CANBERRA

Canberra 1400 Series of Modular Nuclear Instruments

Instruction Manual

STABILIZATION PULSER
MODEL 1501

CANBERRA INDUSTRIES 50 SILVER ST., MIDDLETOWN, CONNECTICUT 06457 • 203-347-6995

STABILIZATION PULSER

MODEL 1501

CANBERRA INDUSTRIES, INC.
50 Silver Street,
Middletown, Conn. 06457

Telephone: 203-347-6995

WARRANTY FOR CANBERRA NUCLEAR INSTRUMENTS

SHIPPING DAMAGE

Shipment should be carefully examined when received for evidence of damage caused by shipping. If damage is found, notify Canberra and the carrier making delivery immediately, as the carrier is normally responsible for damage caused in shipment. Carefully preserve all documentation to establish your claim. Canberra will provide all possible assistance in damage claims.

WARRANTY

This equipment is warranteed by Canberra to be free from defects in materials and workmanship for a period of twelve months from date of shipment, provided that the equipment has been used in a proper manner as detailed in this instruction manual. Repairs or replacement, at Canberra's option, will be made without charge at the Canberra plant during this warranty period. Except for the case of defects discovered upon initial operation, shipping expense to Canberra is to be paid by the customer; shipping expense to return the repaired equipment will be paid by Canberra.

Canberra reserves the right to modify its products without incurring the responsibility for modifying previously manufactured products.

Canberra does not assume any liability for the results of particular installations, as these circumstances are not in our control.

REPAIRS

Any Canberra instrument no longer in its warranty period may be returned, freight prepaid, to our factory for repair and realignment. All such work will be done at the least possible expense to the customer. All equipment thus repaired or realigned will pass through our normal preshipment checkout procedure and will meet or surpass its original specifications when returned. Return shipping expense will, in this case, also be charged to the customer.

TABLE OF CONTENTS

MODEL 1501 STABILIZATION PULSER

1.0 GENERAL

1.1 Description

The Canberra Model 1501 Stabilization Pulser has been designed to provide a source of ultra-stable 60 Hz mercury relay reference pulses for use with digital gain and zero stabilization systems, such as the Canberra Model 1500.

When the spectrum to be stabilized does not have a well-defined naturally occurring peak at an appropriate energy level - a common occurence in zero level stabilization which requires a peak occurring below Channel 30 in the multichannel analyzer - the Model 1501 may be used to provide the necessary peak.

The Model 1501 has a second important application. In combination with an appropriately constructed biased amplifier, such as the Canberra Model 1460, it may be used to provide a pulse output of sufficient amplitude stability to permit simultaneous stabilization of both the multichannel analyzer zero level and the biased amplifier bias level. Using this technique, in combination with a Canberra Model 1500 Twin Digital Stabilizer, the principal causes of long-term resolution loss - system gain and zero drift and biased amplifier bias level drift - are completely eliminated.

The Model 1501 offers an amplitude stability in the 10 - 15 parts per million per °C range (i.e., 0.000015 volts/volt/°C), allowing its use as a system reference of known stability, against which all other system elements may be compared.

2.0 SPECIFICATIONS

2.1 Performance

- Stability: better than 15 parts per million per °C temperature change, better than 50 parts per million (0.00005 volts/volt) over 24 hours

- Attenuator Stability: better than 5 parts per million per °C temperature change

- Attenuator Accuracy: better than 0.1% into 93 ±0.1 ohms

- Pulse Height Control Linearity: better than 0.25%, resettable to 0.1%

2.2 Controls

- Pulse Height: front panel ten-turn potentiometer and turns-counting dial to select pulse amplitude between 0.2 and ±10 volts unterminated, 0.1 to ±5 volts into 93 ohms

- Attenuator: front panel toggle switches to select factors by which pulse height selected is to be divided - X2, X5, X10, X10, X10 into terminated output

- Mode: front panel toggle switch to select positive or negative output, or to disable mercury relay

- Reference Zener Adjust: internal 22-turn potentiometer to adjust the current of the reference zener diode for maximum stability

2.3 Outputs

- Output: 0 to ±10 volts unterminated (divided by the attenuation factors selected); risetime less than 500 nanoseconds, fall time constant 5 microseconds or 50 microseconds, internally selected; output impedance 93 ohms

- Trigger: +8 volt rectangular pulse 3 microseconds wide; used to trigger an oscilloscope or to provide the reference pulse trigger input required by the Model 1500 Twin Digital Stabilizer

2.4 Other Data

2.4.1 Power

. +24V	- 25mA	+12V	- 25mA
. -24V	- 25mA	-12V	- 25mA
. 115VAC	- 25mA		

2.4.2 Physical

- Size: standard single width module (1.35 inches wide) per TID-20893

- Weight: 1.6 lbs.

3.0 INITIAL OPERATION

3.1 Initial Setup

1. Insert the Model 1501 into an AEC compatible bin/power supply such as the Canberra Model 1400

2. Connect the Trigger Out to the trigger input of an oscilloscope with a risetime of less than five nanoseconds (Tektronix 581, 585, 453, 454, or equivalent)

3. Connect the Output of the pulser to the signal input of the oscilloscope

4. Set the vertical gain of the oscilloscope to 2 volts/cm; set the time base to 10 microseconds/cm

5. Set the Pulse Height control on the Model 1501 to 10.0; set all Attenuator switches to OUT; set the output polarity to POS

6. Use the external positive triggering mode on the oscilloscope

3.2 Initial Checkout

1. Turn on the bin power supply

2. Observe the nominal ten volt positive output from the Model 1501; the Model 1501 has two internally selectable output pulse shapes: a moderate rise (about 500 nanoseconds), rapid fall (about five microseconds) simulating a main amplifier output used for zero or bias level stabilization, and a moderate rise (about 500 nanoseconds), slow fall (about 50 microseconds) simulating a preamplifier output used for gain stabilization. The Model 1501 is normally shipped with its output set to simulate a main amplifier output, ready for use in zero or bias level stabilization in conjunction with a Model 1500 Twin Digital Stabilizer.

3. Rotate the Pulse Height control; observe the amplitude of the output signal being reduced or increased accordingly. The accuracy of the Pulse Height control is determined by the Helipot used; the reading of the turns-counting dial should equal the observed voltage to within about 3% (i.e., 5.0 equals 5.0 volts $\pm$150mV)

4. Switch the front panel attenuator switches in and out; observe the amplitude of the output pulse being reduced by the indicated factors; when the Model 1501 is terminated by 93 $\pm$0.1 ohms, these attenuators are accurate to better than 0.1%

5. Switch the Mode/Polarity switch to OFF; observe the output disappear

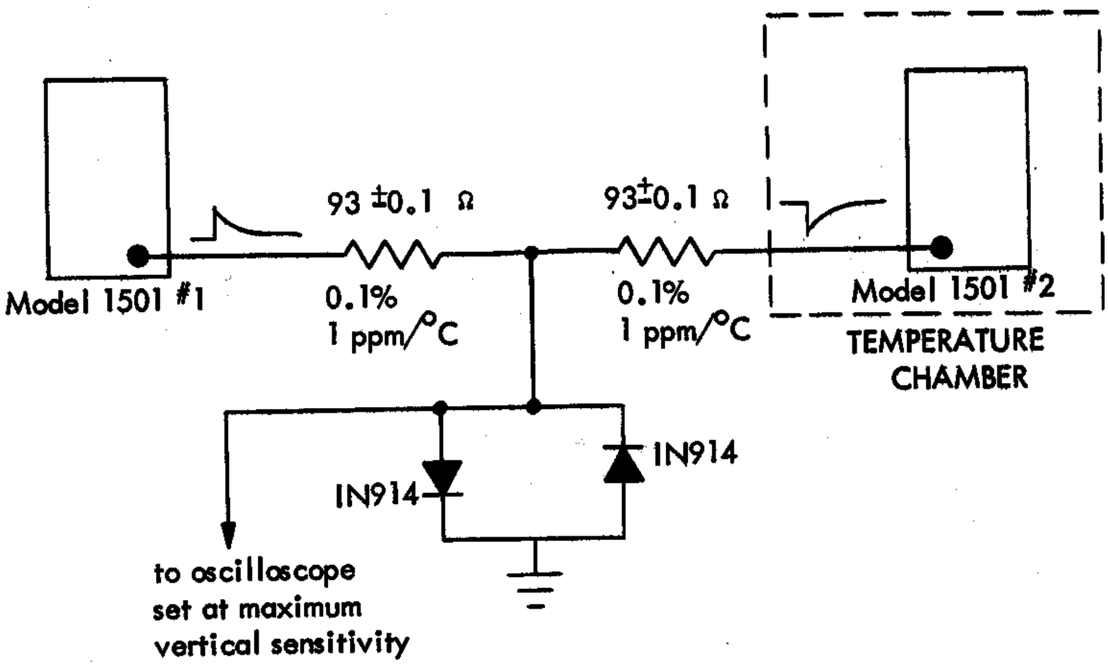
6. Switch the Mode/Polarity switch to NEG; observe that the Model 1501 output is now negative

7. With a BNC "tee" connector, examine the Trigger Out pulse; observe that it is always positive eight volts, three microseconds wide, regardless of the output found at the Output connector

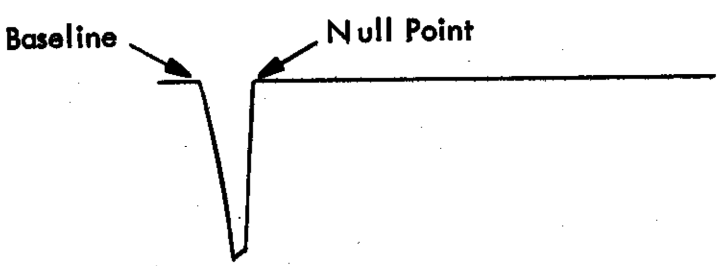
3.3 Testing the Stability of the Model 1501

1. Unfortunately, the average user will never be able to test the stability of the Model 1501 Stabilization Pulser - rather, he will never be able to observe any instability. Ten to 15 parts per million per °C means 100 to 150 microvolts change for the full-scale output per °C, too small to be observed on an oscilloscope, and only 0.04 to 0.06 channels on a 4096 channel multichannel analyzer per °C

2. Thus, except for a laboratory with extremely elaborate DC and pulse calibration equipment, the only reasonable test is to "buck" or compare the outputs of two Model 1501 pulsers, one being temperature cycled and one remaining at ambient temperature:



3. With the above setup, the two outputs should essentially cancel, after both are set to be exactly equal at about five volts output; because of small differences in output timing, one pulse may well follow the first, so the oscilloscope trace will appear as:



The amplitudes should be adjusted so that the baseline and null point are at zero voltage at the beginning of the test.

4. Now, although the absolute stability of either pulser cannot be measured, these two can be compared one to another to partially verify the stated specifications of 10 - 15 ppm/°C and 50 ppm over 24 hours

5. Any change with temperature or time will appear on the oscilloscope as a difference between the baseline and null point; the typical high quality oscilloscope has a maximum vertical sensitivity of 10mV per cm, so a deviation of 2mV (80 ppm) can be observed; the extra factor of 2 implied is to compensate for the voltage division performed by the summing resistors

6. Note that extremely high quality summing resistors must be used, as any change in their values will cause an apparent error in the summed pulser outputs, which would in fact be due to temperature or aging changes in these resistors

3.4 Changing Output Pulse Shape

1. The Model 1501 was designed for two principal applications: to serve as a zero or bias cut reference peak generator in conjunction with a Model 1500 Twin Digital Stabilizer, or to serve as a gain reference peak generator in conjunction with the same stabilizer

2. The first application is best served by feeding the Model 1501 Output signals into the Reference Input on the front panel of the Model 1500; for this use the output pulse shape of the Model 1501 should approximate that of the main shaping amplifier pulses with which it will be mixed in the Model 1500. Thus, the fall time should be relatively short.

3. The second application is best served by feeding the Model 1501 Output pulses into the Test Input of the system preamplifier in the system to be stabilized; for this use the output pulse shape of the Model 1501 should approximate that of the preamplifier pulses with which it will be mixed in the preamplifier. Thus, the fall time should be relatively long.

4. The Model 1501 has been designed to provide the two output pulse shapes required by these two applications. As shipped, the Model 1501 has been set to meet the first condition (i.e., the output pulse has a rapid fall time)

5. This output pulse shape may easily be changed to the second possible condition (i.e., slow decay) by removing the left side cover and locating the left upper green printed circuit board jumper switch situated just toward the front panel from the mercury relay.

Removing this jumper from the two pins on which it is situated (in a vertical position) and rotating and replacing it so it spans the two pins which place it in a horizontal position will effect this output pulse shape change

6. During this process, the user will notice a second green printed circuit jumper switch located just below and forward of the jumper switch described above

7. This jumper is not to be touched except for periodic recalibration and realignment of the unit. In such a case, a high quality milliammeter should be placed across the two pins exposed when this second jumper is removed, and the current read adjusted for exactly 7.5mA, using the printed circuit mounted potentiometer located below this green jumper switch

8. After this adjustment, remove the milliammeter and replace this jumper

9. This is the only adjustment to be made in the Model 1501, and is in fact the only adjustment possible

4.0 CONTROLS, INPUTS, OUTPUTS

4.1 Controls

1. PULSE HEIGHT: this front panel ten-turn potentiometer selects the fraction of full scale output (0 - 10 volts divided by the attenuator switches set to the IN position) from 0 to 1.0; in general, the output should be reduced by the attenuator switches so that the desired value is obtained when the PULSE HEIGHT control is set between 3.00 and 10.00; the output amplitude normally used for zero level stabilization is about 100mV, for bias level stabilization 100mV plus the bias cut in volts, and for gain stabilization between five and ten volts

2. ATTENUATOR SWITCHES: these front panel toggle switches determine the full-scale output of the Model 1501; the full-scale output is ten volts (unterminated) or five volts (into 93 ohms) divided by the product of the attenuator switches selected. For example, if the X2, X5, X10, X10 switches were selected, the full-scale output (unterminated) would be $\frac{10 \text{ volts}}{2 \times 5 \times 10 \times 10} = 10\text{mV}$
The attenuator resistors are specially constructed 5 ppm/^{o}C, 0.1% accuracy precision resistors.

3. MODE: this front panel toggle switch selects the POS or NEG output polarity for the Model 1501, or permits the mercury relay to be disabled, increasing its useful life when not in use; this switch does not affect the polarity of the Trigger Output, which is always positive

NOTE: Newer versions of the Model 1501 have a phase control switch whose two positions are labelled A and B, on the rear panel; this switch has a useful function only when two Model 1501 pulsers are used with a single Model 1500 Twin Digital Stabilizer, one for zero or bias reference and one for gain reference. In this case, one of the pulsers should be set to A and the other to B. This will prevent the zero/bias reference pulse from trying to enter the multi-channel analyzer ADC input at the same time as the gain reference pulse from the second pulser. When only one Model 1501 Stabilization Pulser is being used, this control has no useful function, and may be ignored.

4.2 Input Requirements

1. Since this module is a pulse generator, the only input required is DC low voltage power to operate the internal circuitry, and AC power to operate the mercury relay; the power requirements (from any AEC compatible bin/power supply) are listed in Section 2.4.1 of this manual

4.3 Output Specifications

1. OUTPUT: the output found at this front panel BNC connector is determined by the PULSE HEIGHT and ATTENUATOR controls (amplitude) and by the internal pulse shape selector (pulse shape) described in 3.4 of this manual; the output amplitude will be ten volts (polarity determined by the MODE control) divided by the product of the attenuation factors selected and by the fraction of full-scale selected on the PULSE HEIGHT control; for example, if the X2, X5, X10 attenuators were selected and the PULSE HEIGHT control were set at 3.3, the resulting unterminated output would be $\frac{10 \text{ volts}}{2 \text{ X5 X10 X3.3}} = 33\text{mV}$. The pulse shape would be as described in Section 3.4. The output impedance is 93 ohms, so one-half the unterminated output would be observed if the load impedance is also 93 ohms.

2. TRIGGER OUT: the pulse found at these two output connectors (one front panel, one rear panel) is always +8 volts, 3 micro-seconds wide, regardless of the positions of any controls found on the Model 1501, except of course, for the OFF position of the MODE switch .