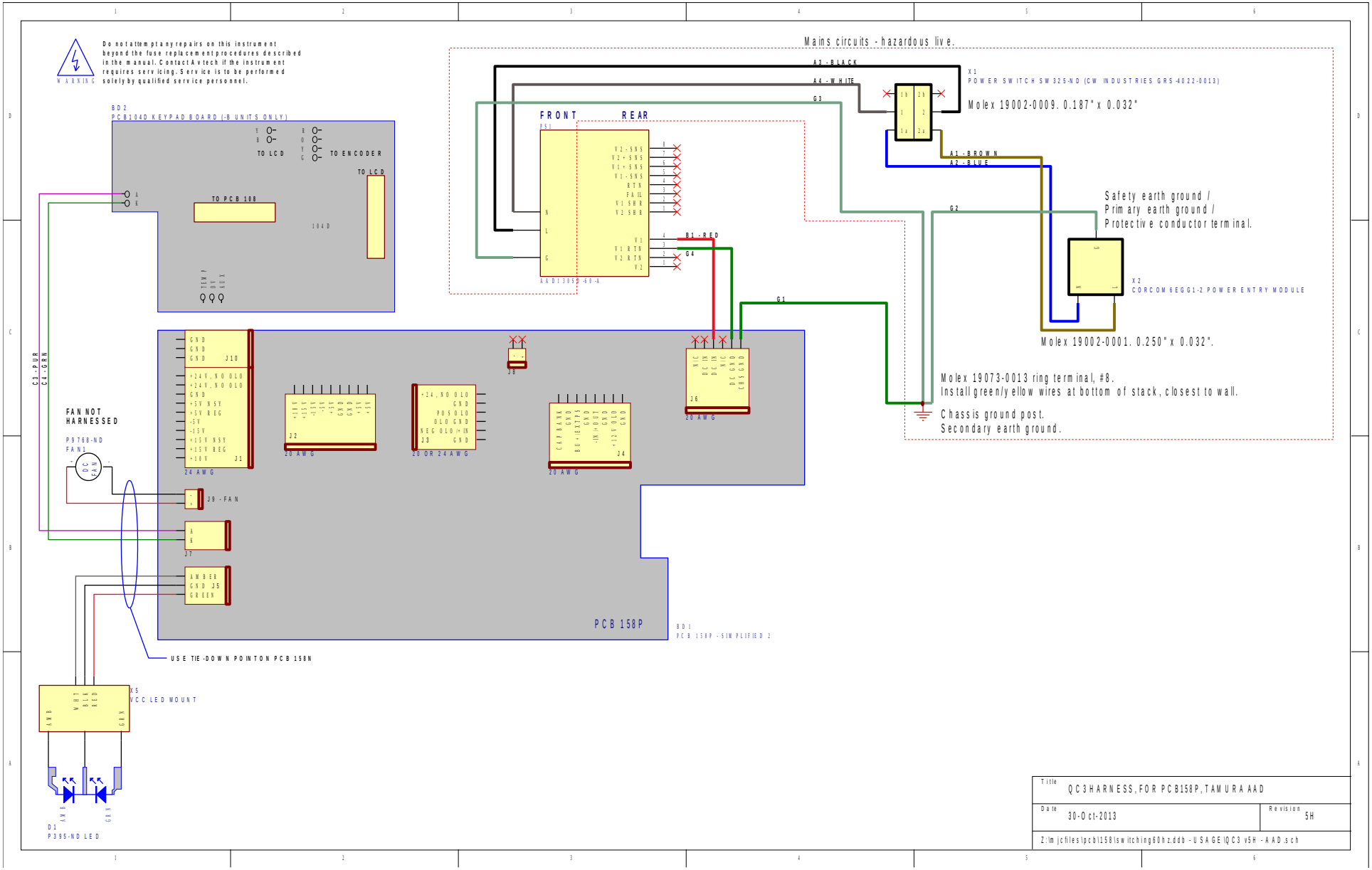
The rear-panel TRIG input, used in the external trigger mode, is protected by a diode clamping circuit. However, the protection circuit is not foolproof, and it is possible for a grossly excessive signal to damage the trigger circuitry on the main timing control board (the 4×10 inch board on the right side of the instrument).

The IC that is most likely to fail under these conditions is installed in a socket. It is a standard TTL IC in a 16-pin plastic DIP package, model 74F151 or equivalent.

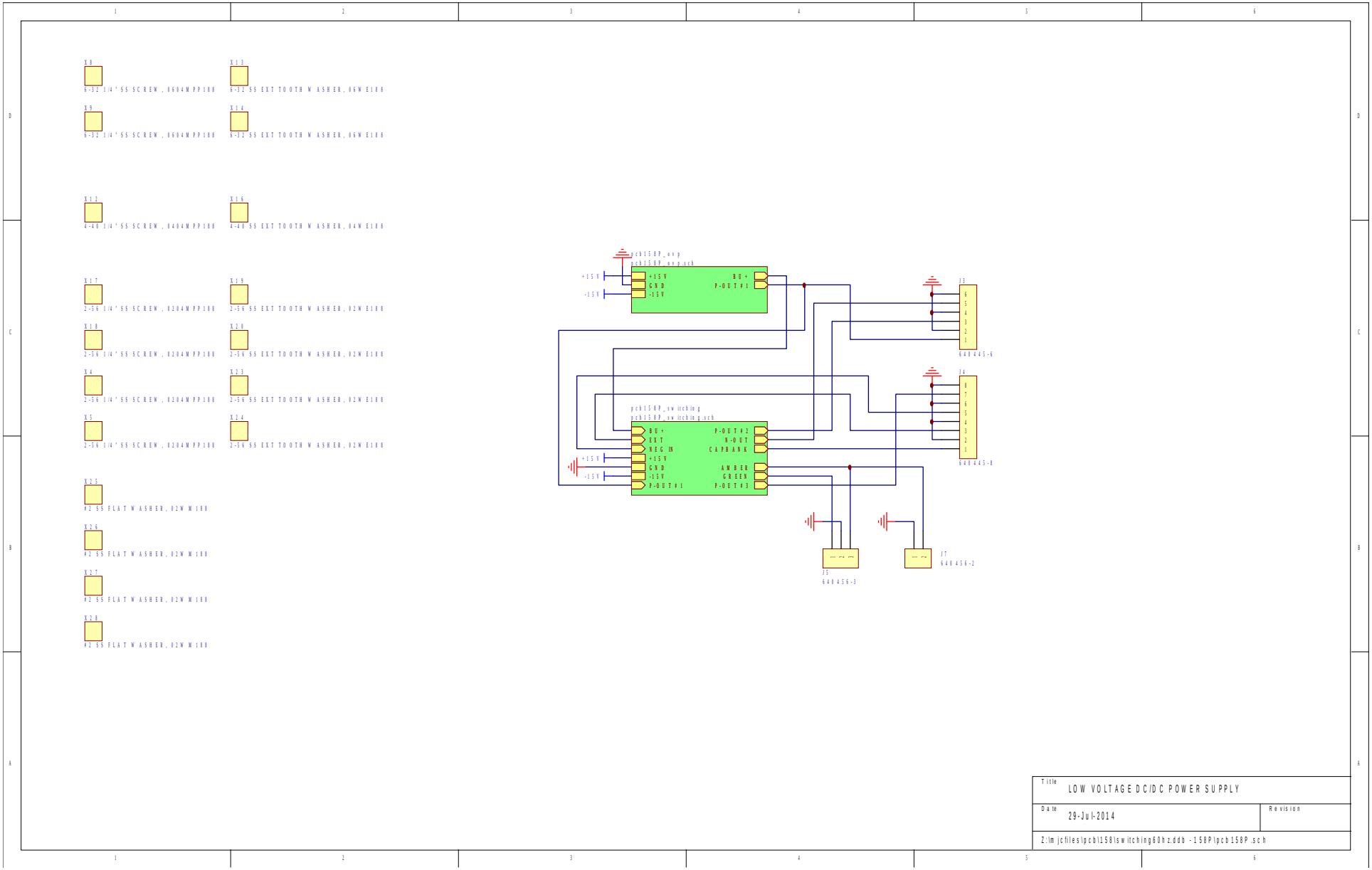
If you suspect that this IC has been damaged, turn off the power and replace this IC. It may be replaced by a 74F151, 74LS151, 74ALS151, or 74HCT151.

WIRING DIAGRAMS

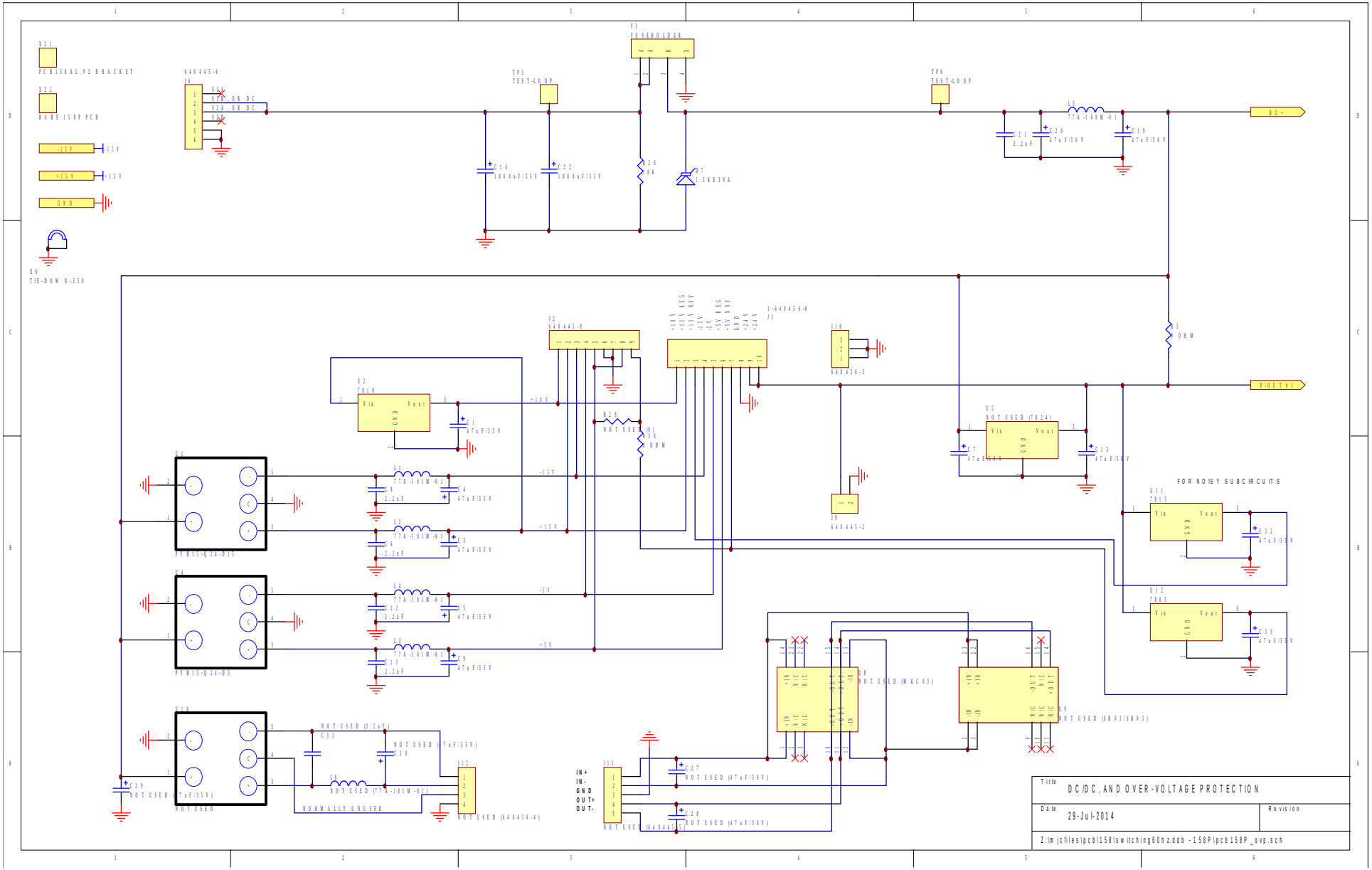
WIRING OF AC POWER



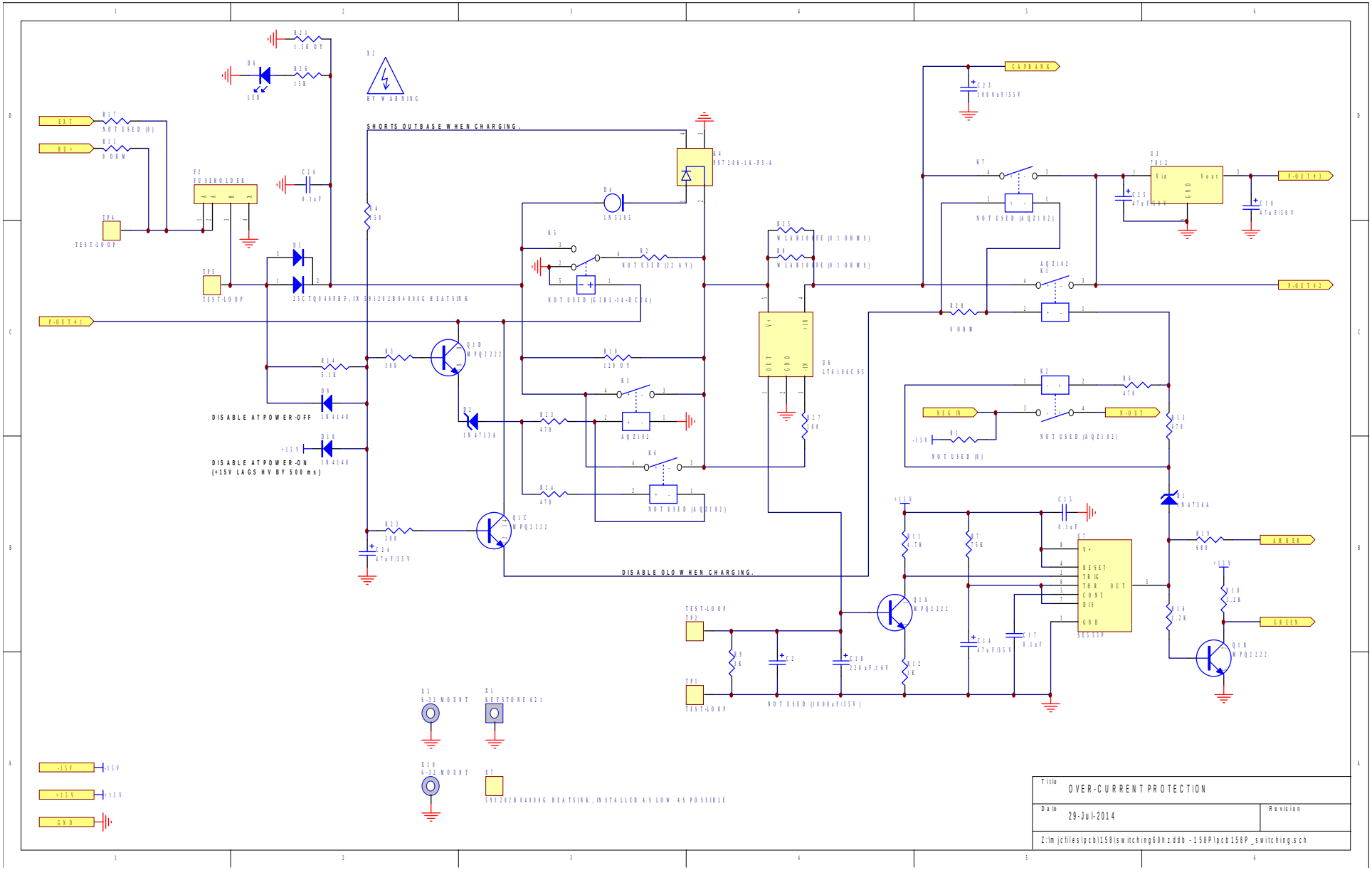
PCB 158P - LOW VOLTAGE POWER SUPPLY, 1/3



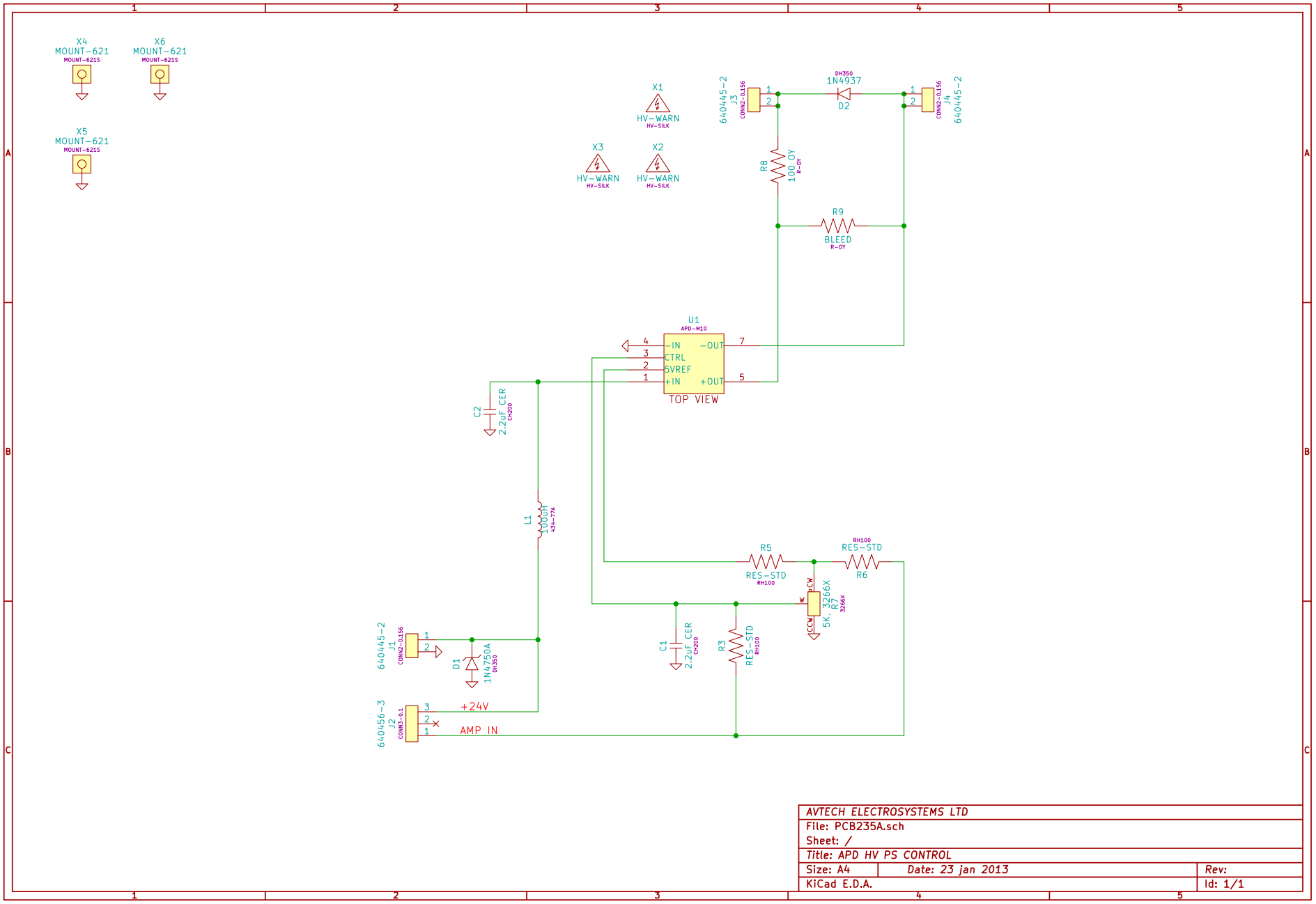
PCB 158P - LOW VOLTAGE POWER SUPPLY, 2/3



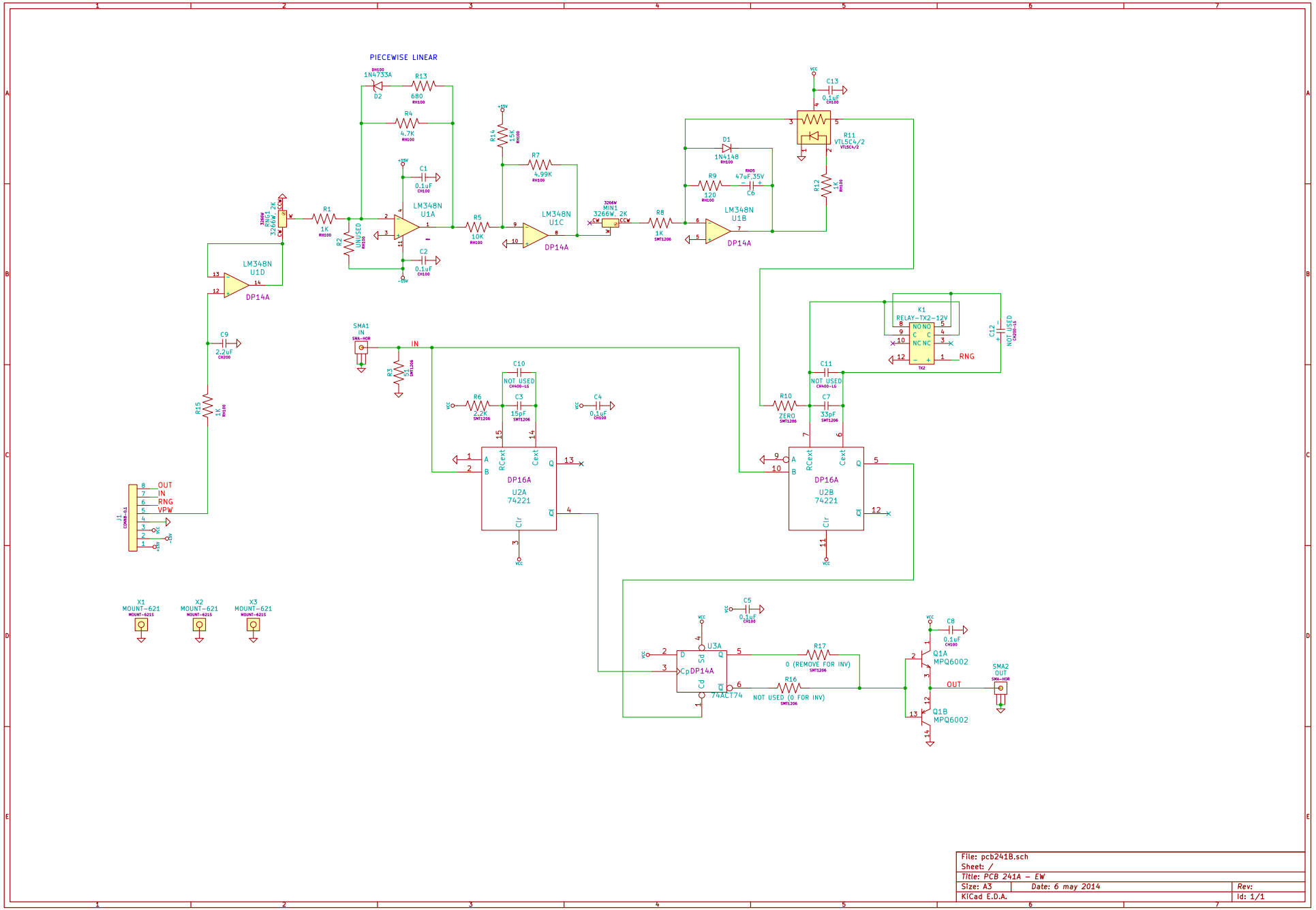
PCB 158P - LOW VOLTAGE POWER SUPPLY, 3/3



PCB 235A - HIGH VOLTAGE DC POWER SUPPLY

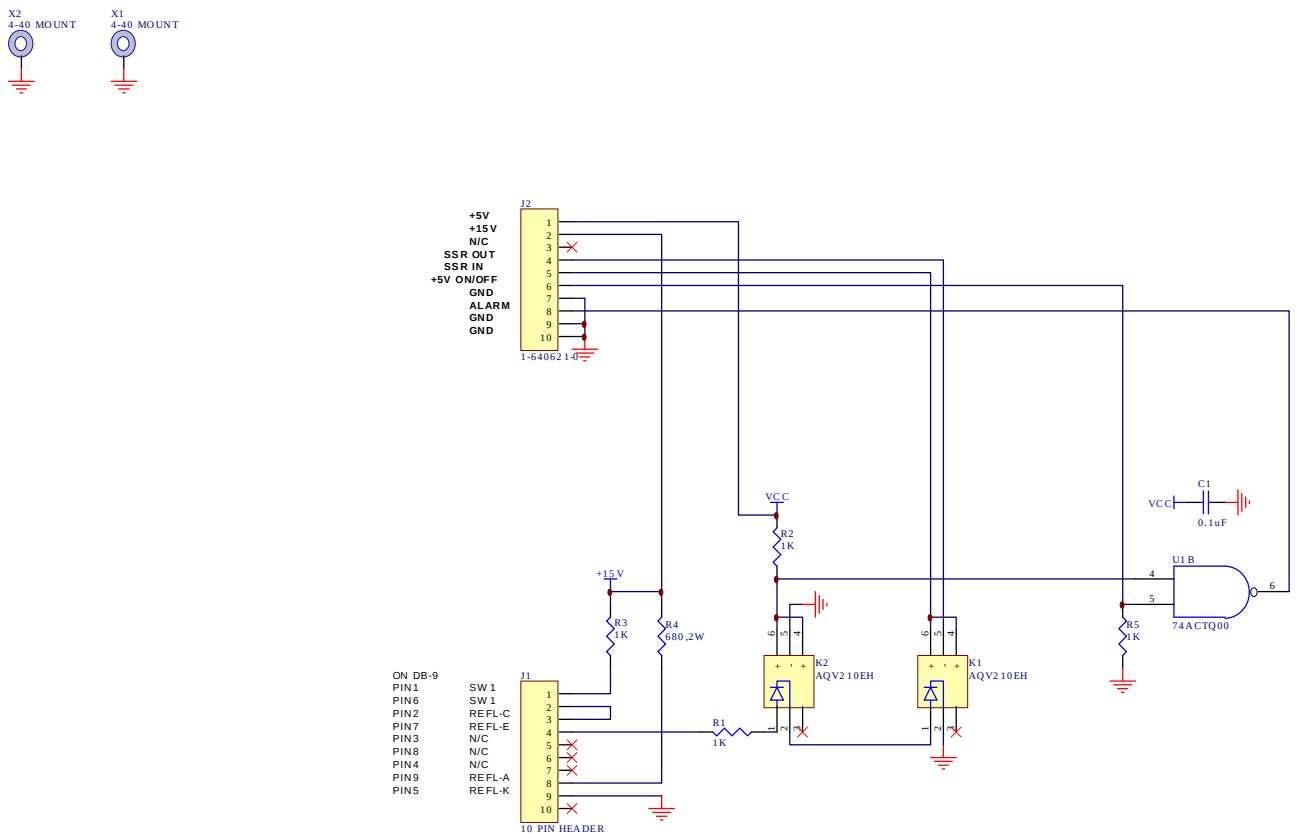


PCB 241B - PULSE WIDTH CONTROL



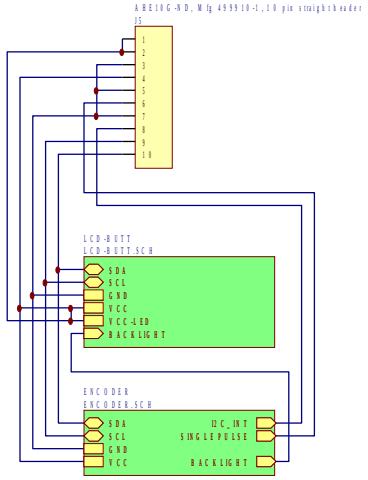
File: pcb241B.sch		
Sheet: /		
Title: PCB 241A – EW		
Size: A3	Date: 6 may 2014	Rev:
KiCad E.D.A.		Id: 1/1

PCB 201A - INTERLOCK



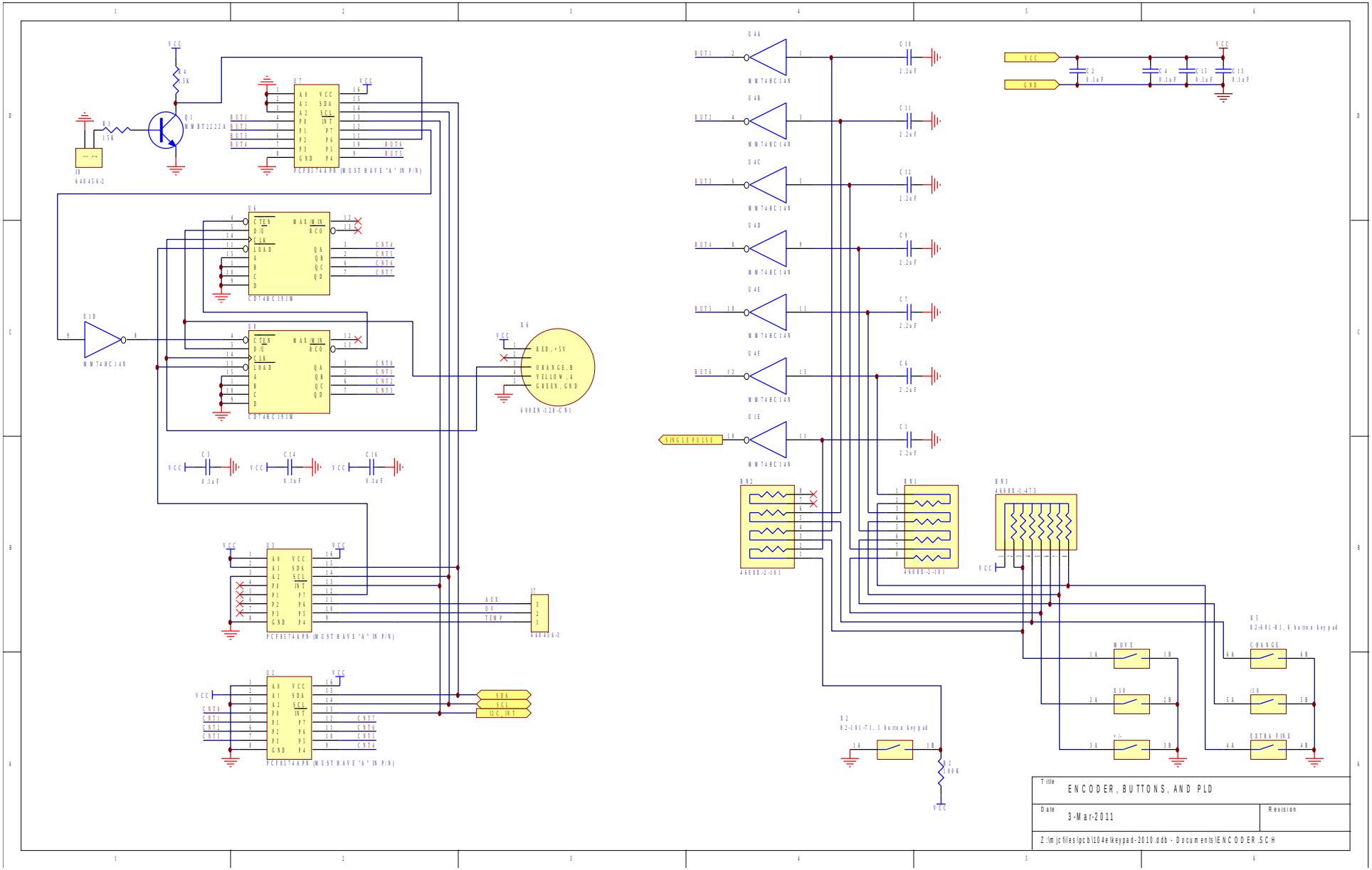
PCB 201 INTERLOCK	
Printed 17-Apr-2015	Revision 1A
Z:\mjcfiles\pcb\201\interlock.ddb - 201A\pcb201a.sch	

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

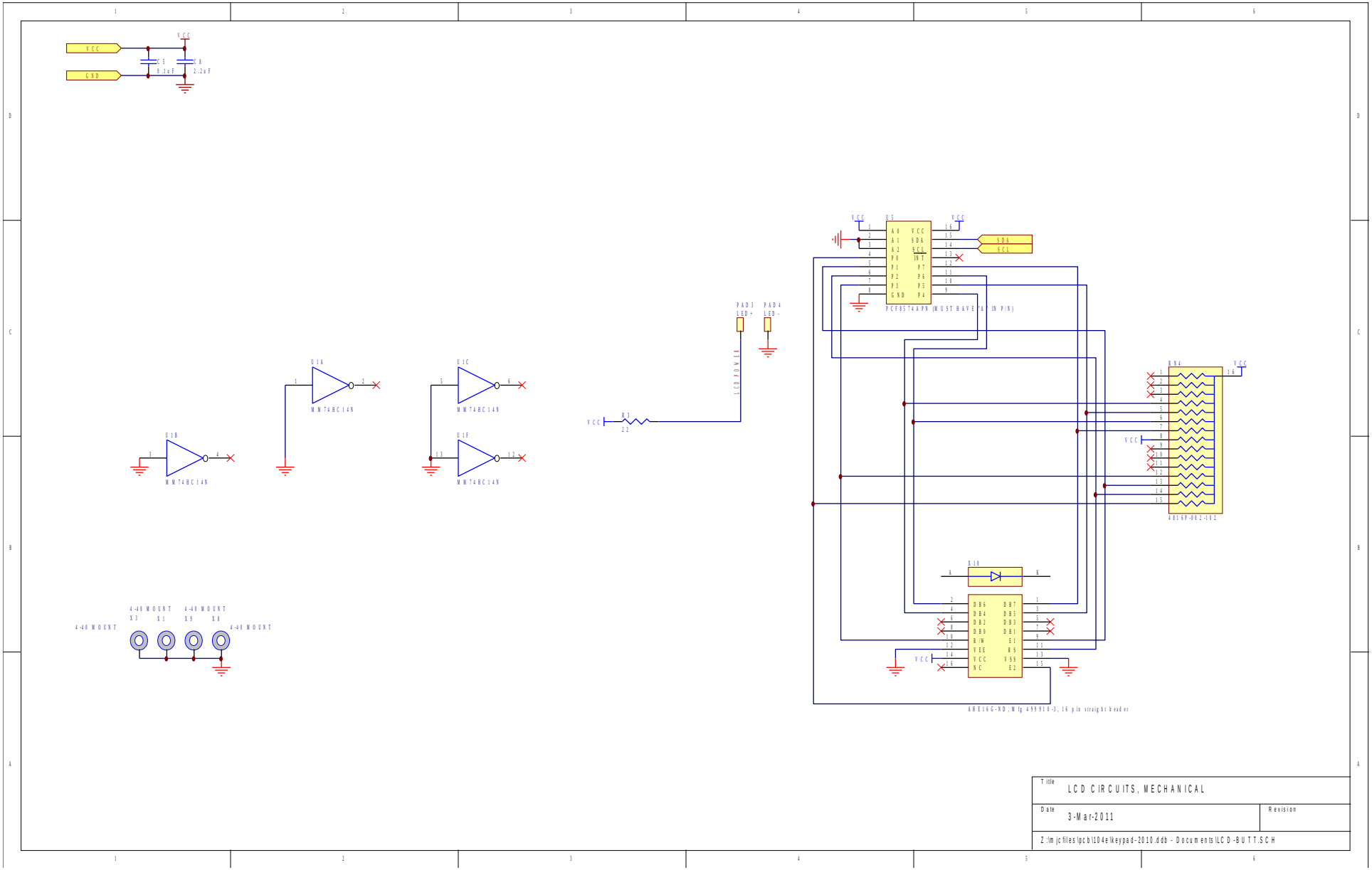


Title	PANEL TOP-LEVEL SCHEMATIC
Date	3-Mar-2011
Revision	
Z:\mjcfiles\pcb\104e\keypad-2010.ddb - Documents\Panelbrd.prj	

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

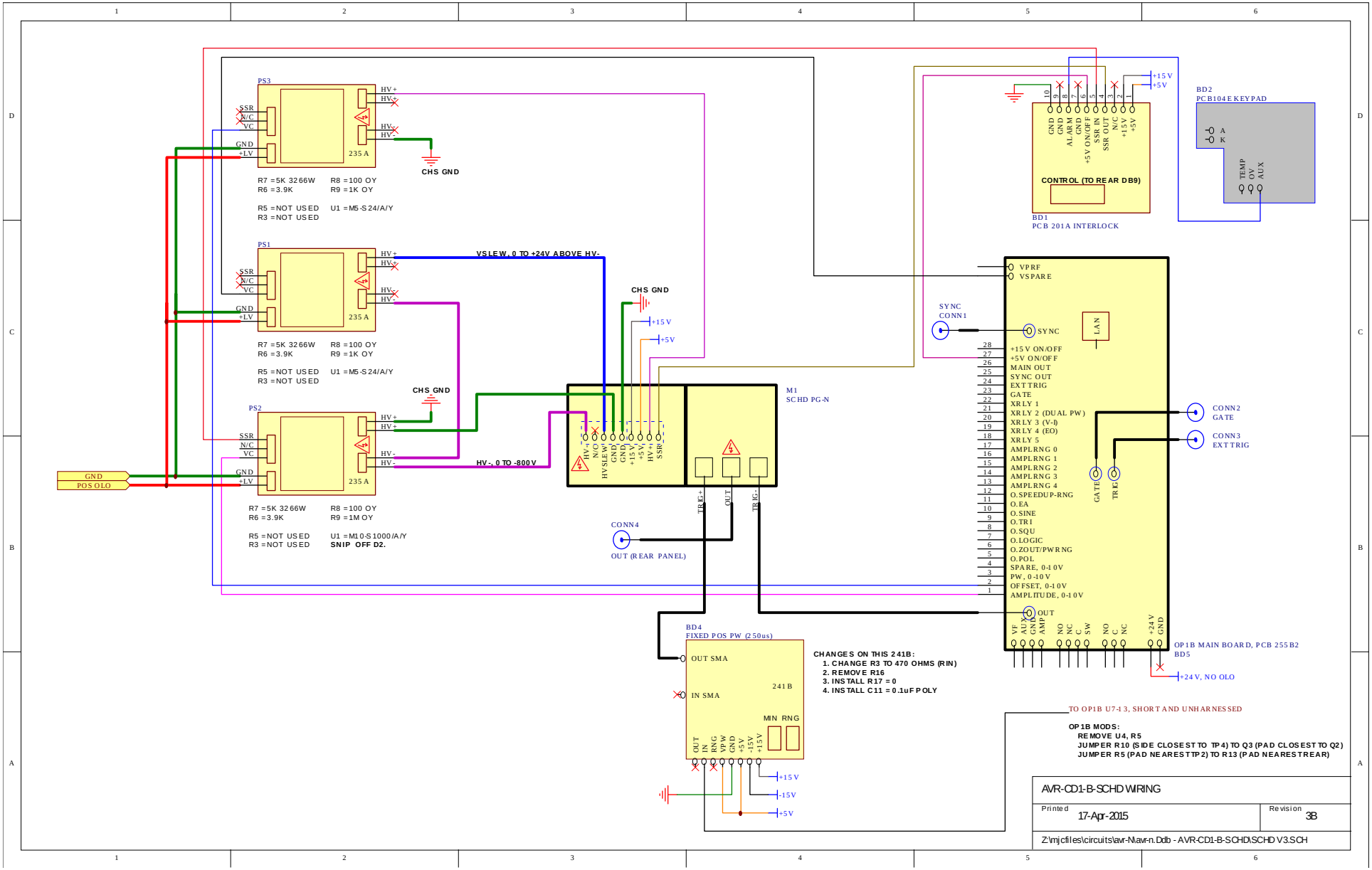


PCB 104E - KEYPAD / DISPLAY BOARD, 3/3

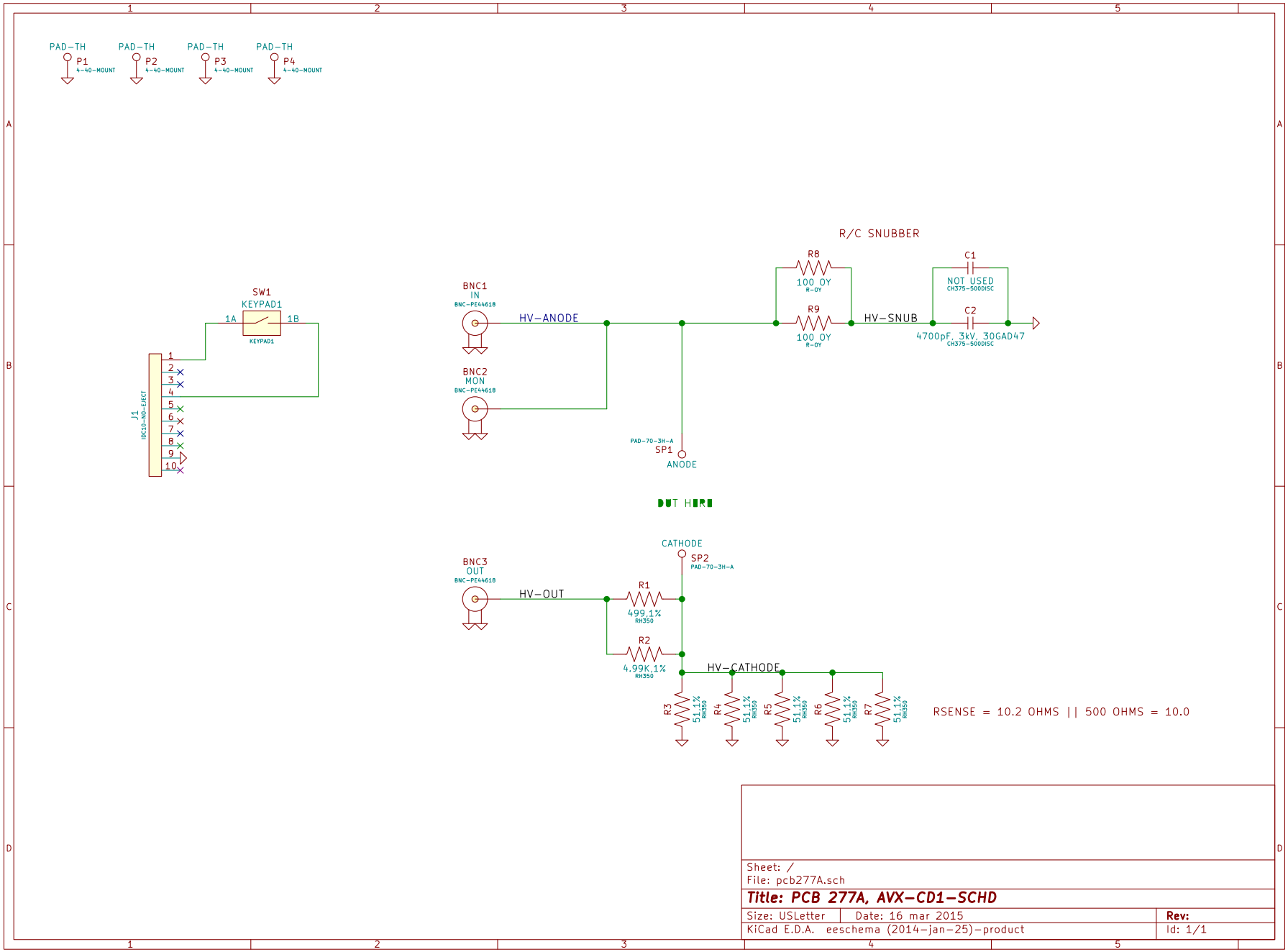


Title	LCD CIRCUITS, MECHANICAL
Date	3-Mar-2011
Revision	
Z:\mjcfiles\pcb\104e\keypad-2010.ddb - Documents\LCD-BUTT.SCH	

MAIN WIRING


PS3
PS1
PS2
235 A
HV+
HV-
SSR
N/C
VC
GND
+LV
CHS GND
R7 =5K 3266W
R6 =3.9K
R8 =100 OY
R9 =1K OY
R5 =NOT USED
R3 =NOT USED
U1 =M5-S24/A/Y
VSLEW, 0 TO +24V ABOVE HV-
HV-, 0 TO -800V
+15V
+5V
GND
POS OLO
M1
SCHD PG-N
HV+
N/O
HVSLEW
GND
+15V
+5V
HV-
SSRR
TRG+
OUT
TRG-
CONN4
OUT (REAR PANEL)
BD1
PCB 201A INTERLOCK
CONTROL (TO REAR DB9)
GND
ON
ALARM
+5V ON/OFF
SSR IN
SSR OUT
BD2
PCB104E KEYPAD
A
K
TEMP
0V
AUX
SYNC
CONN1
LAN
VPRF
VSPARE
+15V ON/OFF
+5V ON/OFF
MAIN OUT
SYNC OUT
EXT TRIG
GATE
XRLY 1
XRLY 2 (DUAL PW)
XRLY 3 (V-I)
XRLY 4 (EO)
XRLY 5
AMPLRNG 0
AMPLRNG 1
AMPLRNG 2
AMPLRNG 3
AMPLRNG 4
O.SPEEDUP-RNG
O.EA
O.SINE
O.TRI
O.SQU
O.LOGIC
O.ZOUT/PWRNG
O.POL
SPARE, 0-10V
PW, 0-10V
OFFSET, 0-10V
AMPLITUDE, 0-10V
OUT
VF
AUX
GND
AMP
NO
NC
C
SW
+24V
CONN2
GATE
CONN3
EXT TRIG
TRF
OP1B MAIN BOARD, PCB 255B2
BD5
+24V, NO OLO
BD4
FIXED POS PW (250us)
OUT SMA
IN SMA
241B
MIN RNG
OUT
IN
RNG
VPW
GND
-15V
+15V
CHANGES ON THIS 241B:
1. CHANGE R3 TO 470 OHMS (RIN)
2. REMOVE R16
3. INSTALL R17 = 0
4. INSTALL C11 = 0.1uF POLY
TO OP1B U7-13, SHORT AND UNHARNESSED
OP1B MODS:
REMOVE U4, R5
JUMPER R10 (SIDE CLOSEST TO TP4) TO Q3 (PAD CLOSEST TO Q2)
JUMPER R5 (PAD NEAREST TP2) TO R13 (PAD NEAREST REAR)
AVR-CD1-B-SCHD WIRING
Printed
17-Apr-2015
Revision
3B
Z:\mjcfiles\circuits\avr-N\avr-n.Ddb - AVR-CD1-B-SCHD\SCHD V3.SCH

TEST JIG WIRING (AVX-CD1-SCHD)



PERFORMANCE CHECK SHEET