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SINCE 1975

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**INSTRUCTIONS**

**MODEL AV-1010-C**

**0 TO  $\pm 100$  VOLTS, 2 AMP,  
10 ns RISE & FALL TIME**

**LAB PULSE GENERATOR AND LASER DIODE DRIVER**

**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.

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## INTRODUCTION

The AV-1010-C is a high performance instrument capable generating amplitudes up to  $\pm 100$  V into  $50 \Omega$  at repetition rates up to 1 MHz. Pulse widths are variable up to 10 ms. Rise and fall times are fixed at less than 10 ns. The AV-1010-C provides single or double pulse output and can be triggered or gated by an external source. A front-panel pushbutton can also be used to trigger the instrument. The output pulse width can be set to follow an input trigger pulse width and the output amplitude can be controlled by an externally applied 0 to +10 Volts DC control voltage.

The output impedance depends on the amplitude range selected. For the  $\pm 100$ V ranges, the output impedance is approximately  $2\Omega$ . In the lower ranges ( $\pm 30$ V and below), the output impedance is  $50\Omega$ .

The MOSFET output stages will safely withstand any combination of front panel control settings, output open or short circuits, and high duty cycles. An internal power supply monitor removes the power to the output stage for five seconds if an average power overload exists. After that time, the unit operates normally for one second, and if the overload condition persists, the power is cut again. This cycle repeats until the overload is removed. With a  $50\Omega$  load the unit will withstand duty cycles as high as 10%. The output stage will source up to 2.5 Amps (and will automatically shut down if the load current exceeds 2.5 Amps).

Application notes describing the use of the AV-1010 and AV-1011 families of pulse generators are available on the Avtech web site, <http://www.avtechpulse.com>. In particular, application notes describing techniques for driving laser diodes, and for using pulse transformers to boost the output current, are presented.

## SPECIFICATIONS

Model:	AV-1010-C
Output amplitude into 50Ω:	Range 1: 0.3 to 1 V Range 2: 0.3 to 3 V Range 3: 0.3 to 10 V Range 4: 0.3 to 30 V Range 5: 0.3 to 100 V (10 turn fine control)
Output polarity:	+ or -, switch-selectable
Rise time, fall time:	≤ 10 ns
Pulse width:	50 ns to 10 ms (6 position switch & fine control)
Pulse repetition rate:	10 Hz to 1 MHz (5 position switch & fine control)
Maximum duty cycle:	50 Ω load, maximum amplitude: 10 % 10 kΩ load, maximum amplitude: 80 %
Output impedance:	50 Ω in 1, 5, 10 & 30 V ranges 2 Ω in the 100 V range
Pulse aberrations:	≤ ± 5 % of amplitude
Jitter:	Pulse width: ≤ .1%, typically < .01% Delay/Advance: ≤ .1%, + 0.5 ns Period: ≤ .1%, + 0.5 ns
Delayed/advanced range:	100 ns to 10 ms, relative to SYNC OUT
Sync output:	+3 Volts, 50 ns ( $R_L > 1 \text{ k}\Omega$ )
Gated operation:	Triggers when the gate input is open circuited (or $V_{APPLIED} \geq +2 \text{ V}$ )
External trigger:	Mode A: TTL (0 - 5V), > 50 ns width Mode B: TTL (0 - 5V), $PW_{IN} = PW_{OUT}$ Includes single-pulse pushbutton
Minimum propagation delay, external trigger modes:	Advance: 200 ns Delay: 300 ns Double pulse: 200 ns $PW_{IN} = PW_{OUT}$ : 100 ns
Protected against:	open and short circuits, high duty cycle
Connectors:	BNC female
Power source:	120/240 Volts, ± 10 % (switchable) 48 Hz to 66 Hz, 100 VA maximum
Dimensions (H x W x D):	100 mm x 430 mm x 375 mm (3.9" x 17" x 14.8")
Weight:	≤ 10 kg (22 lbs)
Chassis material:	Aluminum. Anodized aluminum front panel with cast aluminum side panels (with blue-gray plastic trim) and aluminum top and bottom panels with blue-gray plastic trim.
Operating temperature:	+ 10° C to + 50° C
Accessories furnished:	one detachable 6' power cord, one operation-maintenance manual
Option available:	19" rack mount kit (-R5)

## INSTALLATION

### VISUAL CHECK

After unpacking the instrument, examine to ensure that it has 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.

### PLUGGING IN THE INSTRUMENT

Examine the rear of the instrument. There will be a male power receptacle, a fuse holder and the edge of the power selector card visible. Confirm that the power selector card is in the correct orientation.

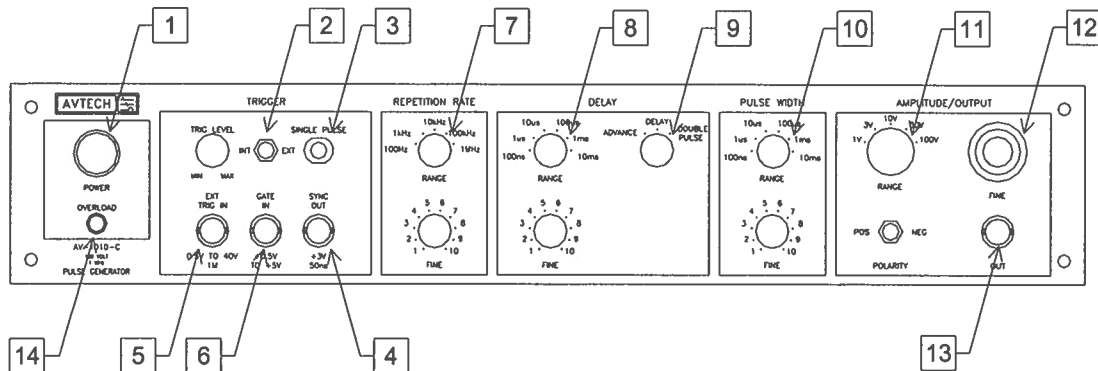
For AC line voltages of 110-120V, the power selector card should be installed so that the "120" marking is visible from the rear of the instrument.

For AC line voltages of 220-240V, the power selector card should be installed so that the "240" marking is visible from the rear of the instrument.

If it is not set for the proper voltage, remove the fuse and then grasp the card with a pair of pliers and remove it. Rotate horizontally through 180 degrees. Reinstall the card and the correct fuse.

In the 120V setting, a 1.0A slow blow fuse is required. In the 240V setting, a 0.5A slow blow fuse is required.

## FRONT PANEL CONTROLS



1. **POWER Switch.** The POWER push button switch applies AC prime power to the primaries of the transformer, turning the instrument on. The push button lamp (#382 type) is connected to the internal +15V DC supply.
2. **INT/EXT Switch.** In the "INT" position the instrument is internally triggered and the "SYNC OUT" connector provides a SYNC output for triggering other instruments, such as oscilloscopes. In the "EXT" position the instrument is triggered by a  $\pm 0.5V$  to  $\pm 40V$ , 50 ns (or wider) input pulse on the "EXT TRIG IN" connector, or by pressing the "SINGLE PULSE" push button.
3. **SINGLE PULSE Push Button.** The "SINGLE PULSE" push button will trigger the instrument manually for one cycle of output, when the "INT/EXT" switch is in the "EXT" position. Otherwise, the push button has no effect.
4. **SYNC OUT.** When the "INT/EXT" switch is in the "INT" position, 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  $R_L > 1\text{ k}\Omega$  with a pulse width of about 50 ns.
5. **TRIG IN.** When the "INT/EXT" switch is in the "EXT" position, the external trigger ( $\pm 0.5$  Volts to  $\pm 40$  Volts, PW 50 ns) is applied to this connector. This input presents a high impedance ( $1\text{ M}\Omega$ ). The "TRIG LEVEL" dial controls the trigger level of the external input. The fully counter-clockwise position corresponds to -40V, and the fully clockwise position corresponds to +40V.
6. **GATE Input.** The GATE input will suppress the triggering of the instrument if taken to a TTL LOW level (i.e. 0 to 0.5V). If it is left open or taken to a TTL HIGH level (3V to 5V), normal triggering will occur ( $R_{IN} = 1\text{ k}\Omega$ ).

7. REPETITION RATE Controls. The rotary switch marked "RANGE" selects the pulse repetition rate for the internally triggered mode. The vernier (labelled "FINE") provides continuously variable control of each range. There are five ranges and the instrument is set to the rate indicated on the front panel when the vernier is in the clockwise position.

10 Hz - 100 Hz  
 100 Hz - 1 kHz  
 1 kHz - 10 kHz  
 10 kHz - 100 kHz  
 100 kHz - 1.0 MHz

8. DELAY Controls. The rotary switch selects one of six ranges and the vernier provides continuously variable control of each range. The instrument is set to the delay indicated on the front panel when the vernier is in the clockwise position.

minimum - 100 ns  
 100 ns - 1 us  
 1 us - 10 us  
 10 us - 100 us  
 100 us - 1 ms  
 1 ms - 10 ms

9. ADVANCE, DELAY, DOUBLE PULSE. With this three-position switch in the ADVANCE position, the leading edge of the output pulse precedes the leading edge of the SYNC output. When in the DELAY position, the leading edge of the SYNC output precedes the leading edge of the main output. When in the DOUBLE PULSE position, the main output provides two successive output pulses having a separation determined by the DELAY (8) controls.

10. PULSE WIDTH Controls. The rotary switch selects one of six ranges and the vernier provides continuously variable control of each range. The instrument is set to the pulse width indicated on the front panel when the vernier is in the clockwise position.

minimum - 100 ns  
 100 ns - 1 us  
 1 us - 10 us  
 10 us - 100 us  
 100 us - 1 ms  
 1 ms - 10 ms

Note: When switching to wider pulse width ranges at high output amplitudes, the output amplitude may drop as the duty cycle is suddenly increased. To return the amplitude to its proper value, reduce the duty cycle briefly (by rotating the pulse width vernier control counterclockwise, or reducing the repetition rate). The internal power supply will recover, and the controls can be returned to their original settings.



11. **AMPLITUDE RANGE Switch.** This five-position switch controls the amplitude full-scale range (and output impedance). The full-scale range may be set to 1V, 3V, 10V, 30V, or 100V. The two-position switch immediately below the amplitude range switch controls the output polarity (positive or negative)/

In the 100V range, the output impedance is  $2\Omega$ . In the other ranges, the output impedance ( $Z_{OUT}$ ) is  $50\Omega$ .

The full-scale range values assume that a  $50\Omega$  load is being used. If a high impedance load is used (i.e.  $R_L \gg 50\Omega$ ), then the actual full-scale range will be twice the indicated value in ranges with a  $Z_{OUT}$  of  $50\Omega$ .

The best waveform will be obtained if the lowest-possible range is used, and if a  $50\Omega$  load is used.

12. **AMPLITUDE FINE.** The ten-turn amplitude vernier provides continuously variable control of the peak amplitude of the main output from 0 to the full-scale range value, as set by the range switch.

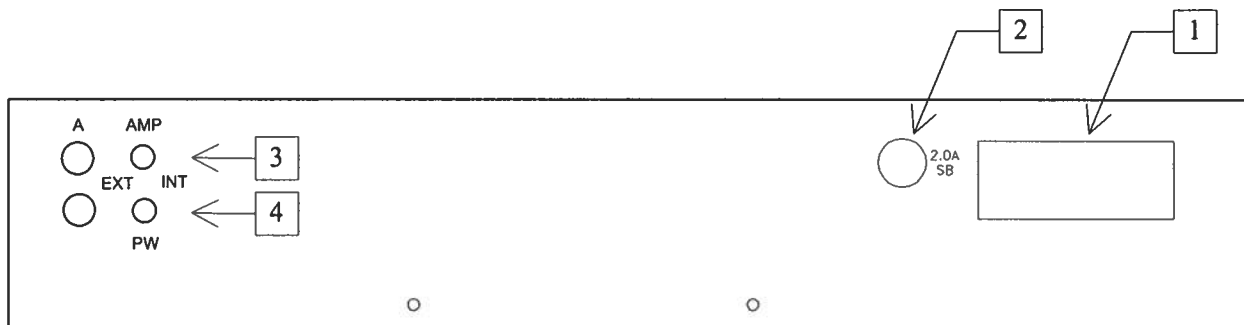
13. **OUT.** This BNC connector provides the main output signal, into load impedances of  $50\Omega$  or greater. (The best waveforms will be obtained for  $50\Omega$  loads, however.)

14. **OVERLOAD.** An automatic overload protective circuit controls the front panel overload light. 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 turn the output of the instrument OFF and turn the indicator light ON. The light will stay ON (i.e. output OFF) for about 5 seconds after which the instrument will attempt to turn ON (i.e. light OFF) for about 1 second. If the overload condition persists, the instrument will turn OFF again (i.e. light ON) for another 5 seconds. If the overload condition has been removed, the instrument will turn on and resume normal operation. Overload conditions may be removed by:

- Reducing PRF (i.e. switch to a lower range)
- Reducing pulse width (i.e. switch to a lower range)
- Removing output low load impedance (if any)
- Reducing the output amplitude (i.e. switch to a lower range)

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

## REAR PANEL CONTROLS



1. **AC POWER INPUT.** A three-pronged recessed male connector is provided on the back panel for AC power connection to the instrument. Also contained in this assembly is a slow blow fuse and a removable card that can be removed and repositioned to switch between 120V AC in and 240V AC in.

For AC line voltages of 110-120V, the power selector card should be installed so that the "120" marking is visible from the rear of the instrument.

For AC line voltages of 220-240V, the power selector card should be installed so that the "240" marking is visible from the rear of the instrument.

If it is not set for the proper voltage, remove the fuse and then grasp the card with a pair of pliers and remove it. Rotate horizontally through 180 degrees. Reinstall the card and the correct fuse.

In the 120V setting, a 1.0A slow blow fuse is required. In the 240V setting, a 0.5A slow blow fuse is required.

2. **2.0A SB.** This fuse protects the output stage if the output duty cycle rating is exceeded.
3. **AMP.** To voltage control the output amplitude, set the switch in the EXT position and apply 0 to +10 Volts to the "A" BNC connector ( $R_{IN} \geq 10 \text{ k}\Omega$ ).
4. **PW.** The pulse generator may be triggered externally in a  $PW_{OUT} = PW_{IN}$  mode by setting this switch in the EXT position and the front panel INT/EXT/MAN switch in the EXT position and applying a TTL level pulse of the desired pulse width to the A BNC connector.

## OPERATIONAL CHECK

This check is to confirm that the instrument is fully functional. Set the controls to the following values:

### FRONT PANEL

- INT/EXT Switch: INT position
- REPETITION RATE RANGE Switch: 10 kHz
- REPETITION RATE Vernier: Maximum (fully clockwise)
- DELAY RANGE Switch: 1 us
- DELAY Vernier: MID range
- ADVANCE, DELAY, DOUBLE PULSE: DELAY
- PULSE WIDTH RANGE Switch: 1 us
- PULSE WIDTH Vernier: Maximum (fully clockwise)
- AMPLITUDE RANGE Switch: 30V
- POLARITY Switch: +
- AMPLITUDE Vernier: 5.0 (half-maximum)

### REAR PANEL

- AMP: INT
- PW: INT

Connect a cable from the SYNC OUT connector to the TRIG input of an oscilloscope. Connect a 2W (or higher) 50 Ohm load to the OUT connector and place the scope probe across this load.

Set the oscilloscope to trigger externally with the vertical setting at 5 Volts/div and the horizontal setting at 1 us/div. Then follow the instructions below and compare what is seen on the oscilloscope to what is described. Only approximate values are needed to confirm operation.

STEP	CONTROL	OPERATION	RESULTS
1	Power	Push in (ON)	+15V pulses at the main output, with period 100 us, pulse width 1.0 us, <10ns rise & fall times.
2	Repetition Rate Vernier	Rotate to Minimum (fully counter-clockwise), then to Maximum (fully clockwise)	Period rises to about 1 ms then falls to about 100 us.
3	Delay Vernier	Rotate to Maximum (fully clockwise), then to Minimum (fully counter-clockwise)	Pulses shift to the right on the oscilloscope by 1 us, then back.
4	Pulse Width Vernier	Rotate to Minimum (fully counter-clockwise), then to Maximum (fully clockwise)	Pulse width varies from 100 ns to 1.0 us.
5	Polarity Switch	Switch to -, then to +	Pulse polarity becomes negative & then positive.
6	Amplitude Range Switch	Switch to 100V	The output pulse amplitude will jump to +50V.

## OTHER INFORMATION

### TOP COVER REMOVAL

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).

### ELECTROMAGNETIC INTERFERENCE

To prevent electromagnetic interference with other equipment, all used outputs should be connected to shielded 50 $\Omega$  loads using shielded 50 $\Omega$  coaxial cables. Unused outputs should be terminated with shielded 50 $\Omega$  BNC terminators or with shielded BNC dust caps, to prevent unintentional electromagnetic radiation. All cords and cables should be less than 3m in length.

### 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.

### REGULAR MAINTENANCE

The fan grille, located on the bottom of the instrument, should be cleaned once a year so that it does not become blocked. To clean the grille, use a high-power vacuum cleaner.

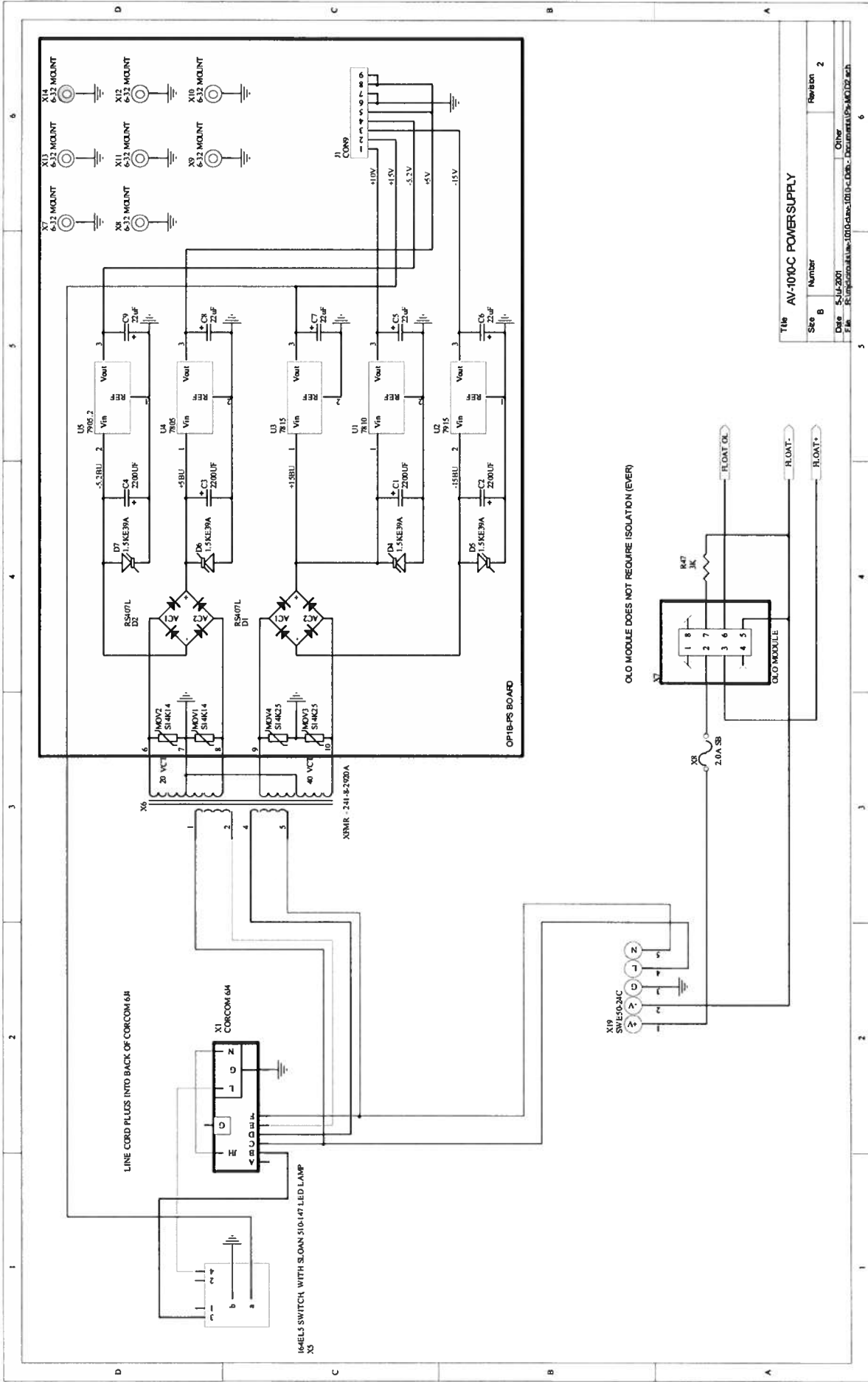
### APPLICATION NOTES

Application notes are available on the Avtech web site, at <http://www.avtechpulse.com/appnote>.

### MANUAL FEEDBACK

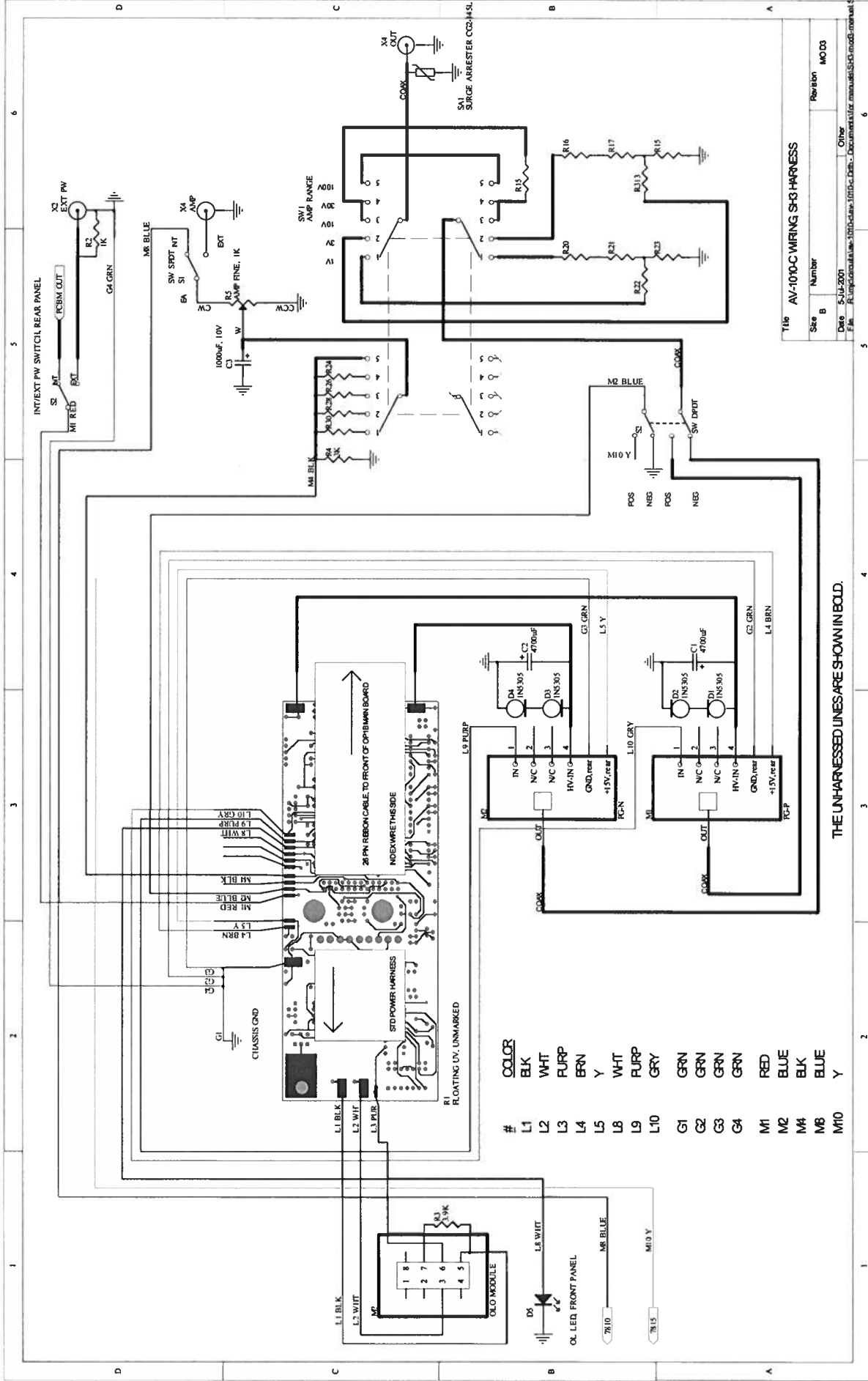
Please report any errors or omissions in this manual, or suggestions for improvement, to [info@avtechpulse.com](mailto:info@avtechpulse.com). Thanks!

WIRING DIAGRAM - POWER SUPPLY



Title		AV-100C POWER SUPPLY
Size	Number	Revision 2
Date	5-Jul-2001	
File	P:\Component\Av-100\Draw\010-C-001-01.dwg - Decimals=15; Mils=100	

WIRING DIAGRAM - MAIN CIRCUITS



PERFORMANCE CHECK SHEET



July 25, 2001