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NANOSECOND WAVEFORM ELECTRONICS
SINCE 1975

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INSTRUCTIONS

MODEL AV-1022-C

0 TO ± 5 VOLTS, 10 MHz

GENERAL PURPOSE PULSE GENERATOR

SERIAL NUMBER: _____

WARRANTY

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

TECHNICAL SUPPORT

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INTRODUCTION

The Avtech AV-1022-C is a versatile, general-purpose, low-cost, 10 MHz laboratory pulse generator, useful everywhere from undergraduate university classrooms to the most advanced research and development laboratories. This pulse generator features variable pulse repetition frequency (PRF), delay, pulse width, amplitude, and baseline.

The generator can be triggered internally or externally. The internal trigger is continuously variable from 1 Hz to 10 MHz. The delay and pulse width are variable up to 500 ms. The amplitude is variable from 0 to $\pm 5V$. Rise and fall times less than 10 ns (20%-80%).

The main output has all of its characteristics variable, and is designed to drive 50Ω loads. A synchronizing trigger output is also supplied, for triggering oscilloscopes and other test equipment (50 ns wide, +2V into 50Ω).

This instrument is intended for use in research and development laboratories.

SPECIFICATIONS

| | |
|-----------------------------------|---|
| Model: | AV-1022-C |
| No. of channels out: | One |
| PRF: | 1 Hz to 10 MHz |
| Amplitude (to 50 Ohms): | 0 to ± 5 Volts |
| Pulse width: | 50 ns to 0.5 sec, or DC |
| Rise & fall times (20%-80%): | Main: ≤ 10 ns |
| Source impedance: | 50 Ohms |
| Polarity (main output): | Positive or negative (two-position selector switch) |
| Duty cycle (max): | 80% (100% in PW DC mode) |
| Waveform aberrations: | Overshoot, undershoot, ringing and slope aberration are less than $\pm 3\%$ at amplitudes of 300 mV and higher with outputs terminating in 50 Ohms. |
| Propagation delay: | 130 ns to 0.5 sec (Ext trig in to pulse out) |
| Trigger required (Ext trig mode): | + 5 Volts, ≥ 25 ns (TTL). Trig input impedance: 50 Ohms |
| Sync delay, jitter: | 35 ns to 0.5 sec, $\leq \pm 50$ ps or $\pm 0.05\%$ (sync out to pulse out) |
| Sync output: | +2 Volts, 50 ns, will drive 50 Ohm loads |
| Signal connectors: | BNC |
| Power requirement: | 120/240 Volts (switchable) 50 - 60 Hz (30 Watts) |
| Dimensions (H x W x D): | 100 mm x 215 mm x 375 mm (3.9" x 8.5" x 14.8") |
| Weight & chassis material: | 4.5 kg (10 lbs), anodized aluminum, with blue-grey plastic trim |
| Mounting & Temperature range: | Any, $+10^{\circ}\text{C}$ to $+40^{\circ}\text{C}$ |

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 is 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, as shown below:



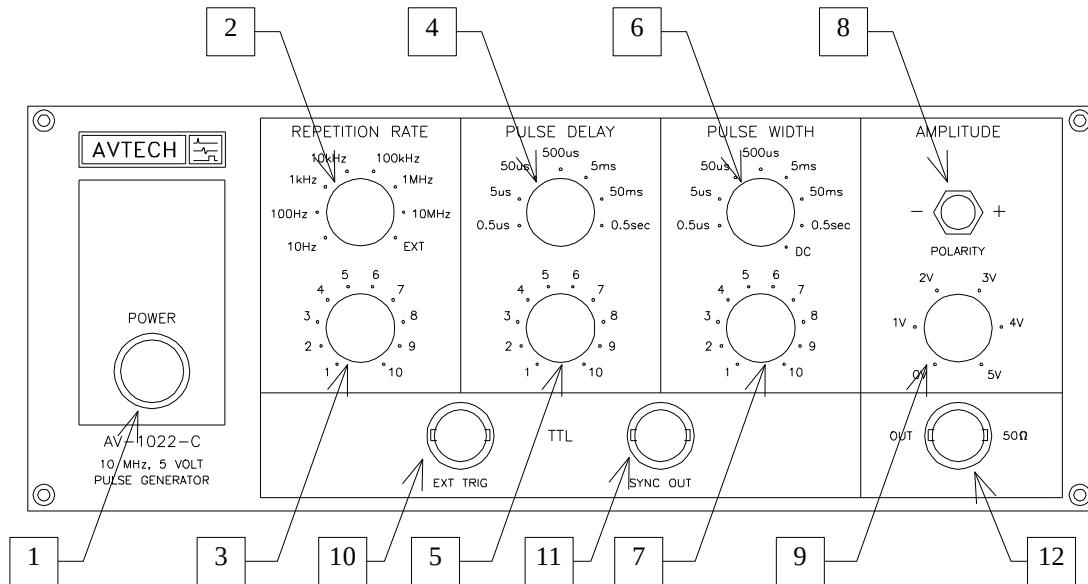
For AC line voltages of 220-240V, the power selector card should be installed so that the “240” marking is visible from the rear of the instrument, as shown below:



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 0.5A slow blow fuse is required. In the 240V setting, a 0.25A slow blow fuse is required.

FRONT PANEL CONTROLS



1. POWER switch. The POWER pushbutton switch applies AC prime power to the primaries of the transformer, turning the instrument on.
2. REPETITION RATE range switch. This selects one of the seven internal clock pulse repetition rate ranges, or the external triggering mode:

1 Hz - 10 Hz
 10 Hz - 100 Hz
 100 Hz - 1 kHz
 1 kHz - 10 kHz
 10 kHz - 100 kHz
 100 kHz - 1 MHz
 1 MHz - 10 MHz
 EXT

In the "EXT" position the instrument is triggered by a TTL pulse (0 to +5V) on the "EXT TRIG" connector.

3. REPETITION RATE fine control. This varies the pulse repetition rate within the selected range.
4. PULSE DELAY range switch. This controls the delay between the SYNC OUT output (see item 11) and the main OUT output (item 12). This switch selects one of the seven delay ranges.

50 ns - 0.5 us

0.5 us - 5 us
 5 us - 50 us
 50 us - 500 us
 500 us - 5 ms
 5 ms - 50 ms
 50 ms - 0.5 s

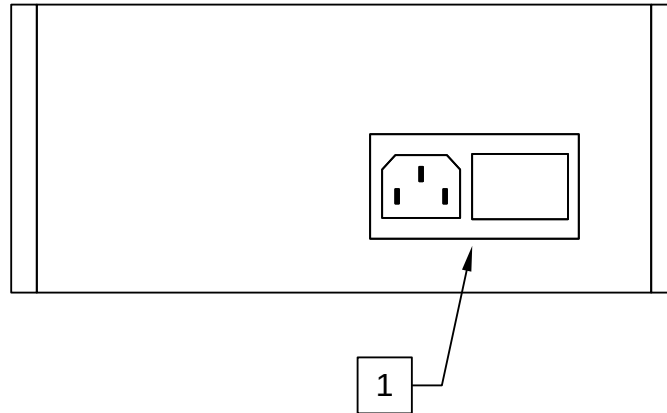
5. PULSE DELAY fine control. This varies the delay within the selected range.
6. PULSE WIDTH range switch. This selects one of eight pulse width ranges:

50 ns - 0.5 us
 0.5 us - 5 us
 5 us - 50 us
 50 us - 500 us
 500 us - 5 ms
 5 ms - 50 ms
 50 ms - 0.5 s
 DC

When set to the "DC" position, the output waveform is a constant DC voltage (i.e. there is no pulsing).

7. PULSE WIDTH fine control. This varies the pulse width within the selected range. This control has no effect in the DC mode.
8. POLARITY switch. This controls the polarity (+ or -) of the output waveform.
9. AMPLITUDE fine control. This varies the magnitude of the output amplitude between 0 and 5 Volts.
10. EXT TRIG connector. If the REPETITION RATE range switch (item 2) is in the "EXT" position, the instrument will be triggered by an external TTL-level trigger applied to this connector. Note that this input is terminated in 50Ω. If the REPETITION RATE range switch is not in the "EXT" position, this input has no effect. However, it should be left unconnected to avoid electromagnetic interference with the internal clock.
11. SYNC OUT connector. This output supplies a TTL-level pulse (nominally) to trigger oscilloscopes or other measurement equipment. The output pulse width is nominally fixed at 50ns.
12. OUT connector. This connector provides the main output. It will supply up to +5V into 50Ω. The output impedance is 50Ω.

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.

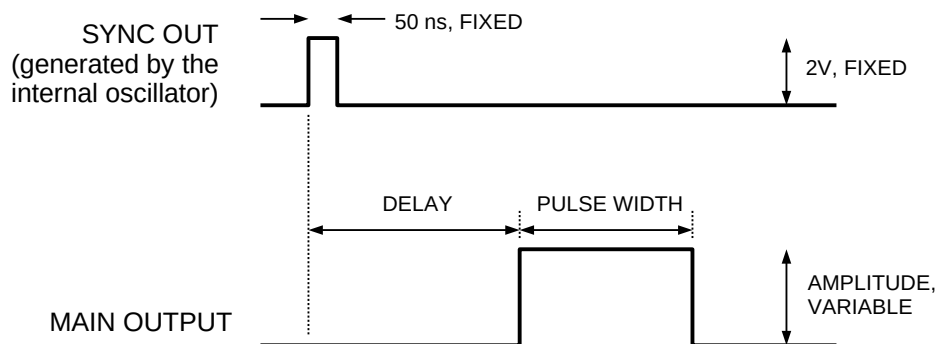
If it is not set for the proper voltage, remove the fuse and then grasp the card with a pair of pliers and remove it. Rotate horizontally through 180 degrees. Reinstall the card and the correct fuse.

In the 120V setting, a 0.5A slow blow fuse is required. In the 240V setting, a 0.25A slow blow fuse is required. See the “Installation” section for more details.

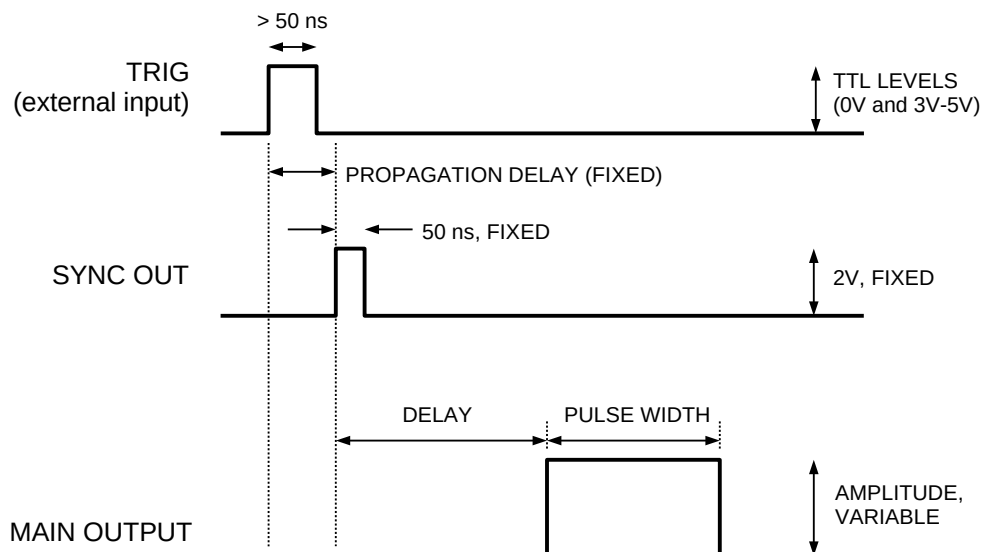
GENERAL INFORMATION

BASIC PULSE CONTROL

This instrument generated 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: SYNC OUT and OUT. The SYNC OUT pulse is a fixed-width pulse that is generated immediately after triggering. This pulse can be used to trigger oscilloscopes or other measurement systems. The main output channel is referenced to the SYNC OUT pulse. This relationship is illustrated below:



The next figure illustrates the relationship between the signals when an external TTL-level trigger is used (i.e., the REPETITION RATE switch is set to "EXT"):



MINIMIZING WAVEFORM DISTORTIONS

USE 50Ω TRANSMISSION LINES

Connect the load to the pulse generator with 50Ω transmission lines (e.g. RG-58 or RG-174 cable). If possible, use a 50Ω load. If the actual device under test has a high impedance, consider adding a 50Ω termination in parallel with the load to properly terminate the transmission line.


USE LOW-INDUCTANCE LOADS

Lenz's Law predicts that for an inductive voltage spike will be generated when the current through an inductance changes. Specifically, $V_{\text{SPIKE}} = L \times di_{\text{LOAD}}/dt$, where L is the inductance, i_{LOAD} is the load current change, and t is time. For this reason, it is important to keep any parasitic in the load low. This means keeping wiring short, and using low inductance components. In particular, wire-wound resistors should be avoided.


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.

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.

OPERATIONAL CHECK

This check is to confirm that the instrument is fully functional. In all tests, use 50 Ω cable with female BNC connectors on each end. Set the controls to the following values:

- REPETITION RATE range switch: 100 kHz position
- REPETITION RATE fine control: fully counter-clockwise (minimum frequency)

- PULSE DELAY range switch: 50us position
- PULSE DELAY fine control: fully counter-clockwise (minimum delay)

- PULSE WIDTH range switch: 5us position
- PULSE WIDTH fine control: fully clockwise (maximum pulse width)

- AMPLITUDE control: fully clockwise (maximum amplitude)

- POLARITY switch: +

Connect a 50 Ω coaxial cable from the SYNC OUT connector to the TRIG input of an oscilloscope. Connect 50 Ω , 2 Watt load between the OUT connector signal line and ground. Connect an oscilloscope probe to the main output.

Set the oscilloscope to trigger externally with the vertical setting at 2 Volts/div and the horizontal setting at 20 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). | +5V pulses with period > 100 us, pulse width 5 us, and rise & fall times of 10 ns. |
| 2 | PULSE DELAY fine control | Rotate fully clockwise, then fully counter-clockwise | The pulses shift to the right on the oscilloscope by 50 us, then back |
| 3 | PULSE WIDTH fine control | Rotate fully counter-clockwise, then fully clockwise | The pulses narrow to <0.5 us, then widen back to 5 us. |
| 4 | REPETITION RATE fine control | Rotate fully clockwise, then fully counter-clockwise | The frequency rises to > 100 kHz, then falls back to < 10 kHz. |
| 5 | AMPLITUDE fine | Rotate fully counter- | The pulse amplitude falls to 0 |

| | | | |
|---|--------------------------|---------------------------------|---|
| | control | clockwise, then fully clockwise | V, then rises back to +5 V. |
| 6 | POLARITY switch | Switch to "-" | Pulse amplitude switches from +5V to -5V. |
| 7 | PULSE WIDTH range switch | Set to "DC" | Constant -5V DC output. (No pulsing). |

Steps 1 to 7 confirm that the pulse delay, pulse width, and amplitude controls are functioning properly.

Step 8 is optional, and is to confirm that the instrument can be triggered externally. First connect a pulse generator or other signal source with a 10 kHz frequency, a pulse with of at least 40ns, and TTL logic levels (0 and 5V) to the EXT TRIG input connector. (The voltage applied to this input must not go below zero volts, or exceed +5V.) Then proceed with step 8:

| | | | |
|---|------------------------------|--------------|--|
| 8 | REPETITION RATE range switch | Set at "EXT" | +5V pulses with period > 100 us, pulse width 5 us, and rise & fall times of 10 ns. |
|---|------------------------------|--------------|--|

This completes the operational check.

PERFORMANCE CHECK SHEET