



AVTECH ELECTROSYSTEMS LTD.

NANOSECOND WAVEFORM ELECTRONICS  
SINCE 1975

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

## INSTRUCTIONS

MODEL AVM-3-C-PWT-AT-M-P-HIKA

+4 TO +20 VOLTS, 10 MHz

HIGH SPEED PULSE GENERATOR

WITH 150 ps RISE 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 disassembled, modified or subjected to conditions exceeding the applicable specifications or ratings. This warranty is the extent of the obligation assumed by Avtech with respect to this product and no other warranty or guarantee is either expressed or implied.

### TECHNICAL SUPPORT

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

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E-mail: [info@avtechpulse.com](mailto:info@avtechpulse.com)

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

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Manual Reference: /files/server1/officefiles/instructword/avm/AVM-3-C-PWT-AT-M-P-HIKA,ed1.odt.  
Last modified February 29, 2024.  
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## INTRODUCTION

The AVM-3-C-PWT-AT-M-P-HIKA is a high performance instrument capable of generating up to +20V into 50Ω loads at repetition rates up to 10 MHz. The output pulse width is variable from 2 to 10 ns. The rise time is less than 150 ps, and the fall time is less than 600 ps.

The output is designed to drive 50Ω loads. (A 50Ω load is required for proper operation.) The output is AC-coupled.

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

## SPECIFICATIONS

|   |  |
|---|--|
| Model:                                      | AVM-3-C  |
| Maximum amplitude (into 50Ω) <sup>1</sup> : | 20V  |
| Pulse width (FWHM):                         | 2 - 10 ns  |
| Maximum PRF:                                | 10 MHz   |
| Rise time (20% - 80%):                      | ≤ 150 ps   |
| Fall time (80% - 20%):                      | ≤ 600 ps   |
| Required load <sup>2</sup> :                | 50 Ohms  |
| Polarity:                                   | Positive   |
| Fixed propagation delay:                    | ≤ 30 ns (Ext trig in to pulse out)                               |
| Variable delay, internal trigger mode:      | 0 to 50 ns   |
| Jitter:                                     | ±15 ps, (EXT TRIG in to pulse out)                               |
| External trigger:                           | TTL-level (Low: 0V, High: +3V to +5V), 10 ns or wider.           |
| Trigger input impedance:                    | 50Ω  |
| Sync output:                                | +3 Volts, width varies with PRF (always > 10 ns), will drive 50Ω |
| Monitor output option:                      | Provides a 20 dB attenuated coincident replica of main output    |
| Connectors:                                 | Out, Monitor: SMA, Trig, Sync: BNC,                              |
| Dimensions (H x W x D):                     | 100 x 215 x 375 mm (3.9" x 8.5" x 14.8")                         |
| Power requirement:                          | 100 - 240 V, 50 - 60 Hz.   |
| Chassis material:                           | Aluminum   |
| Temperature range:                          | +5°C to +40°C  |

- 1) For operation at amplitudes of less than 20% of full-scale, best results will be obtained by setting the amplitude near full-scale and using external attenuators on the output.
- 2) A 50 Ohm load is required. Other loads may damage the instrument. Consult Avtech ([info@avtechpulse.com](mailto:info@avtechpulse.com)) if you need to drive other load impedances.

## 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



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

declare that this pulse generator meets the intent of Directive 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 will lie with the representative, unless other arrangements (under Article 9) have been made.

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





## 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)

## INSTALLATION

### VISUAL CHECK

After unpacking the instrument, examine to ensure that it has not been damaged in shipment. Visually inspect all connectors, knobs, and handles. Confirm that a power cord and a manual (this manual) are with the instrument. If the instrument has been damaged, file a claim immediately with the company that transported the instrument.

### POWER RATINGS


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

The maximum power consumption is 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.

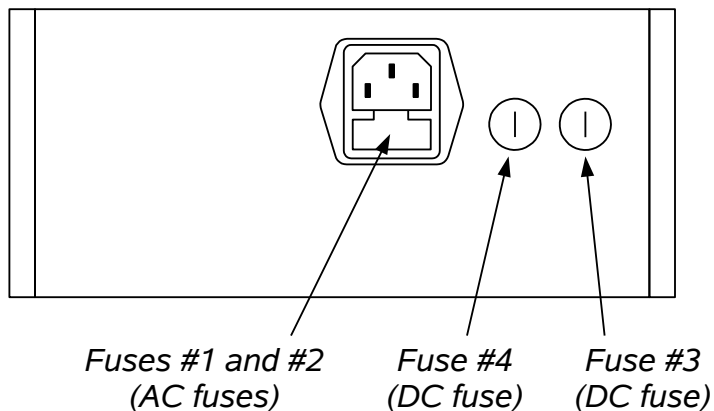
## ENVIRONMENTAL CONDITIONS

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  $\pm 10$  % of the nominal voltage;
6. no pollution or only dry, non-conductive pollution.

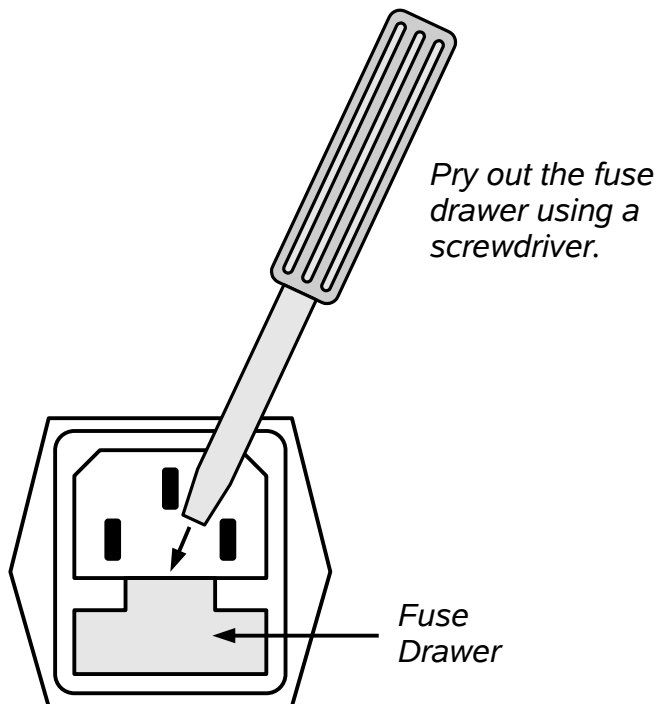
## FUSES

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

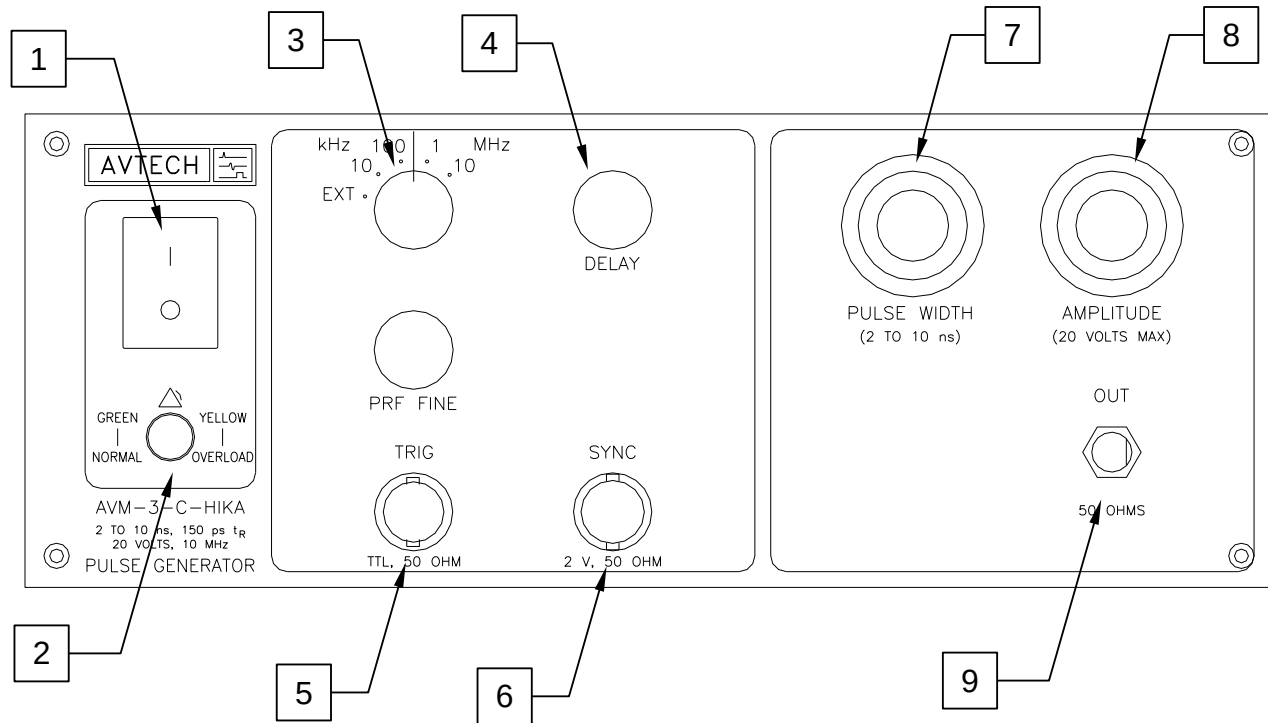
The following table lists the required fuses:

| 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                   | 0.8A, 250V, Time-Delay | 5×20 mm   | 0218.800HXP                  | F2418-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.
2. OVERLOAD Indicator. When the instrument is powered, this indicator is normally green, indicating normal operation. If this indicator is yellow, an internal automatic overload protection circuit has been tripped. If the unit is overloaded (by operating at an exceedingly high duty cycle or by operating into a very low impedance), the protective circuit will disable the output of the instrument and turn the indicator light yellow. The light will stay yellow (i.e. output disabled) for about 5 seconds after which the instrument will attempt to re-enable the output (i.e. light green) for about 1 second. If the overload condition persists, the output will be disabled again (i.e. light yellow) for another 5 seconds. If the overload condition has been removed, the instrument will resume normal operation.  
  
This overload indicator may flash yellow briefly at start-up. This is not a cause for concern.
3. PRF Range Switch and Fine Dial. This switch sets the pulse repetition frequency (PRF) range of the internal oscillator. The marked value of each position is the upper limit of the range, approximately. The fine dial directly below the switch varies the PRF within the set range. When set to the "EXT" position, the instrument is

triggered by externally-generated pulses applied to the TRIG input.

4. DELAY Control. Controls the relative delay between the reference output pulse provided at the SYNC output and the main output. This delay is variable over the range of 0 to 50 ns, approximately. At high frequencies, this delay should be kept nearly fully counter-clockwise, so that the delay does not exceed the period (otherwise, the triggering may stop). The variable delay circuitry only functions in the internal trigger mode. The delay is not adjustable when triggering externally.
5. TRIG Input. The external trigger signal is applied at this input when the PRF range switch is in the "EXT" position.

For standard units, a TTL logic level pulse (i.e., 0V = TTL LOW, +3V to +5V = TTL HIGH) is required to trigger this input, and the input impedance is 50 $\Omega$  to ground (or 1k $\Omega$ , for units with the -Z1K option).

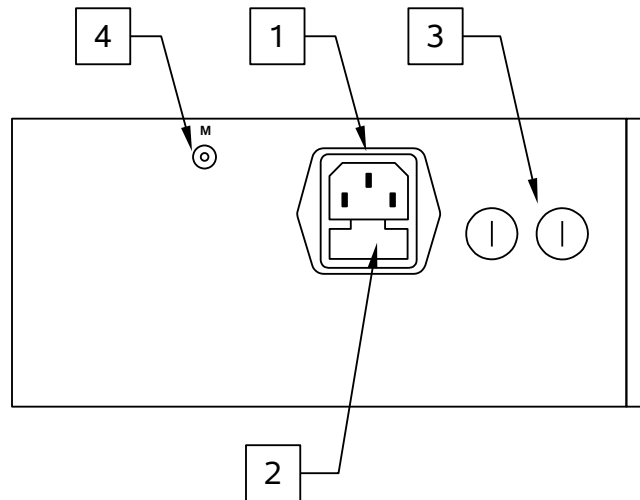
For units with the -ECL option, an ECL logic level pulse (i.e., -1.6V = ECL LOW, -0.8V = ECL HIGH) is required to trigger this input, and the input impedance is 50  $\Omega$  to -2V.

The input pulse width should be > 10 ns.

6. SYNC Output. This output precedes the main output, and is typically used to trigger an oscilloscope. When triggering internally, the SYNC pulse width varies, but is always > 10 ns. When triggering externally, the SYNC output is a buffered replica of the TRIG input. The amplitude is fixed at +3V approximately, and this output will drive 50 Ohms or higher.
7. Pulse Width Control. This dial controls the pulse width.
8. Amplitude Control. This dial controls the pulse amplitude.
9. OUT Connector. This is the main output. (This output *requires* a 50 $\Omega$  load to function properly).



## REAR PANEL CONTROLS

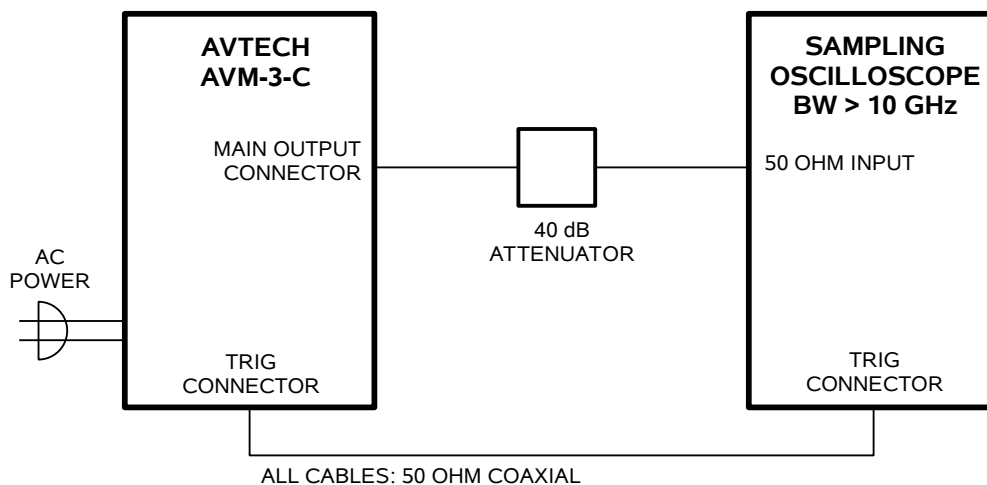


1. AC POWER INPUT. An IEC-320 C14 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket.
2. AC FUSE DRAWER. The two fuses that protect the AC input are 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. M OUTPUT CONNECTOR. (Present on units with -M option only.) This SMA connector output provides a 20 dB attenuated coincident replica of main output, for monitoring purposes.

## GENERAL INFORMATION

### BASIC TEST ARRANGEMENT

The AVM-3-C-PWT-AT-M-P-HIKA should be tested with a sampling oscilloscope with a bandwidth of at least 10 GHz to properly observe the high-speed waveform. A typical test arrangement is shown below:



The attenuator is required to prevent damage to the sampling oscilloscope.

### GENERAL OPERATING NOTES

It is recommended that the DELAY control first be set maximum counter-clockwise and then be turned clockwise until a stable display is obtained. The stability of the display on some sampling oscilloscopes is very sensitive to the trigger delay setting, particularly at high PRF (e.g. > 10 MHz). If necessary, consult your oscilloscope's instruction manual for the proper triggering method.

### AMPLITUDE INTERACTION

Some properties of the output pulse may change as a function of the amplitude setting. For some demanding applications, it may be desirable to use a combination of external attenuators and the amplitude pot to achieve the desired output amplitude.

## MINIMIZING WAVEFORM DISTORTIONS

### USE 50 OHM TRANSMISSION LINES AND LOADS

Connect the load to the pulse generator with 50 $\Omega$  transmission lines (e.g. RG-58 or RG-174 cable).

This instrument requires a 50 $\Omega$  load for proper operation. It will not properly drive a high-impedance load. The output stage will be damaged if it is operated into an open circuit (or any other high impedance). Failures due to improper output loading are not covered by the warranty.

### USE LOW-INDUCTANCE LOADS

Lenz's Law predicts that for an inductive voltage spike will be generated when the current through an inductance changes. Specifically,  $V_{\text{SPIKE}} = L \times di_{\text{LOAD}}/dt$ , where L is the inductance,  $i_{\text{LOAD}}$  is the load current change, and t is time. For this reason, it is important to keep any parasitic in the load low. This means keeping wiring short, and using low inductance components. In particular, wire-wound resistors should be avoided.

## PREVENTING DAMAGE

The AVM-3-C-PWT-AT-M-P-HIKA may fail if triggered at a PRF greater than 10 MHz.


This unit is designed to operate into a load impedance of 50 Ohms and the output stage will be damaged if it is operated into an open circuit (or any other high impedance). Failures due to improper output loading are not covered by the warranty.

The lifetime of the switching elements in the pulse generator module is proportional to the running time of the instrument. For this reason the prime power to the instrument should be turned off when the instrument is not in use.


## 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.

### ELECTROMAGNETIC INTERFERENCE

To prevent electromagnetic interference with other equipment, all used outputs should be connected to shielded 50Ω loads using shielded 50Ω coaxial cables. Unused outputs should be terminated with shielded 50Ω 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.

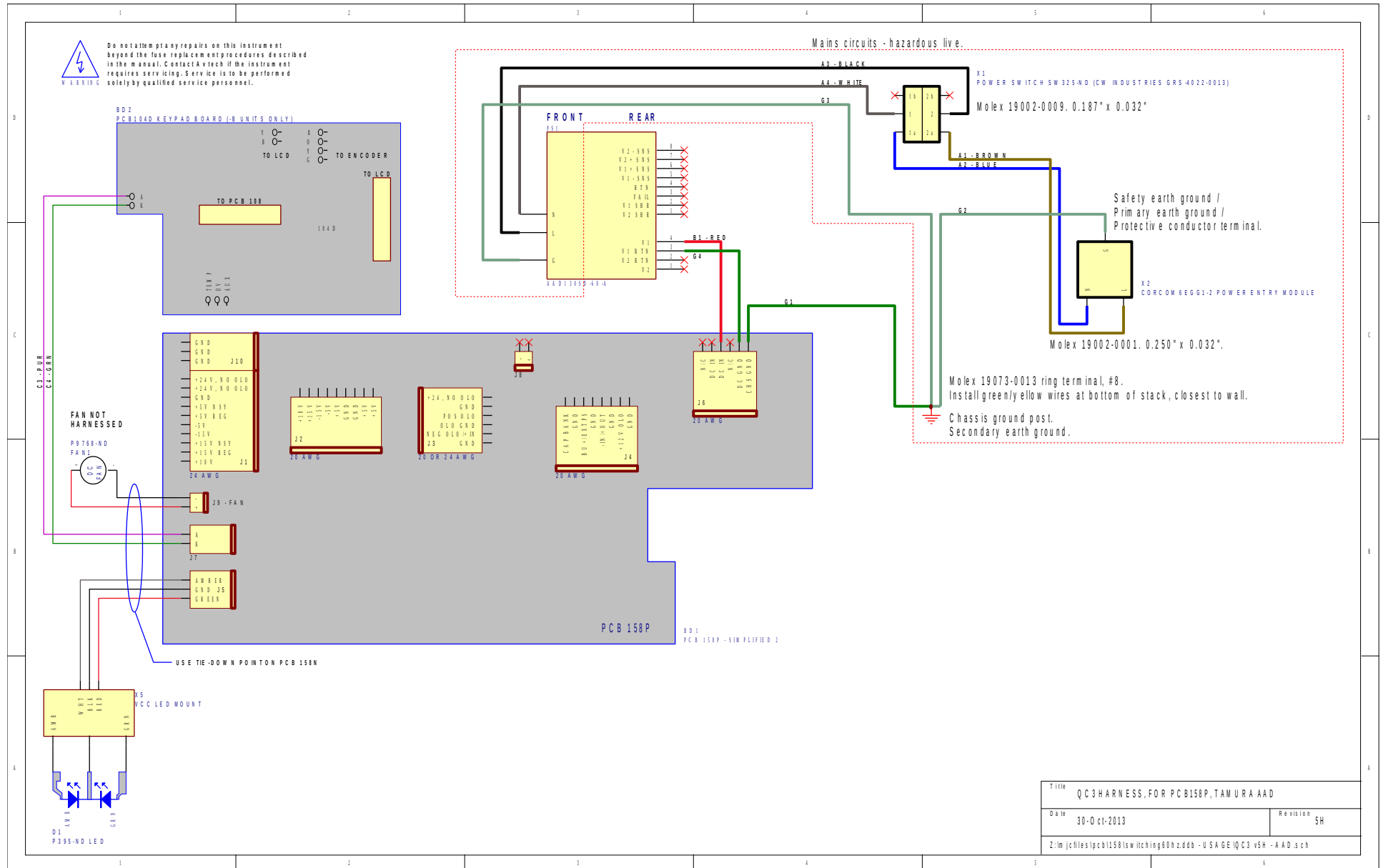
On occasion, one or more of the four rear-panel fuses may require replacement. All fuses can be accessed from the rear panel. See the “FUSES” section for details.

### 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.

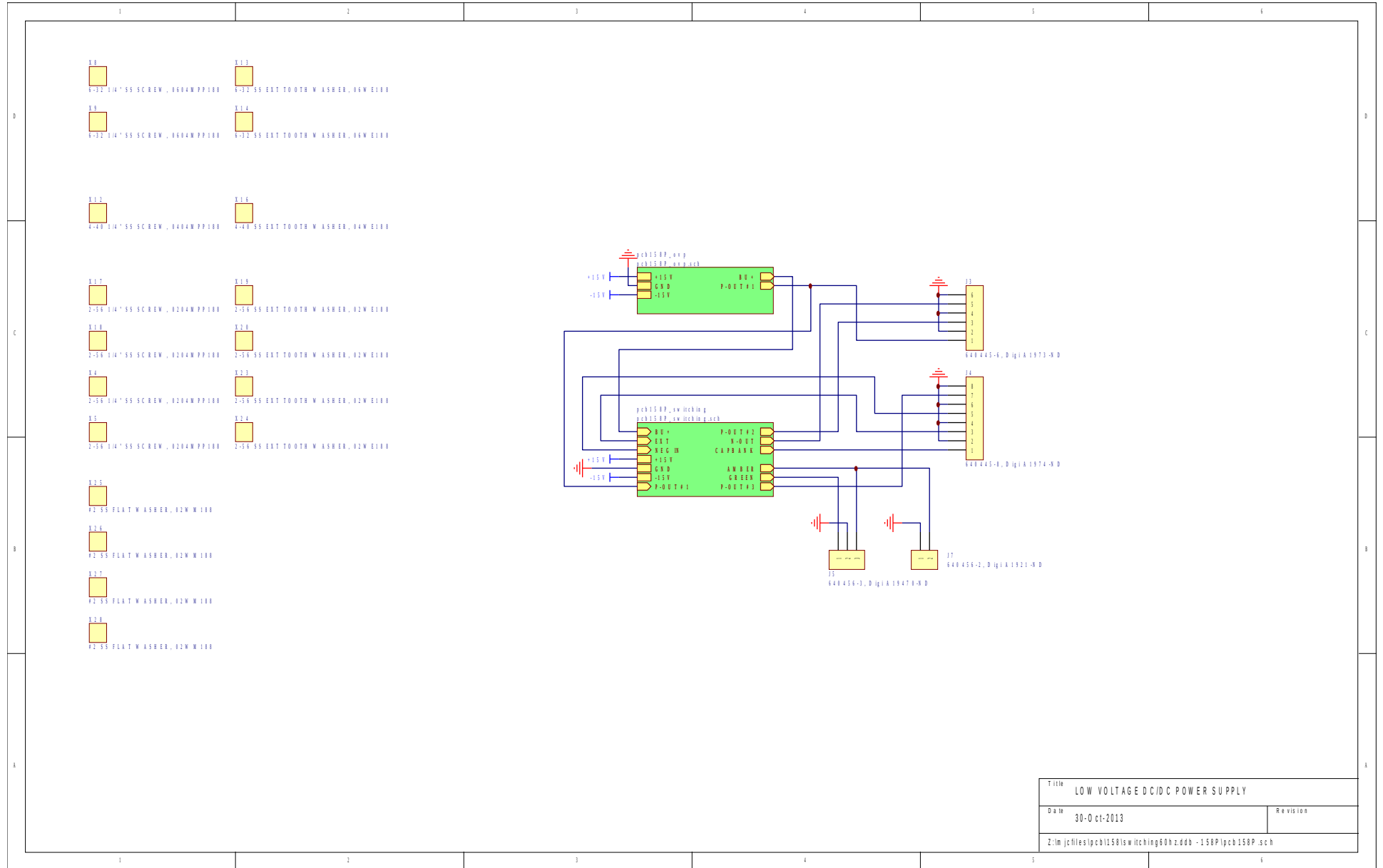
# WIRING DIAGRAMS

## WIRING OF AC POWER



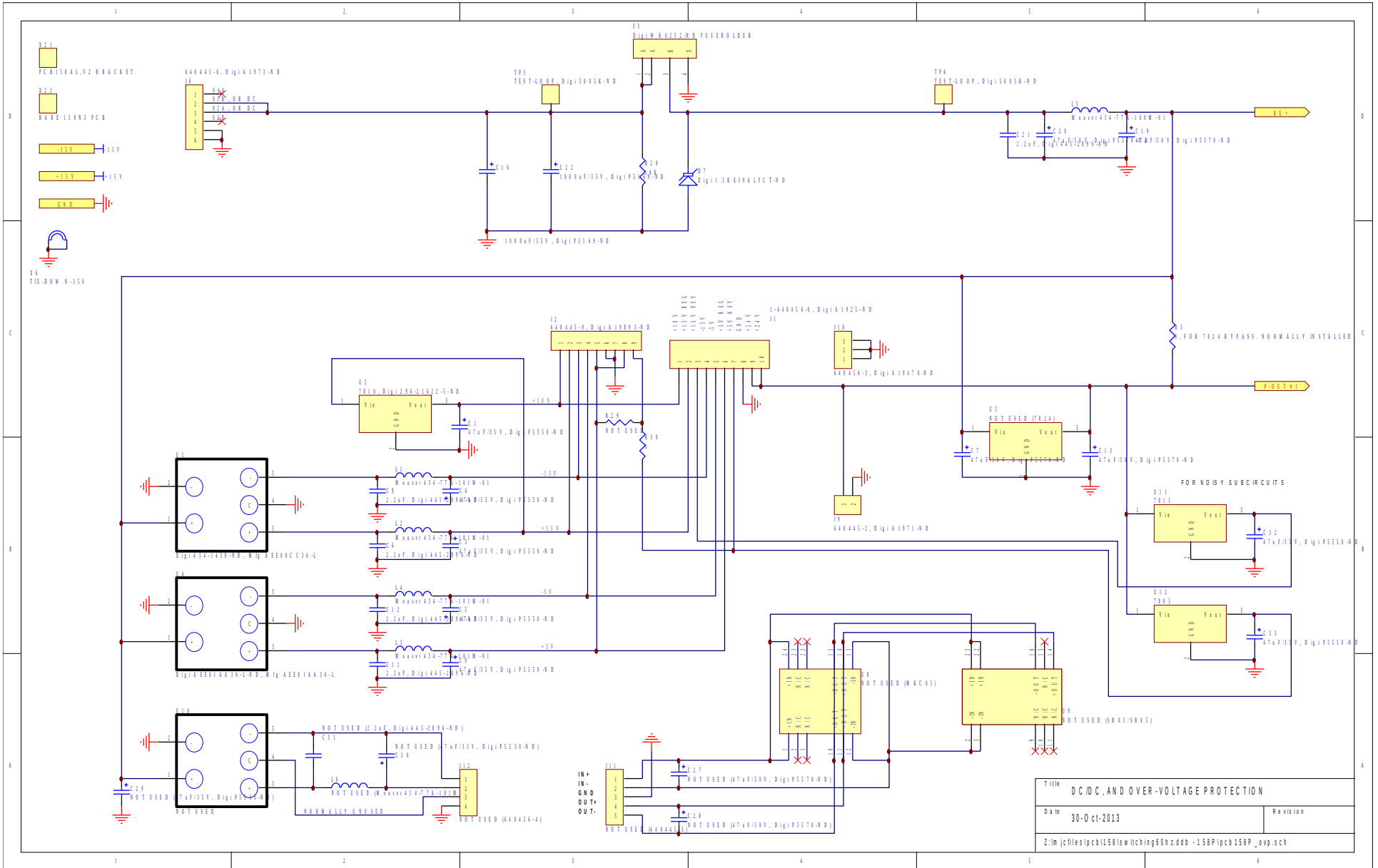
|   |             |
|---|-------------|
| Title QC3 HARNESS, FOR PCB158P, TAMURA AAD                          |             |
| Date 30-Oct-2013  | Revision 5H |
| Z:\m\jch\files\pcb158p\wiring\00h.z.dbb - USA GE IQC3 v5H - AAD.sch |             |

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

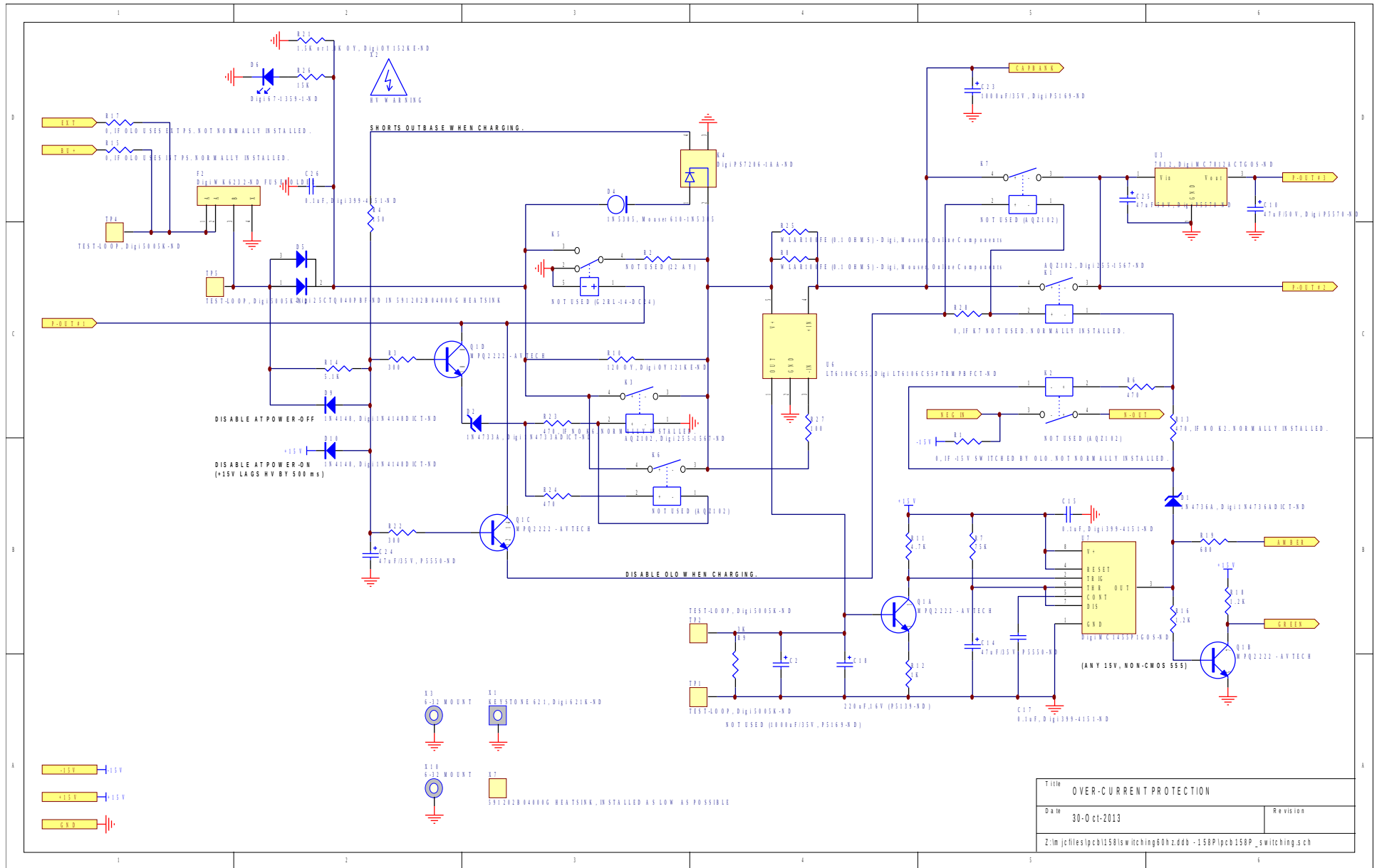


|   |             |                                |
|---|-------------|--------------------------------|
| Title   |             | LOW VOLTAGE DC/DC POWER SUPPLY |
| Date  | 30-Oct-2013 | Revision                       |
| Z:\m\jcf\files\pcb\158\sw\hching\60hz.ddb - 158P\pcb 158P.sch |             |                                |

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

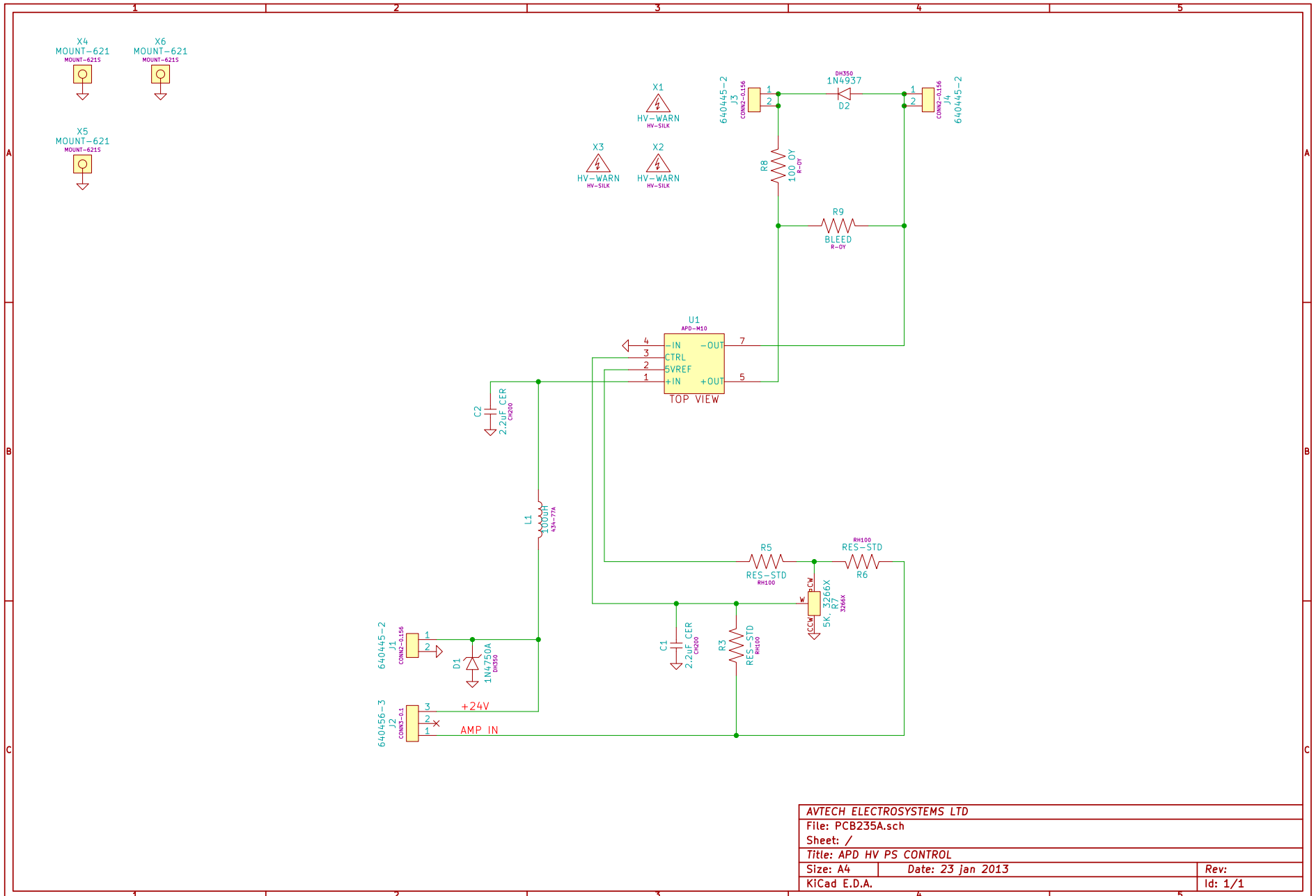


# PCB 158P - LOW VOLTAGE POWER SUPPLY, 3/3



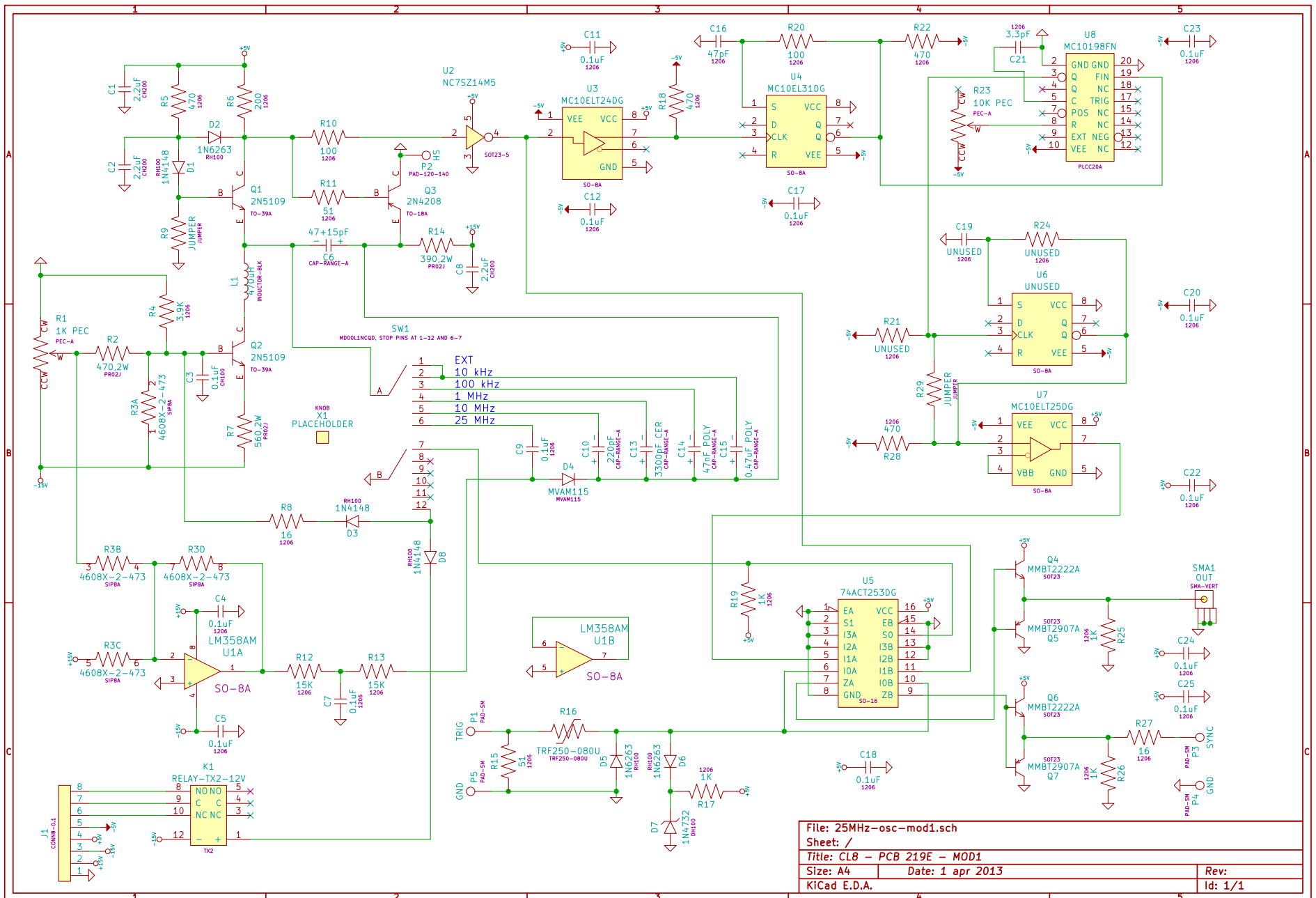


# PCB 235A - HIGH VOLTAGE DC POWER SUPPLY



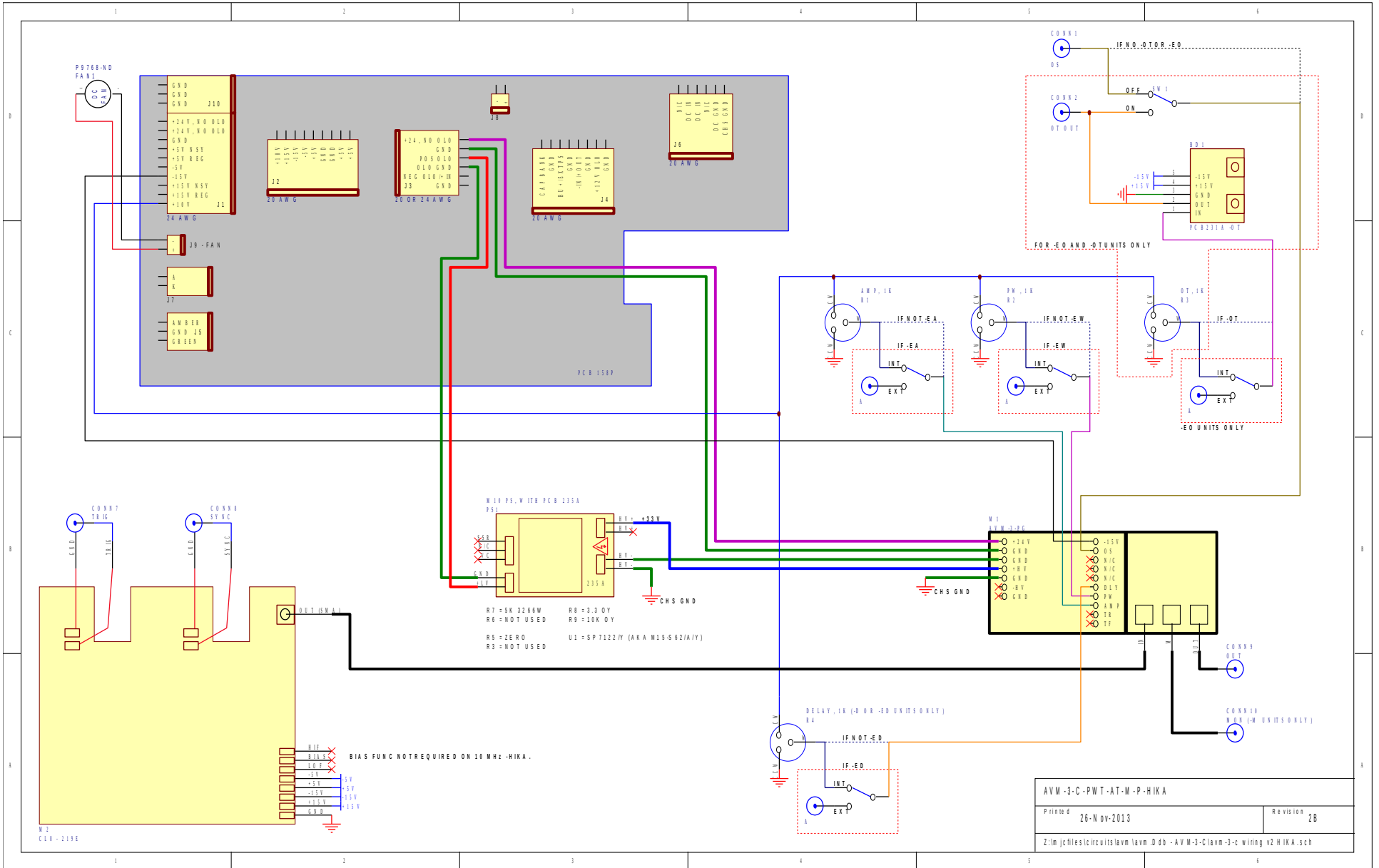
|                           |                   |         |
|---------------------------|-------------------|---------|
| AVTECH ELECTROSYSTEMS LTD |                   |         |
| File: PCB235A.sch         |                   |         |
| Sheet: /                  |                   |         |
| Title: APD HV PS CONTROL  |                   |         |
| Size: A4                  | Date: 23 Jan 2013 | Rev:    |
| KiCad E.D.A.              |                   | Id: 1/1 |

# PCB 219E - INTERNAL OSCILLATOR AND EXTERNAL TRIGGER CIRCUIT



|                              |  |                  |  |
|------------------------------|--|------------------|--|
| File: 25MHz-osc-mod1.sch     |  | Rev:             |  |
| Sheet: /                     |  | Id: 1/1          |  |
| Title: CL8 - PCB 219E - MOD1 |  | Date: 1 apr 2013 |  |
| Size: A4                     |  |                  |  |
| KiCad E.D.A.                 |  |                  |  |

# MAIN WIRING



|   |             |
|---|-------------|
| <b>AVM-3-C-PWT-AT-M-P-HIKA</b>  |             |
| Printed 26-Nov-2013   | Revision 28 |
| Z:\lm\jcf\files\circuits\lsvm\lsvm.Ddb -AVM-3-C\lsvm-3-c wiring v2 HIKA.sch |             |

PERFORMANCE CHECK SHEET