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NANOSECOND WAVEFORM ELECTRONICS  
SINCE 1975

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OTTAWA, ONTARIO  
CANADA K2C 3H4

## INSTRUCTIONS

MODEL AVX-FD3-PS

0 to 250 MHz FREQUENCY DIVIDER

WITH AN ADJUSTABLE

DIVISION FACTOR OF 0-65535

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 +1-613-226-5772 (Intl)

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Manual Reference: Z:\officefiles\instructword\avx-fd\AVX-FD3-PS,edition4.odt.  
Last modified August 17, 2006.  
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## INTRODUCTION

The AVX-FD3-PS is a high-speed frequency divider that can operate at pulse repetition frequencies up to 250 MHz. The main output can be set to generate a pulse for every N input pulses, where N can vary from 0 to 65535. The output pulse width is equal, approximately, to one input period (except when N=1, in which case the output pulse width is equal to the input pulse width). A second output is also available, which generates a pulse for every 2N input pulses. This output has 50% duty cycle.

All outputs are ECL-level (i.e. logic high = -0.8V, logic low = -1.6V). The outputs can drive loads of 50Ω to ground or 50Ω to -2V, for maximum flexibility. The standard AVX-FD3-PS accepts an ECL-level input, but small-signal and differential ECL inputs are available as options.

A TTL "RESET" input and an OPERATE/RESET switch are also provided. A logic-high level on the TTL input resets the internal counters to a default state. This input is useful for synchronization purposes. The OPERATE/RESET switch performs a similar function when it is set to the RESET position. After the reset condition is removed, the first output pulse will occur after N input pulses, where N is the divisor setting.

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

## OPTIONAL FEATURES

The following options are available for the AVX-FD3-PS:

- DECL option: Inputs and outputs are differential ECL.
- EP option: Provides complementary output pulses.
- IP option: Accepts pulse or sine wave input from 0.2 to 5.0 Volts peak to peak.

SPECIFICATIONS

Model:	AVX-FD3-PS
Maximum input frequency:	N > 1: 0 - 250 MHz N = 1: 0 - 125 MHz
Division factor (N):	0 to 65535
Input level:	ECL (-0.8 and -1.6V)
Input termination:	50 $\Omega$ to -2V
Input pulse width:	$\geq 1$ ns
Output level:	ECL (-0.8 and -1.6V)
Outputs:	OUT1: $f_{OUT1} = f_{IN}/N$ OUT2: $f_{OUT2} = f_{OUT1}/2$
Output pulse width:	OUT1: one input period, i.e. $PW_{OUT1} = 1/f_{IN}$ OUT2: 50% duty cycle, i.e. $PW_{OUT2} = 1/f_{OUT1}$
Jitter:	$\leq 100$ ps
Connectors:	BNC
Prime power:	100 - 240 Volts, 50 - 60 Hz
Dimensions (H x W x D):	100 mm x 215 mm x 375 mm (3.9" x 8.5" x 14.8")
Temperature range:	+5°C to +40°C

## EUROPEAN REGULATORY NOTES

### 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.

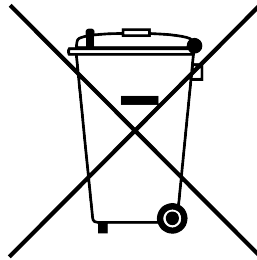
### DIRECTIVE 2002/96/EC (WEEE)

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	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

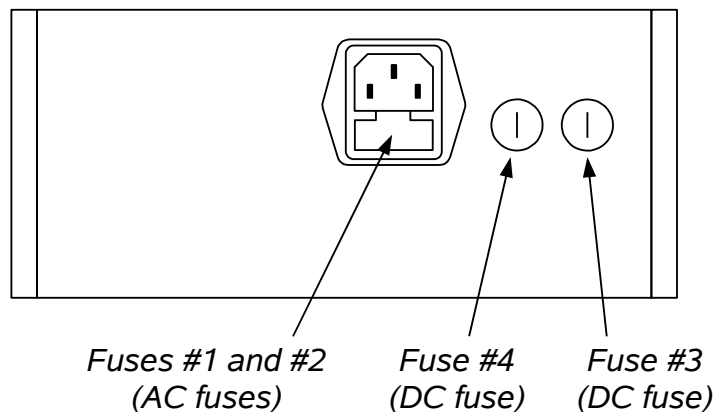
This instrument is intended for use under the following conditions:

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.

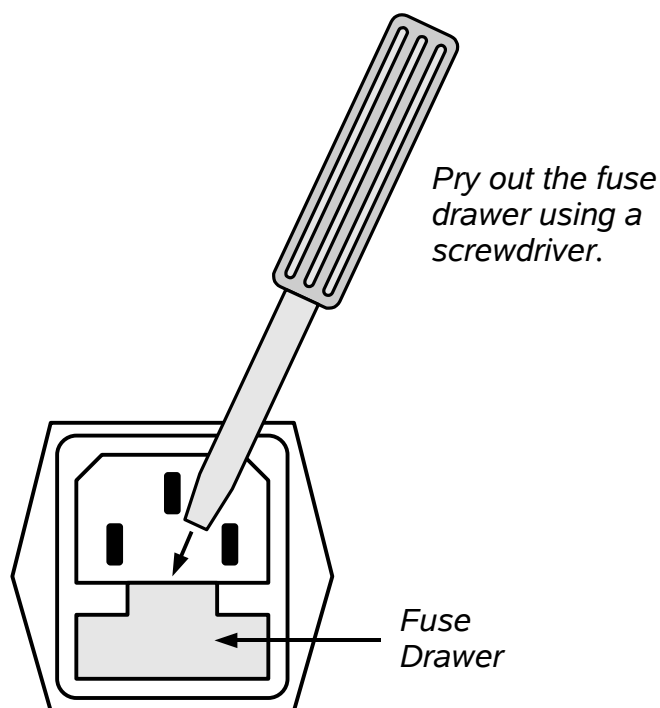
## FUSES

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

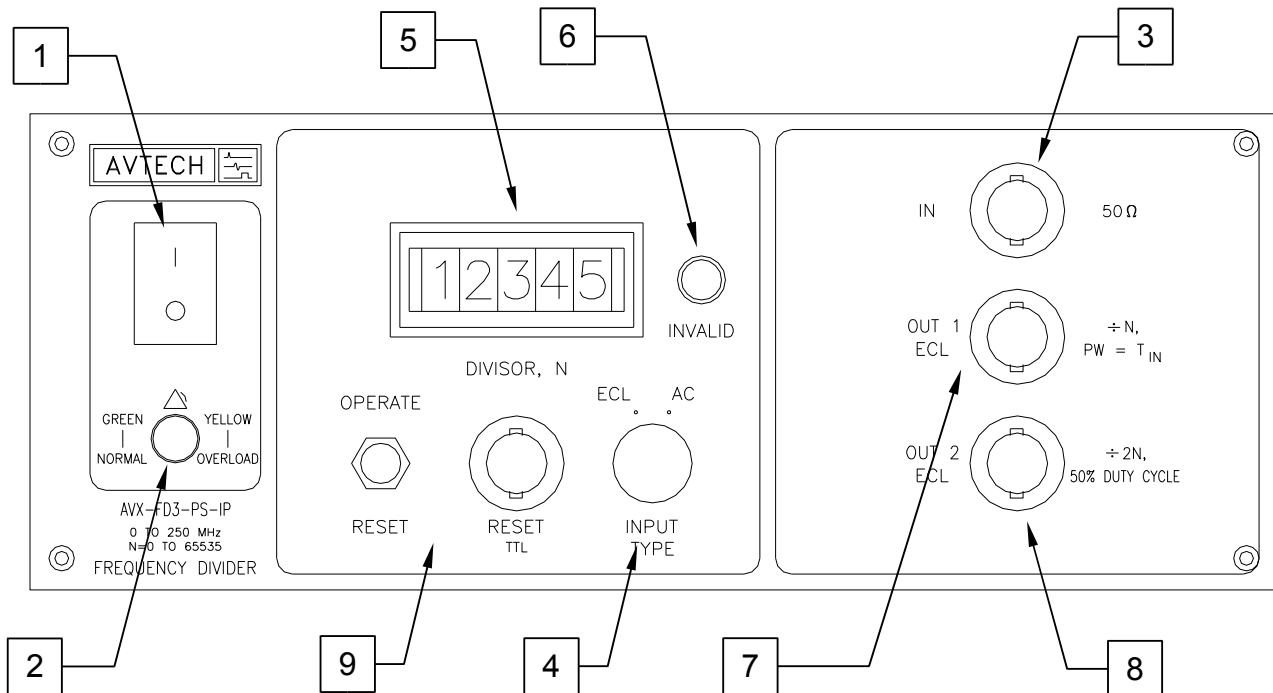
The following table lists the required fuses:

Fuses	Nominal Mains Voltage	Rating	Case Size	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	Not used. A spare 0.8A fuse is installed here.			

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.** An input signal is applied to this BNC connector. For standard models, the IN connector is terminated with a 50Ω shunt resistance to -2V (which is a standard termination for ECL logic circuits), and ECL logic levels (i.e. -0.8V and -1.6V) are required to trigger the instrument. For models with the -IP and/or -DECL models, see the description of the “Input Type Switch” (item 4) for the expected input levels in each mode.

Models with the -DECL Option will also have an “Inverted-In” connector. When the “Input Type Switch” (item 4) is set to the “DECL” position, the instrument trigger

circuit senses the difference between the signal on the non-inverted input (item 3) and this inverted input. In this mode, this input is terminated with a 50Ω shunt resistance to -2V (which is a standard termination for ECL logic circuits), and ECL logic levels (i.e. -0.8V and -1.6V) are required to trigger the instrument.

4. INPUT TYPE SWITCH. (Present on -IP and -DECL models only.) This switch controls the trigger level of the input. Depending on the options included on the instrument, this switch may be set to the following settings:

*ECL*: Standard mode. ECL logic levels (i.e. -0.8V and -1.6V) are required on the main input (item 6) to trigger the instrument. (On models with the -DECL option, the non-inverted input is used for this mode.) The input is terminated internally with a 50Ω shunt resistance to -2V (which is a standard termination for ECL logic circuits).

*DECL*: Different ECL mode. ECL logic levels (i.e. -0.8V and -1.6V) are required on the non-inverted input (item 6) and the inverted input (item 7) to trigger the instrument. The two inputs are terminated internally with a 50Ω shunt resistance to -2V (which is a standard termination for ECL logic circuits). The internal trigger circuit senses the difference between these two inputs.

*AC*: Small-signal mode. A sine wave (or 50% duty cycle square wave) signal with an amplitude of between 0.2 to 5.0 Volts peak-to-peak is required on the main input (item 6) to trigger the instrument. (On models with the -DECL option, the non-inverted input is used for this mode.) The input is terminated internally with a 50Ω shunt resistance to ground. The input is AC-coupled in this mode.

5. DIVISION FACTOR THUMBWHEEL SWITCH. This switch determines the division factor, N. The input and output pulse repetition frequencies ( $f_{in}$  and  $f_{out}$ ) are related by:  $f_{out} = f_{in} / N$ . Standard units have three adjustable digits. Units with the -XN option have 5 adjustable digits.
6. INVALID DIVISOR INDICATOR. This indicator becomes yellow if the divisor is set outside of the valid range of 0 to 65535.
7. OUT 1 CONNECTOR. This connector supplies the main output. The pulse repetition frequency of this output is 1/N of the input pulse repetition frequency. The output levels are ECL (i.e. -0.8V and -1.6V). This output should be terminated by a 50Ω load to ground or -2V. The pulse width of this output is equal to one period of the input signal (except when N=1, in which case the output pulse width is approximately equal to the input pulse width).

Models with the -DECL Option will also have an “OUT 1 INVERTED” connector. This output is identical to item 7, except that the logic levels are inverted.

8. OUT 2 CONNECTOR. This connector supplies the secondary output. The pulse repetition frequency of this output is 1/2 of the "OUT 1" output pulse repetition frequency. The duty cycle of this output is 50%.

Models with the -DECL Option will also have an “OUT 2 INVERTED” connector.

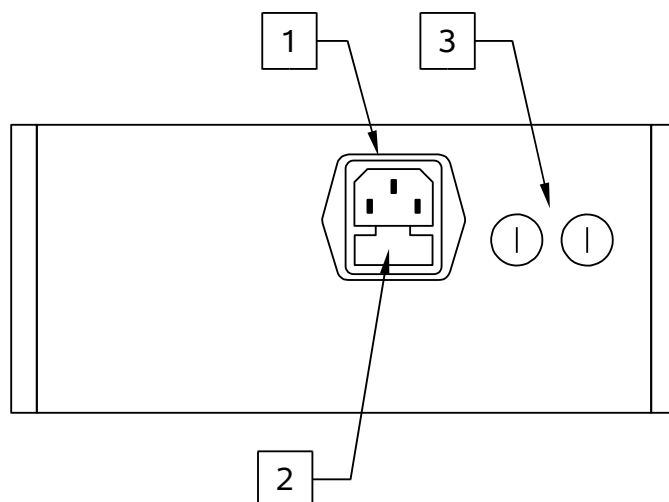
This output is identical to item 8, except that the logic levels are inverted.

9. RESET CONNECTOR & SWITCH. A TTL-level pulse on the RESET connector will reset the internal counters to a default state. This can be used for synchronisation purposes. The connector may be left unconnected without interfering with normal operation.

The OPERATE/RESET switch can be used to achieve this function manually. That is, setting this switch to the “RESET” position will reset the internal counters to a default state.



## REAR PANEL CONTROLS

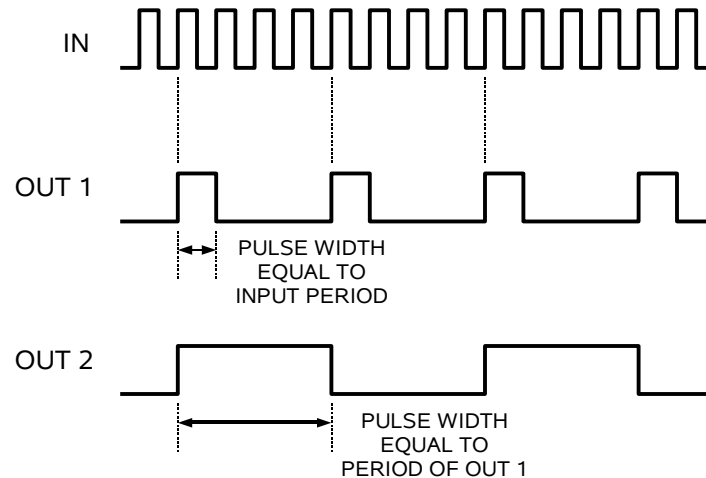


1. AC POWER INPUT. An IEC-320 C14 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket.
2. AC FUSE DRAWER. The two fuses that protect the AC input are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

### OPERATION FOR $2 \leq N \leq 65535$

The figure below shows the basic relationship between the input signal and the two outputs, for  $2 \leq N \leq 65535$ . The main output, OUT 1, generates a pulse for every N input cycles, and the output pulse width is approximately equal to one input period ("T"). The second output, OUT 2, generates a pulse for every 2N input cycles. It has 50% duty cycle.



*Inputs and Outputs For N=3*

Models with the “-DECL” output also provided inverted (i.e., logical complement) versions of the OUT 1 and OUT 2 signals.

### OPERATION FOR $N > 65535$

If N is set greater than 65535, no output will be generated (i.e. the outputs will remain at ECL logic low, -1.6V), and the "Invalid Divisor" indicator will light.

### OPERATION FOR $N = 0$

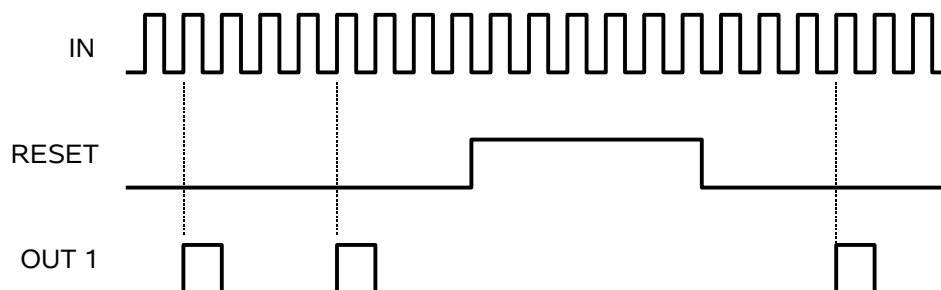
If N is set to zero, no output will be generated (i.e. the main output will remain at ECL logic low, -1.6V). The "Invalid Divisor" indicator will not light.

### OPERATION FOR $N = 1$

The divider operates slightly differently for  $N = 1$ . In this case, the internal divider circuitry is bypassed, and the input is routed directly to the OUT 1 output (after passing through a buffer stage). The output pulse width is approximately equal to the input pulse width. Note that if the input pulse width is very narrow, the buffer circuit may not be able to respond quickly enough.

## RESET OPERATION

The front-panel reset input can be used for synchronization, as shown below:



In this example,  $N=4$ . When the reset input is TTL high, the internal counter are reset to zero and are held at zero until the reset input switches to TTL low. An output pulse is generated on the fourth input pulse after the reset line returns to TTL low.


## OUTPUT TERMINATION

All used outputs should be terminated with a  $50\Omega$  load, for minimum waveform distortion. The load can be connected to ground or  $-2V$ , as desired. (The former is a typical termination for pulse generators, and the latter is a common ECL-specific termination.)


## 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.

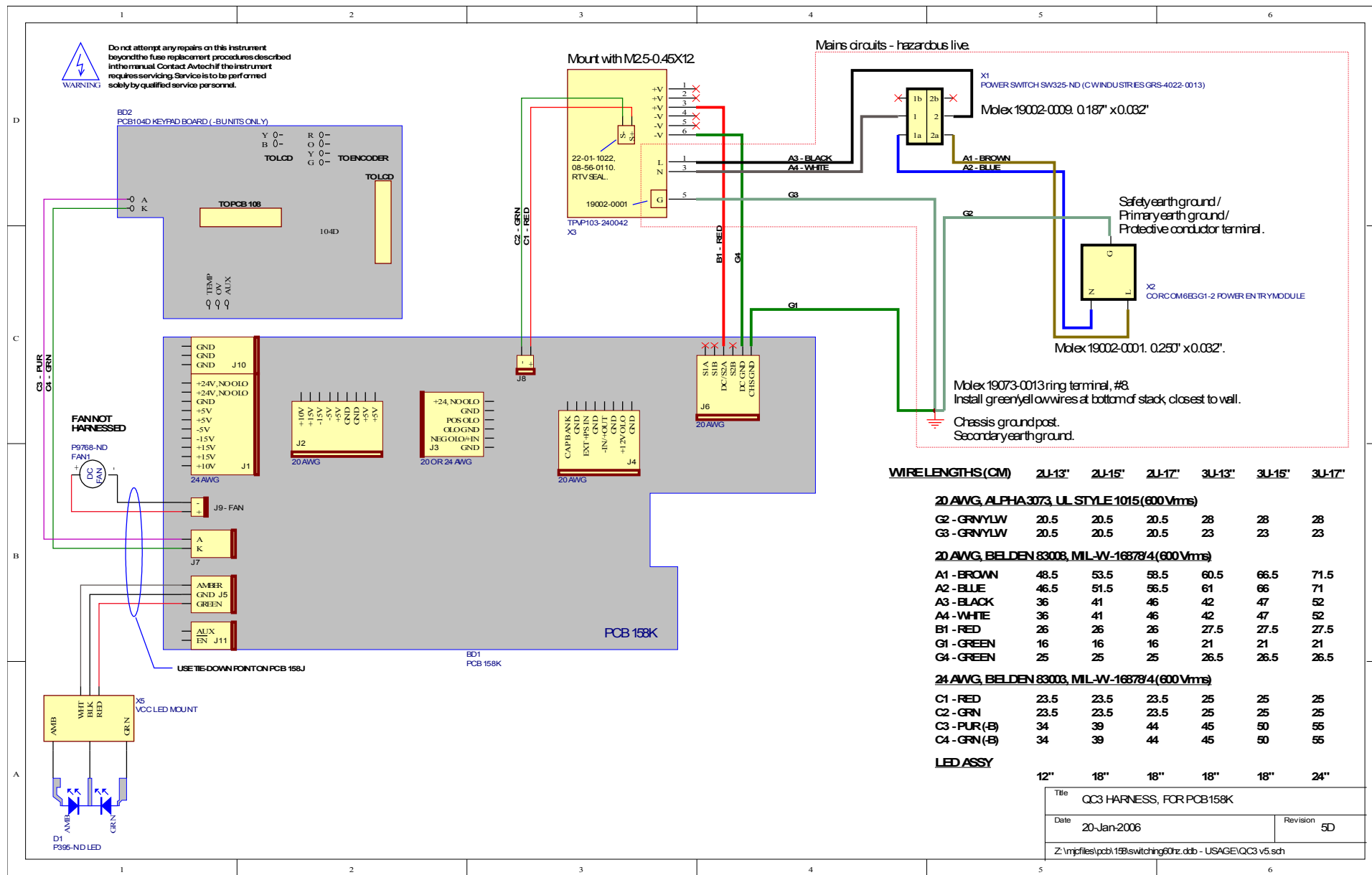
On occasion, one or more of the four rear-panel fuses may require replacement. All fuses can be accessed from the rear panel. See the “FUSES” section for details.

### CLEANING

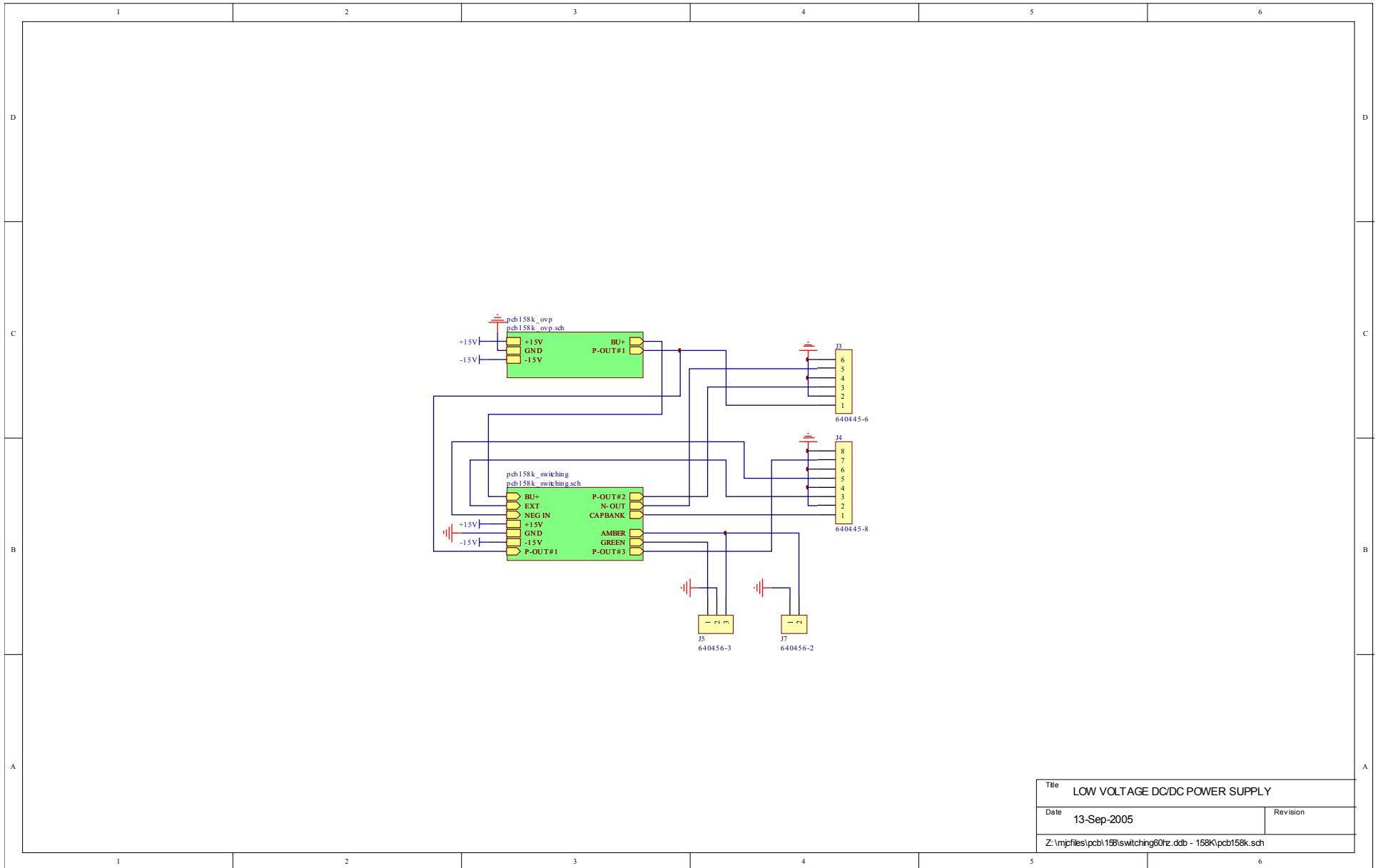
If desired, the interior of the instrument may be cleaned using compressed air to dislodge any accumulated dust. (See the “TOP COVER REMOVAL” section for instructions on accessing the interior.) No other cleaning is recommended.

# WIRING DIAGRAMS

## WIRING OF AC POWER

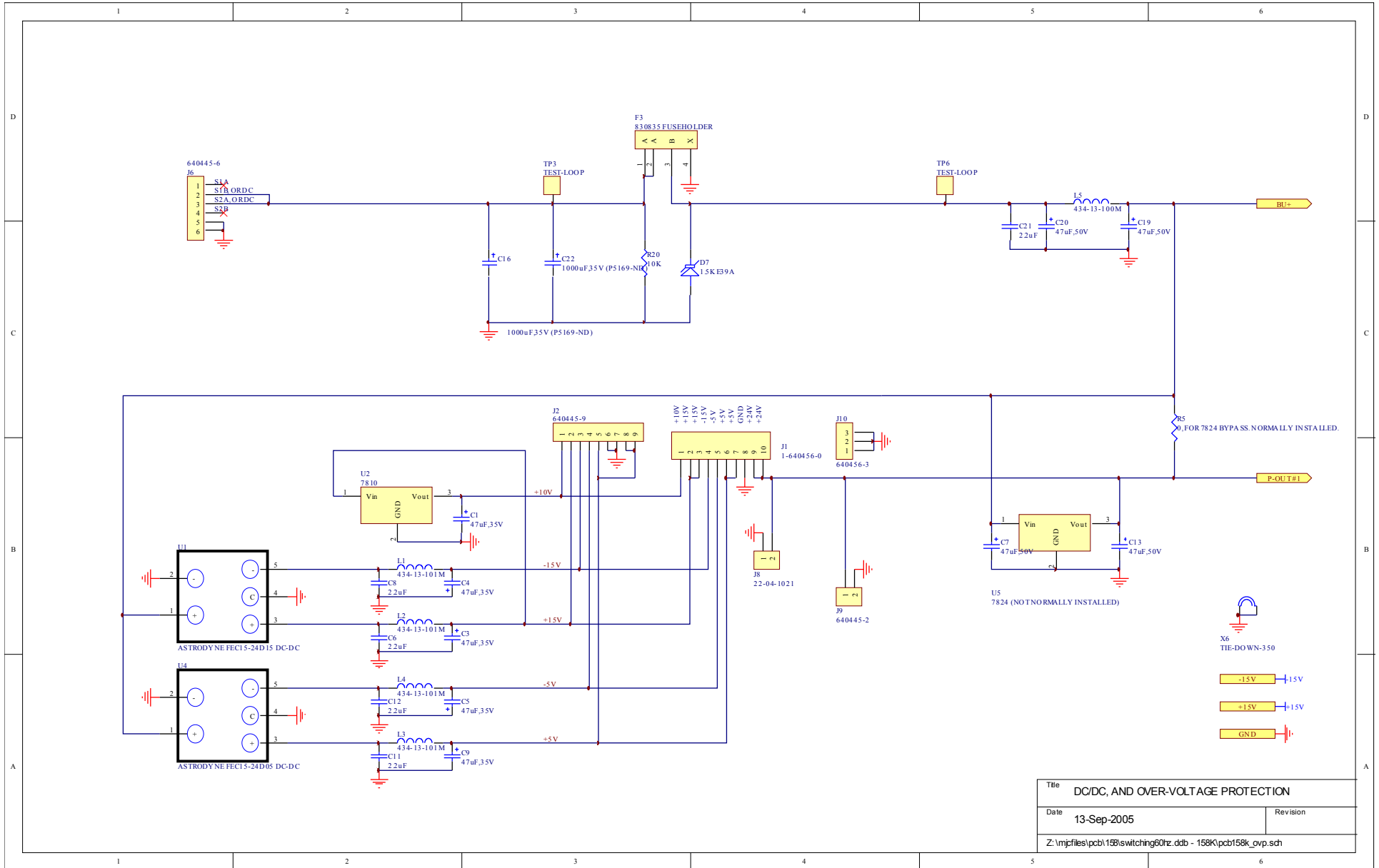


# PCB 158K - LOW VOLTAGE POWER SUPPLY, 1/3



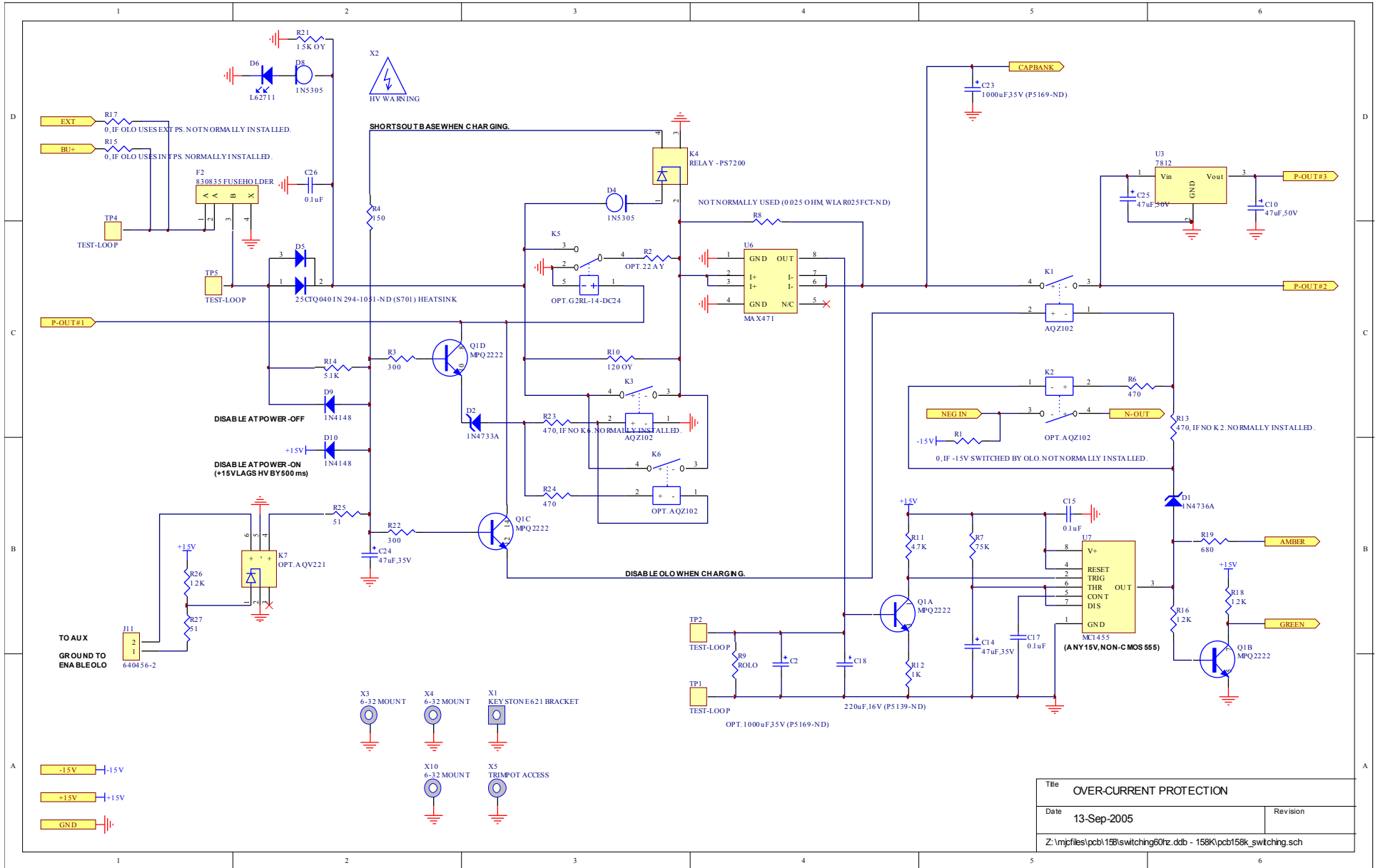
Title		LOW VOLTAGE DC/DC POWER SUPPLY
Date	13-Sep-2005	Revision
Z:\mpjfiles\pcb158\switching60hz.ddb - 158K\pcb158k.sch		

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



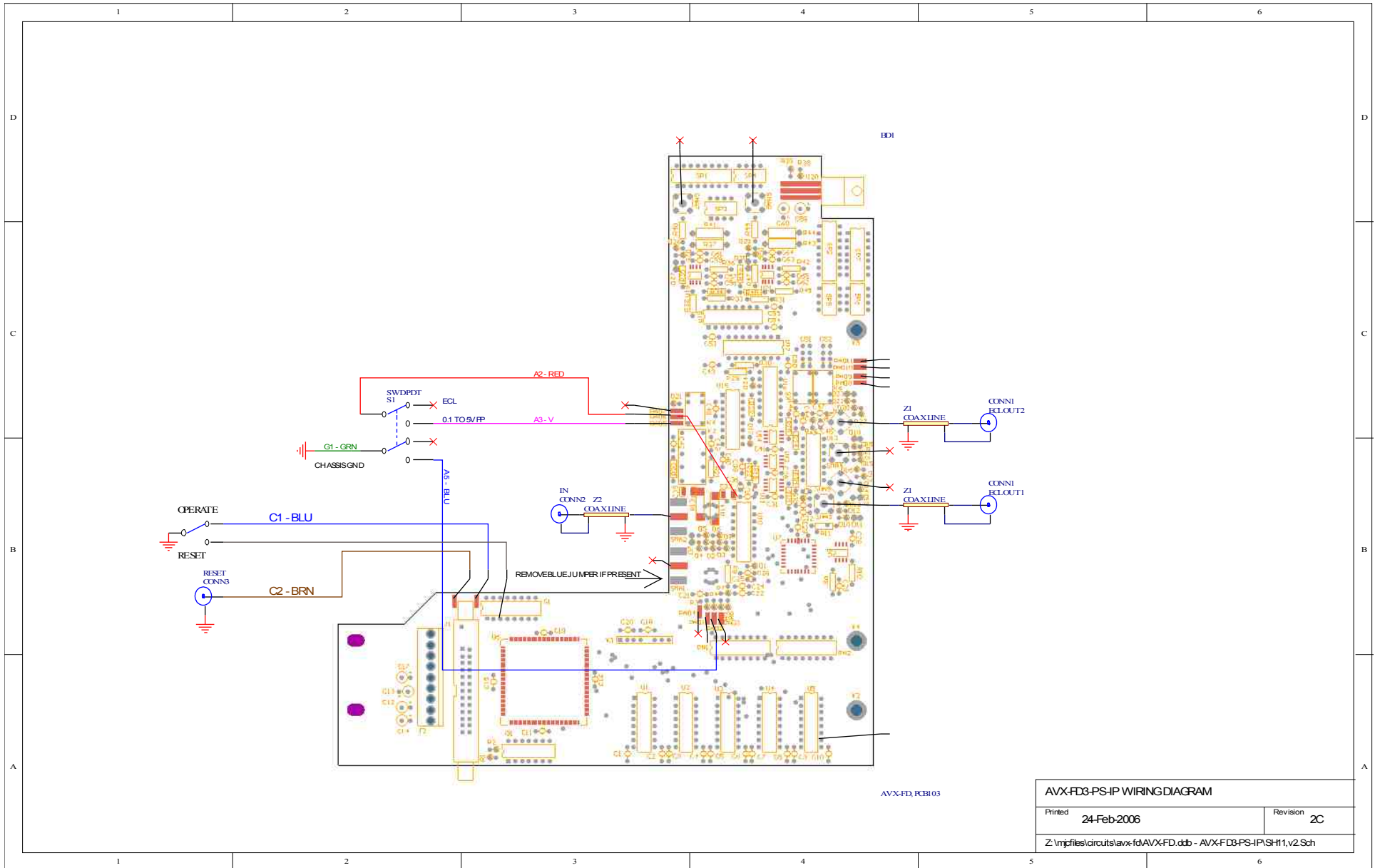


# PCB 158K - LOW VOLTAGE POWER SUPPLY, 3/3



Title OVER-CURRENT PROTECTION	
Date 13-Sep-2005	Revision
Z:\mpjfiles\pcb158\switching00tr.ddb - 158K\pcb158k_switching.sch	

# MAIN WIRING (WITH -IP OPTION)



AVX-FD3-PS-IP WIRING DIAGRAM

Printed	24-Feb-2006	Revision	2C
Z:\mpfiles\circuit\slav-fd\AVX-FD.dbb - AVX-FD3-PS-IP\SH11.v2.Sch			

PERFORMANCE CHECK SHEET