SPECIFICATIONS (*Cont.*)

GENERAL

Terminals: RF output, Type 874 Locking Connector. Modulation, binding posts.

Mounting: Bench or relay rack.

Power Input: 105 to 125 (or 210 to 250) volts, 50 to 60 cps, 85 watts. Instrument will operate satisfactorily (except for line-frequency sweep) at power-line frequencies up to 400 c.

Tube Complement: Two each 6197 and 12AT7, one each 6AN8, 6AV5GA, 12AX7, 12BH7A, 5651, 5836 (Reflex Klystron), 5965.

Accessories Supplied: Type 874-R22 Patch Cord, Type 874-C58 Cable Connector, Type CAP-22 Power Cord, and spare fuses.

Dimensions: Width 19, height 7½, depth 15½ inches (485 by 195 by 395 mm), over-all; panel, 19 by 7 inches (485 by 180 mm).

Net Weight: 38 pounds (17.5 kg).

Type		*Code Word*	*Price*
1360-AM	**Microwave Oscillator, Bench Mount**	BURLY	**$1100.00**
1360-AR	**Microwave Oscillator, Rack Mount**	BASSO	**1100.00**

U.S. Patent No. 2,548,457

MORE AND BETTER PULSES FROM THE UNIT PULSE GENERATOR

The Type 1217-A Unit Pulser[1] was, like its companion instruments in the unit line, designed for maximum utility, minimum complexity, and low cost. The thousands of these compact, high performance devices that are now in use have shown that the design was indeed a successful blend of these often conflicting factors. Time has made available new circuits and components, and experience has shown where improvements would be both desirable and practical. In the redesign the goals set were simple: to make every possible improvement compatible with the two conditions of no increase in price and no increase in power supply requirements.

[1]R. W. Frank, "Pulses in a Small Package — A Pulse Generator for the Unit Line," *General Radio Experimenter*, 28, 10, March, 1954.

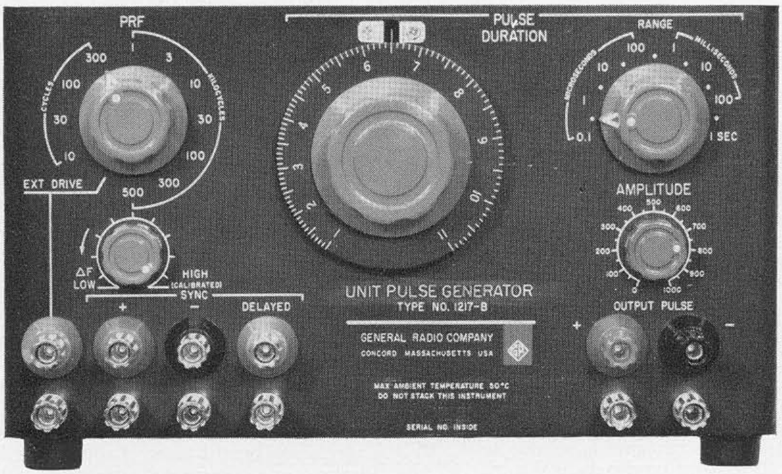


Figure 1. Panel view of the Unit Pulse Generator.

TABLE I

Comparison of Major Characteristics of the Types 1217-A and 1217-B

Characteristic	1217-A	1217-B
Pulse Rise Time	<50 nsec	<20 nsec (50 ohms)
Pulse Fall Time	<150 nsec	<10 nsec (50 ohms)
Pulse Duration	Continuous 150 nsec — 60 msec	Continuous 100 nsec — 1 sec
PRF (Internal)	Steps 30 cps — 100 kc	Continuous 2.5 cps to 500 kc
PRF (External)	Locked 30 cps — 100 kc	Continuous dc to 1 Mc
Pulse Amplitude (1-kilohm output impedance)	±20 v into 1 kilohm	±40 v into 1 kilohm
Input Sensitivity	30 v at 100 kc	0.3 v at 1 Mc
Accuracy PRF and Duration	±15%	±5%
Delayed Pulse	None	To trigger a second generator

Similarity between the new TYPE 1217-B Unit Pulse Generator and its popular predecessor goes little further than the four digits of its type number. Significant changes have been made in all performance specifications. The most important parameters are listed for comparison in Table I. It can be seen that, in every instance, the performance figures are increased by at least 2:1 and often by more than 10:1.

This performance is achieved in two ways:

(1) The TYPE 1217-B uses better devices; being neither wholly "transistorized" nor wholly "vacuum tube-ized" it takes full advantage of the best properties of both modern transistors and vacuum tubes.

(2) The TYPE 1217-B has completely unconventional circuitry for all functions—every component works full time. In fact, through a series arrangement of timing and output circuits, the 55-ma input current from the power supply is used to provide 40 ma of useful load current.

The new design has other new features, not clearly shown in Table I, which can be better appreciated after some of the new circuit characteristics are more completely explained. These will be discussed in the section on applications, below, after the circuits have been explained in some detail.

CIRCUITS

Block Diagram

Figure 2 is a block diagram of the circuit. In block form things look quite conventional. The input circuits consist of a Schmitt trigger circuit driven by an amplifier connected to the input terminals so that the pulse generator will be started by a triggering pulse once per cycle of any input waveform at any

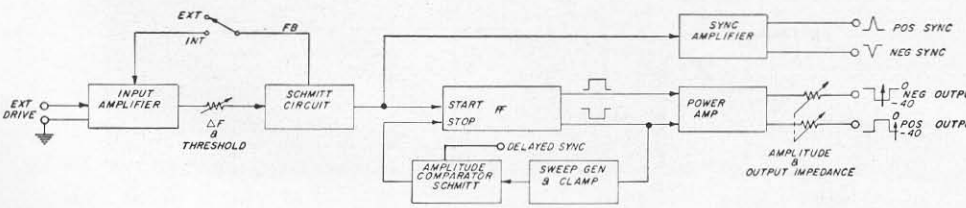


Figure 2. Block diagram of the circuit system.

frequency from dc to over one megacycle per second. Conventional—yes, but every active part of this input-triggering circuit is converted to a stable *RC*-controlled oscillator when internally produced pulse repetition frequency (prf) is desired. This oscillator will produce any desired recurrence frequency between 2.5 cps and 500 kc.

The trigger pulse from these input circuits: (1) operates a sync-pulse-producing stage to form both positive and negative pre-triggers, and (2) starts the pulse-generating and timing circuits.

A transistor-bistable circuit, set by the trigger from the input circuit, simultaneously operates the pulse output stage and the pulse-timing circuit. The output stages, producing both positive and negative pulses, are a pair of power pentodes acting as 40-ma current sources. The timing circuits are comprised of a switch tube, a high-speed clamp and a Schmitt trigger. When the transistor bistable switches, starting the pulse, the timing switch is turned off. A precision capacitor is charged to the point where the Schmitt trigger operates, producing a reset trigger for the bistable control circuit, thereby terminating the pulse.

The 40-ma current-source output pentodes are directly connected to the output terminals through a 1-kilohm amplitude control.[2] Forty-volt positive and negative pulses are thereby produced at full amplitude. Since the connection to the output terminals is direct, the dc component of the pulses is present, and ramp-off cannot occur, no matter how great the pulse duration.

Input Circuits

Figure 3 is a simplified schematic diagram of the input circuits and prf oscillator. The switching for the circuit is shown here in proper position for the aperiodic-input-circuit connection.

In this connection V_1 amplifies the input signal, and the voltage divider R_1 and variable resistor R_2 apply the amplified input signal to the Schmitt circuit, V_2. R_2 in this application permits an adjustment of the dc component of the input signal either to optimize the triggering sensitivity or to adjust the phase of the output pulse with respect to the input signal over a limited range.

When the PRF selector switch is thrown to any one of its other twelve positions

[2]This output circuit configuration is identical to that of the General Radio TYPE 1391-B Pulse, Sweep, and Time-Delay Generator.

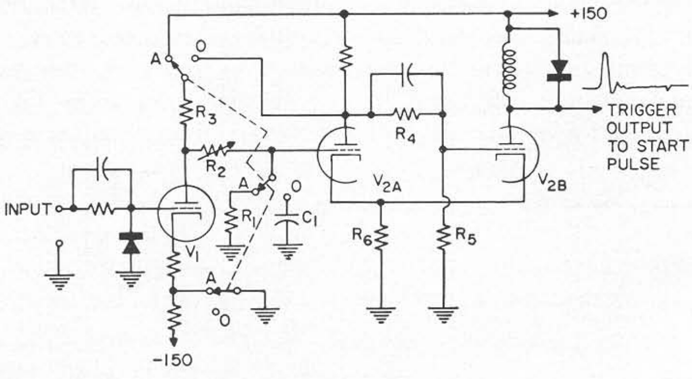


Figure 3. Elementary schematic of the input circuits.

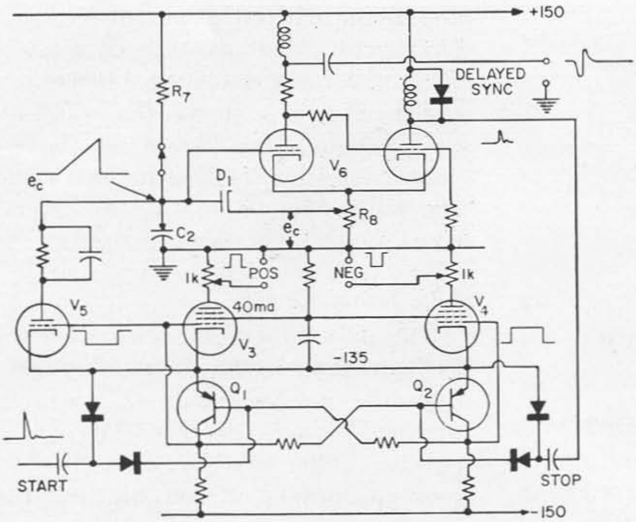


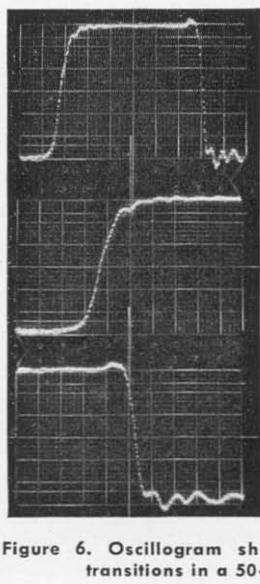
Figure 5. Elementary schematic of the pulse-timing and output circuits.

tion is set by the cathode current of the amplitude-comparator Schmitt in R_8. Any variations in this current will affect both the initial and final voltage values. Again, as in the input circuits, this comparator is stabilized by heavy current feedback and the triggering voltage is determined by precision resistors.

Output Circuits

Figure 5 also shows the output circuits. Before a start trigger pulse is received from the input circuits Q_1 is on and Q_2 off. V_3 is therefore conducting at (nearly) zero-bias and V_4 is off. When a trigger pulse is received Q_2 goes on bringing V_4 on. V_3 and V_4 are a pair of power pentodes which pass 40 ma when on at zero-bias. The interruption of plate current in V_3 produces a 40-volt positive pulse in its load resistor. Simultaneously V_4 turning on produces a 40-volt negative pulse across its load resistor. The extreme speed of Q_1 and Q_2 in the transistor flip-flop switches these plate currents on and off very rapidly. A typical positive current transition is of the order of 15 nanoseconds, while the negative transitions are typically 8 nsec. (See Figure 6.)

The very rapid current transitions are applied to the 1-kilohm output potentiometers and an internal stray-capacitance of approximately 30 pf. With no external loading the rise time of voltage is approximately 60 nsec. External capacitance will increase this rise time by

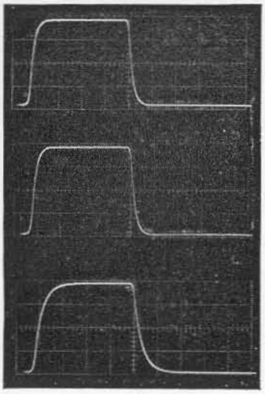


0.12-μ sec pulse in 1-nsec rise time sampling system; 20 nsec/cm.

Positive transition, 10 nsec/cm

Negative transition, 10 nsec/cm

Figure 6. Oscillogram showing typical output transitions in a 50-ohm system.

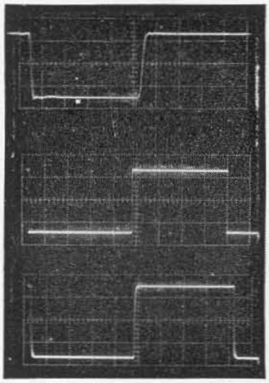


0.4 volt, peak-to-peak, into 10 ohms; 0.1 μ sec/cm

4 volts, peak-to-peak, into 100 ohms; 0.1 μsec/cm

40 volts, peak-to-peak, into 1 kilohm; 0.1 μsec/cm

Figure 7. Open-circuit rise-and fall-time oscillograms; 'scope has 12-pf probe.



A
2-volt, 0.5-μ sec pulse; 50-ohm termination; 0.1 μ sec per division

B
2-volt, 5-μ sec pulse; 50-ohm termination

C
As in (B), but with open-circuit termination, 40-volt pulse

Figure 8. 2-volt pulses into 50 ohms.

approximately 2 nsec/pf. With this output circuit form, no overshoot will ever be observed, and the rise and fall of output voltage is purely exponential (see Figure 7 where the output pulse is shown as presented on a Tektronix 543 oscilloscope with 12-pf probe).

When the ultimate current rise times are to be utilized it is necessary to terminate the pulse generator in an impedance appropriate to the coaxial cable (50 or 93 ohms) to be used. Fast 2-volt pulses in a 50-ohm system are shown in Figure 8.

APPLICATIONS

The extremely wide ranges of pulse duration and prf produced by this pulse generator fit it for almost any application in which a pulse is needed. There are so many applications that it is difficult to select a sample group to be included here. The new model has demonstrated itself to be far more useful than its predecessor because:

(1) Its duration control, being more accurately calibrated, can be used for quantitative measurement of maximum and minimum durations, for example, over which a flip-flop will function. The pulse duration can be established without the need to read an oscilloscope.

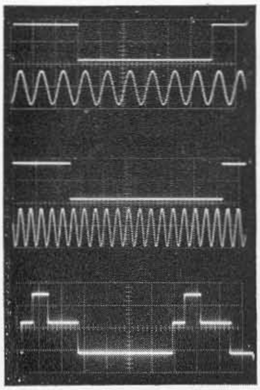
(2) Since the amplitude control varies output impedance, the instrument can be set to produce a correct driving-point impedance for any passive pulse network.

(3) Its linear current-source output system produces a clean pulse of easily adjustable and equal rise-fall time.

(4) Since the prf can be continuously varied it is possible, for example, to establish the resolution failure point of a flip-flop precisely.

(5) The aperiodic synchronizing circuit for external control of the prf makes it possible to drive the instrument from an *RC* or beat oscillator over the full range of that oscillator with no control adjustments on the pulse generator. Therefore, the prf accuracy and stability is that of the driving oscillator. It is also possible to produce pulses with a random frequency distribution.

(6) The stability of the internal prf oscillator makes it possible to use the Type 1217-B in systems as a precise frequency divider of high ratio (Figure 9, A and B).



A
9:1 division of 1-Mc input sine wave 1 μsec/cm; prf = 111.1 kc

B
20:1 division of 1-Mc input sine wave

C
Complex pulse from two generators in parallel

Figure 9.

(7) The presence of a threshold control for the external synchronizing circuit makes it easily possible to produce single pulses. A 1.5-volt cell and Micro Switch can also be used to produce single pulses from a hand-held trigger generator.

(8) The linear, dc coupled output permits paralleling to provide complex output pulses with no external adding networks, as shown in Figure 9C.

Beyond the general increases in applicability obtained through the design improvements listed above, experience has shown that the TYPE 1217-B is a useful source for measurements on transistor systems. It can operate saturated transistor switches, both *npn* and *pnp*, without coupling networks. Since the pulse generator is direct-coupled, the solid-state switches can be operated over its full duration-range. Figure 10 shows the connections for driving a *pnp* transistor switch. The low output impedance of the TYPE 1217-B is normally sufficient for hold-back during the pulse off-time. Figure 11 shows the direct connection for switching *npn* transistors.

— R. W. FRANK

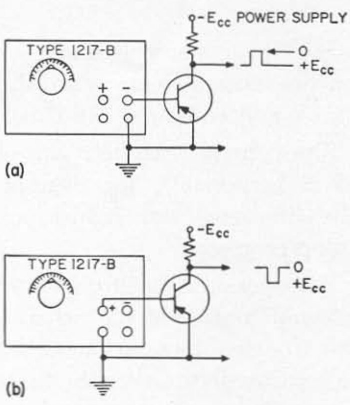


Figure 10. Control of *pnp* transistor switch.

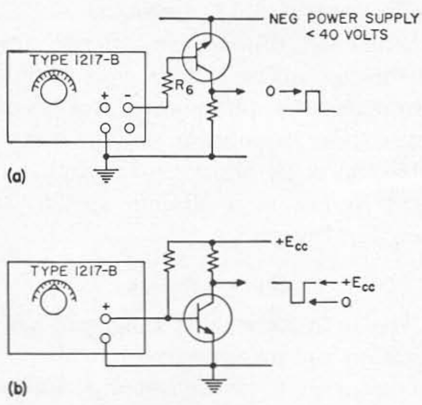


Figure 11. Control of *npn* transistor switch.

SPECIFICATIONS

PULSE REPETITION FREQUENCY

Internally Generated: 2.5 cps to 500 kc with calibrated points in a 1-3 sequence from 10 cps to 300 kc, and 500 kc, all ±5%. Continuous coverage of the range from 2.5 cps to 500 kc with an uncalibrated control lowering the frequency of the calibrated points.

Externally Controlled: Aperiodic, dc to 1 Mc with 1-v rms input (0.5 v at 500 kc and lower); input impedance, at 0.5 v rms, approximately 100 kilohms shunted by 50 pf.

OUTPUT PULSE CHARACTERISTICS

Duration: 100 nsec to 1 sec in seven decade ranges, ±5% of reading, or ±2% of full scale or ± 25 nsec, whichever is greater.

Rise Time:

a. Into terminated 50- or 100-ohm cables all transitions will have rise times less than 20 nanoseconds (typically 12 nsec).

b. On high-voltage output (40 v at 1 kilohm) rise time will be limited by load capacitance.

SPECIFICATIONS (*Cont.*)

Rise and fall times typically 60 nsec + 2 nsec/pf external load capacitance.

Voltage: Positive and negative 40-ma current pulses available simultaneously. DC coupled, with dc component negative with respect to ground. 40 volts peak into 1-kilohm internal load impedance for both negative and positive pulses. Output control marked in approximate output impedance.

Overshoot: Overshoots and noise in pulse, less than 5% of amplitude with correct termination.

Ramp-off: less than 1% everywhere.

Synchronizing Pulses:

Pre-pulse: Positive and negative 10-volt pulses of 150-nsec duration. If positive sync terminal is shorted, negative pulse can be increased to 50 v. Sync-pulse source impedance:

positive — approx 300 ohms
negative — approx 1 kilohm

Delayed Sync Pulse: The delayed sync pulse consists of a negative-going transition of approximately 5 volts and 100-nsec duration coincident with the late edge of the main pulse. The duration control reads the time between the pre-pulse and the delayed sync pulse. The delayed sync-pulse negative transition is immediately followed by a positive transition of approximately 5 volts amplitude and 150-nsec duration to reset the input circuits of a following pulse generator. (See oscillogram above.)

1-μ sec pulse into 50 ohms with delayed sync pulse

STABILITY

PRF and pulse-duration jitter are dependent on power-supply ripple and regulation.

a. With Type 1201 Power Supply (recommended), input terminals short-circuited,

PRF Jitter	0.01%
Pulse-Duration Jitter	0.01%

b. With Type 1203 Power Supply

PRF Jitter	0.05%
Pulse-Duration Jitter	0.05%

POWER REQUIRED

300 v at 55 ma, 6.3 v at 3 amp. Type 1203-B Unit Power Supply or Type 1201-B Unit Regulated Power Supply is recommended.

DIMENSIONS

Width 9½, height 5¾, depth 6½ inches (240 by 150 by 165 mm), over-all.

NET WEIGHT

4½ pounds (2.1 kg).

Type		*Code Word*	*Price*
1217-B	Unit Pulse Generator	AMASS	$250.00

AUTOMATIC MEASUREMENT OF PHONOGRAPH REPRODUCERS

By B. B. BAUER, *Vice President*
CBS Laboratories, Stamford, Connecticut

Among the latest of manual procedures to yield to automation is the measurement of phonograph reproducer characteristics. This is made possible by development of the new CBS Laboratories Type STR 100 Stereophonic Frequency Test Record, which is adapted for use with General Radio Type 1521-A Graphic Level Recorder.

A stereophonic record contains two related program channels which are identified with orthogonal modulations of the walls of a single groove. The left channel corresponds to the inner groove wall, the one closest to the center, and the right channel to the outer groove wall (away from the center). The positive directions of these modulations are at