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NANOSECOND WAVEFORM ELECTRONICS  
SINCE 1975

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### INSTRUCTIONS

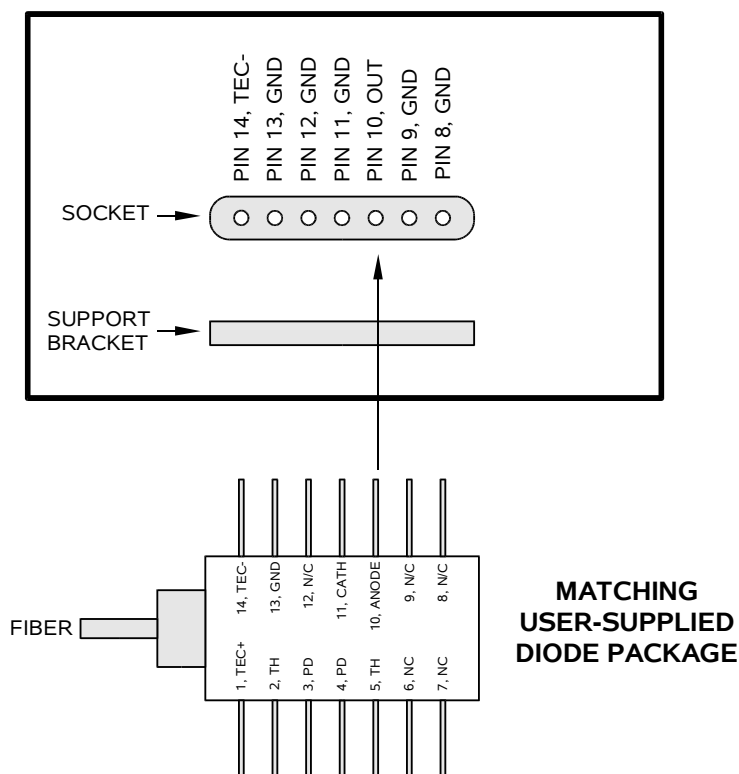
MODEL AVO-9E-C-P1-P-TITC

0 TO 400 mA, 3 ns RISE TIME

HIGH PERFORMANCE LASER DIODE DRIVER

WITH PLUG-IN SOCKET OUTPUT MODULE

#### AVX-S1 SOCKET VIEW



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: 613-226-5772 or 1-800-265-6681

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

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Manual Reference: Z:\officefiles\instructword\AVO-9\AVO-9E-C-P1-P-TITC,edition1.sxw.

Last modified June 20, 2005.

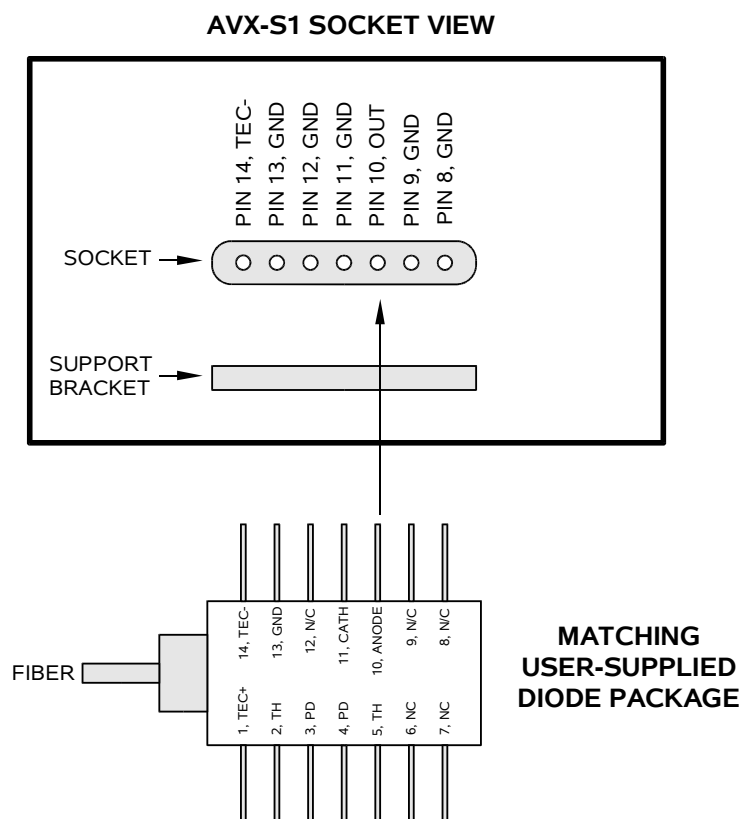
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## INTRODUCTION

The AVO-9E-C-P1-P-TITC is a high performance instrument capable of generating up to 400 mA of current into diode loads, at repetition rates up to 10 kHz. The pulse width is variable from 15 ns to 200 ns.

The AVO-9E-C-P1-P-TITC consists of a mainframe unit and an AVX-S1 series output module, which provides a socket into which the user's laser diode may be inserted. The mainframe generates voltage pulses of between 0 and +23V. The output module connects to the instrument mainframe via a detachable 2 foot long coaxial cable. The output module contains the necessary elements to match the laser diode to the pulse generator mainframe. A DC bias current of 0 to +100 mA may be applied to the laser diode by applying the desired DC current to a solder terminal on the output module. The output modules include an SMA output connector that provides an attenuated coincident replica of the diode current.

The output module is provided with a socket that will accept pins 8-14 of the user-supplied Qphotonics QFBGLD-1064-100 butterfly-packaged laser diode. A positive pulse will be applied to the diode anode (pin 10). Pins 8-9 and 11-13 will be grounded. Access to pin 14 is provided through a solder terminal. Pins 1-7 will remain unconnected and accessible to the user.



## SPECIFICATIONS

Model:	AVO-9E-C-P1-P-TITC <sup>1</sup>	
Amplitude <sup>2</sup> :	0 to 400 mA	
Maximum voltage output of mainframe ( $V_{\text{MAINFRAME}}$ ):	23V	
Allowed load voltage range:	0 to 3V	
Pulse width (FWHM):	15 to 200 ns	
PRF:	1 Hz to 10 kHz	
Rise and fall times (20%-80%):	$\leq 3$ ns	
Related 50 $\Omega$ series:	AVMR-2	
Polarity:	Positive	
Propagation delay: (Ext trig in to pulse out)	$\leq 50$ ns	
Jitter: (Ext trig in to pulse out)	$\pm 15$ ps	
DC offset or bias insertion:	Apply required DC bias current in the range of $\pm 100$ mA to solder terminal on output module.	
Sync delay: (sync out to pulse out)	Variable 0 to 200 ns	
Sync output: (to 50 $\Omega$ )	+ 3 Volts, 200 ns	
Trigger required: (ext trig mode)	+ 5 V (TTL) $\geq 50$ ns	
Connectors:	Out:	User-specified socket. See original quotation.
	Other:	Trig: BNC, Monitor: SMA
Power requirements:	100 - 240 Volts, 50 - 60 Hz	
Dimensions:	Mainframe:	100 x 215 x 375 mm (3.9" x 8.5" x 14.8")
(H x W x D)	Output module:	41 x 66 x 76 mm (1.6" x 2.6" x 3.0"), cast aluminum, blue enamel
Temperature range:	+5°C to +40°C	

- 1) -C suffix indicates stand-alone lab instrument with internal clock and line powering. (See <http://www.avtechpulse.com/formats/> for details of the instrument formats).
- 2) 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, between the mainframe and the output module.

ORIGINAL QUOTATION

Date: Tue, 07 Jun 2005 15:19:56 -0400  
From: Avtech Sales  
Subject: Avtech pulse generator (new model number: AVO-9E-C-P1-P-TITC)

XXXXX,

Following our phone conversation earlier today, I am pleased to report that:

- 1) We can reduce the minimum pulse width from 20 ns to 15 ns.
- 2) We can provide an internally-trigger PRF range of 1 Hz to 10000 Hz, instead of the standard 1 kHz to 10 MHz.
- 3) We can provide 2 week delivery.

To reflect the modified specifications in (1) and (2) above, we need to change the model number slightly, to AVO-9E-C-P1-P-TITC (instead of -TITA). WE WILL REQUIRE A REVISED PURCHASE ORDER, WITH THE UPDATED MODEL NUMBER. Please fax a revise P.O. to us.

The price is unchanged. I am pleased to re-quote as follows, with the updated model number and specifications:

Quote number: 12628

Model number: AVO-9E-C-P1-P-TITC

Description: 400 mA Laser Diode Driver (Pulsed Voltage)

Polarity: positive

Output socket: An output module is provided with a socket that will accept pins 8-14 of the user-supplied Qphotonics QFBGLD-1064-100 butterfly-packaged laser diode. A positive pulse will be applied to the diode anode (pin 10). Pins 8-9 and 11-14 will be grounded. Pins 1-7 will remain unconnected and accessible to the user.

Pulse width: 15 ns to 200 ns (instead of the standard 20-200 ns range).

PRF: 1 Hz to 10000 Hz (instead of the standard 1 kHz - 10 MHz range).

Other: as per the standard AVO-9E-C-P1-P described at <http://www.avtechpulse.com/laser/avo-9e>

Price: \$XXXXX US each, FOB destination. Includes 10% premium for rush delivery.

Quote valid for: 60 days

Delivery: 2 weeks after receipt of order.

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

Thank you for your interest in our products!

Regards,  
Dr. Michael J. Chudobiak  
Chief Engineer

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

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## EUROPEAN REGULATORY NOTES

### EC DECLARATION OF CONFORMITY

We

Avtech Electrosystems Ltd.  
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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.

## INSTALLATION

### VISUAL CHECK

After unpacking the instrument mainframe and the output module, examine to ensure that they have not been damaged in shipment. Visually inspect all connectors, knobs, and handles. Confirm that a power cord, a coaxial cable, 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	Manufacturer	Part Number
Continental Europe	European CEE 7/7 "Schuko" 230V, 50Hz	Volex ( <a href="http://www.volex.com">http://www.volex.com</a> )	17850-C3-326
		Qualtek ( <a href="http://www.qualtekusa.com">http://www.qualtekusa.com</a> )	319004-T01
United Kingdom	BS 1363, 230V, 50Hz	Qualtek ( <a href="http://www.qualtekusa.com">http://www.qualtekusa.com</a> )	370001-E01
Switzerland	SEV 1011, 2 30V, 50Hz	Volex ( <a href="http://www.volex.com">http://www.volex.com</a> )	2102H-C3-10
Israel	SI 32, 220V, 50Hz	Volex ( <a href="http://www.volex.com">http://www.volex.com</a> )	2115H-C3-10
North America, and all other areas	NEMA 5-15, 120V, 60 Hz	Qualtek ( <a href="http://www.qualtekusa.com">http://www.qualtekusa.com</a> )	312007-01

## 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

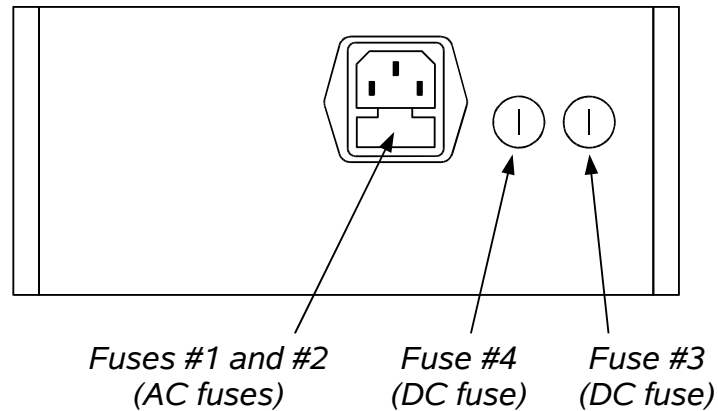
This instrument is intended for use under the following conditions:

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.

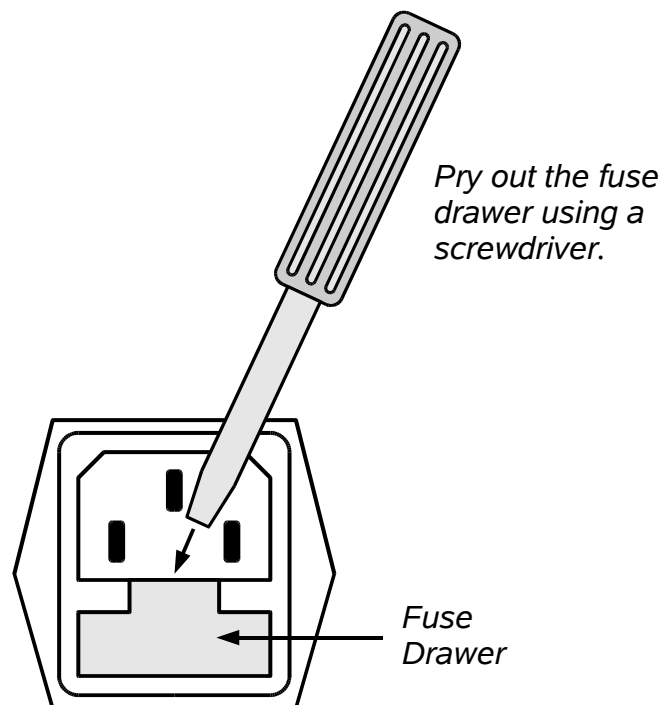
## FUSES

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

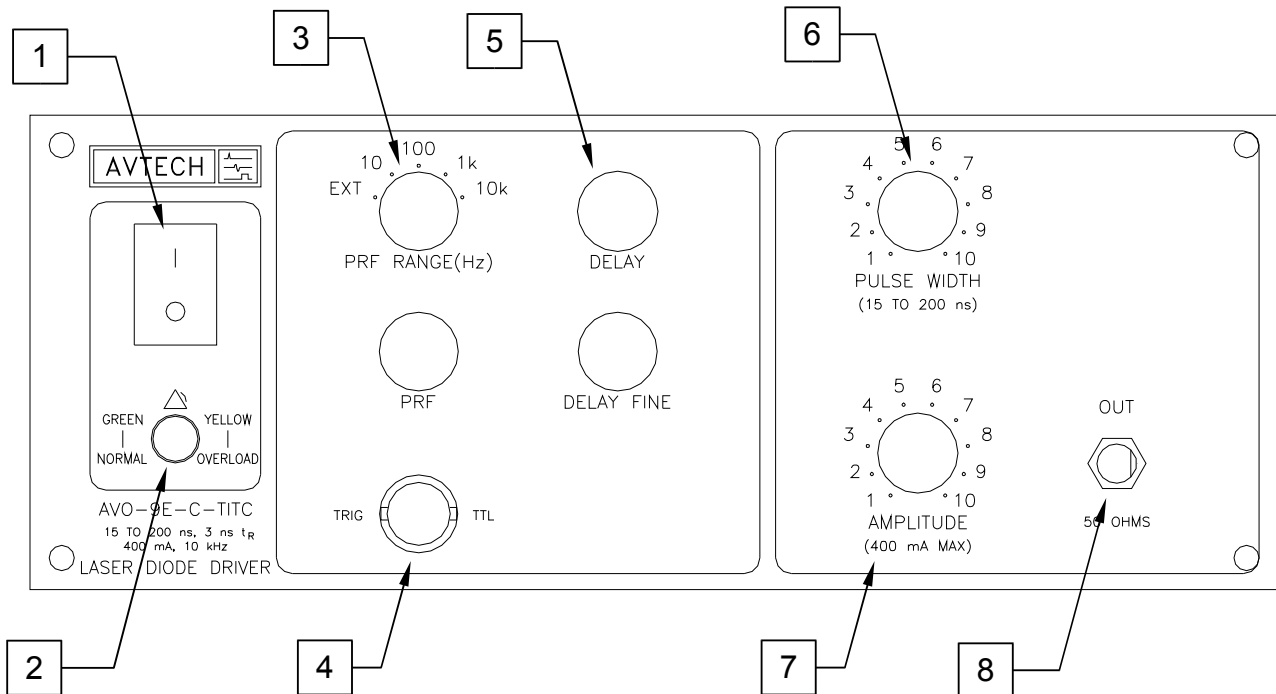
The following table lists the required fuses:

Fuses	Nominal Mains Voltage	Rating	Case Size	Manufacturer's Part Number (Wickmann)	Distributor's Part Number (Digi-Key)
#1, #2 (AC)	100-240V	0.5A, 250V, Time-Delay	5×20 mm	1950500000	WK5041-ND
#3 (DC)	N/A	0.5A, 250V, Time-Delay	5×20 mm	1950500000	WK5041-ND
#4 (DC)	N/A	0.25A, 250V, Time-Delay	5×20 mm	1950250000	WK5035-ND

The fuse manufacturer is Wickmann (<http://www.wickmann.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) **PRF Range Switch.** 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 10:1 range, approximately. The vernier dial directly below the switch varies the PRF within the set range.

If this switched is set to the “EXT” position, the instrument is triggered by a signal

applied to the TRIG connector, rather than by the internal oscillator.

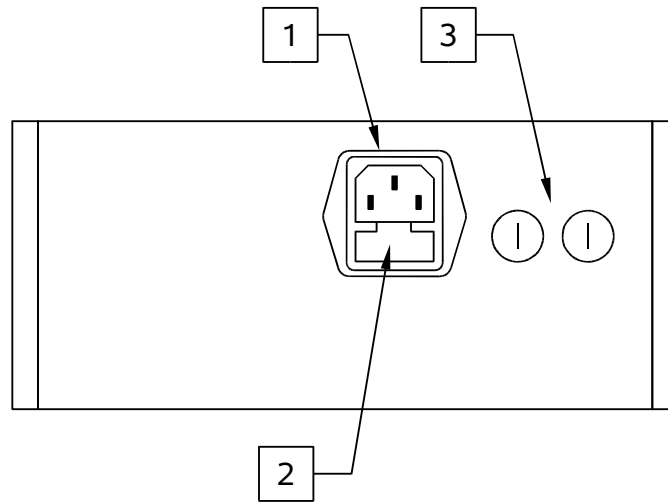
- 4) TRIG Connector. When the PRF Range Switch is set to “EXT”, the instrument is triggered by a TTL pulse applied to this connector. The pulse must be at least 50 ns wide.

When the PRF Range Switch is set to one of the four internal oscillator ranges, this connector is an output, which supplies a 2V, 200 ns wide pulse for each trigger event. This output may be used to trigger oscilloscopes or other equipment.

- 5) Delay Controls. When the PRF Range Switch is set to one of the four internal oscillator ranges, the main output is advanced or delayed relative to the TRIG output pulse (item 3). The delay is variable up to 200 ns, approximately, using the DELAY and DELAY FINE dials.
- 6) Pulse Width Control. This dial controls the pulse width.
- 7) Amplitude Control. This dial controls the amplitude.
- 8) OUT Connector. This SMA connector is connected to the output module, when the output module is used to drive a diode load. If the output module is not used, this output will generate up to 23V into a load impedances of 50Ω. (NOTE: when the output module is not used, this output *requires* a 50Ω load to function properly).



## REAR PANEL CONTROLS

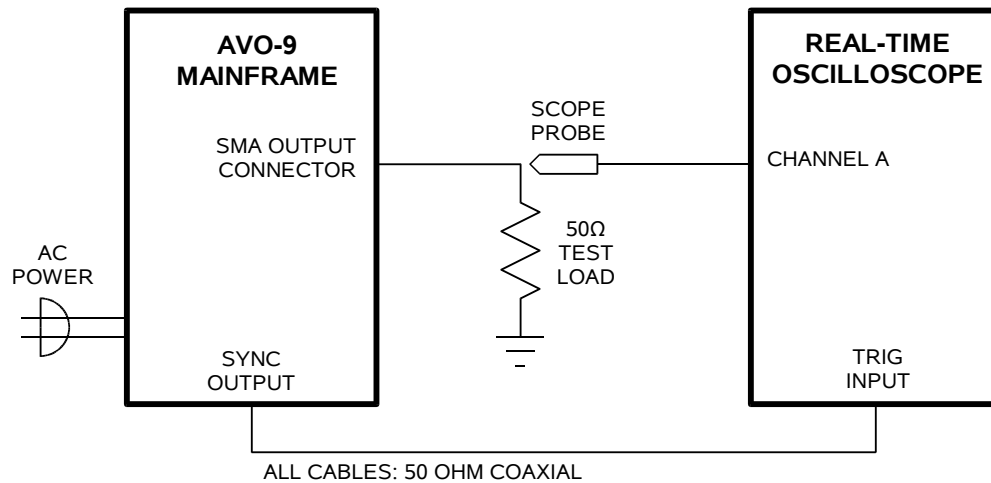


1. AC POWER INPUT. An IEC-320 C14 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket.
2. AC FUSE DRAWER. The two fuses that protect the AC input are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

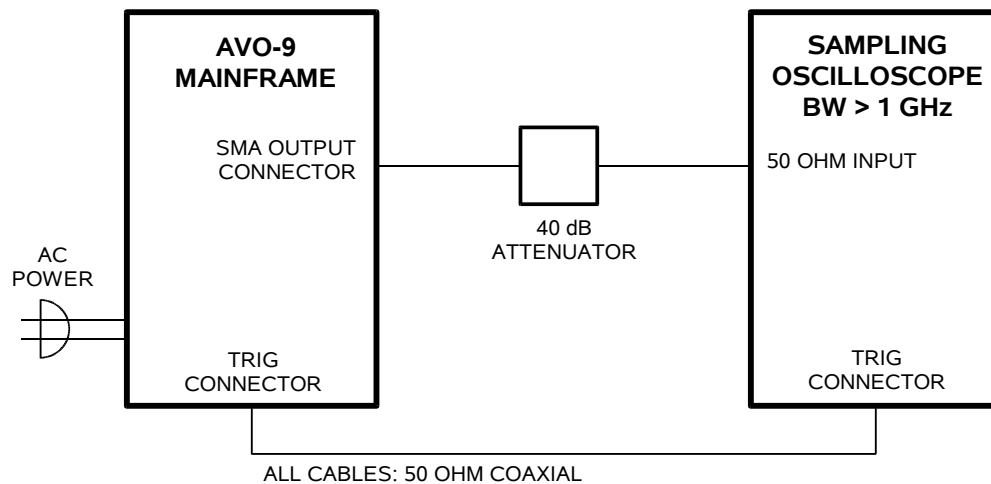
## GENERAL INFORMATION

### MINIMAL TEST ARRANGEMENT - WITHOUT OUTPUT MODULE

The AVO-9E-C-P1-P-TITC can be tested initially without the supplied output module. If the output module is not used, the mainframe output generates 0 to +23V into a 50 Ohm load, as illustrated below:



Since the AVO-9E-C-P1-P-TITC can generate pulses with rise times  $< 3$  ns, it may be necessary to use a sampling oscilloscope, rather than a real-time oscilloscope. In this case, the test arrangement should be altered as shown below:

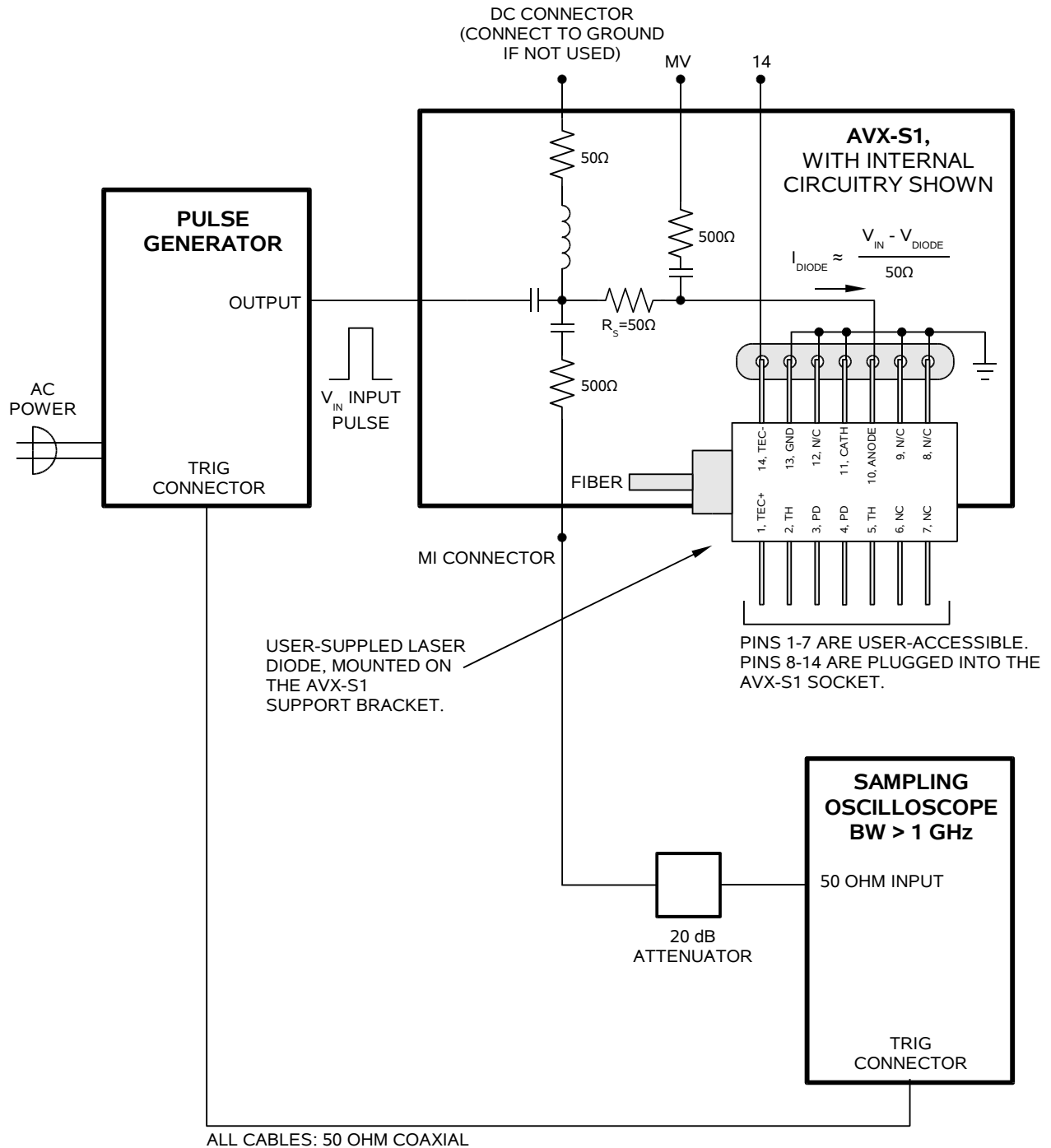


Since most sampling oscilloscopes have limited input amplitude ranges, attenuators are required.

When the output module is not used, a 50 Ohm load impedance is *required* for proper test operation.

**NORMAL TEST ARRANGEMENT**

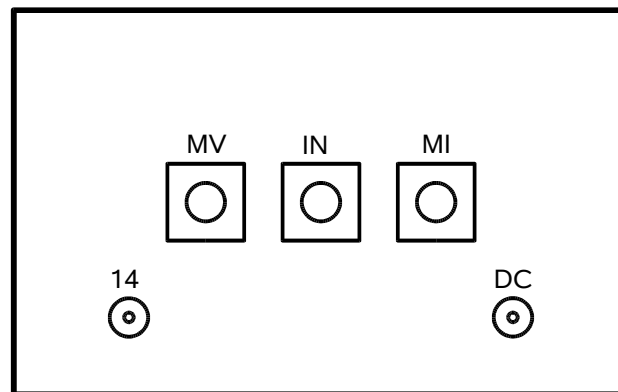
To fully test the AVO-9E-C-P1-P-TITC, and for normal operation, the output module should be connected as shown below:



The diode load is inserted into the socket on the output module, as shown above.

An oscilloscope may be used to monitor the MI and MV outputs, the locations of which are shown in the figure above. A forward DC bias may be applied to the laser diode by connecting a DC potential of 0 to +10 Volts to the DC solder terminal. The application of a small forward bias often yields a more ideal diode current waveform (as observed on the MI port). The DC port must be shorted to ground if a bias is not applied.

A solder terminal is provided which offers access to pin 14 of the diode under test. Typically this is a "TEC-" terminal.



AVX-S1 OUTPUT MODULE, CONNECTOR VIEW

### INSTALLING THE DIODE

To install the diode in the output module socket, align the diode so that pins 8-14 are facing the socket, and the mounting flange of the diode is underneath the main body of the diode. Gently and slowly insert the diode into the socket. Insert it far enough that the mounting holes on the diode align with the mounting holes on the support bracket. Secure the diode to the support bracket using four 2-56 screws.

It may be necessary to first loosen the two 4-40 screws that attach the support bracket to the main body of the AVX-S1, to provide optimal alignment of the bracket. Re-tighten the screws after optimal alignment has been obtained.

It is recommended that pins 8-14 be trimmed from their normal length to a shorter length of 7 mm. This will make it easier to insert and remove the diode.

### AMPLITUDE CONTROL

When using the output module, the pulse current through the diode load is given by:

$$I_{\text{DIODE}} \approx (V_{\text{IN}} - V_{\text{DIODE}}) / 50\Omega$$

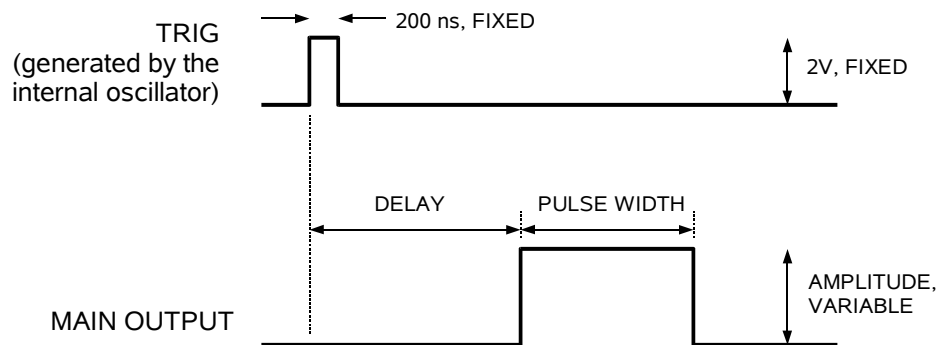
where  $V_{IN}$  is the amplitude of the input pulse and  $V_{DIODE}$  is the forward voltage drop across the diode (typically 2 or 3V).

### BASIC PULSE CONTROL

This instrument can be triggered by its own internal clock or by an external TTL trigger signal. When triggered internally, two mainframe output channels respond to the trigger: OUT and SYNC.

- OUT. This is the main output. The maximum output voltage is 23V.
- TRIG. The TRIG pulse is a fixed-width TTL-level reference pulse used to trigger oscilloscopes or other measurement systems.

These pulses are illustrated below:



*Figure A*

When triggered externally, the TRIG connector acts as an input. The delay controls do not function in this mode.

### PULSE WIDTH / AMPLITUDE INTERACTION

The pulse width and delay of the output pulse may vary slightly with the amplitude setting, particularly at lower amplitudes. For some demanding applications, it may be desirable to use external attenuators in conjunction with the AVO-9E-C-P1-P-TITC, instead of generating a low-amplitude pulse directly.

## PROTECTING YOUR INSTRUMENT

### DO NOT EXCEED 10 kHz

The output stage may be damaged if triggered by an external signal at a pulse repetition frequency greater than 10 kHz.

### USE A 50Ω LOAD

The mainframe output stage may be damaged if the output is not terminated into the output module or a 50Ω dummy load.


### INSTALL THE DIODE CORRECTLY

**NOTE:** Trim the diode leads to **no longer than 0.5" / 1.25 cm in length**. If the leads are longer than that, they may cause an internal short circuit in the output module, which may cause damage to the diode and the output module.


## 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](mailto: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 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.

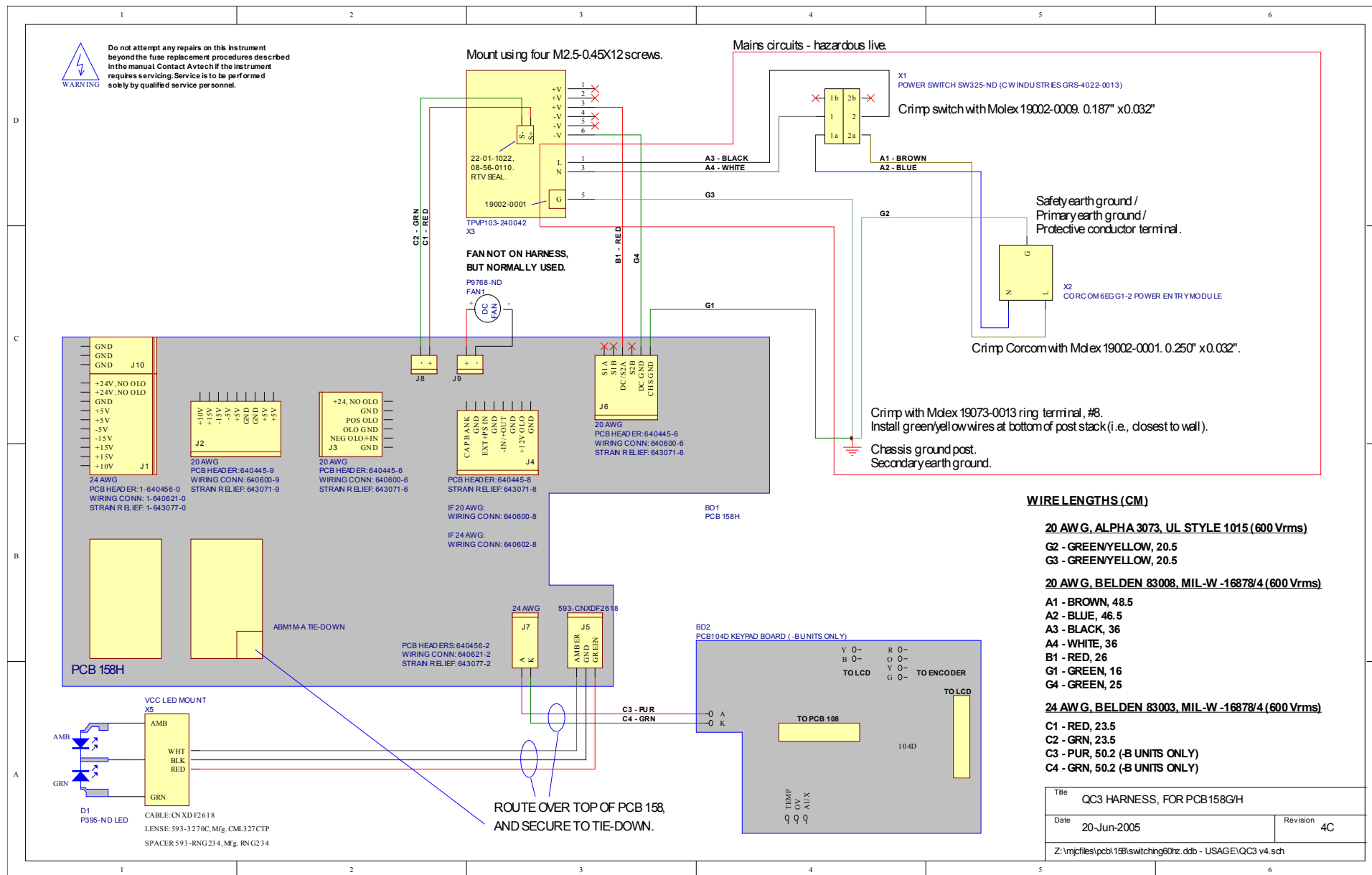
### CLEANING

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.



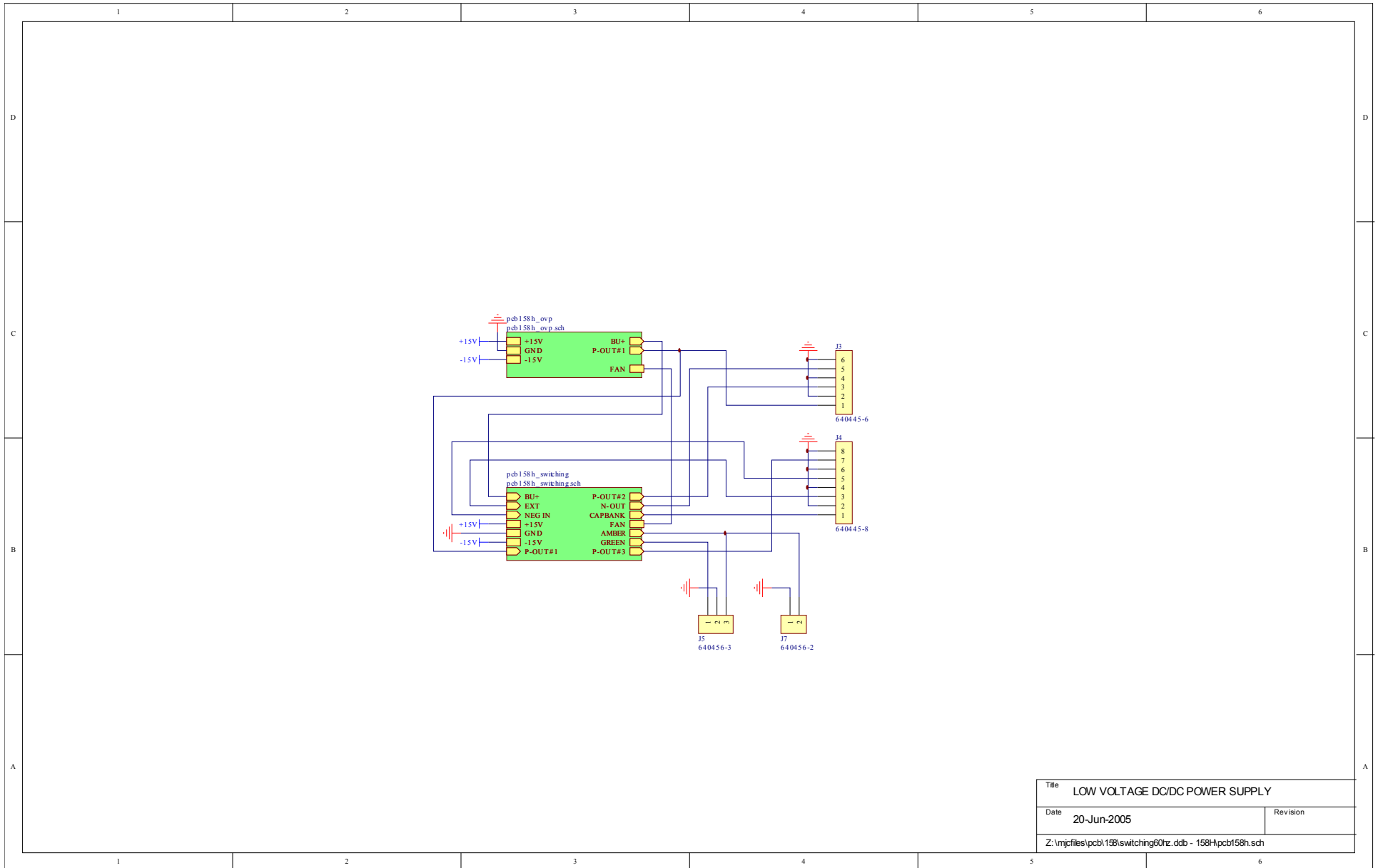
# WIRING DIAGRAMS

## WIRING OF AC POWER


123456

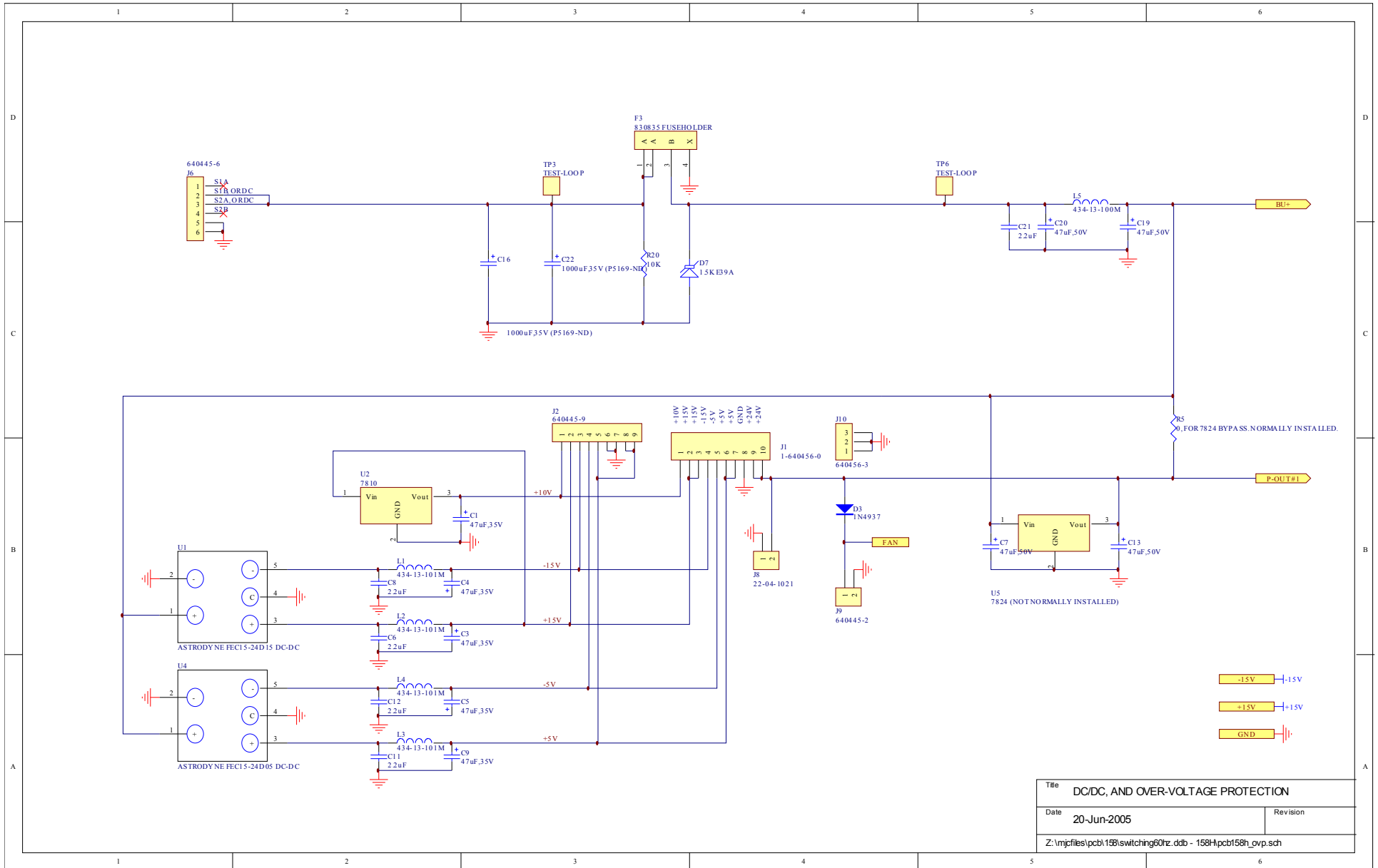
Title QC3 HARNESS, FOR PCB158GH	
Date 20-Jun-2005	Revision 4C
Z:\mjc\files\pcb158\switching60Hz.ddb - USAGE\QC3 v4.sch	

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

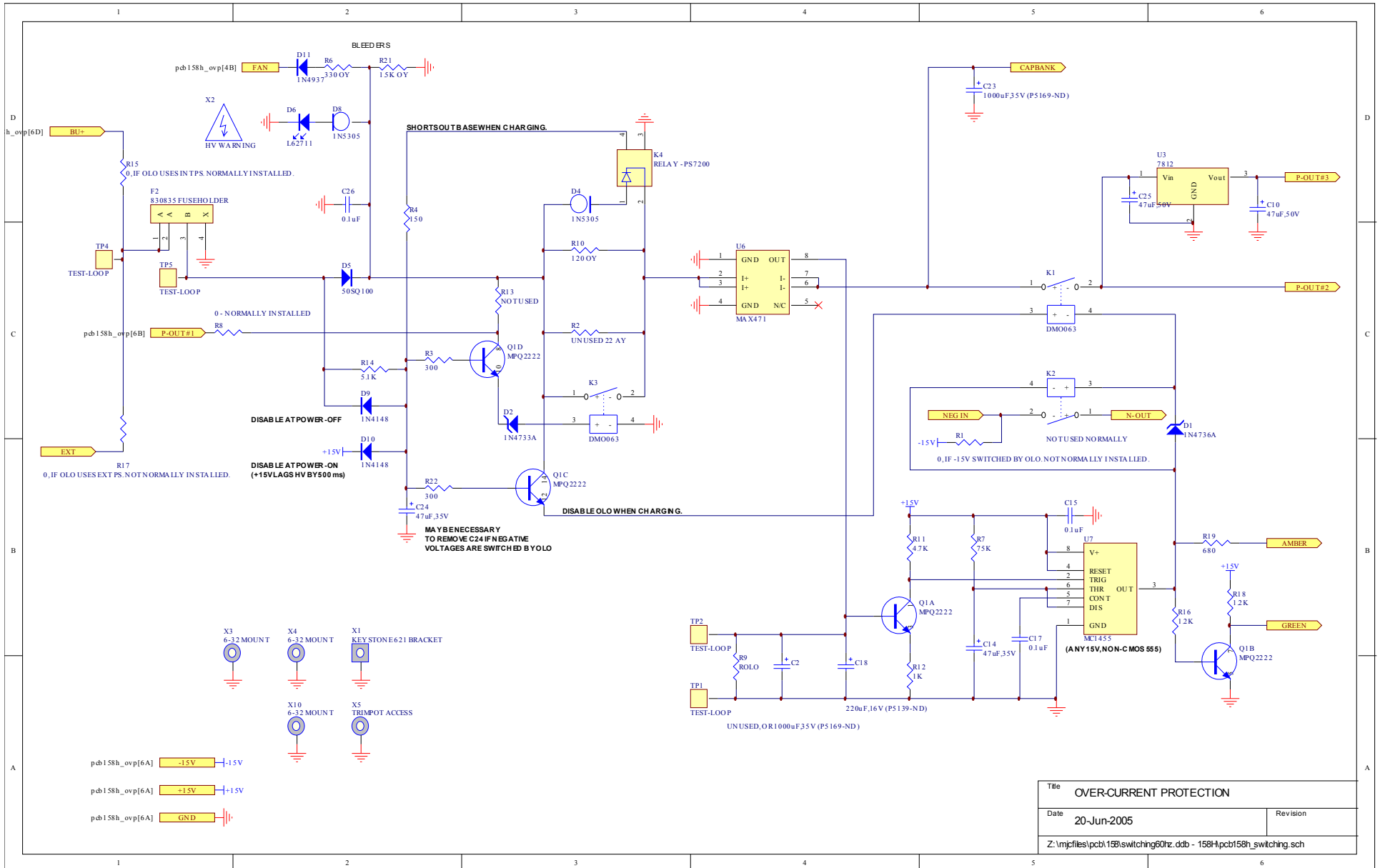


Title		LOW VOLTAGE DC/DC POWER SUPPLY
Date	20-Jun-2005	Revision
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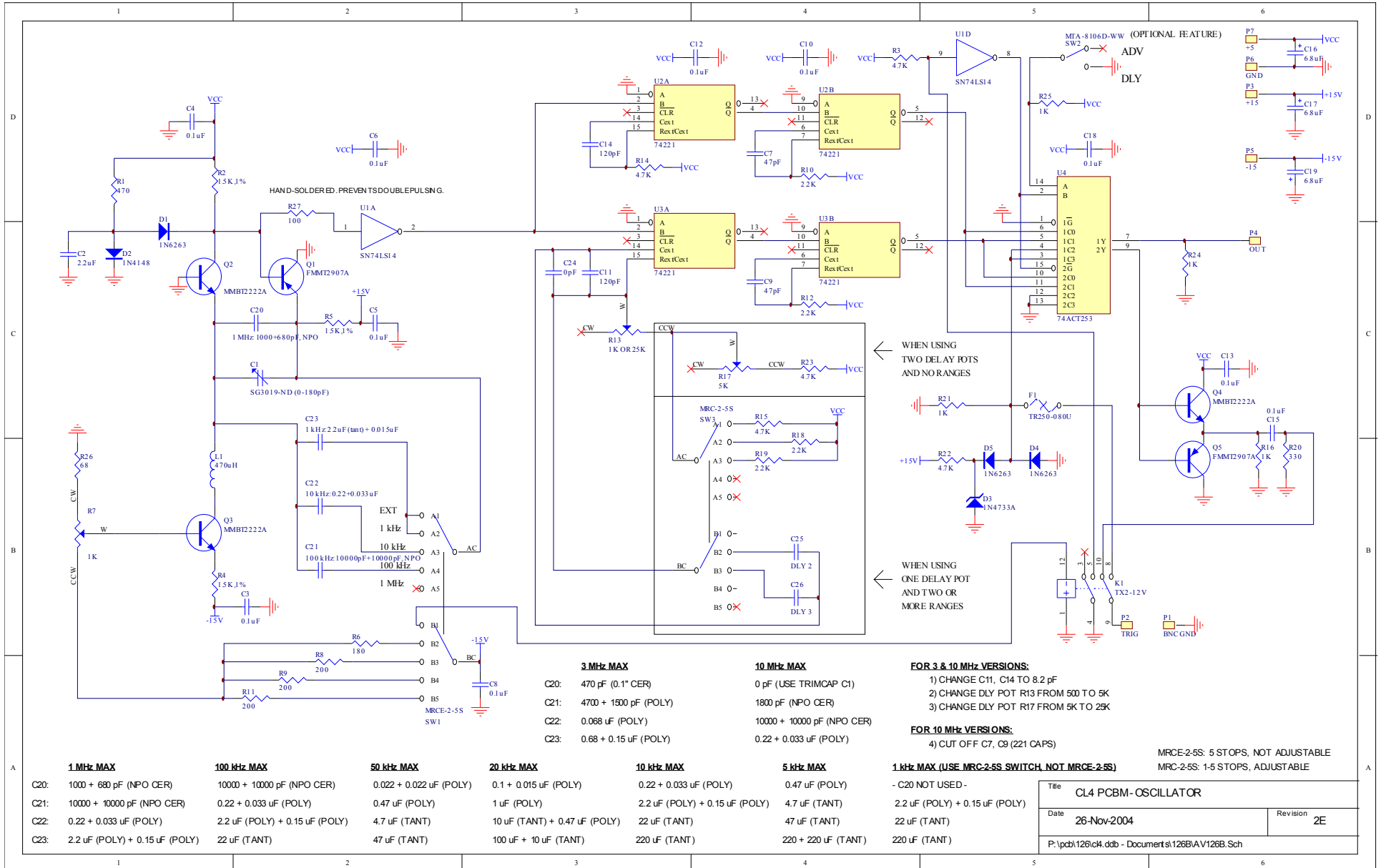
# PCB 158H - LOW VOLTAGE DC POWER SUPPLY, 2/3



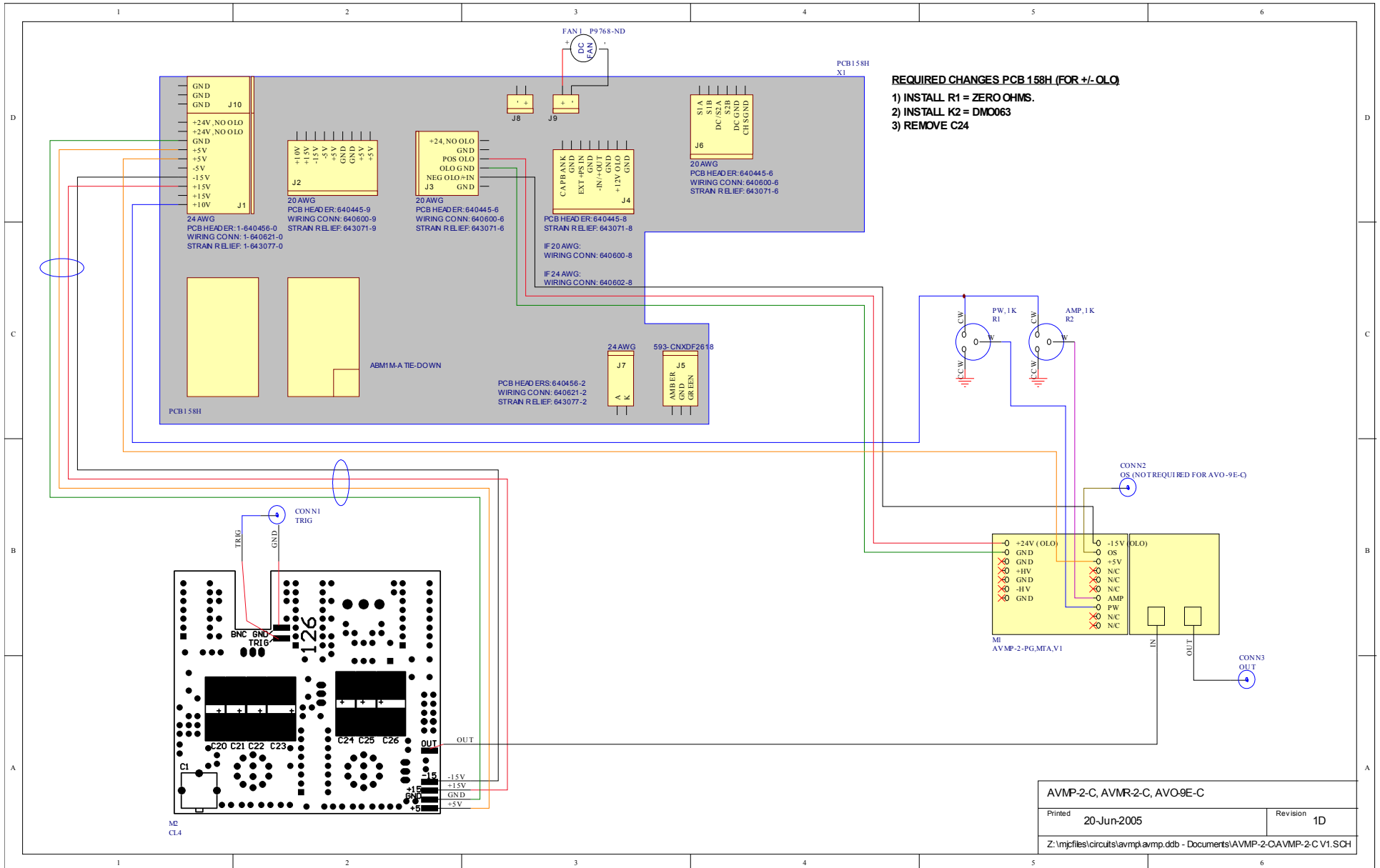
# PCB 158H - LOW VOLTAGE DC POWER SUPPLY, 3/3



# PCB 126B - OSCILLATOR AND TRIGGER CIRCUIT



# MAIN WIRING



PERFORMANCE CHECKSHEET