INSTRUCTIONS

MODEL AV-1002-C-TRF PULSE GENERATOR

S.N.:

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 is either expressed or implied.

INTRODUCTION

The Avtech AV-1002-C-TRF 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, rise and fall times, amplitude, and baseline. Additionally, the generator can be triggered either internally or externally, as well as by the manual "Single Pulse" pushbutton. All trigger sources can be gated by a TTL-type pulse. PRF is continuously variable from 1Hz to 10MHz, delay to 1 second, pulse width to 500 ms, and amplitude and baseline offset to ±10V. Rise and fall times are independently variable (within a given range) from less than 5ns to 1ms. Three outputs are supplied, the first being the Main output, which has all of its characteristics variable, and is designed to drive 50Ω loads. The other two outputs are "logic" outputs, which can provide either TTL or ECL-type pulses and their complements into 50Ω. A synchronizing trigger output is supplied when operating off of the internal trigger (+2V into 50Ω, +4V into 1MΩ.)

SPECIFICATIONS

PULSE REPETITION FREQUENCY

The PRF is continuously variable from 1 Hz to 10 MHz in 7 ranges, each range providing a ratio of approximately 10 between its highest and lowest frequency.

DELAY

The delay between the SYNC output or the external trigger is variable up to 1000 ms in eight ranges. Delay is variable over 75% of the pulse period up to 1MHz, decreasing to 50% at 10MHz.

PULSE WIDTH (AND DUTY CYCLE)

Pulse width is measured at the 50% amplitude point, and is continuously variable from 50ns to 500ms. Duty cycle may range up to 80%. Higher duty cycles may often be obtained by reversing the Polarity switch, and adjusting the baseline to obtain an inverted pulse.

RISE/FALL TIMES

The rise and fall times are measured from the 10% to 90% amplitude levels with the output terminated into 50Ω. Each is independently variable within the same range (i.e. the maximum ratio between them is just over 10:1). The rise and fall times are continuously variable between 5ns and 1ms, in 5 ranges.

BASELINE

The baseline, or offset, of the main output pulse is determined by a one-turn control. When the amplitude is set on the 10V range, the baseline is continuously variable between +10V and -10V. When in the 5V and 1V ranges, the baseline is continuously variable between +5V and -5V. (This is because in the 5V and 1V ranges, a 50Ω resistor is placed in series with the output and the load. This reduces the maximum output level, but provides backmatching which tends to reduce reflections and other waveform distortions.) Note that the sum of the baseline offset and the pulse amplitude can not exceed ±10V, and that all of these values are valid only for a 50Ω load.

AMPLITUDE

The amplitude of the main output is continuously variable between zero and ten volts, with the polarity controlled by the polarity switch. The amplitude can be varied in three ranges, from 0 to 1V, 0 to 5V, and 0 to 10V.

The lower two ranges switch in a 50Ω backmatching resistor onto the output, for improved waveform quality. The 10V range does not have any backmatching. Note that

the sum of the pulse amplitude and the baseline offset can not exceed ±10V, and that all of these values are valid only for a 50Ω load.

LOGIC OUTPUTS

The logic outputs provide either a TTL-type signal and its logic complement, or an ECL-type pulse and its logic complement, depending on the setting of the "TTL/ECL" switch. The outputs have the same PRF, delay, and pulse width as the main output, but do not have variable rise/fall times, or any amplitude control. They are designed to drive 50Ω loads, but will drive any load greater than 50Ω with the penalty of increased waveform distortion.

SYNC OUT

When triggering off of the internal clock, the SYNC OUT/TRIG IN connector is used as a SYNC output, allowing the user to synchronize other equipment to the instrument (e.g. oscilloscopes). This output provides approximately +2V into a 50Ω load, or +4V into a 1MΩ load. This pulse leads the other outputs by a duration set by the "DELAY" controls, and has a pulse width of approximately 10ns. A sync signal is not provided in the external mode.

EXTERNAL TRIGGER

When the "INT/EXT" switch is in the EXT position, the instrument triggers off of an external signal, which must be supplied by either a TTL type signal (i.e. 0 to +5V) on the "SYNC OUT/TRIG IN" connector or by pressing the "SINGLE PULSE" pushbutton. The external trigger must be at least 4ns wide. This input has a high input impedance (greater than 1kΩ).

SINGLE PULSE

Pressing the "SINGLE PULSE" pushbutton with the "INT/EXT" switch in the "EXT" position will generate a single output pulse on the Main and Logic outputs. Pressing the "SINGLE PULSE" pushbutton with the switch in the "INT" position has no effect.

GATE IN

The "GATE IN" input is a high impedance input that can be used to suppress the triggering of the instrument. Leaving this input unconnected, or applying a TTL high level (e.g. +2.8V to 5V) will permit normal triggering. Taking the input low (to ground, or less than +0.8V) will inhibit any sort of triggering.

JITTER

Repetition rate, delay, and pulse width jitter are less than ±50ps or ±0.05%, whichever is greater.

WAVEFORM ABERRATIONS

Overshoot, undershoot, ringing, and top slope aberration are less than ±3% at amplitudes of 300mV and higher with outputs terminated in 50Ω.

OUTPUT PROTECTION

The instrument will not be damaged by any combination of front panel setting, or open or short circuits.

OPERATING TEMPERATURE

The instrument is rated for operation in ambient temperatures of +15˚C to +40˚C.

POWER REQUIRED

A maximum of 30W is required. The instrument can operate on 120V AC or 240V AC, selectable on the back panel, at 50 to 60 Hz.

PHYSICAL CHARACTERISTICS

The instrument is contained in a 4" x 16" x 12" anodized aluminum chassis with handles, with a mass of 10kg. Signal connectors are all BNC type.

ACCESSORIES

One instruction manual and one power cord are supplied with the instrument. An optional 19" rack mounting kit is available (Avtech Part No. -R4)

INSTALLATION

VISUAL CHECK

After unpacking the instrument, examine to ensure that it has not been damaged in shipment. Visually inspect all connectors, knobs, and the handles. Confirm that a power cord and instruction manual are with the instrument. (If the instrument has been damaged in shipment, 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 will be visible. Confirm that the power selector is in the correct orientation - it should be marked either 120 or 240, indicating whether it expects 120V AC or 240V AC. If it is not set for the proper voltage, remove the fuse, 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 1/2A slow blow fuse is required. In the 240V setting, a 1/4A slow blow fuse is required.

OPERATIONAL CHECK

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

INT/EXT Switch: INT position

REPETITION RATE RANGE Switch: 1 MHz

REPETITION RATE Vernier: MAX

DELAY RANGE Switch: 100ns

DELAY Vernier: MIN

PULSE WIDTH RANGE Switch: 500ns

PULSE WIDTH Vernier: MAX

RISE/FALL RANGE Switch: 100ns

RISE Vernier: MIN

FALL Vernier: MIN

GND/VAR Switch: GND

POLARITY Switch: +

AMPLITUDE RANGE Switch: 10V

AMPLITUDE Vernier: MAX

LOGIC Switch: TTL

Connect a cable from the SYNC OUT/TRIG IN connector to the TRIG input of an oscilloscope (preferably one rated for at least 20MHz.) A second cable from the main output should be connected to a male arm of a BNC T-connector. On a second arm of the T-connector, a 2W 50Ω termination should be installed. The third arm is then connected to the oscilloscope input. Alternatively, a BNC 50Ω feedthru adapter may be placed between the output cable and the oscilloscope input. Or, a 50Ω resistor may be placed across a BNC-banana plug adapter at the output, and a scope probe can then be clipped onto the resistor. Any of the three methods for terminating the output in 50Ω can be used.

Set the oscilloscope to trigger externally. Then follow the instructions on the next page, 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)	+10V pulses at the main output, with period 1μs, pulse width 500ns, <10ns rise and fall times.
2	REPETITION RATE VERNIER	Rotate to MIN, then to MAX	Period rises to about 10μs, then falls to about 1μs.
3	DELAY VERNIER	Rotate to MAX, then to MIN	Pulses shift to the right on the oscilloscope by 100ns, then back.
4	PULSE WIDTH VERNIER	Rotate to MIN, then to MAX	Pulses become very narrow (about 50ns wide), then return to 500ns pulse width.
5	RISE VERNIER	Rotate to MAX, then to MIN	Rise time increases to 100ns, then decreases.
6	FALL VERNIER	Rotate to MAX, then to MIN	Fall time increases to 100ns, then decreases.
7	POLARITY SWITCH	Switch to -, then to +	Pulses swing between 0 and -10V, then swing between 0 and +10V.
8	BASELINE SWITCH	Switch to VAR	Pulses may shift up or down.
9	BASELINE VERNIER	Rotate to -10V	Pulses swing between -10V and 0V.
10	BASELINE SWITCH	Switch to GND	Pulses swing between 0 and +10V.
11	AMPLITUDE RANGE	Switch to 5V, then 1V, then back to 10V	Amplitude falls to +5V, then +1V, then rises back up to +10V.
12	OUT	Remove cable, place on LOGIC connector	Oscilloscope shows pulses swinging between 0V and +3V, with period 1μs, and pulse width 500ns.
13	TTL/ECL SWITCH	Switch to ECL	Oscilloscope shows pulses swinging between -0.8V and -1.6V, with period 1μs, and pulse width 500ns.
14	TTL/ECL SWITCH	Switch to TTL	Oscilloscope trace is the same as in step 11.
15	LOGIC	Remove cable, place on LOGIC connector	Oscilloscope shows inverted pulses swinging between 3V and 0V, with period 1μs, and low time 500ns.

OPERATING INSTRUCTIONS

POWER Switch

The POWER pushbutton switch applies AC prime power the primaries of the transformer, turning the instrument on. The pushbutton lamp (#382 type) is connected to the +15V DC supply.

INT/EXT Switch

In the "INT" position the instrument is internally triggered and the "SYNC OUT/TRIG IN" connector provides a SYNC output, which allows one to trigger other instruments, such as oscilloscopes. In the "EXT" position the instrument is triggered by a TTL level input pulse on the "SYNC OUT/TRIG IN" connector, or by pressing the "SINGLE PULSE" pushbutton.

SINGLE PULSE Pushbutton

The "SINGLE PULSE" pushbutton will trigger the instrument manually for one cycle of output, when the "INT/EXT" switch is in the "EXT" position. Otherwise, the pushbutton has no effect.

SYNC OUT/TRIG IN Connector

When in 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 the main output by a duration set by the "DELAY" controls, and has an approximate amplitude of +2V in 50Ω, or +4V into 1MΩ, with a pulse width of about 10ns. When the switch is in the "EXT" position, the external trigger is applied to this connector. This input presents a high impedance (greater than 1kΩ). Should an input impedance of 50Ω be required, it must be added manually at the input.

GATE Input

The GATE input will suppress the triggering of the instrument if grounded, or taken to a TTL LOW level (i.e. 0 to 0.8V). If it is left open, or taken to a TTL HIGH level (i.e. +2.4V to 5.0V), normal triggering will occur. This connector has a high input impedance (greater than 1kΩ.)

REPETITION RATE Controls

The rotary switch marked "RANGE" selects the pulse repetition rate for the internally triggered mode.
The vernier (labelled "MIN - MAX" provides continuously variable control of each range. There are seven ranges and the instrument is set to the rate indicated on the front panel when the vernier is in the "MAX" position.

DELAY Controls

The rotary switch selects one of several 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 "MAX" position.

PULSE WIDTH Controls

The rotary switch selects one of several 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 "MAX" position.

RISE/FALL RANGE Switch

The rotary switch selects one of five transition time ranges for both the rising and falling edge of the main output pulses.

RISE and FALL Controls

The RISE and FALL verniers provide continuously variable control of the rising and falling times for each range. The instrument is set to the transition time indicated by the RISE/FALL RANGE switch when its respective vernier is in the "MAX" position.

GND/VAR Baseline Switch

The GND/VAR switch allows the baseline offset of the main output pulse to be either fixed at ground potential (GND, zero Volts) or to be continuously variable between +10V and -10V (or +5V and -5V, depending on the amplitude range selected. See descriptions below.)

BASELINE Control

The BASELINE Control varies the baseline offset of the main output pulse when the GND/VAR switch is in the "VAR" position. If the amplitude range switch is in the 10V range, the baseline may be varied between +10V and -10V, into a 50Ω load. If the range switch is in the 5V or 1V ranges, the baseline may be varied between +5V and -5V. This is due to the fact that in the 1V and 5V ranges, the instrument switches in a 50Ω backmatching resistor in series with the output. This, is effect, forms a resistive divider, limiting the baseline to 5V, but the backmatching provides a more electrically ideal situation.

POLARITY Switch

If the polarity switch is in the "+" position, the main output pulse will pulse upwards (i.e. to a more positive level.) If it is in the "-" position, the output will pulse downwards, to a more negative level. This switch does not affect the BASELINE controls.

AMPLITUDE RANGE Switch

When in the 1V range, the main output is between variable in amplitude from 0 to ±1V, peak to peak. Similarly, in the 5V and 10V ranges, the amplitude is variable from 0 to ±5V and ±10V respectively. The 1V and 5V have 50Ω backmatching on the output, as mentioned in the baseline descriptions, while the 10V range does not.

AMPLITUDE Controls

The amplitude vernier provide continuously variable control of the peak to peak amplitude of the main output, from zero Volts to the maximum set by the range switch.

TTL/ECL Switch

The two logic outputs will provide a TTL pulse (approx. 0V to +3.5V) and its complement, or an ECL pulse (approx. -0.8V to -1.6V) and its complement, depending upon the position of the switch. These outputs will drive 50Ω loads.

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 1/2A slow-blow fuse, and a removable card, that can be removed and repositioned to switch between 120V AC in and 240V AC in.

TOP AND BOTTOM COVER REMOVAL

The interior of the instrument may be accessed by removing the four Phillips screws on the rear panel. With the four screws removed, the top cover may be slid back (and off). In addition, the bottom cover may also be slid back (and off).

ELECTROMAGNETIC INTERFERENCE

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