OPERATION & MAINTENANCE

HANDBOOK

MODEL 101

PULSE GENERATOR

4-17-67

DATAPULSE

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SECTION I

SPECIFICATIONS

1.1 GENERAL INFORMATION

The Datapulse Model 101 is an unusually compact high performance and low cost pulse generator. Unique circuit design utilizing a minimum of advanced solid state components, sets new standards for pulse generator reliability and economy and extends versatility.

The instrument is designed for a wide spectrum of pulse testing, circuit development and general laboratory applications. Its capabilities include simultaneous positive and negative variable amplitude outputs; single or double pulse operation; internal or external triggering; synchronous or asynchronous gating; and internal or external sine wave triggering. Each of the two outputs deliver 2 watts into 50 ohm loads. All operating controls and test connectors are on the front panel except the 115-230 line voltage selector switch which is on the back.

1.2 REPETITION RATE

The repetition rate is continuously variable from 10 Hz to 10 MHz by means of a six step decade selector switch and a fill-in vernier control for either single or double pulse operation. Effective repetition rates to 20 MHz may be set up in the double pulse mode by proper positioning of the second pulse.

1.3 EXTERNAL TRIGGER

Reliable triggering at any point on the input waveform between 0.25 volts and 5 volts above (or below) its average dc level for positive (or negative) going waveforms with a minimum duration of 30 nanoseconds at frequencies from 0 to 10 MHz is obtained by proper selection of slope polarity and level controls. Sine wave signals above 1 volt rms at frequencies of 50 Hz to 10 MHz may be used for external triggering. The input impedance is greater than 2.5k ohms and the maximum transient amplitude which may be applied is ±5 volts.

1.4 LINE VOLTAGE TRIGGER

The unit may be triggered from any point on the positive or negative slope of the ac line voltage waveform for either internal or external (see 1.3 above) operation. In both cases the trigger point is determined by the setting of the slope level control. The trigger signal is supplied by the power transformer secondary for internal operation. To simulate triggering on the crest of the sine wave where the rise time is less than the minimum required, it is necessary to incorporate a suitable pulse delay setting.

1.5 SINGLE PULSE

The instrument may be triggered manually by a pushbutton for one cycle (single or double pulse) of output.

1.6 GATED OPERATION

External gate signal levels more positive than +1 volt are required to enable the main pulse outputs for either synchronously or asynchronously gated modes. Levels greater than 10 volts may not be applied.

1.6.1 Synchronous Gating

The repetition rate generator circuit is disabled in this mode of operation until the unit receives an external gating signal. The generator turns off again when the signal is removed. This synchronizes the first main pulse of the gated burst to the leading edge of the gating signal and stops the pulse train when the signal turns off. Both trigger outputs are also gated.

1.6.2 Asynchronous Gating

In this mode, the time delay circuit is disabled while the repetition rate generator operates continuously. Both the main pulse output and the reference trigger begin with the first cycle occurring after the application of the gate for either external or internal triggering. The advanced trigger output is not gated and is available as a clock pulse on internally triggered operations.

1.6.3 Coincidence Gating

This mode of operation is achieved by combining external gating with external triggering so that the main pulse outputs occur only when the two are coincident.

1.7 TRIGGER OUTPUTS

The trigger outputs are positive with an amplitude of 2 volts from a 50 ohm source impedance and a duration of approximately 50 nanoseconds.

1.7.1 Advance Trigger

This trigger is available on internally triggered operations only and occurs approximately 10 percent of the repetition rate period before the reference trigger.

1.7.2 Reference Trigger

The reference trigger occurs approximately 30 nanoseconds after the unit is triggered from an external source, or 10% of the repetition rate period after the advance trigger on internally triggered operations.

1.8 PULSE MODE

Single or double pulse operation is available.

1.8.1 Single Pulse

In single pulse operation one pulse per cycle occurs at the main pulse outputs at the end of the delay period.

1.8.2 Double Pulse

Two pulses per cycle occur at the outputs in this mode. One pulse occurs approximately 30 nanoseconds after the reference trigger and the second at a position determined by the pulse delay controls. The two pulses are essentially identical in width, amplitude and polarity.

1.9 PULSE DELAY

The pulse delay (with respect to the reference trigger output) is continuously variable by means of a six position decade switch and a fill-in vernier control over a range of 30 nanoseconds to 10 milliseconds. The maximum duty cycle is at least 70 percent.

1.10 PULSE WIDTH

The pulse width (at 50 percent point of rise and fall) is continuously variable by means of a six position decade switch and a fill-in vernier control over a range of 30 nanoseconds to 10 milliseconds. The maximum duty cycle is at least 70 percent.

1.11 MAIN PULSE OUTPUT

Positive and negative main pulse outputs are provided simultaneously. They are dc coupled to voltage sources with their baselines at ground potential and are accessible through separate 50 ohm variable attenuators. The source impedance is very low at maximum amplitude, increasing to essentially 50 ohms at amplitudes of less than 5 volts. The amplitude controls are continuously variable from 10 volts to less than 0.5 volts when the outputs are applied to 50 ohm loads.

1.12 PULSE OUTPUT COUNTDOWN

Main pulse outputs stably counted down from the trigger repetition rate by ratios up to 100:1 are obtainable by setting the pulse delay controls for a delay time that is greater than the trigger period. External or internal triggers received during the delay are held off. On countdown operation, the reference trigger output occurs at the counted-down rate while the advanced trigger which is available on internally triggered operation occurs at the trigger rate.

1.13 RISE AND FALL TIME

With a 50 ohm resistive load applied to the output, the main pulse rise time is less than 5 nanoseconds and the fall time is less than 7 nanoseconds.

1.14 JITTER

Repetition rate, delay and width jitter are less than 0.1 percent.

1.15 WAVEFORM ABERRATION

Overshoot, undershoot, ring and top slope aberration are typically less than ±5 percent (with a maximum of ±7 percent) at amplitudes greater than 2 volts when the outputs are properly terminated by 50 ohm loads.

1.16 OUTPUT PROTECTION

Output stages will not be damaged by any combination of panel control settings and will withstand short circuits to ground of any duration. The unit is not rated for operation into loads at other than ground potential.

1.17 OUTPUT MIXING

Multiple units may be diode mixed with no loss of amplitude when the outputs are of the same polarity by means of the Type 2302 Pulse Mixer, available as an accessory. Opposite polarity outputs may be resistor mixed with a resultant loss of amplitude.

1.18 OPERATING TEMPERATURE

The instrument is rated for operation in ambient temperatures of 0° to 50° C.

1.19 POWER REQUIRED

Approximately 10 watts at 105-125 volts and 50-400 Hz ac is required by the unit. All power supplies within the instrument are regulated against line and load changes. A two-position slide switch mounted on the back panel permits the unit to be operated from either 115 or 230 volt line sources.

1.20 PHYSICAL CHARACTERISTICS

The cabinet is russet brown with brushed aluminum trim and has removable top and bottom covers and tilt-up brackets for bench use. The front panel is brushed aluminum finished with black etched and filled markings and trim. The unit weighs approximately 8 pounds and is 3-1/2 inches high by 8-1/2 inches wide and 11 inches deep. Units may be rack mounted by means of Type 1005 (single unit) or Type 1006 (double unit) Rack Mounting Sets.

1.21 ACCESSORIES AVAILABLE

1.21.1 Type 1005 Rack Mounting Set

This standard modular relay rack panel (19 inches wide by 3-1/2 inches high) permits single units to be rack mounted.

1.21.2 Type 1006 Rack Mounting Set

Two instruments are mounted in this 19 inch wide, 3-1/2 inch high standard size rack panel.

1.21.3 Type 2003 50 Ohm Termination

This characteristic impedance load may be used as a convenient termination of either the output pulse in various test applications or as a load for the idle output to avoid distortion interference of the output being used.

1.21.4 Type 2101 Inverting Transformer

This transformer is used to invert the positive trigger output (advanced or reference) for test applications requiring a negative synchronous pulse output.

1.21.5 Type 2302 Mixer Unit

Multiple unit outputs of the same polarity are conveniently mixed with no loss of amplitude by this accessory.

1.21.6 Type 2401 Variable Integrator

The application of the Model 101 pulse generator with its fixed rise time output pulses may be extended by the 2401 Variable Integrator which provides a means of varying pulse rise and fall times.

1.21.7 Instruction Manuals

One instruction manual is supplied with each unit. Additional manuals are available at $5.00 each.

SECTION II

OPERATING INSTRUCTIONS

2.1 GENERAL INFORMATION

The basic capabilities of the Model 101 Pulse Generator satisfy a broad range of pulse test requirements. These consist of repetition rates to 10 MHz, single or double pulse mode operation, 5 nanosecond rise time, ±10 volt output amplitudes, ±250 millivolt trigger sensitivity and variable pulse width and delay to 10 milliseconds. Flexible external gating and triggering with countdown capability extends this usefulness, and 1000:1 coverage on delay and width timing control ranges provides extra convenience of operation.

The external gating capability makes synchronous, asynchronous or coincidence gating possible. In the synchronous gate mode, the output pulse train is synchronous with the leading edge of an externally applied gate waveform with negligible difference in the pulse waveform between the first and last pulse in the gated burst.

In the asynchronous mode, the output pulse train is normally off while the oscillator continuously provides advanced trigger outputs. Application of an external gating signal enables the pulse outputcircuitry, beginning with the first advanced trigger after the gate is applied and continuing until the gate is removed. The reference trigger output is available during the pulse train.

Coincidence gating is achieved by application of a gate pulse at the gating input and a trigger source at the external trigger input. The 101 produces a pulse whenever the two are coincident.

The external trigger circuit utilizes slope level and polarity controls and provides sensitivity of 250 millivolts for oscilloscope type triggering.

Synchronous countdown of external trigger is useful in applications requiring frequency division. With the delay set greater than the period of an external trigger, the output pulse rate is a subharmonic of the trigger rate, counted down by a factor set by the delay control. Similar operation may be secured by using the internal oscillator. The advanced trigger output occurs at the oscillator rate and the reference trigger and pulse outputs occur at the subharmonic rate.

The repetition rate selector switch permits the unit to be triggered from any point on the positive or negative slope of the ac line voltage waveform. This may be applied to power control circuity design using SCR's thyratrons, etc.

The 1000:1 coverage on delay and width timing control ranges made possible by a unique circuit design allows extremely wide vernier coverage with little or no sacrifice in resolution.

2.2 DESCRIPTION OF CONTROLS AND CONNECTORS

2.2.1 Power Switch

WARNING

> Do not connect the unit to a line source nor turn it on before verifying that the 115-230 line voltage selector switch is in the correct position.

The POWER toggle switch connects or disconnects ac input voltage to the transformer primary within the instrument and lights the red pilot lamp when it is turned ON.

2.2.2 Repetition Rate Control

The larger eleven position REPETITION RATE knob selects either the trigger mode or the repetition rate range and the smaller vernier knob provides continuously variable frequency control for each repetition rate range setting.

There are six repetition rate ranges in decade steps. The instrument will be set to the repetition rate indicated by the selector knob position when the vernier knob is fully clockwise.

The EXT TRIG SLOPE (+) and (-) positions provide for instrument triggering from an external source by either a positive or negative going waveform.

In the LINE SLOPE positions the unit is triggered from either the positive or negative slope of the ac line voltage waveform.

The SINGLE PULSE position of the REPETITION RATE selector knob allows the instrument to be triggered manually by the red SINGLE PULSE button for one cycle of output.

The setting of the TRIGGERING LEVEL control determines the amplitude point of either a positive or negative signal that will operate the unit for both external and line voltage triggering.

A BNC connector (TRIGGER INPUT) is provided for the input signal when the instrument is triggered from an external source.

2.2.3 Gate Mode

The three position GATE MODE slide switch determines whether the main pulse output will be continuous (in the NON-GATED position) or will occur in gated bursts as controlled by an externally applied gating signal. In the two gated modes, internal circuits are disabled and main output pulses occur only when a gate signal is applied to the unit.

The repetition rate generator circuit is disabled when the GATE MODE switch is in the SYNC position. The first main pulse of a gated burst in this mode is synchronized to the leading edge of the gating signal. Both trigger outputs are also gated.

In the ASYNC position the main output is held off by disabling the time delay circuit and the repetition rate generator is uninterrupted. Both the main pulse output and the reference trigger begin with the first cycle occurring after the application of the gate for either internal or external triggering. The advanced trigger output is not gated and is available as a clock pulse on internally triggered operations.

The BNC connector labeled ENABLING GATE INPUT is provided for the gate signal input when the unit is operated in either of the gated modes.

2.2.4 Trigger Outputs

Two BNC connectors labeled TRIGGER OUTPUT provide for advanced and reference trigger outputs of approximately 50 nanoseconds duration.

The ADVANCED trigger is available on internally triggered operations only and occurs approximately 10 percent of the pulse period before the reference trigger.

The REFERENCE trigger occurs approximately 30 nanoseconds after the unit is triggered from an external source.

2.2.5 Pulse Mode Switch

Single or double pulse operation is selected by the two position PULSE MODE switch. In the SGL position one pulse per cycle occurs at the outputs following the reference trigger by a period determined by the pulse delay controls. Two identical pulses occur when the slide switch is in the DBL position with the second pulse at a position determined by the pulse delay controls and the first pulse approximately 30 nanoseconds after the reference trigger.

2.2.6 Pulse Delay Control

The larger six position PULSE DELAY knob selects the range in decade steps and the smaller vernier knob provides continuously variable control for each position for delay times ranging from 30 nanoseconds to 10 milliseconds. The instrument will be set to the delay indicated by the selector knob position when the vernier knob is fully clockwise.

2.2.7 Pulse Width Control

The larger six position PULSE WIDTH knob selects the range in decade steps and the smaller vernier knob provides continuously variable control for each position for pulse widths ranging from 30 nanoseconds to 10 milliseconds. The instrument will be set to the pulse width indicated by the selector knob position when the vernier knob is fully clockwise.

2.2.8 Amplitude Control

The POSITIVE and NEGATIVE AMPLITUDE knobs provide continuously variable control from 10 volts to less than 0.5 volts for the simultaneously occurring positive and negative main output pulses. For both outputs the baseline is at ground potential and the source impedance is very low (approximately 50 ohms or less).

The POS OUTPUT BNC connector couples the variable parameter positive pulse to an external load.

The NEG OUTPUT BNC connector couples the variable parameter negative pulse to an external load.

The GRD jack provides access to the instrument ground for test connections.

2.3 OPERATING PROCEDURE

2.3.1 Equipment (or equivalent) Required

a. Tektronix Model 661 Sampling Oscilloscope.

b. Tektronix Model 543 Real Time Scope with CA Plug-in Unit.

c. Datapulse Model 101 Pulse Generator.

d. Datapulse Type 2003 Power Termination.

2.3.2 Preliminary Settings

WARNING

Do not connect the unit to a line source nor turn it on before verifying that the 115-230 line voltage selector switch is in the correct position.

a. Turn the REPETITION RATE selector knob to the 0.1 MHz position and the vernier knob fully clockwise.

b. Turn the PULSE DELAY selector knob to the 0.1 μS position and the vernier knob fully clockwise.

c. Turn the PULSE WIDTH selector knob to the 1.0 μS position and the vernier knob fully clockwise.

d. Turn both AMPLITUDE knobs fully clockwise to the 10V positions.

e. Set the GATE MODE switch to the NON-GATED position.

f. Set the PULSE MODE switch to the SGL position.

g. Connect the Datapulse Type 2003 Power Termination or a suitable 50 ohm, 2 watt (minimum) load to the POS OUTPUT jack.

2.3.3 Main Pulse Output

a. Set the front panel controls to the preliminary settings in step 2.3.2 (above).

b. Turn the POWER switch ON. The pilot lamp should light.

c. Synchronize the sampling oscilloscope from the REFERENCE TRIGGER OUTPUT, set the sweep for 0.2 μS/cm and the amplitude for 2V/cm.

d. Monitor the positive output at the terminating load with a high impedance probe. A single flat topped pulse 5 cm wide and 5 cm high with near vertical rise and fall time should appear on the oscilloscope.

e. Turn the POSITIVE AMPLITUDE control counterclockwise and note that the amplitude decreases without any noticeable effect on waveshape down to 2 volts. Return the AMPLITUDE to the 10V position.

f. Disconnect the load from the POS OUTPUT and reconnect it to the NEG OUTPUT. The negative pulse should look like the positive pulse inverted on the oscilloscope.

g. Repeat step e (above) for the NEGATIVE AMPLITUDE control.

h. Turn the PULSE WIDTH vernier counterclockwise. The pulse width should follow the control and decrease successively. Return the vernier to its clockwise position.

i. Vary the PULSE DELAY vernier. The pulse should move smoothly left or right, following the control movements.

2.3.4 Double Pulse Mode

a. Turn the unit on with its controls set to the preliminary settings of step 2.3.2.

b. Set the sampling oscilloscope sweep to 1.0 μS/cm and synchronize it to the ADVANCED TRIGGER OUTPUT.

c. Set the PULSE MODE switch to the DBL position.

d. Turn the PULSE DELAY selector to the 10 μS position and its vernier fully counterclockwise.

e. Turn the PULSE DELAY vernier clockwise noting that a second pulse appears on the oscilloscope and moves smoothly from left to right as the vernier is turned clockwise.

f. Vary the PULSE WIDTH vernier. Both pulses should change successively and follow the control variations.

2.3.5 Single Cycle Operation

a. Monitor the output with the real time oscilloscope synchronized to the REFERENCE TRIGGER OUTPUT with its sweep set to 0.1 MS/cm and its amplitude set to 5V/cm.

b. Set the GATE MODE switch to the NON-GATED position and the PULSE MODE switch to SGL.

c. Switch the REPETITION RATE selector to the SINGLE PULSE position.

d. Turn the PULSE DELAY to 10 μS and its vernier fully counter-clockwise.

e. Set the PULSE WIDTH to 0.1 MS with its vernier fully clockwise.

f. Turn the AMPLITUDE to a convenient setting and switch the POWER ON.

g. Press the SINGLE PULSE button and verify that one pulse only appears on the oscilloscope each time the button is pressed.

2.3.6 External Trigger Operation

a. Switch the REPETITION RATE selector to the (+) EXT TRIG SLOPE position and the PULSE WIDTH to 10 μS but retain the other control settings and oscilloscope connections of step 2.3.5.

b. Connect the external trigger source (Datapulse 101 or equivalent) to the TRIGGER INPUT jack and set its REPETITION RATE to 10 KHz with vernier fully clockwise, its PULSE DELAY to minimum and its PULSE WIDTH to approximately 30 nanoseconds.

c. Turn both the trigger source and the unit under test on.

d. Adjust the TRIGGERING LEVEL control until several pulses appear on the oscilloscope.

e. Turn the external trigger source REPETITION RATE vernier counterclockwise and note that the number of pulses on the oscilloscope reduces successively as the trigger repetition rate is decreased.

f. Switch the REPETITION RATE selector to the (-) EXT TRIG SLOPE, the external trigger source to its negative output, and repeat steps d and e (above).

2.3.7 Line Slope Triggering

a. Turn the REPETITION RATE selector to the (+) LINE SLOPE position but retain all other control settings of step 2.3.6.

b. Set the oscilloscope sweep to 5 MS/cm and synchronize it to the ac line (by the oscilloscope sync control).

c. Turn the unit on and vary the TRIGGERING LEVEL control noting that pulses appear on the oscilloscope, then shift and disappear as the control is varied.

d. Switch the REPETITION RATE selector to the (-) LINE SLOPE position and repeat step c.

2.3.8 Gating Operation

a. Set the REPETITION RATE selector to 0.1 MHz with its vernier fully clockwise.

b. Turn the PULSE DELAY selector to 0.1 µS and its vernier fully counterclockwise.

c. Switch the PULSE WIDTH selector to 1.0 µS with its vernier fully clockwise.

d. Set the PULSE MODE switch to SGL and the POSITIVE AMPLITUDE to the 10V position.

e. Set the GATE MODE switch to the SYNC position.

f. Connect an external gating source (Datapulse 101, or equivalent) to the ENABLING GATE INPUT jack.

g. Set the gating signal REPETITION RATE to 1.0 KHz, PULSE DELAY to 10 µS and PULSE WIDTH to 0.1 MS with all verniers fully clockwise, and adjust its POSITIVE AMPLITUDE to 2 volts.

CAUTION

Do not exceed the maximum permissible signal level of 10 volts.

h. Use the real time oscilloscope with its dual trace attachment to monitor both the gating signal (upper trace) and the POSITIVE OUTPUT of the unit being tested (lower trace). Synchronize the oscilloscope with the gating signal generator REFERENCE TRIGGER OUTPUT and set its sweep to 20 µS/cm. Adjust the amplitude of the upper trace to 1V/cm and the lower trace to 5V/cm.

i. With both the unit under test and the gating signal generator turned on, several pulses should appear on the lower trace synchronized with the gate pulse on the upper trace.

j. Vary the gate signal PULSE WIDTH vernier and note that the pulses on the lower trace disappear successively as the gate pulse width (upper trace) is reduced.

k. Monitor the ADVANCED TRIGGER OUTPUT of the unit under test on the upper trace of the oscilloscope and synchronize the oscilloscope to the REFERENCE TRIGGER OUTPUT of the unit under test. Set the oscilloscope sweep to 2 μS/cm and the amplitude of the upper trace to 2V/cm.

l. Set the REPETITION RATE selector to 1.0 MHz with its vernier fully clockwise, the PULSE WIDTH vernier fully counterclockwise, and the GATE MODE switch to ASYNC.

m. Set the gating signal REPETITION RATE to 10 KHz and PULSE DELAY and PULSE WIDTH to 10 μS with all verniers fully clockwise.

n. Vary the gate signal PULSE WIDTH vernier and note that the pulses on the lower trace disappear successively as the vernier is turned counterclockwise. The advance trigger pulses on the upper trace are not affected.

SECTION III

THEORY OF OPERATION

3.1 GENERAL DESCRIPTION

Refer to the block diagram for the following discussions.

A clock pulse (1 C) with a variable repetition rate is generated by the rate oscillator and applied to the trigger multivibrator which produces the system clock pulse (1 D) for the pulse generator. The oscillator output is also applied to the advance trigger amplifier to provide a synchronous "zero" time reference trigger output for internally triggered operations. When the rate oscillator is turned on by the repetition rate selector in any of the six range positions, its output governs the operation of the remaining circuits through its control of the trigger multivibrator.

When the repetition rate selector is in either of the two external trigger or the two line trigger positions, the external trigger amplifier is turned on and its output (1 B) controls the system clock pulse. No advance trigger occurs because the rate oscillator is turned off.

A sample of the ac line voltage is taken from the power transformer secondary for the line trigger positions. A pushbutton trips the trigger multivibrator directly for one cycle of output when the repetition rate switch selects single pulse operation.

The main output will be continuous in the non-gated mode of operation but will be interrupted and will occur in bursts in either of the two gated modes of switch S2. The AND gate permits the delay multivibrator to be driven continuously by the system clock or to be turned on and off by gate signals from the gate emitter follower.

In the synchronous mode the external gate amplifier controls the rate oscillator and turns it on and off. The main output pulse train is synchronized with the leading edge of the gated waveform and is turned off at the trailing edge.

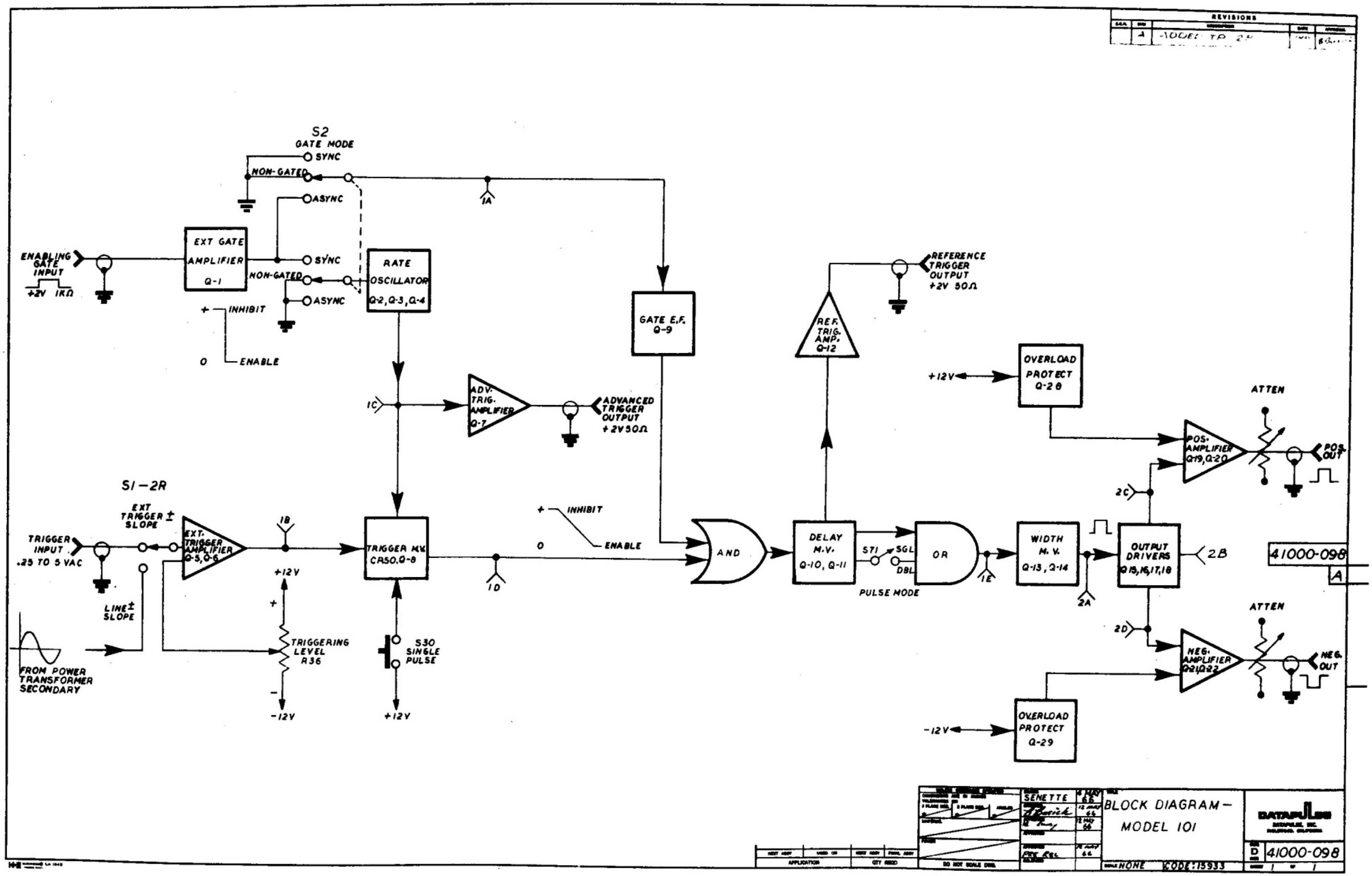
In the asynchronous mode the output of the external gate amplifier is applied to the gate emitter follower to control the delay multivibrator rather than the rate oscillator. The signal from the gate emitter follower gates the signal from the trigger multivibrator through the AND gate to the delay multivibrator. This permits the rate oscillator to provide a continuous output of advance trigger pulses and causes the output pulse train to begin with the first advance trigger after the gate is applied and to continue until the gate is removed. The reference trigger output is gated in both modes of operation.

Both the leading and trailing edges of the delay multivibrator output waveform are differentiated to produce trigger pulses separated in time by the delay period. These are applied to the reference trigger amplifier and to the width multivibrator through the OR gate. Switch S71 disconnects the leading pulse from the input to the width multivibrator (1 E) in the single pulse mode so that the main output is a single pulse separated in time from the reference trigger output by the delay period.

In the double pulse mode, the width multivibrator is turned on twice during each cycle by the two trigger pulses. The first pulse occurs approximately 30 nanoseconds after the reference trigger output and the second at a point determined by the pulse delay controls. Both pulses are essentially identical. The pulse width in either mode is determined by the period of the width multivibrator.

The output of the width multivibrator (2 A) is used by the output drivers to generate a signal (2 C) to drive the positive output amplifier. An inverted version (2 B) generates the signal (2 D) used to drive the negative output amplifier.

Variable attenuators provide output pulse amplitude control. The overload protection circuits are current sensitive and turn off their respective power supplies when either output is overloaded.



S2
GATE MODE
SYNC
NON-GATED
ASYNC
SYNC
NON-GATED
ASYNC
ENABLING GATE INPUT
+2V 1KΩ
EXT GATE AMPLIFIER Q-1
+ INHIBIT
0 ENABLE
RATE OSCILLATOR Q-2, Q-3, Q-4
1A
1C
ADV. TRIG. AMPLIFIER Q-7
ADVANCED TRIGGER OUTPUT +2V 50Ω
GATE E.F. Q-9
REF. TRIG. AMP. Q-12
REFERENCE TRIGGER OUTPUT +2V 50Ω
S1-2R
EXT TRIGGER ± SLOPE
TRIGGER INPUT .25 TO 5 VAC
LINE ± SLOPE
FROM POWER TRANSFORMER SECONDARY
EXT. TRIGGER AMPLIFIER Q-5, Q-6
1B
+12V
+
TRIGGERING LEVEL R36
-
-12V
TRIGGER M.V. CR50, Q-8
S30 SINGLE PULSE
+12V
1D
+ INHIBIT
0 ENABLE
AND
DELAY M.V. Q-10, Q-11
S71 SGL DBL
PULSE MODE
OR
1E
WIDTH M.V. Q-13, Q-14
2A
OUTPUT DRIVERS Q15,16,17,18
2B
2C
2D
+12V
OVERLOAD PROTECT Q-28
POS. AMPLIFIER Q19, Q-20
ATTEN
POS. OUT
NEG. AMPLIFIER Q21, Q22
ATTEN
NEG. OUT
-12V
OVERLOAD PROTECT Q-29
41000-098
A
REVISIONS
BLOCK DIAGRAM — MODEL 101
SENETTE
DATAPULSE, INC.
D 41000-098
NONE
CODE: 15933
1 OF 1
PRE REL
DO NOT SCALE DWG
APPLICATION

3.2 CIRCUIT DESCRIPTION

Refer to the schematic diagram for the following discussions.

3 2.1 Repetition Rate Oscillator

The internal rate oscillator is an emitter coupled multivibrator with high level positive feedback for ac provided by the timing capacitors C6 through C11. This circuit supplies a free-running basic rate that governs the remaining circuits and provides system clock output pulses. In addition, it has the capability of synchronously starting oscillations that begin at the leading edge of a control gate and continue until the gate is removed. The oscillator circuit consists of transistors Q2, Q3, and Q4 and their related circuit components.

To trace the cycle of operation, assume that Q4 is cut off and Q2 is conducting; the waveform at the base of Q4 will then be rising exponentially toward ground. The emitter of Q4 will be held near ground by the conducting emitter of Q2 and when the base of Q4 reaches ground, Q2 will start to cut off. The resulting positive step at the collector of Q2 will be transferred through emitter follower Q3 and the timing capacitor (C6 through C11) to the base of Q4. Q3 provides a low impedance discharge path for the timing capacitor through diode CR3 to ground. Q4 will regeneratively turn on while Q2 is turned off but the circuit will remain in this condition for only a short time because of the low impedance of CR3. It will again become regeneratively unstable and Q4 will be cut off when the timing capacitor discharges through CR3, starting the cycle over again.

The collector of Q4 provides an isolated output that does not affect the timing circuitry and is used to drive the trigger multivibrator (CR50 and Q8) and the advance trigger amplifier (Q7). The positive step at the collector of Q4, when it is cut off operates the trigger multivibrator and the negative step, when Q4 again conducts drives the advance trigger amplifier. The negative step always appears somewhat before the turnoff of Q4 and is present whenever the rate oscillator is running.

3.2.2 External Gate Amplifier

Q1 is a buffer amplifier stage which inverts the external gate and provides the standardized output to gate the rate oscillator and the delay multivibrator. The base to emitter drop of Q1 sets the gate amplitude requirement and base resistor R2 provides input impedance as well as protection from overdrive.

In the asynchronous gating mode, the output of Q1 drives Q9 which is used to gate the delay multivibrator. The rate oscillator is not gated.

In synchronous gating, the rate oscillator is stopped at a point in its cycle just before the turn off of Q4 would normally occur and is held in this condition by the current through resistor R4 and diode CR1. The application of a gate signal drives the collector of Q1 abruptly negative and allows Q4 to turn off by stopping the current flow in R4 and CR1 that was holding its base positive. The sudden drop at the collector of Q1 also produces a negative step through R7 to the collector of Q2 comparable to the step that turns Q2 on during normal oscillations. This causes the oscillator to start promptly at the leading edge of the gate, just as though it had been running before the gate was applied.

3 2.3 Advance Trigger Amplifier

The advance trigger amplifier Q7 is designed to differentiate the output of the rate oscillator by means of its small emitter bypass capacitor C55. It uses the negative going edge of pulses from Q4 to produce positive triggers at its collector. These are terminated in a 51 ohm resistor R62, and applied to the advance trigger output jack.

3.2.4 Trigger Multivibrator

The positive going output from Q4 is applied through diode CR52 to the trigger multivibrator circuit consisting of CR50, Q8 and their related circuit components. CR50 is a 5 milliampere tunnel diode functioning as a high speed Schmidt Trigger circuit. The current swing available from Q4 is determined by the circuit parameters and is assured to be more than the swing required to trip CR50 from its low voltage to its high voltage condition and back again as the rate oscillator cycles.

At each positive transition of CR50 a fast step is applied to Q8, which serves as an output pulse shaper for the trigger multivibrator. Q8 is biased by resistors R54, R55, and R57 in the on state with enough current for high band width operation. By virtue of the small emitter bypass capacitor C53, a sharp differentiated pulse appears at the collector of Q8 and is used to trigger the delay multivibrator. Q8 also serves to prevent the reaction of the delay multivibrator from reaching the rate generator.

3.2.5 Delay Multivibrator

The delay multivibrator consists of transistors Q10 and Q11 and their related circuit components. These transistors form a complementary one-shot multivibrator whose pulse width determines the delay interval. In order to achieve the high ratio of delay to recovery time, the transistors are arranged so that both are normally conducting and during the delay period, both are turned off. At the end of the delay period, both conduct heavily, providing a short recovery period and permitting the delay period to be almost as long as the period of the rate oscillator.

A negative trigger from the trigger multivibrator applied to the base of Q11 through diode CR51 starts to cut Q11 off. The resulting positive waveform at the collector of Q11 is applied to the base of Q10 cutting Q10 off and causing its collector to go negative. This adds to the negative signal at the base of Q11, completing its turn off and causing Q11 to block the negative signal from the trigger source.

When Q10 is cut off, the voltage at its emitter which is initially at ground starts to build up because of the charging of the timing capacitors (C70 through C75) through timing resistors R71 and R72. When this voltage reaches the voltage of the base of Q10 which is determined by the setting of delay potentiometer R75, Q10 starts to conduct again. A regenerative turn-on of both transistors follows with Q10 turning Q11 on and Q11 reinforcing the turn-on at the base of Q10.

The basic period is determined by the timing capacitors which are selected for decade ranges and vernier fill-in is provided by delay potentiometer R75. The collector of Q11 is allowed to make a full 12 volt amplitude output by the disconnect action of diode CR70. The output pulse is differentiated at the collector of Q11 by inductor L70 and resistor R77.

3.2.6 Pulse Transformer

Pulse transformer T70 is used to provide the several outputs required of the circuit. As shown in the schematic, the transformer windings which have dots have a positive spike at the beginning of the delay period and a negative spike at the end.

In order for the width multivibrator to operate properly in the single pulse mode it must receive a negative trigger from the pulse transformer at the end of the delay period. In the double pulse mode, it must receive a negative trigger at both the beginning and the end of the delay period. These two requirements are met by connecting opposite ends of two windings of the pulse transformer and applying the resulting pulse waveforms through the diode mixers CR72 and CR73. The pulse mode switch S71 disconnects the negative output appearing at the beginning of the delay time during single pulse operation.

3.2.7 Reference Trigger Amplifier

An additional output is taken from the pulse transformer at the beginning of the delay period as a negative trigger and applied to the base of Q12, the reference trigger amplifier. These triggers will be counted down if the period of the delay generator is longer than the period of the incoming triggers. Q12 responds only to the negative going triggers at its base and produces a positive pulse into 51 ohms (R81) at its collector for the reference trigger output. Diode CR71 prevents Q12 from being turned on by the current available from +12 volts through R79 until the negative base signal appears and also keeps Q12 from being responsive to the positive portion of the base waveform.

3.2.8 Width Multivibrator

The width multivibrator circuit is the same as the delay multivibrator circuit and consists of transistors Q13, Q14 and their related circuit components. The input trigger is supplied by the pulse transformer. The basic width ranges, in decade steps are determined by timing capacitors C90 through C95 with vernier fill-in supplied by width potentiometer R95. The output from the collector of Q14 is applied to the output driver stages across resistor R96.

A detailed circuit description is obtained by substituting the corresponding circuit component in the detailed description of the delay multivibrator circuit.

3.2.9 Gate Emitter Follower

In addition to operating as a steering diode for the delay multivibrator input, CR51 is used to inhibit triggers from Q8 (trigger multivibrator pulse shaper) when the gate waveform at the base of Q9 is in its positive or inhibit condition. This gate depends on the fact that the collector of Q8 can be readily raised by the emitter of Q9 in such a manner as to back bias CR51 sufficiently to prevent the passage of triggers from Q8. The resistor divider (R50 and R51) in the base of Q9 serves to set the gate waveform level at the emitter of Q9 to the dc level for proper gating operation of the delay multivibrator.

3.2.10 External Trigger Amplifier

The external trigger amplifier consists of transistors Q5 and Q6 and the associated switching circuits. The transistors are arranged as an emitter coupled differential amplifier centered about ground. The dc component of the input signal is removed by coupling capacitors C31 and C32 while the triggering level potentiometer, R36, makes it possible to re-establish ground at any desired point on the incoming waveform.

Either a noninverted output from Q6 or the inverted phase from Q5 is applied to the trigger multivibrator depending on which collector is supplied current from +12 volts. This is controlled by the two external trigger positions of the repetition rate selector switch. The output from the collector being used is applied to the trigger multivibrator through diode CR30 or CR31 while +6 volts is applied to the unused collector through either CR32 or CR33. For example, in the positive external trigger mode, Q6 supplies its output through CR31 and receives collector current from +12 volts while Q5 is prevented from contributing to the output because CR30 is back biased by the drop across CR32.

The output is applied to the tunnel diode of the trigger multivibrator which requires 5 milliamperes to swing it from one state to the other. Therefore the input sensitivity is determined by the input required to supply this 5 milliamperes.

3.2.11 Single Cycle Operation

The single pulse pushbutton trips the trigger multivibrator by current made available from +12 volts by the single pulse position of the repetition rate selector switch. The trigger amplifier circuit is disabled in this mode because neither collector is supplied current from +12 volts. Switch chatter is decoupled by resistor R34 and capacitor C30.

3.2.12 Output Driver and Amplifier Circuits

The driver circuits which consist of transistors Q15 through Q18 are essentially overdriven amplifiers which contain diodes to aid in the prevention of stored charge effects. The output amplifiers Q19 through Q22 are emitter followers which have their currents applied through decoupling networks whose impedance is constant with frequency. This helps to reduce tilt of the output due to low collector voltages reflecting through to the emitter.

Diodes CR110 and CR111 form a Baker Clamp to aid the recovery of Q16. Diode CR112 holds the bases of Q19 and Q20 slightly below ground to slice off small baseline irregularities prior to the leading edge of the pulse. Constant impedance bridge "T" attenuators connect the output transistors to the output terminals.

The positive going signal applied to the base of Q15 by the width multivibrator turns Q15 on. The current in Q15 turns Q16 on and drives the bases of Q19 and Q20 positive causing them to turn on. The resulting positive pulse at the emitters of Q19 and Q20 is applied to the positive output through a variable attenuator network which provides output amplitude control.

The emitter current of Q15 is taken by the grounded base stage Q17 to the negative pulse driver Q18. Q18 is turned on and diode CR131 helps reduce stored charge effects. The collector of Q18 and the base of the output transistors are held slightly above ground by the current through CR132. This helps remove irregularities from the baseline for the negative pulse. The negative output is supplied by emitter followers Q21 and Q22 through its variable attenuator.

3.2.13 Power Supplies

The current required by the output stages varies considerably with duty factor and is measured in the power supply by a pair of overload protection transistors Q28 and Q29. When the drop across the current sensing resistors reaches approximately the base to emitter voltage of the transistors, a signal is fed to the regulators shutting down the power supply and preventing the output transistors from being overloaded.

The remainder of the power supply is a straightforward regulator consisting of a simple pass transistor error amplifier and zener reference diode. The positive and negative 12 volt supplies are essentially identical and the +6 volts is provided by a single emitter follower referenced to zener diode CR507.

SECTION IV

CALIBRATION

4.1 CALIBRATION PROCEDURE

4.1.1 Equipment (or equivalent) Required

a. Triplett Model 630 VOM.

b. Tektronix Model 661 Sampling Oscilloscope.

c. Tektronix Model 543 Real Time Oscilloscope with a CA Plug-in.

d. Datapulse Model 101 Pulse Generator.

e. Datapulse Type 2003 Power Termination.

4.1.2 Power Supply Section

a. Remove the top panel by taking out the four mounting screws.

b. Check the ac line voltage between points BA and BR on the right rear corner of the circuit board. The voltage should be between 105 volts and 125 volts.

c. Check the following dc voltages for the indicated tolerances (the voltage points are marked on the top of the circuit board):

1. +12 volts ±0.6 volts dc (four test points)

2. +6 volts ±0.3 volts dc

3. -12 volts ±0.6 volts dc (two test points)

4.1.3 Repetition Rate Generator

a. Remove the bottom panel by taking off the four rubber feet.

b. Turn the REPETITION RATE selector to 1.0 MHz and the vernier fully clockwise.

c. Set the GATE MODE switch to the NON-GATED position and the PULSE MODE switch to the SGL position.

d. Turn the PULSE WIDTH selector to 0.1 μS and the vernier fully clockwise.

e. Connect the 50 ohm, 2 watt (minimum) power termination to the POS OUTPUT jack.

f. Adjust the POSITIVE AMPLITUDE control to any convenient setting.

g. Turn the POWER switch ON.

h. Monitor the output at the terminating load on the real time oscilloscope using a high impedance probe.

i. Use an oscilloscope to measure the repetition rate and verify that it is 1.0 MHz (with a period of 1.0 microseconds). If it is not, R15 (the oscillator calibration potentiometer) should be adjusted to the repetition rate indicated on the front panel by the position of the selector (in this case 1.0 MHz). R15 is on the circuit board in the front left corner under the repetition rate control assembly, labeled OSC on the top and accessible from the bottom as a screwdriver adjustment.

CAUTION

Be sure the REPETITION RATE vernier is fully clockwise before adjusting R15.

j. Turn the REPETITION RATE vernier fully counterclockwise and note that the frequency goes down to less than 0.1 MHz. If it does not, recheck the adjustment setting from the previous step.

NOTE

If it is not possible to set R15 correctly, the oscillator circuit is probably malfunctional.

k. Turn the REPETITION RATE selector to 0.1 MHz and the vernier fully clockwise. Switch the PULSE WIDTH to 1.0 μS and use the oscilloscope to verify that the repetition rate is 0.1 MHz. Turn the REPETITION RATE vernier fully counterclockwise and verify that the frequency is less than 10 KHz.

l. Set the REPETITION RATE selector to 10 KHz with the vernier fully clockwise and switch the PULSE WIDTH to 10 μS. Verify that the repetition rate is 10 KHz for these settings and less than 0.1 KHz with the vernier fully counterclockwise.

m. Set the REPETITION RATE selector to 1.0 KHz with the vernier fully clockwise and switch the PULSE WIDTH to 0.1 MS. Verify that the repetition rate is 1.0 KHz for these settings and less than 0.1 KHz with the vernier fully counterclockwise.

n. Turn the REPETITION RATE selector to 0.1 KHz with the vernier fully clockwise and the PULSE WIDTH selector to 1.0 MS. Verify that the repetition rate is 100 Hz for these settings and less than 10 Hz with the vernier fully counter-clockwise.

o. Set the REPETITION RATE selector to 10 MHz with the vernier fully clockwise, switch the PULSE WIDTH selector to 0.1 μS and turn its vernier fully counterclockwise. Verify that the repetition rate is 10 MHz for these settings. If it is not, trimmer capacitor C11 should be adjusted to get the proper repetition rate. C11 is mounted on the repetition rate control assembly and is accessible from the top as a screw-driver adjustment.

NOTE

Use a nonmetalic insulated screw-driver for this adjustment.

CAUTION

Be sure the REPETITION RATE vernier is fully clockwise before adjusting C11.

p. Turn the REPETITION RATE vernier fully counterclockwise and note that the frequency goes down to less than 1.0 MHz.

4.1.4 Pulse Delay Circuit

a. Monitor both the POS OUTPUT and the REFERENCE TRIGGER OUTPUT using the real time oscilloscope with its dual trace attachment. Synchronize the oscilloscope to the REFERENCE TRIGGER OUTPUT.

b. Set the GATE MODE switch to the NON-GATED position, the PULSE MODE switch to SGL and the POSITIVE AMPLITUDE to a convenient setting.

c. Set both PULSE DELAY and the PULSE WIDTH selectors to 1.0 μS with their verniers fully clockwise. Turn the REPETITION RATE selector to 0.1 MHz and its vernier fully clockwise.

d. Verify that 1.0 microseconds of delay occurs between the reference trigger and the positive output on the scope. If not, R71 (the delay calibration potentiometer) should be adjusted for the correct delay. R71 is near the center of the circuit board, labeled DEL on the top and accessible from the bottom as a screwdriver adjustment.

CAUTION

Be sure the PULSE DELAY vernier is fully clockwise before adjusting R71.

e. Turn the PULSE DELAY and PULSE WIDTH selectors to 10 μS and their verniers fully clockwise. Set the REPETITION RATE selector to 10 KHz with its vernier fully clockwise. Verify that 10 microseconds delay occurs between the reference trigger and the output pulse.

f. Switch the PULSE DELAY and PULSE WIDTH selectors to 0.1 MS and the REPETITION RATE selector to 1.0 KHz with all verniers fully clockwise. Verify that a delay of 100 microseconds occurs between the reference trigger and the output pulse for these settings.

g. Turn the PULSE DELAY and PULSE WIDTH selectors to 1.0 MS and the REPETITION RATE selector to 0.1 KHz with all verniers fully clockwise. Verify a delay of 1.0 milliseconds for these settings.

h. Set the PULSE DELAY and PULSE WIDTH selectors to 10 MS with their verniers fully clockwise and turn the REPETITION RATE vernier fully counterclockwise with its selector set to 0.1 KHz. Verify a 10 millisecond delay.

i. Set the PULSE DELAY and PULSE WIDTH selectors to 0.1 μS and the REPETITION RATE selector to 1.0 MHz with all verniers fully clockwise. Verify a delay of 0.1 microseconds that goes down to less than 30 nanoseconds when the PULSE DELAY vernier is turned fully counterclockwise. If not, trimmer capacitor C70 should be adjusted for the proper delay setting. C70 is mounted on the pulse delay control assembly and is accessible from the top as a screwdriver adjustment.

NOTE

Use a nonmetalic insulated screwdriver for this adjustment.

CAUTION

Be sure the PULSE DELAY vernier is fully clockwise before adjusting C75.

4.1.5 Pulse Width Circuit

a. Monitor the POS OUTPUT with the real time scope synchronized to either TRIGGER OUTPUT.

b. Set the GATE MODE to the NON-GATED position, the PULSE MODE switch to SGL and the POSITIVE AMPLITUDE to a convenient setting.

c. Set the PULSE WIDTH selector to 1.0 μS and the REPETITION RATE selector to 0.1 MHz with both verniers fully clockwise.

Use the scope to verify that the pulse width is 1.0 microseconds. If the setting is incorrect, adjust R91 (the width calibration potentiometer). R91 is mounted on the circuit board near the POWER switch, labeled WID on the top and accessible from the bottom as a screwdriver adjustment.

CAUTION

Be sure the PULSE WIDTH vernier is fully clockwise before adjusting R91.

Switch the PULSE WIDTH selector to 10 μS and the REPETITION RATE selector to 10 KHz with both verniers fully clockwise. Verify that the pulse width is 10 microseconds.

Set the PULSE WIDTH selector to 0.1 MS and the REPETITION RATE selector to 1.0 KHz with both verniers fully clockwise. Verify that the pulse width is 0.1 milliseconds.

Turn the PULSE WIDTH selector to 1.0 MS, the REPETITION RATE selector to 0.1 KHz and both verniers fully clockwise. Verify a pulse width of 1.0 milliseconds.

Switch the PULSE WIDTH selector to 10 MS with its vernier fully clockwise and turn the REPETITION RATE vernier fully counterclockwise with its selector set to 0.1 KHz. Verify a pulse width of 10 milliseconds.

Set the PULSE WIDTH selector to 0.1 μS and the REPETITION RATE selector to 1.0 MHz with both verniers fully clockwise. Verify a pulse width of 0.1 microseconds that goes down to less than 30 nanoseconds when the PULSE DELAY vernier is turned fully counterclockwise. If not, trimmer capacitor C90 should be adjusted for the proper width. C90 is on the pulse width control assembly and is accessible from the top as a screwdriver adjustment.

NOTE

Use a nonmetalic insulated screwdriver for this adjustment.

CAUTION

Be sure the PULSE WIDTH vernier is fully clockwise before adjusting C95.

FIRST USED	LAST USED	OMITTED
DS501	DS501	
F501	F501	
Q1	Q29	
T70	T501	T1-69, 71-500
L70	L70	L1-69
S1	S502	S3-29, 31-69, 72-89, 91-500
CR1	CR507	CR4-29, 34-48, 54-69, 75-89, 91-109, 116-129, 136-500
C1	C513	C13-29, 33-49, 56-69, 78-89, 96-109, 112-129, 136-500
R1	R517	R22-29, 43-49, 63-69, 85-89, 98-109, 116-119, 123-129, 139-142, 146-500

REFERENCE DESIGNATIONS

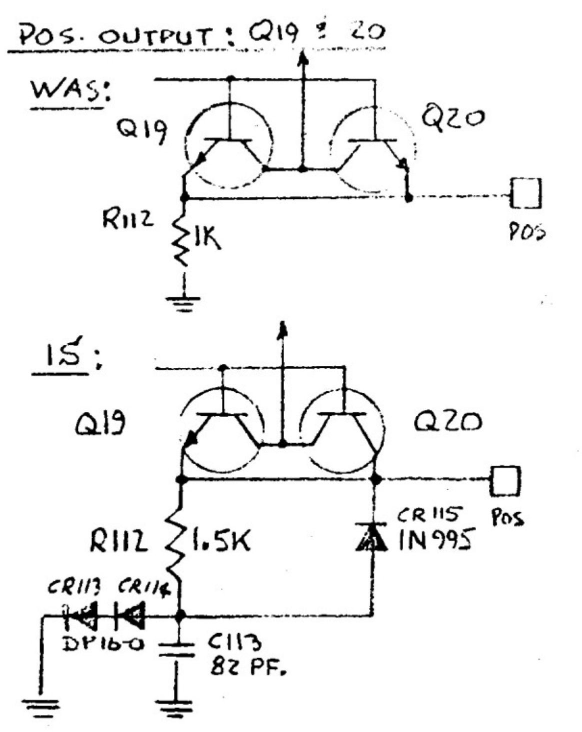
ADDENDA AND ERRATA

Datapulse Model 101 Pulse Generator

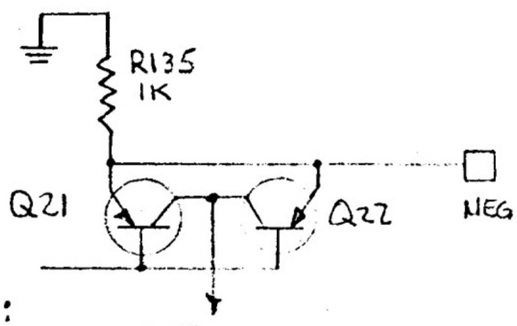
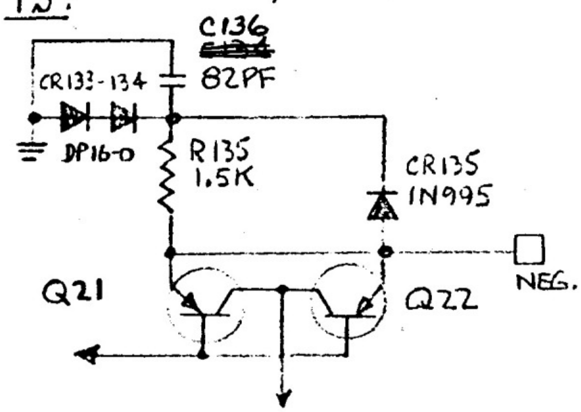
E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
2021	8-26-66	Transistor Equiv.	SM 1330, P/N 12685-004 is an acceptable substitute for DP63-6, P/N 22635-006.
2028	6-9-66	Manual	Section I, paragraphs 1.7, 1.7.1, 1.7.2 and 1.9 should read as follows: 1.7 TRIGGER OUTPUTS The trigger outputs are positive with a duration of approximately 50 nanoseconds. 1.7.1 <u>Advance Trigger</u> The advance trigger has an amplitude of 1.7 volts from a 50 ohm source impedance and is available on internally triggered operations only. It occurs approximately 10 percent of the repetition rate period before the reference trigger. 1.7.2 <u>Reference Trigger</u> The reference trigger has an amplitude of 2.0 volts from a 50 ohm source and occurs approximately 30 nanoseconds after the unit is triggered from an external source, or 10 percent of the repetition rate period after the advance trigger on internally triggered operations. 1.9 PULSE DELAY The pulse delay (with respect to the reference trigger output) is continuously variable by means of a six position decade switch and a fill-in vernier control over a range of approximately 40 nanoseconds to 10 milliseconds. The maximum duty cycle is at least 70 percent.
2081	8-26-66	Transistor Substitution	2N2102, P/N 12686 may be used in lieu of 2N2270, P/N 12695-001.

ADDENDA AND ERRATA

E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
2096	9-9-66	Tech. Data Sheet M101	Specification Change 1. On reverse side of sheet, left c column, last paragraph - Pulse Duration: Change 30 nsec to 35 nsec. 2. Right column - Rise and Fall Time: Change "...and fall time is less than seven nanoseconds." to "...and fall time is 7 nanosec typ.; 10 nanosec. max."
		Manual Para. 1.10, 2.2.7, 4.1.5	3. Change min. pulse width spec. from 3 nsec to 35 nsec.
		Para. 1.13	Same as Item 2.
		Para. 3.2.12, Sub. Para. 4	After the first sentence, add the following: "C131 is a drive adjustment to provide the best output waveform."
2126	10-26-66	J40000-154B	Change Pos. and Neg. output circuits as shown:



ADDENDA AND ERRATA

E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
			NEG. OUTPUT: Q21 & Q22. WAS:  IS: 
		L/M37000-429 Rev. B	Ass'y - Main Circuit Board 1. Change R112 and 135 from 1 k, 1/4w, 5%, P/N 10010-102 to 1.5k, 1/4w, 5%, P/N 10010-152. 2. Add C113 and 136, 82 pF, 500V, 5%, P/N 11017-820. 3. Add CR115 and 135, Diode, 1N995, P/N 12144-003. 4. Add CR113, 114, 133, 134, Diode, DP16-0, P/N 22164-000.
2120	10-13-66	Manual	Jitter Specifications - Change from 0.1% to 0.1% typical, 0.15% max. on each range (within highest decade on width and delay ranges).
1126	10-14-66	J40000-154A	Incorporated E.O. 's: 2051, 2071, 2077A, 2080, 2095, 2106, 2119.

ADDENDA AND ERRATA

E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
2219	3-6-67	Manual and Tech. Bulletin	Model 101 - Specifications Make the following changes: From: Advance trigger - positive pulse..... approximately 50 ns duration... Reference trigger - positive pulse.... approximately 50 ns duration... To: Advance trigger - positive pulse.... typically 15 ns duration... Reference trigger - pulse... typically 15 ns duration....
2234	3-23-67	Tech. Bulletin Manual Pg. 1-4, 1.15	Waveform Aberration Change: "... at amplitudes greater than 2V...." To: "... at amplitudes greater than 3V...."
		Pg. 2-5, Para. 2.3.3e	Change: " .. to 2 volts." To: "... to 3 volts."
2235	3-23-67	J40000-154C L/M37000-429 "B"	Schematic Change C134, 82 pF, capacitor to C136, ref. des. (located at junction of CR134, R135, CR135 near Q21 and Q22).
2254	4-17-67	TB-Manual	Model 101 - Specifications CHANGE: ADVANCED TRIGGER: Positive pulse, minimum 1.7V from 50 ohm source typically 15 ns duration. Available on internally triggered operations only. Occurs approx. 10% of the repetition rate period before the reference trigger. REFERENCE TRIGGER: Positive pulse, minimum 2V from 50 ohm source, typically 15 ns duration. Occurs approx. 30 ns after triggering from an external source.

ADDENDA AND ERRATA

E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
2281B	5-26-67	J40000-154C L/M37000-430	Schematic - Front End Add a 0.1 μF, 75V, ceramic capacitor, P/N 11242-104 across contacts of S30 single cycle pushbutton switch.
2282	6-1-67	J40000-154C L/M37000-429	Schematic - Front End Add a capacitor, 82 pF, 500V, 5%, P/N 11077-820 in parallel with R2, 1 k, 1/4W resistor.
2648A	12-27-68	J40000-154	schematic 1. Add an asterisk * to C6 co cito on Rep. Rate Switch S1.
2648B	12-27-68	4/M37000-433	2. Change C6 from 8.2uF, 20V, 10% P/N 11511-825 to 10uF, 20V, 10% P/N 11511-106.
2620B	11-4-68	J40000-154	schematic - model 101 1. Add a 2.7K*, 1/4W, 5% Resistor P/N 10010-272 (Ref. Des. R139) from the Emitter of Q17 to -12V. 2. Change R131 from 470Ω, 1/4W, 5% P/N 10010-471 to 430Ω, 1/4W, 5%, P/N 10010-431.
		4M 37000-429	3. Same as above, item 2.
		J40000-337	schematic - model 100A 4. Same as item 1. 5. Same as item 3. NOTE: Item 1, R139 is selective by having an *, - Remove item 1 from List of mat'l.

DATAPULSE
DIVISION OF DATAPULSE INCORPORATED

SERVICE BULLETIN
NO. 1-65

SEMICONDUCTOR REPLACEMENTS

(Applicable to all Datapulse Models except the Model 100 and 102)

Datapulse makes extensive use of house labeled semiconductors, superseding or used in place of commercial equivalents. In most cases, these are procured against relaxed or actual commercial equivalent specifications, and commercial equivalents as listed below may, therefore, be used as replacements.

DATAPULSE TYPE NO.*	DATAPULSE PART NO.	COMMERCIAL EQUIVALENT
Diodes:		
DP16-0	22164-000	1N3600
DP16-1	22164-001	1N3604
DP16-2	22164-002	HPA1003
DP19-0	22194-000	1N2070
DP19-1	22194-001	1N4002
DP19-6	22194-006	1N2071
Transistors:		
DP43-0	22435-000	2N984
DP46-0	22465-000	2N964A
DP46-1	22465-001	None**
DP59-0	22595-000	2N1132A
DP60-0	22605-000	2N2411
DP60-1	22605-001	None**
DP60-2	22605-002	2N2904 or 2N3133
DP60-3	22605-003	2N2894
DP60-4	22605-004	2N3209
DP60-5	22605-005	FT1702
DP60-6	22605-006	2N3640
DP63-0	22635-000	2N2369 or 2N2501
DP63-1	22635-001	2N3723
DP63-2	22635-002	None**
DP63-3	22635-003	2N2369A
DP63-4	22635-004	2N3646 or 2N3605 or ME9021 or MPS3646
DP63-6	22635-006	2N2270

*Some earlier publications show Type No. without the dash.

**Replacements for the following items should be procured from Datapulse:

DP46-1 is selected from 2N2964A for high Beta.
DP60-1 is selected from 2N22894 for high V eco.
DP63-2 is selected from 2N914 for tighter Beta toleranc

11/22/66

DATAPULSE® a galaxy of pulse instruments

Model 101 8½"W x 3½"H x 11"D

Model 110FP-A2

Model 110A

Model 111

DATAPULSE/Pulse Generators

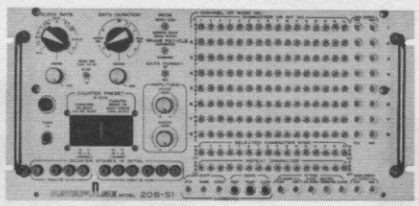
Datapulse offers a full line of fast pulse generators, providing a wide range of rep. rates and output powers. Relay rack mount and 115/230V, 50/60 cycle power is available for all units. Inquiries are invited on modifications and special requirements such as automatic programming and multipulse systems, etc.

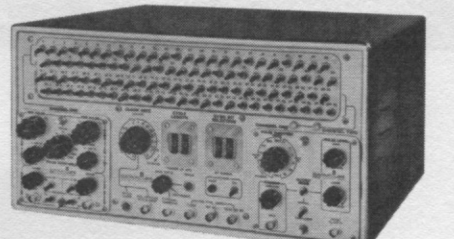
	MODEL	REP. RATE	DELAY	DURATION	RISE & FALL TIMES	OUTPUT	PRICE
	100	5Hz — 500KHz (1 MHz Ext. Trigger)	0.2µs—100ms	0.1µs—100ms	to 30ns rise to 40ns fall	+35V, —80V open cct, ±10V into 50Ω	$ 345.00
	101*	10Hz — 10MHz sgl. or dbl. pulse	40ns to 10ms	35ns to 10ms	Typically <5ns rise <7ns fall (Max. 10ns)	Simultaneous ±10V into 50Ω	$ 395.00
	102	2Hz — 3MHz	0.2µs—10ms	50ns—10ms	variable 10-500ns	±50V into 50Ω	$ 720.00
	102-S1A			Like 102 but offers variety of multipulse formats.			$1650.00
	102-S3	Like 102 except also provides two pulses per cycle at rep rates to 800KHz, with separation variable from 0.5µs to 10ms.					$ 920.00
	102-S4	Like 102 except provides up to 10ms delay or advance of main pulse and five-turn control resolution on delay.					$ 920.00
	103M*	<5Hz — 5MHz	0.1µs—5ms, two channels provided	Outputs are provided by plug-in Output Units (see below) — 1 reqd. for single pulse, 2 for double pulse.			$ 880.00
	106A*	10Hz — 12MHz sgl. or dbl. pulse	<40ns—5ms	<25ns—5ms	separately variable 10ns—1ms	Simultaneous ±12V into 50Ω	$ 950.00
	108*	10Hz — 10MHz	0—5ms	<25ns—5ms	Variable 7—50ns	±50V into 50Ω	$1480.00
	108L*	10Hz — 10MHz	0—5ms	<30ns—5ms	Separately variable linear rise 12ns—12.5µs	±50V into 50Ω	$1980.00
	109*	4Hz — 40MHz sgl. or dbl. pulse	10ns advance to 50ms delay	10ns—50ms	<5 nanosec	Simultaneous ±10V into 50Ω	$690.00
	110A*	4Hz — 40MHz sgl. or dbl. pulse	10ns advance to 50ms delay	10ns—5ms	Separately variable linear 4ns—500µs	Simultaneous ±10V into 50Ω DC offset to 10V	$1250.00
	111*	4Hz — 40MHz sgl. or dbl. pulse	15ns advance to 50ms delay	8ns to 0.5ms	Separately variable linear 2ns to 500ns rise 3ns to 500ns fall	±5V into 50Ω DC offset to 5 volts	$1480.00
Programmable	110FP*	Like 110A except allows remote control and/or automatic programming of all pulse parameters except amplitude.					$2530.00
Programmable	110FP-A2*	Provides manual control of programmed functions or allows programming from parallel logic lines of all parameters, including amplitude.					$3590.00
Programmable	G2*	Incorporated in 110FP-A2, also available separately, for control of pulse amplitudes. Allows attenuation to be varied from 0—39.9 dB in 0.1 dB steps.					$920.00
Programmable	250*	0.2µs — 1599ms period	0—159.9ms	0.1µs—159.9ms	10ns to 15V 50ns to 50V	±0.1—50V into 50Ω	$7210.00
			Timing and amplitude automatically programmable from BCD logic level lines. Timing derived from 0.005% accuracy 10Hz clock.				

*Fully solid-state instrument

Model 208-S1

Model 201 8½"W x 3½"H x 11"D





Model 200M

DATAPULSE/Digital Data Generators

Solid state off-the-shelf digital test instruments for high-speed simulated serial data, serial words, and pulse programs for general logic and systems development and magnetic memory and tape equipment design and test. Basic units may be economically modified for added channels for special program lengths.

MODEL	CLOCK RATE	SERIAL BITS/WD	NO. OF CHANNELS (BITS/CHARACTER)	OUTPUT	OTHER FEATURES	PRICE
200M	2Hz–2MHz	1–100 or 1–50	1 or 2	Outputs are provided by plug-in Output Units (see below) 1 req'd for 1 channel, 2 req'd for 2 channel use.	Selectable sync bit, Single word command	\$3710.00
202M	5Hz–5MHz	16	2		Each channel may be delayed 0.1μs–5ms from clock.	\$1720.00
201	to 10MHz	16	1	Simultaneous and complementary NRZ outputs to 10V, variable baseline offset to $\pm$10V.	Provides RZ formats when triggered from async-gated pulse generator.	\$680.00
202M-S1	Like Model 202M except also providing single word command capability and last bit sync output.					\$2200.00
203	10Hz to 20MHz	1–100 or 1–50	1 or 2	$\pm$5V into 50 ohms variable duration 10ns to 5ms or NRZ	Variable delay 0–50ms for NRZ or variable width; bit and word repeat modes, word command & frame command, PCM mode.	\$5700.00
206	2Hz–2MHz	16 fixed plus bits or pair repeats	6	+12V from 100Ω programmed triggers	Selected sync. from any combination of intervals	\$3590.00
206M	2Hz–2MHz	1–100	6	+6V from 100 ohms	Independent delay, width, and amplitude	\$7170.00
208	5Hz–5MHz	1 to 16 plus variable repeats	8	6V into 50 ohms RZ or NRZC Variable width optional	Manual or triggered single frame	\$6680.00
208-S1	Same as 208, except provides simultaneous positive and negative outputs and pulse duration control from 0.5μs to 5ms.					\$7460.00
215C	1Hz–1MHz	Independently selectable word lengths for sync. and data words 1–32 bits.	1 PCM channel. 3 independent word types: sync, common and special frames to 512 words.	True and complement variable amplitude and lower level from 1 to 12 volts from 50 ohms, RZ, NRZ and bi-phase.	Provides for data perturbation and a reference data output (fixed output level 12 volts from 50 ohms). Common data word may be externally programmed. Special data word may be inserted in any word position except the first.	\$4750.00

DATAPULSE/Plug-in Output Units

Datapulse solid state plug-in output units provide a wide choice of output characteristics from a single basic instrument, including very fast rise time, high power, variable waveform, selectable DC levels, and audio signal modulation. Units are interchangeable. (For use with Models 103M, 202M, and 200M)

TYPE	DURATION	RISE TIME	OUTPUT	OTHER FEATURES	PRICE
P901	50ns–2ms or NRZ*	Variable <20–> 300ns	Simultaneous $\pm$15V into 50Ω	Current source, separate controls for $\pm$outputs. Outputs may be mixed.	\$570.00
P902	2μs–50ms or NRZ*	Approx. 0.1μs	Upper level 1 to 15V lower level −1 to −15V, from 600Ω	On-off modulates external carriers (to 20kc) providing up to 16V p–p, from 600Ω	\$470.00
P903	50ns–2ms or NRZ*	<5 nanosec.	Simultaneous $\pm$5V into 50Ω	Outputs may be mixed	\$270.00
P904	<0.2μs	<50 nanosec.	$\pm$15V or $\pm$5V into 50Ω	Two channels provided i.e., only 1 unit req'd. for two channel instrument	\$185.00
P905	50ns–500μs	Variable <20ns–1μs	$\pm$25V into 50Ω	5% waveform aberrations	\$610.00
P906	2ns–200ns	<1ns	$\pm$10V into 50Ω	Two units with Model 103M provide double pulse operation	\$980.00

*NRZ OUTPUT IS PROVIDED ONLY WHEN USED WITH MODELS 200M, 202M, or 202M-S1.

PRICES AND DATA SUBJECT TO CHANGE WITHOUT NOTICE.
PRICES ARE DOMESTIC LIST, F.O.B. CULVER CITY, CALIFORNIA.

P901

P902

P903

P904

P905

P906

DATAPULSE®

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WARRANTY

Datapulse Incorporated warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, transistors, fuses or batteries which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective.

Instruments returned under this Warranty will not be accepted at the Datapulse plant without prior authorization by a Datapulse representative or by the service manager of Datapulse Incorporated.

Datapulse Incorporated reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of Datapulse Incorporated and Datapulse Incorporated neither assumes nor authorizes any other person to assume for them any other liability in connection with the sales of Datapulse Incorporated instruments.