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# INSTRUCTIONS

## MODEL AV-106B-B

0 to 100 AMP, 0 to 100 V, 1 us RISE TIME
LASER DIODE DRIVER
WITH IEEE 488.2 AND RS-232 CONTROL

SERIAL NUMBER: _____

## WARRANTY

Avtech Electrosystems Ltd. warrants products of its manufacture to be free from defects in material and workmanship under conditions of normal use. If, within one year after delivery to the original owner, and after prepaid return by the original owner, this Avtech product is found to be defective, Avtech shall at its option repair or replace said defective item. This warranty does not apply to units which have been dissembled, modified or subjected to conditions exceeding the applicable specifications or ratings. This warranty is the extent of the obligation assumed by Avtech with respect to this product and no other warranty or guarantee is either expressed or implied.

## TECHNICAL SUPPORT

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Manual Reference: /fileserver1/officefiles/instructword/av-106/AV-106B-B,ed5.sxw.
Last modified February 29, 2024.

# INTRODUCTION

The Model AV-106B-B pulse generator is designed for pulsing laser diode and other low impedance loads with rectangular pulses as high as 100 Amperes into load voltages up to 100V, with 1 us rise and fall times.

The current and voltage polarities depend on the model number:

"-P" units: 0 to +100 A amplitude, 0 to +100 V compliance

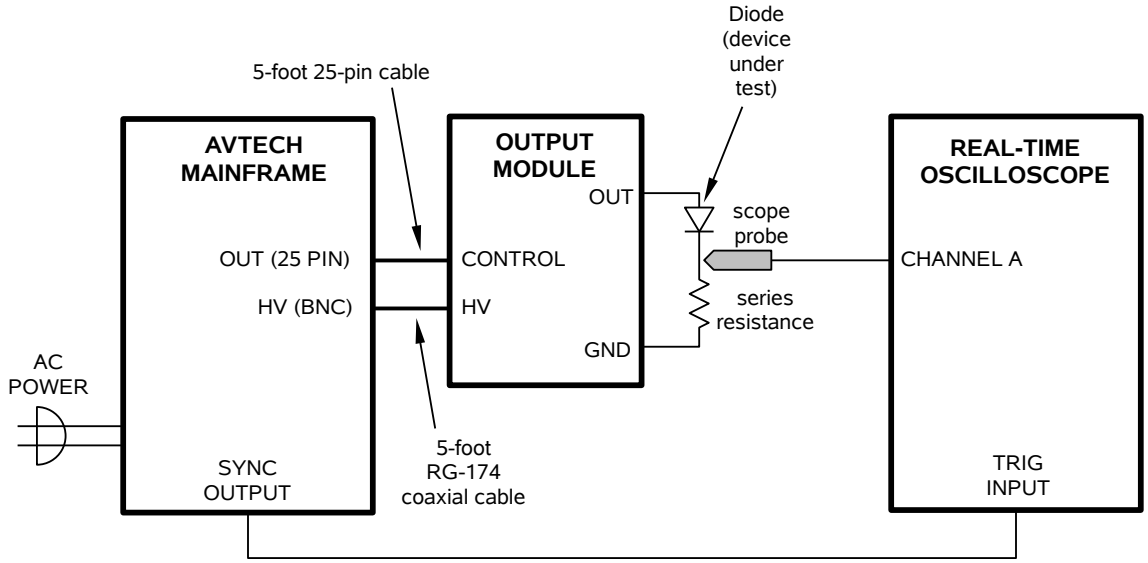
"-N" units: 0 to -100 A amplitude, 0 to -100 V compliance

"-PN" units: 0 to +100 A amplitude, 0 to +100 V compliance
*and*
0 to -100 A amplitude, 0 to -100 V compliance

The pulse repetition frequency can vary from 1 to 100 Hz, and pulse widths can vary from 2 us to 200 us. The maximum duty cycle is 0.1%.

The Model AV-106B-B pulse generator is a current pulser. The current amplitude is largely independent of the load voltage. The load voltage must not exceed 100V.

The AV-106B-B system consists of an instrument mainframe and an output module (dual polarity units have two output modules). The output module connects to the mainframe using two detachable cables: a 25-conductor cable carries the control signals, and a single-conductor shielded RG-58 cable carries the high voltage power supply (125V, approximately).




The diode is shown oriented for positive (-P) operation. It must be reverse for negative (-N) units.

The loads can be connected across the banana posts on the output module.

-PN units have two output modules, one for each polarity. Only one module is connected at a time.

The AV-106B-B has two amplitude ranges, of 0-30A and 30-100A, nominally, allowing the instrument to be used at both moderate and very high current levels. (The instrument automatically selects the appropriate range based on the amplitude setting.)

The AV-106B-B can be controlled from the front panel, or via a computer connected to the IEEE 488.2-compliant GPIB port, or the RS-232 serial port.

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

# SPECIFICATIONS

| | |
|---|---|
| Model: | AV-106B-B |
| GPIB, RS-232 control: | Standard on -B units. |
| Amplitude:<br>-P units:<br>-N units:<br>-PN units: | <br>0 to +100A.<br>0 to -100A.<br>0 to ±100A. |
| Pulse width: | 2 to 200 us |
| Rise time, fall time: | ≤ 1 us |
| PRF: | 1 Hz to 100 Hz |
| Duty cycle: (max) | 0.1% |
| Output impedance: | ≥ 50 Ohms |
| Current regulation: | Load voltage change from 0 to 100 Volts: ≤ 5% |
| Load voltage range:<br>-P units:<br>-N units:<br>-PN units: | <br>0 to +100 Volts.<br>0 to -100 Volts.<br>0 to +100 Volts for positive output,<br>0 to -100 Volts for negative output. |
| Propagation delay, (Jitter): | ≤ 100 ns,<br>(± 100 ps ± 0.03% of sync delay, Ext trig in to pulse out) |
| Ext. trigger in: | Mode A: + 5 Volts, 50 ns or wider (TTL),<br>Mode B: + 5 Volts, $PW_{IN} = PW_{OUT}$ (TTL) |
| Sync delay:<br>(sync to pulse out) | 0 to ± 200 us |
| Sync output: | + 3 Volt, 200 ns, will drive 50 Ohm loads |
| Gate input: | Synchronous or asynchronous, active high or low, switchable.<br>Suppresses triggering when active. |
| Connectors: | Out: Solder terminals Trig: BNC Sync: BNC Gate: BNC HV: BNC |
| Power requirements: | 100 - 240 Volts, 50 - 60 Hz |
| Dimensions: | Mainframe: 100 x 215 x 375 mm (3.9” x 8.5” x 14.8”)<br>Output module: 152 x 152 x 229 mm (6” x 6” x 9”) |
| Temperature range: | +5°C to + 40°C |

# EUROPEAN REGULATORY NOTES

## EC DECLARATION OF CONFORMITY

We

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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

CE

## 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 (two output modules for -PN versions), examine to ensure that they have not been damaged in shipment. Visually inspect all connectors, knobs, liquid crystal displays (LCDs), and the handles. Confirm that a power cord, a GPIB cable, and two instrumentation manuals (this manual and the “Programming Manual for -B Instruments”) 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 90 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 (http://www.volex.com) | 17850-C3-326 |
| | | Qualtek (http://www.qualtekusa.com) | 319004-T01 |
| United Kingdom | BS 1363, 230V, 50Hz | Qualtek (http://www.qualtekusa.com) | 370001-E01 |
| Switzerland | SEV 1011, 2 30V, 50Hz | Volex (http://www.volex.com) | 2102H-C3-10 |
| Israel | SI 32, 220V, 50Hz | Volex (http://www.volex.com) | 2115H-C3-10 |
| North America, and all other areas | NEMA 5-15, 120V, 60 Hz | Qualtek (http://www.qualtekusa.com) | 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

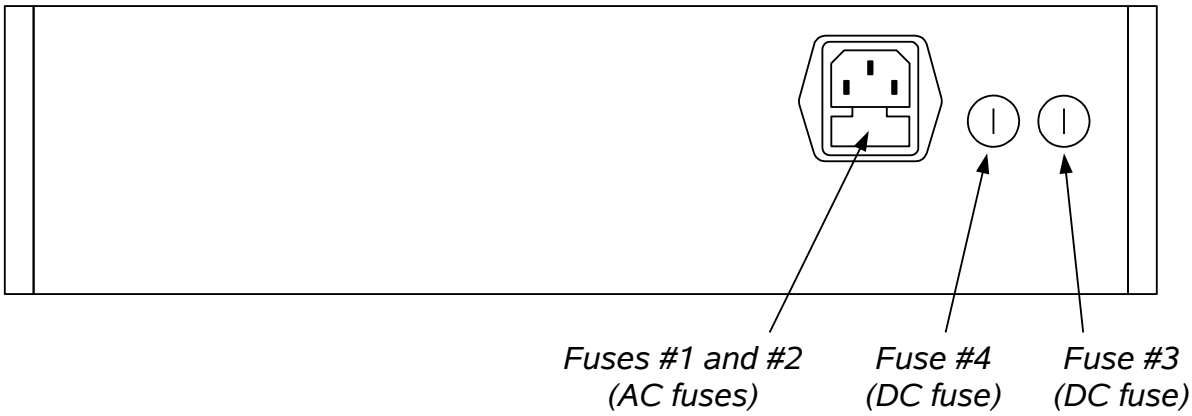
This instrument is intended for use under the following conditions:

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

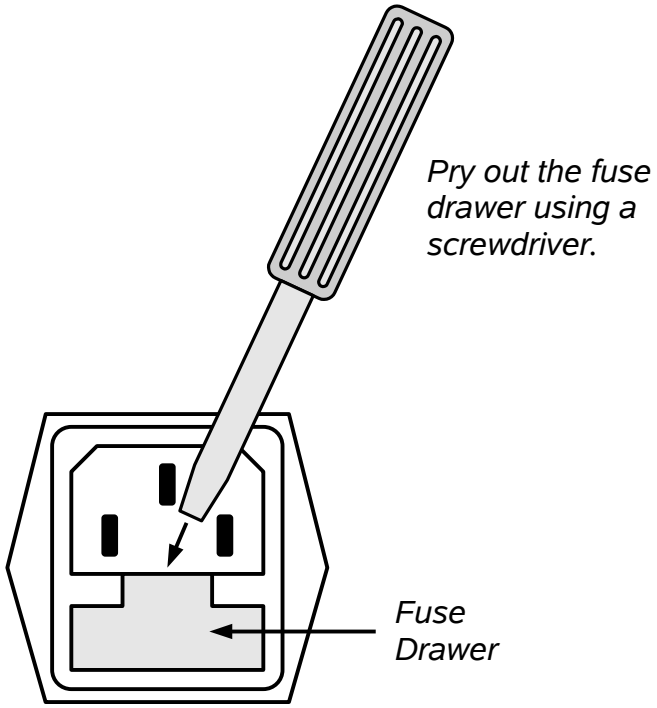
## FUSES

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

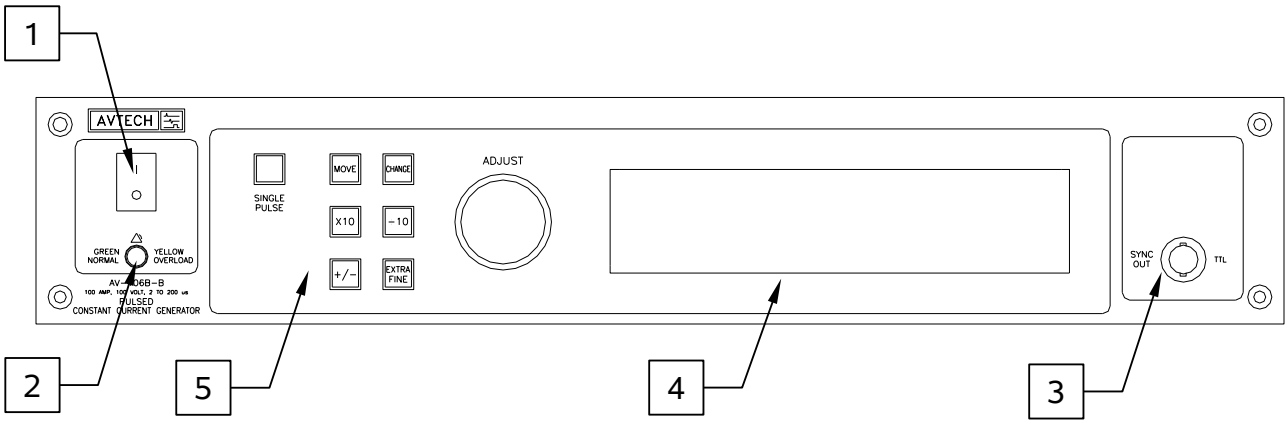
The following table lists the required fuses:

| Fuses | Nominal Mains Voltage | Rating | Case Size | Manufacturer's Part Number (Wickmann) | Distributor's Part Number (Digi-Key) |
|---|---|---|---|---|---|
| #1, #2 (AC) | 115 V | 0.8A, 250V, Time-Delay | 5×20 mm | 1950800000 | WK5046-ND |
| | 230 V | 0.5A, 250V, Time-Delay | 5×20 mm | 1950500000 | WK5041-ND |
| #3 (DC) | N/A | 2.5A, 250V, Time-Delay | 5×20 mm | 1951250000 | WK5058-ND |
| #4 (DC) | N/A | 2.0A, 250V, Time-Delay | 5×20 mm | 1951200000 | WK5057-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.

   Note that the output stage will safely withstand a short-circuited load condition.

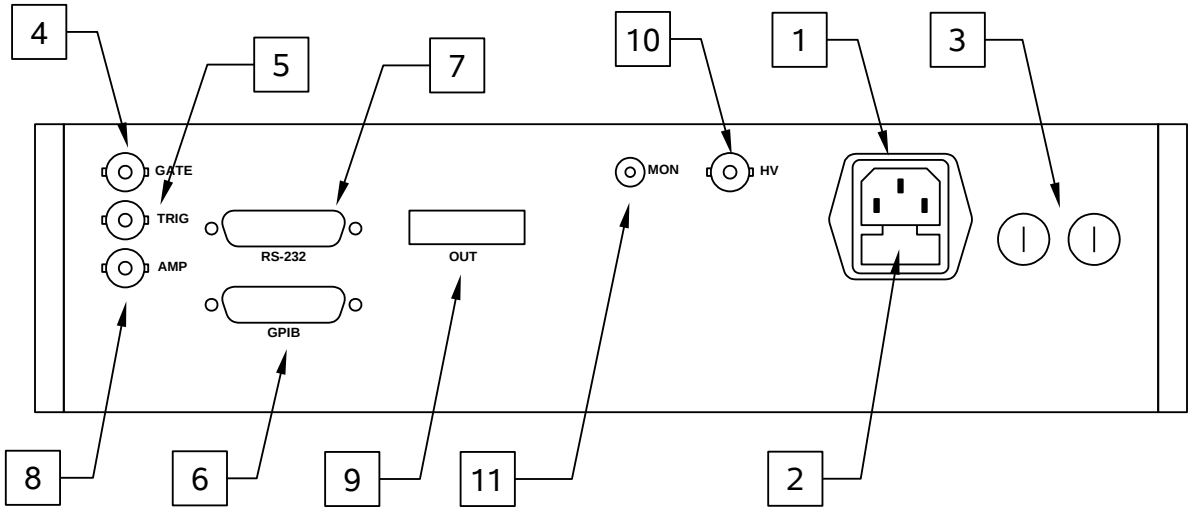
3) SYNC OUT. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal leads (or lags) the main output by a duration set by the "DELAY" controls and has an approximate amplitude of +3 Volts to $R_L$ > 50Ω with a pulse width of approximately 100 ns.

4) LIQUID CRYSTAL DISPLAY (LCD). This LCD is used in conjunction with the keypad to change the instrument settings. Normally, the main menu is displayed, which lists the key adjustable parameters and their current values. The “Programming Manual for -B Instruments” describes the menus and submenus in detail.

5) KEYPAD.

| Control Name | Function |
|---|---|
| MOVE | This moves the arrow pointer on the display. |
| CHANGE | This is used to enter the submenu, or to select the operating mode, pointed to by the arrow pointer. |
| ×10 | If one of the adjustable numeric parameters is displayed, this increases the setting by a factor of ten. |
| ÷10 | If one of the adjustable numeric parameters is displayed, this decreases the setting by a factor of ten. |
| +/- | If one of the adjustable numeric parameters is displayed, and this parameter can be both positive or negative, this changes the sign of the parameter. |
| EXTRA FINE | This changes the step size of the ADJUST knob. In the extra-fine mode, the step size is twenty times finer than in the normal mode. This button switches between the two step sizes. |
| ADJUST | This large knob adjusts the value of any displayed numeric adjustable values, such as frequency, pulse width, etc. The adjust step size is set by the "EXTRA FINE" button.<br><br>When the main menu is displayed, this knob can be used to move the arrow pointer. |

## MAINFRAME 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. GATE. This TTL-level (0 and +5V) logic input can be used to gate the triggering of the instrument. This input can be either active high or active low, depending on the front panel settings or programming commands. (The instrument triggers normally when this input is unconnected). When set to active high mode, this input is pulled-down to ground by a 1 kΩ resistor. When set to active low mode, this input is pulled-up to +5V by a 1 kΩ resistor.

5. TRIG. This TTL-level (0 and +5V) logic input can be used to trigger the instrument, if the instrument is set to triggering externally. The instrument triggers on the rising edge of this input. The input impedance of this input is 1 kΩ. (Depending on the length of cable attached to this input, and the source driving it, it may be desirable to add a coaxial 50 Ohm terminator to this input to provide a proper transmission line termination. The Pasternack (www.pasternack.com) PE6008-50 BNC feed-thru 50 Ohm terminator is suggested for this purpose.)

   When triggering externally, the instrument can be set such that the output pulse width tracks the pulse width on this input, or the output pulse width can be set

independently.

6. GPIB Connector. A standard GPIB cable can be attached to this connector to allow the instrument to be computer-controlled. See the “Programming Manual for -B Instruments” for more details on GPIB control.

7. RS-232 Connector. A standard serial cable with a 25-pin male connector can be attached to this connector to allow the instrument to be computer-controlled. See the “Programming Manual for -B Instruments” for more details on RS-232 control.

8. AMP Connector. (Optional. Present on -EA units only.) The output amplitude can be set to track the voltage on this input. Zero Volts in corresponds to zero amplitude output, and +10V in corresponds to maximum amplitude out. This mode is activated by selecting "Ext Control" on the front-panel amplitude menu, or with the "source:voltage external" command.

9. OUT. The 25-pin cable from the output module is connected to this connector.

10. HV BNC Connector. The shielded RG-58 cable from the output module is connected to this connector. This carries the high-voltage power supply (either +125V or -125V, depending on the output polarity) to the output module.

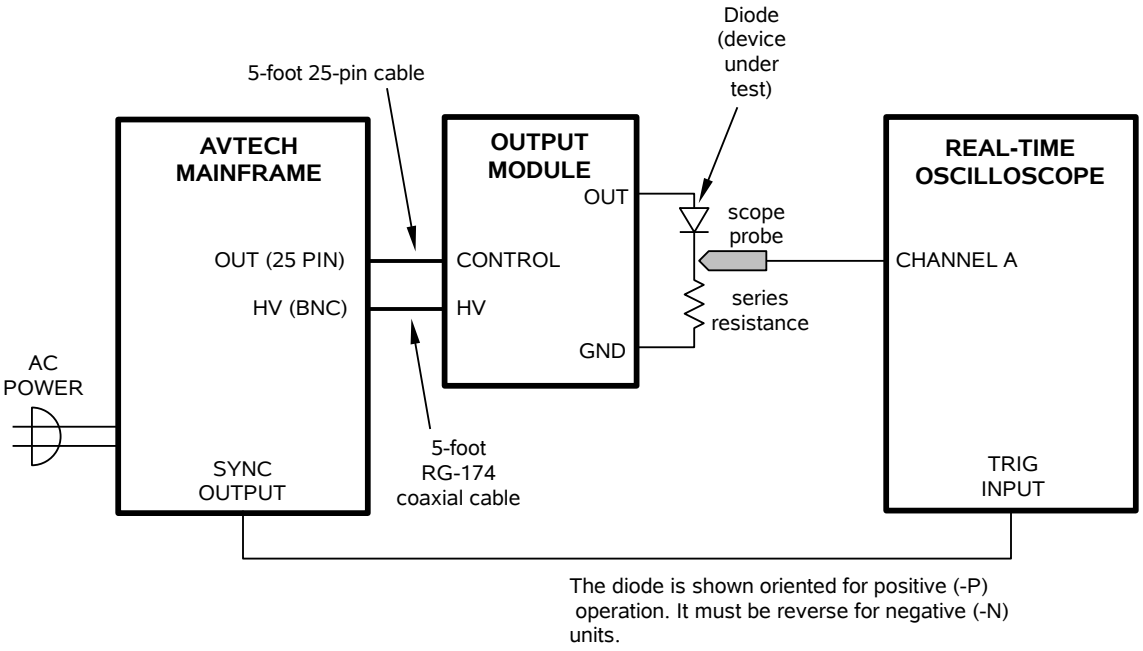
11. MON Connector. (Optional. Present and active on -M units only.) This is a current monitor output. This output provides a voltage waveform that is proportional to the current waveform on the output. The monitor relationship is: $V_{MON} = I_{OUT} \times 0.01\Omega$, for a load of > 1 kΩ. (The monitor output can also drive a 50Ω load, but the output voltage will be reduced by a factor of 2. This output is short-circuit protected.)

# OUTPUT MODULE CONTROLS AND CONNECTORS

## OUTPUTS

The main output on the output module is a red banana post. A metal banana post serves as a ground connection.

A typical connection scheme is shown below for positive output modules, supplied with "-P" and "-PN" units:




For negative units (or negative use of dual-polarity units), the diode must be reversed.

A resistance in series with the laser diode in shown in the figure. Since the AV-106B-B is a current pulser, this resistance is optional - it is not required for current limiting. However, it may be useful for current monitoring.

The load should be connected between the OUT and GND terminals using very short leads (< 0.5 cm).

## DUAL POLARITY CONNECTIONS

"-PN" units are supplied with two output modules. Only one is used at a time. Always turn off the mainframe before disconnecting one module and reconnecting the other.

## P1, P2 CONTROLS

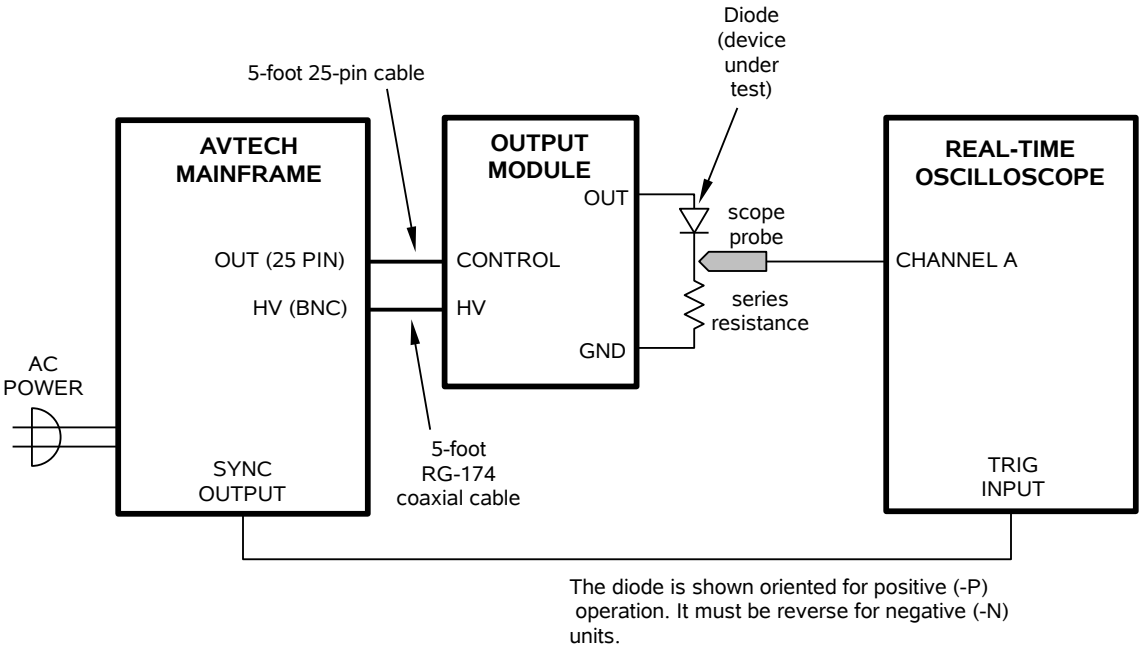
Two ten-turn potentiometer controls, located on the top surface of the output module adjacent to the model label, are used to set the accuracy of the output amplitude setting. Both are set at the factory and should not be changed.

The P1 pot is a scale control, that adjusts the output amplitude proportionately. However, if a small discrepancy is noticed between the output setting and the measured current, the “diag:ampl:cal” command should be used before attempting to adjust this manual control.

The P2 pot can be used to null out any current pulses observed with the amplitude set to zero. This should not normally require adjusting.

# GENERAL INFORMATION

## BASIC TEST ARRANGEMENT




The equipment should be connected in the general fashion shown above.

Output modules should always be connected to the mainframe **BEFORE power is applied**.

Proper choice of test resistance is important. It is essential that the resistive test load be low-inductance. (Wirewound resistors are not acceptable, unless many are connected together in parallel.) The power dissipated in the resistor is given by

$$P_{AVERAGE} = I^2 \times R \times PW / T, \quad P_{PEAK} = I^2 \times R$$

where “I” is the current, “R” is the resistance, “PW” is the pulse width, and “T” is the pulse period (1/frequency).

The power rating of the resistance should exceed this average power rating by a large margin. Beware that some low-value resistors exhibit a significant temperature-dependence, even when the average power dissipated is below the resistor’s power rating. This is particularly true if the peak power exceeds the resistor’s power rating.

Factory tests are conducted with a 1.0 Ω load capable of dissipating at least 20 W. Higher load resistance values may be used but the output voltage must be limited to 100V or less.

## CURRENT MEASUREMENT

Measuring current is more difficult than measuring voltage. There are three basic approaches to measuring pulsed current:

1. Rely on the accuracy of the amplitude setting (typically 5%), as displayed on the LCD display.

2. Use a high-performance current transformer, such as a Pearson 2878. The output voltage of the transformer is proportional to the sensed current. The Pearson 2878 is useful for pulse widths up to 200 us. The Pearson 410 will operate at pulse widths up to 1 ms, but the 2878 is preferred since it is physically smaller, and requires a shorter lead length. This reduces the added inductance in the load circuit, and thus minimizes inductive waveform distortions. (See the "Load Protection" section for more information on inductive distortions.)

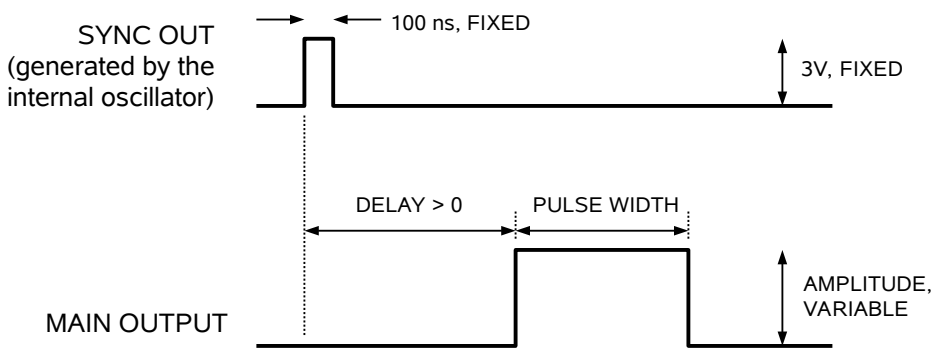
3. Use a low-resistance, low-inductance, current-sensing resistor connected in series with the load. To minimize inductance, it is usually wise to connect several resistors in parallel. Beware that wirewound resistors usually have far too much inductance to be useful as current-sensing resistors.

4. Use the optional “-M” current monitor. This optional feature provides a rear-panel output connector, whose voltage waveform is proportional to the current waveform on the main output.

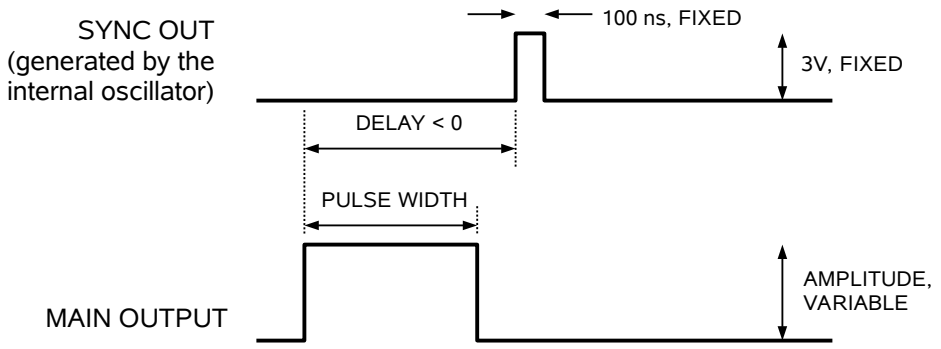
## BASIC PULSE CONTROL

This instrument can be triggered by its own internal clock or by an external TTL trigger signal. In either case, two output channels respond to the trigger: OUT and SYNC. The OUT channel is the signal that is applied to the load. Its amplitude and pulse width are variable. The SYNC pulse is a fixed-width TTL-level reference pulse used to trigger oscilloscopes or other measurement systems. When the delay is set to a positive value the SYNC pulse precedes the OUT pulse. When the delay is set to a negative value the SYNC pulse follows the OUT pulse.

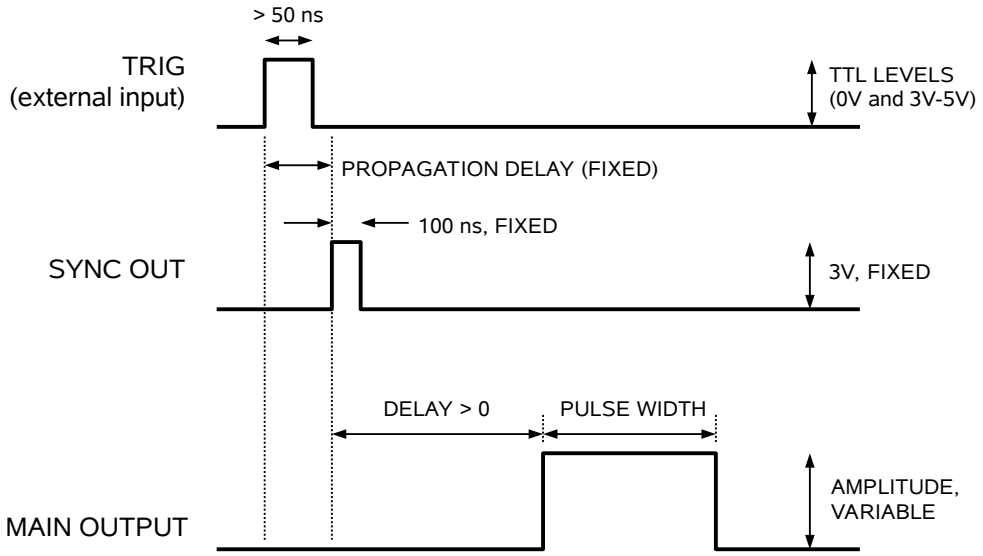
These pulses are illustrated below, assuming internal triggering and a positive delay:



If the delay is negative, the order of the SYNC and OUT pulses is reversed:

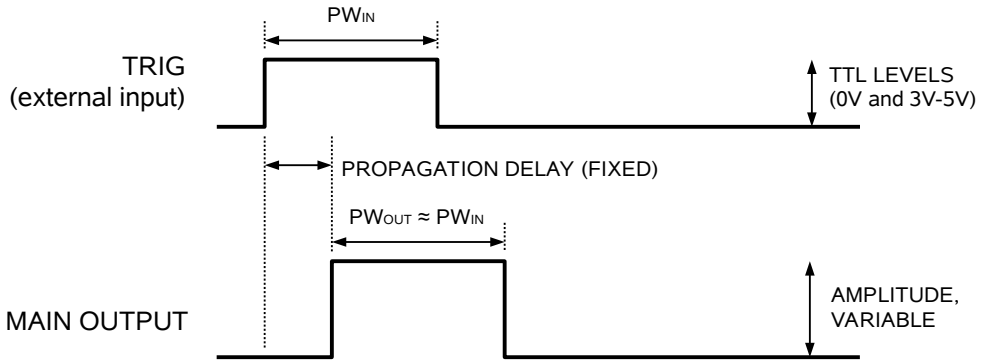



The next figure illustrates the relationship between the signal when an external TTL-level trigger is used:




As before, if the delay is negative, the order of the SYNC and OUT pulses is reversed.

The last figure illustrates the relationship between the signal when an external TTL-level trigger is used in the $PW_{IN}$=$PW_{OUT}$ mode. In this case, the output pulse width equals the external trigger's pulse width (approximately), and the delay circuit is bypassed:




The delay, pulse width, and frequency (when in the internal mode), of the OUT pulse can be varied with front panel controls or via the GPIB or RS-232 computer interfaces.

## TRIGGER MODES

This instrument has four trigger modes:

Internal Trigger: the instrument controls the trigger frequency, and generates the clock internally.

External Trigger: the instrument is triggered by an external TTL-level clock on the back-panel TRIG connector.

Manual Trigger: the instrument is triggered by the front-panel “SINGLE PULSE” pushbutton.

Hold Trigger: the instrument is set to not trigger at all.

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

## PULSE WIDTH MODES

This instrument has two pulse width modes:

Normal: the instrument controls the output pulse width.

$PW_{IN}=PW_{OUT}$: the output pulse width equals the pulse width of the trigger signal on the “TRIG” connector. The instrument must be in the external trigger mode.

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

## GATING MODES

Triggering can be suppressed by a TTL-level signal on the rear-panel GATE connector. The instrument can be set to stop triggering when this input high or low, using the front-panel gate menu or the appropriate programming commands. This input can also be set to act synchronously or asynchronously. When set to asynchronous mode, the GATE will disable the output immediately. Output pulses may be truncated. When set to synchronous mode, the output will complete the full pulse width if the output is high, and then stop triggering. No pulses are truncated in this mode.

## MONITOR CIRCUIT ("-M" OPTION)

Units with the "-M" option include a rear-panel current monitor output. This output generates a voltage waveform approximately proportional to the output current waveform. The monitor voltage output is related to the output current by

$$V_{MON} = I_{OUT} \times 0.01 \text{ Volt/Amp, approx, into a high-impedance load}$$

In other words, the monitor generates a 5V output for a 100A pulse, approximately. The monitor will drive a 50 Ohm load, but the output voltage will be reduced by a factor of 2 compared to the above equation.

## WARM-UP TIME

This instrument will benefit from a 10 minute warm-up time before use. This allows time for the output amplitude control circuit to stabilize.

# INSTRUMENT AND LOAD PROTECTION

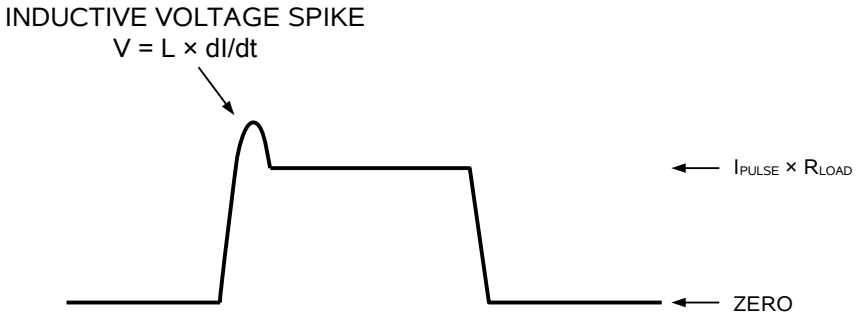
## LENZ'S LAW AND INDUCTIVE VOLTAGE SPIKES

This instrument is designed to pulse resistive and diode loads and will exhibit a large output spike when used to drive a load with significant inductance (as predicted by LENZ'S LAW). For this reason the load should be connected to the output using low inductance leads (as short as possible and as heavy a gauge as possible). Wire lengths should not exceed 1 to 2 inches (2.5 to 5 cm).

Wirewound resistors are not acceptable resistive loads, unless many are connected together in parallel.

The voltage developed across an inductance L (in Henries), when the current is changing at a rate given by $dI_{LOAD}/dt$ (in Amps/sec), is: $V_{SPIKE} = L \times dI_{LOAD}/dt$.

Some load inductance is unavoidable. As a result, the output voltage waveform (measured across a resistance) will have some distortion on the leading edge, as shown:




Attaching a current transformer (for measuring current waveforms) can add significant inductance, because of the necessary wire length that must be fed through the transformer. The Pearson 2878 requires approximately 1.5", and the 410 requires 3". Both will degrade the output current rise time.

## ATTACHING AND DETACHING LOADS

To avoid damaging the loads connected to main outputs, the loads should only be connected to or removed from the instrument when the instrument is off. Do not connect loads when the instrument is on and the output amplitude is not zero. This can cause sparking.

## CHANGING PARAMETERS WHEN A LOAD IS ATTACHED

If your load is easily damaged, the amplitude should be reduced to zero before changing the trigger source, frequency, pulse width, or other pulse parameters. This protects the loads from possible short transient effects.

## ATTACHING AND DETACHING OUTPUT MODULES

Output modules should always be connected to the mainframe **BEFORE power is applied**.

"-PN" units are supplied with two output modules. Only one is used at a time. Always turn off the mainframe before disconnecting one module and reconnecting the other.

## START-UP CHECK-LIST FOR LOCAL CONTROL

1) The instruction manual has been studied thoroughly.

2) The “Local Control” section of the “Programming Manual for -B Instruments” has been studied thoroughly.

3) The output module is connected to the mainframe as shown in the “Basic Test Arrangement” section. The output module should always be connected to the mainframe BEFORE power is applied. For dual polarity “-PN” units, this test sequence should be repeated for both output modules.

4) The load is connected to the output banana posts. (The output post is red, and ground is metallic). For initial testing, it is recommended that a resistive load be used. Factory tests are conducted using a 1 Ohm, 20 Watt resistive load composed of 10 Ohm, 2 Watt resistors connected in parallel (Ohmite part number OY100K - see www.ohmite.com). Wirewound resistors are not acceptable resistive loads.

5) Turn on the prime power to the mainframe. The main menu will appear.

6) The arrow pointer should be pointing at the frequency menu item. If it is not, press the MOVE button until it is.

7) Press the CHANGE button. The frequency submenu will appear. Rotate the ADJUST knob until the frequency is set at the desired setting. The arrow pointer should be pointing at the “Internal” choice. If it is not, press MOVE until it is.

8) Press CHANGE to return to the main menu.

9) Press the MOVE button to move the arrow pointer to the pulse width menu item. Press CHANGE to bring up the pulse width submenu, and rotate the ADJUST knob until the pulse width is set at the desired setting. The arrow pointer should be pointing at the “Normal” choice. If it is not, press MOVE until it is. Press CHANGE to return to the main menu.

10) Connect a scope probe across the resistive test load. In addition, a current probe may be used to monitor the load current.

11) Press the MOVE button to move the arrow pointer is pointing at the output item. Press CHANGE to bring up the output submenu. The arrow pointer should be initially be pointing at the “Output Off” choice. Press MOVE so that the arrow pointer is pointing at the “Output On” choice. (The mainframe is now supplying a trigger to the output module.) Press CHANGE to return to the main menu.

12) Press the MOVE button to move the arrow pointer to the amplitude menu item. Press CHANGE to bring up the amplitude submenu, and rotate the ADJUST knob

until the amplitude is set at the desired setting. A rectangular pulse should appear on the scope and the amplitude should increase as the ADJUST knob is rotated.

13) Observe the pulse width and pulse period on the scope and confirm that the duty cycle does not exceed 0.1% and that the peak current does not exceed 100 Amps.

14) Adjust pulse width, pulse period (i.e. PRF) and amplitude to obtain the desired settings.

15) If additional assistance is required:

Tel: (613) 226-5772, Fax: (613) 226-2802
Email: info@avtechpulse.com

# CALIBRATION ADJUSTMENTS

## ADJUSTING AMPLITUDE ACCURACY

The AV-106B-B has two amplitude ranges: 0 to 30A, and 30A to 100A, approximately. The calibration of each range can be adjusted by a few percent if necessary.

If it is found that the output amplitude settings (as set by the front-panel controls or programming commands) do not agree exactly with measured values of amplitude (i.e., by examining the output on an oscilloscope) in one of these ranges, the amplitude calibration can be updated using software commands.

The following procedure is suggested:

6) Connect a precision, high-power resistive load to the output. (As an example, suppose 1Ω is used.)

7) Connect the pulse generator to a computer using the GPIB or RS232 ports.

8) Turn on the pulse generator, and set the time controls (frequency, delay, pulse width) to typical values.

9) Turn on the outputs.

10) Set the output amplitude to 80% of the maximum current for that range. For instance, if the 30A to 100A range requires calibration, set the amplitude to 80A.

11) Observe the voltage across the load. (Using the 1Ω example, suppose that 83V is observed.) From this, calculate the measured current (83A in this example).

12) Send the measured value to the instrument using the following command:

    diag:ampl:cal 83A

    The internal software compares the supplied measured value to the programmed value, and adjusts the internal calibration data to null out any differences.

13) Observe the voltage across the load again. The amplitude setting should now agree with the measured value.

## OTHER CALIBRATION PROCEDURES

Please visit http://www.avtechpulse.com/appnote/ for the latest recommended procedures for calibrating amplitude and timing parameters.

# PROGRAMMING YOUR PULSE GENERATOR

## KEY PROGRAMMING COMMANDS

The “Programming Manual for -B Instruments” describes in detail how to connect the pulse generator to your computer, and the programming commands themselves. A large number of commands are available; however, normally you will only need a few of these. Here is a basic sample sequence of commands that might be sent to the instrument after power-up:

```
*rst                        (resets the instrument)
trigger:source internal     (selects internal triggering)
frequency 10 Hz         (sets the frequency to 10 Hz)
pulse:width 1 us            (sets the pulse width to 1 us)
pulse:delay 10 us           (sets the delay to 10 us)
output on                   (turns on the output)
source:current 15 A         (sets the current amplitude to 15 amperes)
```

For triggering a single event, this sequence would be more appropriate:

```
*rst                        (resets the instrument)
trigger:source hold         (turns off all triggering)
pulse:width 2 us            (sets the pulse width to 2 us)
output on                   (turns on the output)
source:current 10 A         (sets the current amplitude to 10 amperes)
trigger:source immediate    (generates a single non-repetitive trigger event)
trigger:source hold         (turns off all triggering)
output off                  (turns off the output)
```

To set the instrument to trigger from an external TTL signal applied to the rear-panel TRIG connector, use:

```
*rst                        (resets the instrument)
trigger:source external     (selects internal triggering)
pulse:width 5000 ns     (sets the pulse width to 5 us)
pulse:delay 1 us            (sets the delay to 1 us)
source:current 5            (sets the current amplitude to 5 amperes)
output on                   (turns on the output)
```

To set the instrument to trigger from an external TTL signal applied to the rear-panel TRIG connector, and have the output pulse width track the pulse width of the input trigger, use:

| | |
|---|---|
| *rst | (resets the instrument) |
| trigger:source external | (selects internal triggering) |
| pulse:width in | (sets the pulse width to $PW_{OUT} = PW_{IN}$ mode) |
| source:current 15 A | (sets the current amplitude to 15 amperes) |
| output on | (turns on the output) |

Beware the in the $PW_{OUT} = PW_{IN}$ mode, the onus is on the user to make sure that all duty cycle ratings are observed.

These commands will satisfy 90% of your programming needs.

## ALL PROGRAMMING COMMANDS

For more advanced programmers, a complete list of the available commands is given below. These commands are described in detail in the “Programming Manual for -B Instruments”. (Note: this manual also includes some commands that are not implemented in this instrument. They can be ignored.)

| Keyword | Parameter | Notes |
|---|---|---|
| DIAGnostic: | | |
| :AMPLitude | | |
| :CALibration: | <numeric value> | [no query form] |
| LOCAL | | |
| OUTPut: | | |
| :[STATe] | <boolean value> | |
| :PROTection | | |
| :TRIPped? | | [query only] |
| REMOTE | | |
| [SOURce]: | | |
| :FREQuency | | |
| [:CW \| FIXed] | <numeric value> | |
| [SOURce]: | | |
| :CURRent | | |
| [:LEVel] | | |
| [:IMMediate] | | |
| [:AMPLitude] | <numeric value> \| EXTernal | |
| :PROTection | | |
| :TRIPped? | | [query only] |
| [SOURce]: | | |
| :PULSe | | |
| :PERiod | <numeric value> | |
| :WIDTh | <numeric value> \| IN | |
| :DCYCle | <numeric value> | |
| :HOLD | WIDTh \| DCYCle | |
| :DELay | <numeric value> | |

```
        :GATE
            :TYPE               ASYNC | SYNC
            :LEVel              HIgh | LOw
STATUS:
    :OPERation
        :[EVENt]?                                   [query only, always returns "0"]
        :CONDition?                                 [query only, always returns "0"]
        :ENABle                 <numeric value>     [implemented but not useful]
    :QUEStionable
        :[EVENt]?                                   [query only, always returns "0"]
        :CONDition?                                 [query only, always returns "0"]
        :ENABle                 <numeric value>     [implemented but not useful]
SYSTem:
    :COMMunicate
        :GPIB
            :ADDRess            <numeric value>
        :SERial
            :CONTrol
                :RTS            ON | IBFull | RFR
            :[RECeive]
                :BAUD           1200 | 2400 | 4800 | 9600
                :BITS           7 | 8
                :ECHO           <boolean value>
                :PARity
                    :[TYPE]     EVEN | ODD | NONE
                :SBITS          1 | 2
    :ERRor
        :[NEXT]?                                    [query only]
        :COUNT?                                     [query only]
    :VERSion?                                       [query only]
TRIGger:
    :SOURce                     INTernal | EXTernal | MANual | HOLD | IMMediate
*CLS                                                [no query form]
*ESE                            <numeric value>
*ESR?                                               [query only]
*IDN?                                               [query only]
*OPC
*SAV                            0 | 1 | 2 | 3       [no query form]
*RCL                            0 | 1 | 2 | 3       [no query form]
*RST                                                [no query form]
*SRE                            <numeric value>
*STB?                                               [query only]
*TST?                                               [query only]
*WAI                                                [no query form]
```

# MECHANICAL INFORMATION

## TOP COVER REMOVAL

If necessary, the interior of the instrument may be accessed by removing the four Phillips screws on the top panel. With the four screws removed, the top cover may be slid back (and off).

⚠ Always disconnect the power cord and allow the instrument to sit unpowered for 10 minutes before opening the instrument. This will allow any internal stored charge to discharge.

There are no user-adjustable internal circuits. For repairs other than fuse replacement, please contact Avtech (info@avtechpulse.com) to arrange for the instrument to be returned to the factory for repair. Service is to be performed solely by qualified service personnel.

⚠ Caution: High voltages are present inside the instrument during normal operation. Do not operate the instrument with the cover removed.

## RACK MOUNTING

A rack mounting kit is available. The -R5 rack mount kit may be installed after first removing the one Phillips screw on the side panel adjacent to the front handle.

## ELECTROMAGNETIC INTERFERENCE

To prevent electromagnetic interference with other equipment, all used outputs should be connected to shielded loads using shielded coaxial cables. Unused outputs should be terminated with shielded coaxial terminators or with shielded coaxial dust caps, to prevent unintentional electromagnetic radiation. All cords and cables should be less than 3m in length.

# MAINTENANCE

## REGULAR MAINTENANCE

This instrument does not require any regular maintenance.

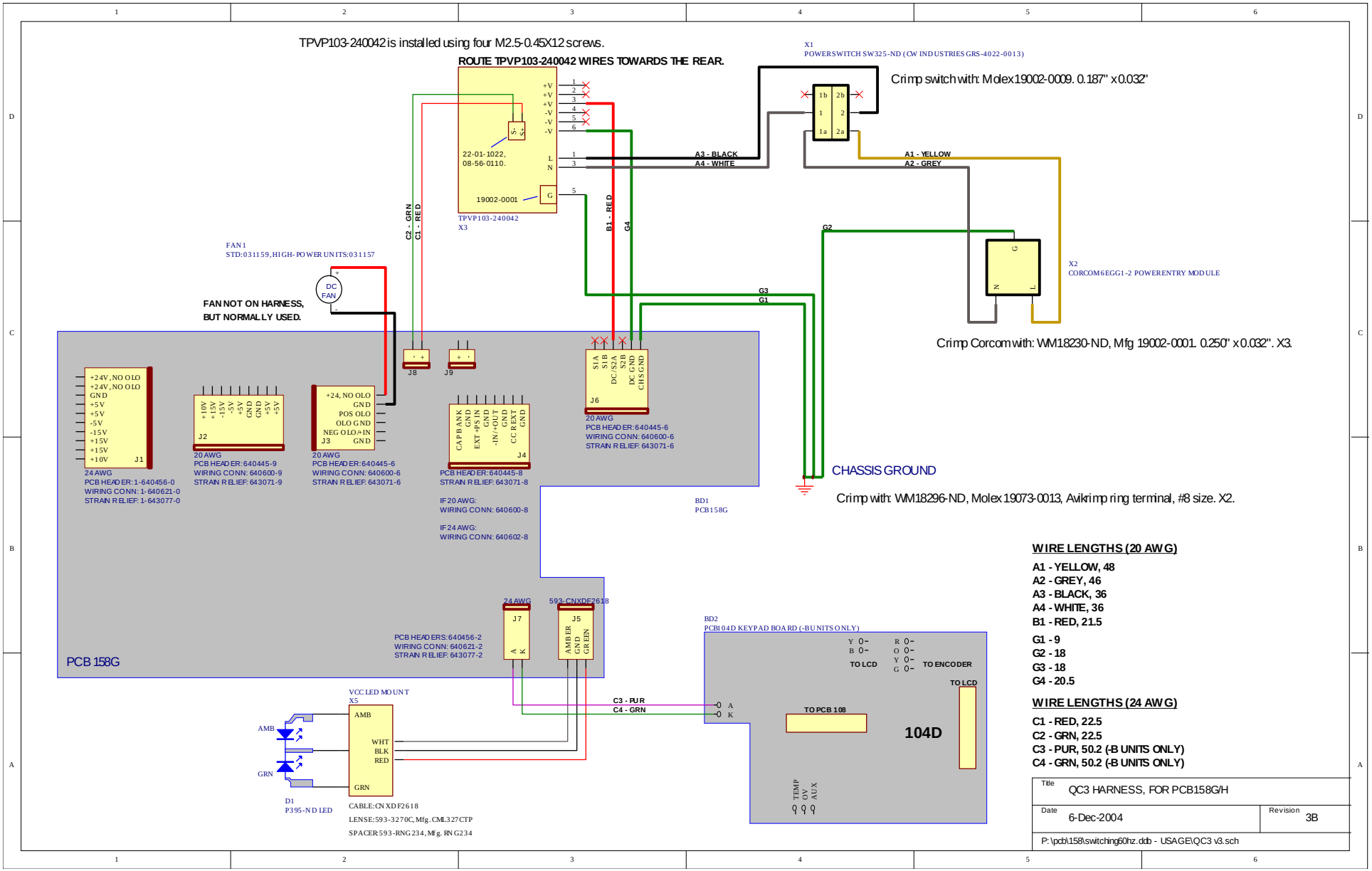
On occasion, one or more of the four rear-panel fuses may require replacement. All fuses can be accessed from the rear panel. See the “FUSES” section for details.

## CLEANING

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

# WIRING DIAGRAMS

## WIRING OF AC POWER




**WIRE LENGTHS (20 AWG)**

**A1 - YELLOW, 48**
**A2 - GREY, 46**
**A3 - BLACK, 36**
**A4 - WHITE, 36**
**B1 - RED, 21.5**

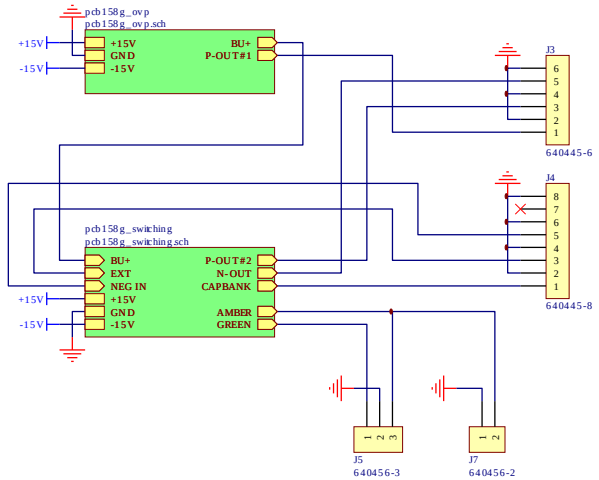
**G1 - 9**
**G2 - 18**
**G3 - 18**
**G4 - 20.5**

**WIRE LENGTHS (24 AWG)**

**C1 - RED, 22.5**
**C2 - GRN, 22.5**
**C3 - PUR, 50.2 (-B UNITS ONLY)**
**C4 - GRN, 50.2 (-B UNITS ONLY)**

| | |
|---|---|
| Title | QC3 HARNESS, FOR PCB158G/H |
| Date | 6-Dec-2004 |
| Revision | 3B |
| P:\pcb\158\switching60hz.ddb - USAGE\QC3 v3.sch | |

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




| | |
|---|---|
| Title | LOW VOLTAGE DC/DC POWER SUPPLY |
| Date | 6-Dec-2004 |
| Revision | |
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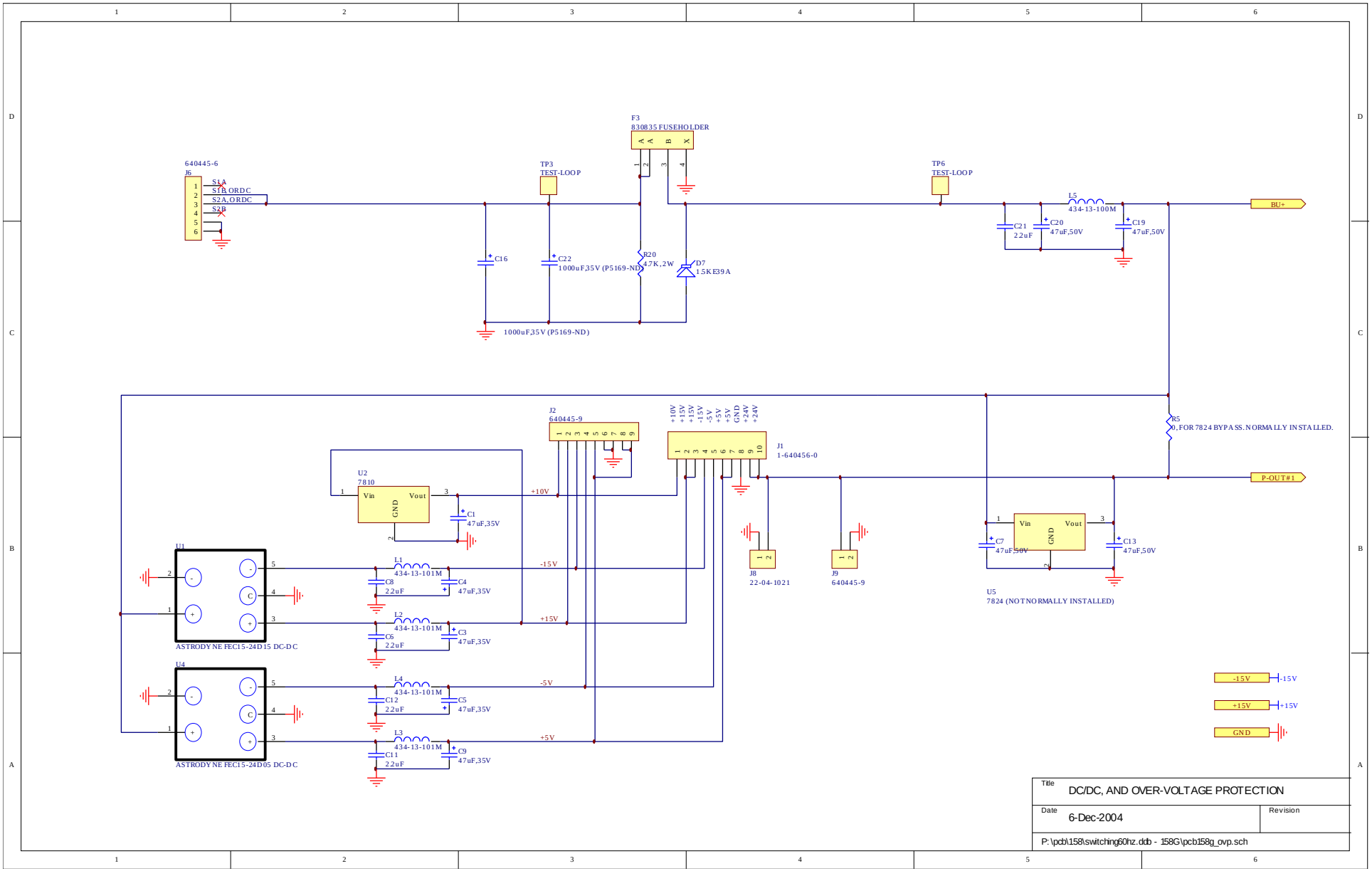
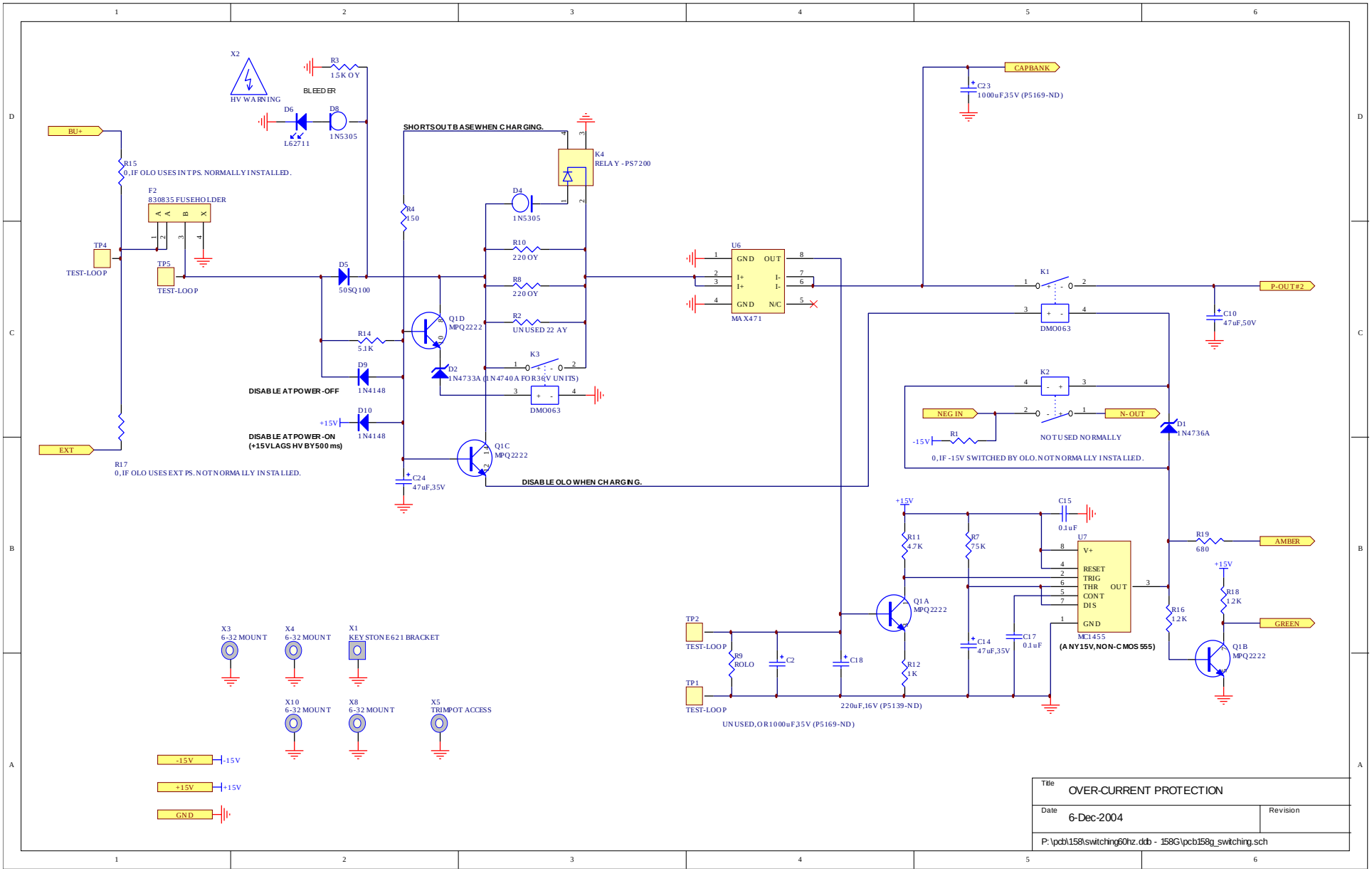
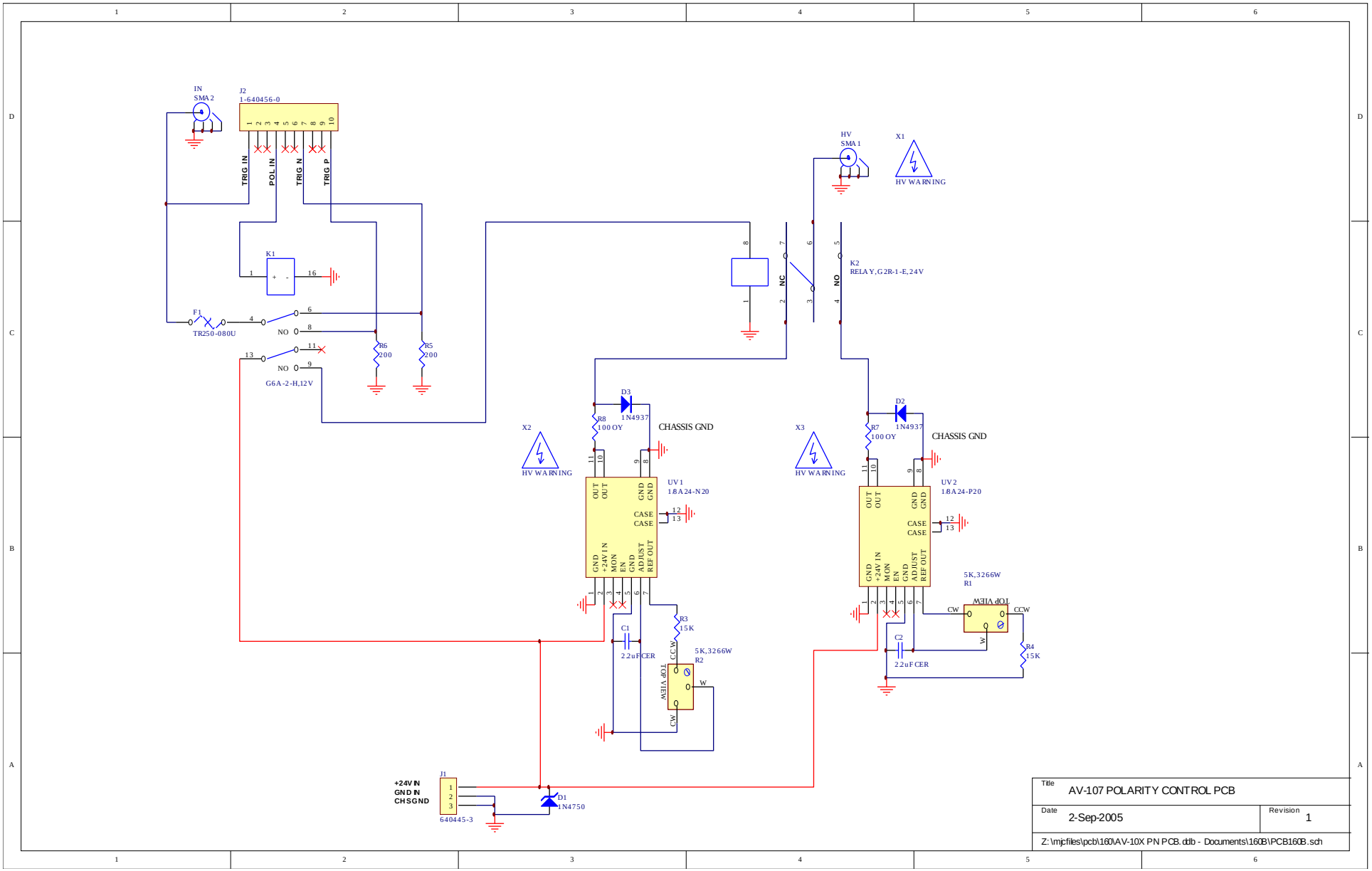
# PCB 158G - LOW VOLTAGE POWER SUPPLY, 2/3



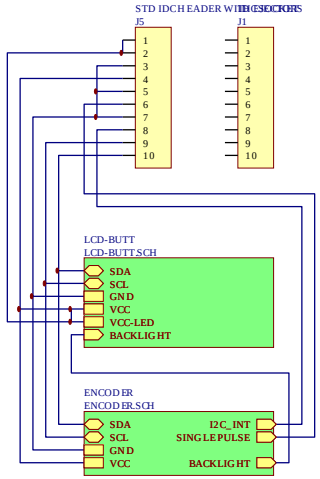
# PCB 158G - LOW VOLTAGE POWER SUPPLY, 3/3



# PCB 160B - HIGH VOLTAGE POWER SUPPLY

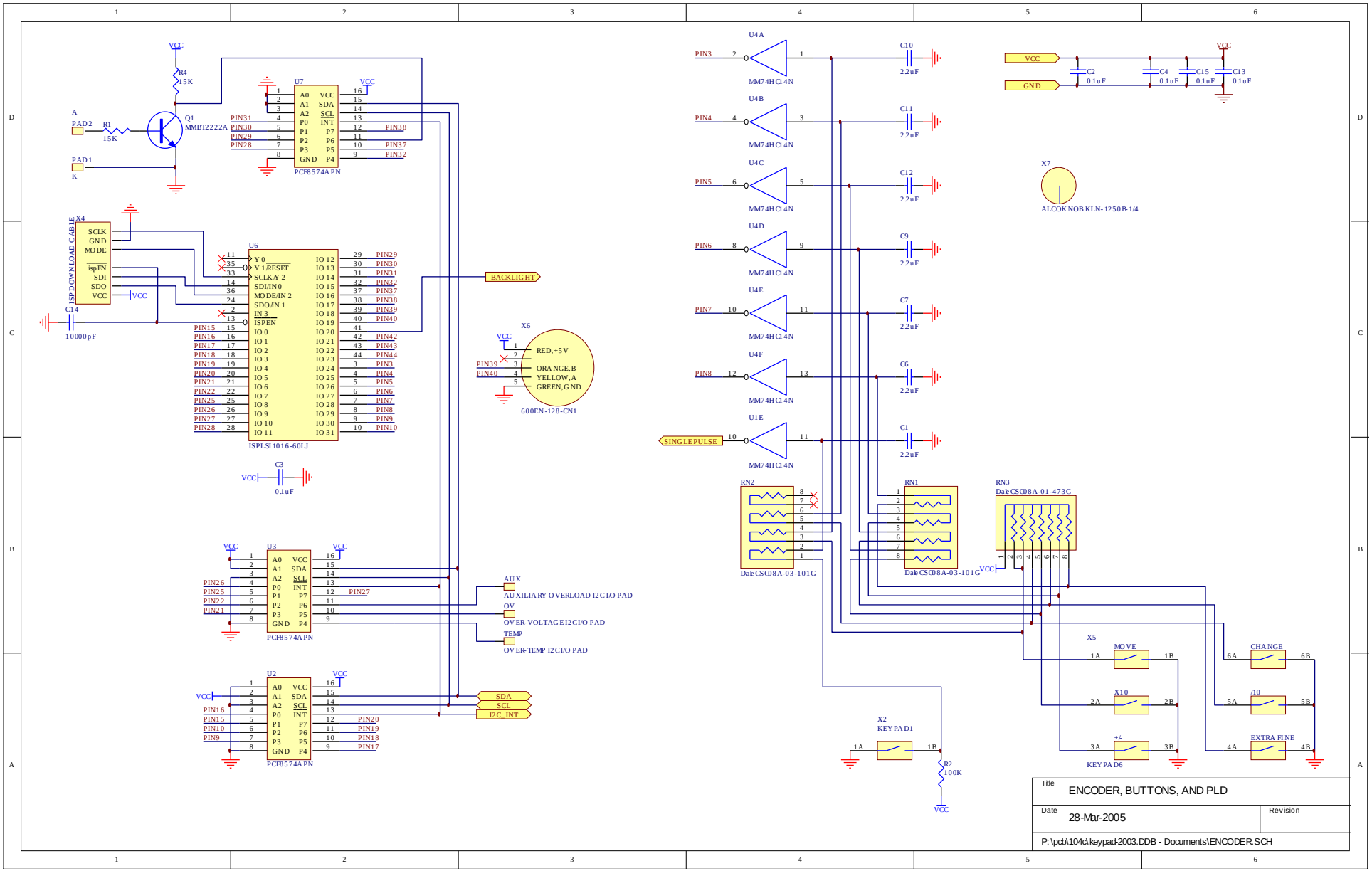


# PCB 104C - KEYPAD / DISPLAY BOARD, 1/3

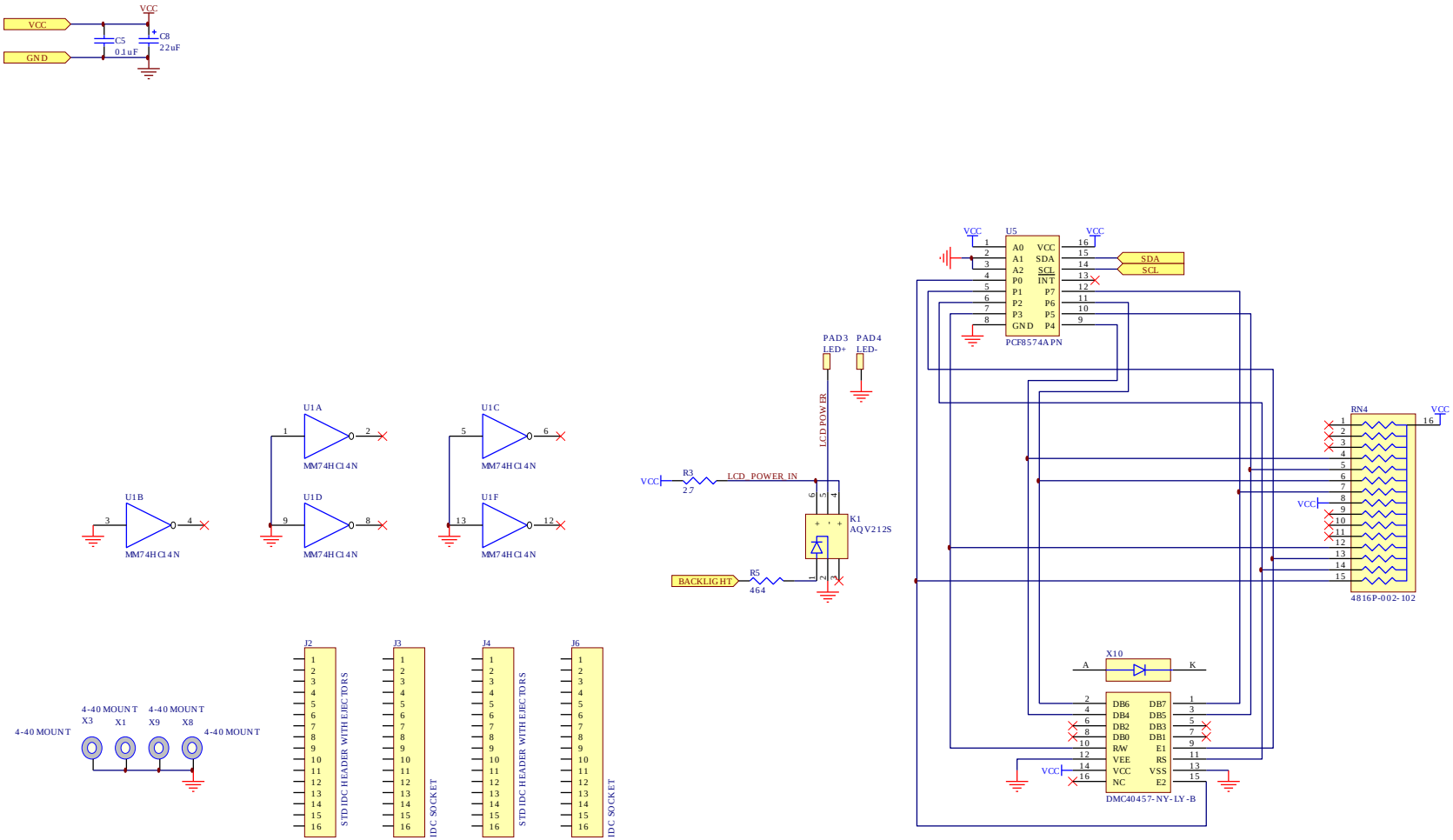



| | |
|---|---|
| Title | PANEL TOP-LEVEL SCHEMATIC |
| Date | 28-Mar-2005 |
| Revision | |
| P: \pcb\104c\keypad-2003.DDB - Documents\Panelbrd.prj | |

# PCB 104C - KEYPAD / DISPLAY BOARD, 2/3

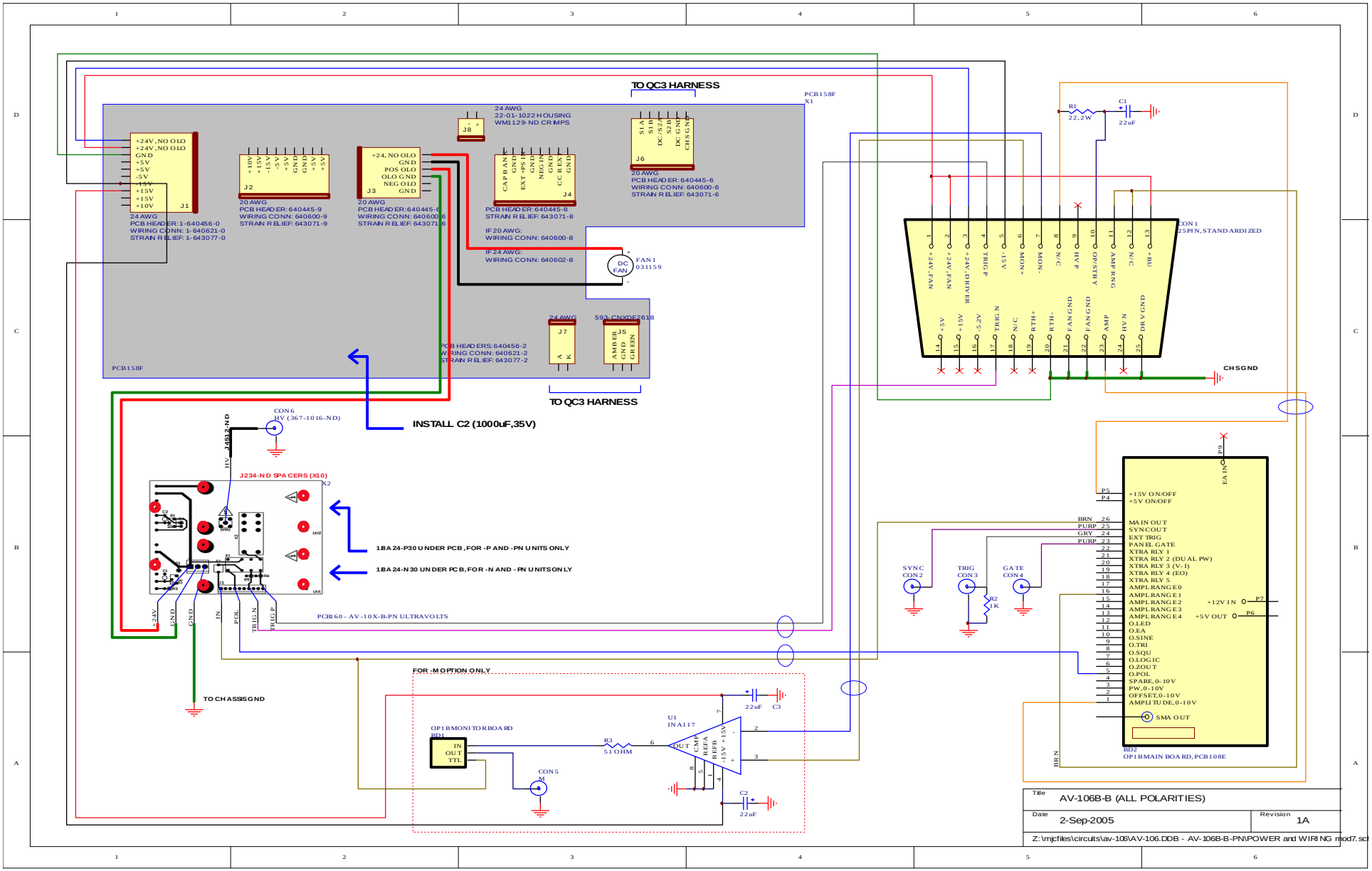


# PCB 104C - KEYPAD / DISPLAY BOARD, 3/3




| | |
|---|---|
| Title | LCD CIRCUITS, MECHANICAL |
| Date | 28-Mar-2005 |
| Revision | |
| P:\pcb\104c\keypad-2003.DDB - Documents\LCD-BUTT.SCH | |

# MAIN WIRING


TO QC3 HARNESS
PCB158F
X1
24 AWG
22-01-1022 HOUSING
WM1129-ND CRIMPS
J8
J6
20 AWG
PCB HEADER: 640445-6
WIRING CONN: 640600-6
STRAIN RELIEF: 643071-6
J1
24 AWG
PCB HEADER: 1-640456-0
WIRING CONN: 1-640621-0
STRAIN RELIEF: 1-643077-0
J2
20 AWG
PCB HEADER: 640445-9
WIRING CONN: 640600-9
STRAIN RELIEF: 643071-9
J3
20 AWG
PCB HEADER: 640445-6
WIRING CONN: 640600-6
STRAIN RELIEF: 643071-6
J4
PCB HEADER: 640445-8
STRAIN RELIEF: 643071-8
IF 20 AWG:
WIRING CONN: 640600-8
IF 24 AWG:
WIRING CONN: 640602-8
DC FAN
FAN 1
031159
J7
24 AWG
J5
593-CNXDE2618
PCB HEADERS: 640456-2
WIRING CONN: 640621-2
STRAIN RELIEF: 643077-2
PCB158F
TO QC3 HARNESS
INSTALL C2 (1000uF,35V)
CON6
HV (367-1016-ND)
HV - J383-ND
J234-ND SPACERS (X10)
X2
18A24-P30 UNDER PCB, FOR -P AND -PN UNITS ONLY
18A24-N30 UNDER PCB, FOR -N AND -PN UNITS ONLY
PCB160 - AV-10X-B-PN ULTRAVOLTS
TO CHASSIS GND
FOR -M OPTION ONLY
OP1BMONITORBOARD
BD1
R3
51 OHM
U1
INA117
22uF
C3
C2
CON5
M
R1
22,2W
C1
22uF
CON1
25PIN, STANDARDIZED
CHSGND
R2
1K
SYNC
CON2
TRIG
CON3
GATE
CON4
P9
EA IN
+15V ON/OFF
+5V ON/OFF
MAIN OUT
SYNC OUT
EXT TRIG
PANEL GATE
XTRA RLY 1
XTRA RLY 2 (DUAL PW)
XTRA RLY 3 (V-I)
XTRA RLY 4 (EO)
XTRA RLY 5
AMPLRANGE0
AMPLRANGE1
AMPLRANGE2
AMPLRANGE3
AMPLRANGE4
O.LED
O.EA
O.SINE
O.TRI
O.SQU
O.LOGIC
O.ZOUT
O.POL
SPARE, 0-10V
PW, 0-10V
OFFSET, 0-10V
AMPLITUDE, 0-10V
+12V IN
+5V OUT
SMA OUT
BD2
OP1BMAIN BOARD, PCB108E
Title
AV-106B-B (ALL POLARITIES)
Date
2-Sep-2005
Revision
1A
Z:\mjcfiles\circuits\av-106\AV-106.DDB - AV-106B-B-PN\POWER and WIRING mod7.sch

# PERFORMANCE CHECK SHEET