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INSTRUCTIONS

MODEL AVR-A-1-S1-B-P-NRL2

TWO CHANNEL
PULSE 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.

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TABLE OF CONTENTS

INTRODUCTION

Model AVR-A-1-S1-B-P-NRL2 pulse generator has two main output channels. Channel 1 has amplitude variable from 0 to +200 Volts, with 2 ns rise and fall times, and pulse widths variable from 50 ns to 500 ns. Channel 2 has amplitude variable from 0 to +150 Volts, with 1 ns rise and fall times, and a fixed FWHM pulse width of 2 ns. Both channels require 50 Ω loads.

The AVR-A-1-S1-B-P-NRL2 is a highly flexible instrument. Aside from the internal trigger source, it can also be triggered or gated by external TTL-level signals. A front-panel pushbutton or a computer command can also be used to trigger the instrument.

The AVR-A-1-S1-B-P-NRL2 features 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.

SPECIFICATIONS

Model:	AVR-A-1-S1-B-P-NRL2	
Channel:	Channel 1	Channel 2
Amplitude: (50 Ohm load)	0 to +200 Volts, variable	0 to +150 Volts, variable
Pulse width:	50 ns to 0.5 μs	2 ns, FWHM, fixed
Rise time, fall time:	≤ 2 ns	1 ns
PRF:	0 to 100 kHz	
Duty cycle (max):	0.5%	
Propagation delay: (Ext trig in to pulse out)	≤ 100 ns	
Jitter (Ext trig in to pulse out):	± 100 ps ± 0.03% of sync delay	
Trigger required:	external trigger mode: + 5 Volts, 10 ns or wider (TTL)	
Sync delay:	Variable 0 to ± 1.0 μs (sync out to pulse out)	
Sync output:	+ 5 Volts, 200 ns, will drive 50 Ohm loads	
Gate input:	Synchronous, active high or low, switchable. Suppresses triggering when active.	
Connectors:	BNC	
Dimensions:	100 mm x 430 mm x 375 mm (3.9" x 17" x 14.8")	
GPIB and RS-232 control:	Standard on -B units	
Power requirements:	120/240 Volts (switchable) 50 - 60 Hz	

INSTALLATION

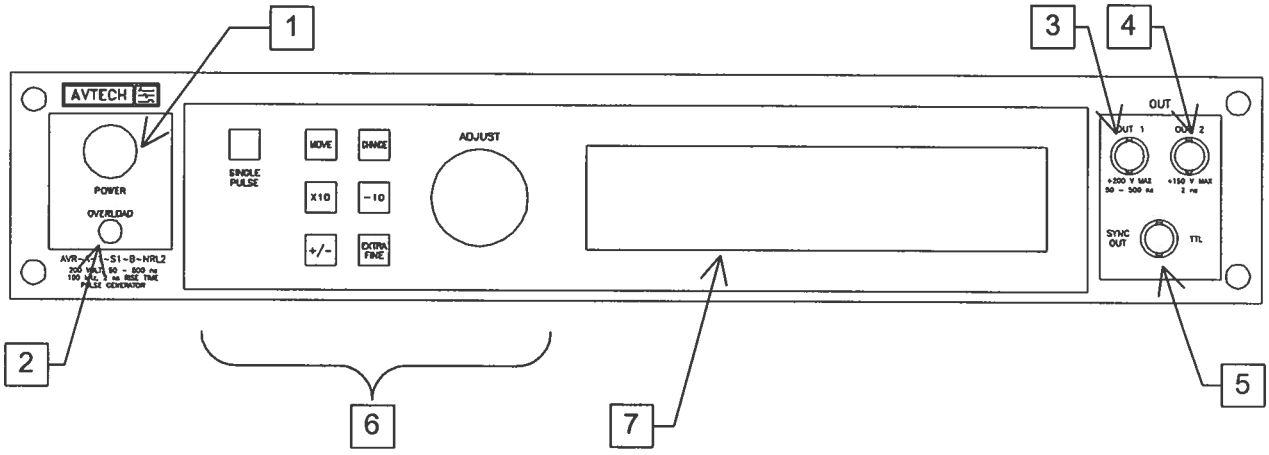
VISUAL CHECK

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 and two instrumentation manuals (this manual and the "OP1B Interface Programming 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 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 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 1/2A 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. OVERLOAD. The AVR-A-1-S1-B-P-NRL2 is protected in its internal software against conflicting or dangerous settings. As an additional protective measure, an automatic overload circuit exists, which 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.

   This overload indicator may come on briefly at startup. This is not a cause for concern.

3. OUT 1 CONNECTOR. This BNC connector provides the Channel 1 output signal. This output must be terminated with a load impedance of 50Ω.

4. OUT 2 CONNECTOR. This BNC connector provides the Channel 2 output signal. This output must be terminated with a load impedance of 50Ω.

5. 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

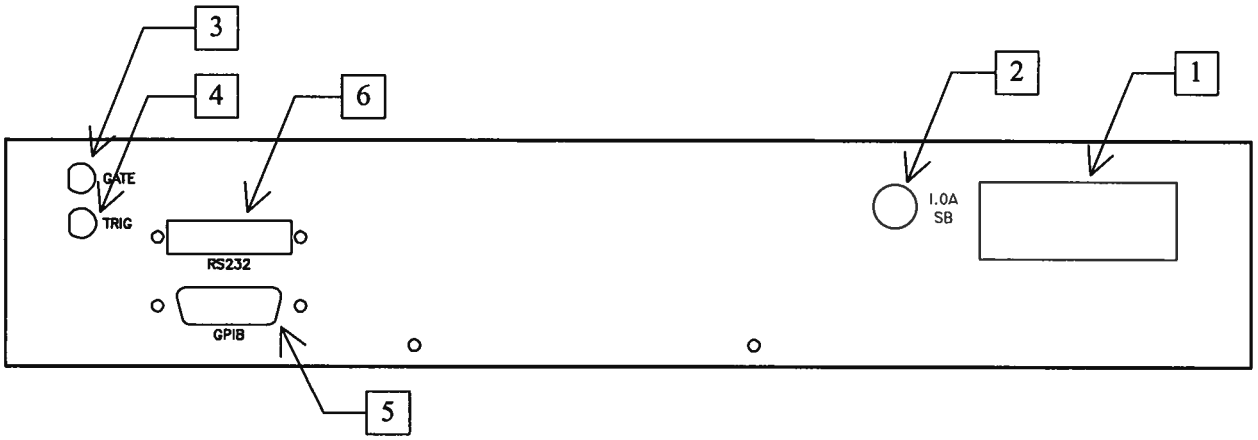
of +3 Volts to R_L > 1kΩ with a pulse width of approximately 200 ns.

6. 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 "OP1B Interface Programming Manual" describes the menus and submenus in detail.

7. 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. 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 1.0A slow blow fuse and a removable card that can be removed and repositioned to switch between 120V AC in and 240V AC in.

2. 1.0A SB. This fuse protects the DC power supply to the output stage.

3. 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).

4. 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 instrument can also be set such that the output pulse width tracks the pulse width on this input, or the output pulse width can be set independently.

5. GPIB Connector. A standard GPIB cable can be attached to this connector to allow the instrument to be computer-controlled. See the "OP1B Interface Programming Manual" for more details on GPIB control.

6. 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 "OP1B Interface Programming Manual" for more details on RS-232 control.

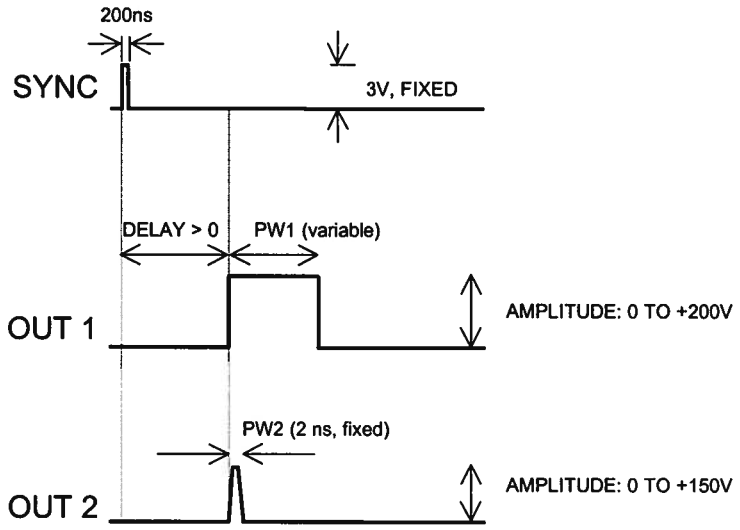
GENERAL INFORMATION

BASIC PULSE CONTROL

This instrument can be triggered by several sources - its own internal clock, an external TTL trigger signal, the front-panel "SINGLE PULSE" pushbutton, or by a computer-generated command. In any case, three output channels respond to the trigger: OUT 1, OUT 2, and SYNC. OUT 1 and OUT 2 are the main outputs, with variable amplitudes. The SYNC pulse is a TTL-level reference pulse used to trigger oscilloscopes or other measurement systems. The SYNC pulse serves as a reference point for the delay settings.

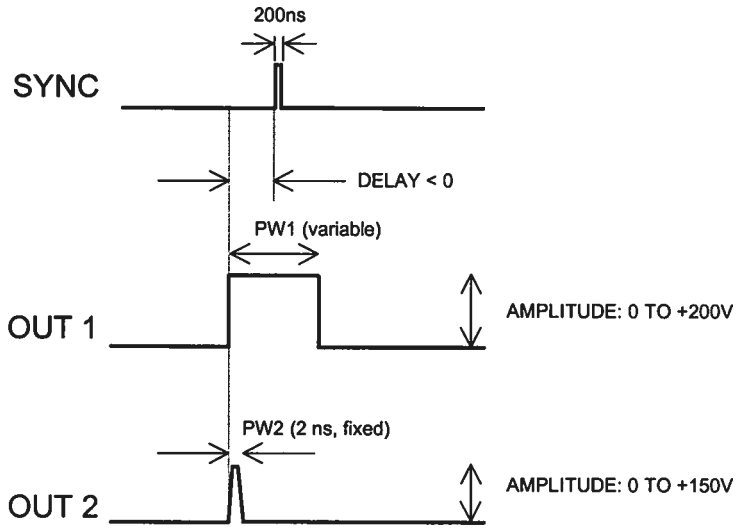
When the delay is set to a positive value the SYNC pulse precedes the OUT 1 and OUT 2 pulses. This order is reversed for negative delays. OUT 1 and OUT 2 are approximately coincident.

These pulses are illustrated below for a positive delay:



Basic Output Pulses for Delay > 0

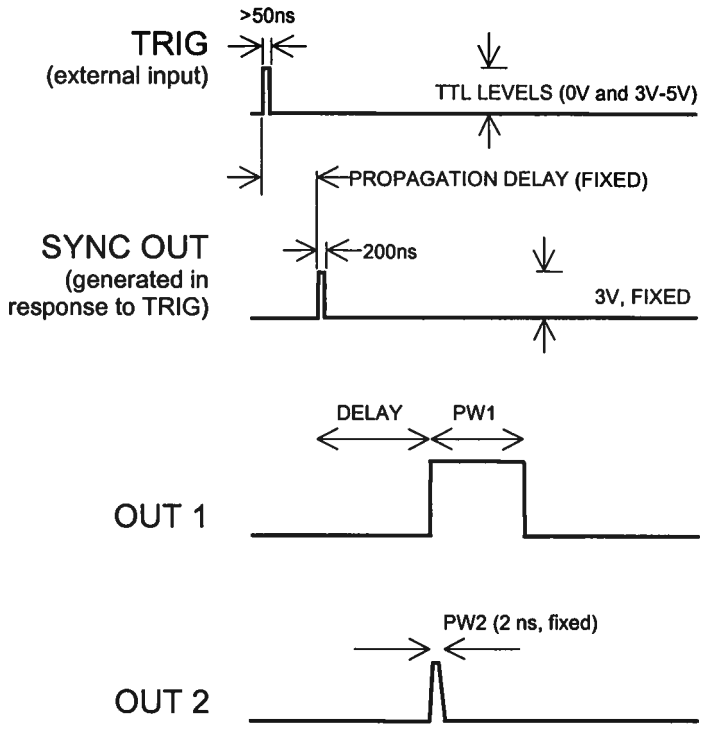
The order of the output pulses is reversed for negative delays:



Basic Output Pulses for Delay < 0

The delay, pulse width, and frequency (when in the internal mode), of the OUT pulse can be varied with front panel controls or via the GPIB or RS-232 computer interfaces.

The next figure illustrates the relationship between the signal when an external TTL-level trigger is used:



External Triggering

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 "OP1B Interface Programming Manual" for more details.)

WARNING: The output stage may be damaged if triggered by an external signal at a pulse repetition frequency greater than 100 kHz.

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. When gated, the output will complete the full pulse width if the output is high, and then stop triggering. Pulses are not truncated.

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 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 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.

PROTECTING YOUR INSTRUMENT AND YOUR LOAD

DO NOT EXCEED 0.5% DUTY CYCLE

When triggering internally, the instrument will automatically prohibit conflicting settings. However, when triggering externally the user must take care to ensure that the output duty cycle for the Channel 1 output must not exceed 0.5%, or the output stage may be damaged.

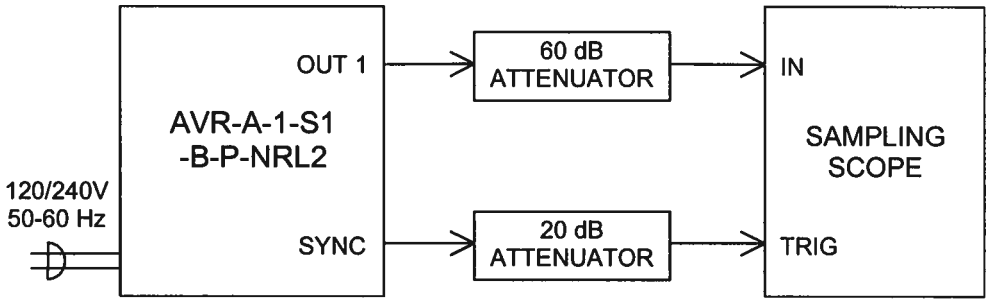
TERMINATE THE OUTPUTS WITH 50 OHMS

Both channels require 50 Ω loads for proper operation. If a channel is unused and unloaded, set the amplitude to 0 Volts for that channel.

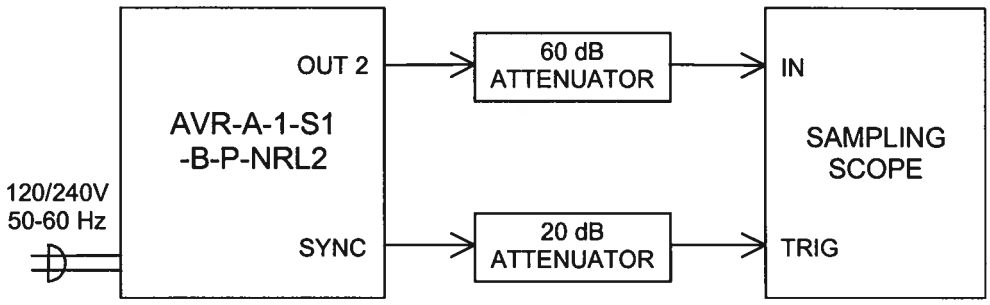
OPERATIONAL CHECK

This section describes a sequence to confirm the basic operation of the instrument. It should be performed after receiving the instrument. It is a useful learning exercise as well.

Before proceeding with this procedure, finish reading this instruction manual thoroughly. Then read the "Local Control" section of the "OP1B Interface Programming Manual" thoroughly. The "Local Control" section describes the front panel controls used in this operational check - in particular, the MOVE, CHANGE, and ADJUST controls.



BASIC TEST ARRANGEMENT FOR TESTING CHANNEL 1



BASIC TEST ARRANGEMENT FOR TESTING CHANNEL 2

1) Connect the pulse generator to a sampling oscilloscope as shown above in the "Basic Test Arrangement For Testing Channel 1" figure. Note that:

   a) The use of 60 dB attenuator at the scope vertical input channel will insure a peak input signal to the scope of less than 1 Volt (necessary only if sampling scope used). If a high impedance real time scope is used, the pulse generator should be terminated using a shunt 50 Ohm resistor, for optimum performance.

b) The SYNC output channel provides TTL level signals (approximately 0 and +3V). To avoid overdriving the TRIG input channel of some scopes, a 20 dB attenuator should be placed at the input to the scope trigger channel.

c) The bandwidth capability of components and instruments used to display the pulse generator output signal (attenuators, cables, connectors, etc.) should exceed 1 GHz.

2) Turn on the AVR-A-1-S1-B-P-NRL2. The main menu will appear on the LCD.

3) To set the AVR-A-1-S1-B-P-NRL2 to trigger from the internal clock at a PRF of 10 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 10 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.

4) 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) 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.

5) To set the Channel 1 pulse width to 200 ns:

a) Press the MOVE button until the arrow pointer is pointing at the PW1 menu item.

b) Press the CHANGE button. The pulse width submenu will appear. Rotate the ADJUST knob until the pulse width is set at 200 ns.

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.

6) At this point, nothing should appear on the oscilloscope.

7) To change the output amplitude:

a) Press the MOVE button until the arrow pointer is pointing at the AMP1 menu item.

b) Press the CHANGE button. The amplitude submenu will appear. Rotate the ADJUST knob until the amplitude is set at +200V.

c) Observe the oscilloscope. You should see 200 ns wide, +200V pulses. If you do not, you may need to adjust the delay setting to a value more compatible with your sampling oscilloscope. Repeat step 4 if required. You may also need to adjust the sampling scope controls.

d) Rotate the ADJUST knob. The amplitude as seen on the oscilloscope should vary. Return it to +200V.

e) Press CHANGE to return to the main menu.

8) Try varying the pulse width, by repeating step (5). As you rotate the ADJUST knob, the pulse width on the oscilloscope will change. It should agree with the displayed value.

9) Connect the pulse generator to a sampling oscilloscope as shown above in the "Basic Test Arrangement For Testing Channel 2" figure.

10)To change the output amplitude:

a) Press the MOVE button until the arrow pointer is pointing at the AMP2 menu item.

b) Press the CHANGE button. The amplitude submenu will appear. Rotate the ADJUST knob until the amplitude is set at +150V.

c) Observe the oscilloscope. You should see 2 ns wide, +150V pulses. If you do not, you may need to adjust the delay setting to a value more compatible with your sampling oscilloscope. Repeat step 4 if required. You may also need to adjust the sampling scope controls.

d) Rotate the ADJUST knob. The amplitude as seen on the oscilloscope should vary. Return it to +150V.

11)Press CHANGE to return to the main menu.

This completes the operational check.

PROGRAMMING YOUR PULSE GENERATOR

KEY PROGRAMMING COMMANDS

The "OP1B Interface Programming Manual" 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 1000 Hz	(sets the frequency to 1000 Hz)
pulse:width 500 ns	(sets the channel 1 pulse width to 500 ns)
pulse:delay 20 ns	(sets the delay to 20 ns)
output on	(the outputs are activated)
volt:ampl1 200 V	(sets the channel 1 amplitude to +200 V)
volt:ampl2 100 V	(sets the channel 2 amplitude to +100 V)

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

*rst	(resets the instrument)
trigger:source hold	(turns off all triggering)
pulse:width 500 ns	(sets the channel 1 pulse width to 500 ns)
pulse:delay 20 ns	(sets the delay to 20 ns)
output on	(turns on the output)
volt:ampl1 200 V	(sets the channel 1 amplitude to +200 V)
volt:ampl2 100 V	(sets the channel 2 amplitude to +100 V)
trigger:source immediate	(generates a single non-repetitive trigger event)
trigger:source hold	(turns off all triggering)
output off	(turns off both outputs)

These commands will satisfy 90% of your programming needs.

Note that the amplitude commands require that a channel number be added to the end of the command header. If no channel number is added, Channel 1 is assumed.

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 "OP1B Interface Programming

Manual". (Note: this manual also includes some commands that are not implemented in this instrument. They can be ignored.)

Keyword	Parameter	Notes
DIAGnostic:		
:AMPLitude		
:CALibration	<numeric value>	[no query form]
LOCAL		
OUTPut:		
:[STATe]	<boolean value>	
:PROTection		
:TRIPped?		[query only]
REMOTE		
[SOURce]:		
:FREQuency		
[:CW | FIXed]	<numeric value>	
[SOURce]:		
:VOLTage		
[: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	
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]

PERFORMANCE CHECKSHEET

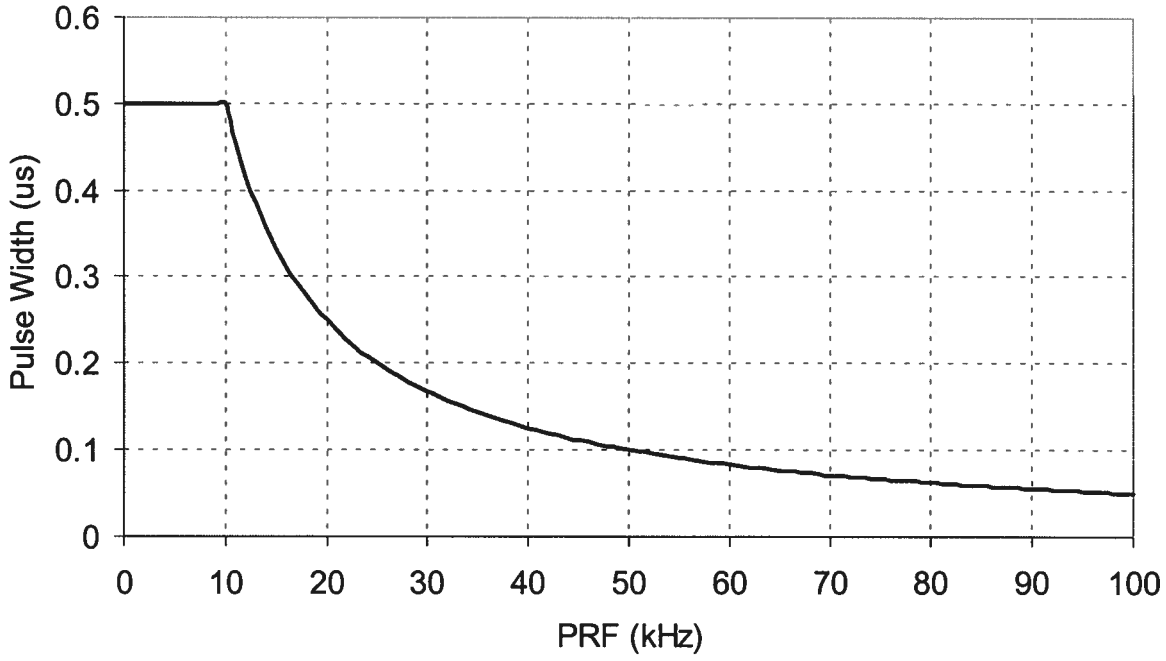
PROTECTING YOUR INSTRUMENT AND YOUR LOAD

DO NOT EXCEED 0.5% DUTY CYCLE

When triggering internally, the instrument will automatically prohibit conflicting settings. However, when triggering externally the user must take care to ensure that the output duty cycle for the Channel 1 output must not exceed 0.5%, or the output stage may be damaged.

The chart below shows the duty cycle limitation as a function of frequency.

Figure 1A: Maximum Pulse Width Versus PRF



TERMINATE THE OUTPUTS WITH 50 OHMS

Both channels require 50 Ω loads for proper operation. If a channel is unused and unloaded, set the amplitude to 0 Volts for that channel.

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