AVTECH ELECTROSYSTEMS LTD.
NANOSECOND WAVEFORM ELECTRONICS
SINCE 1975

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OTTAWA, ONTARIO
CANADA K2C 3H4

INSTRUCTIONS

MODEL AV-156A-B-P-ARLB

0 TO +2 AMP, 1 us to 10 ms

PULSED CONSTANT CURRENT GENERATOR

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

Phone: 888-670-8729 (USA & Canada) or +1-613-226-5772 (Intl)
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Manual Reference: /fileserver1/officefiles/instructword/av-156/AV-156A-B-P-ARLB,ed1.odt.
Last modified February 29, 2024.

INTRODUCTION

The Model AV-156A-B-P-ARLB pulsed constant current generator is capable of producing rectangular pulses with amplitudes as high as +2 Amperes, with < 200 ns rise and fall times. The internal trigger source can be used to trigger the instrument at frequencies between 1 Hz and 10 kHz. An external TTL trigger pulse, a front-panel pushbutton, and a computer can also be used to trigger the instrument. The maximum duty cycle is 80% for amplitudes up to 1A, and 40% for amplitudes up to 2A.

The AV-156A-B-P-ARLB pulse generator is a current pulser. The current amplitude is largely independent of the load voltage. For proper operation, the load voltage ($V_{LOAD} = I_{LOAD} \times R_{LOAD}$) must lie in the range of 0 to +20V.

These models feature front panel keyboard and adjust knob control of the output pulse parameters along with a four line by 40 character back-lit LCD display of the output amplitude, pulse width, pulse repetition frequency, and delay. The instrument includes memory to store up to four complete instrument setups. The operator may use the front panel or the computer interface to store a complete “snapshot” of all key instrument settings, and recall this setup at a later time.

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

SPECIFICATIONS

Model:	AV-156A-B-P-ARLB
Amplitude:	0.01 - 2.0 A
Pulse width:	1 us to 10 ms
Max. pulse repetition freq:	10 kHz
Max. duty cycle:	80% for amplitudes of 0-1 Amp 40% for amplitudes of 1-2 Amps
Rise time, fall time:	< 200 ns, for amplitudes > 200 mA. The rise time at lower currents may increase somewhat, due to the effect of parasitic capacitance.
Polarity:	Sources current.
Output current regulation:	< 2 % load voltage change from 0 Volts to maximum rated voltage
Load voltage range:	0 to +20V
Jitter: (Ext trig in to pulse out)	< ± 200 ps ± 0.03% of sync delay
Trigger required:	External trigger mode: TTL, PW > 50 ns
Sync delay: (Sync out to pulse out)	0 to ±1.0 seconds
Sync output:	+3 Volts, 200 ns, will drive 50 Ohm loads
Gate input:	Active high or low, switchable. Suppresses triggering when active.
Monitor output:	Back-panel BNC connector provides a coincident replica of the output current.
Connectors, main output:	Rear-panel DB9 female. Pins 1-5 = signal, pins 6-9 = ground.
Supplied output cable and cable-to-PCB adapter:	AV-CLZ11-60 cable (see http://www.avtechpulse.com/transmission/av-clz11) with AV-CTLX-ENC adapter (see http://www.avtechpulse.com/accessories/av-ctlx). This specially-designed output cabling is designed to minimize signal distortions, and has Z_0 = 11 Ohms.
Connectors, other:	Sync output: BNC, front-panel. Gate, Ext Trig, Monitor: BNC, rear-panel
GPIB and RS-232 control:	Standard feature. See page See http://www.avtechpulse.com/gpib for details.
LabView Drivers:	Check http://www.avtechpulse.com/labview for availability and downloads
Power requirements:	100 - 240 Volts, 50 - 60 Hz
Dimensions: (H x W x D)	100 mm x 430 mm x 375 mm (3.9" x 17" x 14.8")
Chassis material:	cast aluminum frame & handles, blue vinyl on aluminum cover plates
Temperature range:	+5°C to +40°C

ORIGINAL QUOTATION

Date: Thu, 31 May 2007 14:28:30 -0400
From: Avtech Sales
Subject: Avtech current pulser quote

XXXXX,

Following our telephone conversation, I am pleased to re-quote as follows:

Quote number: 13830

Model number: AV-156A-B-P-ARLB

Description: Current Pulser or Laser Diode Driver with IEEE-488.2 GPIB and RS-232 Computer Control Ports

Amplitude: +10 mA to +2 A

Polarity: positive only (sources current)

Pulse width (FWHM): 1 us to 10 ms

Maximum pulse repetition frequency (PRF): 10 kHz

Maximum duty cycle, for amplitudes up to +1A: 80%

Maximum duty cycle, for amplitudes of +1A to +2A: 40%

Rise and fall time (20%-80%): < 200 ns, for amplitudes > 200 mA. (The rise time at lower currents may increase somewhat, due to the effect of parasitic capacitance.)

Load voltage range: 0 to +20V

Output connector: DB37 female. Pins 1-19 = signal, pins 20-37 = ground.
(note: later changed to DB9 female. Pins 1-5 = signal, pins 6-9 = ground.)

Supplied output cable and cable-to-PCB adapter: AV-CLZ11-60 cable (see http://www.avtechpulse.com/transmission/av-clz11) with AV-CTLX-ENC adapter (see http://www.avtechpulse.com/accessories/av-ctlx). This specially-designed output cabling is designed to minimize signal distortions, and has Z0 = 11 Ohms.

Current monitor: none

Other: similar to the standard AV-156A-B, described at http://www.avtechpulse.com/current/av-156a

Price: $XXXXX US each, FOB destination.

Quote valid for: 60 days

Estimated delivery: 8-10 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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Ogdensburg   fax: 800-561-570 or 613-226-2802   LCD Merivale
New York   Ottawa, Ontario
USA 13669-0265   email: info@avtechpulse.com   Canada K2C 3H4
                      http://www.avtechpulse.com/

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)

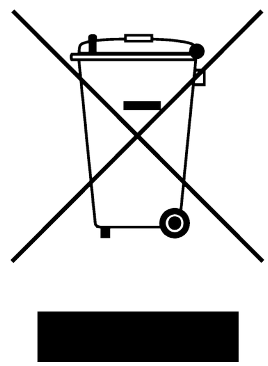
This instrument is exempt from Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment. Specifically, Avtech instruments are considered "Monitoring and control instruments" (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 with 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, examine to ensure that it has 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	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:

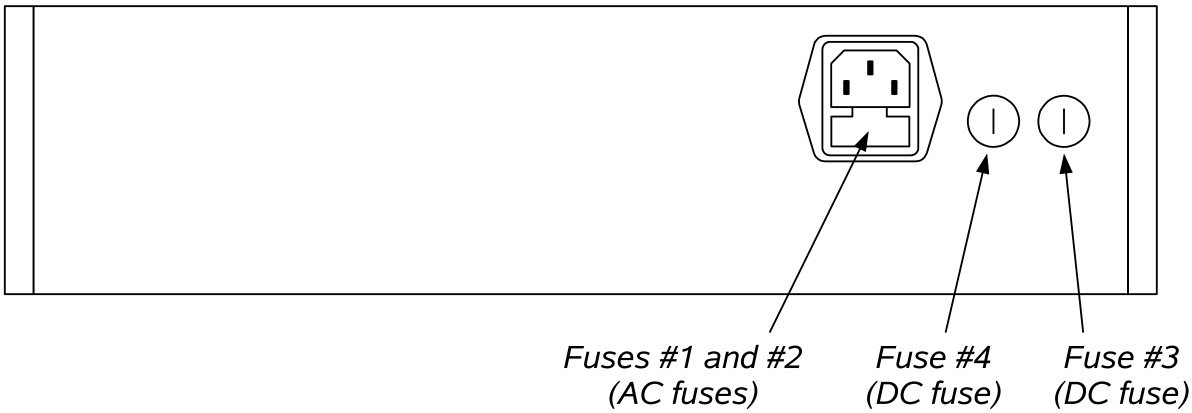
1. indoor use;
2. altitude up to 2 000 m;
3. temperature 5 °C to 40 °C;
4. maximum relative humidity 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C;
5. Mains supply voltage fluctuations up to ±10 % of the nominal voltage;
6. no pollution or only dry, non-conductive pollution.

LABVIEW DRIVERS

A LabVIEW driver for this instrument is available for download on the Avtech web site, at http://www.avtechpulse.com/labview. A copy is also available in National Instruments' Instrument Driver Library at http://www.natinst.com/.

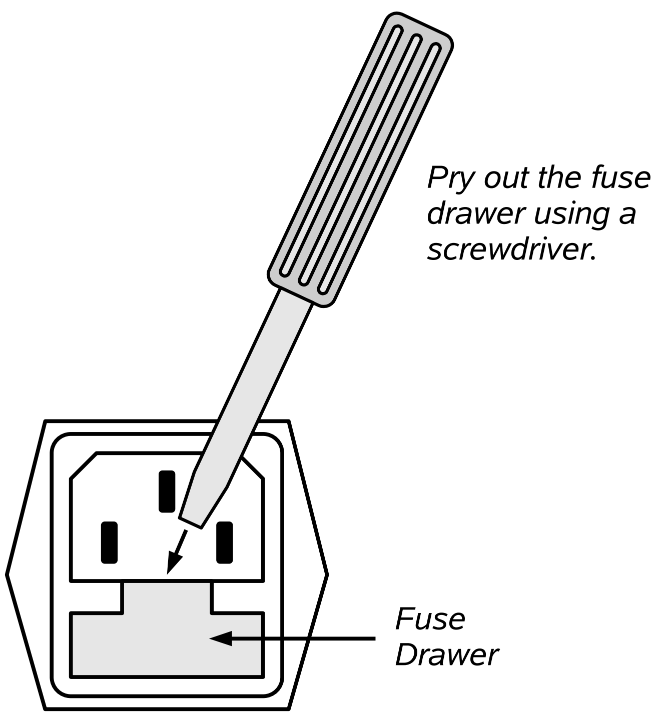
FUSES

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

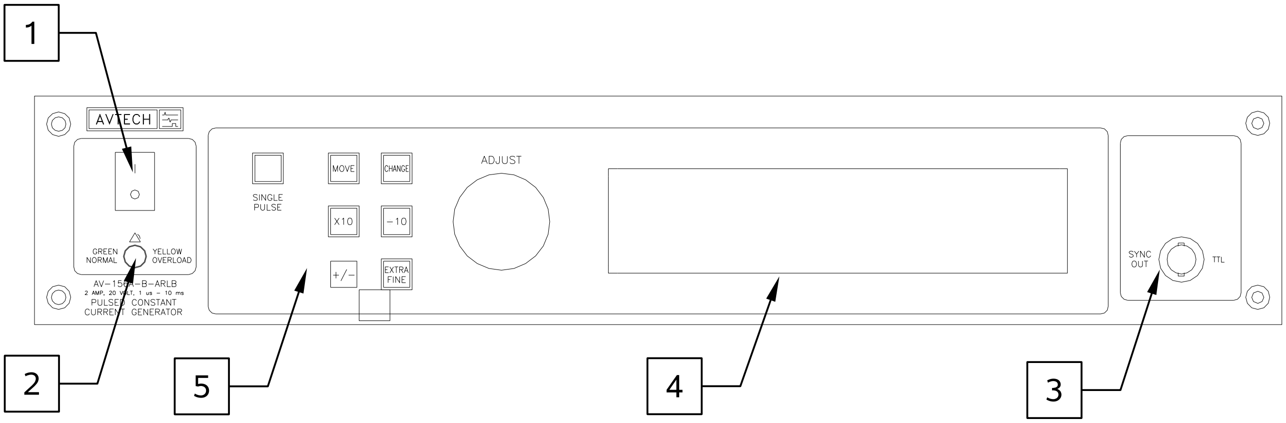
The following table lists the required fuses:

Fuses	Nominal Mains Voltage	Rating	Case Size	Recommended Replacement Part	
				Littelfuse Part Number	Digi-Key Stock Number
#1, #2 (AC)	115 V	0.5A, 250V, Time-Delay	5×20 mm	0218.800HXP	F2418-ND
	230 V	0.5A, 250V, Time-Delay	5×20 mm	0218.500HXP	F2416-ND
#3 (DC)	N/A	1.6A, 250V, Time-Delay	5×20 mm	021801.6HXP	F2424-ND
#4 (DC)	N/A	1.0A, 250V, Time-Delay	5×20 mm	0218001.HXP	F2419-ND

The recommended fuse manufacturer is Littelfuse (http://www.littelfuse.com).

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

FRONT PANEL CONTROLS



1) POWER Switch. This is the main power switch. When turning the instrument on, there may be a delay of several seconds before the instrument appears to respond.

2) OVERLOAD Indicator. When the instrument is powered, this indicator is normally green, indicating normal operation. If this indicator is yellow, an internal automatic overload protection circuit has been tripped. If the unit is overloaded (by operating at an exceedingly high duty cycle or by operating into a very low impedance), the protective circuit will disable the output of the instrument and turn the indicator light yellow. The light will stay yellow (i.e. output disabled) for about 5 seconds after which the instrument will attempt to re-enable the output (i.e. light green) for about 1 second. If the overload condition persists, the output will be disabled again (i.e. light yellow) for another 5 seconds. If the overload condition has been removed, the instrument will resume normal operation.

   This overload indicator may flash yellow briefly at start-up. This is not a cause for concern.

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

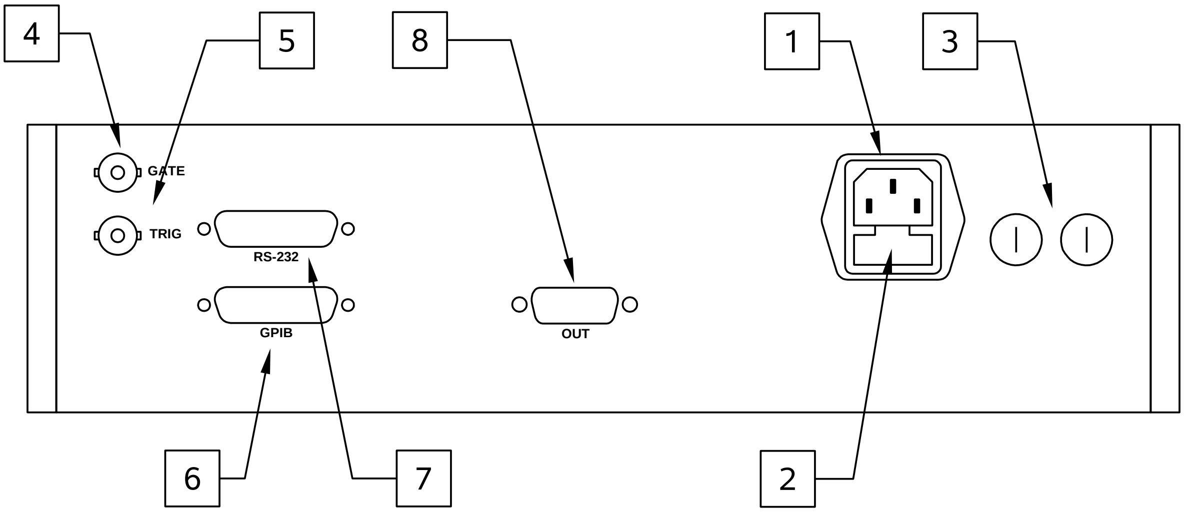
3) SYNC OUT. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal leads (or lags) the main output by a duration set by the "DELAY" controls and has an approximate amplitude of +3 Volts to R_L > 50Ω with a pulse width of approximately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

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. OUT. This is the main output. The AV-CLZ11-60 transmission line plugs into this DB-9 female connector. Pins 1-5 (the upper row) are connected to the signal out, and pins 6-9 (the lower row) are connected to ground.

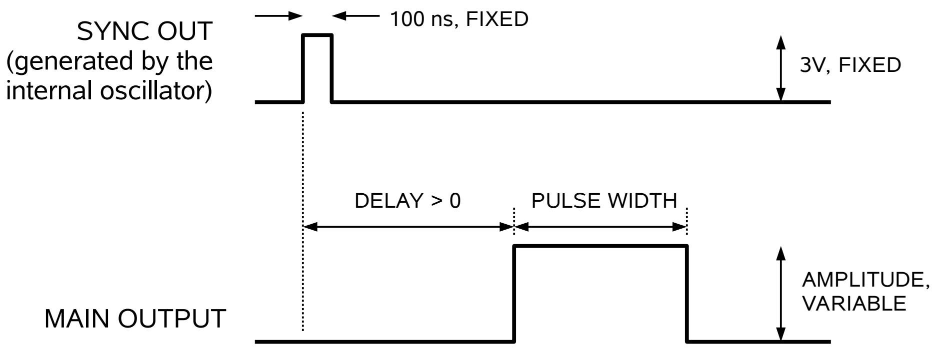
GENERAL INFORMATION

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 device under test. 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.

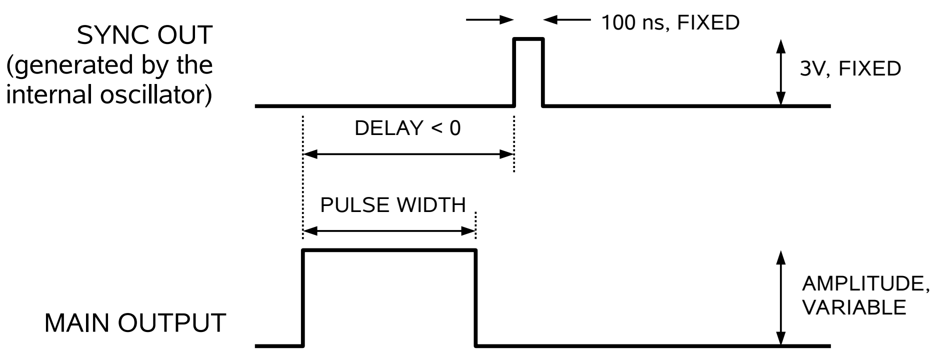
In the diagrams below, positive amplitude is assumed. (For “-N” units, the output waveforms are inverted in polarity.)

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



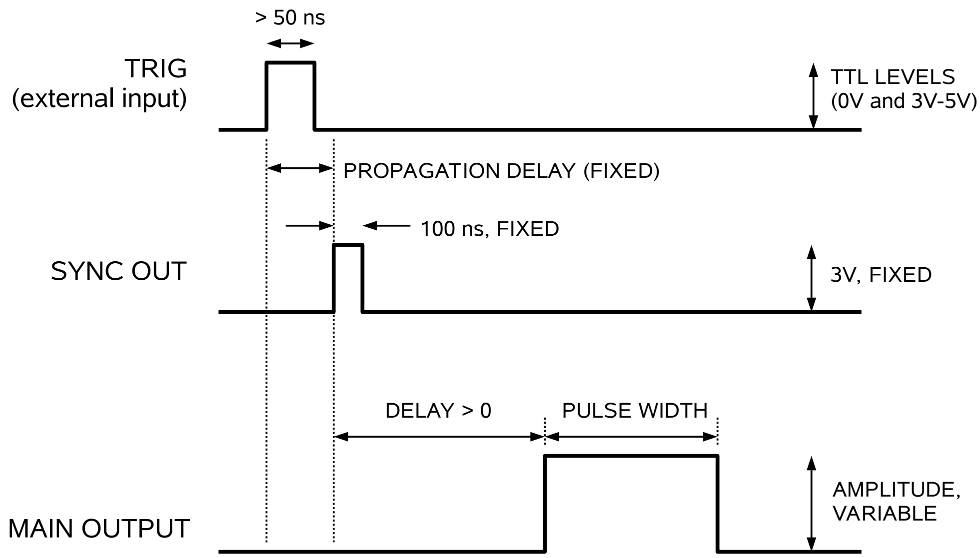
Basic Output Pulses for Delay > 0

The order of the output pulses is reversed for negative delays:



Basic Output Pulses for Delay < 0

When the triggering is set to external mode, a TTL-level pulse on the TRIG input will trigger the pulse generator, as shown below:



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

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.)

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.

AVOID EXCESS POWER DISSIPATION

To prolong the life of the output stages of the instrument, the internal power dissipation should be minimized whenever practical. The power dissipated in the output stage can be calculated using:

$$P_{DISS} = (36 \text{ Volts} - V_{LOAD}) \times I_{PEAK} \times \text{Duty Cycle}$$

To minimize power dissipation, keep the current amplitude and duty cycle as low as practical. Operation into larger load resistance is preferred over operation into a low load resistance, since $V_{LOAD} = I_{PEAK} \times R_{LOAD}$.

OUTPUT CONNECTIONS

The main output is provided on a rear-panel DB-9 female connector. Pins 1-5 of this connector (the upper row) are connected to the signal out, and pins 6-9 (the lower row) are connected to ground.

An AV-CLZ11-60 transmission line is supplied with the instrument. One end plugs into the rear-panel connector. The other end is terminated with a DB-9 male connector. Pins 1-5 of this connector (the upper row) are connected to the signal out, and pins 6-9 (the lower row) are connected to ground. The cable is reversible - either end can be plugged into the rear panel. This cable can be ordered separately, as model AV-CLZ11-60. (Lengths longer than 60 cm are also available – see http://www.avtechpulse.com/transmission/av-clz11 for details.)

The user may connect a load to the end of the AV-CLZ11-60 transmission line using a load that has a DB-9 female connector. To construct your own connectorized load, consider using a Norcomp L77-DE09S DB-9 female connector with solder cup pins. This is readily available from Mouser (http://www.mouser.com/, stock number 523-L77-DE09S). Care must be taken to construct the connectorized test load to conform to local safety standards. Voltages of up to 20V, approximately, will be present on the load during normal operation. Pins 1-5 short be connected together to provide the signal output, and pins 6-9 should be connected together to provide the ground.

It may be simpler to modify the supplied test load. The supplied test load has this connector pre-installed, and a safety enclosure is provided. This test load is described in the next section.

USING THE SUPPLIED TEST LOAD (AV-CTL11-ENC)

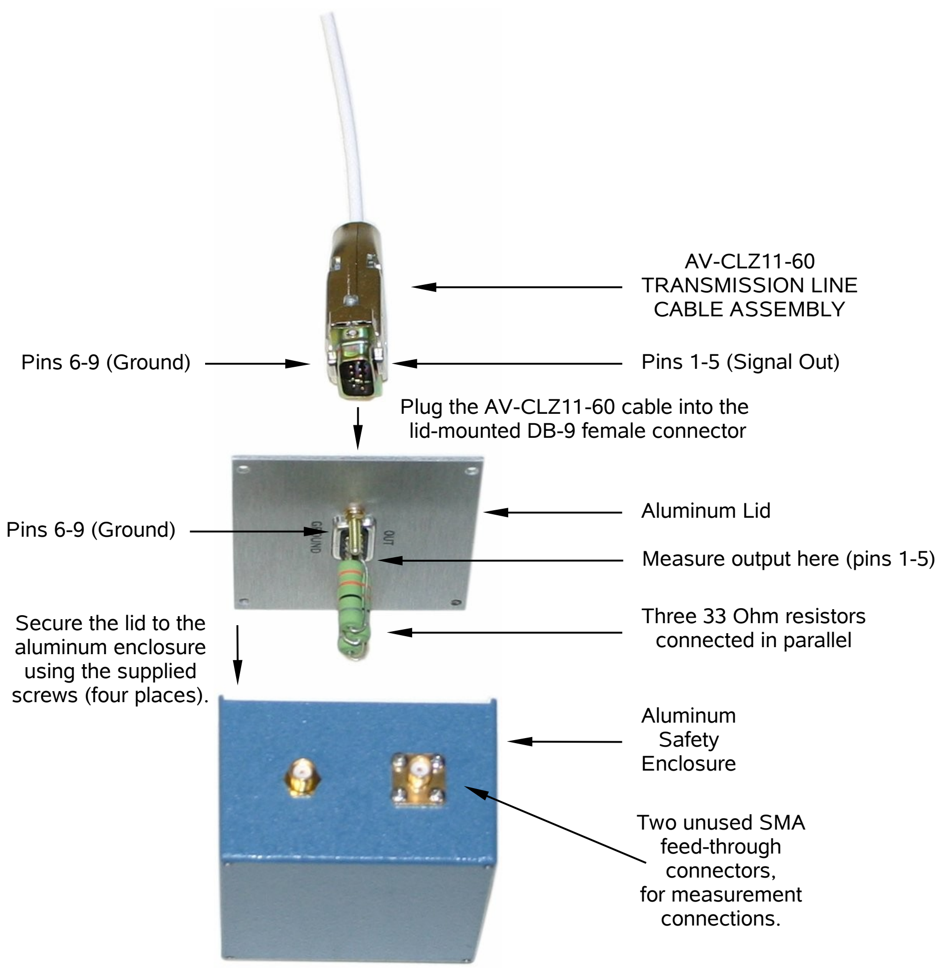
The supplied test load consists of a DB-9 female connector mounted on the lid of a small aluminum box chassis. Inside the chassis, an 8 mm by 50 mm circuit board is sandwiched between the two rows of solder cups on the rear of the connector. Three Ohmite OX-series 3.3 Ohm resistors are connected in parallel between the two rows of solder cups. This provides a total resistance of $3.3\ \Omega / 3 \approx 1.1\ \Omega$.

Two unused SMA connectors are provided for making connections through the chassis wall, if desired. A 5/16" hole, plugged with a screw is also provided. The screw may be removed to provide an access hole to the interior of the chassis.

The test load has a maximum power dissipation rating of 3 Watts. Take care not exceed this!

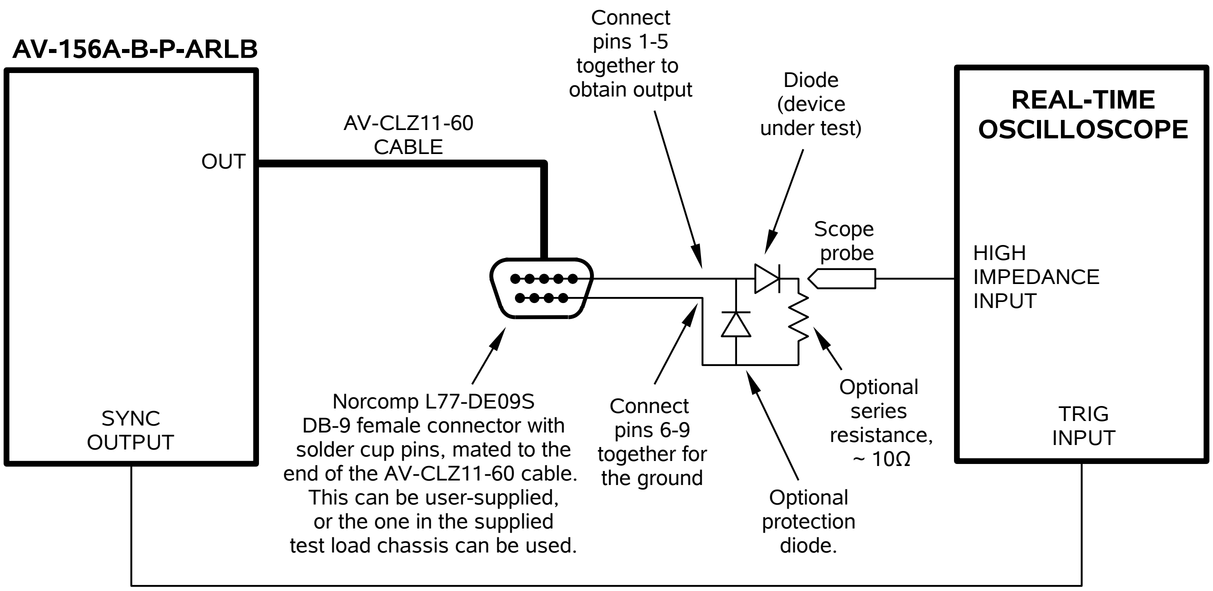
This test load can be ordered separately, as model AV-CTL11-ENC. It can also be ordered with no resistors installed, as model AV-CTLX-ENC.

The basic mechanical connection scheme for the AV-CTL11-ENC is shown below:



TEST ARRANGEMENT

The basic test arrangement is shown below:



A resistance may be added series with the diode load, to provide transmission line matching and current sensing. If connected as shown above, the resistor voltage displayed on the oscilloscope is directly proportional to the diode current. It is essential the low-inductance resistors be used. Several non-inductive, medium power resistors should be used in parallel (for instance, three 3.3 Ohm 1W resistors – more may be required for higher-average power applications). The Ohmite OX or OY series (www.ohmite.com) are appropriate.

It is also recommended that a low-capacitance, high-voltage, ultra-fast Schottky rectifier diode be connected for reverse-bias protection, especially for sensitive or costly devices under test. The 1N5819 is an example of a suitable diode. Note, however, that the capacitance added by the protection diode may degrade the output rise time slightly.

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).

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: $V_{SPIKE} = L \times dI_{LOAD}/dt$.

For this reason, the length of leads used to connect the load to the circuit board should be kept extremely short (< 0.5 cm).

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.

MEASURING OUTPUT CURRENT

Two basic methods can be used to observe the current waveform through the load. The first is to observe the voltage waveform across the resistance present in the load. If the resistance is non-inductive, the voltage waveform will be directly proportional to the current waveform (Ohm's Law). Keeping the parasitic inductance low is critical for reliable measurements. If a diode is connected in series with the resistance, it may be advantageous to ensure the diode is placed before the resistance, so that one end of the resistance is grounded. This will eliminate the need for differential voltage measurements. This method is shown in the "TEST ARRANGEMENT" section above.

Alternatively, a high-speed current probe or current transformer can be used to observe the current waveform. However, many current probes are AC-coupled, limiting the maximum observable pulse width to a few microseconds. A few DC-coupled (Hall effect) probes are available from suppliers such as Tektronix.

START-UP CHECK-LIST FOR LOCAL CONTROL

1. Connect the supplied test load (AV-CTL11-ENC) to the rear-panel of the mainframe, using the AV-CLZ11-60 cable.

2. Connect a cable from the SYNC OUT connector to the TRIG input of an oscilloscope. Set the oscilloscope to trigger externally.

3. Connect an oscilloscope probe to the signal side of the resistors in the test load. It may be necessary to connect the probe using the SMA feed-throughs on the test load enclosure. On the oscilloscope, set the channel A vertical scale to 50 V/div, and the horizontal scale to 2 us/div. (A 50 Ohm measurement system, without a high impedance probe, can also be used if desired. This may be more mechanically convenient. See the "TEST ARRANGEMENT" section for details.)

4. Turn on the instrument. The main menu will appear on the LCD.

5. To set the instrument to trigger from the internal clock at a PRF of 1 kHz:

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

    b) Press the CHANGE button. The frequency submenu will appear. Rotate the ADJUST knob until the frequency is set at 1 kHz.

    c) The arrow pointer should be pointing at the “Internal” choice. If it is not, press MOVE until it is.

    d) Press CHANGE to return to the main menu.

6. To set the delay to 100 ns:

    a) Press the MOVE button until the arrow pointer is pointing at the delay menu item.

    b) Press the CHANGE button. The delay submenu will appear. Rotate the ADJUST knob until the delay is set at 100 ns.

    c) Press CHANGE to return to the main menu.

7. To set the OUT pulse width to 10 us:

    a) Press the MOVE button until the arrow pointer is pointing at the “PW” menu item.

    b) Press the CHANGE button. The pulse width submenu will appear. Rotate the ADJUST knob until the pulse width is set at 10 us.

c) The arrow pointer should be pointing at the “Normal” choice. If it is not, press MOVE until it is.

d) Press CHANGE to return to the main menu.

8. At this point, nothing should appear on the oscilloscope.

9. To enable the output:

    a) Press the MOVE button until the arrow pointer is pointing at the output menu item.

    b) Press the CHANGE button. The output submenu will appear.

    c) Press MOVE until the arrow pointer is pointing at the “ON” choice.

    d) Press CHANGE to return to the main menu.

10. To change the OUT output amplitude:

    a) Press the MOVE button until the arrow pointer is pointing at the AMP menu item.

    b) Press the CHANGE button. The amplitude submenu will appear. Rotate the ADJUST knob until the amplitude is set at 2 A.

    c) Observe the oscilloscope. You should see 10 us wide, 22V pulses on the probe connected to the main output.

    d) Press CHANGE to return to the main menu.

11. Try varying the pulse width, by repeating step (7). As you rotate the ADJUST knob, the pulse width on the oscilloscope will change. It should agree with the displayed value.

12. This completes the operational check.

CALIBRATION PROCEDURES

All calibration procedures are performed in software. There are no user-adjustable trimpots inside the instrument.

To calibrate the timebase, please see the Avtech Technical Brief 4, "How Can I Calibrate the Timebase of my Avtech Pulse Generator?" on the web at http://www.avtechpulse.com/appnote/techbrief4/ for more information and sample LabView drivers.

To calibrate the amplitude and offset, please see the Avtech Technical Brief 5, "How Can I Calibrate the Amplitude and Offset of my Pulse Generator?" on the web at http://www.avtechpulse.com/appnote/techbrief5/ for more information.

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 100 ns	(sets the pulse width to 100 ns)
pulse:delay 1 us	(sets the delay to 1 us)
output on	(turns on the output)
source:curr 2A	(sets the voltage amplitude to 2 Amps)

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

*rst	(resets the instrument)
trigger:source hold	(turns off all triggering)
pulse:width 100 ns	(sets the pulse width to 100 ns)
output on	(turns on the output)
source:curr 2A	(sets the voltage amplitude to 2 Amps)
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 100 ns	(sets the pulse width to 100 ns)
pulse:delay 1 us	(sets the delay to 1 us)
source:curr 2A	(sets the voltage amplitude to 2 Amps)
output on	(turns on the output)

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
            :POINT              <numeric value> <numeric value>
LOCAL
OUTPut:
    :[STATe]                    <boolean value>
    :PROTection
        :TRIPped?                                            [query only]
REMOTE
[SOURce]:
    :FREQuency
        [:CW | FIXed]           <numeric value>
[SOURce]:
    :CURRent
        [:LEVel]
            [:IMMediate]
                [:AMPLitude]    <numeric value>
        :PROTection
            :TRIPped?                                        [query only]

[SOURce]:
    :PULSe
        :PERiod                 <numeric value>
        :WIDTh                  <numeric value>
        :DCYCle                 <numeric value>
        :HOLD                   WIDTh | DCYCle
        :DELay                  <numeric value>
        :GATE
            :LEVel              HIgh | LOw
            :TYPE               ASYNC | SYNC
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.

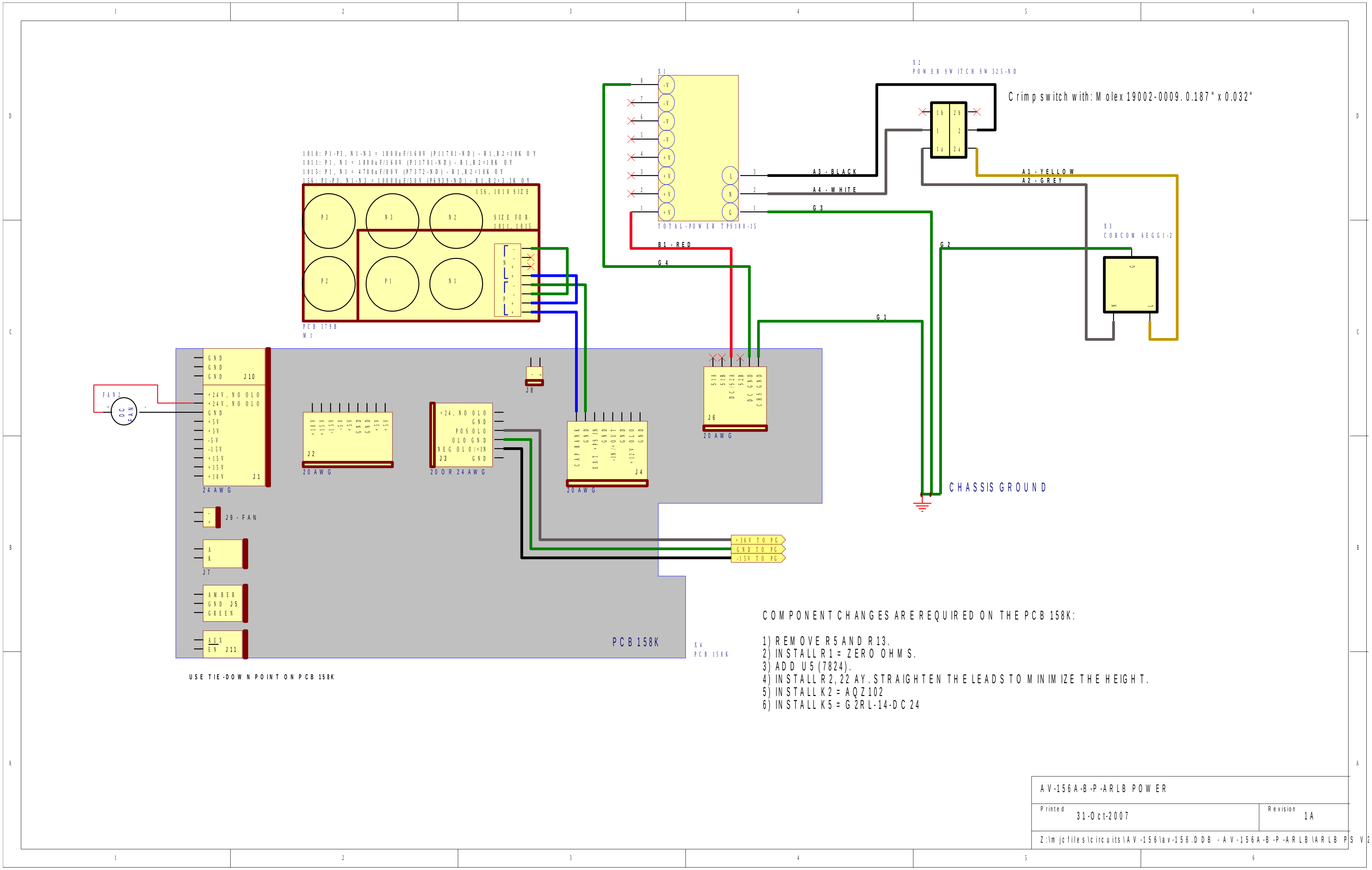
On occasion, one or more of the four rear-panel fuses may require replacement. All fuses can be accessed from the rear panel. See the “FUSES” section for details.

CLEANING

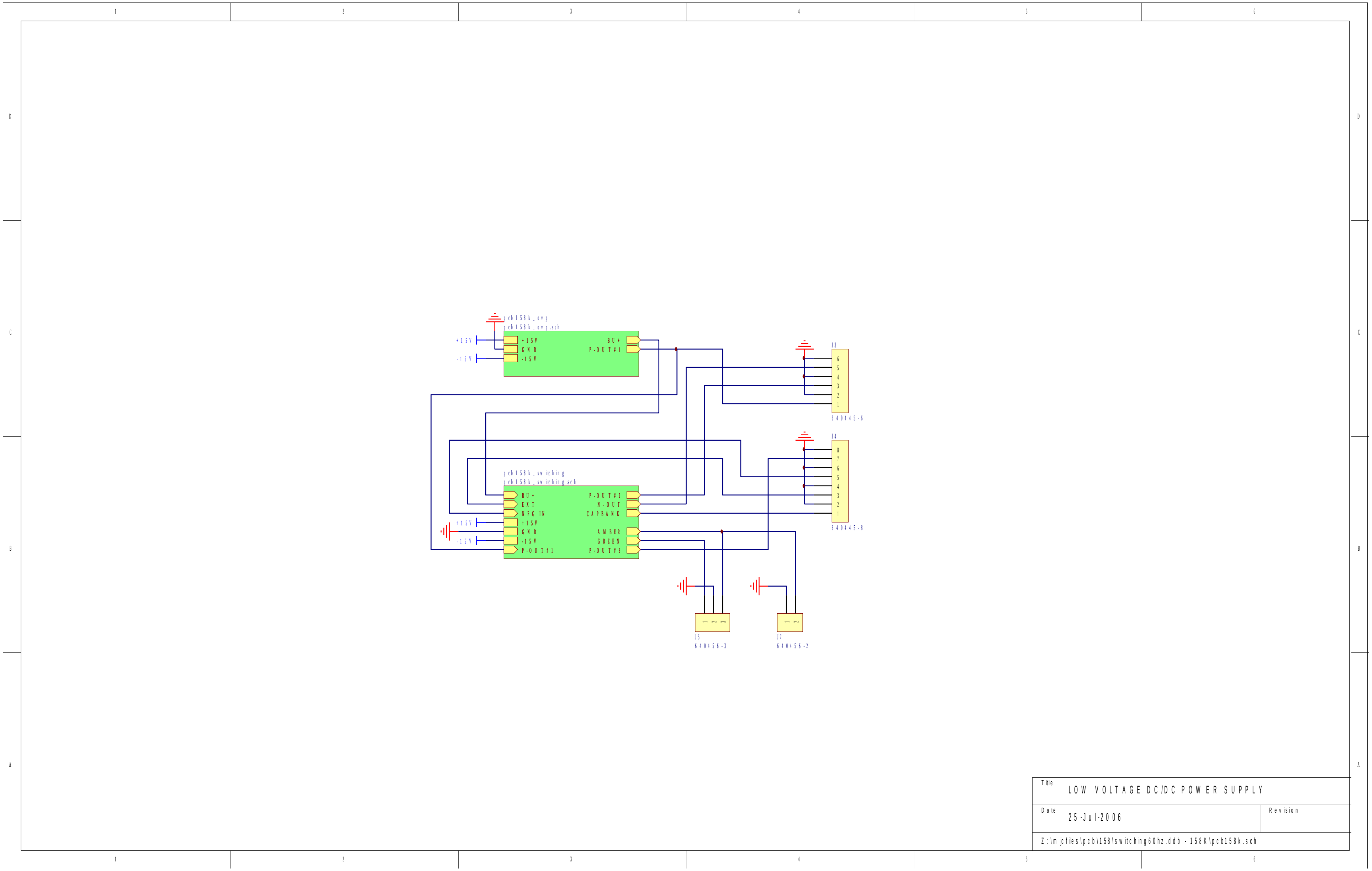
If desired, the interior of the instrument may be cleaned using compressed air to dislodge any accumulated dust. (See the “TOP COVER REMOVAL” section for instructions on accessing the interior.) No other cleaning is recommended.

WIRING DIAGRAMS

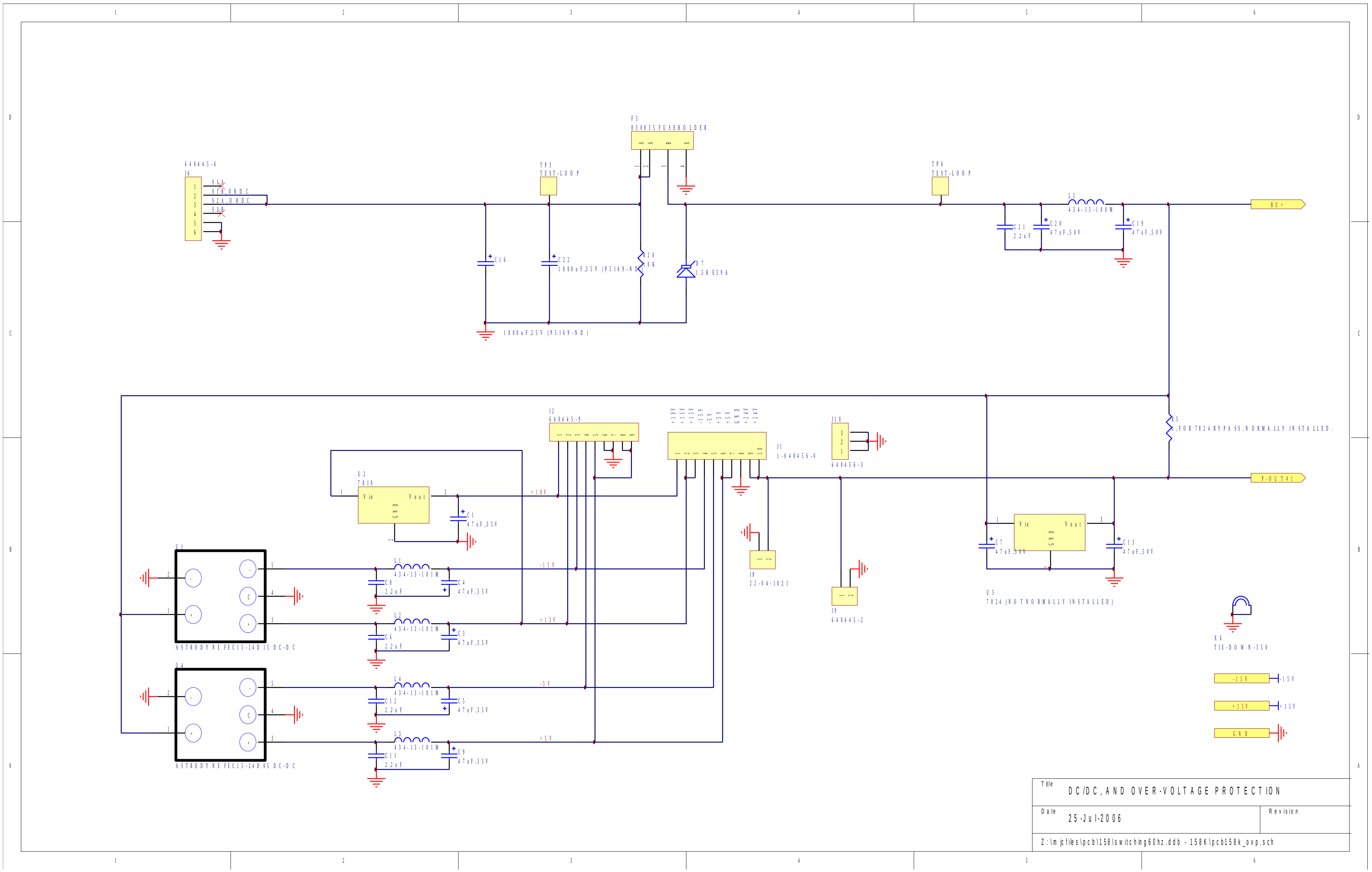
WIRING OF AC POWER



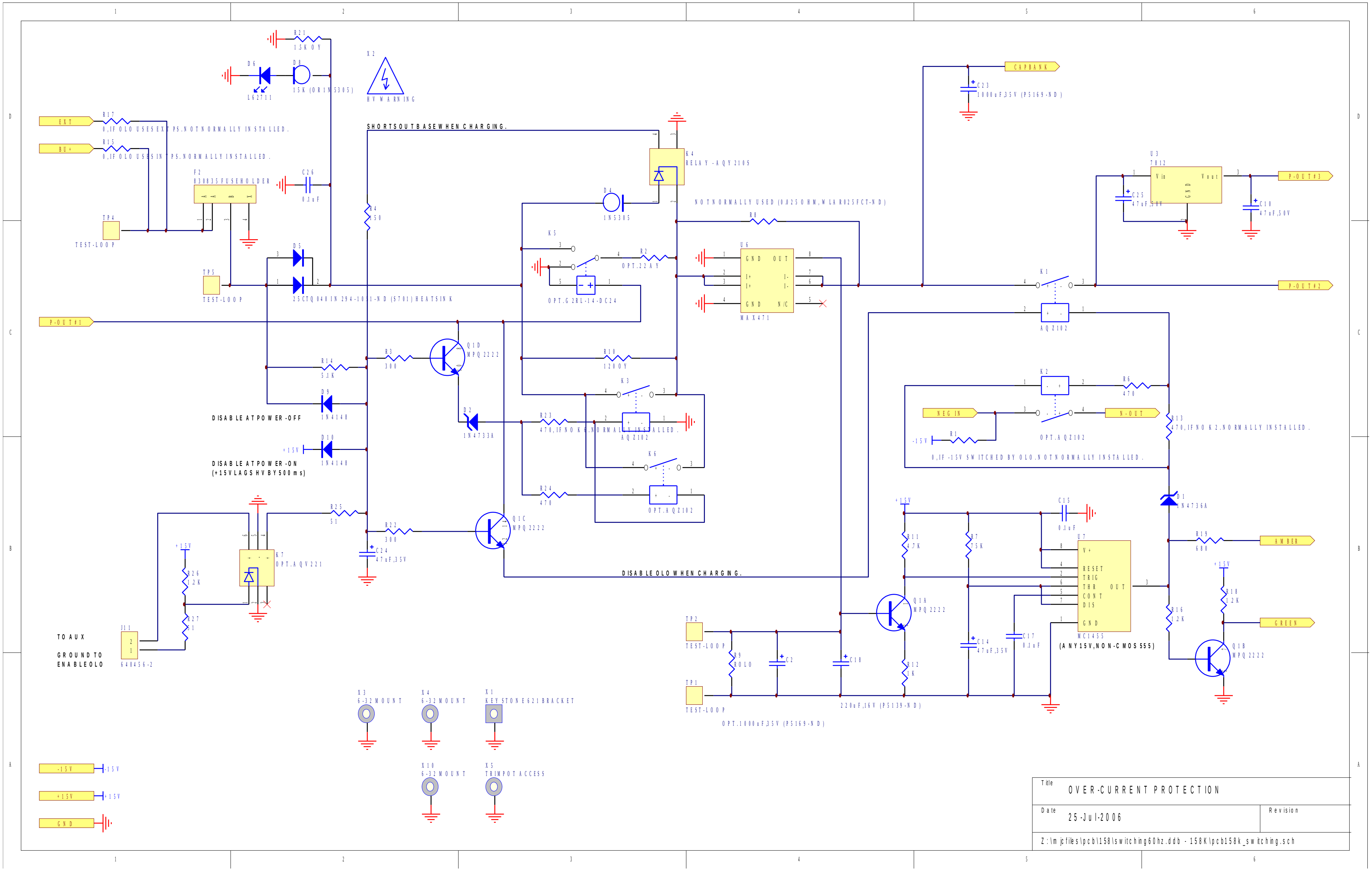
PCB 158K - LOW VOLTAGE DC POWER SUPPLY, 1/3



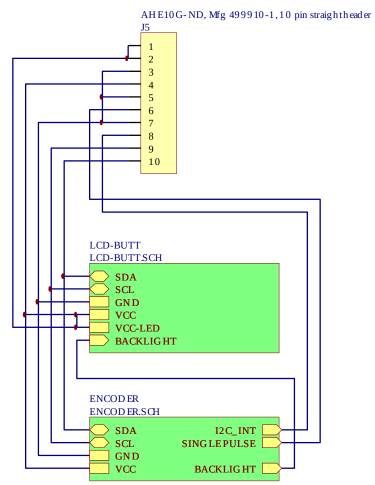
PCB 158K - LOW VOLTAGE DC POWER SUPPLY, 2/3



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

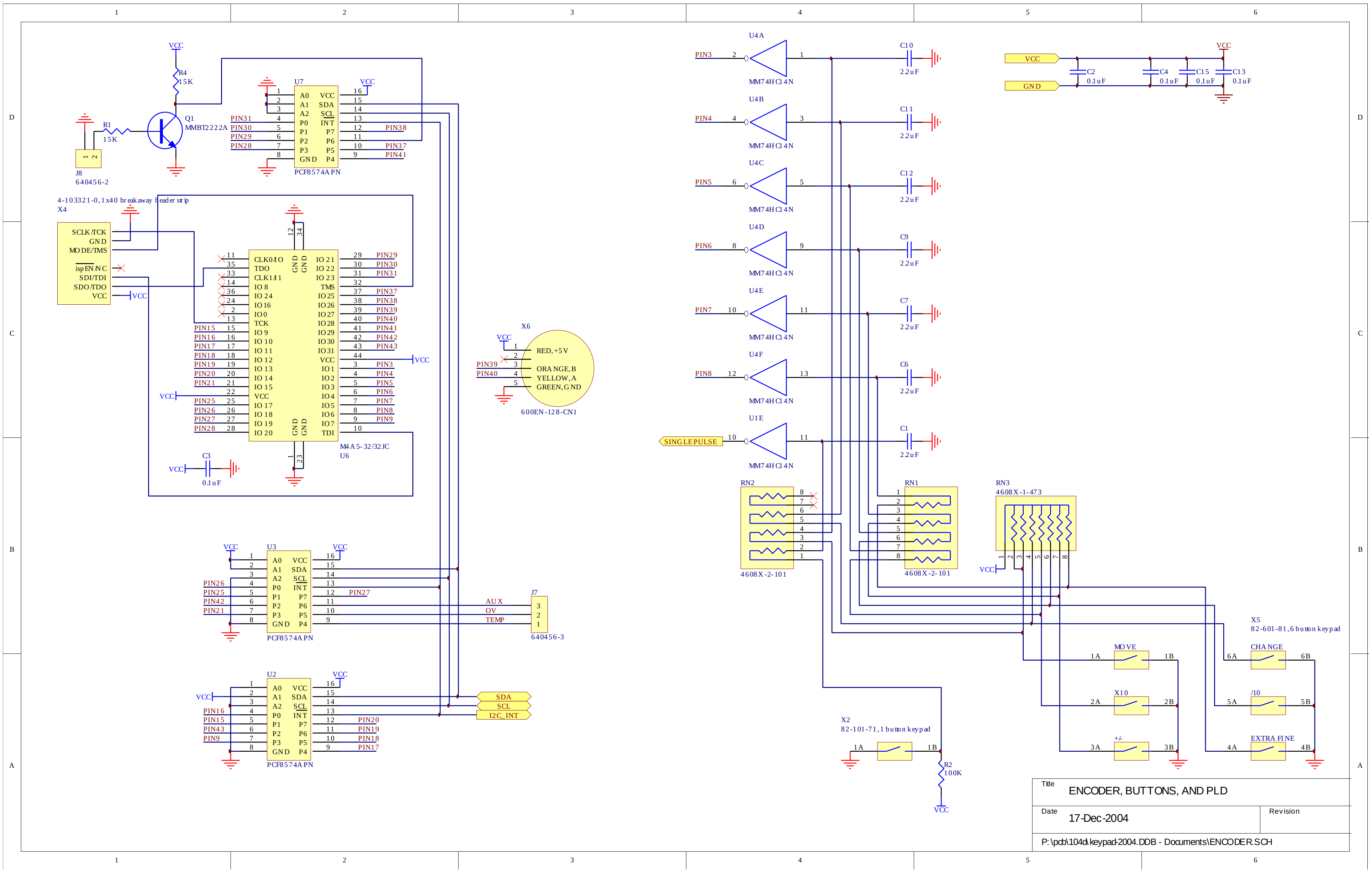


PCB 104D - KEYPAD / DISPLAY BOARD, 1/3



Title	PANEL TOP-LEVEL SCHEMATIC	
Date	17-Dec-2004	Revision
P:\pcb\104d\keypad-2004.DDB - Documents\Panelbrd.prj		

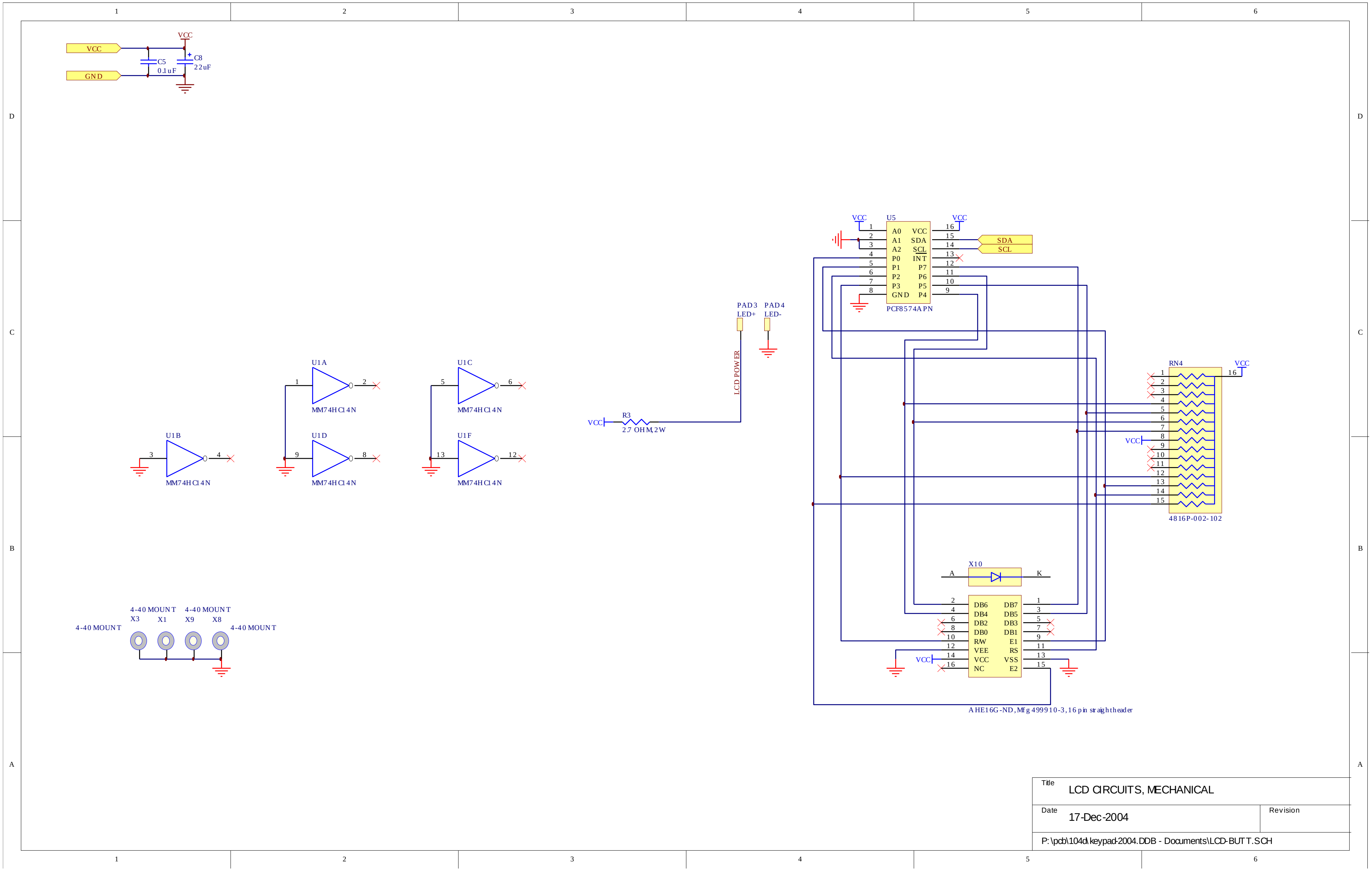
PCB 104D - KEYPAD / DISPLAY BOARD, 2/3



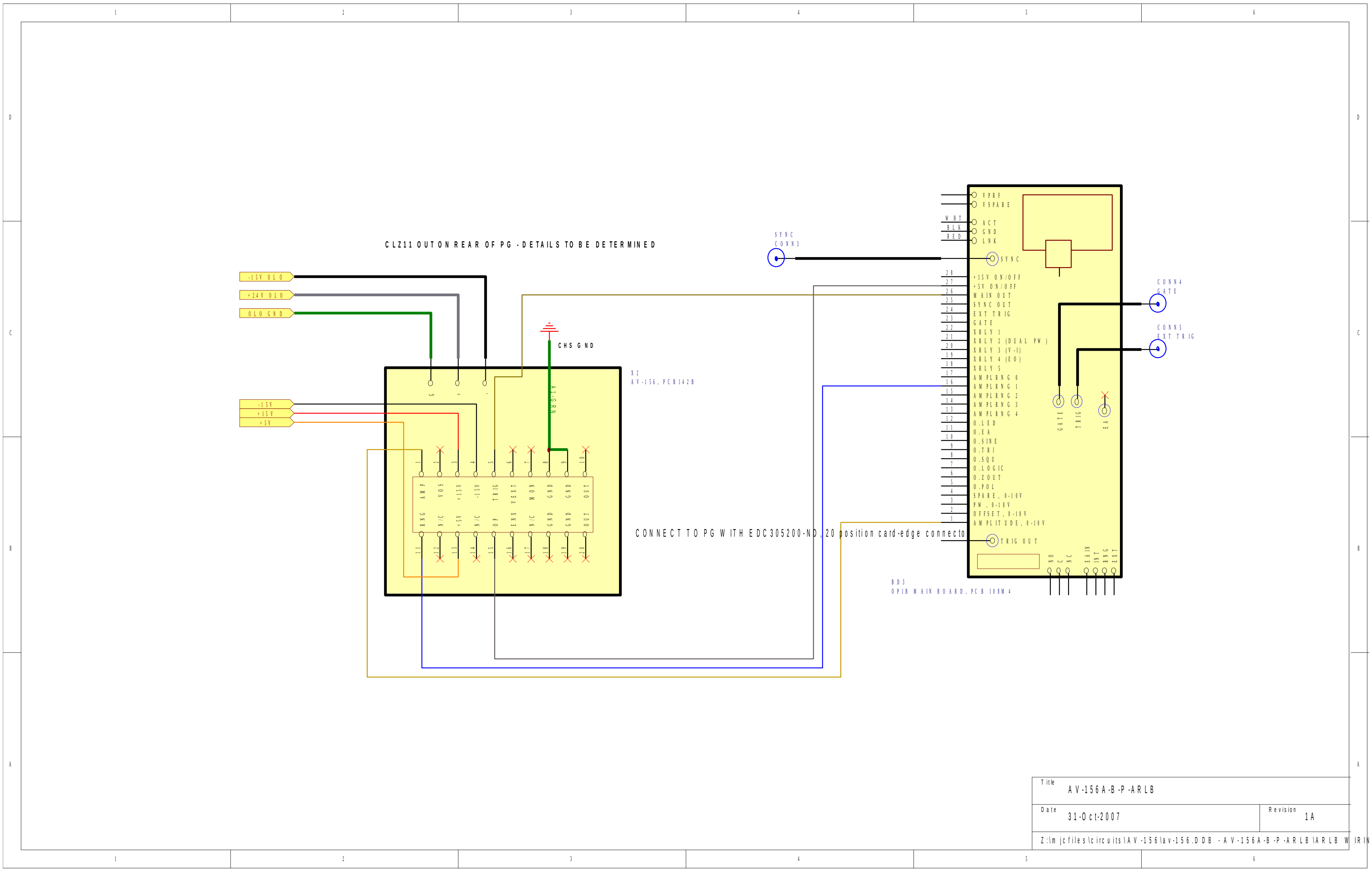
Title	ENCODER, BUTTONS, AND PLD
Date	17-Dec-2004
Revision	

P:\pcb\104d\keypad-2004.DDB - Documents\ENCODER.SCH

PCB 104D - KEYPAD / DISPLAY BOARD, 3/3



MAIN WIRING


CLZ11 OUT ON REAR OF PG - DETAILS TO BE DETERMINED
-15V OLO
+24V OLO
OLO GND
-15V
+15V
+5V
CHS GND
A1-GRN
G
+
-
X2
AV-156, PCB142B
AMP
VOS
+15V
-15V
TRIG
VEXT
MON
GND
GND
OUT
RNG
N/C
+5V
N/C
OP
ENX
N/C
GND
GND
OUT
CONNECT TO PG WITH EDC305200-ND, 20 position card-edge connecto
SYNC
CONN3
VPRF
VSPARE
WHT
BLK
RED
ACT
GND
LNK
SYNC
+15V ON/OFF
+5V ON/OFF
MAIN OUT
SYNC OUT
EXT TRIG
GATE
XRLY 1
XRLY 2 (DUAL PW)
XRLY 3 (V-I)
XRLY 4 (EO)
XRLY 5
AMPLRNG 0
AMPLRNG 1
AMPLRNG 2
AMPLRNG 3
AMPLRNG 4
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
TRIG OUT
CONN4
GATE
CONN5
EXT TRIG
GATE
TRIG
EA
NO
C
NC
EAIN
INT
RNG
EXT
BD3
OP1B MAIN BOARD, PCB 108M4
Title
AV-156A-B-P-ARLB
Date
31-Oct-2007
Revision
1A
Z:\mjcfiles\circuits\AV-156\av-156.DDB - AV-156A-B-P-ARLB\ARLB WIRIN

PERFORMANCE CHECK SHEET