AVTECH ELECTROSYSTEMS LTD.

NANOSECOND WAVEFORM ELECTRONICS
SINCE 1975

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

INSTRUCTIONS

MODEL AVR-CD2-B

REVERSE RECOVERY TIME TESTER

WITH ADJUSTABLE di/dt

OF < 70 TO > 200 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)
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Manual Reference: /fileserver1/officefiles/instructword/avr-cd1/AVR-CD2-B,ed1.odt.
Last modified February 29, 2024.

INTRODUCTION

The AVR-CD2-B is a high performance, GPIB and RS232-equipped instrument intended for reverse recovery time testing of MOSFET body diodes and other semiconductor devices.

The AVR-CD2-B will apply a 5 us wide forward bias pulse with an adjustable amplitude of +0.8A to +40A to a device under test (DUT). At the end of that pulse, the current ramps downward at an adjustable rate of < 70 to > 200 A/us until the diode stops conducting. (dI/dt is measured between the time when the current crosses from positive to negative, t_0, up to t_0 + 100 ns.)

The maximum specified ramp duration is 0.55 us, and the maximum allowed reverse current is -55A.

The current waveforms generated by this instrument are intended for MIL-STD-750-3 Method 3473.1 Test Condition A tests.

Standard AVR-CD2-B models include one AVX-CD2-MIX diode test jig. The instrument mainframe is connected to the test jig using a DB-25 control cable. The standard test jig contains a variety of pin sockets and posts, which may be used to hold the device under test (DUT). The AVX-CD2-MIX includes pin socket layouts to accommodate the following package/pinout combinations:

1. TO-204AA (N-Channel TO-3 with 40 mil leads), as per MIL-PRF-19500/543N.
2. TO-204AA (P-Channel TO-3 with 40 mil leads), as per MIL-PRF-19500/562E.
3. TO-204AE (N-Channel TO-3 with 60 mil leads), as per MIL-PRF-19500/543N.
4. TO-205AF (N-Channel low-profile TO-39), as per MIL-PRF-19500/556K.
5. TO-205AF (P-Channel low-profile TO-39), as per MIL-PRF-19500/565E.

For all layouts, the gate pin is tied to the source pin.

The output signal is provided on a BNC connector on the test jig. This output should be terminated with 50 Ohms (a suitable terminator is provided with the instrument), and connected to a user-supplied high-bandwidth (≥ 300 MHz) oscilloscope. The output signal is generated by a Pearson 2878 current transformer in series with the DUT, and the voltage it generates is directly proportional to the current through the diode (50 mV per Amp, nominally, into a 50 Ohm termination). By observing the current waveform through the diode, the reverse recovery time may be determined.

The AVR-CD2-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-CD2-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:	AVR-CD2-B
Intended application:	MOSFET diode reverse recovery time tests, as per MIL-STD-750-3 Method 3473.1 Condition A.
Basic waveform:	A positive current pulse followed immediately by a negative-going current ramp
Positive current duration:	5 us
Positive current amplitude:	+0.8A to +40A, adjustable[1]
Negative-going ramp rate:	< 70 to > 200 A/us, adjustable[1,2]
Maximum reverse current:	> -55A
Maximum ramp duration:	> 0.55 us
Reverse bias voltage range:	-20 to -50V, adjustable. Normally set at -50V, unless this exceeds the diode breakdown voltage.
Maximum PRF:	10 Hz
Supplied test jig:	Model AVX-CD2-MIX. Includes pin socket layouts to accommodate the following package/pinout combinations: 1. TO-204AA (N-Channel TO-3 with 40 mil leads), as per MIL-PRF-19500/543N. 2. TO-204AA (P-Channel TO-3 with 40 mil leads), as per MIL-PRF-19500/562E. 3. TO-204AE (N-Channel TO-3 with 60 mil leads), as per MIL-PRF-19500/543N. 4. TO-205AF (N-Channel low-profile TO-39), as per MIL-PRF-19500/556K. 5. TO-205AF (P-Channel low-profile TO-39), as per MIL-PRF-19500/565E. For all layouts, the gate pin will be tied to the source pin.
Jig daughterboards:	Customized daughterboards available by request.
Mainframe to jig cable:	DB-25 male/male straight-through.
Connectors:	BNC female
Output waveform:	When the output is terminated with the provided 50 Ohm terminator, the output voltage is proportional to the DUT current: $V_{OUT} = I_{DUT} \times 50$ mV / Amp, The output is generated internally by an integrated Pearson 2878 current transformer.
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
Ethernet port, for remote control using VXI-11.3, ssh, telnet, & web:	-VXI option: Recommended as a modern alternative to GPIB / RS-232. See http://www.avtechpulse.com/options/vxi for details.
Trigger modes:	Internal trigger, external trigger (TTL level pulse, > 10 ns, 1 kΩ input impedance), front-panel “Single Pulse” pushbutton, or single pulse trigger via computer command.
Variable delay (Sync to main out):	0 to 1.0 seconds, for all trigger modes (including external trigger).
Sync output:	+3 Volts, 100 ns, will drive 50 Ohm loads
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) The amplitude and ramp 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.
2) As measured between the time when the current crosses from positive to negative (t_0) to t_0 + 100 ns.

REGULATORY NOTES

FCC PART 18

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

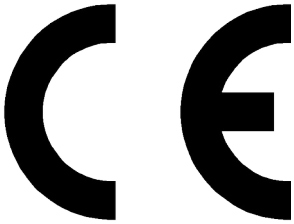
This instrument is enclosed in a rugged metal chassis and uses a filtered power entry module (where applicable). The main output signal is provided on a shielded connector that is intended to be used with shielded coaxial cabling and a shielded load. Under these conditions, the interference potential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



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declare that this pulse generator meets the intent of Directive 2004/108/EG for Electromagnetic Compatibility. Compliance pertains to the following specifications as listed in the official Journal of the European Communities:

EN 50081-1 Emission

EN 50082-1 Immunity

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

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

DIRECTIVE 2002/95/EC (RoHS)

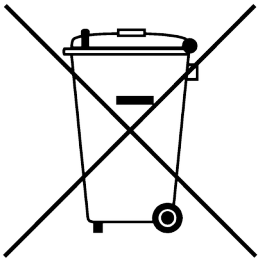
This instrument is exempt from Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment. Specifically, Avtech instruments are considered "Monitoring and control instruments"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

DIRECTIVE 2002/96/EC (WEEE)

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

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

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



AC POWER SUPPLY REGULATORY NOTES

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

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

and is compliant with:

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

FIRMWARE LICENSING

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

Earlier firmware versions do not contain any open source software.

INSTALLATION

VISUAL CHECK

After unpacking the instrument, examine to ensure that it has not been damaged in shipment. Visually inspect all connectors, knobs, liquid crystal displays (LCDs), and the handles. 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) One AVR-CD2-B mainframe
2) One 6 ft / 2m DB25 control cable
3) One 5 ft / 1.5m BNC-to-BNC coaxial cable
4) One BNC feed-through 50 Ohm terminator
5) One AVX-CD2-MIX test jig
6) One standard GPIB cable, 2m length
7) One AC Power Cord
8) One Programming Manual for "-B" Instruments
9) One AVR-CD2-B Instruction Manual

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.

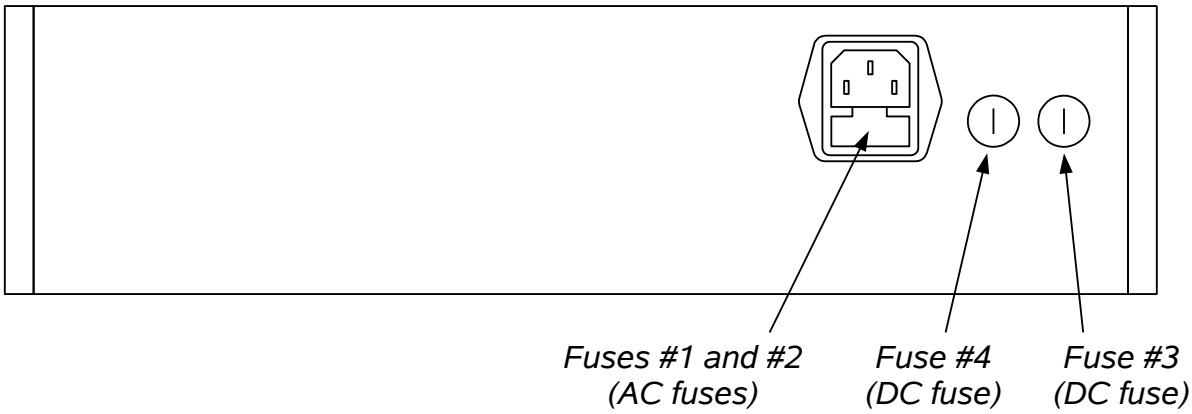
ENVIRONMENTAL CONDITIONS

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.

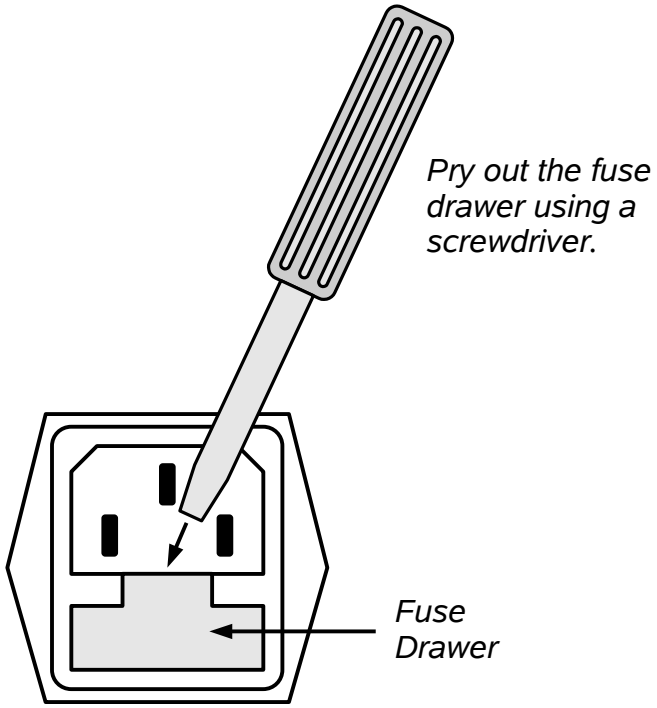
FUSES

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

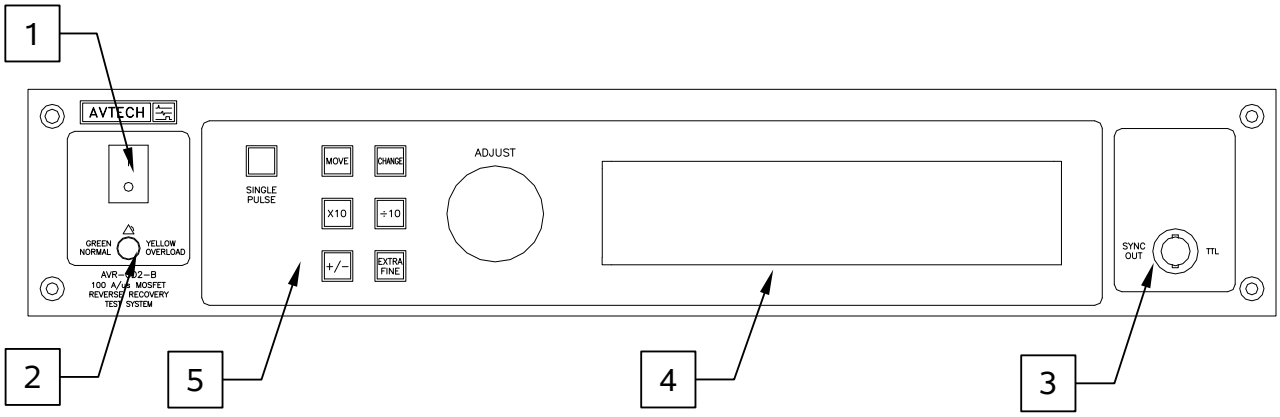
The following table lists the required fuses:

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.

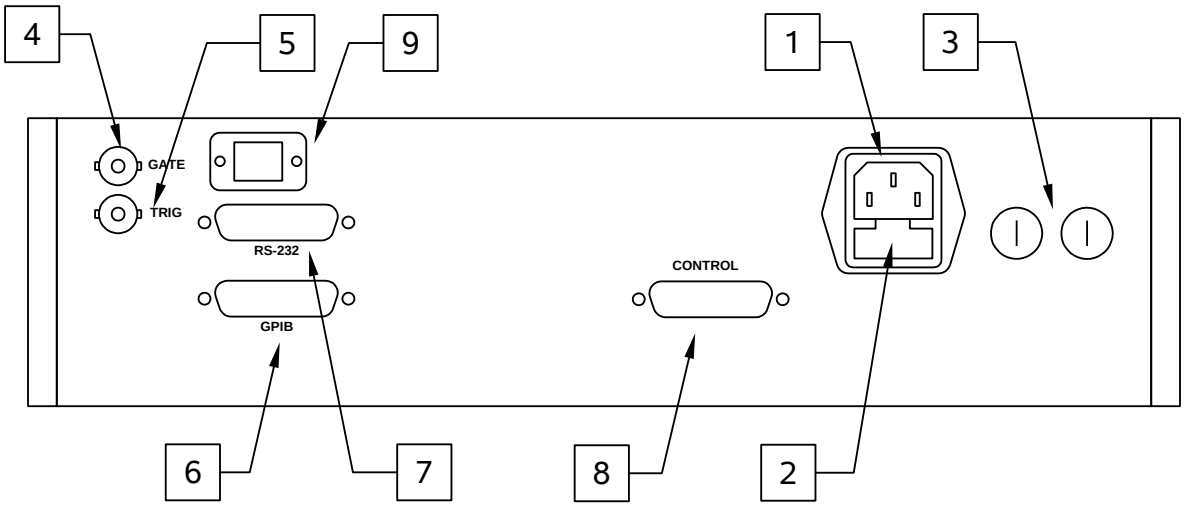
3. SYNC OUT. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal leads (or lags) the main output by a duration set by the "DELAY" controls and has an approximate amplitude of +3 Volts to R_L > 50Ω with a pulse width of approximately 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. CONTROL Connector. This DB-25 female connector must be connected to the corresponding connector on the test jig using the supplied DB-25 male/male straight-through cable. Do not connect or disconnect the cabling while the instrument is powered.

9. 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.

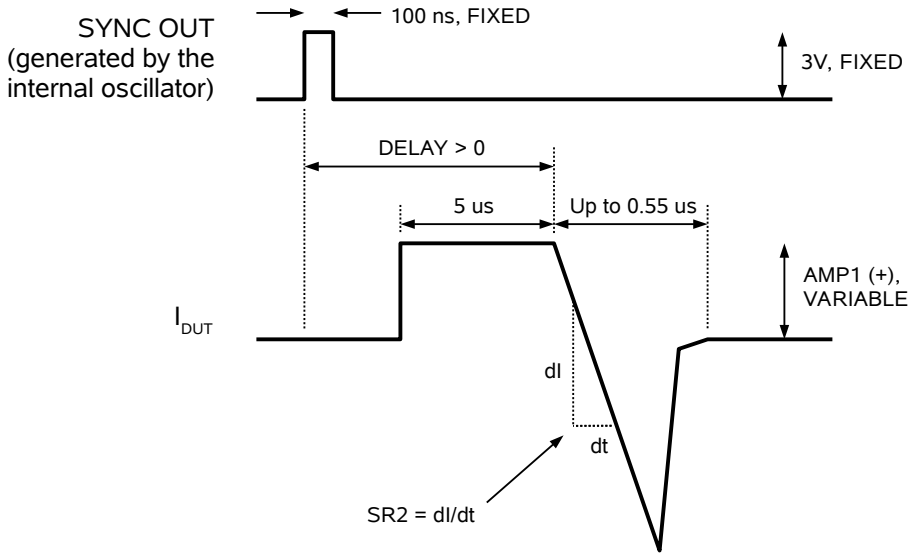
BASIC CONTROLS

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 output (I_{DUT}, the current through the DUT) and the SYNC output.

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:



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.

BASIC AMPLITUDE CONTROL

There are three amplitudes that must be set from the front panel or by computer commands.

AMP1 is the amplitude of the forward current pulse. It may be set anywhere between +0.8 and +40 Amps. This may be adjusted from the AMP1 menu of the front panel display, or using a command like “sour:curr1 +5A”.

AMP2 is the DC bias voltage applied to the source of the ramp transistor. This may be adjusted from -20 to -50V, but it should always be set as negative as possible. That is, always set it at -50V, unless this exceeds the DUT's breakdown voltage. This may be adjusted from the AMP2 menu of the front panel display, or using a command like "sour:volt2 -50V". (We suggest setting this at -50V, even if the test specification normally calls for a reduced voltage.)

SR2 is the "slew rate" of the negative-going ramp. This may be adjusted from the SR2 menu of the front panel display, or using a command like "sour:curr:slew2 105 A/us". dI/dt is measured between the time when the current crosses from positive to negative, t_0, up to t_0 + 100 ns.

ACCURACY

The amplitude and ramp 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 and ramp settings should *always* be verified by oscilloscope measurements.

Particular care may be needed when operating at low forward currents (< 5 A). The actual output amplitude may be subject to some thermal drift, and should be verified. Also, the ramp rate setting becomes inaccurate at low currents. The ramp rate setting should be treated as a relative control at low currents, rather than an accurate absolute control. Despite the inaccuracies, it should always be possible to obtain ramp rates in the range of 70 to 200 A/us for all forward current values (0.8 to 40A).

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.

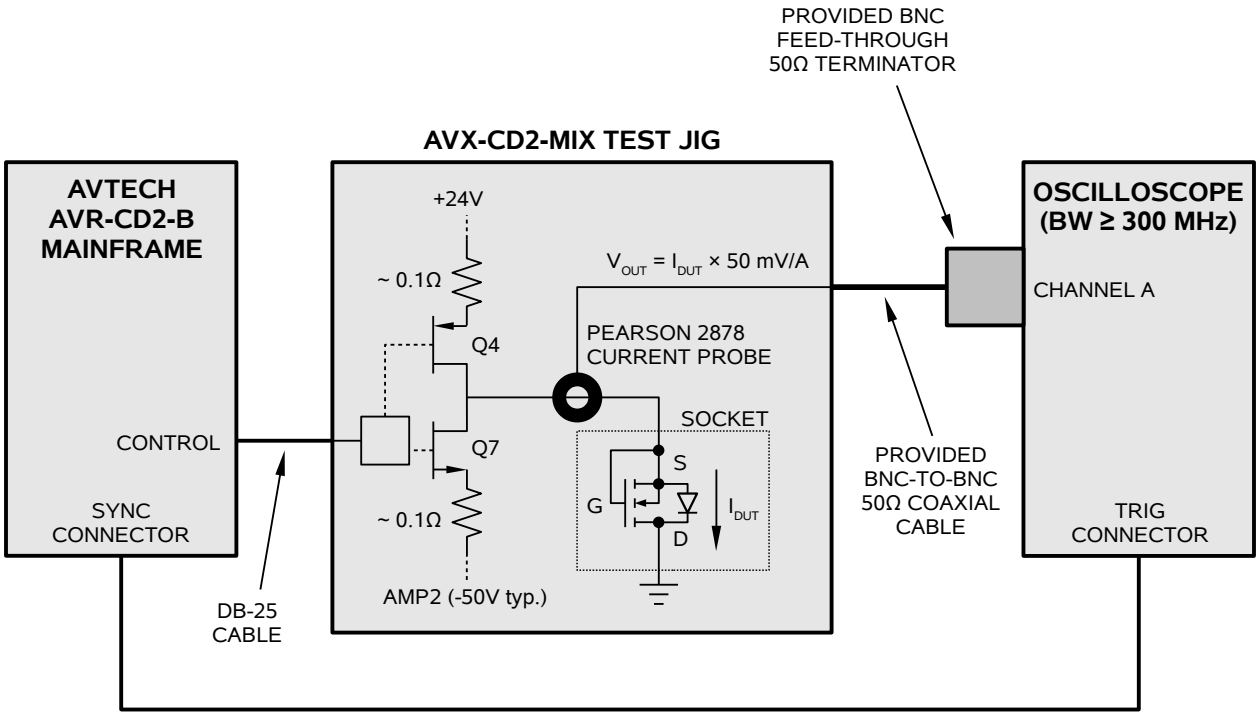
These modes can be selected using the front panel trigger menu, or by using the appropriate programming commands. (See the "Programming Manual for -B Instruments" for more details.)

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-CD2-B is shown in the figure below. The mainframe is connected to the test jig using the supplied DB-25 control cable, and the test jig is connected to the user-provided oscilloscope with the supplied BNC-to-BNC cable and feed-through terminator. The oscilloscope input impedance should be high (≥1 Megohm).



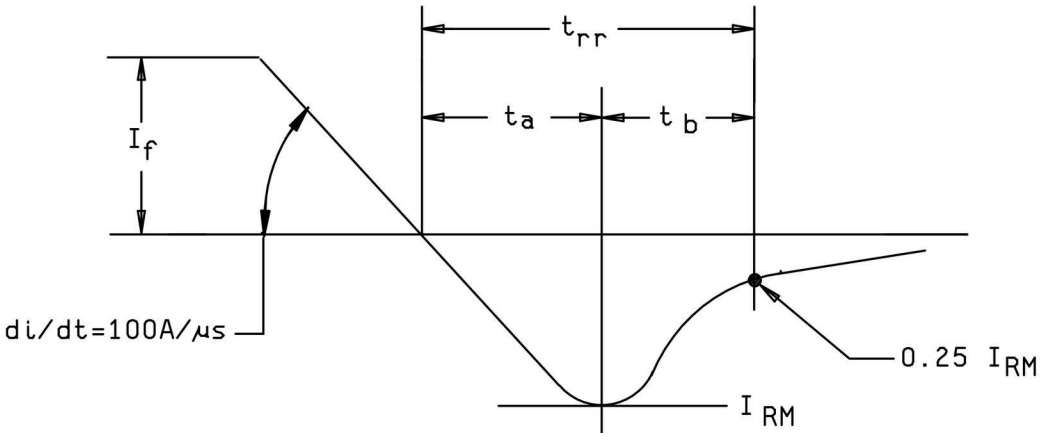
The embedded Pearson 2878 current transformer monitors the current through the DUT, and provides the output signal.

SAFETY INTERLOCK

The mainframe provides DC voltages of up to 50V 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.

MEASUREMENT THEORY

The figure below, taken from MIL-STD-750-3 Method 3473.1 Test Condition A, shows the basic waveform definitions:



I_f is the same as “AMP1” on the front panel.

di/dt is the same as “SR2” on the front panel.

t_{rr}, t_a, t_b, and $I_{RM(REC)}$ are measured by the user on the attached oscilloscope.

RAMP RATE NOTES

Although not specified in the standard, Avtech measures dI/dt between the time when the current crosses from positive to negative, t_0, up to $t_0 + \Delta$, where Δ = 100 ns.

Using a much smaller value of Δ can be problematic, because the waveform may “curve” at the very start of the ramp. That is, the dI/dt rate may initially be significantly lower than expected. The instrument has been designed to ensure that a ramp rate of at least 100 A/us is typically observed under these conditions if the ramp rate setting is set at its maximum value. Higher ramp rates may be impossible to achieve.

This curving will also lead to large inaccuracies in the ramp rate setting at low forward currents (< 5 A). The ramp rate setting should be treated as a relative control at low currents, rather than an accurate absolute control. Despite the inaccuracies, it should always be possible to obtain ramp rates in the range of 70 to 200 A/us for all forward current values (0.8 to 40A).

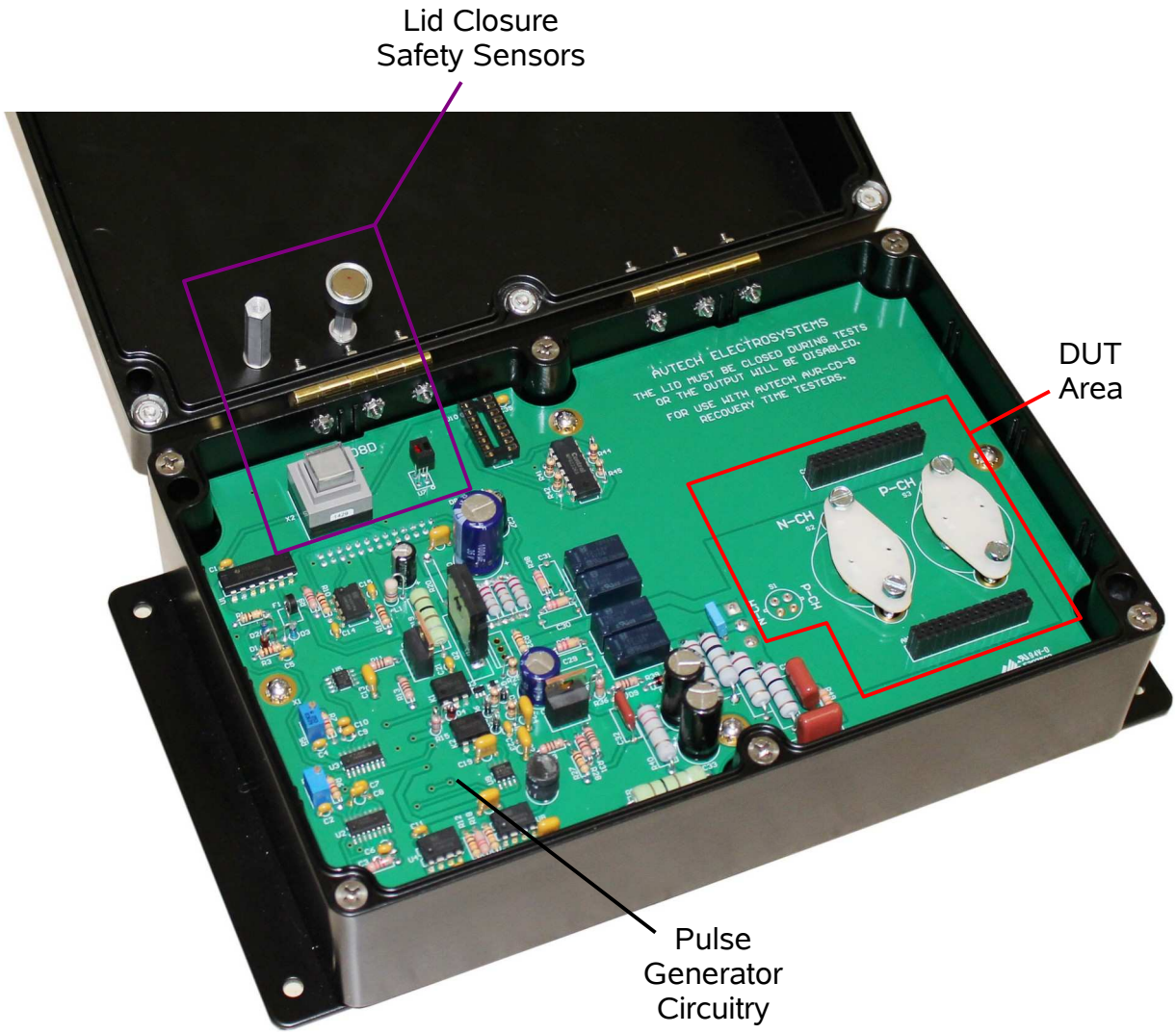
The curving is due to the nature of the circuit specified in Figure 3473-4 of MIL-STD-750-3. Using a current source to charge the gate capacitance of the main ramp MOSFET leads to an *approximately* linear dI/dt, but not *exactly* linear, because the gate capacitance of the MOSFET is heavily voltage-dependent.

STANDARD TEST JIG MECHANICAL ASPECTS

One AVX-CD2-MIX test jig is normally supplied with the mainframe, unless the customer has requested a different or additional test jigs.

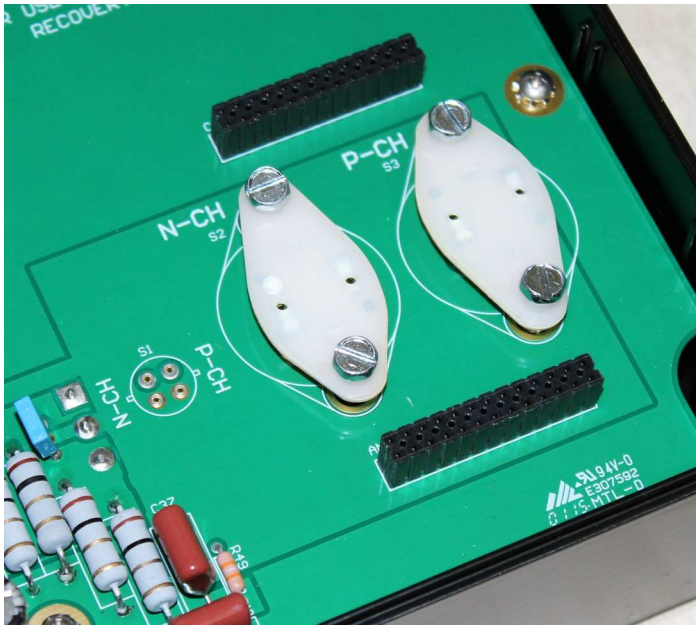
AVX-CD2-MIX TEST JIG

The basic test jig mechanical layout is shown below:

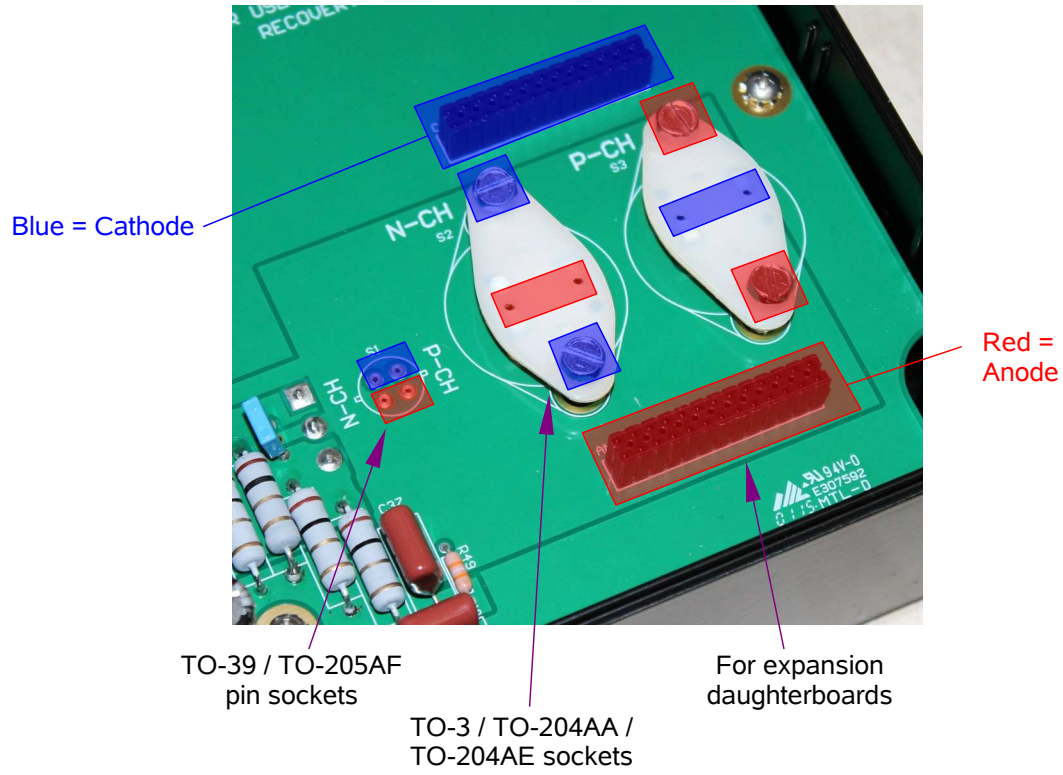


DUT AREA

The DUT area is shown in detail below:



The anode pins are highlighted in red, and the cathode pins in blue, in the next photo:

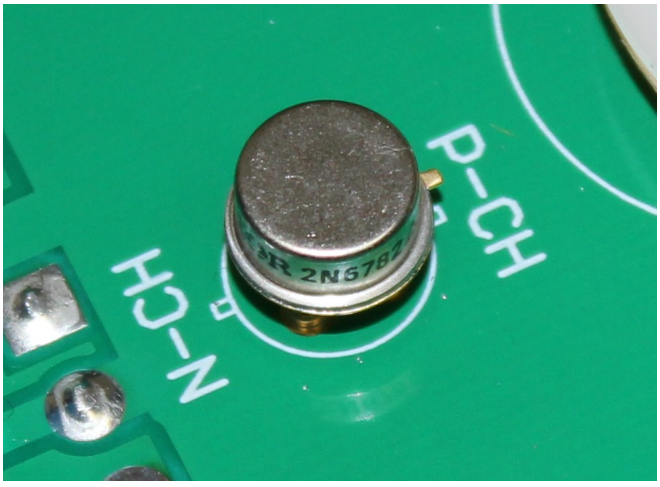


INSTALLING TO-39 / TO-205AF N-CHANNEL DEVICES

N-Channel MOSFETs with the conventional pinout should be installed as shown below, with the case tab over the silkscreened tab marked “N-CH”. This will connect the drain/case (diode cathode) to one cathode pin socket, and the gate and source (diode anode) to the two anode pin sockets. One cathode pin socket will be left unused.

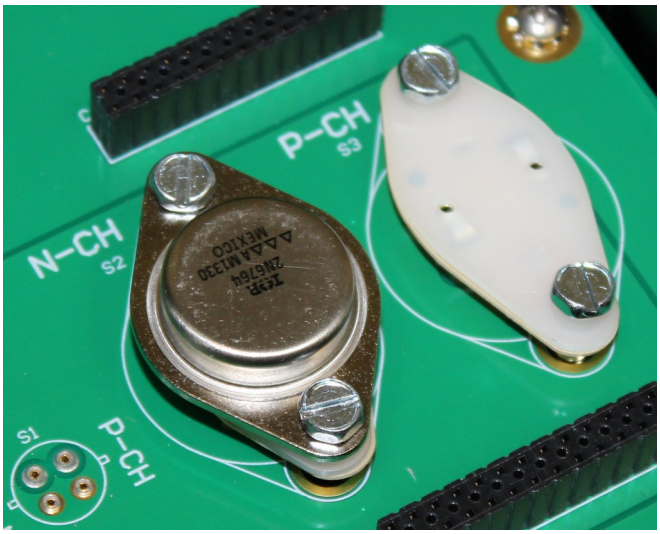
INSTALLING TO-39 / TO-205AF P-CHANNEL DEVICES

P-Channel MOSFETs with the conventional pinout should be installed as shown below, with the case tab over the silkscreened tab marked “P-CH”. This will connect the drain (diode anode) to one anode pin socket, and the gate and source (diode cathode) to the two cathode pin sockets. One anode pin socket will be left unused.



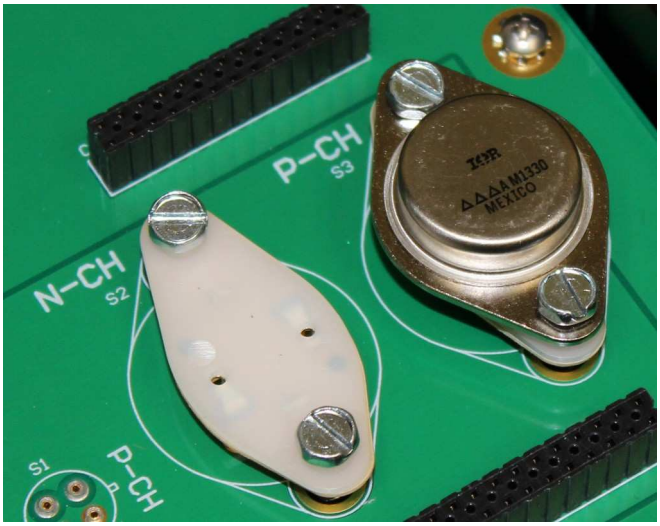
INSTALLING TO-3 / TO-204AA / TO-204AE N-CHANNEL DEVICES

N-Channel MOSFETs with the conventional pinout (case = drain) in the socket marked “N-CH”. The two leads will be connected to the anode drive, and the drain/case will be connected to the cathode signal. Make sure the case holes align correctly with the screws. Note that the two screws *must* be tightened and used to provide electrical contact with the drain/case.



INSTALLING TO-3 / TO-204AA / TO-204AE P-CHANNEL DEVICES

P-Channel MOSFETs with the conventional pinout (case = drain) in the socket marked “P-CH”. The two leads will be connected to the cathode signal, and the drain/case will be connected to the anode drive. Make sure the case holes align correctly with the screws. Note that the two screws *must* be tightened and used to provide electrical contact with the drain/case.



EXPANSION DAUGHTERBOARDS

Two 2×13 standard 0.1” sockets are provided to accept daughterboards, to handle other package types. All 26 pins in each socket are wired in parallel. One socket is connected to the anode drive, and one is connected to the cathode signal. The two sockets are 2.3” apart.

TEST JIG CONNECTORS

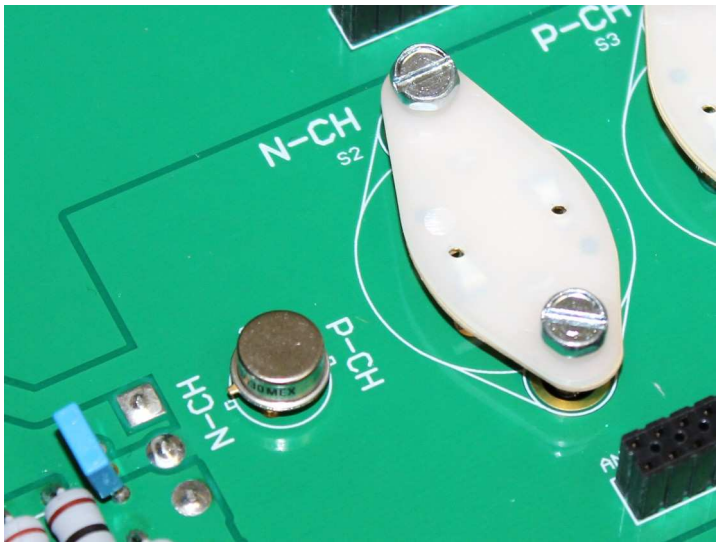
The OUT and CONTROL connectors are on the rear of the jig, below the hinges:

TYPICAL RESULTS

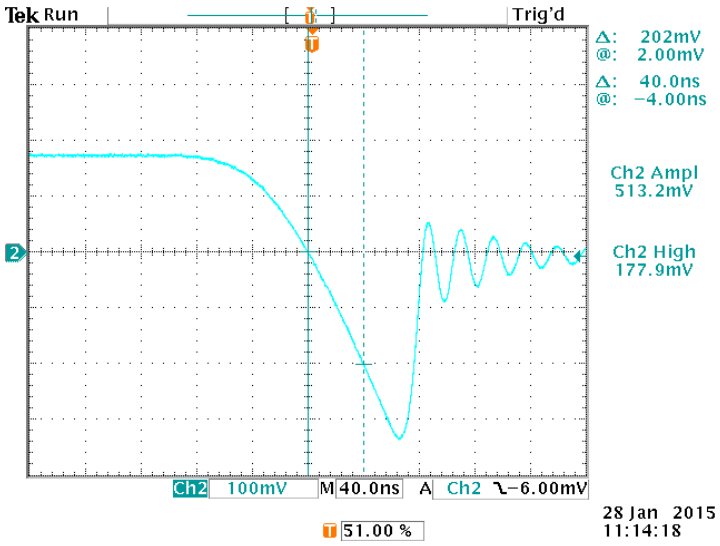
Obtaining meaningful results with the AVR-CD2-B requires care, experience, and an understanding of diode transient behavior and the impact of inductive and capacitive parasitics. To assist the user, typical results are provided below. The user should be able to reliably duplicate these results.

2N6782

An International Rectifier 2N6782 N-Channel MOSFET (available from Newark, stock number 09F6539) was tested. It is packaged in a TO-205AF package, more commonly called a low-profile TO-39. The installation is shown below. The case tab is aligned with the silkscreening for the N-Channel tab position.



MIL-PRF-19500/556L specifies that the 2N6782 body diode shall be tested with I_F = +3.5A and dI/dt ≤ 100 A/us, and the resulting t_{RR} shall be less than 180 ns.



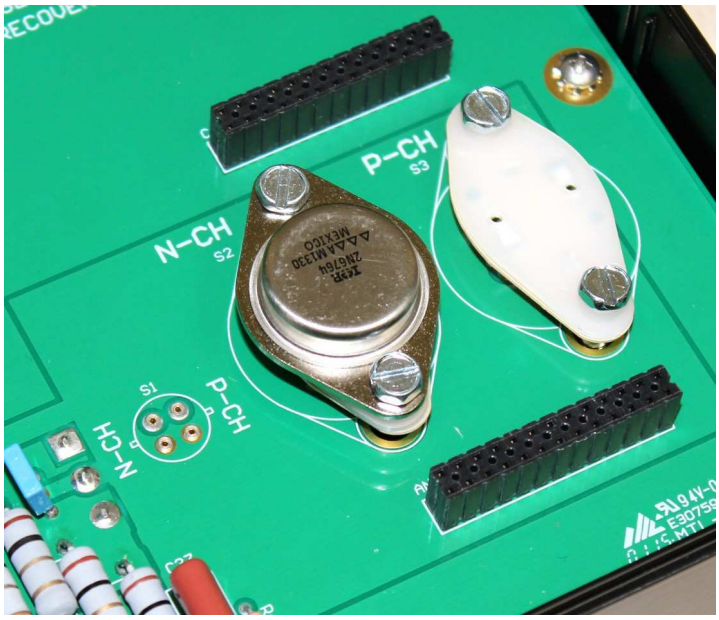
In the waveform above, I_F = 177.9 mV ÷ 50 mV/A = +3.558A.

The vertical cursors are positions to calculate the dI/dt rate – it is 202 mV ÷ 50 mV/A ÷ 40 ns = 101 A/us.

The t_{RR} time is ~ 80 ns, easily meeting the 180 ns requirement.

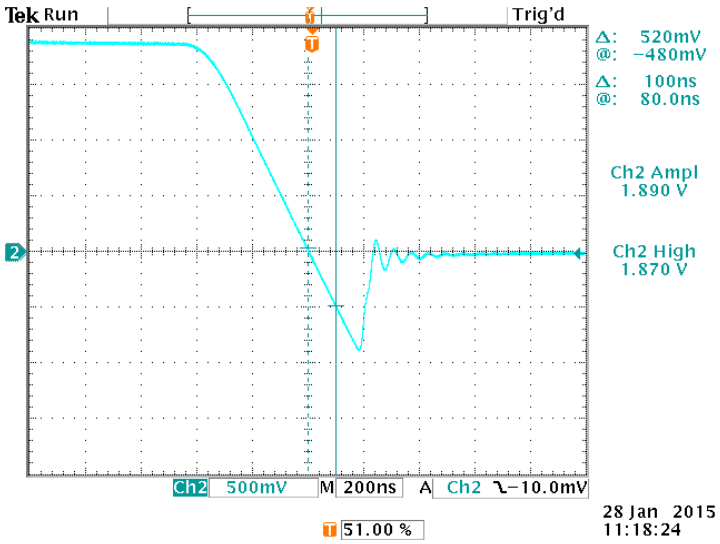
2N6764

An International Rectifier 2N6764 N-Channel MOSFET (available from Newark, stock number 94B8152) was tested. It is packaged in a TO-204AE package, more commonly called a TO-3 (with heavier 60 mil leads). The installation is shown below:



Note that the two screws *must* be tightened and used to provide electrical contact with the drain/case.

MIL-PRF-19500/543N specifies that the 2N6764 body diode shall be tested with I_F = +38A and dI/dt = 100 A/us, and the resulting t_{RR} shall be less than 500 ns.



In the waveform above, I_F = 1.87 V ÷ 50 mV/A = +37.4A.

The vertical cursors are positions to calculate the dI/dt rate – it is 520 mV ÷ 50 mV/A ÷ 100 ns = 104 A/us.

The t_{RR} time is ~ 230 ns, easily meeting the 500 ns requirement.

TROUBLESHOOTING

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

1) The test jig output *must* be terminated with 50 Ohms. Use the supplied terminator, and make sure the oscilloscope input impedance is high.

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.

4) Remember that you need to set 3 amplitude values (AMP1, AMP2, and SR2). AMP2 should normally be -50V.

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 1000 Hz	(sets the frequency to 100 Hz)
sour:curr1 +2A	(sets the forward current to +2A)
sour:curr:slew2 200A/us	(sets the forward current to 200 A/us)
sour:volt2 -50	(sets the negative bias to -50V)
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:curr1 +2A	(sets the forward current to +2A)
sour:curr:slew2 200A/us	(sets the forward current to 200 A/us)
sour:volt2 -50	(sets the negative bias to -50V)
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:curr1 +2A	(sets the forward current to +2A)
sour:curr:slew2 200A/us	(sets the forward current to 200 A/us)
sour:volt2 -50	(sets the negative bias to -50V)
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		
[:LEVel]		
[:IMMediate]		
[:AMPLitude]	<numeric value>	
:PROTection		
:TRIPped?		[query only]
: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

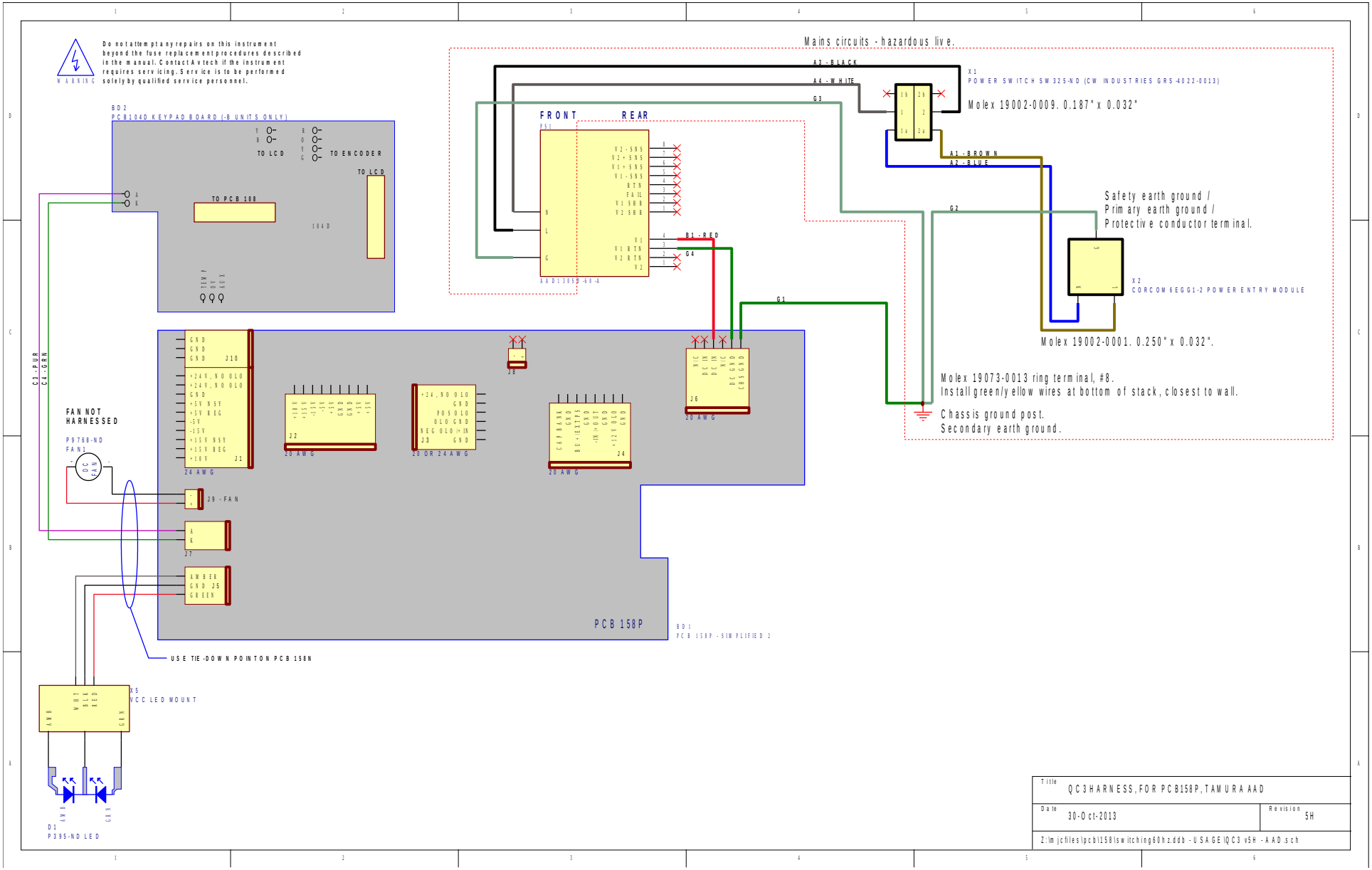
The rear-panel TRIG input, used in the external trigger mode, is protected by a diode clamping circuit. However, the protection circuit is not foolproof, and it is possible for a grossly excessive signal to damage the trigger circuitry on the main timing control board (the 4×10 inch board on the right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

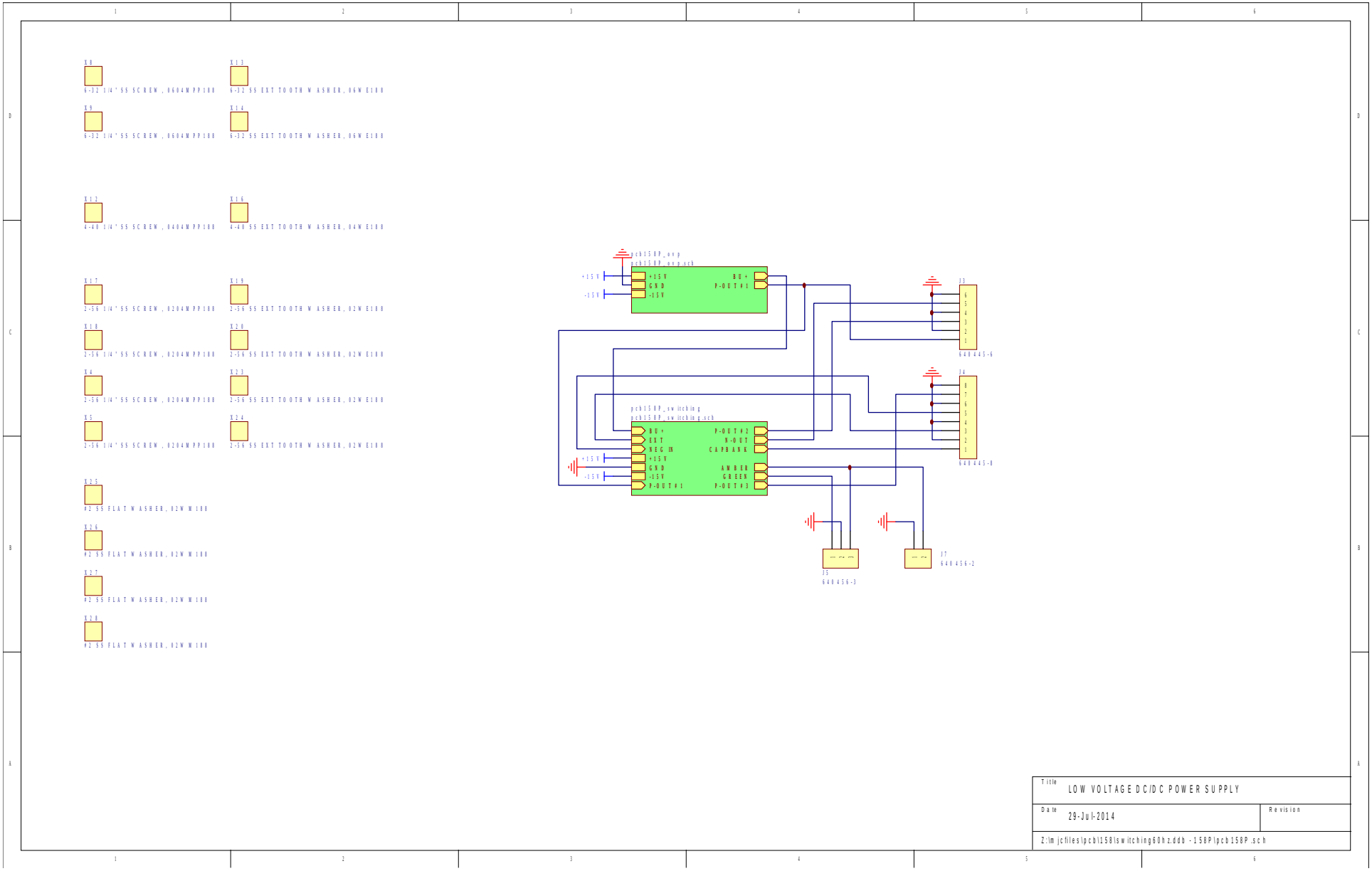
If you suspect that this IC has been damaged, turn off the power and replace this IC. It may be replaced by a 74F151, 74LS151, 74ALS151, or 74HCT151.

WIRING DIAGRAMS

WIRING OF AC POWER

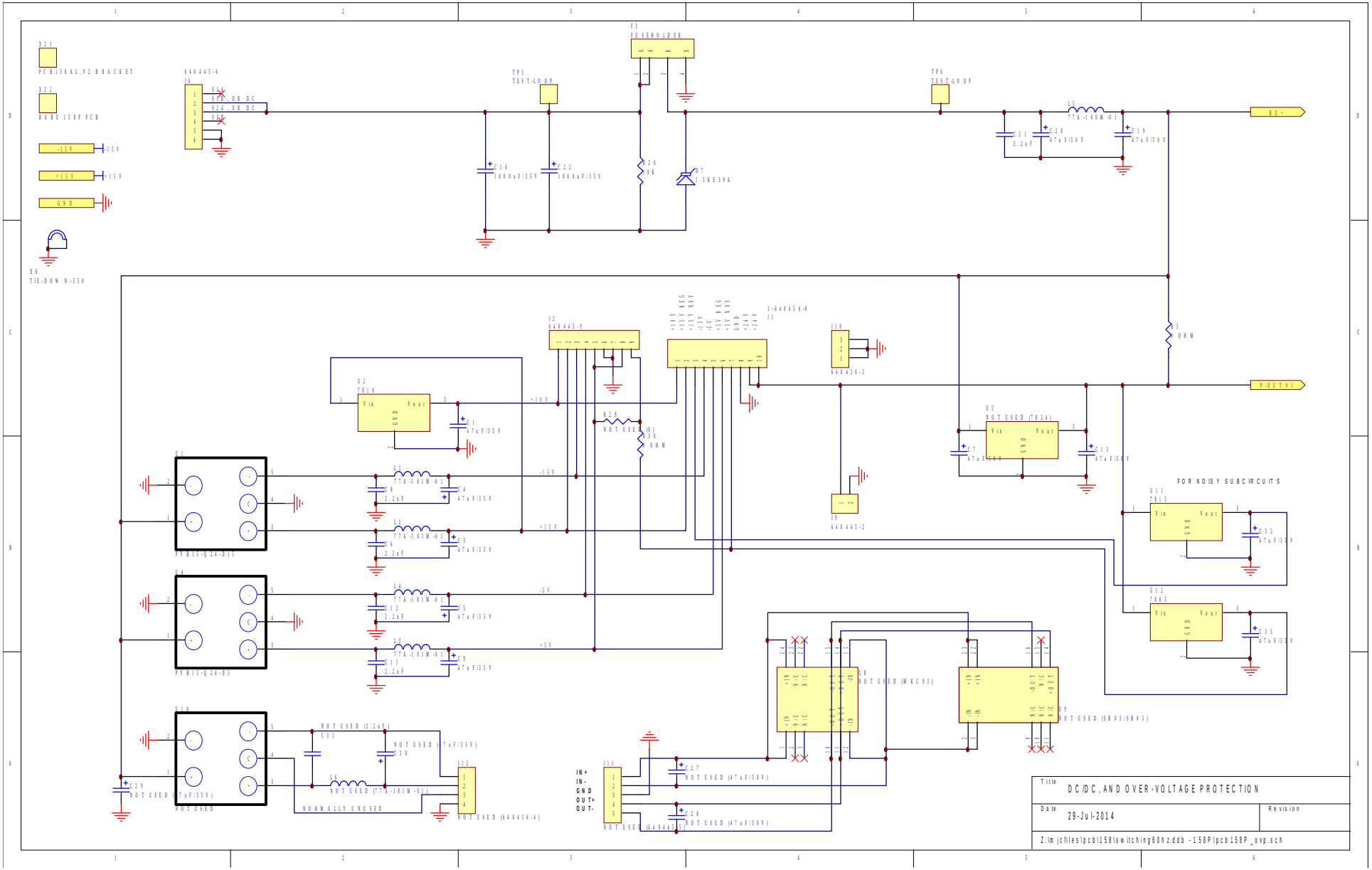


PCB 158P - LOW VOLTAGE POWER SUPPLY, 1/3

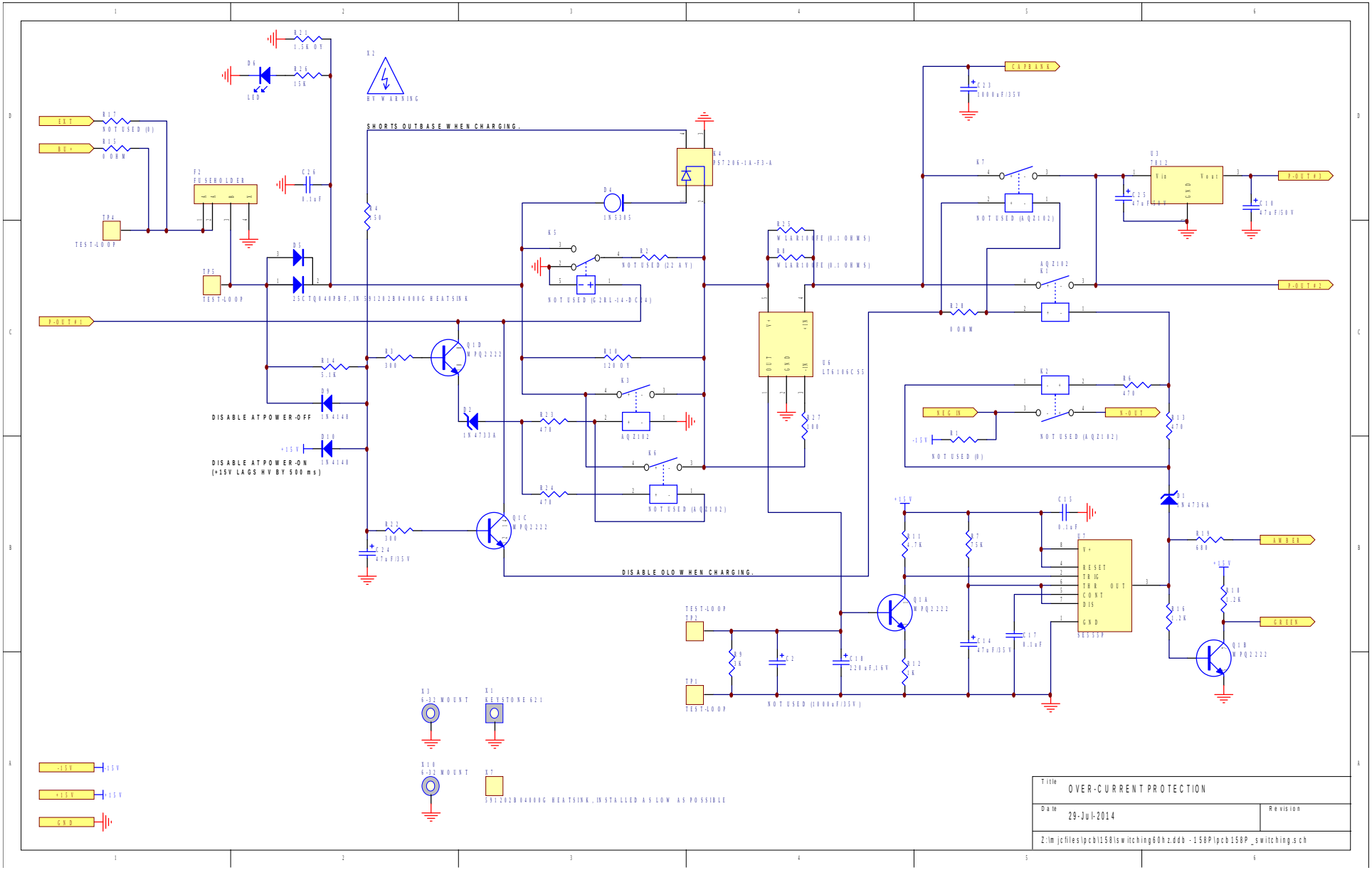


Title	LOW VOLTAGE DC/DC POWER SUPPLY
Date	29-Jul-2014
Revision	
Z:\mjcfiles\pcb\158\switching60hz.ddb - 158P\pcb158P.sch	

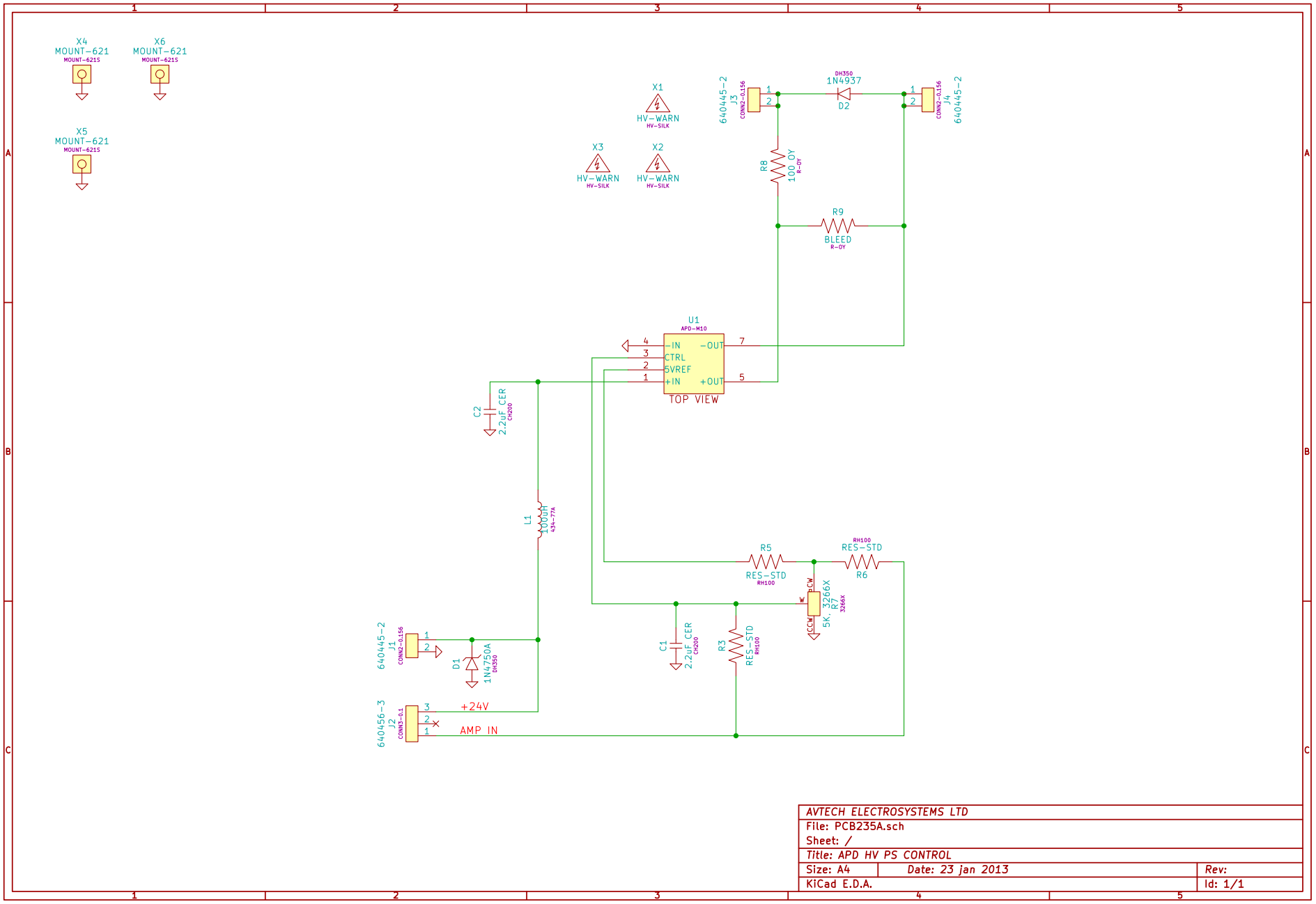
PCB 158P - LOW VOLTAGE POWER SUPPLY, 2/3



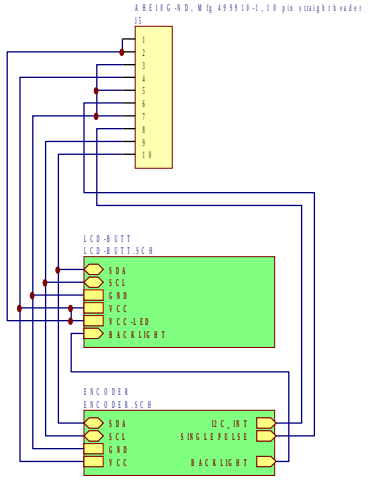
PCB 158P - LOW VOLTAGE POWER SUPPLY, 3/3



PCB 235A - HIGH VOLTAGE DC POWER SUPPLY

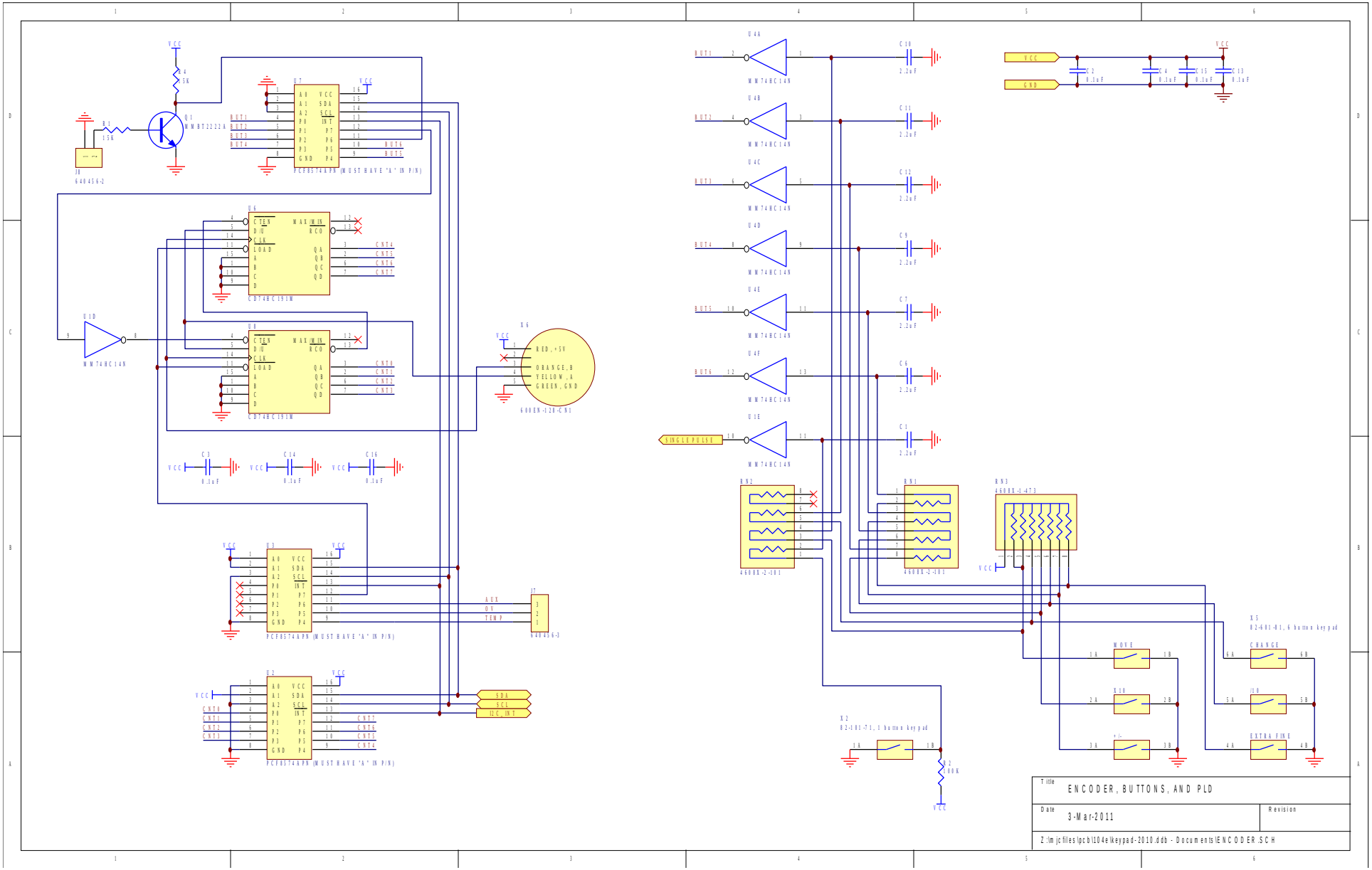


PCB 104E - KEYPAD / DISPLAY BOARD, 1/3

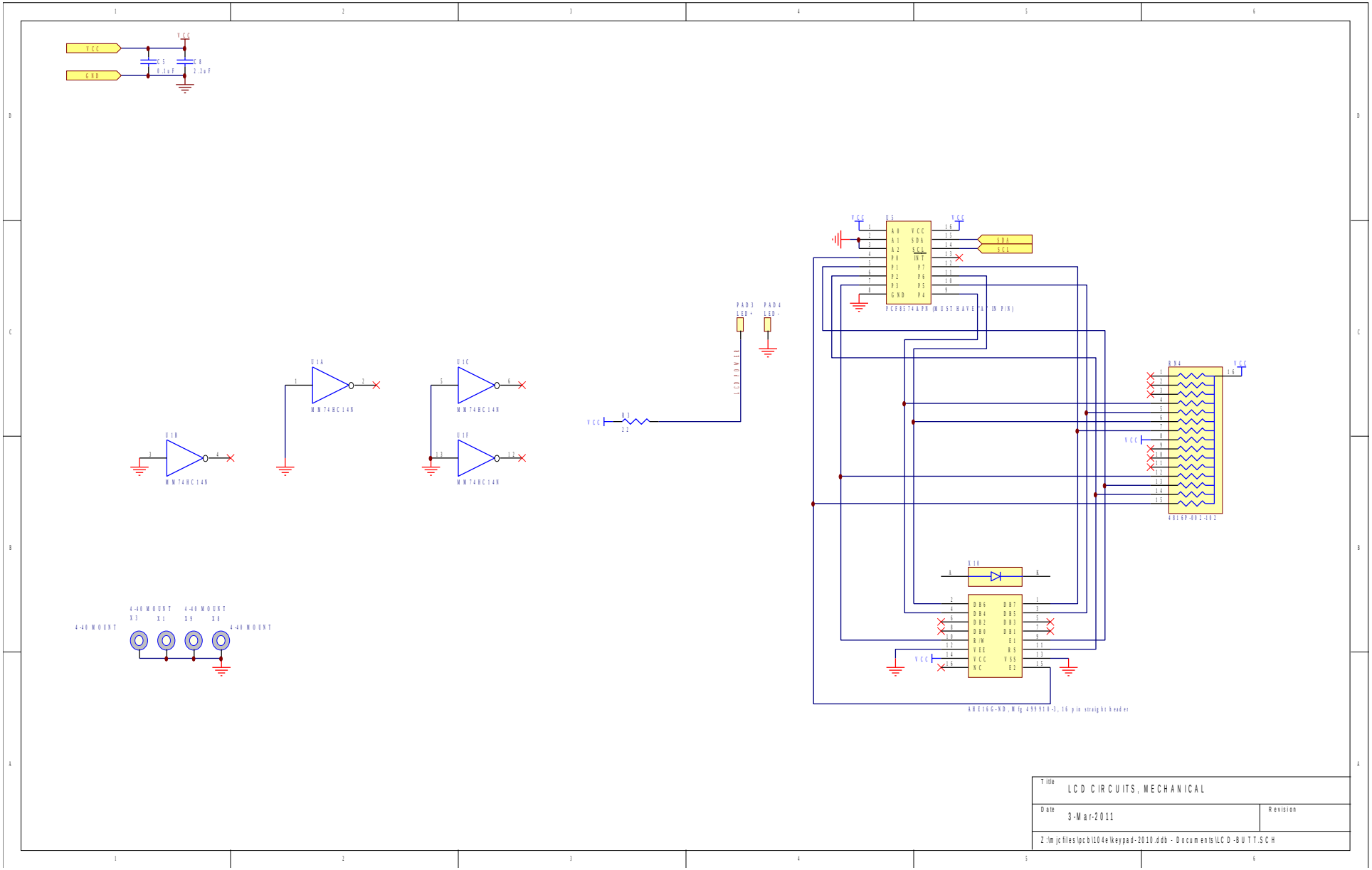


Title	PANEL TOP-LEVEL SCHEMATIC
Date	3-Mar-2011
Revision	
Z:\mjcfiles\pcb\104e\keypad-2010.ddb - Documents\Panelbrd.prj	

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

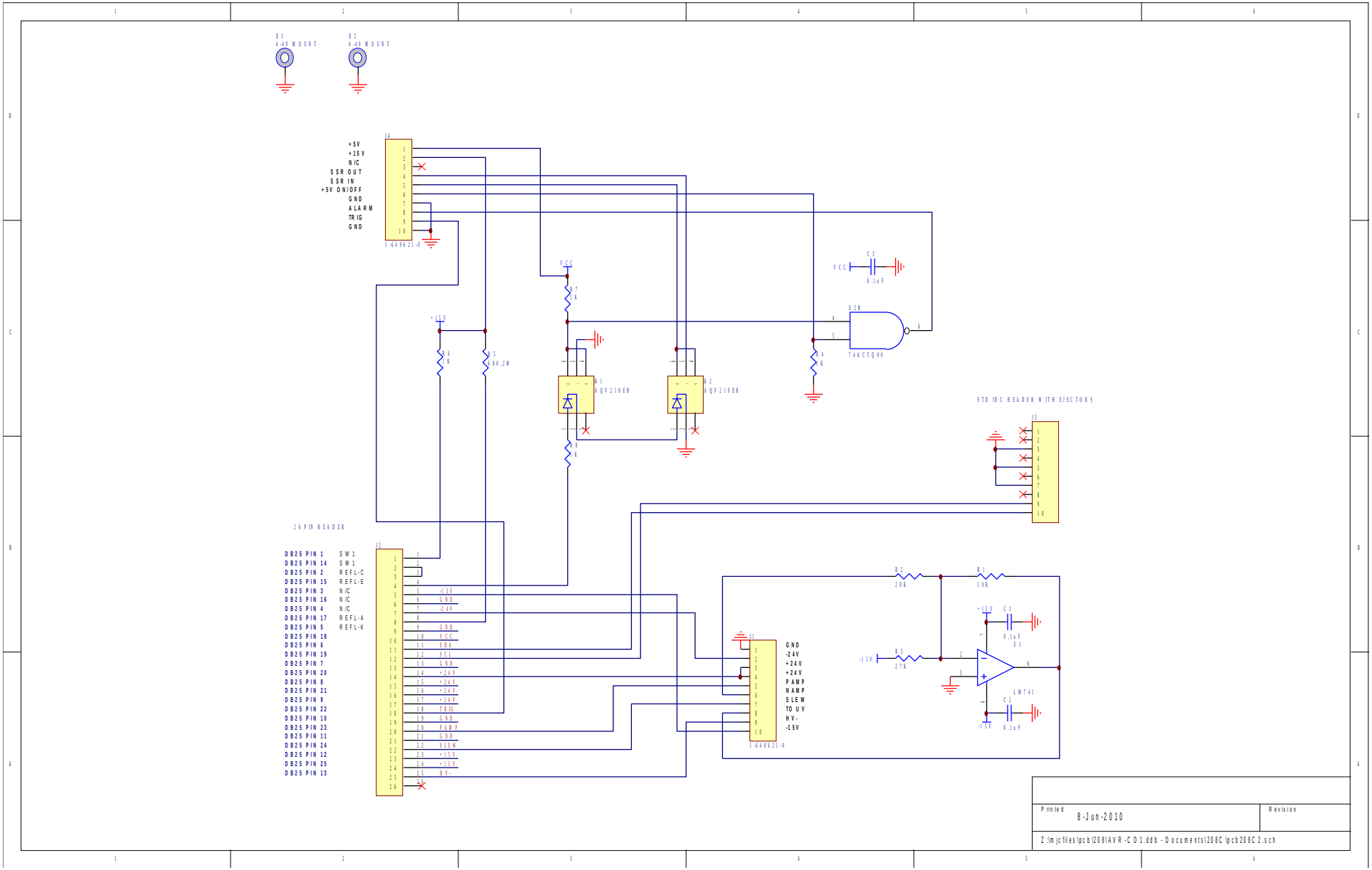


PCB 104E - KEYPAD / DISPLAY BOARD, 3/3



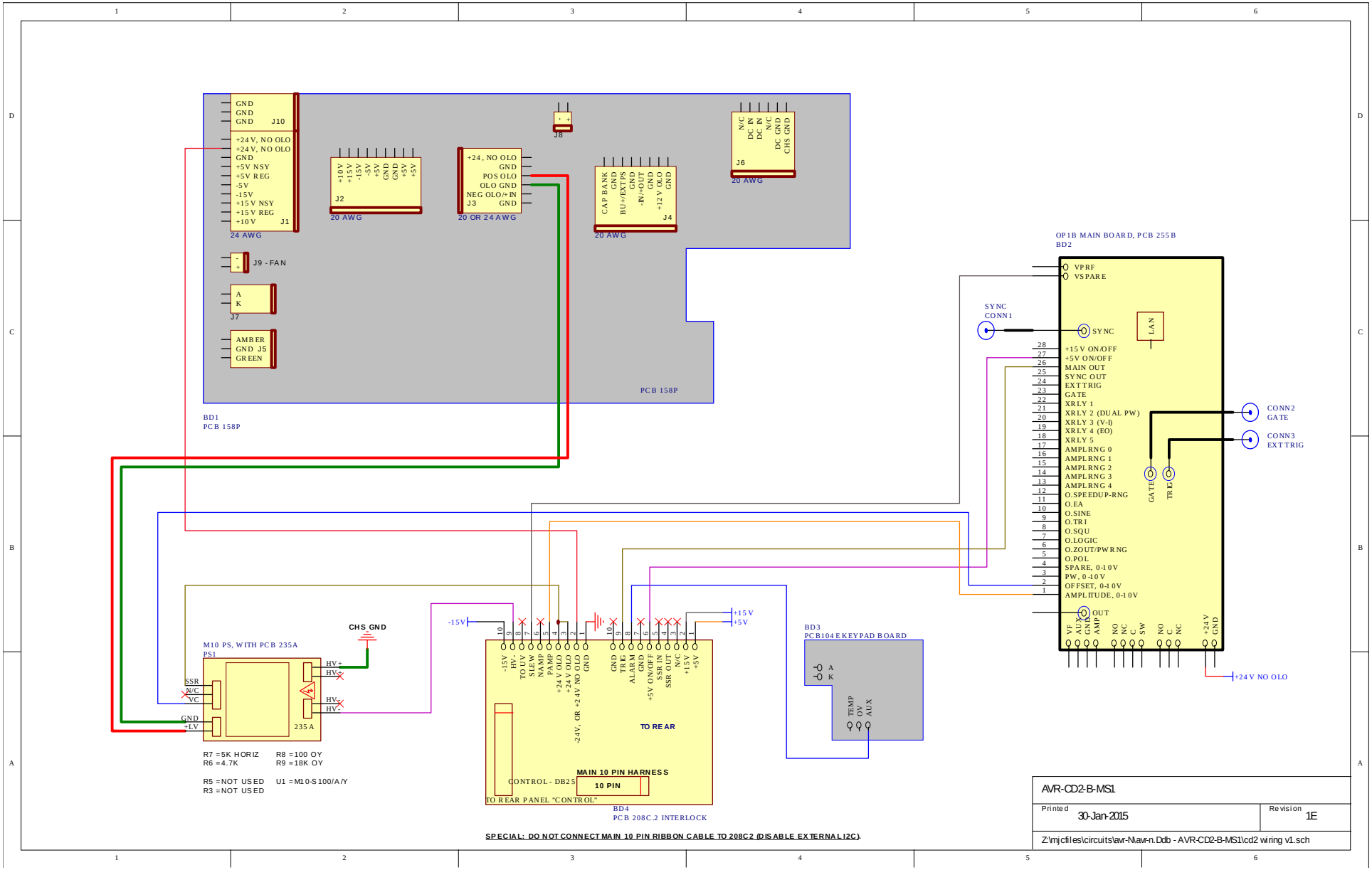
Title	LCD CIRCUITS, MECHANICAL
Date	3-Mar-2011
Revision	
Z:\mjcfiles\pcb\104e\keypad-2010.ddb - Documents\LCD-BUTT.SCH	

PCB 208C.2 – MAINFRAME TO JIG INTERFACE

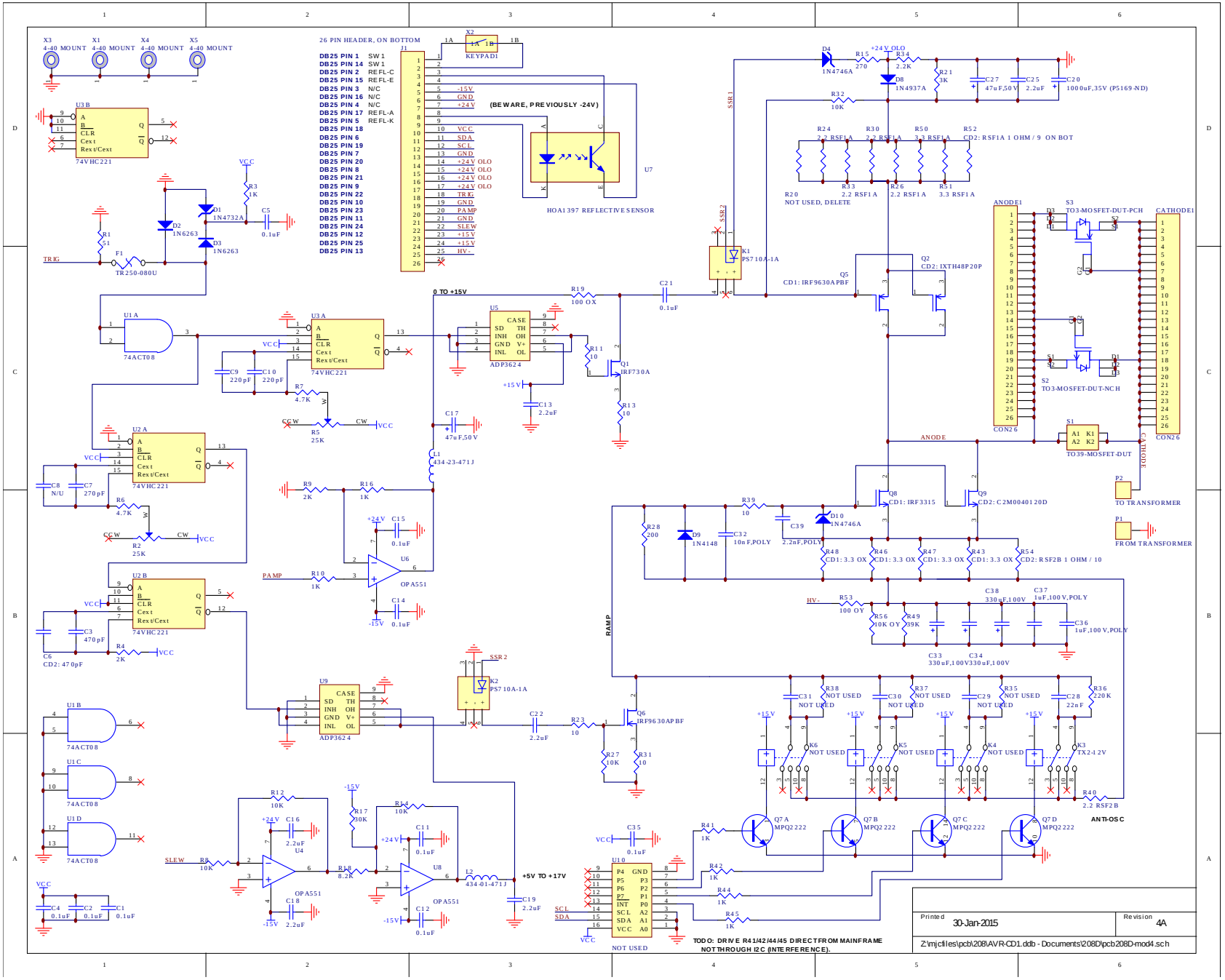


Printed 8-Jun-2010	Revision
Z:\mjcfiles\pcb\208IAVR-CD1.ddb - Documents\208C\pcb208C2.sch	

MAIN WIRING


PCB 158P
BD1
PCB 158P
J10
J1
J2
J3
J4
J6
J8
J9 - FAN
J7
24 AWG
20 AWG
20 OR 24 AWG
OP1B MAIN BOARD, PCB 255B
BD2
SYNC CONN1
LAN
CONN2 GATE
CONN3 EXT TRIG
M10 PS, WITH PCB 235A
PS1
CHS GND
235 A
R7 =5K HORIZ
R8 =100 OY
R6 =4.7K
R9 =18K OY
R5 =NOT USED
U1 =M10-S100/A/Y
R3 =NOT USED
TO REAR
MAIN 10 PIN HARNESS
10 PIN
CONTROL - DB25
TO REAR PANEL "CONTROL"
BD4
PCB 208C.2 INTERLOCK
BD3
PCB104 E KEYPAD BOARD
+24 V NO OLO
SPECIAL: DO NOT CONNECT MAIN 10 PIN RIBBON CABLE TO 208C2 (DISABLE EXTERNAL I2C).
AVR-CD2-B-MS1
Printed
30-Jan-2015
Revision
1E
Z:\mjcfiles\circuits\avr-n\avr-n.Ddb - AVR-CD2-B-MS1\cd2 wiring v1.sch

STANDARD TEST JIG WIRING (AVX-CD2-MIX)



PERFORMANCE CHECK SHEET