AVTECH ELECTROSYSTEMS LTD.

NANOSECOND WAVEFORM ELECTRONICS
SINCE 1975

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BOX 5120, LCD MERIVALE
OTTAWA, ONTARIO
CANADA K2C 3H4

INSTRUCTIONS

MODEL AVR-EB7-B

± 200 mA REVERSE RECOVERY

MEASUREMENT SYSTEM

WITH < 2.5 ns SWITCHING TIME

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)
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Manual Reference: /fileserver1/officefiles/instructword/avr-eb/avr-eb7-b/AVR-EB7-B,ed1.odt.
Last modified February 29, 2024.

INTRODUCTION

The AVR-EB7-B is a high performance, GPIB and RS232-equipped instrument capable of generating a bipolar waveform into a 50 Ohm resistance. Normally, a diode will be placed in series with this resistance, allowing diode currents of up to +/- 200 mA to be generated.

More specifically, the AVR-EB7-B mainframe generates a 2 us wide forward-bias pulse with amplitude adjustable up to +10V / +200 mA. A negative pulse is super-imposed onto the forward pulse 500 ns after the start of the forward pulse. The amplitude of the negative is nominally adjustable up to -20V, for a total output of +10V-20V = -10V or -200 mA. (The negative voltage can actually be adjusted to -26V, to provide some margin for diodes with high effective resistance.) The negative pulse lasts for 200 ns. After that, the output waveform becomes positive again, completing the 2 us forward pulse.

The mainframe output has a forward-to-reverse voltage switching time of < 2.5 ns (typically 1.0 ns), approximately. The speed of the waveform that is actually applied to the DUT depends on the test jig used.

Standard AVR-EB7-B models include one AVX-TRR-MIX diode test jig. The instrument mainframe is connected to the test jig using one coaxial cable and one DB-9 control cable. The standard test jig contains a variety of pin sockets and posts, which may be used to hold the diode device under test (DUT). The test jig has a hinged lid, which must be fully closed to protect the user from high voltages. The output will be automatically disabled if the lid is left open. The standard AVX-TRR-MIX test jig will accommodate TO-220AC (2 lead) packages, DO-style packages with (leads bent at 90°), and standard and reverse-polarity TO-3 packages.

The AVR-EB7-B may also be provided with different or additional a customized test jigs, to meet particular customer package requirements.

The AVR-EB7-B 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-EB7-B 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[1]:	AVR-EB7-B	
Recovery type:	Reverse recovery	
Intended application:	High-speed small-signal diodes	
Basic waveform:	A positive pulse interrupted by a negative pulse	
Pulse polarity:	-	+
Voltage output[2,5,7]: (to R_L = 50Ω)	-0.2V to -20V	+0.1V to +10V
Corresponding diode current[2,5] (approx., depends on V_{DIODE}):	-10 mA to -200 mA	+10 mA to +200 mA
Pulse width (FWHM):	200 ns	500 ns[9]
Rise time(10%-90%):	< 2.5ns[10]	< 20 ns
Output impedance during pulse (inside the mainframe):	50 Ohms	
Maximum PRF:	5 kHz	
Delay:	500 ns after start of +pulse[6]	0 to ±1s, variable
Included test jig[3]:	AVX-TRR-MIX	
Connectors:	BNC on mainframe, SMA on jigs	
GPIB & RS-232:	Standard on -B units. See http://www.avtechpulse.com/gpib for details.	
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	

1) -B suffix indicates IEEE-488.2 GPIB and RS-232 control of amplitude, pulse width, PRF and delay (see http://www.avtechpulse.com/gpib).
2) For operation at amplitudes of less than 10% of full-scale, best results will be obtained by setting the amplitude near full-scale and using external attenuators on the output.
3) Customized jigs available upon request.
4) The 10 ns (10%-90%) rise time filter is included as a standard feature. To add an 8 ns filter, add the -F8NS option to the model number. To add a 12 ns filter, add the -F12NS option to the model number. To add a 20 ns filter, add the -F20NS option to the model number. The rise time filter rise time accuracy is ±20%.
5) The amplitude settings should not be relied upon for any degree of accuracy, because the dynamics of the device under test can affect the actual generated waveforms. Amplitude settings should always be verified by oscilloscope measurements.
6) Thus the diode must come to forward steady-state within 500 ns.
7) The diode must have a breakdown voltage exceeding these amplitude limits. Contact Avtech for special arrangements if $I_{MAX} \times 50\Omega > V_{BR}$.
8) Maximum pulse width is reduced to 500 ns for units with the -DIPFP option.
9) The full forward pulse width is 2 us, but the reverse pulse is super-imposed on the forward pulse 500 ns after the start of the forward pulse.
10) Increases to 4.5 ns for units with the -DIPFP option, due to the switching relay inductance.
11) Depends on the parasitic inductance of the DUT and its leads.

REGULATORY NOTES

FCC PART 18

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

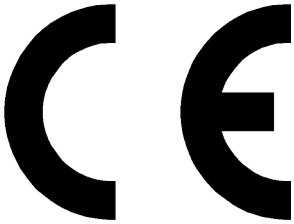
This instrument is enclosed in a rugged metal chassis and uses a filtered power entry module. The main output signal is provided on a shielded connector that is intended to be used with shielded coaxial cabling and a shielded load. Under these conditions, the interference potential of this instrument 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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Ottawa, Ontario
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declare that this pulse generator meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance pertains to the following specifications as listed in the official Journal of the European Communities:

EN 50081-1 Emission

EN 50082-1 Immunity

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

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

DIRECTIVE 2002/95/EC (RoHS)

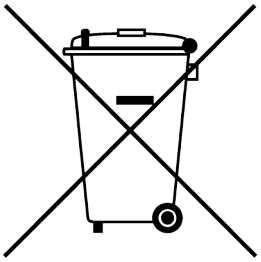
This instrument is exempt from Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment. Specifically, Avtech instruments are considered "Monitoring and control instruments"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

DIRECTIVE 2002/96/EC (WEEE)

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

Customers who have purchased Avtech equipment through local representatives should consult with the representative to determine who has responsibility for WEEE compliance. Normally, such responsibilities 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.



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.

The following items should be with the instrument:

1) A power cord.
2) A GPIB cable
3) Two instrumentation manuals (this manual and the “Programming Manual for -B Instruments”).
4) One AVX-TRR-MIX test jig (with a hinged lid)
5) Two 60 cm SMA-to-SMA cables.
6) A 2 meter DB-25 control cable.

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.

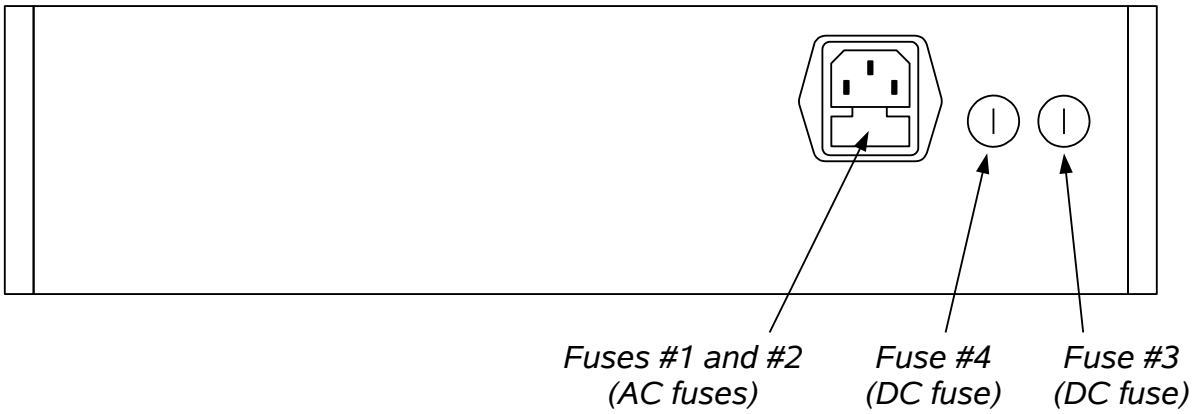
ENVIRONMENTAL CONDITIONS

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.

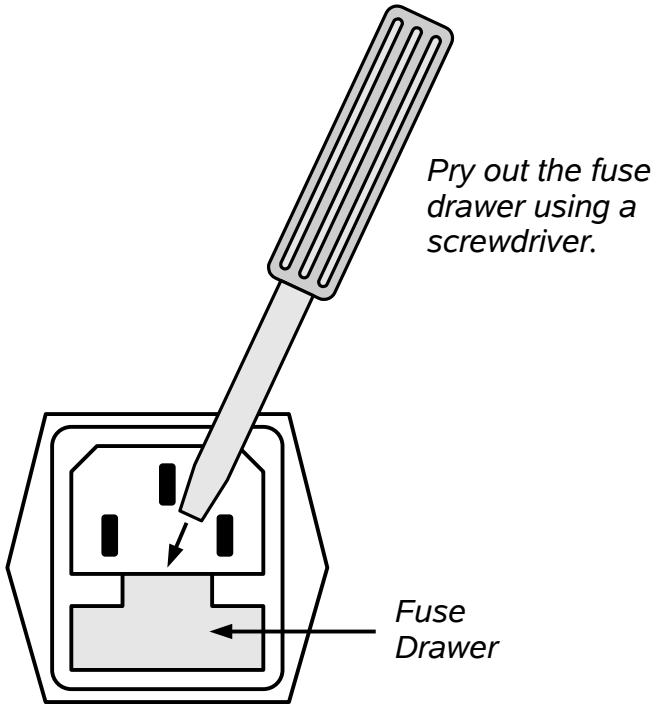
FUSES

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

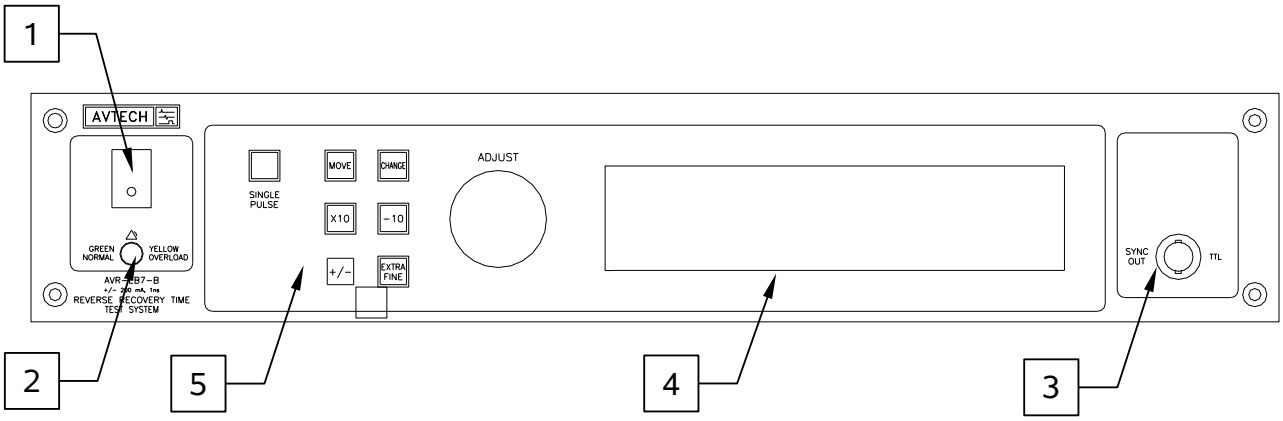
The following table lists the required fuses:

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 may be a delay of several seconds before the instrument appears to respond.

2. OVERLOAD Indicator. When the instrument is powered, this indicator is normally green, indicating normal operation. If this indicator is yellow, an internal automatic overload protection circuit has been tripped. If the unit is overloaded (by operating at an exceedingly high duty cycle or by operating into a very low impedance), the protective circuit will disable the output of the instrument and turn the indicator light yellow. The light will stay yellow (i.e. output disabled) for about 5 seconds after which the instrument will attempt to re-enable the output (i.e. light green) for 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.

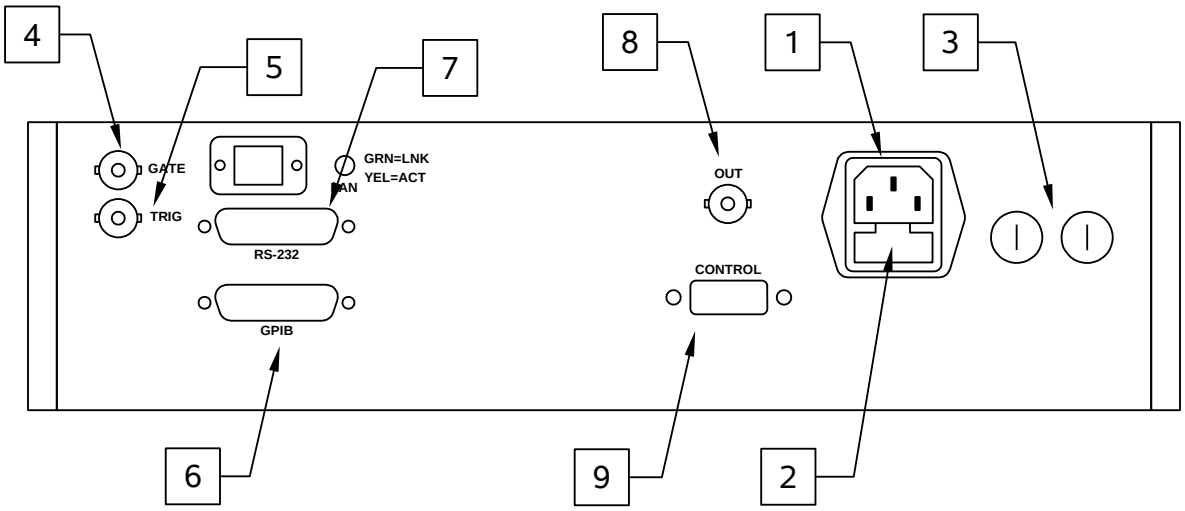
3. SYNC OUT. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal leads (or lags) the main output by a duration set by the "DELAY" controls and has an approximate amplitude of +3 Volts to R_L > 50Ω with a pulse width of approximately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



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. See the "Programming Manual for -B Instruments" for more details on RS-232 control.

8. OUT CONNECTOR. This SMA 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 SMA-to-SMA coaxial cable.

   The voltages on the OUT connector are not hazardous.

9. CONTROL Connector(s). Depending on the exact configuration of the instrument, one or two "CONTROL" connectors may be present on the back panel.

   If just one CONTROL connector is present, it will be a DB-9 female connector.

   If two CONTROL connectors are present, one will be a DB-9 female connector and one will be a DB-25 female connector. Only one of the two connectors should be used at a time. Use the one that matches the CONTROL connector on the test jig being used (i.e., DB-9 or DB-25).

   The mainframe CONTROL connector should be connected to the corresponding connector on the test jig using the supplied cable. This cable contains the safety interlock signals that ensure that the test jig lid is closed.

   For DB-9 cables, the pinout is as follows:

   Pin 1 - To test jig switch 1.
   Pin 2 - To test jig switch 2.
   Pin 3 - N/C.
   Pin 4 - N/C.
   Pin 5 - Ground.
   Pin 6 - To test jig switch 1.
   Pin 7 - To test jig switch 2.
   Pin 8 - N/C.
   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.

   For DB-25 cables, the pinout is as follows:

   Pin 1 - To test jig switch 1.
   Pin 2 - To test jig switch 2.
   Pin 3 - N/C.
   Pin 4 - N/C.
   Pin 5 - Ground.
   Pin 6 - Ground.
   Pin 7 - Ground.

Pin 8 - +5V DC.
Pin 9 - +5V DC.
Pin 10 - pin socket select signal (TTL).
Pin 11 - pin socket select signal (TTL).
Pin 12 - pin socket select signal (TTL).
Pin 13 - pin socket select signal (TTL).
Pin 14 - To test jig switch 1.
Pin 15 - To test jig switch 2.
Pin 16 - N/C.
Pin 17 - Safety sensor power supply (+15V through 680 Ohms).
Pin 18 - N/C.
Pin 19 - Ground.
Pin 20 - +5V DC.
Pin 21 - +5V DC.
Pin 22 - pin socket select signal (TTL).
Pin 23 - pin socket select signal (TTL).
Pin 24 - pin socket select signal (TTL).
Pin 25 - pin socket select signal (TTL).

When the test jig lid is safely closed, Pin 1 is shorted to Pin 14, and Pin 2 is shorted to Pin 15.

TIMING CONTROL

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: OUT and SYNC.

The OUT output is a bipolar signal that may either drive a 50 Ohm load, or the test described later. The positive and negative amplitudes are adjustable. The pulse widths are fixed.

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 PULSE output. When the delay is set to a negative value the SYNC pulse follows the PULSE output.

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

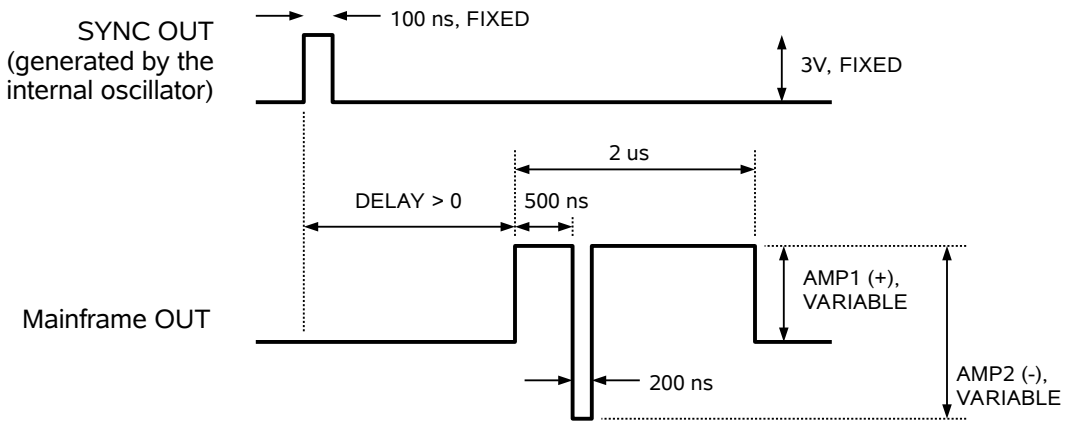


Figure A

If the delay is negative, the order of the SYNC and PULSE outputs is reversed:

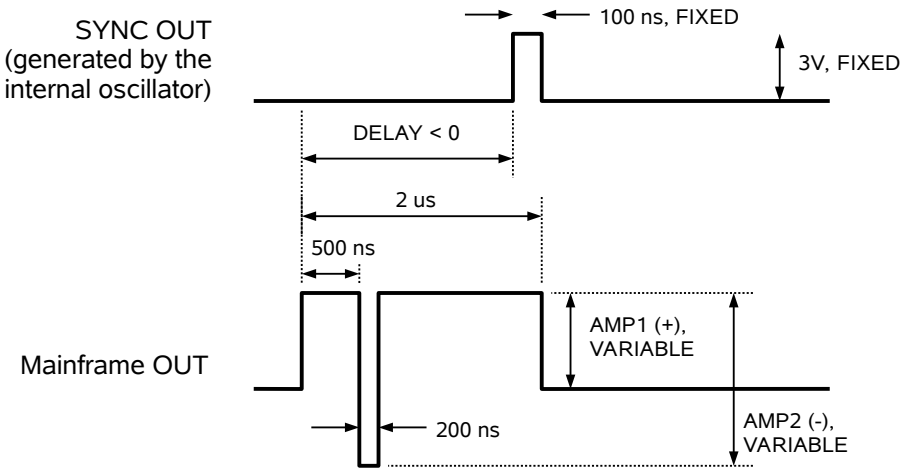


Figure B

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

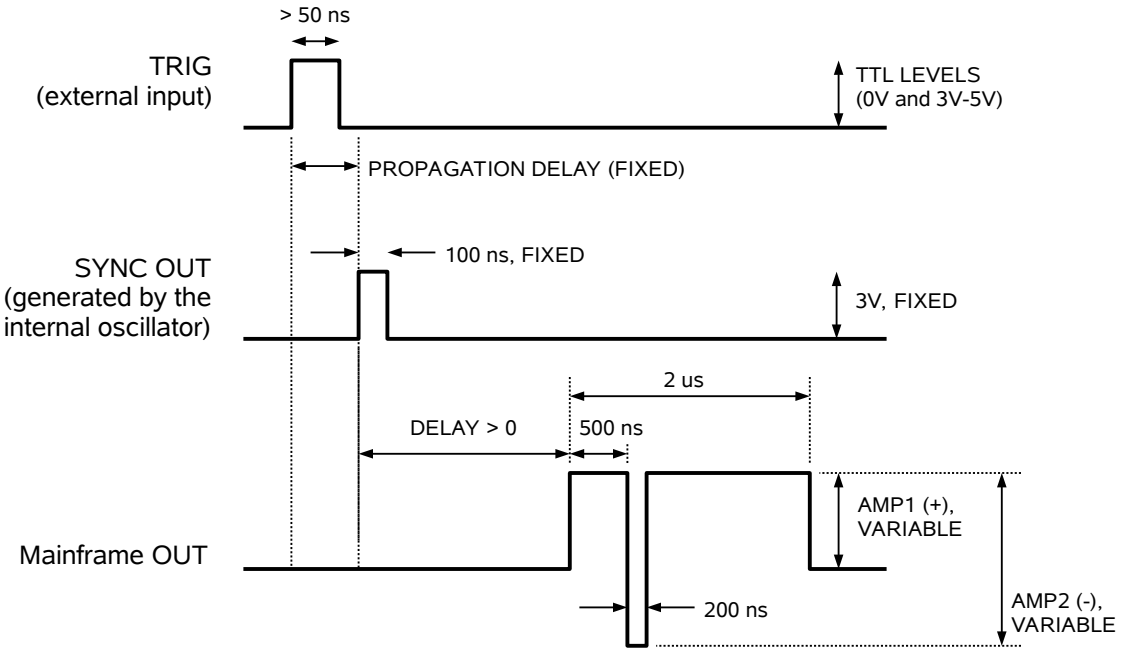


Figure C

As before, if the delay is negative, the order of the SYNC and PULSE outputs is reversed.

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

TRIGGER MODES

This instrument has four trigger modes:

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

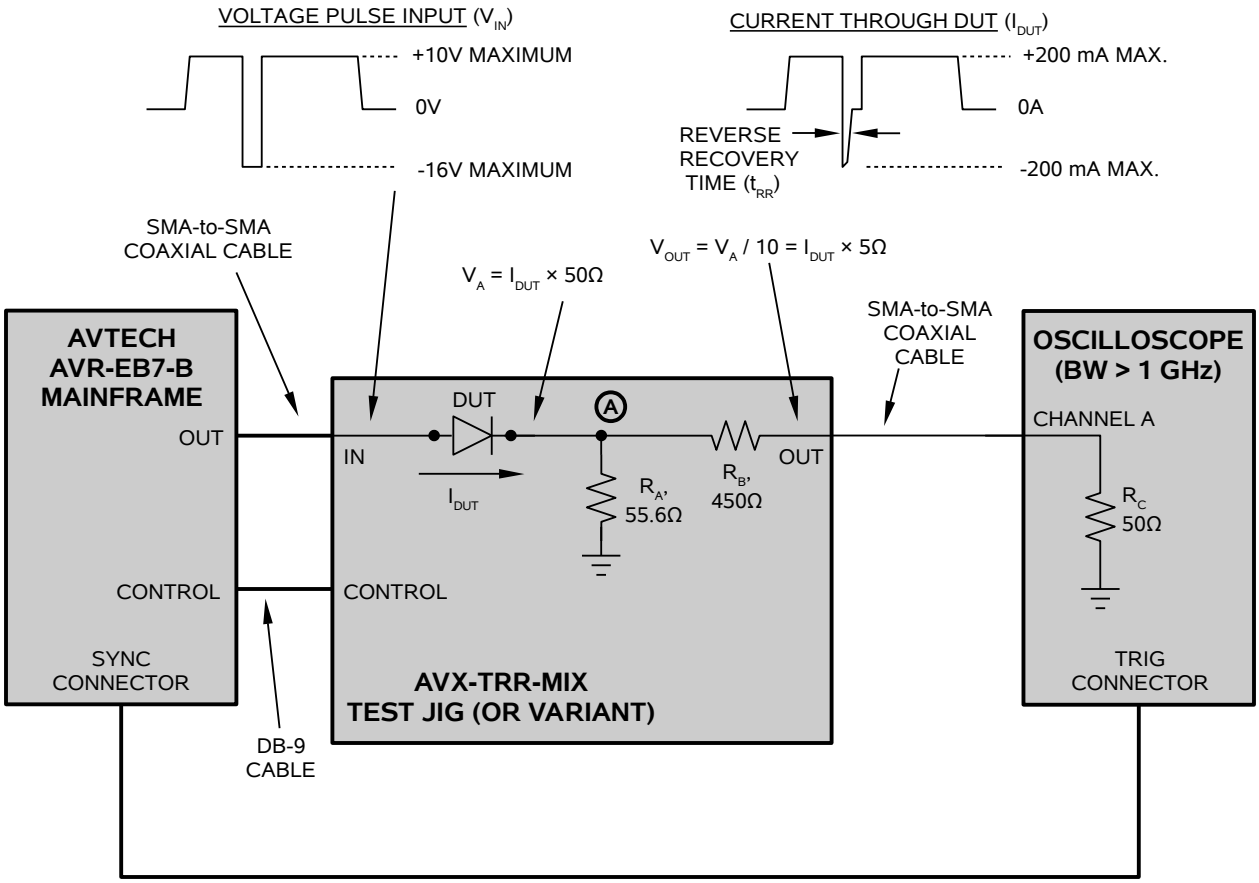
These modes can be selected using the front panel trigger menu, or by using the appropriate programming commands. (See the “Programming Manual for -B Instruments” for more details.)

GATING MODES

Triggering can be suppressed by a TTL-level signal on the rear-panel GATE connector. The instrument can be set to stop triggering when this input high or low, using the front-panel gate menu or the appropriate programming commands. 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-EB7-B is shown in the figure below. The OUT output on the instrument mainframe is connected to the IN input on the AVX-TRR-MIX test jig using the supplied SMA-to-SMA coaxial cable, and the control cable is connected using the supplied DB-9 cable.



⚠ A 50 Ohm resistance (R_C in the diagram above) must be connected to ground on the output. This can be a discrete resistor, a feed-through terminator, or the input impedance of an oscilloscope. If a high-speed sampling oscilloscope is used, the input should be protected by adding attenuator on the input. In the diagram above, the supplied 50 Ohm feed-through terminator is used to provide the required 50 Ohm resistance.

The total effective resistance of resistors R_A, R_B, and R_C in the diagram above is 50 Ohms. Thus, the voltage at point "A" is simply given by:

$$V_A = I_{DUT} \times 50\Omega$$

where I_{DUT} is the current through the device under test. A 450 Ohm resistance (R_B) is present in series with the measurement output. When a 50 Ohm resistance (R_C) is installed on the output (by the user), the output voltage will be one-tenth of V_A due to the resistor-divider effect. That is:

$$V_{OUT} = V_A / 10 = I_{DUT} \times 5\Omega$$

This is the key equation for relating the observed voltage waveform to the DUT current.

SETTING THE AMPLITUDE LEVELS

The amplitudes of the positive and negative portions of the mainframe OUT waveform may be set from the front panel of the instrument, or by computer command.

The positive voltage ("AMP1" on the front panel display) is related to the forward diode current by:

$$I_{FORWARD} \approx (AMP1 - V_F) / (50\Omega + R_{DIODE\text{-}FORWARD})$$

where V_F is the forward voltage drop of the diode (typically 0.7V for the classic silicon PN junction diode, and usually somewhat lower for a Schottky diode), and $R_{DIODE\text{-}FORWARD}$ is the effective resistance of the diode under forward bias.

The negative voltage ("AMP2" on the front panel display) is related to the reverse diode current by:

$$I_{REVERSE} \approx (AMP1 + AMP2) / (50\Omega + R_{DIODE\text{-}REVERSE}).$$

Where $R_{DIODE\text{-}REVERSE}$ is the effective resistance of the diode under reverse bias.

⚠ The reverse current is controlled by the sum of the two amplitudes, not by just the negative voltage. For instance, if AMP1 = +10V, then AMP2 must be more negative than -10V to generate a negative current.

For example, to generate a +100 mA forward current and a -200 mA reverse current into an ideal diode with V_F = 0.7V, you would set AMP1 = +5.7V and AMP2 = -15.7V, so that (+5.7V – 0.7V) / 50 Ohms = + 100 mA and (+5.7V + (-15.7V)) / 50 Ohms = - 200 mA.

It is important to note that $R_{DIODE\text{-}FORWARD}$ and $R_{DIODE\text{-}REVERSE}$ are not the same, and that they may change during the transient. Furthermore, depending on the design of the diode under test, it is possible that $R_{DIODE\text{-}REVERSE}$ may be so high that it is impossible to achieve the full -200 mA of reverse current. (The ideal diode would of course have $R_{DIODE\text{-}REVERSE} = \infty$). The AMP2 voltage can actually be increased to -26V (rather than the nominal maximum of -20V) to increase the likelihood of obtaining the full -200 mA of reverse current.

⚠ At low test currents (~ 10 mA), the I-V curve of the diode will normally be highly nonlinear, and the required negative voltage may not be well-predicted by the above equations. The user will normally need to adjust the voltage amplitudes based on the actual measured output currents, especially for low current levels.

Most test procedures for measuring recovery time will use a particular ratio of forward to reverse currents - for example, $I_{REVERSE}$ / $I_{FORWARD}$ = 2.

AMPLITUDE ACCURACY

⚠ Due to the variations in V_F and $R_{DIODE\text{-}FORWARD}$ and $R_{DIODE\text{-}REVERSE}$ as a function of operating conditions, the AMP1 and AMP2 settings *should not be relied upon for any degree of accuracy*. Instead the voltage at the OUT terminal on the test jig *must* be monitored with a calibrated oscilloscope.

INCORRECT ORIENTATION

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.

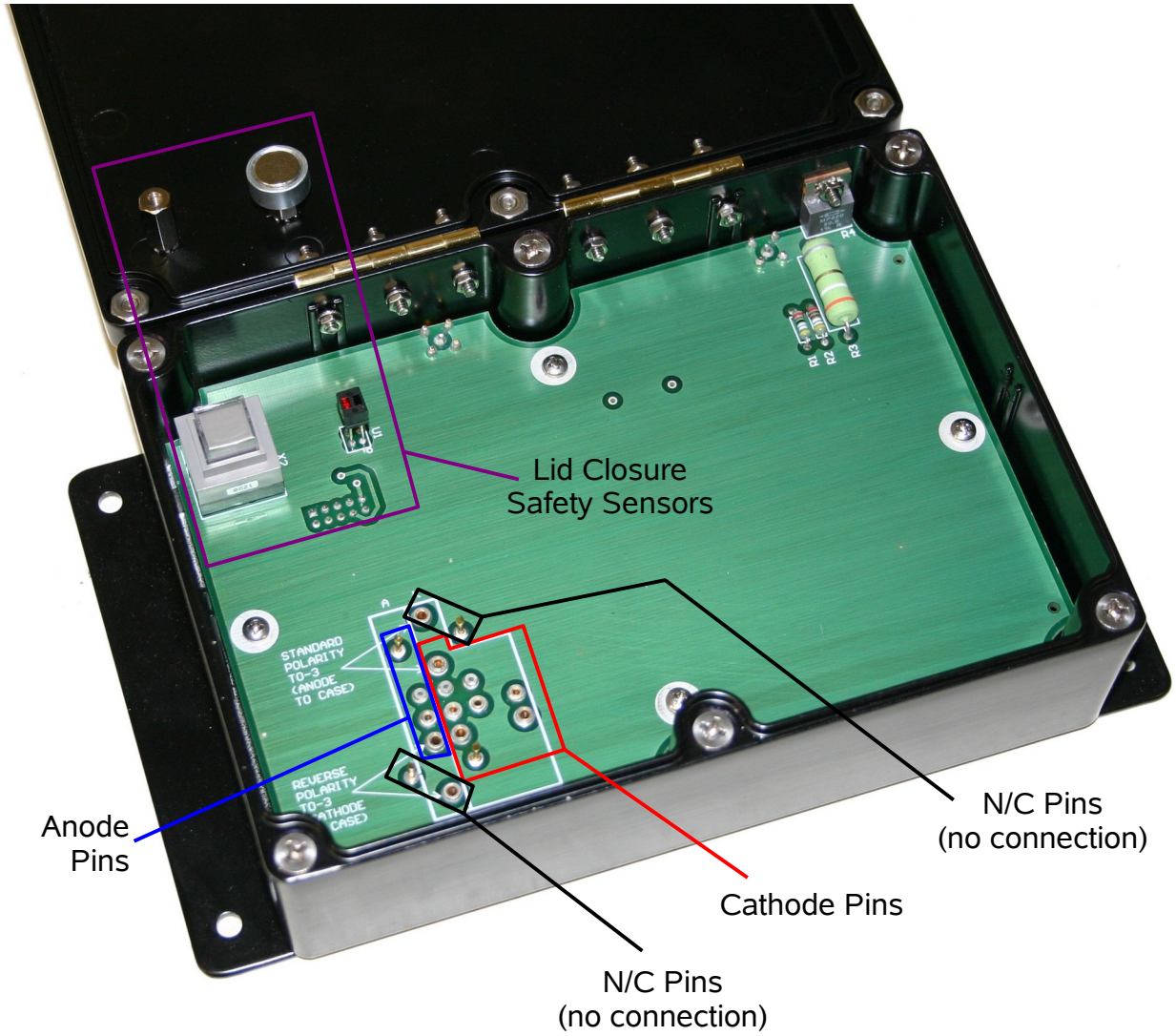
The AVR-EB7-B does not generate any hazardous voltages on the outputs.

STANDARD TEST JIG MECHANICAL ASPECTS

One AVX-TRR-MIX test jig is normally supplied with the mainframe, unless the customer has requested a different or additional test jigs.

AVX-TRR-MIX TEST JIG

The AVX-TRR-MIX test jig 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, TO-3 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.

The procedure for inserting most axial and TO-220 packages is straightforward. Simply insert the DUT between one of the Anode pin sockets (in the blue area above) and one of the Cathode sockets (in the red area above). Select the sockets with the most appropriate hole size, and try to minimize all lead lengths, to minimize parasitic inductance.

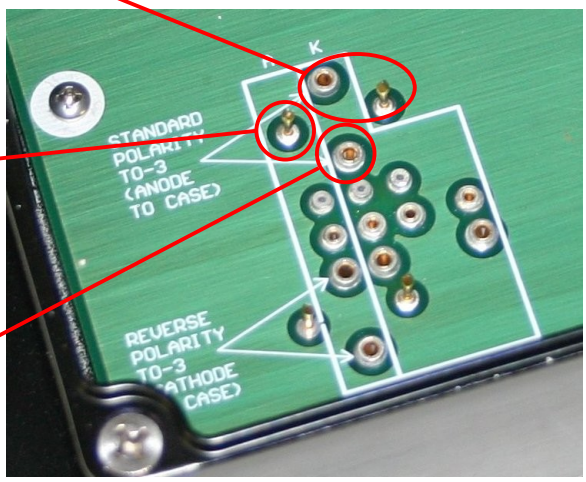
This jig will also accommodate a number of TO-3 configurations, outlined below. If the case is connected to the anode, and the pin(s) are used for the cathode, the arrangement shown below must be used:

This socket and spring pin provide mechanical support only. They are not electrically active.

This spring pin must contact the underside of the case. It provides the anode connection.

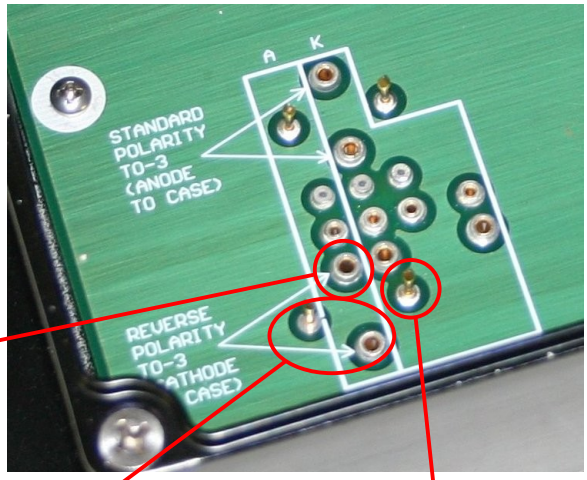
The cathode pin of interest must be inserted into this socket. For dual-diode devices, rotate the TO-3 package so that the desired diode cathode is inserted here.

For TO-3 packages with Case = Anode



If the case is connected to the cathode, and the pin(s) are used for the anode, the arrangement shown below must be used:

For TO-3 packages with Case = Cathode



The anode pin of interest must be inserted into this socket. For dual-diode devices, rotate the TO-3 package so that the desired diode anode is inserted here.

This socket and spring pin provide mechanical support only. They are not electrically active.

This spring pin must contact the underside of the case. It provides the cathode connection.

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

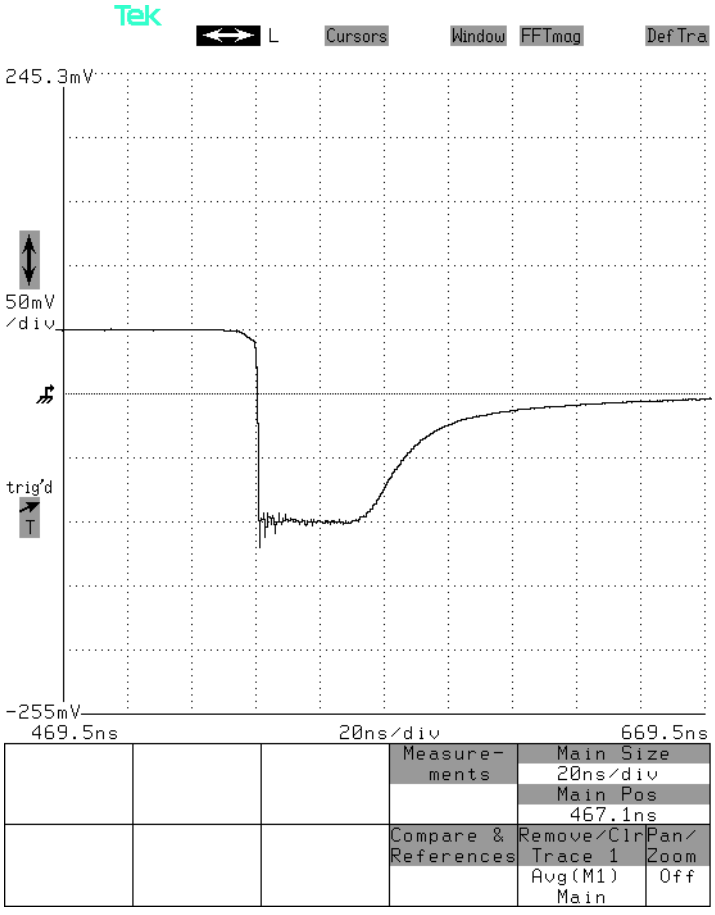
TYPICAL RESULTS

Obtaining meaningful results with the AVR-EB7-B requires care, experience, and an understanding of diode transient behavior and the impact of inductive and capacitive parasitics. To assist the user, typical results for commercially available diodes are provided below. The user should be able to reliably duplicate these results.

The waveforms in this section were generated using a Tektronix 11801C sampling oscilloscope with 20 dB of attenuation. The bandwidth of the oscilloscope is 18 GHz.

1N4937 RESULTS

The On Semiconductor 1N4937 is a 1A, 600V DO-41 fast-recovery rectifier. With the amplitudes set to +5.3V and -16.2V to obtain I_F = +100 mA and I_R = -200 mA, the following reverse recovery waveform is obtained at the test jig "OUT" terminal of the AVR-TRR-MIX jig:

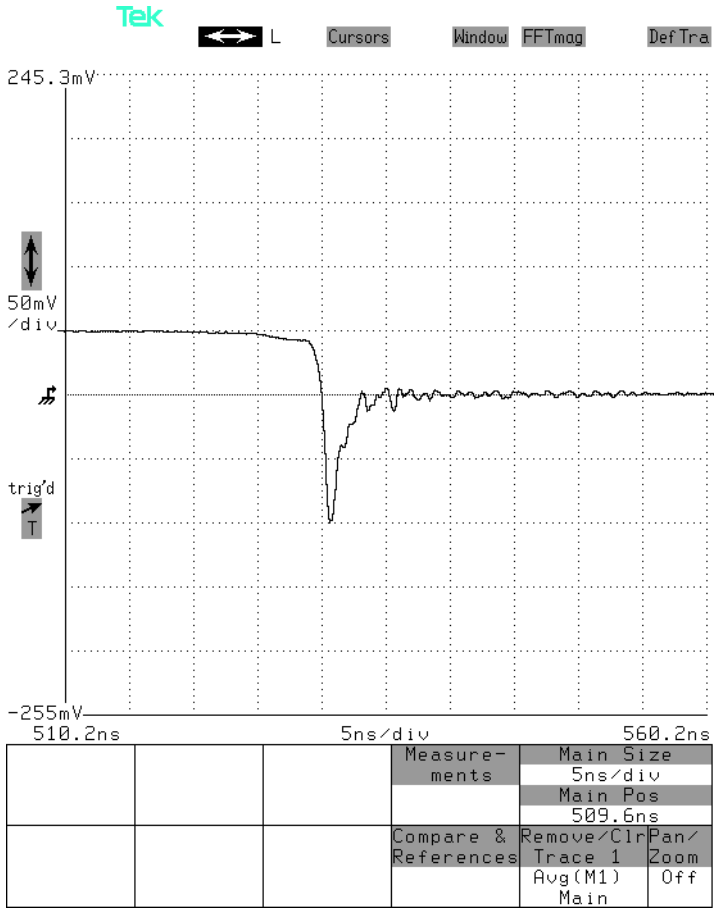


50 mV/div (= 100 mA/div), 20 ns/div.
AVX-TRR-MIX, S/N 12538.

The time to recovery to 25% of the maximum reverse current is approximately 60 ns.

1N4148 RESULTS

The 1N4148 is a faster, lower-current small-signal switching diode. Setting the amplitudes to obtain I_F = +100 mA and I_R = -200 mA, the following reverse recovery waveform is obtained at the test jig "OUT" terminal of the AVR-TRR-MIX jig:



50 mV/div (= 100 mA/div), 5 ns/div.
AVX-TRR-MIX, S/N 12538.

For this device, the transient is complete within 3 ns.

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 1000 Hz       (sets the frequency to 1000 Hz)
pulse:delay 1 us        (sets the delay to 1 us)
volt:ampl1 +10          (sets the positive pulse amplitude to +10 V)
volt:ampl2 -20          (sets the negative pulse amplitude to -20 V)
output on               (turns on the output)
```

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

```
*rst                    (resets the instrument)
trigger:source hold     (turns off all triggering)
output on               (turns on the output)
pulse:delay 1 us        (sets the delay to 1 us)
volt:ampl1 +10          (sets the positive pulse amplitude to +10 V)
volt:ampl2 -20          (sets the negative pulse amplitude to -20 V)
trigger:source immediate (generates a single non-repetitive trigger event)
trigger:source hold     (turns off all triggering)
output off              (turns off the output)
```

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

```
*rst                    (resets the instrument)
trigger:source external (selects internal triggering)
pulse:delay 1 us        (sets the delay to 1 us)
volt:ampl1 +10          (sets the positive pulse amplitude to +10 V)
volt:ampl2 -20          (sets the negative pulse amplitude to -20 V)
output on               (turns on the output)
```

These commands will satisfy 90% of your programming needs.

ALL PROGRAMMING COMMANDS

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

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]:		
:VOLTage		
[:LEVel]		
[:IMMediate]		
[:AMPLitude]	<numeric value>	
:PROTection		
:TRIPped?		[query only]
STATUS:		
:OPERation		
:[EVENt]?		[query only, always returns "0"]
:CONDition?		[query only, always returns "0"]
:ENABle	<numeric value>	[implemented but not useful]
:QUEStionable		
:[EVENt]?		[query only, always returns "0"]
:CONDition?		[query only, always returns "0"]
:ENABle	<numeric value>	[implemented but not useful]
SYSTem:		
:COMMunicate		
:GPIB		
:ADDRess	<numeric value>	
:SERial		
:CONTrol		
:RTS	ON | IBFull | RFR	
:[RECeive]		
:BAUD	1200 | 2400 | 4800 | 9600	
:BITS	7 | 8	
:ECHO	<boolean value>	
:PARity		
:[TYPE]	EVEN | ODD | NONE	
:SBITS	1 | 2	
:ERRor		

:[NEXT]?		[query only]
:COUNT?		[query only]
:VERSion?		[query only]
TRIGger:		
:SOURce	INTernal | EXTernal | MANual | HOLD | IMMediate	
*CLS		[no query form]
*ESE	<numeric value>	
*ESR?		[query only]
*IDN?		[query only]
*OPC		
*SAV	0 | 1 | 2 | 3	[no query form]
*RCL	0 | 1 | 2 | 3	[no query form]
*RST		[no query form]
*SRE	<numeric value>	
*STB?		[query only]
*TST?		[query only]
*WAI		[no query form]

MECHANICAL INFORMATION

TOP COVER REMOVAL

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

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

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

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

RACK MOUNTING

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

ELECTROMAGNETIC INTERFERENCE

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

MAINTENANCE

REGULAR MAINTENANCE

This instrument does not require any regular maintenance.

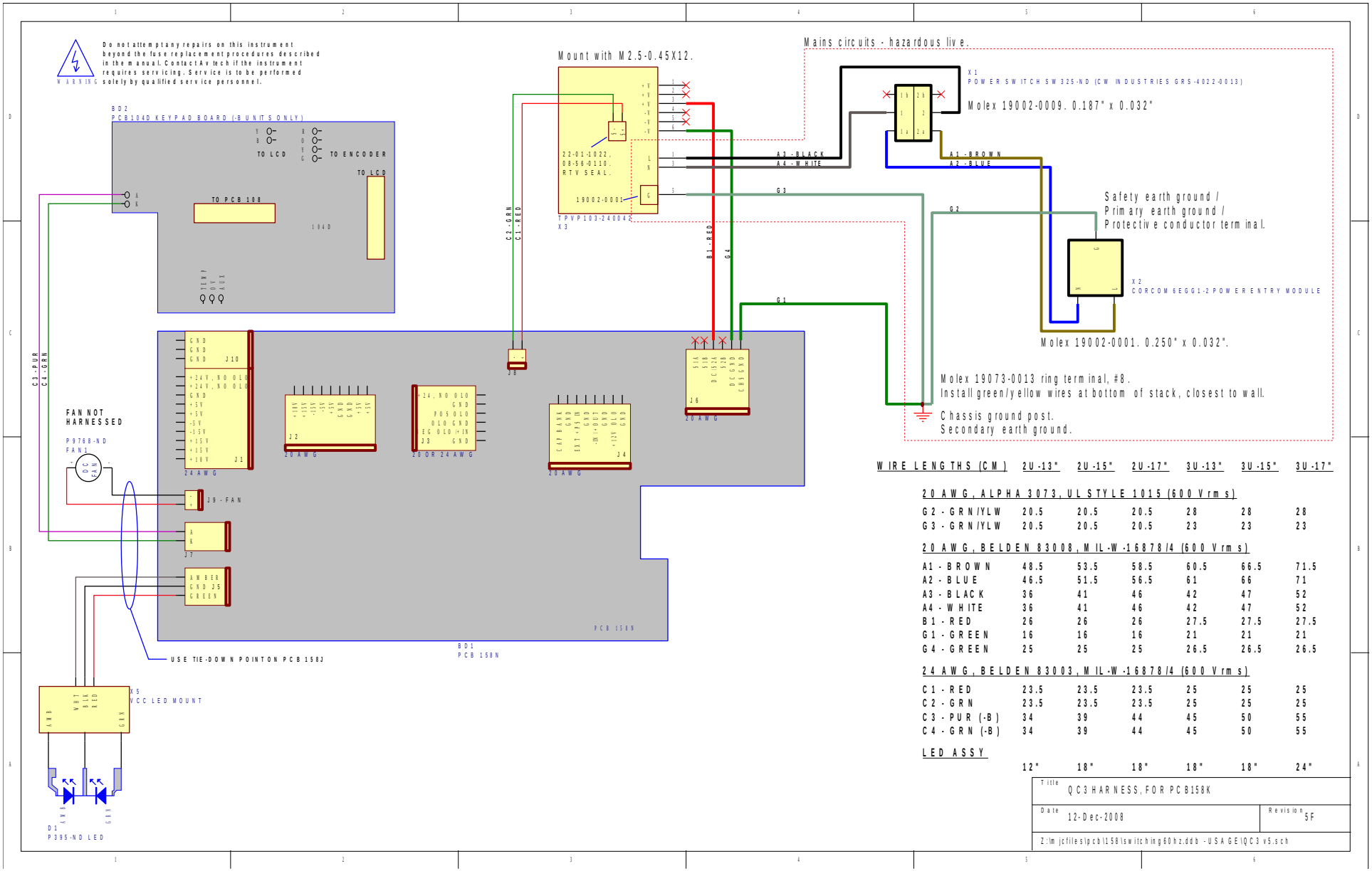
On occasion, one or more of the four rear-panel fuses may require replacement. All fuses can be accessed from the rear panel. See the “FUSES” section for details.

CLEANING

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

WIRING DIAGRAMS

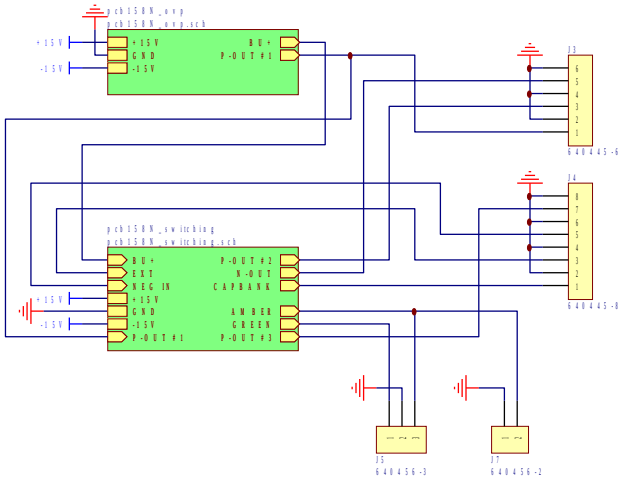
WIRING OF AC POWER



WIRE LENGTHS (CM)	2U-13"	2U-15"	2U-17"	3U-13"	3U-15"	3U-17"
20 AWG, ALPHA 3073, UL STYLE 1015 (600 Vrms)						
G2 - GRN/YLW	20.5	20.5	20.5	28	28	28
G3 - GRN/YLW	20.5	20.5	20.5	23	23	23
20 AWG, BELDEN 83008, MIL-W-16878/4 (600 Vrms)						
A1 - BROWN	48.5	53.5	58.5	60.5	66.5	71.5
A2 - BLUE	46.5	51.5	56.5	61	66	71
A3 - BLACK	36	41	46	42	47	52
A4 - WHITE	36	41	46	42	47	52
B1 - RED	26	26	26	27.5	27.5	27.5
G1 - GREEN	16	16	16	21	21	21
G4 - GREEN	25	25	25	26.5	26.5	26.5
24 AWG, BELDEN 83003, MIL-W-16878/4 (600 Vrms)						
C1 - RED	23.5	23.5	23.5	25	25	25
C2 - GRN	23.5	23.5	23.5	25	25	25
C3 - PUR (-B)	34	39	44	45	50	55
C4 - GRN (-B)	34	39	44	45	50	55
LED ASSY						
	12"	18"	18"	18"	18"	24"

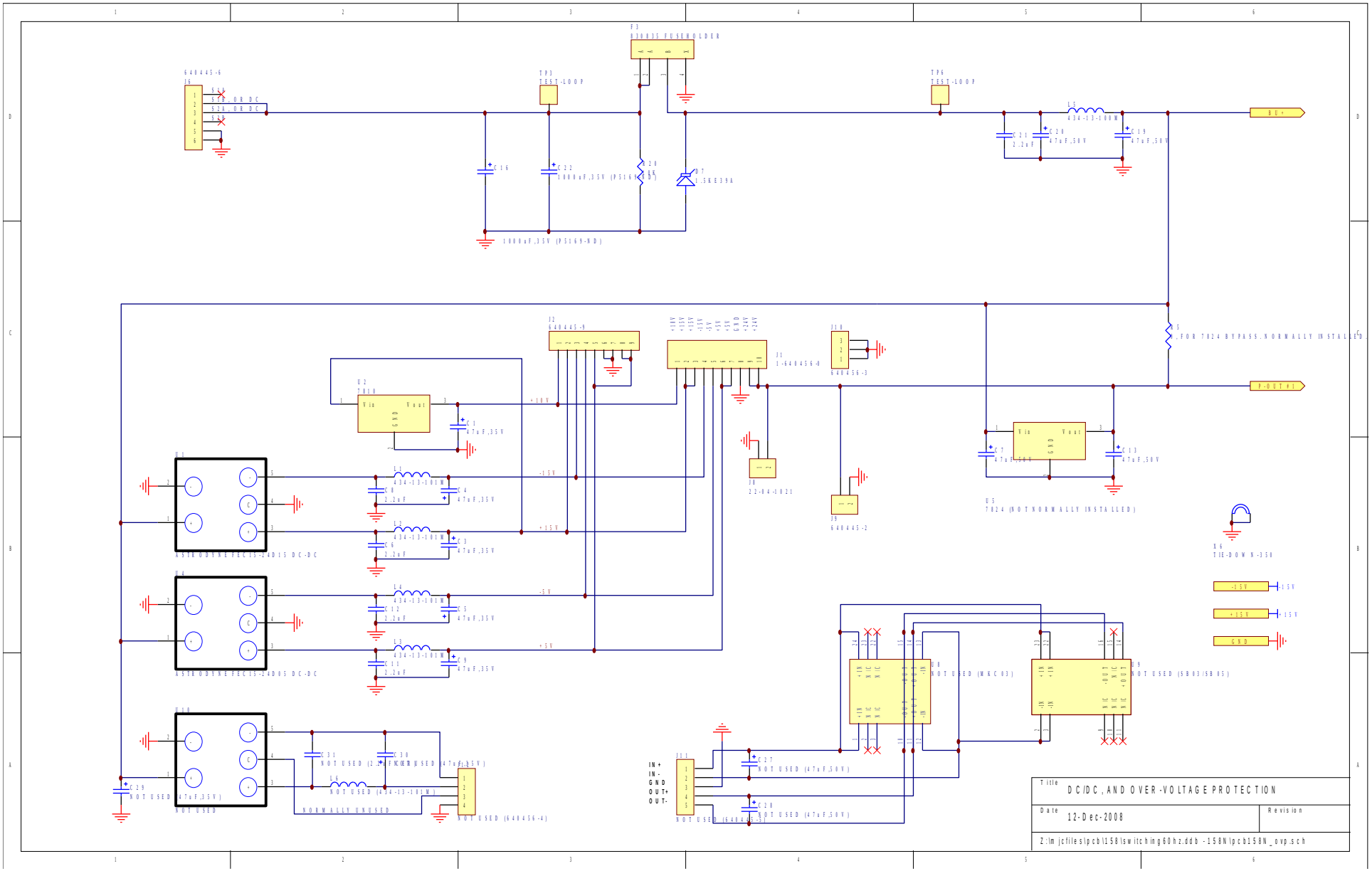
Title	QC3 HARNESS, FOR PCB158K
Date	12-Dec-2008
Revision	5F
	Z:\mjcfiles\pcb\158\switching60hz.ddb - USAGE\QC3 v5.sch

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

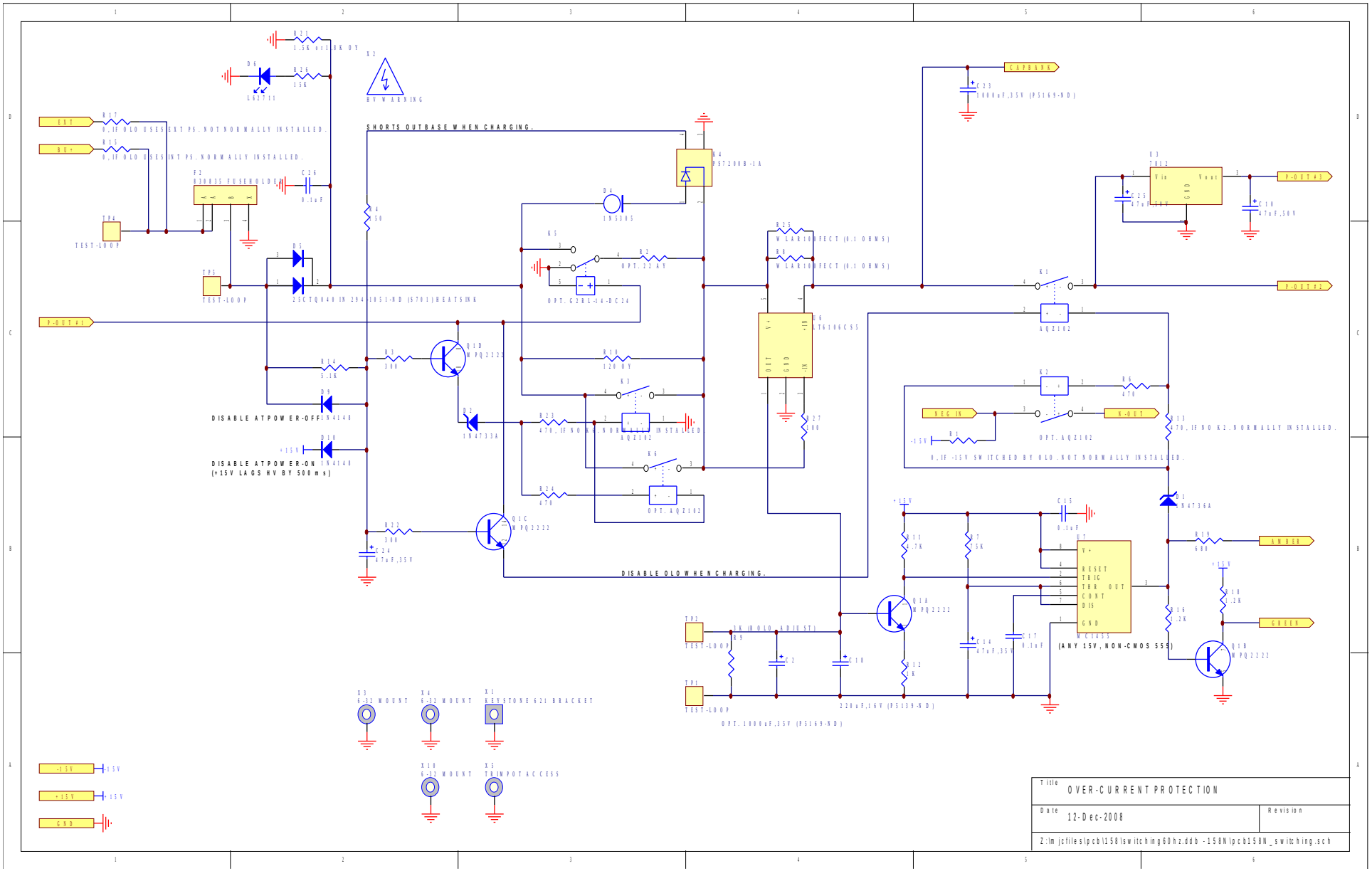


Title	LOW VOLTAGE DC/DC POWER SUPPLY
Date	12-Dec-2008
Revision	
Z:\mjcfiles\pcb158\switching60hz.ddb - 158N\pcb158N.sch	

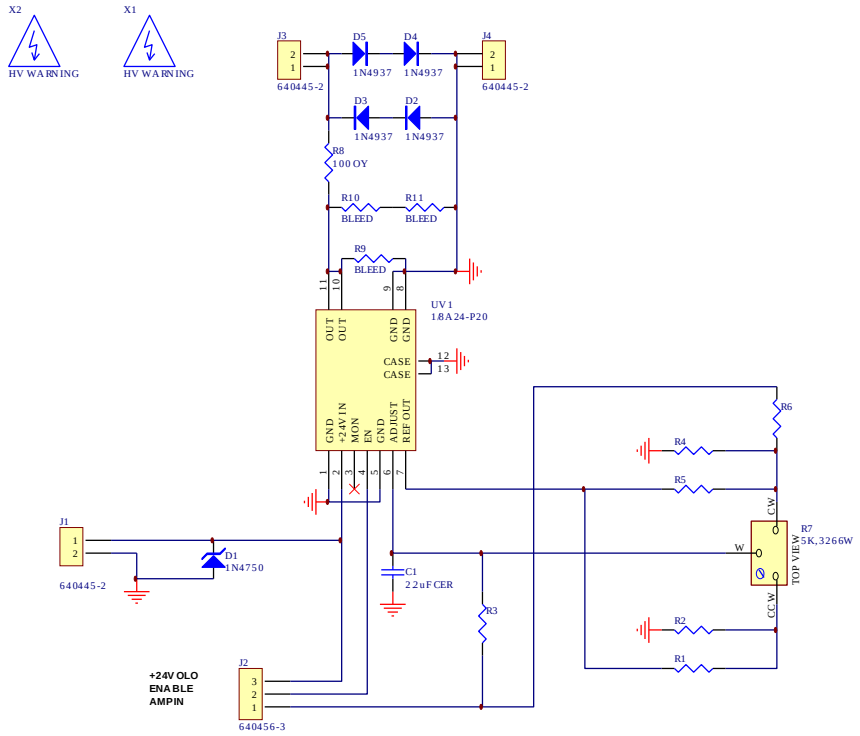
PCB 158N - LOW VOLTAGE POWER SUPPLY, 2/3



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

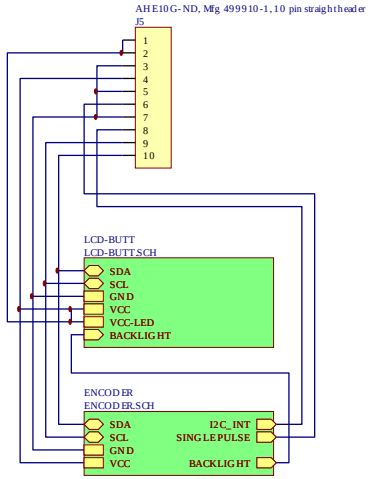


PCB 168B - HIGH VOLTAGE DC POWER SUPPLY



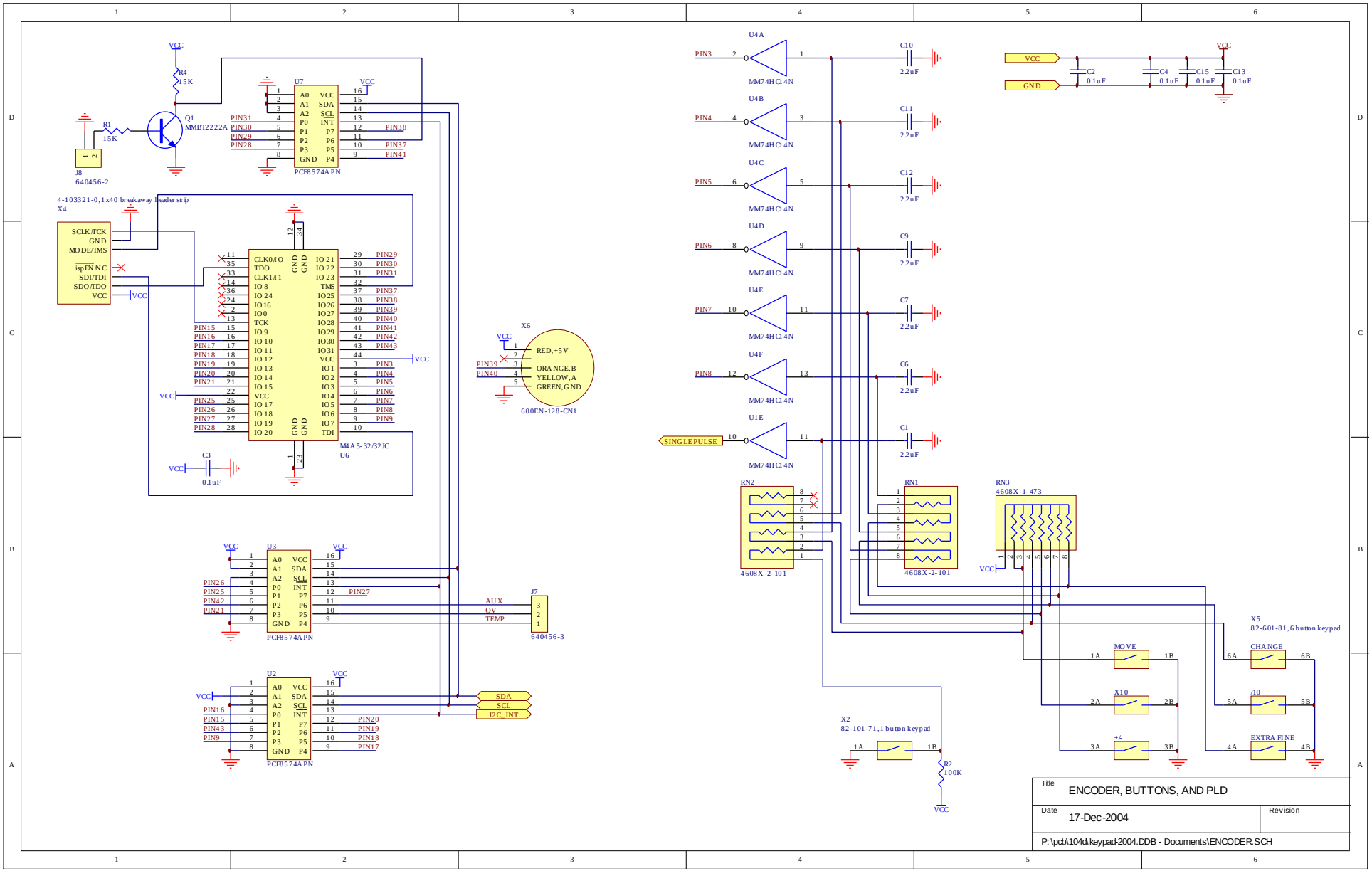
Title	UV-A CONTROL PCB
Date	3-Nov-2005
Revision	1
Z:\mjcfiles\pcb\168\UV-A control\UV-A control.ddb - 168B\PCB168B.sch	

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

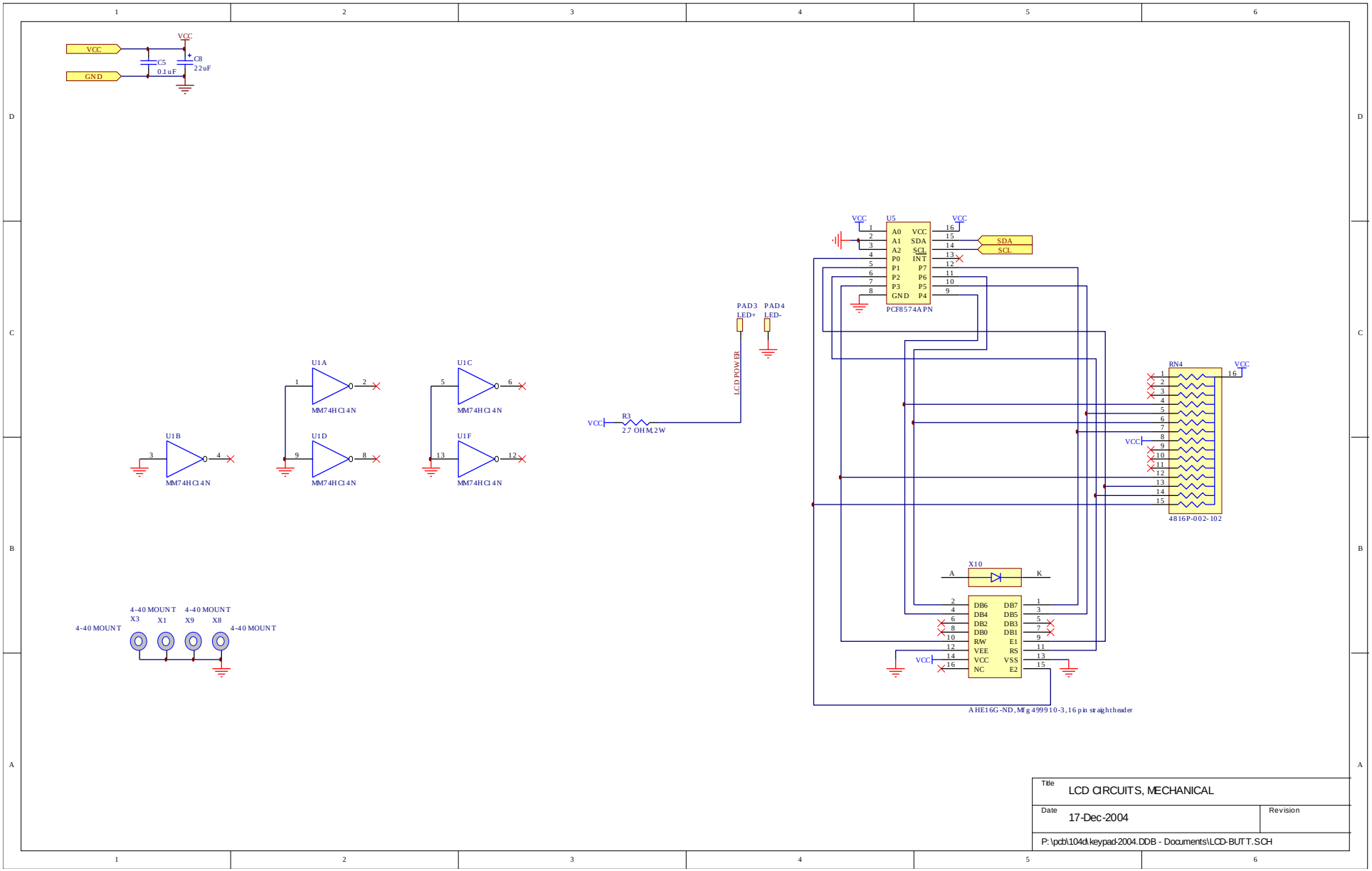


Title	PANEL TOP-LEVEL SCHEMATIC
Date	17-Dec-2004
Revision	
P:\pcb\104d\keypad-2004.DDB - Documents\Panelbrd.prj	

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

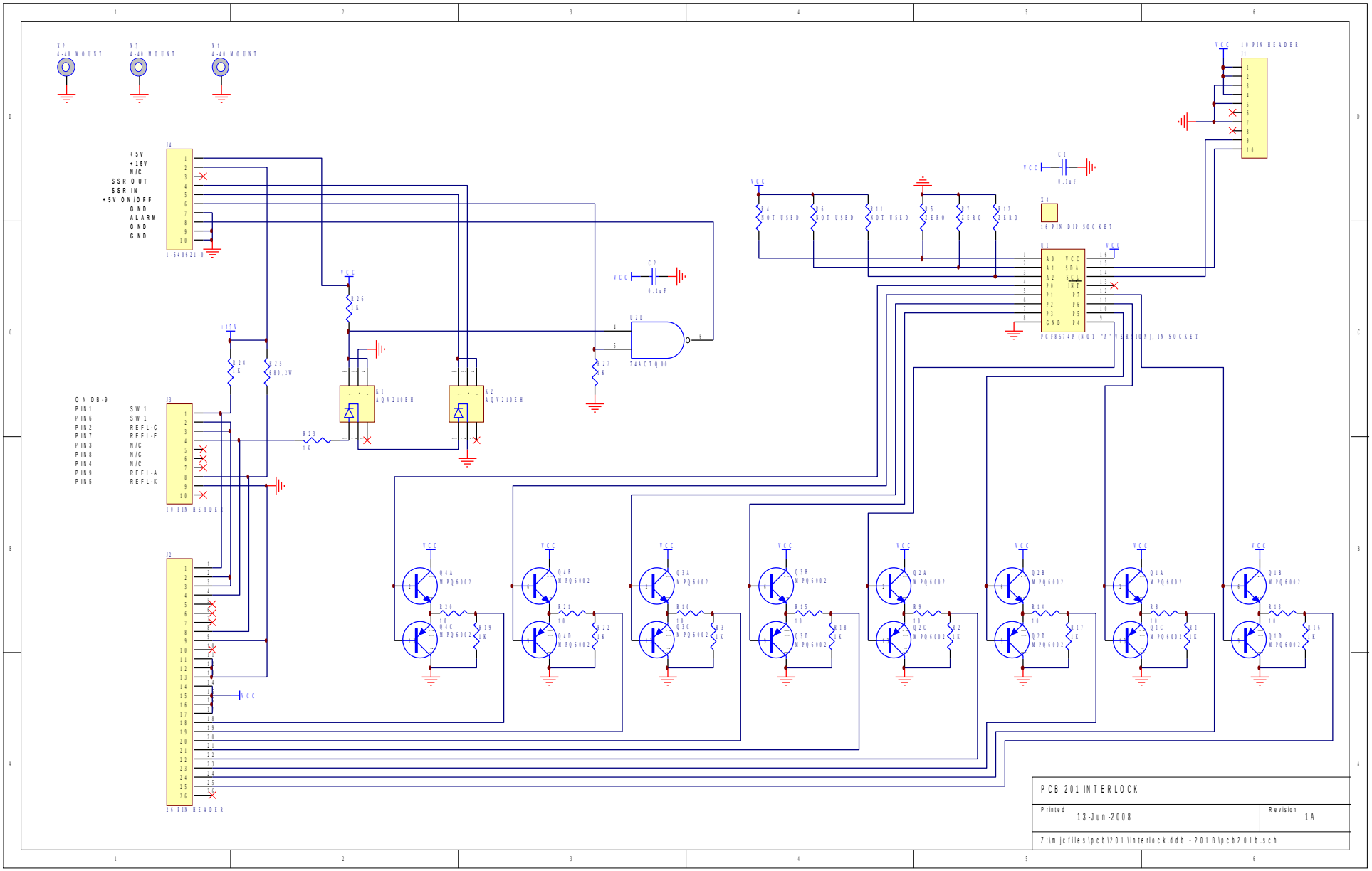


PCB 104D - KEYPAD / DISPLAY BOARD, 3/3

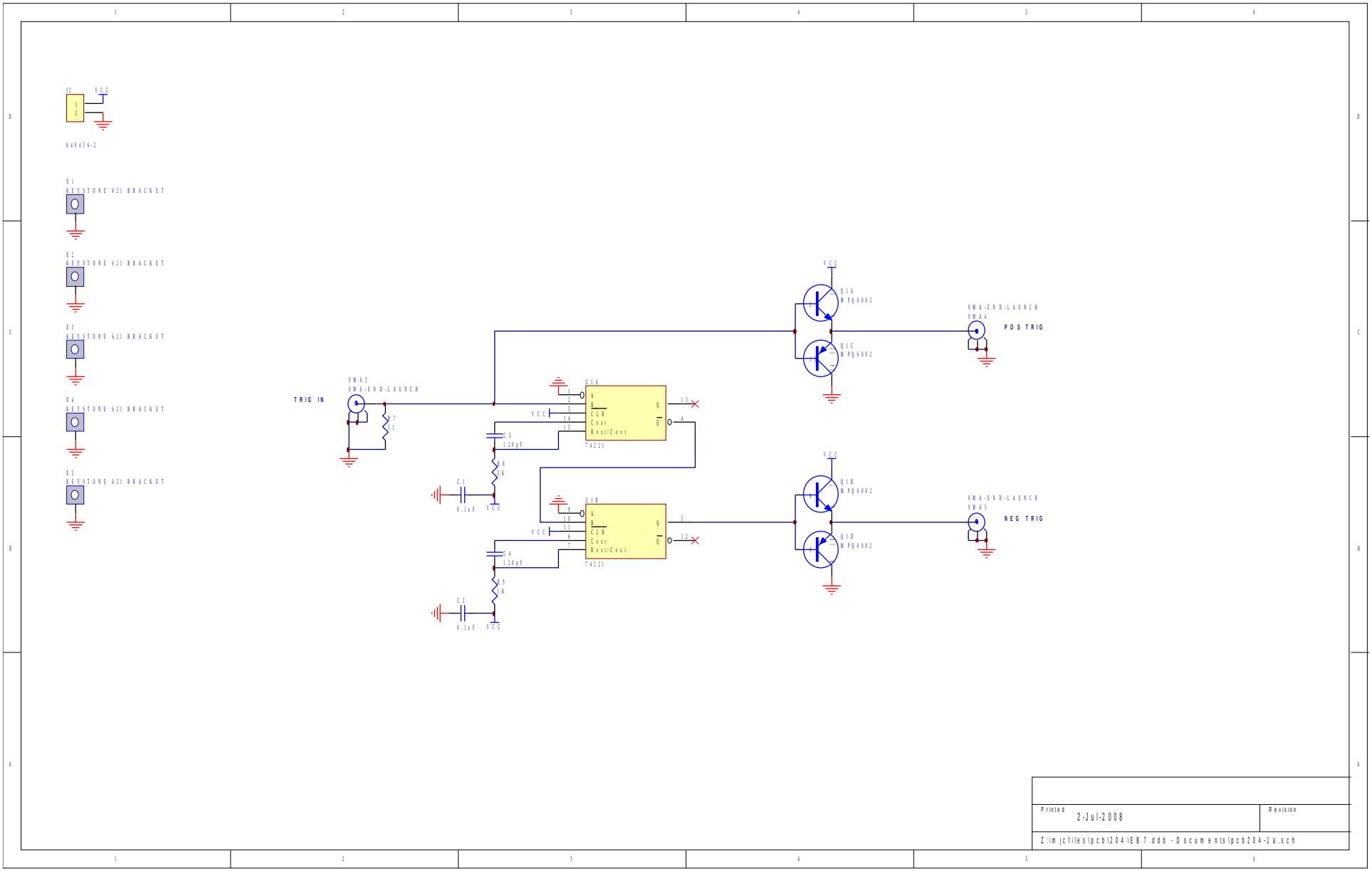


Title	LCD CIRCUITS, MECHANICAL
Date	17-Dec-2004
Revision	
P:\pcb\104d\keypad-2004.DDB - Documents\LCD-BUTT.SCH	

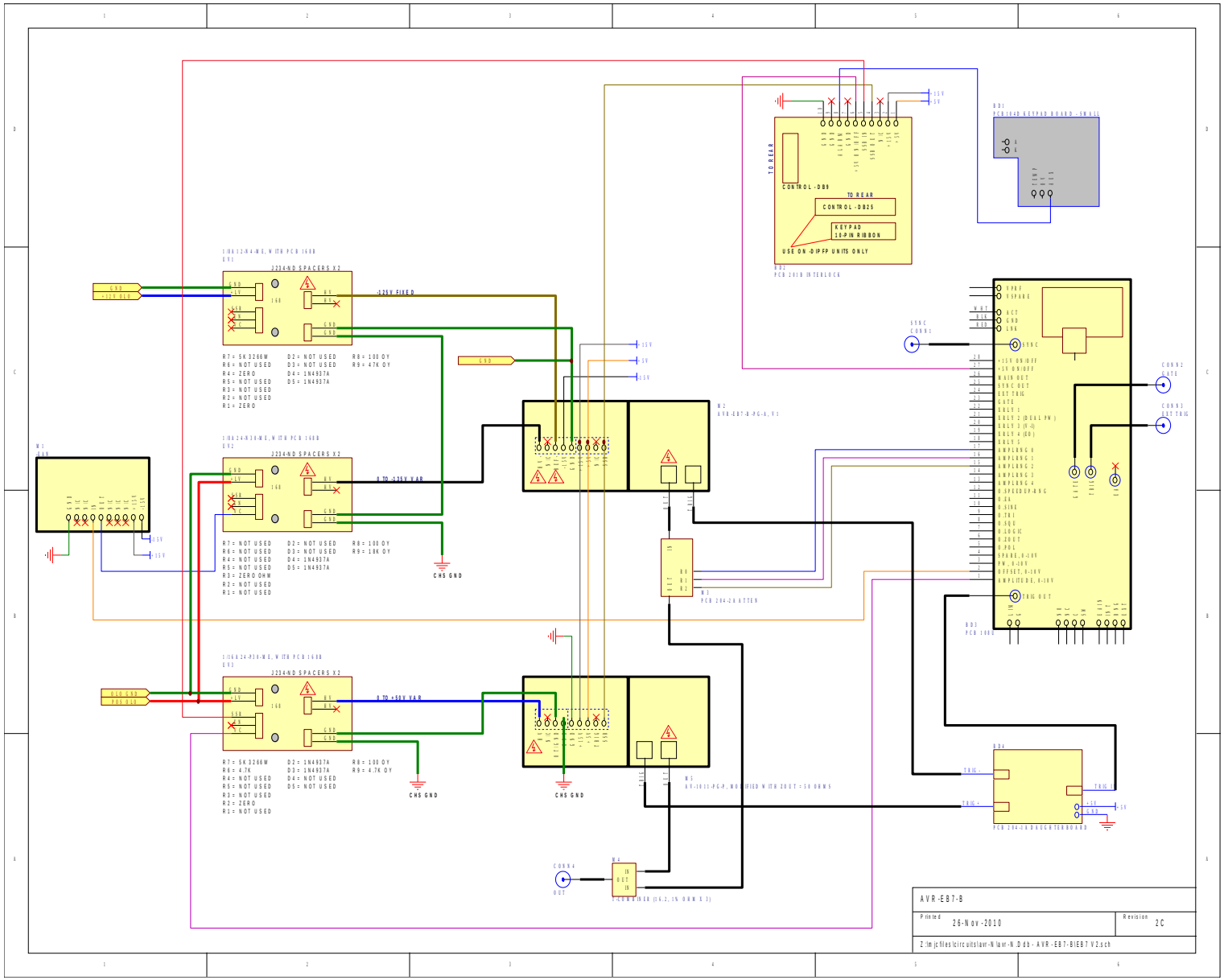
PCB 201B - INTERLOCK CONTROL



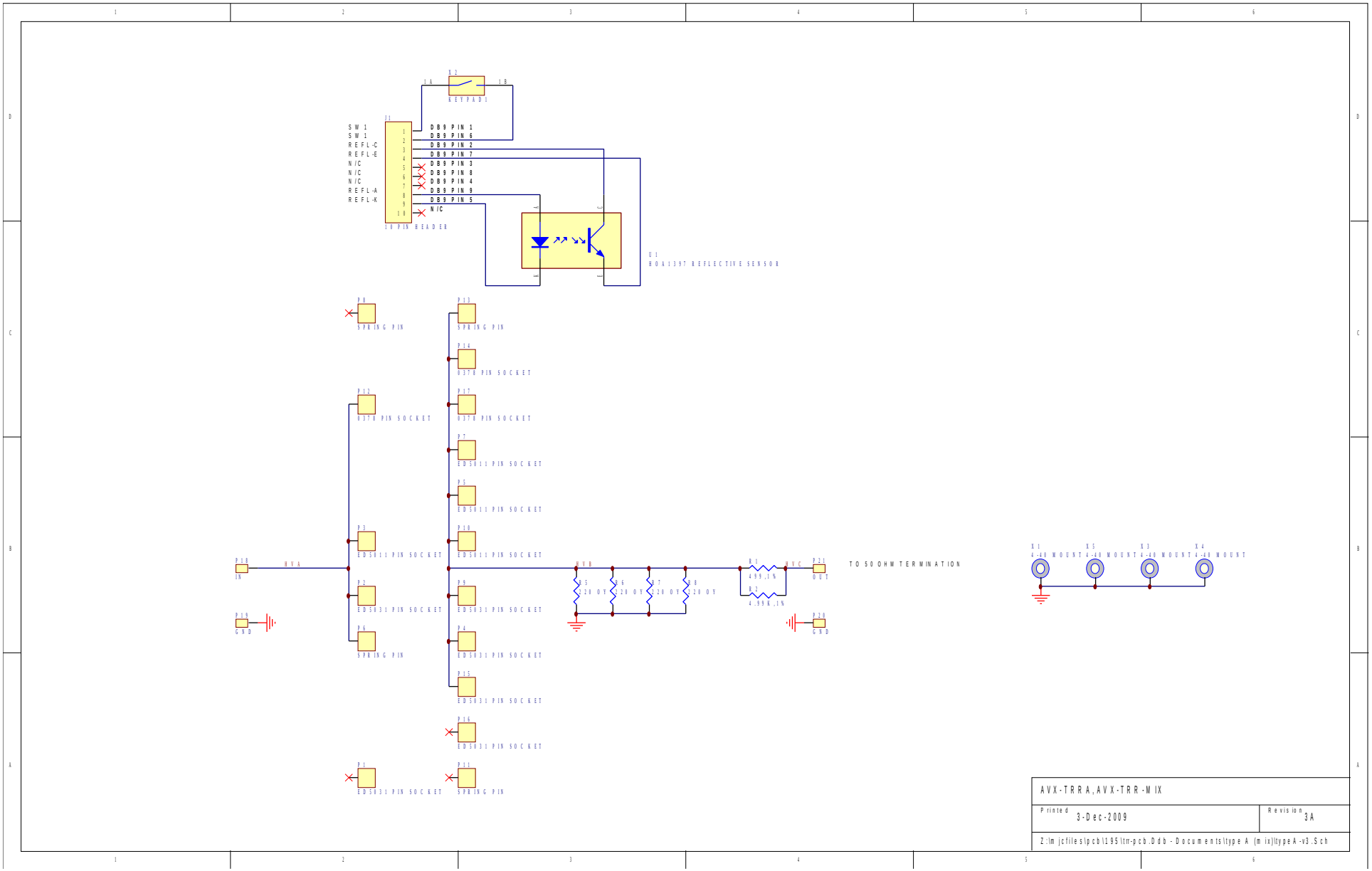
PCB 204-1A – NEGATIVE TIMING CONTROL PCB



MAIN WIRING


TO REAR
CONTROL - DB9
TO REAR
CONTROL - DB25
KEYPAD
16-PIN RIBBON
USE ON - DIP FF UNITS ONLY
J234-ND SPACERS X2
-125V FIXED
0 TO -125V VAR
CHS GND
AVR-EB7-B-PG-A, V1
PCB 284-2A ATTEN
AVR-EB7-B
Printed 26-Nov-2010
Revision 2C
Z:\lm jc\files\circuits\avr-N\avr-N.D.db - AVR-EB7-B\EB7V2.sch

TEST JIG WIRING (AVX-TRR-MIX)



PERFORMANCE CHECK SHEET