



AVTECH ELECTROSYSTEMS LTD.

NANOSECOND WAVEFORM ELECTRONICS  
SINCE 1975

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

## INSTRUCTIONS

MODEL AVMP-5-P-PS-TUE1

+2 TO +10 VOLTS, 0.5 TO 5 MHz

HIGH SPEED DUAL-CHANNEL PULSE GENERATOR

WITH < 500 ps RISE AND FALL TIMES

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)

Fax: 800-561-1970 (USA & Canada) or +1-613-686-6679 (International)

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

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

## TABLE OF CONTENTS

<b>WARRANTY.....</b>	<b>2</b>
<b>TECHNICAL SUPPORT.....</b>	<b>2</b>
<b>TABLE OF CONTENTS.....</b>	<b>3</b>
<b>INTRODUCTION.....</b>	<b>5</b>
<b>ORIGINAL QUOTATION AND SPECIFICATIONS.....</b>	<b>6</b>
<b>REGULATORY NOTES.....</b>	<b>8</b>
FCC PART 18.....	8
EC DECLARATION OF CONFORMITY.....	8
DIRECTIVE 2002/95/EC (RoHS).....	9
DIRECTIVE 2002/96/EC (WEEE).....	9
<b>INSTALLATION.....</b>	<b>10</b>
VISUAL CHECK.....	10
POWER RATINGS.....	10
CONNECTION TO THE POWER SUPPLY.....	10
PROTECTION FROM ELECTRIC SHOCK.....	11
ENVIRONMENTAL CONDITIONS.....	12
<b>FUSES.....</b>	<b>13</b>
AC FUSE REPLACEMENT.....	13
DC FUSE REPLACEMENT.....	14
FUSE RATINGS.....	14
<b>FRONT PANEL CONTROLS.....</b>	<b>15</b>
<b>REAR PANEL CONTROLS.....</b>	<b>16</b>
<b>GENERAL INFORMATION.....</b>	<b>17</b>
BASIC TEST ARRANGEMENT.....	17
BASIC PULSE CONTROL.....	17
<b>MINIMIZING WAVEFORM DISTORTIONS.....</b>	<b>19</b>
USE 50Ω TRANSMISSION LINES AND LOADS.....	19
USE LOW-INDUCTANCE LOADS.....	19
<b>PREVENTING DAMAGE.....</b>	<b>19</b>
<b>MECHANICAL INFORMATION.....</b>	<b>20</b>
TOP COVER REMOVAL.....	20
RACK MOUNTING.....	20
ELECTROMAGNETIC INTERFERENCE.....	20

- MAINTENANCE.....21**
  - REGULAR MAINTENANCE.....21
  - CLEANING.....21
- WIRING DIAGRAMS.....22**
  - WIRING OF AC POWER, STYLE 1.....22
  - WIRING OF AC POWER, STYLE 2.....23
  - PCB 158N - LOW VOLTAGE POWER SUPPLY, 1/3.....24
  - PCB 158N - LOW VOLTAGE POWER SUPPLY, 2/3.....25
  - PCB 158N - LOW VOLTAGE POWER SUPPLY, 3/3.....26
  - MAIN WIRING.....27
- PERFORMANCE CHECK SHEET.....28**

Manual Reference: /fileserv1/officefiles/instructword/avmp/AVMP-5-P-PS-TUE1,ed1.odt.  
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## INTRODUCTION

The AVMP-5-P-PS-TUE1 is a high performance customized dual-channel pulse generator. Two main outputs (A and B) are generated. The outputs are synchronous unipolar positive outputs with B 180 degrees out of phase with respect to A.

The output amplitudes are controlled by a single (shared) ten-turn locking dial. The amplitude may be adjustable from  $< +2V$  to  $+10V$ .

The instrument is externally triggered. A TTL-level trigger signal with 50% duty cycle and a pulse repetition frequency of 0.5 to 5 MHz must be used to trigger the instrument. The output duty cycle is controlled by the input duty cycle. The instrument is designed to operate with 50% input and output duty cycles. The input impedance is 50 Ohms.

The rise time and fall times are less than 500 ps.

The outputs are designed to drive  $50\Omega$  loads. (A  $50\Omega$  load is required for proper operation.)

This instrument is intended for use in research and development laboratories.

ORIGINAL QUOTATION AND SPECIFICATIONS

Date: Fri, 08 May 2009 11:00:48 -0400  
From: Avtech Sales  
Subject: Re: Avtech Quote  
To: XXXXX  
Technische Universiteit Eindhoven

XXXXX,

We are pleased to quote as follows:

Quote number: 14754

Model number: AVMP-5-P-PS-TUE1

Output amplitude: +2V to +10V, adjustable. The output amplitude is controlled by a locking ten-turn dial.

Load resistance: Must be 50 Ohms.

Number of outputs: Two (A and B). The outputs are synchronous unipolar positive outputs with B 180 degrees out of phase with respect to A. The output amplitudes are controlled by a single (shared) ten-turn locking dial.

Repetition rate range: 0.5 to 5.0 MHz. The output repetition rate equals input trigger repetition rate.

Duty cycle: Fixed at 50%. Requires a 50% fixed duty cycle input trigger.

Rise and fall times: < 500 ps, 20% - 80%. (Our original estimate was for 300 ps but subsequent tests have indicated that we may not be able to achieve 300 ps.)

Input trigger: requires a 50% fixed duty cycle TTL input trigger signal in the range of 0.5 to 5 MHz. No internal oscillator is provided.

Connectors: BNC

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 & handles, blue vinyl on aluminum covers.

Temperature range: +5 degrees to +40 degrees Celsius.

Price: \$XXXXX US each (includes 5% academic discount), Ex-works, Ottawa, Canada.

Quote valid for: 8 weeks

Estimated delivery: 8-10 weeks after receipt of order (excluding export permit\* delays).

\*Export Permit: These instruments are very high performance pulse generators, which are considered to be "Nuclear-Related Dual-Use Goods"

under government regulations. As such, an "End Use Statement" must be completed when ordering. The necessary form is attached (in PDF format). We will use the information in the completed form to apply for an export license from the Canadian government, which will take 1 to 6 weeks to obtain. We cannot ship your order without the license. Please return the completed form to us by fax.

WEEE/ROHS notes: The form available at [http://www.avtechpulse.com/green/weee\\_agreement.pdf](http://www.avtechpulse.com/green/weee_agreement.pdf) must be completed and faxed to Avtech prior to any direct sales by Avtech to European customers.

Please call or email me if I can be of further assistance.

Thank you for your interest in our products!

Dr. Michael J. Chudobiak  
Chief Engineer

--- Avtech Electrosystems Ltd. ----- since 1975 ---

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Pulse Generators - Laser Diode Drivers - HV Amplifiers  
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## 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](mailto: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](mailto: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 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 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.



## INSTALLATION

### VISUAL CHECK

After unpacking the instrument mainframe and the transformer module, examine to ensure that they have not been damaged in shipment. Visually inspect all connectors, knobs, and handles. Confirm that a power cord and an instrumentation 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 <sup>1</sup>	370001-E01
Australia, New Zealand	AS 3112:2000, 230-240V, 50 Hz	-AC01	Qualtek <sup>1</sup>	374003-A01
Continental Europe, Korea, Indonesia, Russia	European CEE 7/7 "Schuko" 230V, 50 Hz	-AC02	Qualtek <sup>1</sup>	364002-D01
North America, Taiwan	NEMA 5-15, 120V, 60 Hz	-AC03	Qualtek <sup>1</sup>	312007-01
Switzerland	SEV 1011, 230V, 50 Hz	-AC06	Qualtek <sup>1</sup>	378001-E01
South Africa, India	SABS 164-1, 220-250V, 50 Hz	-AC17	Volex <sup>2</sup>	2131H 10 C3
Japan	JIS 8303, 100V, 50-60 Hz	-AC18	Qualtek <sup>1</sup>	397002-01
Israel	SI 32, 220V, 50 Hz	-AC19	Qualtek <sup>1</sup>	398001-01
China	GB 1002-1, 220V, 50 Hz	-AC22	Volex <sup>2</sup>	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

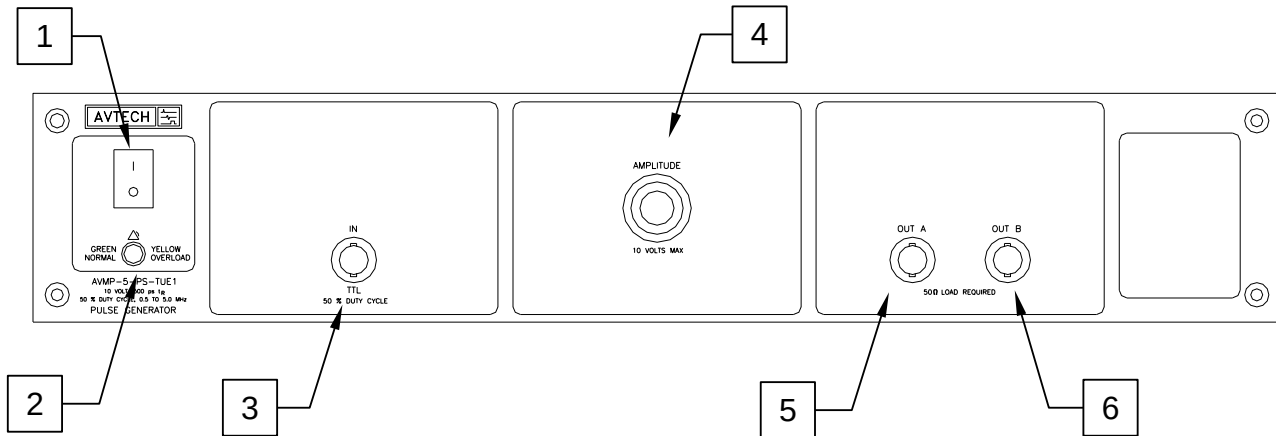
The following table lists the required fuses:

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	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>).

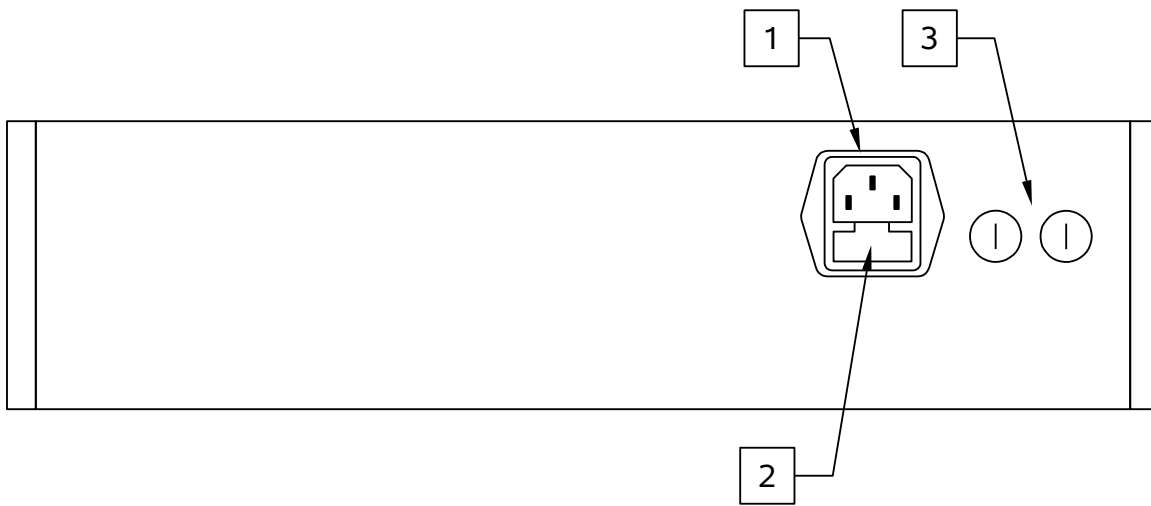
Replacement fuses may be easily obtained from Digi-Key (<http://www.digikey.com>) and other distributors.

## 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 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) IN Connector. The instrument is triggered by a TTL-level pulse applied to this connector. The signal must have 50% duty cycle, and have a repetition rate of 0.5 to 5 MHz. The input impedance of this connector is 50 Ohms.
- 4) Amplitude Control. This dial controls the amplitude of both outputs.
- 5) OUT A Connector. This SMA connector provides one of the two main outputs. This output *requires* a 50Ω load to function properly.
- 6) OUT B Connector. This SMA connector provides one of the two main outputs. This output *requires* a 50Ω load to function properly.

## REAR PANEL CONTROLS



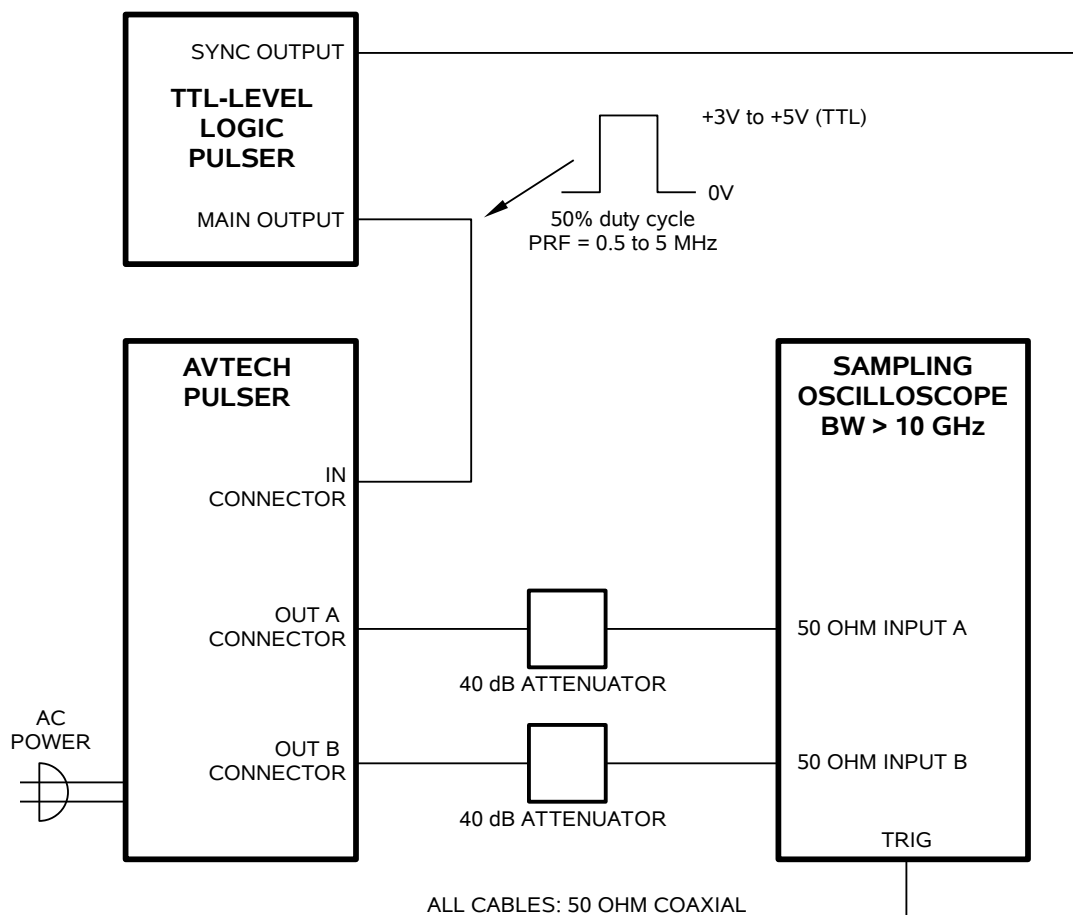
1. AC POWER INPUT. An IEC-320 C14 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket.
2. AC FUSE DRAWER. The two fuses that protect the AC input are 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.



## GENERAL INFORMATION

### BASIC TEST ARRANGEMENT

The AVMP-5-P-PS-TUE1 should be tested with a dual-channel sampling oscilloscope with a bandwidth of at least 10 GHz to properly observe the high-speed waveform. (The cables and attenuators must also have a bandwidth of at least 10 GHz.) A typical test arrangement is shown below:



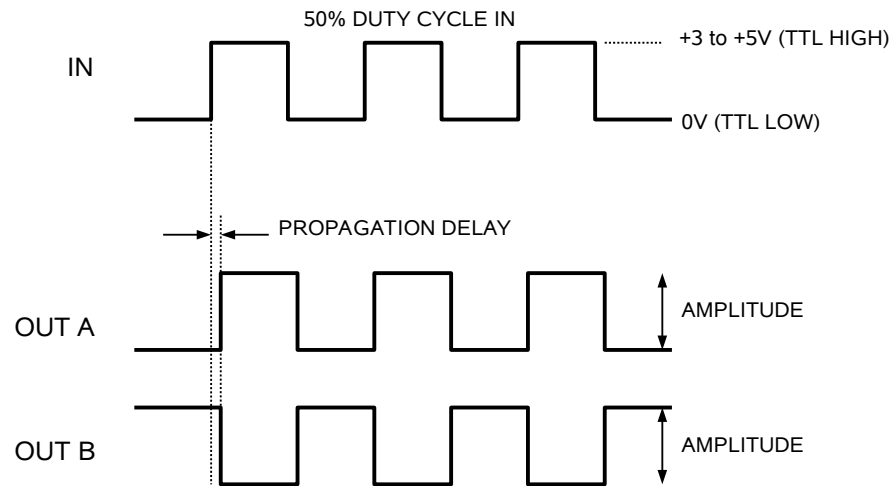
The attenuators are required to prevent damage to the sampling oscilloscope. A 40 dB attenuator with sufficient voltage rating should be used on the main output.

### BASIC PULSE CONTROL

The instrument is externally triggered. A TTL-level trigger signal with 50% duty cycle and a pulse repetition frequency of 0.5 to 5 MHz must be used to trigger the instrument. The output duty cycle is controlled by the input duty cycle. The instrument is designed

to operate with 50% input and output duty cycles. The input impedance is 50 Ohms.

The relationship between the IN, OUT A, and OUT B pulses is shown below:



## MINIMIZING WAVEFORM DISTORTIONS

### USE 50Ω TRANSMISSION LINES AND LOADS

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

This instrument requires a 50Ω 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 AVMP-5-P-PS-TUE1 may fail if triggered at a PRF greater than 5 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.

### 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.

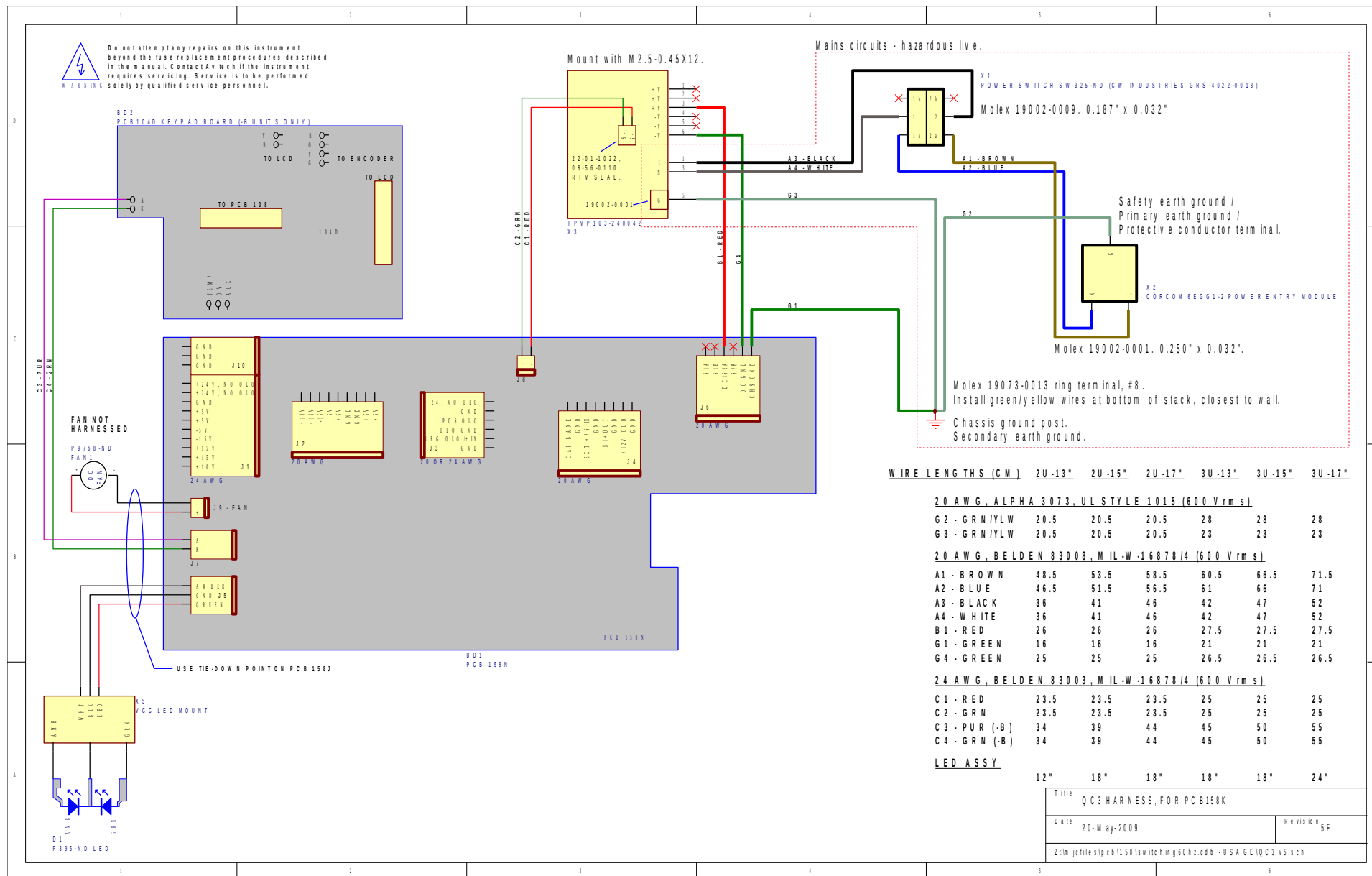
On occasion, one or more of the four rear-panel fuses may require replacement. All fuses can be accessed from the rear panel. See the “FUSES” section for details.

### CLEANING

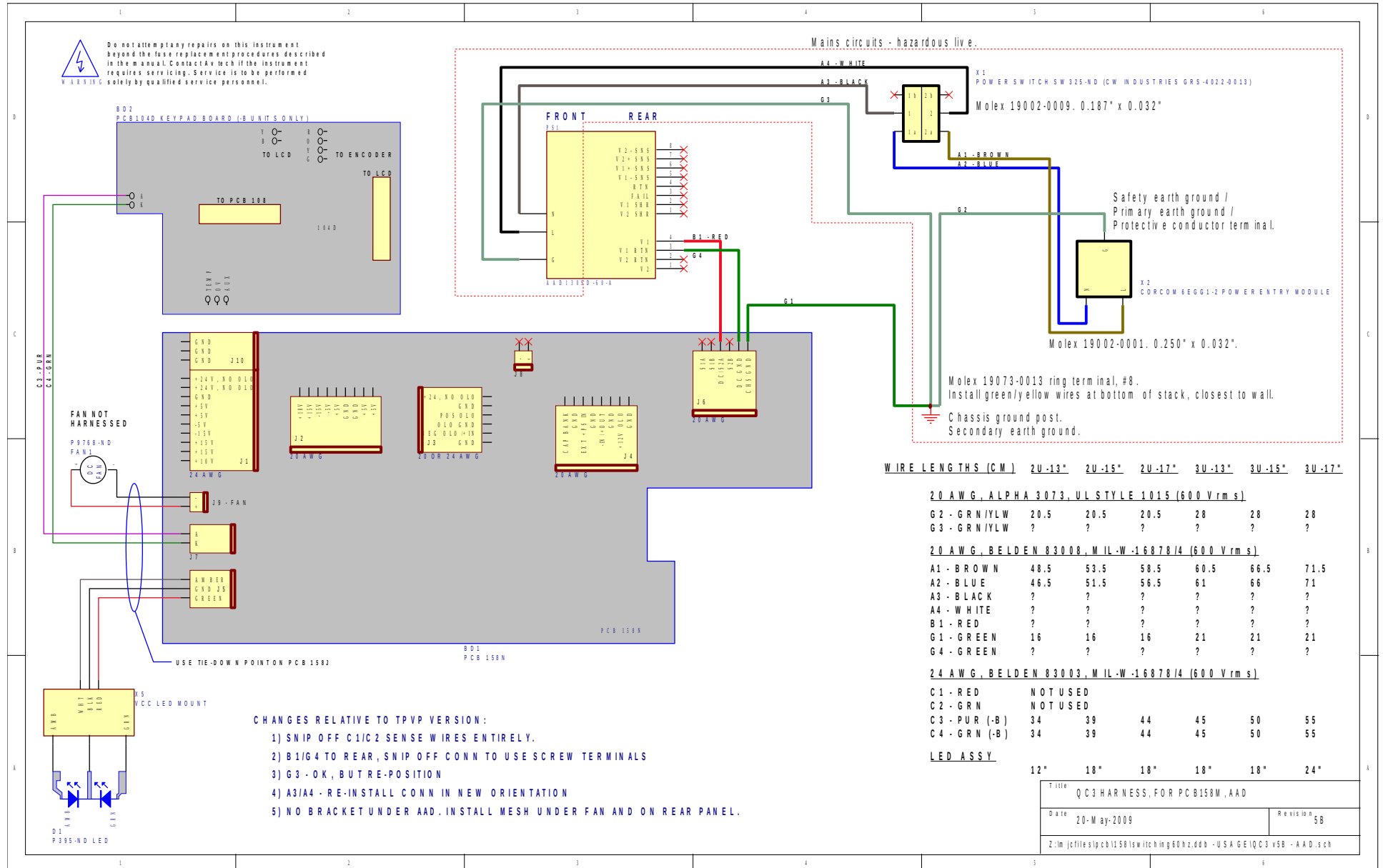
If desired, the interior of the instrument may be cleaned using compressed air to dislodge any accumulated dust. (See the “TOP COVER REMOVAL” section for instructions on accessing the interior.) No other cleaning is recommended.

# WIRING DIAGRAMS

## WIRING OF AC POWER, STYLE 1

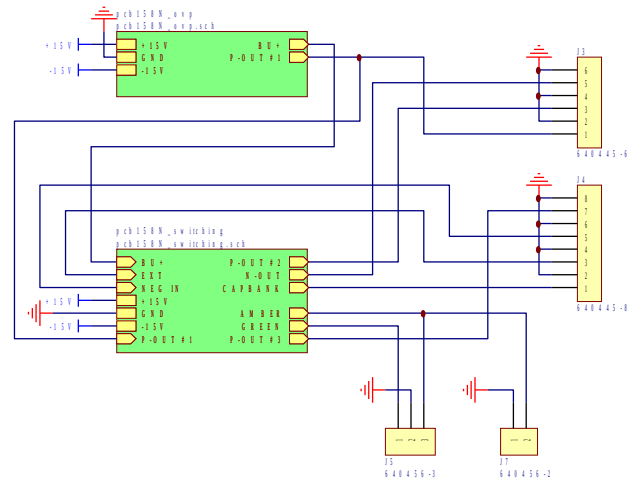


# WIRING OF AC POWER, STYLE 2



Title: QCS HARNESS, FOR PCB158M, AAD	
Date: 20-May-2009	Revision: 5B
Z:\m\j\files\ip\ch\158\sw\itc\hng\60hz.dbb - USA GE\QC3 v5B - AAD.sch	

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



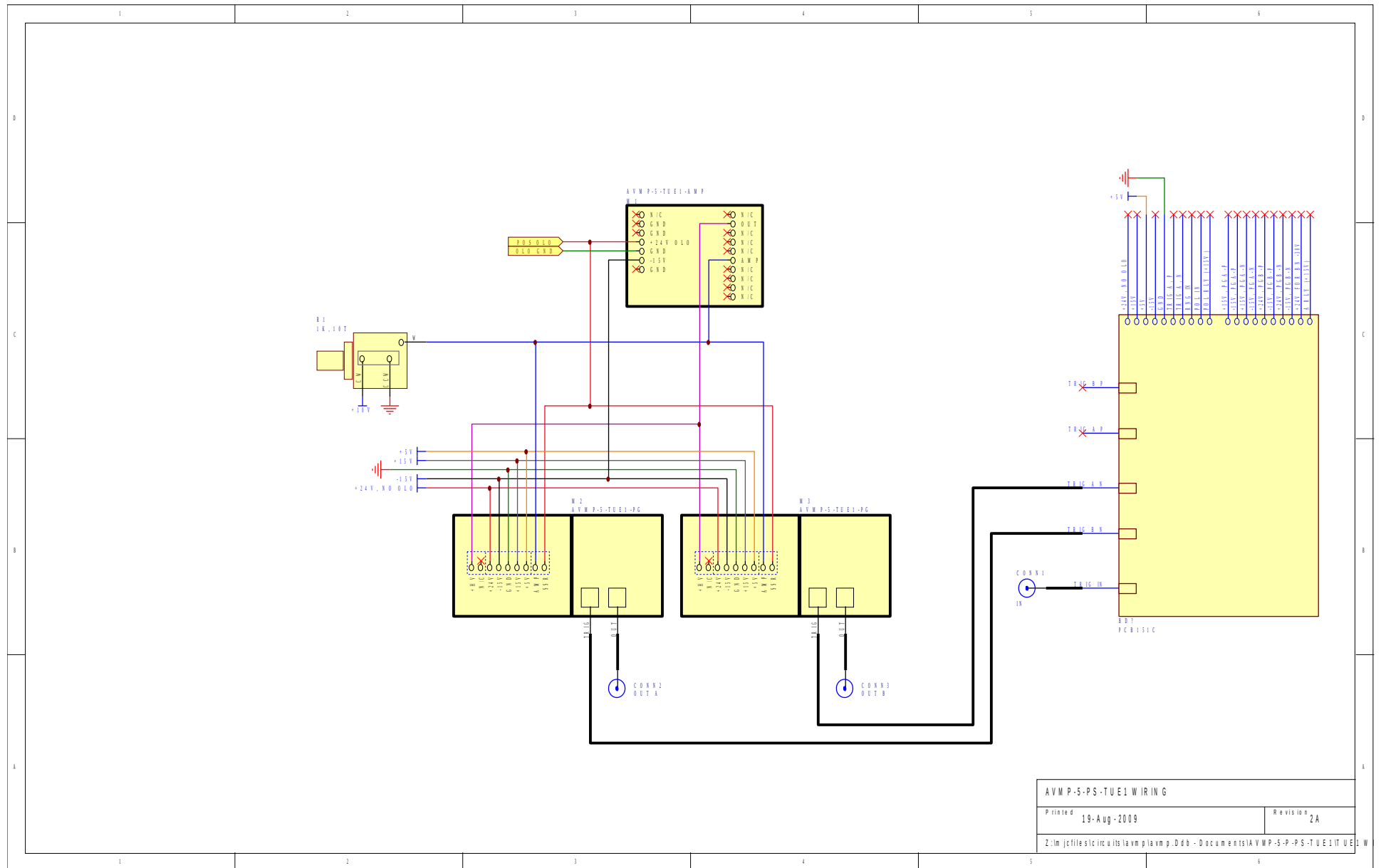
Title		LOW VOLTAGE DC/DC POWER SUPPLY
Date	12-Dec-2008	Revision
Z:\m\jcf\files\pcb158\switching\60hz.ddb - 158N\pcb158N.sch		







# MAIN WIRING



AVMP-5-PS-TUE1 WIRING	
Printed 19-Aug-2009	Revision 2A
Z:\m\jcf\esic\in\utis\avm\plavm.p\Draw - Documents\AVMP-5-P-PS-TUE1\TUE1.W	

PERFORMANCE CHECK SHEET